MWJ

THE MODERN WAR JOURNAL

"TO WIN TOMORROW'S WARS, TODAY"

INNOVATION AND AUTONOMY IN FUTURE WAR

ALSO FEATURING:

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"An indomitable will and broad military knowledge, combined with a strong character, are attributes of the successful leader. Only by continual study of military history and of the conduct of war with careful attention to current developments can the officer acquire the above-stated attributes of leadership."

–General Albert C. Wedemeyer, West Point Class of 1919 and key American military strategist in WWII

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About *The Modern War Journal*

The Modern War Journal (MWJ) is produced by the Modern War Institute at West Point (MWI) in support of MWI's mission to generate new knowledge for the profession of arms, enhance the West Point curriculum, and serve as an intellectual resource for solving military problems. In furtherance of MWI's three goals of *research*, *integrate*, and *educate*, this journal features content from academics, policy makers, and practitioners of the profession of arms—from the cadet level to the commander in chief—presented here with one goal: to help win tomorrow's wars, today.

Winning tomorrow's wars begins today—with thought, with study, and with leadership. It begins with understanding that the emerging battlefield is not only a space of weapons and platforms, but of perception, influence, and strategic imagination. And most importantly, it begins with recognizing that at the heart of every conflict, every decision, and every transformation, stands a leader.

This publication capitalizes on West Point's unique positioning as the US Military Academy to highlight speeches given on West Point's grounds, interviews with West Point leaders and visitors to the Academy, and content submitted by cadets, the operational joint US military force, and service members of allied nations.

Through the MWJ, MWI affirms our commitment to fostering a professional discourse that is both intellectually rigorous and operationally relevant. We aim to empower readers not just with insight, but with foresight. Our hope is that this journal becomes a catalyst for dialogue across ranks, services, and disciplines.

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FROM THE DIRECTOR

The *Modern War Journal* exists for one purpose: to strengthen the profession of arms. With this second edition, that purpose is more urgent than ever.

The theme of this issue—Innovation and Autonomy in the Future Fight—reflects a reality already unfolding. Artificial intelligence, autonomous systems, and drone-dominated battlefields are not future concepts. They are reshaping combat today. They are compressing decision cycles, altering risk calculations, and redefining what advantage looks like on the modern battlefield.

Our task is not to admire this transformation. It is to lead it.

This edition confronts the implications head-on. It examines AI and mission command, innovation under fire in Ukraine, the changing role of Joint Terminal Attack Controllers, and the institutional demands of human-machine integration. These are not academic curiosities; they are warfighting requirements.

Innovation does not equal advantage. Technology absent doctrine creates vulnerability. Speed absent judgment creates strategic risk. Autonomy absent accountability erodes trust—the foundation of our profession. The decisive edge will belong to leaders who can integrate new capabilities while preserving disciplined command, ethical clarity, and combat effectiveness.

At the Modern War Institute, we generate knowledge to improve how the Army and joint force fight and win. That requires intellectual rigor, operational relevance, and leaders prepared to think clearly in environments shaped by machine speed and persistent competition. It requires officers who understand both the potential and the limits of artificial intelligence. And it requires institutions willing to adapt with discipline and purpose.

The first edition established this platform. This second edition raises expectations. The character of war is evolving rapidly. Our responsibility remains constant: understand it, shape it, and win.

Colonel Patrick J. Sullivan, PhD
Director, Modern War Institute at West Point

FROM THE EDITOR

With the publication of this second edition of the *Modern War Journal*, we continue a conversation that is no longer theoretical or distant, but immediate. The character of war is evolving at a pace that challenges our institutions, doctrine, and assumptions about control, decision-making, and the role of the human in conflict. This issue's theme—Autonomy and Innovation in Future War—addresses those challenges directly.

Autonomy is more than a technological advancement; it is a conceptual disruption. From unmanned systems operating at the tactical edge to algorithmic decision-support tools informing operational and strategic planning, machines are increasingly participating in the conduct of war. At the same time, innovation—technological, organizational, and doctrinal—has become a strategic imperative. The question is no longer whether change will occur, but whether we will shape it deliberately or be shaped by it.

In these pages, we examine how autonomous systems are altering the calculus of war through new understandings of speed, mass, and risk. We explore the implications of distributed formations enabled by autonomous capabilities, as well as the ethical tensions inherent in delegating lethal authority to machines.

A consistent theme runs throughout this issue: future advantage will not belong solely to the force with the most advanced technology, but to the one that best integrates technology with people, doctrine, and purpose. The enduring nature of war—its violence, friction, and political character—remains unchanged. But its character is being reshaped by code as much as by steel. Success will depend on leaders who can harness innovation without surrendering judgment, accelerate decisions without eroding strategic clarity, and preserve moral responsibility in an age of machine speed.

How do we prepare commanders to exercise mission command in formations that include autonomous teammates? How do we build acquisition systems agile enough to keep pace with commercial innovation? How do we deter adversaries who may operate with fewer ethical constraints in their use of AI-enabled capabilities? And how do we ensure innovation strengthens, rather than undermines, the trust that anchors the profession of arms? These are not abstract concerns; they are defining issues for this generation of military professionals.

Autonomy and innovation will shape tomorrow's battlefields. Our responsibility is to ensure they do so in ways that strengthen our profession, uphold our values, and secure victory.

The conversation continues…

Dr. Charles Faint
Editor in Chief, *Modern War Journal*

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Innovation and Autonomy in Future War

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Maintaining Our Strategic Advantage: AI and Mission Command

Adam Ropelewski

ABSTRACT: Artificial intelligence (AI) is rapidly reshaping modern warfare by accelerating data processing, enhancing targeting, and supporting operational decision-making. As the US Army integrates AI-enabled systems across the force, it must ensure these technologies strengthen rather than undermine the principles of mission command. Mission command—built on trust, decentralized decision-making, and empowered leaders—has long provided the Army with a strategic advantage. Properly applied, AI can enhance this advantage by improving shared understanding, reducing cognitive burdens on commanders and staffs, and enabling faster, better-informed decisions in increasingly complex and data-driven battlespaces. However, integrating AI also presents risks. Overreliance on algorithmic recommendations could weaken leader initiative and erode the flexibility essential to mission command. To avoid this, the Army must prioritize training, leader development, and AI literacy while maintaining human judgment at the center of critical decisions. By integrating AI in ways that support—not replace—human leadership, the Army can preserve its culture of trust and initiative while maintaining a decisive advantage in future conflicts.

From the dawn of the Stone Age's spears to today's main battle tanks and drones, technology has constantly changed the tools of war. How we apply those tools is critical. Artificial Intelligence (AI) may be this century's most significant driver of change and perhaps even cause a revolution in military affairs. As the Army adopts AI, the US Army must ensure AI enables the proven concepts of mission command, or risk undermining its mission command culture of trust and empowerment.

AI is already being used on battlefields in Europe and the Middle East. It has been used to aid decision-making as well as to select and attack targets.[1] Our adversaries and allies are increasing their research and development into military applications of AI. Noticing this, the Pentagon is racing to deploy AI across military operations before adversaries gain an irreversible edge. The Army is using traditional research and development and its new venture-capital-like FUZE program to inject cutting-edge technology into the force rapidly.[2] Army leadership will need to decide how AI interacts with mission command as new equipment is developed and fielded.

If AI is used to augment mission command rather than replace it, the Army will be able to rely on a time-tested advantage that already resides within its ranks, one that is the envy of the world: trusted and empowered leaders. Mission command is the doctrinal backbone of the Army's approach to command and control. Its principles (competence, mutual trust, shared

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[1] Reuters, "Russia says it is ramping up AI-powered drone deployments in Ukraine," October 11, 2024, accessed October 01, 2025, https://www.reuters.com/business/aerospace-defense/russia-says-it-is-ramping-up-ai-powered-drone-deployments-ukraine-2024-10-11.

[2] Nicholas Nofziger, "Army calls for innovation, urges collaboration at Demand Signal Forum," DVIDS, September 16, 2025, accessed November 5, 2025, https://www.dvidshub.net/news/548326/army-calls-innovation-urges-collaboration-demand-signal-forum.

understanding, commander's intent, mission orders, disciplined initiative, and risk acceptance) grant subordinate leaders the flexibility to act decisively when orders are incomplete or delayed.[3]

The best way the Army can maintain its strategic advantage is to provide leaders with AI-enabled capabilities that complement the principles and existing mission command doctrine. Doing so requires not only technical investment but also a cultural and training shift that preserves autonomy while enhancing situational understanding at all echelons.

AI in Modern Warfare

To date, examples of AI's use have been mainly tied to targeting. Israel's ferocious attack on Gaza has been aided by its "Gospel" AI system. Gospel reviews intelligence (possibly derived from other AI-enabled systems) and makes a targeting recommendation at a rate that has been estimated to be "at least 50 times faster" than human analysts.[4] Ukraine and Russia have both employed AI in their war by enhancing drone systems to identify, track, and target, as well as to counter drones by kinetic and non-kinetic means. It should be noted that there is no evidence that any nation has employed an AI-empowered weapon system without maintaining a human in the loop.[5][6][7] While not yet used on a battlefield, China's reported AI efforts have ranged from strategic planning to tactical targeting and decision-making.[8]

Similarly, the US Army is taking a broad approach towards adopting AI into all levels of war. Tactically, the Army has experimented with AI tools that support targeting, course of action development, and equipment maintenance.[9] Two of the most significant initiatives that

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[3] US Army, FM 6-0 *Commander and Staff Organization and Operations* (Washington, DC: Headquarters, Department of the Army, 2022).

[4] Geoff Brumfel, "Israel is using an AI system to find targets in Gaza. Experts say it's just the start," NPR, December 14, 2023, accessed October 1, 2025, https://www.npr.org/2023/12/14/1218643254/israel-is-using-an-ai-system-to-find-targets-in-gaza-experts-say-its-just-the-st.

[5] Reuters, "Auterion says it will provide Ukraine with 33,000 AI drone guidance kits," Reuters, July 28, 2025, accessed October 01, 2025, https://www.reuters.com/business/aerospace-defense/auterion-says-it-will-provide-ukraine-with-33000-ai-drone-guidance-kits-2025-07-28/.

[6] Reuters, "Russia says it is ramping up AI-powered drone deployments in Ukraine," Reuters, October 11, 2024, accessed October 01, 2025, https://www.reuters.com/business/aerospace-defense/russia-says-it-is-ramping-up-ai-powered-drone-deployments-ukraine-2024-10-11/.

[7] Sinead Baker and Jake Epstein, "Ukraine is using an AI-powered, automated turret to shoot down Russia's devastating Shahed drones," Business Insider, June 2, 2025, accessed October 01, 2025, https://www.businessinsider.com/ukraine-ai-powered-turret-shoot-russia-shahed-drones-sky-sentinel-2025-6/.

[8] Amy J. Nelson and Gerald L. Epstein, "The PLA's Strategic Support Force and AI Innovation," Brookings, December 23, 2022, accessed October 1, 2025, https://www.brookings.edu/articles/the-plas-strategic-support-force-and-ai-innovation-china-military-tech/; Department of Defense, Military and Security Developments Involving the People's Republic of China, Annual Report to Congress (Washington, DC: Department of Defense, 2024).

[9] Michael Zequeira, "Artificial Intelligence as a Combat Multiplier," *Military Review*, September 2024, accessed October 1, 2025, https://www.armyupress.army.mil/Journals/Military-Review/Online-Exclusive/2024-OLE/AI-Combat-Multiplier; Vinicius G. Goecks and Nicholas Waytowich, "COA-GPT: Generative Pre-trained Transformers

incorporate AI are Next Generation Command and Control (NGC2) and Maven Smart Systems (MSS). Both will significantly impact command and staff processes.

NGC2 "integrates information from previously siloed warfighting systems and enables the use of artificial intelligence and machine learning tools to rapidly organize and analyze data to improve commanders' decision advantage."[10] NGC2 seeks to build an integrated, software-based architecture enabling decision dominance and AI-assisted staff functions.[11]

MSS "combines sensors, artificial intelligence, and machine learning to modernize battlefield operations, including targeting, logistics planning, and predicting supply needs for deployed troops."[12] MSS's use of AI to process data within command workflows, particularly in intelligence, surveillance, reconnaissance, logistics, and targeting, reduces cognitive burden and speeds decision-making.[13]

AI Must Boost the US Army's Strength: Mission Command

As military operations grow more data-centric and faster-paced, these principles remain foundational but require evolution to stay relevant in an AI-rich battlespace.

AI offers significant potential to augment mission command and enhance shared understanding and decision-making. The Army has already acknowledged this in Futures Command's *Concept for Command and Control 2028*:

> *AI with widest access to networked sensors and large volumes of seemingly disparate data and information can rapidly make sense of information and feedback from Army and all other linked data sources to generate decision-quality information and provide*

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for," March 28, 2024, accessed October 1, 2025, https://arxiv.org/pdf/2402.01786; Cole Chmielewski and Sean Murphy, "Artificial Intelligence Assisted Maintenance tool undergoes successful unit testing," US Army, September 5, 2025, accessed October 1, 2025, https://www.army.mil/article/288173/artificial_intelligence_assisted_maintenance_tool_undergoes_successful_unit_testing.

[10] PEO C3N Public Affairs, "Army announces Next Generation Command and Control (NGC2) prototype award," US Army, July 18, 2025, accessed October 1, 2025, https://www.army.mil/article/287180/army_announces_next_generation_command_and_control_ngc2_prototype_award.

[11] Mark Pomerleau, "Army turning attention to AI for decision dominance with Next-Gen Command and Control," DefenseScoop, July 23, 2025, accessed October 5, 2025, https://defensescoop.com/2025/07/23/army-next-gen-command-and-control-ai-for-decision-dominance.

[12] Tish Williamson and Installation Contracting Command Public Affairs, "Contracting personnel use AI, Maven Smart System simulation during warfighter exercise," US Army, March 3, 2025, accessed October 1, 2025, https://www.army.mil/article/283473/contracting_personnel_use_ai_maven_smart_system_simulation_during_warfighter_exercise.

[13] Tish Williamson and Installation Contracting Command Public Affairs, "Contracting personnel use AI, Maven Smart System simulation during warfighter exercise," US Army, March 3, 2025, accessed October 1, 2025, https://www.army.mil/article/283473/contracting_personnel_use_ai_maven_smart_system_simulation_during_warfighter_exercise.

reasoned probability predictions, decreasing the cognitive burden on commanders and staffs and increasing the speed and quality of decision making.[14]

Culture Shift: Innovation and Training with AI

Beyond execution, the Army leverages junior leaders as conduits of innovation, especially at the tactical edge. Bottom-up technical adaptations exploit the creativity of NCOs and junior leaders. Because NCOs train the force and maintain discipline and efficiency, they are natural conduits for normalizing incremental innovation. Their feedback is seen as vital to the process.[15]

Junior leaders are vital to the Army's innovation ecosystem because their hands-on, field-level experience gives developers real-time insight into what truly works under combat-like conditions. During ongoing transformation events, such as Project Convergence (PC) and Transforming in Contact (TiC) rotations at combat training centers, soldiers operate new systems "in the dirt," document performance failures, and brief leaders and program representatives, leading to adjustments in development.[16][17][18]

These efforts illustrate how NCO insights can accelerate development and effective adoption by providing the Army and industry with grounded, iterative feedback that shortens the development cycle, builds user trust, and aligns emerging technologies with the realities of tactical operations. NCOs are essential to developing the future capabilities.

Leaders must strike the right balance in training (and execution) of leveraging technology and adhering to the principles of mission command without overly relying on it. Overreliance on AI could hamstring ingenuity, as subordinate commanders default to algorithmic advice derived from data without accounting for commander and leader dialogue. It would be prudent for the combat training center cadre to assess the extent of their reliance on AI.

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[14] US Army Futures Command, *Army Futures Command Concept for Command and Control 2028: Pursuing Decision Dominance* (Austin, TX: US Army Futures Command Futures and Concepts Center, 2021).

[15] Michelle Tan, "Action, Not Words: Weimer Focuses on Helping NCOs Shape Army of the Future," Association of the United States Army, October 3, 2024, accessed October 29, 2025, https://ausa.org/articles/action-not-words-weimer-focuses-helping-ncos-shape-army-future.

[16] Claire Heininger, "Soldiers experiment with Next-Generation C2 at Project Convergence," US Army, March 17, 2025, accessed October 8, 2025, https://www.army.mil/article/283805/soldiers_experiment_with_next_generation_c2_at_project_convergence.

[17] Katie Smith, Brian Hester, and Garrett O'Keefe, "Empowering Change: The Role of Non-Commissioned Officers in Implementing Transformation in Contact," Small Wars Journal, January 7, 2025, accessed October 10, 2025, https://smallwarsjournal.com/2025/01/07/empowering-change/.

[18] Brian Hester, "NCOs Enable Continuous Transformation," *Muddy Boots*, October 28, 2024, accessed October 3, 2025, https://www.armyupress.army.mil/Journals/NCO-Journal/Muddy-Boots/Continuous-Transformation.

Risk

Integrating AI into the force within the mission command framework is not without risk and demands attention to competence and leader development. Leaders must not only know how to use AI tools but also understand their mechanics, limitations, failure modes, and biases. Doctrine and education must evolve so that AI literacy becomes integral to leader development.

Use and repetitions in training will "help combat leaders gain familiarity with systems to trust agentic outputs and build the resiliency to withstand the tempo of data-centric warfare."[19] This understanding will need to grow quickly as the Army and its industrial base partners rush to deliver capabilities to the force.

Along with training leaders to incorporate AI and other technologies, the Army must retain them. "Institutional changes to how we recruit, develop, and retain a technologically competent and data-literate force are critical to preserving our asymmetric advantage. As technology continues to advance, so too must our Army."[20]

Ethical and legal constraints, especially in lethal domains, require that AI systems adhere to international law, rules of engagement, and auditability.[21] However, while AI may help assess risk, the moral, tactical, and legal responsibility for critical decisions must remain with human leaders. As AI systems become more advanced and autonomous, it will continue to be the commander's responsibility to assume and mitigate a mission's risk.

Trust is Our Strength

While the Army is focused on developing and integrating AI across its hierarchy, adversaries are taking a different approach; their reluctance to grant subordinates a degree of autonomy and their distrust of junior leaders' decision-making expose their weaknesses and highlight the Army's strategic advantage in decision-making. For example, China is taking a big swing at AI, and the People's Liberation Army (PLA) has shifted doctrine to "intelligentization," aiming to embed AI, big data, and autonomy into command, sensing, and strike networks.[22] While policies are

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[19] Benjamin Jensen and Jake S. Kwon, "The US Army, Artificial Intelligence, and Mission Command," War on the Rocks, March 10, 2025, accessed October 1, 2025, https://warontherocks.com/2025/03/the-u-s-army-artificial-intelligence-and-mission-command.

[20] James E. Rainey and Gary M. Brito, "Sustaining Our People Advantage in Data-Centric Warfare," *Military Review*, March 2024, accessed October 27, 2025, https://www.armyupress.army.mil/journals/military-review/online-exclusive/2024-ole/sustaining/.

[21] Mathias Anneken et al., "Ethical Considerations for the Military Use of Artificial Intelligence in Reconnaissance," ARXIV, January 31, 2025, accessed October 7, 2025, https://arxiv.org/pdf/2502.03376.

[22] Glonek, Joshua. 2024. "The Coming Military AI Revolution." *Military Review,* May-June 2024, accessed October 10, 2025. https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/May-June-2024/MJ-24-Glonek/.

accelerating AI development, integration is tightly governed to not undermine political oversight.[23]

Our adversaries' inability to truly trust subordinates with enhanced technology will keep them tactically and strategically at a disadvantage. As Sergeant Major of the Army Michael Weimer has put it: "What we're learning [from TiC] is… 'Holy cow, the people skills are just as important, if not more.'"[24]

By allocating significant resources to developing new technologies that incorporate AI into junior leader-led formations, within the principles of mission command, the Army is well-positioned to maintain a strategic advantage in the long term. Subordinate leaders are key to mission command as they are entrusted at the tactical edge to execute disciplined initiative, consider prudent risk, and achieve the commander's intent. Their AI tools should support, not nullify, the principles of mission command.

Ultimately, the Army's attainment of a durable strategic advantage will depend on sustained investment in AI and its prudent, systematic integration in accordance with the doctrinal principles of mission command.

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[23] Elisa B. Kania, "Testimony before the US-China Economic and Security Review Commission," *Center for a New American Security,* June 7, 2019, accessed October 10, 2025, https://www.uscc.gov/sites/default/files/June%207%20Hearing_Panel%201_Elsa%20Kania_Chinese%20Military%20Innovation%20in%20Artificial%20Intelligence.pdf.

[24] Michelle Tan, "People Skills: Smart Soldiers at Forefront of Transformation, SMA Says," Association of the United States Army, October 6, 2025, accessed October 29, 2025, https://www.ausa.org/articles/people-skills-smart-soldiers-forefront-transformation-sma-says.

Transformative Effects of Russia's 2022-2025 War in Ukraine

Mark Temnycky, Isak Kulalic, and Robert Person

ABSTRACT: When Russia launched its full-scale invasion of Ukraine in February 2022, it forced the United States, NATO, and the European Union to re-evaluate fundamental aspects of their national security and defense policies. Before the invasion, only six out of NATO's 30 members allocated two percent of their gross domestic product toward defense, and very few European countries prioritized their defense capabilities and national security. Now, as of Summer 2025, 23 out of NATO's 32 members have met that overall defense spending target, and 29 allies met the equipment spending target (20% of defense budgets). Russia's war in Ukraine has clarified the need for collective security across the European continent, and it has reminded the Western world that it should not take security for granted. In short, Russia's 2022 full-scale invasion of Ukraine has had transformative effects on national security for the United States, Europe, Russia, and Ukraine.

Introduction

This essay examines how the 2022 Russian invasion of Ukraine has transformed strategic, tactical, political, and social approaches to security in the West, and it calls for the United States and Europe to further enhance their defense capabilities. Prioritizing American and European defense and strengthening transatlantic ties while studying Ukraine's successes during the war will lead to a safer and more secure European continent.

The Second World War decimated Europe. Scholars and economists said that reconstructing Europe would cost tens of billions of dollars, and world leaders wanted to ensure that such a great catastrophe would not occur again. To prevent future devastation, several European countries, the United States, and Canada came together to establish the North Atlantic Treaty Organization. This group was created to "protect the freedom and security of its members through political and military means."[1] The organization was also formed to provide several countries with security against the Soviet Union.[2] Following its inception in 1949, members of the organization came together to ensure peace and stability on the European continent.[3]

NATO achieved these objectives, and by the time the Soviet Union collapsed in 1991, NATO members had successfully prevented another large-scale ground war on the continent. Other Western and Central European countries would later join the alliance, which further led to cooperation and collaboration among member states as they discussed the importance of national security and defense on the European continent and beyond.

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[1] US Mission to the North Atlantic Treaty Organization, "About NATO," US Mission to the North Atlantic Treaty Organization, accessed 6 February 2025, https://nato.usmission.gov/about-nato/#:~:text=Formed%20in%201949%20with%20the,its%20global%20network%20of%20partners.

[2] US Office of the Historian, "North Atlantic Treaty Organization (NATO), 1949," US Department of State, accessed 6 February 2025, https://history.state.gov/milestones/1945-1952/nato#:~:text=The%20North%20Atlantic%20Treaty%20Organization,security%20against%20the%20Soviet%20Union.&text=NATO%20was%20the%20first%20peacetime,outside%20of%20the%20Western%20Hemisphere.

[3] Robert Person and Michael McFaul, "Why NATO Is More Than Democracy's Best Defense," Journal of Democracy, April 2024, https://www.journalofdemocracy.org/online-exclusive/why-nato-is-more-than-democracys-best-defense/

This attention to defense capabilities, however, changed after the Soviet collapse. Believing that there were no longer direct threats to Western values, democracy, and security, many European countries deprioritized their national defense.[4] Several allies cut back their defense budgets, believing they should focus on economic power instead.[5] Many of these members believed that defense spending was no longer a priority, and several countries reduced the size of their militaries. In other words, there was a sense of peace and stability on the European continent from 1991 to 2021.

As a result, NATO shifted its strategy from "threat-based planning" to "capabilities-based planning."[6] At the time of its foundation, NATO perceived the Soviet Union as a threat. The alliance developed strategies to identify and counter Soviet capabilities effectively. Once the Soviet Union collapsed, however, NATO adopted a new approach that focused on developing core strengths and resources for a broad spectrum of missions and challenges in the absence of a major state-based threat or challenger.[7]

Russia's full-scale invasion of Ukraine in February 2022 would change this mindset. With the war in its fourth year, NATO members have begun to place more emphasis on defense spending, national security, and the defense industrial base. Russia's war has also influenced how the United States, the European continent, Russia, and Ukraine perceive national security, defense, and other capabilities.

What lessons have the United States, NATO, and the European Union learned during Europe's most significant land war since the Second World War? What are the transformative effects on US and European national security?

NATO and EU Security Architecture During Russia's 2022-2025 War of Aggression in Ukraine

Russia's full-scale military incursion in Ukraine in February 2022 has forced the United States, NATO, and the EU to reconsider national security and defense strategies. For example, the war has prompted NATO members to increase their defense spending beyond the 2% of GDP target set by the 2014 Wales Pledge.[8]

Since 2022, allies have been exploring how to strengthen their security posture following the surprise Russian invasion in February 2022 that caught many NATO and EU members off guard. It has challenged their understanding of peace and stability on the European continent, and both

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[4] Paal Sigurd Hilde, "European Defense Capabilities During the Russian Invasion of Ukraine," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[5] Robert Kagan, "New Europe, Old Russia," Carnegie Endowment for International Peace, 6 February 2008, https://carnegieendowment.org/posts/2008/02/new-europe-old-russia?lang=en.
[6] MAJ John Christianson, "Threat-Based and Capabilities-Based Strategies in a Complex World," United States Air Force, 2016, https://apps.dtic.mil/sti/tr/pdf/AD1021927.pdf.
[7] Ibid.
[8] Clara Falkenek, "Who's at 2 Percent? Look How NATO Allies Have Increased Their Defense Spending Since Russia's Invasion of Ukraine," Atlantic Council, 8 July 2024, https://www.atlanticcouncil.org/blogs/econographics/whos-at-2-percent-look-how-nato-allies-have-increased-their-defense-spending-since-russias-invasion-of-ukraine/; NATO, "Funding NATO," NATO, 19 December 2024, https://www.nato.int/cps/em/natohq/topics_67655.htm#:~:text=The%202%25%20defence%20investment%20guideline,ensure%20the%20Alliance's%20military%20readiness.

NATO and the EU have stated that they are fully committed to supporting Ukraine during this period, though positions across individual member states vary.

Delivering assistance to Ukraine, however, has been challenging. Aid to Ukraine has compelled the US, NATO, and the EU to revitalize the defense industrial base.[9] To date, the US, NATO, the EU, and dozens of other countries have provided hundreds of billions of dollars in defense, humanitarian, medical, and financial assistance to Ukraine.[10] In the case of defense aid, the US, NATO, and the EU have sent millions of rounds of ammunition, various types of weapons, defense equipment, and vehicles.

The situation has not been helped by the simple reality that Ukraine's rate of consumption of said aid has far outpaced both the defense production capabilities of Western partners and allies, as well as the rate at which aid can be sent to Ukraine.[11] As a result, the US, NATO, and the EU have been forced to reconsider industry standards in supply chain management and defense acquisition. Doing so has involved addressing burden sharing amongst allies as a means of reducing defense production redundancies whilst enhancing the abilities of the US, NATO, and the EU to pool their resources.[12] If successfully implemented, such moves would not merely lessen the burden upon defense industries in Western countries, but they may also strengthen ties between NATO and EU members by fostering a more collaborative model of contributing to the defense-industrial sector.[13] This would allow allies to develop a robust defense collective, which will be necessary in independently tackling European security concerns, while the United States reconsiders its defense priorities.[14] Resolving these issues in a timely manner, however, has proven to be a struggle.[15]

Europe must also find a way to increase its defense capabilities. Over the past three years, Ukrainian forces have successfully defended their country against the ongoing Russian invasion. Through the use of Western weaponry, technology, and assistance, and with Ukrainian grit and resilience, the Ukrainians have decimated the Russian military. Despite Ukraine's successes, Russia has attempted to shift the narrative of the war.[16] Throughout the invasion, Russian officials fabricated their battlefield reports. They have exaggerated and misreported their successes to sway opinions about their capabilities.[17] These attempts are not only to influence the

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[9] NATO, "The Hague Declaration," NATO, 25 June 2025, https://www.nato.int/cps/en/natohq/official_texts_236705.htm.
[10] Mark Temnycky, "Three Years Later, Despite Critics' Claims, the World Still Stands with Ukraine," *The Hill*, 26 February 2025, https://thehill.com/opinion/international/5163035-global-support-for-ukraine/.
[11] Mark Temnycky, "Ammunition War Between Russia and the West," *Kyiv Post*, 3 April 2024, https://www.kyivpost.com/opinion/30517.
[12] Ibid.
[13] Mark Temnycky, "How Ukraine Can Build Western Weapons at Home - And Win," *19FortyFive*, 19 February 2025, https://www.19fortyfive.com/2025/02/how-ukraine-can-build-western-weapons-at-home-and-win/.
[14] James Rogers, "Europe: Britain Looks East," *Britain's World*, 3 February 2025, https://www.britainsworld.org.uk/p/the-memorandum-02-2025.
[15] Temnycky, "Ammunition War Between Russia and the West," *Kyiv Post*.
[16] Hans Petter Midttun, "I Am Confident Russia Will Lose This Year. Here's Why," Euromaidan Press, 9 January 2025, https://euromaidanpress.com/2025/01/09/i-am-confident-russia-will-lose-this-year-heres-why/.
[17] Ruslan Leviev, "Russian Military Reporting on the War," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.

Russian government about its continued involvement in the full-scale invasion of Ukraine but also to wear down Western countries and their willingness to continue aiding Ukraine.[18]

As a result, Europe needs a coalition that will continue to commit itself to helping Ukraine, especially as the Trump administration reevaluates—and likely reduces—American support to Kyiv. This will not only strengthen Ukraine's defense abilities while fighting against the Russian invasion, but it will also help strengthen European security, ensuring that future land wars do not occur. In other words, enhancing defense capabilities and readiness will lead to deterrence against future Russian aggression.

What might this European defense collective entail? One solution may be the need for a European defense force. During Russia's war, the EU has toyed with establishing a defense force. It has also considered an EU defense budget. This European security collective could be created through intergovernmental means, which would include non-EU members.[19] Empowering intergovernmental actors would ensure that EU member states could not veto defense priorities and proposals when seeking to strengthen European national security. It would also provide a voice to non-EU member states, as their security on the European continent is equally important. For example, Ukrainian officials have frequently met with their NATO and EU counterparts to discuss matters related to Russia's war. This continued communication ensures that Ukraine, NATO, and the EU will move forward on defense as a collective. It also strengthens their position on the national defense of the European continent.

Creating a unified European defense collective would also resolve any ambiguity in discussions about defense between European states. In the case of NATO, Article 5 states that an attack on one member state is to be considered an attack on all. But there are no legal consequences if member states do not uphold Article 5.[20] Currently, each NATO member state can interpret how it will respond to a call for Article 5, and nothing prohibits members from being inactive.

Furthermore, in the case of NATO Article 3, there are no agreements on what it means for member states to maintain and develop their ability to resist armed attacks by aggressors. Differences in the interpretation of the treaty text have led some European states to enhance their defense capabilities, while others have not prioritized their defense readiness. In addition, if a defense collective was formed in Europe, this initiative would outline clear expectations about what is necessary to ensure that each European country can defend its borders and the borders of its neighbors. The Europeans could draw from the existing framework in NATO and the EU when creating this new European defense collective.

During this process, it will also be critical for European countries to reach a consensus on security threats. For example, as the Russian invasion of Ukraine enters its fourth year, not all European members have perceived Russian aggression as a threat to the European continent.[21]

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[18] Tom Rostoks, "Strategy of Attrition," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[19] Pierre Harroche, "An Adult Year: Some Priorities for EU and NATO," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[20] Federica Fazio, "NATO and Collective Defense: A Contextual Analysis of Article 5 in Light of the War in Ukraine," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[21] Edouard Xia, "Belgium in Contemporary Uncertainty: The War in Ukraine and the Return of National Interest," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.

NATO and EU member states in Eastern Europe and Scandinavia have prioritized assistance to Ukraine as they understand the urgency of the Russian threat. Meanwhile, some Western and Central European countries have yet to prioritize defense capabilities as they view other matters as more pressing than the Russian invasion. The different perceptions of Russian aggression have led to disagreements between NATO and EU states, and it has caused rifts in levels of commitment to defense spending and aid to Ukraine. Creating a joint NATO and EU collective security strategy for the European continent's defense, however, would lead to a better-defended and more secure continent.[22]

Finally, not only would these discussions enhance European resolve on national security, but they would also align with the current defense objectives outlined by the United States. Creating a European coalition for defense would lead to a stronger and more unified continent, which would bolster deterrence and support peace.

As the Europeans continue to discuss the need for peace and security, the new US presidential administration under Donald Trump has highlighted the need for a philosophy of "peace through strength."[23] In a statement issued by the new US Secretary of Defense, Pete Hegseth, the US Department of Defense has vowed to revive its defense industrial base, reform its acquisition process, and reestablish deterrence. The Administration believes that achieving these objectives will enhance the United States of America's defense posture and capabilities in a manner that will result in greater peace and stability. Europe would be wise to find ways to adopt the Trump Administration's "peace through strength" philosophy and align with the US Department of Defense's evolving posture by seeking opportunities for both reinforcing existing partnerships with the United States, as well as seeking new opportunities for transatlantic collaborations which will serve to fulfill mutually-shared security objectives.

Lessons Learned From Ukraine's Defense Capabilities During Russia's War

In addition to being the impetus for structural reforms in European defense at the grand strategic and political levels, the war has also spurred transformation at the tactical and operational levels. In this case, the United States, NATO, and the EU have studied Ukraine's defense capabilities during Russia's ongoing invasion. In particular, they have examined Ukraine's response to Russia's cyber-kinetic capabilities, the successes of Ukrainian special operation units against Russia, and Ukraine's usage of drone warfare.

On February 23, 2022, one day before the full-scale invasion, Russian operatives launched successful cyber attacks aimed at disabling Ukraine's critical infrastructure. Given these events, several media outlets and international experts believed that a Russian victory was inevitable, and they expected it would occur quickly.

For example, Microsoft's report, *An Overview of Russia's Cyberattack Activity in Ukraine*, indicated that Russia's "cyber and kinetic operations appeared to be concentrated and

[22] Paul Cormarie, "The Return of Great Debates in French Strategic Culture," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[23] US Department of Defense, "Secretary Hegseth's Message to the Force," US Department of Defense, 25 January 2025, https://www.defense.gov/News/Releases/Release/Article/4040940/secretary-hegseths-message-to-the-force/.

synchronized."[24] Despite these successful cyberattacks, the Ukrainian military stood firm and defended itself against Russian attacks. Microsoft's report then examined the connection between Russian cyberattacks and Russian troop movements in Ukraine. In addition, Microsoft studied critical gaps in Russian decisions so that international experts could understand Russia's capabilities to synchronize cyber and kinetic operations to achieve military victory.

Microsoft's report also prompted a collaborative effort between the Army Cyber Institute Analysis (ACIA) team and Columbia University to conduct an investigation by utilizing the same data sets as Microsoft had to determine the cause of the discrepancy. In contrast with the Microsoft report, the ACIA report noted a failure to find any correlation between cyber and kinetic operations.[25] Their findings revealed that the Microsoft research team made the mistake of interpreting "any cyber event within a certain proximity of a kinetic event and within a specific timeframe as synchronized."[26] In contrast, the on-the-ground situation reflected vast disproportionality in the ratio of cyber-to-kinetic operations as the majority of events consisted of "explosions or remote violence"[27] separated by such times and distances from cyber events as to render the two unrelated.

Furthermore, the report found that trench warfare at the front lines had served to incapacitate the capabilities of Russian forces to carry out an effective "hybrid war" by launching kinetic attacks against Ukrainian targets after they had first been attacked by hacktivist groups. As such, Russian troops often could not attack and seize said targets. This caused a transition in the conflict from a "hybrid" to a "more conventional" war.[28]

Successes of Ukraine's Special Operations Against Russia

In the face of Russia's large-scale invasion of Ukraine, Ukrainian Special Operations Forces (SOF) have demonstrated remarkable adaptability of their capabilities by quickly transitioning from peacetime training and stability missions to operationally effective large-scale conventional operations, which have ultimately held back Russian forces.[29]

Despite vast economic and military disparities, Ukrainian SOF have proven remarkably effective at mounting a resistance against Russia. These capabilities were developed in the aftermath of Russia's invasion of Crimea in 2014, when Ukrainian SFO began receiving military and financial assistance, along with training, from the West.[30] At that time, the Ukrainians also began implementing structural reforms aligning with NATO standards, thus allowing the formation of effective anti-Russian resistance networks. The decentralized command structure of Ukrainian

[24] MAJ Daniel Eerhart, "Cyber-Kinetic Synchronization in Ukraine," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[25] Ibid.
[26] Ibid.
[27] Ibid.
[28] Person, Robert, Isak Kulalic, and John Mayle. "Back to the future: the persistent problems of hybrid war." *International affairs* 100, no. 4 (2024): 1749-1761. Marzena Żakowska and Larry Goodson, "Evolving War in Ukraine: From Hybrid Warfare to Frozen Conflict," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[29] Doug Livermore, "Ukraine Special Operations Forces and the Lessons Learned for Large-Scale Combat Operations," *Small Wars Journal*, 31 January 2025, https://smallwarsjournal.com/2025/01/31/ukraine-special-operations-forces/.
[30] Ibid.

SFO allowed them to swiftly adapt to ever-changing battlefield environments. This adaptability has been further demonstrated on two fronts: tech integration and unconventional warfare tactics.

Regarding tech integration, Ukrainian SFO combined Western-supplied military technology with repurposed civilian technology to carry out strikes on Russian targets while avoiding direct engagement with Russian forces. This has included the use of drones, including the repurposing of civilian drones which drop bombs on Russian military targets and supply lines.[31] In situations where direct combat is deemed a necessity for destroying Russian military equipment, Ukrainian SFO implemented small unit tactics. The capability of Ukrainians to effectively carry out such missions has been greatly aided by their reliance upon Starlink to calculate and conduct strikes.[32]

As for unconventional warfare tactics, Ukrainian SFO have proven highly skilled in implementing guerrilla tactics and carrying out sabotage operations against Russian forces. Doing so has comprised a combination of disrupting supply lines and communication centers, targeting key military infrastructures and command centers, and carrying out targeted strikes on "high-value targets."[33] Furthermore, in their opposition to the Russian invasion, Ukrainian SFO have been heavily reliant on psychological warfare. In particular, deception operations have complicated Russian military planning and operations, and they undermine the morale of Russian forces while maintaining the support of civilian populations under Russian occupation.[34] Finally, the capabilities of Ukrainian SOF to effectively integrate with conventional forces allowed Ukrainian military forces to maximize their results despite limited resources.

Militarization of the Russian State During the 2022-2025 Invasion of Ukraine

Finally, the war in Ukraine has had transformative effects on the Russian Federation itself. Russia's invasion of Ukraine has irrevocably changed the Russian Federation's relationship with the United States, NATO, and the EU, as well as other countries and organizations throughout the world. When the war began, the international community came together to impose stiff sanctions on Russia to punish it for the war. These penalties resulted in a decline in the Russian economy, and the Russian state lost hundreds of billions of dollars.[35] In response, Russian society adopted a more militarized and hostile approach toward relations with the West. These events have also seen a dramatic increase in expressed Russian patriotism.

Post-colonial scholars have observed that leaders of newly independent states often face instability due to a fragile relationship with their national militaries, driven by fears of deep-seated conflicts between political leaders and military officers. Militaries in such states often retain a degree of influence by the former colonizing power and may prompt the latter to stage a coup.

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[31] Livermore, "Ukraine Special Operations Forces and the Lessons Learned for Large-Scale Combat Operations," *Small Wars Journal*.
[32] Nick Patton Walsh, Alex Marquardt, and Florence Davey-Attlee, "Ukraine Relies on Starlink for Its Drone War. Russia Appears to be Bypassing Sanctions to Use the Devices Too," CNN, 26 March 2024, https://www.cnn.com/2024/03/25/europe/ukraine-starlink-drones-russia-intl-cmd/index.html.
[33] Livermore, "Ukraine Special Operations Forces and the Lessons Learned for Large-Scale Combat Operations," *Small Wars Journal*.
[34] Ibid.
[35] Vladimir Milov, "Oil, Gas, and War: The Effect of Sanctions on the Russian Energy Industry," Atlantic Council, 23 May 2024, https://www.atlanticcouncil.org/content-series/russia-tomorrow/oil-gas-and-war/.

These concerns are particularly poignant in light of the dual considerations. For example, states commonly consist of low-capacity authoritarian regimes that lack the resources to develop and maintain monopolies of force over their territories and constituencies. Furthermore, between 1946 and 2008, some two-thirds of authoritarian governments fell to elite-led coups.[36] In light of such circumstances, post-colonial states have commonly differed in creating paramilitary organizations whose purpose is to operate alongside formal institutions for state-building and regime protection against coups. Given the relatively low costs of employing paramilitary forces, it is also a means of overcoming resource scarcity.[37] Finally, post-colonial governments have commonly sought to foster nationalistic and patriotic organizations (particularly youth organizations) at the civilian level.

The Russian dynamic is somewhat different, given that Russia's centuries-long status as a colonial empire places it at the opposite end of this dynamic between the colonizer and the colonized. The breakup of the Soviet Union and, subsequently, the Russian Federation's inability to integrate into Western institutions rendered the former colonial power in a similarly precarious position. Anxieties surrounding the lack of resources and concerns over potential military coups have led the Russian government to pursue the development of a Soviet-style "military-educational complex"[38] as a means of fostering ideological loyalty and promoting broader civil society involvement in civil defense training and preparation at the civilian level. This ultimately bolsters Russia's defense capabilities as future generations of young males come of military age.[39]

This has been pursued via the formation of political, economic, and discursive networks to achieve said aims. Political socialization networks have ranged across Russia but have concentrated in Volgograd, Rostov on Don, and Russian-occupied Crimea.[40] The political networks consist of "historic and cultural centers, veteran's groups, youth groups, and Cossack groups," demonstrating the Kremlin's commitment to disseminating its militarizing ideologies across communities of varying faiths and ethnicities.[41]

The economic networks operate through state-subsidized grants, to which the various centers and groups mentioned above apply to receive the necessary funding. Receiving grants is essentially contingent upon demonstrations of ideological alignment with the Kremlin as well as demonstrating "some connection to the military and values associated with the armed forces of the history of the nation at war."[42]

Discursive networks serve as the Kremlin's means of addressing long-held concerns that Russian history has long been distorted, thus resulting in a lack of historical understanding and respect for

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[36] Megan Cumpston, "Inside the Panopticon: Coup Prevention and Military Capabilities in Surveillance States," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[37] Matthew Dearing, "The Movement of the First: Entry Point to Paramilitarism in Russia," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[38] William E. Odom, "The Soviet Military-Educational Complex," in *Civil-Military Relations in Communist Systems*, ed. Dale R. Herspring and Ivan Völdyes (New York: Routledge, 1978), 79-104, https://www.taylorfrancis.com/chapters/edit/10.4324/9780429043161-5/soviet-military-educational-complex-william-odom.
[39] Jennifer G. Mathers and Allyson Edwards, "Political, Economic and Discursive Networks of Youth Militarization in Russia," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[40] Dearing, "The Movement of the First: Entry Point to Paramilitarism in Russia."
[41] Ibid.
[42] Mathers and Edwards, "Political, Economic and Discursive Networks of Youth Militarization in Russia."

Russia's place in history across Russian society. This could result in an erosion of patriotism, which would subsequently render Russian society increasingly difficult to govern. As a means of addressing such concerns, in 2001 (during Putin's first term), the Russian government introduced a policy of "Patriotic Education,"[43] which typically espouses glorified representations of Russian history in support of the state's ideology. To maximize the "Patriotic Education" of Russian society, the Russian government sought to distribute its funds sufficiently to encompass a range of projects from small towns and villages to big cities. An emphasis is placed on medium-range projects promoting recognition of the Soviet role in the Second World War. This is intended to reach the largest number of people.[44] As such, discursive networks at the local level provide Russian youth with creative and immersive projects that aim to enhance historical understandings with the ultimate aim of fostering youth enthusiasm for future military service as well as weakening the prospects of future political opposition to the Kremlin.[45]

Russia's 2014 invasion of Crimea, and more so its full-scale invasion of Ukraine in 2022, has rendered these discursive networks increasingly vital to the Kremlin as it has sought to present the Russian state, and by extension, the 'Russian World' (or Russkiy Mir) as existentially threatened by a hostile, US-led, international order. Russia believes it has a moral right to challenge this worldview.[46] In the context of Ukraine, this has taken the form of false narratives referencing the role which the Red Army played during the Second World War by portraying the invasion as a necessary "special military operation" aimed at defeating Western-supported Ukrainian Nazis.[47]

The Russian state has also invested resources into developing tandem youth and adult paramilitary organizations, such as the "Movement of the First" and the "Russian Imperial Movement." The "Movement of the First" was established to inculcate Russian nationalism through the teaching of history and culture to Russian youth whilst emphasizing the necessity of future military recruitment against the backdrop of the aforementioned Western-backed "existential threats" facing Russia.[48] Presently, the organization claims its membership to be five million strong.[49] In a similar vein, the "Russian Imperial Movement" is a far-right nationalist organization with an adult-only membership whose ideology lies at the intersection of Russian monarchism and the Russian Orthodox Church.[50]

Conclusion

Overall, Russia's full-scale invasion of Ukraine in February 2022 rejuvenated the conversation about national security within the United States, NATO, the EU, and beyond. Several Western countries have prioritized updated defense strategies to meet the moment while highlighting a need to strengthen coalitions between states in the Western world. It has also challenged the

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[43] Ibid.
[44] Ibid.
[45] Mathers and Edwards, "Political, Economic and Discursive Networks of Youth Militarization in Russia."
[46] Ibid.
[47] Allyson Edwards and Jeff Hawn, "Putin's Golden Calf," New Lines Institute, 5 March 2022, https://newlinesinstitute.org/state-resilience-fragility/putins-golden-calf/.
[48] Matthew Dearing, "The Movement of the First: Entry Point to Paramilitarism in Russia," Paper presented at 2025 West Point Social Sciences Seminar, 5-6 February 2025, West Point, NY.
[49] Ibid.
[50] Ibid.

United States, the European continent, Ukraine, and Russia on how they perceive national security. This has led to transformations within their respective defense apparatuses.

During the three-year war, two-thirds of NATO members met their defense spending targets. They have improved their defense capabilities. The United States, NATO, and the EU have explored the need for defense sharing, which would lessen the burden on the defense industrial base. They have also started to address supply chain issues and prioritize their collective defense. North America and Europe have found it necessary to discuss national security matters and prepare for global threats rather than thinking inward about domestic affairs. This has promoted a sense of unity and strength among NATO and EU members, and it has led to a stronger and more secure North American and European continent.

The Westerners also have Ukraine to thank. During the war, the Ukrainians demonstrated that they could repel the world's second-strongest military force despite having a smaller military force, fewer weapons, and a smaller economy. In addition, the Ukrainians are using innovative methods to ensure their security, and the Westerners are taking notice. For example, the Ukrainians have launched several special operations against the Russian military, which have decimated the Russian army. They have capitalized on drone warfare to ensure that Ukrainian soldiers are not put in harm's way, they have manufactured weapons to fight against the Russians, and they have reminded the West about the importance of defending freedom, democracy, and Western values.

The war in Ukraine also demonstrates that hybrid warfare can escalate into conventional war and even lead to a state of total war. The success of Ukrainian forces against the Russian onslaught provides lessons for the US and its allied militaries. Military organizations must strive toward greater flexibility and adapt to the ever-changing nature of threats and warfare. This includes a combination of enhancing capabilities for integrating new technologies, as well as investing in advanced communications systems that are resistant to jamming. Conventional forces can also strive toward improving their coordination with special forces when such needs arise, as well as emphasizing decision-making at the levels of command to be flexible in the face of ever-changing situations. Meanwhile, as warfare takes on an increasingly 'hybrid' nature, the US, NATO, and the EU should not assume that instances of inefficient and ineffective synchronization of cyber and kinetic tactics result from a lack of experience or institutional knowledge on the part of adversaries.

Finally, these past three years have demonstrated the tendency of authoritarian regimes to commonly rely upon paramilitary organizations, often as a means of substituting for a lack of state capacity to provide for its constituency, as well as a lack of legitimacy in the eyes of the said constituency. This is particularly the case in instances where the officer class of the official militaries of these countries is not aligned with the views of the autocrats in power. It is important to note, however, that the often militant and violent nature of paramilitary organizations threatens to "exacerbate violence, undermine formal institutions, and enhance authoritarian rule," all to the ultimate detriment of the capacity of the state to function.[51]

[51] Dearing, "The Movement of the First: Entry Point to Paramilitarism in Russia."

The time for the United States, NATO, and the EU to address defense capabilities is now. The example set by the Ukrainian military serves as a precedent for future generations to come.

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Pacific Iron: The Case for a Future Armored Reconnaissance Regiment in the Pacific

Joshua Suthoff

ABSTRACT: This article argues that armored forces remain essential to future conflict in the Indo-Pacific, particularly in a potential war over Taiwan. Despite the growing prominence of drones, missiles, and robotic systems, the author contends that combined arms maneuver still requires armored platforms to provide mobile protection, direct firepower, and operational flexibility. Drawing on historical examples from the Pacific theater of World War II and recent observations from modern conflicts such as Ukraine, the article highlights how armor continues to adapt rather than disappear from the battlefield. It proposes the creation of a redesigned Armored Cavalry Regiment (ACR) optimized for Pacific operations—smaller, more deployable, and integrated with robotics, drones, and multi-domain reconnaissance capabilities. Such a formation would help fill a critical gap between light infantry forces and heavier Army units, enabling early-entry forces to sense, strike, and maneuver against mechanized adversaries. Ultimately, the article argues that a modernized armored reconnaissance force could significantly strengthen deterrence and denial strategies against a potential People's Liberation Army invasion of Taiwan.

It is early morning at the Zhuwei fishing port on Taiwan's western coast. Food vendors are starting to line the streets, selling local cuisine to workers as they make their way to the dock and other businesses. The surf quietly laps onto the dark brown sand, and in the distance, dark vessels emerge through the morning mist. In a few moments, it will be clear to the island residents and the world that this is the vanguard of the People's Liberation Army (PLA) invasion force. The persistent PLA air and naval exercise forces departed their training areas, bypassed their standard harassment routes, and are headed to their invasion positions. The invasion force, consisting of hundreds of ships and air and land-based missile units, will execute their preparatory fires and decapitation strikes, causing chaos across the island. PLA mechanized forces flow from the beachheads enroute to Taipei. A rapidly deployed US Marine Littoral Regiment and a US Army Mobile Combat Team (MBCT) with organic drones and supporting joint fire struggle to keep pace as they attempt to delay and deny the PLA mechanized, armored, and robotic forces. PLA suppressive fire on the lightly armed US forces, target saturation, cognitive load, and limited magazine depth quickly reduce friendly commander options and space. One plea repeatedly comes across the command net and chats, "We need friendly armor forward!"

The US joint task force in this vignette, like their predecessors who fought in the Pacific Theater of World War II, knew the benefit of armor employment on the battlefield. Even in the extremely restricted terrain of the Pacific, armored forces remained a critical part of combined arms warfare. These environmental restrictions do not reduce the need for armor support. When correctly positioned, armor proved a critical asset. In the Pacific Theater, land forces used tanks and armored vehicles to reduce obstacles, breach bunkers, destroy enemy armor, evacuate casualties, and deliver supplies. A well-timed and placed armored attack during island operations saved lives and broke Japanese tempo, most notably with the Marines at Guadalcanal and the US

Army at Luzon.[1] At a minimum, these vehicles provided artificial cover on otherwise barren beaches, helping ensure beachhead survival.

As the US joint force plans and organizes to prevent a PLA *fait accompli* of Taiwan, the potential capability and eventual requirement of an armored force to help win the land fight cannot be dismissed. When considering the terrain, threat, and distance of this potential conflict, the supporting armored unit needs to be right-sized and ready to leverage multi-domain assets to both support the infantry and sense and strike under significant contact. An optimized armored reconnaissance regiment assigned to the Pacific that has leveraged technology and decreased deployment overhead will be a significant and lethal force.

We need a serious discussion about the future of armor and should not be distracted by attention-grabbing technology. Successful historical examples highlighting the use of armor by the Marines on Okinawa or the US Army on Luzon are lost as strategists and planners focus on the outsized effectiveness of drones. As mentioned in *Reimaging Combat Power for Tomorrow's Battlefield: The Enhanced Brigade Combat Team,* "the relatively low cost of missiles and drones will ensure their continued presence on the battlefield."[2] As the primacy of robots continues to rise, the US Army cannot afford for a key part of maneuver warfare to lag. Are tanks more vulnerable with the rise of robotics? Yes, but the same can be said for infantry, especially when engaging an enemy combined arms force enhanced with robots. The primary question cannot be, "Do tanks and armor have a place on the future battlefield?" but rather "How must the armor force change to meet the evolving threats, leverage technology, and offer a credible capability at the time of need?" Where does the armor force and its centerpiece, the Armor Brigade Combat Team (ABCT) fit into the joint forces' focus on the Pacific? Since the Marine Corps divested all of their M1 Abrams main battle tanks, the Army is the only force that can develop and test a future armor formation that supports decisive land operations in the Pacific.

Pending a significant evolution in military affairs, there will still be a need for armored vehicles. The size and composition of this force are what must change to stay relevant. Although drone and missile technology have shaped the war in Ukraine, armor is still very much in use. It has not disappeared from the battlefield, instead the techniques and missions of both Russian and Ukrainian armor have changed. Existing vehicles like the M1 and M2 have demonstrated their survivability from Iraq to Ukraine. Armor formations must reorganize and adapt, not disappear. The premature damning of the platforms does not take into consideration that the premier land force, the US Army, has yet to execute future combined arms warfare under the new battlefield constructs; not all futuristic assumptions have been validated.

Like the old decisive action task graphic from ADRP 3-0 *Unified Land Operations*, offense, defense, and stability operations are shown on a sliding scale to accomplish a given mission.[3] The same type of graphic can be applied to future combined arms warfare to represent the appropriate amount of combat arms to accomplish the mission (Figure 1). Armored warfare will continue to have a place in combined arms formations. The quantity of robotics as part of maneuver warfare will continue to increase, but there will still be a requirement for manned

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[1] Steven Zaloga, *Tank Battles of the Pacific War 1941-1945* (Hong Kong: Concord Publications, 1995) 5.
[2] Joshua Suthoff, "Reimagining Combat Power for Tomorrow's Battlefield: The Enhanced Brigade Combat Team," Modern War Institute, April 18, 2025, https://mwi.westpoint.edu/reimagining-combat-power-for-tomorrows-battlefield-the-enhanced-brigade-combat-team/.
[3] US Army, *ADRP 3-0 Unified Land Operations* (Fort Leavenworth, KS: US Army, 2012), 2-3, Figure 2-1.

armor, infantry, and other enablers (fires, engineers, etc.). Force composition will vary based on the mission and theater. Drones have reached a level of capability where they are not additive, but transformative. BCTs, especially armor brigades, must radically transform to stay relevant and leverage this capability.

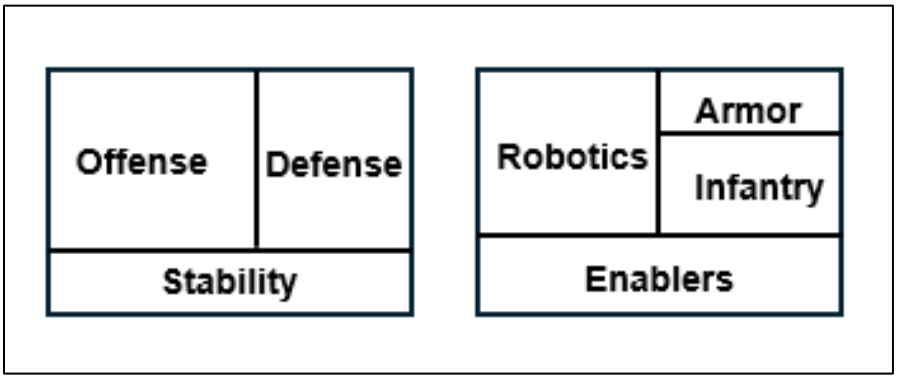

Figure 1: Sliding Scale of Unified Land Operations and Robotics as a part of Combined Arms

The recently published Army Structure 2028-2032 directs the re-establishment of the 3rd Armored Cavalry Regiment (3ACR) at Fort Hood, Texas. This force structure change provides a perfect opportunity to design a new armored cavalry regiment for the next fight. A formation that can balance and employ the benefits of armor and robotics will be an effective adaptation that enables combined arms maneuver. From its current force design as a Stryker Brigade Combat Team (SBCT), the 3rd Cavalry Regiment will transform into an ABCT, consisting of an armored reconnaissance squadron (ARS) and three combined arms battalions (CAB). Both the SBCT and ABCT machinations of the 3rd Regiment are cavalry in name only. The original 3rd ACR of the 1980s and 1990s was a combined arms formation that was equipped with the organic air, ground, and fire support required to conduct reconnaissance and security (R&S) missions. Evolving battlefield technology has made the old 3ACR design obsolete.

The joint forces' focus on the PLA dictates an armored formation designed to rapidly deploy and fight in the Pacific. The status quo ABCT design is not yet optimized to fight on the modern battlefield. The Army's Transformation in Contact (TIC) 2.0 prioritizes increasing ABCTs' lethality and survivability. However, considering the tyranny of distance and the restrictive terrain of the Pacific, the sheer size and logistics tail of an ABCT puts it at a disadvantage when crisis turns into conflict in the region. This shortfall translates into no armor for early-entry infantry forces, reducing lethality and survivability. Continued advancements in robotics, AI, and communications, paired with proven combat vehicles, support a re-evaluation and redesign that increases efficiency and lethality in armored formations. A future ACR that balances these strengths would be a critical asset in the deterrence and denial operations in the Pacific.

Land Power–the Decisive Force, Even in the Pacific

The PLA invasion force is the center of gravity for any attempt to seize Taiwan. Local sea and air control are key joint supporting missions, but physical control of terrain is decisive. Who controls the island of Taiwan controls the narrative of the conflict. Drone and missile technologies have eroded some of the hegemony of traditional air and naval power. Additionally,

the PLA has invested significantly in roll-on/roll-off ships. It is a valid assumption that the PLA will attempt to bring a significant mechanized and armored force for the invasion of Taiwan. Retired Gen. Charles Flynn, the former US Army Pacific commander, noted that land power is critical for holding key terrain in any theater, especially the Pacific.[4] In order to deter and defeat, the US Army must rapidly deploy to the fight with a credible and survivable force. The Marines cannot field an armored force to support their operations, and an Army MBCT is not a complete solution.

Credible deterrence in the Pacific requires a combined arms team. Prudent risk analysis would argue that any light infantry force against mechanized infantry, regardless of the reliability and magazine depth of its drone force, requires friendly armor support. Any credible US force in the Pacific must contain armor to round out all aspects of combined arms maneuver. The future ACR is that element. The restrictive and dense urban terrain of Taiwan does give light infantry the ability to punch above their weight, but this punch is tied to terrain and their drone and missile battle loads. An armored platform and an ACR are the backstop to this shortfall. Their extended direct fire weapons systems will help control the more open terrain along the coast and also provide significant cover and mobile firepower for the infantry. Certain tactical conditions will still require armor to deliver infantry to an objective versus moving through open terrain. Although armor operates at a higher risk in a restricted environment, its ability to breach and reduce obstacles in cities for the supporting infantry is still critical. A combined arms force and the ACR gives the enemy commander an additional dilemma outside the capabilities that a Marine Littoral Regiment or a MBCT can bring to bear organically.

Smaller Package, Bigger Punch

The future ACR would return to its namesake missions of R&S tasks: protect the friendly main body and provide decision space for its higher headquarters. A way to redesign the ACR is by creating three armored robotics squadrons (Figure 2). Each armored robotics squadron would have one multi-functional reconnaissance troop (MFRT) that mirrors the same formation type in the MBCTs.

[4] "Flynn: 'Time Is Now for Land Power' in Indo-Pacific," US Army Pacific, May 17, 2023, https://www.usarpac.army.mil/Our-Story/Our-News/Article-Display/Article/3399009/flynn-time-is-now-for-land-power-in-indo-pacific/; "Podcasts Archive," Australian Strategic Policy Institute, accessed February 20, 2026, https://www.aspi.org.au/podcasts/.

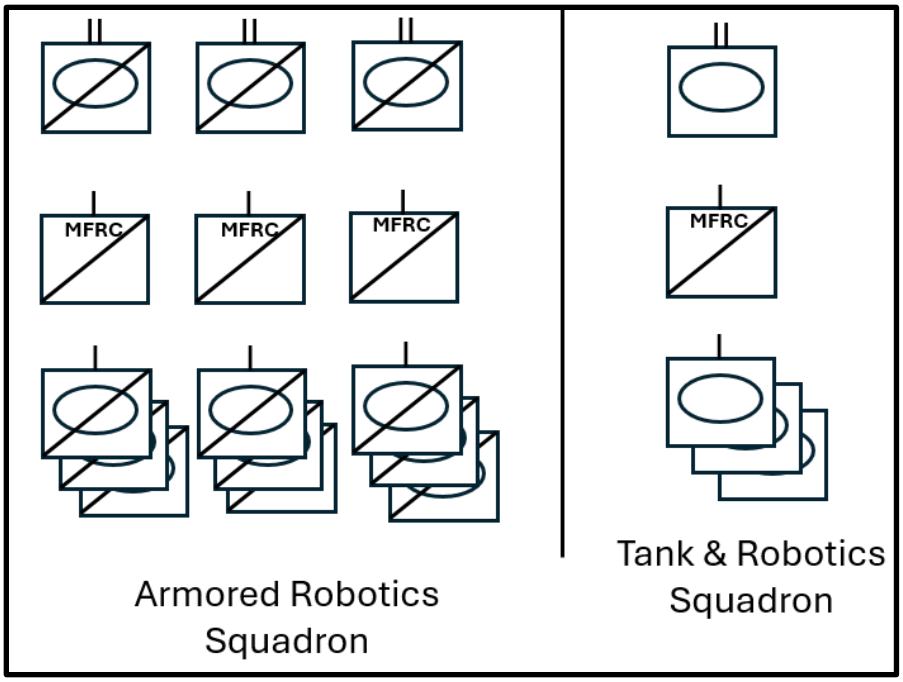

Figure 2: Proposed ACR Task Organization

Infantry Squad Vehicles (ISVs) would serve as the primary support vehicle throughout the ACR. The MFRTs would provide a light multi-domain reconnaissance mix to the armored troops. The three other troops in the squadron would be of the heavy reconnaissance type, with two M2s per platoon instead of the current design of four. A futuristic version of these platoons is a centerpiece in *White Sun War,* a novel about a Taiwan war scenario.[5] As shown in Figure 2, these recon platoons would consist of one section of M2s controlling a section of air and unmanned ground robots (UGV). Cavalry scouts serving as drone operators would operate in the relatively protected squad compartment of the M2. First-person view drones and ground robots would offset the reduction in armored fighting vehicles. Additionally, an ACR that is primarily equipped with ISVs and M2s decreases overall weight and logistics requirements. This reduction provides critical savings for any unit in the Pacific while bringing the benefits of armor early to a conflict.

[5] Mick Ryan, *White Sun War: The Campaign for Taiwan* (Philadelphia: Casemate, 2023).

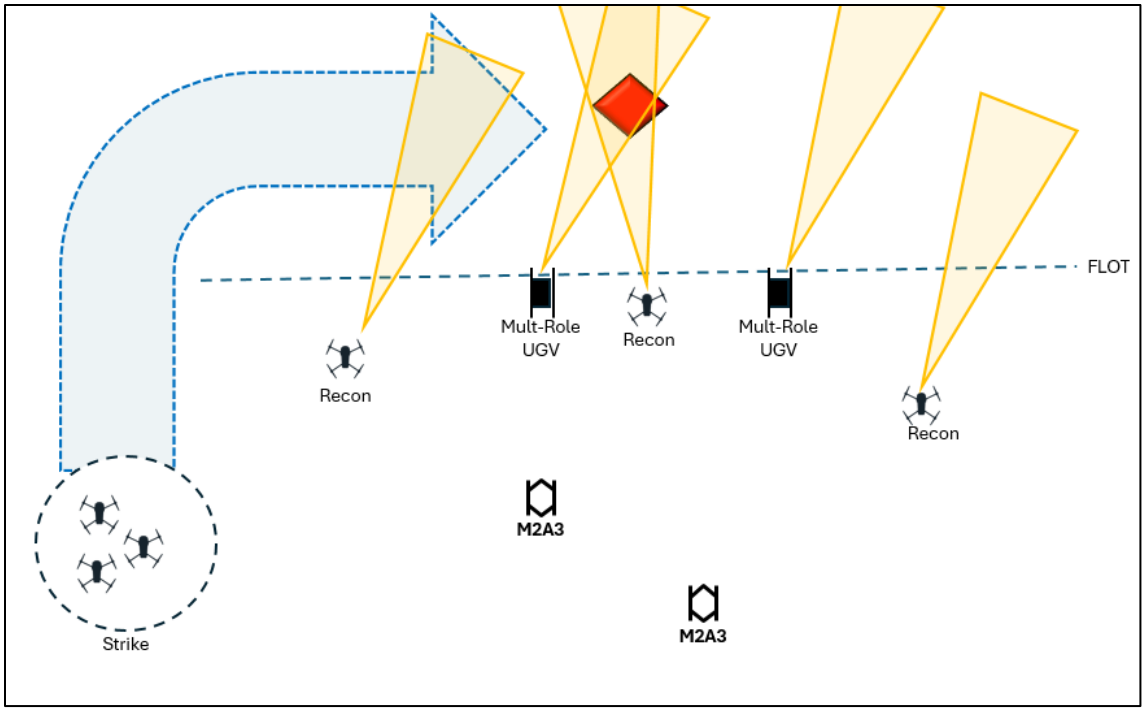

Figure 3: Proposed Framework for Armor and Robotic Teaming

The fourth squadron in the ACR would consist of another MFRT and three tank companies. The primary mission of the tanks and robotics squadron would be to support the other armored robotics squadrons with their R&S tasks, exploitation, or augment light infantry forces like MBCTs and Marine Littoral units. As robotic and vehicle teaming and UGV options improve, the number of tanks per platoon could be reduced from four to two. The ACR ensures a unified armor and robotic force for early entry operations to ensure initial success during conflict. It could be organized and equipped with existing platforms and TIC initiatives.

A Counter-Revolution

Opponents of the divergence from the traditional ABCT design will argue that the ACR sacrifices too much firepower and protection. However, advances in robotics have changed warfare. As Dr. Alex Miller, the US Army Chief Technology Officer (CTO), mentioned in a recent MWI podcast, advancement in robotics will lead to a more efficient way to close with and destroy the enemy.[6] A reduction in armored vehicles per formation is a natural benefit of this technology. More importantly, the ACR adaptation counters two points of the robotic military revolution: mass as a disadvantage and a change to risk calculus.

First, the ACR reduces mass. As noted in the article, *On War in 2027: Five Principles to Guide the Army Transformation Initiative,* the proliferation of drones, missiles, and especially hypersonic missiles will continue to threaten the once dominant mass of the US Army and the joint force. The ACR is smaller to avoid targeting, reduce logistics requirements, and increase the chance that the ACR can reach the fight to be decisive. Cutting the number of armored vehicles

[6] John Amble, "MWI Podcast: The Army and Tomorrow's Technologies." Modern War Institute, August 20, 2025, https://mwi.westpoint.edu/mwi-podcast-the-army-and-tomorrows-technologies/.

in the armored robotics squadrons by half means a whole platoon could be delivered on a C-17 instead of a section or a whole squadron by LSV-7 instead of a troop.[7] The smaller mass provides power projection and maintains unity of command. It also provides a higher headquarters with a more survivable unit that is trained on R&S tasks. Finally, employing existing platforms and reducing personnel requirements saves resources and funding.

Second, the ACR allows leaders to assume more acceptable risk. The future environment will force leaders to adapt the way they think about and manage risk. As capabilities increase, multipurpose air or ground drones will be able to execute extremely high-risk operations like a deliberate breach with minimal human forces forward. A mechanized deliberate breach was once the gold standard for brigade combat teams to train for, but it will involve an unacceptable risk going forward, given overwatching drones. Why send an engineer into a breach when you can send a robot to provide support by fire, another to breach, and a swarm for the initial assault? The same logic applies to other high-risk operations like mine emplacement, casualty evacuation, and sustainment operations.[8] Armored robotics squadrons will fight with drones forward while working with higher headquarters to leverage joint effects.

Pulling Hellscape to the Island

More importantly, the ACR is another option in addition to or in a supporting role to an MBCT. These units will help sense, shape, strike, and provide feedback in the close fight of the US Navy's Hellscape concept along Taiwan coast.[9] During a crisis, an early deployed ACR could position to extend the Hellscape concept onto the island with its complement of air and ground drones. An Army scout overwatching a landing beach could employ their organic one-way drones, request typhon missile strikes, and confirm battle damage assessment by the US Navy drones on PLA forces during a landing. The decentralized nature of modern warfare, evolving technology, and the island's compartmentalized terrain mean a small force could produce oversized effects. There must be a seamless handover line between Hellscape and Army tactical drones for maximum joint effectiveness if a crisis turns into a conflict. Additionally, the survivability and maneuverability of the ACR would help ensure resiliency in not only the joint ground force but also the joint kill web. During periods of effective enemy electronic warfare or convergence that negate drone operations, the ACR has large-caliber weapon systems to destroy targets.

The Right Mind State

ACRs and their scouts are trained to fight forward to complete R&S tasks. Armor leaders through PME and unit training are comfortable in ambiguity, large area of operations, and the complexity that comes with these missions. Prior to conflict, the future ACR would train and

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[7] "Army Watercraft: Shifting Priorities and Lessons Learned," www.army.mil, February 11, 2021, https://www.army.mil/article/243092/army_watercraft_shifting_priorities_and_lessons_learned.
[8] Joshua Suthoff, "Reimagining Combat Power for Tomorrow's Battlefield: The Enhanced Brigade Combat Team," Modern War Institute, April 18, 2025, https://mwi.westpoint.edu/reimagining-combat-power-for-tomorrows-battlefield-the-enhanced-brigade-combat-team/.
[9] "'Hellscape' Swarms Could Be a Cost-Effective Taiwan Defense, Says Report," USNI News, accessed February 20, 2026, https://news.usni.org/2024/07/01/hellscape-swarms-could-be-as-cost-effective-taiwan-defense-says-report

adjust SOPs with a focus on a fight in the Pacific. The physical complexity of an island like Formosa demands refinement to fire control measures, tactical aviation employment, and drone control to increase effectiveness and survivability. The data generated by the changes will drive adaptation in release authority and staff processes, all while headquarters elements are disaggregated and likely on the move. This includes adaptation in AI-enhanced networks to control and receive ISR data from drones. These changes will drive updates to the Army's professional military education and leaders' scope of responsibility. The forty-eight hours before and after a PLA invasion will be some of the toughest experiences throughout the history of warfare and will shape the course and cost of the conflict. Limited communications and periods of drone-induced very high intensity combat will demand the absolute best in mission command and tactical leader capability and competence. These challenges and highlighted friction points are expected by a traditional cavalry unit as they fight ahead of the main body.

A future fight in the Pacific will be the toughest challenge US military leaders at echelon will face. US tactical leaders utilizing offensive ground robots, unattended ground sensors, javelin missiles, and direct fire can overwatch and effect multiple engagement zones. A more capable joint force that is augmented with an armored/drone formation creates an undeniable specter in the mind of PLA decision-makers. In the face of a credible force, the PLA will need to execute a joint force entry into lodgment expansion, all while defending against guerrilla actions and keeping their sea lines of communications open. To maintain relevancy, armor formations must adapt by leveraging technology to increase their power projection, speed, and reduce their size, all while aligning with joint planning priorities. As history has shown, a fight in the Pacific will be incredibly difficult and costly without armor as part of combined arms maneuver. The creation of a future ACR oriented on operating in the Pacific is a logical step.

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Driving Innovation: Propelling Future Autonomy Through the US Army's Acquisition of Hybrid-Electric Tactical Vehicles

Curtis Cranston

ABSTRACT: Since the transition from horses to motors in the early twentieth century, the US Army has relied almost exclusively on a petroleum-based "tether of fuel" that creates critical vulnerabilities during large-scale combat operations. While the Army currently prioritizes AI-enabled autonomous systems, true operational autonomy is fundamentally a power generation requirement that legacy internal combustion engines cannot meet. Hybrid-electric drive (HED) technology provides the essential foundation required for the tools of the future fight. But HED acquisition remains stalled by policy-based misperceptions that frame electrification as a climate policy rather than a warfighting requirement. To overcome these barriers, the Army must adopt a roadmap that clarifies the true impetus of hybrid drive to propel autonomy, mandates modular open system approaches (MOSA) to prevent vendor lock in future development contracts, and utilizes the adaptive acquisition framework to leverage rapid commercial innovation. Prioritizing HED is the non-negotiable step required to decouple US ground forces from known vulnerabilities to unleash the power of ground autonomy to win the wars of tomorrow.

INTRODUCTION

Energy is the lifeblood of our warfighting capabilities.
General David Petraeus (2011)[1]

Adapt or perish, now as ever, is nature's inexorable imperative.
H.G. Wells, T*he Mind at the End of its Tether* (1945)[2]

Since its shift from horses to motor vehicles in the early twentieth century, the US Army has depended solely on oil-derived petroleum fuel to power its land-based tactical and combat vehicle fleet.[3] This reliance on a single operational energy source has only intensified and made the Army's global operations increasingly vulnerable over the last century.

At the same time that this "Achilles heel" has worsened in recent years, the commercial vehicle industry has achieved near-daily technological advances in hybrid-electric propulsion.[4] Nevertheless, the antiquated way in which the Army *sustains* its tactical wheeled-vehicle fleet today looks largely the same as it did a century ago, underscoring the Army's risky "tether of

[1] David H. Petraeus (Commander, International Security Assistance Force/United States Forces–Afghanistan), "Supporting the Mission with Operational Energy," memorandum to the Soldiers, Sailors, Airmen, Marines, and Civilians of US Forces-Afghanistan, June 7, 2011, para. 1, https://www.army.mil/article/63344/petraeus_guidance_on_operational_energy.
[2] H. G. Wells, *The Mind at the End of Its Tether* (London: William Heinemann, 1945), 19.
[3] Paul J. Kern et al., "An Albatross Around the US Military's Neck: The Single Fuel Concept and the Future of Expeditionary Energy," *Modern War Institute at West Point*, June 29, 2021, https://mwi.westpoint.edu/an-albatross-around-the-us-militarys-neck-the-single-fuel-concept-and-the-future-of-expeditionary-energy/.
[4] Virginia Alvino Young, "Electric and Autonomous Vehicles Work Best Together," *Carnegie Mellon University News*, July 20, 2020, https://www.cmu.edu/news/stories/archives/2020/july/electric-autonomous-vehicles.html.

fuel" in future land-based ground conflict.[5] In contrast, the Army's dogged pursuit of automated and autonomous vehicle systems to prepare for future conflict has kept pace with—and perhaps even surpassed—the commercial vehicle industry's market-driven advances in autonomous vehicles.[6] Although revolutionary, those unmanned platforms often continue to rely on a single petroleum-based fuel source to generate the electrical power needed to propel military innovation forward.[7]

Ironically, while the Army's pursuit of autonomous systems outpaces commercial markets, these unmanned platforms often remain tethered to the same antiquated petroleum-based sustainment systems as the horses they replaced a century ago. To achieve true operational autonomy, the Army must recognize that autonomy is a power generation requirement rather than merely a software challenge.

This article first highlights the Army's *opportunity for innovation* by integrating hybrid-electric drive (HED) capabilities into both its legacy ground fleet and its developing autonomous systems to revolutionize how it propels and sustains itself across the battlefield. Second, it emphasizes the Army's intensifying *need for innovation*, not merely to reduce its single-fuel reliance, but also to achieve the immense warfighting advantages—at the tactical, operational, and strategic levels of warfare—that hybrid-electrified tactical vehicles promise over their engine-only counterparts. Third, it identifies the *barriers to innovation*, including the formidable policy- and procedure-based roadblocks that have thus far stalled the Army's efforts to acquire HED for its legacy ground fleet and which will continue to hinder advances in autonomy. Finally, it presents a simple but promising *roadmap to innovation* for Army policymakers and acquisition leaders to procure such game-changing HED capabilities for US ground forces in time for the next global armed conflict.

THE OPPORTUNITY FOR INNOVATION

Although the US Department of War (DoW) is pursuing several simultaneous lines of effort to hybrid-electrify its air- and sea-based platforms, its land-based vehicle fleet—with its size and potential to capitalize on commercial vehicle industry advances more readily—presents the most compelling opportunity for innovation.[8] The Army's operational ground fleet includes thousands of vehicles of two types: "ground combat vehicles" (i.e., heavily armored, predominantly tracked platforms, such as the Abrams main battle tank) and "tactical wheeled vehicles," ranging from

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[5] Neta C. Crawford, *Pentagon Fuel Use, Climate Change, and the Costs of War* (Watson Institute for International and Public Affairs, Brown University, June 12, 2019), 4, 8, https://costsofwar.watson.brown.edu/sites/default/files/papers/Crawford-Pentagon-Fuel-Use-Climate-Change.pdf.
[6] Jen Judson, "Army Picks 3 Startups to Fast-Track Self-Driving Squad Vehicle," *Defense News*, September 2, 2025, https://www.defensenews.com/land/2025/09/02/army-picks-3-startups-to-fast-track-self-driving-squad-vehicle/; Defense Innovation Unit, "Accelerating Autonomous Vehicle Technology for the DoD," *DIU Latest*, April 3, 2024, https://www.diu.mil/latest/accelerating-autonomous-vehicle-technology-for-the-dod.
[7] Nicholas Barry and Surya Santoso, "Modernizing Tactical Military Microgrids to Keep Pace with the Electrification of Warfare," *Military Review* 102, no. 6 (November–December 2022): 95, https://www.armyupress.army.mil/Portals/7/military-review/Archives/English/ND-22/Barry/Barry%20November-December-UA.pdf.
[8] Office of the Under Secretary of Defense for Acquisition and Sustainment, *2023 Department of Defense Operational Energy Strategy* (Washington, DC: Department of Defense, 2023), 6, https://www.acq.osd.mil/log/energy/OE_Strategy_2023.pdf.

light utility vehicles (such as the high mobility multipurpose wheeled vehicle) to medium and heavy equipment transporters.[9] In total, tactical wheeled vehicles outnumber ground combat vehicles ten-to-one and support the widest variety of combat operations by transporting warfighters, equipment, and materiel like munitions, water, and fuel across the battlefield.[10]

Regardless of the vehicle type and purpose, they all have one common requirement—and subsequent vulnerability: oil, or more specifically, one of a few petroleum-based fuel types, such as JP-8 or F-24.[11] After the US Army's historic shift from horses to motor vehicles during the Interwar Period, cracks began to expose the increasingly untenable position of this reliance on a single fuel source to ensure "the Army goes rolling along." In the summer and fall of 1944, General George S. Patton was forced to repeatedly halt the advance of his Third Army because of a lack of gasoline resupply, allowing the Germans to reposition and leading some historians to argue that this fuel shortage delayed the war's end.[12] Nearly fifty years later, in February 1991, as part of Operation Desert Storm in the Gulf War, US Army ground forces again almost outran their logistical support despite quickly penetrating the Iraqi defenses and destroying their resistance. If the Iraqi Republican Guard had not surrendered so quickly, the US Army would have been forced to cede the initiative and take another lengthy operational pause due to critical supply shortages, particularly in petroleum fuel.[13]

As a result of its single-fuel reliance, the US Department of War (DoW) has become the world's largest institutional consumer of petroleum-based fuel, spending more than $10 billion on bulk fuel annually and consuming more than 360,000 barrels of oil each day—only 35 *countries* consume more.[9] Nevertheless, the cost of the DoW's fuel addiction is far more than financial, as highlighted in the recent conflicts in Iraq and Afghanistan, where near-constant enemy attacks

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[9] US Government Accountability Office, *Army Combat Vehicles: Industrial Base Study's Approach Met Research Standards*, GAO-15-548 (Washington, DC: GAO, 2015), 3–4, https://www.gao.gov/products/gao-15-548; Daniel Goure, "The US Army's All-But Forgotten Vehicle Fleet," *Real Clear Defense*, August 22, 2017, https://www.realcleardefense.com/articles/2017/08/22/the_us_armys_all-but_forgotten_vehicle_fleet_112116.html; "Daily Energy Report: A Look at US Military Energy Consumption," *OilPrice*, June 8, 2011, https://oilprice.com/Energy/Energy-General/A-Look-At-US-Military-Energy-Consumption.html.

[10] US Government Accountability Office, *Tactical Wheeled Vehicles: Army Should Routinely Update Strategy and Improve Communication with Industry*, GAO-21-460 (Washington, DC: GAO, 2021), 3–4, https://www.gao.gov/products/gao-21-460.

[11] Kern et al., "An Albatross Around the US Military's Neck," https://mwi.westpoint.edu/an-albatross-around-the-us-militarys-neck-the-single-fuel-concept-and-the-future-of-expeditionary-energy/.

[12] James Mancillas, *Electrification of US Army Ground Force (An Evolutionary Revolution)*, white paper (CALSTART, 2020), 2, https://calstart.org/wp-content/uploads/2020/10/Vehicle_Electrification_Paper_29JUN20.pdf (archived at https://perma.cc/9579-7RL5); Greg Bailey, "The Red Ball Express – The Unknown Link in Winning World War Two?," *History Is Now Magazine*, August 15, 2015, http://www.historyisnowmagazine.com/blog/2015/8/12/the-red-ball-express-the-unknown-link-in-winning-world-war-two (archived at https://perma.cc/SZC9-BWSG); Roland G. Ruppenthal, *Logistical Support of the Armies: Volume I: May 1941—September 1944*, United States Army in World War II: The European Theater of Operations (Washington, DC: Office of the Chief of Military History, 1953), 475, 499–509, 513 (describing the critical fuel shortages from the Allied Forces' invasion on D-Day until September 1944, which drastically slowed the advance of Patton's Third Army from France into Germany).

[13] Gregory J. Hom, *Charging Ahead: How the Army Can Learn from the Past to Prepare for Electric Vehicles in the Future* (Fort Leavenworth, KS: Command and General Staff College, 2020), 1, https://apps.dtic.mil/sti/trecms/pdf/AD1159118.pdf (archived at https://perma.cc/B4KK-4R9B); Jason Carrico, *Mitigating the Need for a Logistic Pause* (Fort Leavenworth, KS: Command and General Staff College, 2006), 17–18, 20–21, https://apps.dtic.mil/sti/pdfs/ADA450161.pdf (archived at https://perma.cc/5D95-X4ZV).

on US fuel resupply convoys accounted for more than one-quarter of all US casualties.[14]

In more recent conflicts, the next era of ground warfare will be defined by the widespread integration of autonomous and semi-autonomous systems. Although aerial drones have become the most visible demonstrations of future autonomous systems, the US military, as well as its allies and adversaries, continues to develop autonomous ground vehicles to perform various direct-combat and warfighting support functions.[15] Future ground platforms, whether purpose-built or incorporated into legacy tactical wheeled vehicles and ground combat vehicles, rely on sophisticated sensors, processors, and AI-enabled decision support. Each of these systems will require reliable electrical power to ensure the proper function of its advanced capabilities. However, even autonomous weapons systems that operate primarily on electricity (via electric motor propulsion systems powered by individual batteries or traction packs) typically rely solely on fuel-powered generators and logistics packages (LOGPACs) to recharge their extensive batteries, thereby limiting the additional operational reach these systems could provide. This vulnerability underscores that the "tether of fuel" must loosen to achieve true operational autonomy and transformation in the future fight.

Future ground platforms, whether purpose-built or integrated into legacy fleets, rely on sophisticated sensors, AI processors, and decision-support tools that require abundant, *reliable electrical power*. HED provides the foundational power bus necessary to run these systems without relying on targetable generator trailers, thereby loosening the 'tether of fuel' that currently limits autonomous reach.

THE NEED FOR INNOVATION

Experiences from recent and ongoing armed conflicts—such as Russia's infamous "40-mile-long" convoy on roads outside Kyiv, where its military was forced to abandon hundreds of stalled combat vehicles after running out of fuel—underscore that the Army's need to procure hybrid-electric capabilities is no longer a long-term policy aspiration but a crucial warfighting imperative.[16] This need is even more crucial given the battlefield advantages that hybrid-electric tactical vehicles (both manned and unmanned) promise over their engine-only legacy counterparts at the tactical, operational, and strategic levels of warfare. Hybrid vehicle propulsion systems leverage the respective benefits of internal-combustion-engine-only vehicles and electric-motor-only vehicles while mitigating the disadvantages of each. The warfighting advantages of HED vehicles are not merely theoretical but already demonstrated through testing of both retrofit anti-idle kits and purpose-built hybrid-electric tactical wheeled vehicle prototypes by organizations like the Ground Vehicle Systems Center (GVSC) under the US Army Combat Capabilities Development Command (DEVCOM) and the Joint Program Office–Joint Light

[14] David Eady et al., *Sustain the Mission Project: Casualty Factors for Fuel and Water Resupply Convoys*, Final Technical Report (US Army Environmental Policy Institute, September 2009), 9, https://apps.dtic.mil/sti/pdfs/ADA534607.pdf.
[15]Kyle Mizokami, "China's New Type 100 Military Tank," *Popular Mechanics*, October 14, 2024, https://www.popularmechanics.com/military/weapons/a69528864/china-new-type-100-military-tank/.
[16] Denys Davydenko et al., "Lessons for the West: Russia's Military Failures in Ukraine," *European Council on Foreign Relations*, August 11, 2022, https://ecfr.eu/article/lessons-for-the-west-russias-military-failures-in-ukraine/.

Tactical Vehicle (JPO-JLTV) under the Assistant Secretary of the Army for Acquisition, Logistics, and Technology (ASA(ALT)).[17]

First, at the lowest, tactical level, the benefits of hybrid-electrified tactical vehicles include the following:

- Lower thermal (10:1 reduction) and audible (5:1 reduction) signatures to reduce targetability;[18]
- Higher torque allowing for faster "sprint speeds" to increase survivability (10 percent decrease in vehicle strikes due to the enhanced ability to displace from positions targeted by enemy fires);[19] and
- Greater onboard electric power generation: A single hybrid-retrofitted vehicle can replace the power generation capacity of *seven towed generator trailers*, effectively eliminating half of a traditional brigade TOC's footprint and removing the primary obstacles to recharging autonomous UAVs and UGVs in the field.[20]

Second, at the operational level of war, the benefits of hybrid-electric tactical wheeled vehicles include:

- Extended operational duration from three to five days: By reducing the "tether of fuel," HED allows units to remain in the fight longer without the operational pauses necessitated by constant resupply, providing the critical margin needed to outlast peer adversaries in contested environments;[21]

- Reduced maintenance demands and increased reliability: Hybrid drivetrains utilize fewer moving parts and place significantly less strain on internal combustion engines, which operate less frequently and within more efficient ranges. Studies indicate that hybrids average 26 percent fewer mechanical issues than legacy engine-only counterparts. This reliability reduces the time vehicles spend "off-line," eases the strain on operational budgets, and minimizes the need for resource-heavy

[17] Dean McGrew (Branch Chief, Powertrain Electrification, GVSC, DEVCOM, AFC), email message to author, March 15, 2024 [hereinafter E-mail, McGrew] (on file with author).
[18] Ibid.
[19] James Mancillas, *White Paper: Electrification of US Army Ground Force (An Evolutionary Revolution)* (Army Futures Command, June 29, 2020), 4, distributed by CALSTART, https://calstart.org/wp-content/uploads/2020/10/Vehicle_Electrification_Paper_29JUN20.pdf; R. J. Hart and Richard Gerth, "The Influence of Ground Combat Vehicle Weight on Automotive Performance, Terrain Traversability, Combat Effectiveness, and Operation Energy" (paper presented at the 2018 NDIA Ground Vehicle Systems Engineering and Technology Symposium, 2018), 7, https://events.esd.org/wp-content/uploads/2018/07/The-Influence-of-Ground-Combat-Vehicle-Weight-on-Automotive-Performance-Terrain-Traversability-Combat-Effectiveness-and-Operational-Energy.pdf.
[20] Ibid; Mancillas, *Electrification of US Army Ground Force*, 2.
[21] National Academies of Sciences, Engineering, and Medicine, *Electrification of the Army's Light Combat Vehicle Fleet: Proceedings of a Workshop—In Brief* (Washington, DC: National Academies Press, 2023), 2, https://doi.org/10.17226/26856.

maintenance LOGPACs, effectively increasing the "force-multiplier" effect of the fleet i.e., 25% less time "off-line");[22]

- Dramatically reduced fuel needs (30% reduction);[23] and
- Less frequent and targetable LOGPAC convoys.[24]

Finally, at the *strategic* level, HED modernization transitions the force from energy-vulnerability to strategic independence, allowing the DoW to reallocate the instruments of national power from securing brittle oil shipping lanes to more direct peer-quality threats.[25] The DoW currently expends billions of dollars and countless man-hours annually to secure the free flow of oil in the Persian Gulf, a strategic burden estimated at $30 billion to $75 billion per year that could be partially alleviated by decoupling ground forces from an annual bulk fuel bill exceeding $10 billion.[26] Prioritizing these acquisitions directly supports the United States' ability to dominate large-scale combat operations (LSCO) by neutralizing an adversary's most effective strategic weapon: the interdiction of over-extended fuel supplies.[27] This shift is a national security imperative because the People's Republic of China (PRC) is currently fielding military HED capabilities at a rate five to six times that of the United States, threatening to offset traditional US military advantages through superior energy resilience.[28]

Tying together the tactical, operational, and strategic benefits, the most compelling impetus for HED is its role as the non-negotiable electric power foundation for the US Army's pursuit of AI-

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[22] Mancillas, *Electrification of US Army Ground Force*, 4; AutoGuide.com Staff, "Hybrids Soar over ICE Vehicles in Reliability, PHEVs and EVs Falter," *AutoGuide*, November 30, 2023, https://www.autoguide.com/auto/featured-articles/hybrids-soar-over-ice-vehicles-in-reliable-phevs-and-evs-falter-44608540 (archived at https://perma.cc/N58K-NPYY).

[23] Dean McGrew (Branch Chief, Powertrain Electrification, GVSC, DEVCOM, AFC), email message to author, March 15, 2024 [hereinafter E-mail, McGrew] (on file with author).

[24] National Academies of Sciences, Engineering, and Medicine, *Electrification of the Army's Light Combat Vehicle Fleet: Proceedings of a Workshop – In Brief* (Washington, DC: The National Academies Press, 2023), 2n5, https://doi.org/10.17226/26856.

[25] Donald L. Wasson, "The Battle of Pydna," *World History*, February 19, 2015, https://www.worldhistory.org/Battle_of_Pydna; Chairman, Joint Chiefs of Staff, Joint Doctrine Note 2-19, *Strategy*, II-2

[26] Mark Delucchi, "The Cost of Protecting Oil in the Persian Gulf," *Resources*, January 16, 2012, https://www.resources.org/common-resources/the-cost-of-protecting-oil-in-the-persian-gulf-1; US Gov't Accountability Off., GAO-23-105531, *DOD Bulk Fuel: Improved Management over Transactions Could Lead to More Reliable Financial Reporting*, 1.

[27] John Whitley, *Three Reforms to Improve Defense Resource Management*, IBM Ctr. for Bus. of Gov't, 8 [June 9, 2022], https://www.businessofgovernment.org/sites/default/files/Three%20Reforms%20to%20Improve%20Defense%20Resource%20Management.pdf; Denys Davydenko et al., "Lessons for the West: Russia's Military Failures in Ukraine," *European Council On Foreign Relations*, August 11, 2022, https://ecfr.eu/article/lessons-for-the-west-russias-military-failures-in-ukraine.

[28] Al Shaffer and John Whitley, "Modular Open System Architecture Allows Continuous Weapon Upgrades," *C4ISR Net*, November 28, 2023, https://www.c4isrnet.com/opinion/2023/11/28/modular-open-system-architecture-allows-continuous-weapon-upgrades.

enabled operational autonomy.[29] True autonomy is not merely a software challenge but a power generation requirement, as future ground platforms rely on sophisticated sensors and AI-enabled processors that demand abundant and reliable electrical power.[30] For example, commercial autonomous vehicles (AVs) typically operate on high-voltage systems ranging from 400V to 800V DC for propulsion, similar to standard electric vehicles. Additionally, their computing, sensors, and actuators require additional power, often utilizing a 12V-48V bus for auxiliary systems. The computing hardware alone can consume 500W to 2.5kW of power, impacting overall range and performance.[31]

While legacy internal combustion engines struggle to supply the high-instantaneous power required for these systems, HED platforms provide a 600-volt Direct Current (DC) bus capable of running high-voltage AI decision-support tools and mission payloads like directed-energy weapons (DEW). As the tactical benefits highlight, fielded testing demonstrated that hybrid-electrified vehicles provided ten times the electrical power production of traditional platforms, replacing the capacity of seven towed generator trailers and providing the electrical backbone necessary to scale autonomous warfighting systems exponentially.[32]

By providing the unit-level endurance to operate independently for three to five days, HED capabilities enable US forces to bypass enemy anti-access/area denial (A2/AD) strategies that specifically target logistics and bulk-fuel vehicles.[33] In an LSCO scenario where a single armored division can consume up to 500,000 gallons of fuel daily, the reduction of unit fuel demand by 50 percent shifts the strategic calculus from logistical survival to offensive lethality.[34] Ultimately, modernizing the tactical fleet with HED establishes credible strategic deterrence by proving to adversaries that US ground forces possess the endurance to outlast peer competitors in contested environments.[35] Hybrid-electric drive tactical vehicles should therefore be recognized

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[29] National Academies of Sciences, Engineering, and Medicine, *Electrification of the Army's Light Combat Vehicle Fleet: Proceedings of a Workshop—In Brief* [Washington, DC: National Academies Press, 2023], 1–2, https://doi.org/10.17226/26886.

[30] James Mancillas, *Electrification of US Army Ground Force (An Evolutionary Revolution)*, white paper [CALSTART, 2020], 2, https://calstart.org/wp-content/uploads/2020/10/Vehicle_Electrification_Paper_29JUN20.pdf; Gregory J. Hom, *Charging Ahead: How the Army Can Learn from the Past to Prepare for Electric Vehicles in the Future* [Fort Leavenworth, KS: Command and General Staff College, 2020], 1, https://apps.dtic.mil/sti/trecms/pdf/AD1159118.pdf.

[31] "High Voltage Vehicles: Why 800-Volt EVs Are on the Rise." *Engineering.com*, August 14, 2023. https://www.engineering.com/high-voltage-vehicles-why-800-volt-evs-are-on-the-rise/.

[32] Dean McGrew [Branch Chief, Powertrain Electrification, GVSC, DEVCOM, AFC], email to author, March 15, 2024; US Gov't Accountability Off., GAO-23-105868, *Directed Energy Weapons: DOD Should Focus on Transition Planning*, 1, https://www.gao.gov/assets/gao-23-105868.pdf.

[33] James Mancillas, *Electrification of US Army Ground Force (An Evolutionary Revolution)*, white paper [CALSTART, 2020], 2–3, https://calstart.org/wp-content/uploads/2020/10/Vehicle_Electrification_Paper_29JUN20.pdf.

[34] Walker Mills and Ryan Wiechens, "The Lethality Case for Electric Military Vehicles," *Modern War Institute at West Point*, December 1, 2022, https://mwi.westpoint.edu/the-lethality-case-for-electric-military-vehicles.

[35] John Whitley, *Three Reforms to Improve Defense Resource Management*, IBM Ctr. for Bus. of Gov't, 8, June 9, 2022, https://www.businessofgovernment.org/sites/default/files/Three%20Reforms%20to%20Improve%20Defense%20Resource%20Management.pdf.

not as a policy aspiration, but as the *essential* power foundation required to transform the character of ground conflict.[36]

THE BARRIERS TO INNOVATION

Despite a demonstrated need for such capabilities, the Army's efforts to acquire hybrid-electric tactical vehicles remain stalled by two formidable barriers that continue to hinder timely innovation and threaten to leave US ground forces dangerously behind their peer adversaries.

First, there are policy-based challenges that continue to block necessary funding for these acquisition programs from the start. Most significantly, these include the polarizing perception that climate change initiatives are behind the Army's hybrid-electrification efforts.[37] This confusion only deepened after Army budget justification books in previous years erroneously connected HED ground vehicle projects to past climate goals.[38] More generally, these policy-based challenges also include Congress's increasing reliance on continuing resolutions and the DoW's relatively low prioritization of ground vehicle research and development (R&D) projects in favor of much costlier and less productive air and sea platform modernization efforts.

Even if hybrid-electric tactical wheeled vehicle programs can overcome these initial policy-based barriers, they also face daunting procedural challenges that persist across the DoW's acquisition systems. Most significantly, common shortfalls include programs' failures in planning for future technological advances, such as obtaining key intellectual property and data rights from initial development contractors. Relatedly, major acquisition programs have historically neglected a modular open-systems approach (MOSA) to ground-vehicle modernization efforts and development contracts. As required by 10 USC. § 4401(a), a MOSA design ensures that major weapons systems and vehicle platforms are built with interchangeable, standardized hardware and software interfaces to enable timely, cost-efficient technological refresh over a system's lifecycle. These deficiencies are especially critical barriers for future systems in which units seek to integrate autonomous capabilities. Without an acquisition strategy that mandates flexibility and open architecture in the design of key interfaces, the foundational power offered by HED platforms cannot efficiently integrate with and evolve alongside the sophisticated autonomous technologies required to transform the character of war.

These types of deficiencies often result in delayed delivery schedules and increased costs of major weapon systems. They also sometimes lead to reductions or even cancellations of higher-priority and more heavily funded acquisition programs, so such deficiencies pose an even

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[36] *Army Tactical Wheeled Vehicle Program Update and Review of Electrification: Hearing Before the S. Comm. on Tactical Air & Land Forces of the H. Comm. on Armed Serv.*, 117th Cong. 34, https://www.congress.gov/117/chrg/CHRG-117hhrg45432/CHRG-117hhrg45432.pdf.

[37] John Donnelly, "New Army Climate Strategy Splits the Parties," *Roll Call*, February 8, 2022, 6:58 p.m., https://rollcall.com/2022/02/08/new-army-climate -strategy-splits-the-parties.

[38] US Department of the Army, *Department of Defense Fiscal Year (FY) 2024 Budget Estimates: Army Justification Book Volume 3a of 3, Research, Development, Test & Evaluation, Army: RDT&E – Volume II, Budget Activity 5A*, March 2023, , 5, 166, 173–76, 248, 249, https://www.asafm.army.mil/Portals/72/Documents/BudgetMaterial/2024/Base%20Budget/rdte/RDTE-Vol%202-Budget%20Activity%205A.pdf.

greater danger to lower-funded programs like those for hybrid-electric ground tactical vehicles. However, even if those programs can avoid such pitfalls, the weak US defense industrial base and the lack of a broader Army modernization strategy for its tactical vehicle fleet make communicating requirements to industry a constant challenge for the acquisitions workforce.[39]

THE ROADMAP TO INNOVATION

To answer these challenges and achieve timely innovation, Army leaders must recognize the immediate warfighting need to acquire hybrid-electric capabilities to propel its future autonomous tactical vehicles. This first means appreciating and responding to key criticisms of such efforts, like concerns over the many critiques of hybrid-electrifying the military's ground fleet, which are representative of hybrid- or all-electric vehicles, as a whole. These critiques generally fall within one of seven main areas: (1) the technological limitations and costs of current EV technology; (2) the sourcing of EV battery materials and components; (3) the safety risks associated with EVs; (4) the perceived inability of the federal government to pivot agilely between energy sources; (5) the apparent climate-focused political motivations of electrification; (6) the DoD's current challenges in procuring electricity for its installations; and (7) the broader concerns over the DoD's rashness in pursuing innovation at all costs. Nevertheless, such skeptics must also appreciate the counterpoints to these critiques to recognize the greater risk they would bear in not deliberately and timely acquiring HED capabilities for our ground vehicle fleet. For example, although there are serious foreign supply chain risks of sourcing of electric battery components (e.g., mining and refinement of rare earth metals like cobalt or lithium-ion), the number of US manufacturers of electric vehicle batteries, hardware, and software is growing, as are efforts to expand domestic sources of lithium.[40] Ultimately, US ground forces can't "catch up" with innovation, so a DoW strategy that stalls internal R&D and advances in HED-powered autonomy until commercial technology and supply chains improve would be ill-advised.

At a strategic level, by recalling the military's historic role as a driver of game-changing battlefield technology (as opposed to merely remaining a "fast follower" behind industry innovation), Congress and Army acquisition leaders can use a novel roadmap to best evaluate, communicate, and meet US ground forces' mounting demand for autonomous tactical ground vehicle modernization.[41] Such a path forward requires a two-pronged approach to overcome both the policy-based and procedural roadblocks to hybrid-electrification. Involving simple yet impactful steps, these approaches aim to improve—and to some extent, buck—traditional methods through which the military currently acquires its tactical vehicles.

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[39] US Government Accountability Office, *Tactical Wheeled Vehicles: Army Should Routinely Update Strategy and Improve Communication with Industry*, GAO-21-460 (July 15, 2021), 3–4, https://www.gao.gov/assets/gao-21-460.pdf.

[40] Patrick Whittle, "US Seeks New Lithium Sources as Demand for Clean Energy Grows," *PBS News Hour*, March 28, 2022, 6:59 p.m. EST, https://www.pbs.org/newshour/economy/u-s-seeks-new-lithium-sources-as-demand-for-clean-energy-grows.

[41] House Committee on Armed Services, Subcommittee on Tactical Air and Land Forces, *Army Tactical Wheeled Vehicle Program Update and Review of Electrification*, 117th Cong., 1st sess., May 27, 2021 (opening statement of Rep. Donald Norcross, Chairman), https://www.congress.gov/117/meeting/house/112695/witnesses/HHRG-117-AS25-M001-20210527.pdf; Office of the Assistant Secretary of the Army (Installations, Energy and Environment), "Internal Memo: Re-characterizing Hybrid-Electrification as a Warfighting Imperative," June 2021.

First, on the policy-based front, Army leaders must better prioritize internal R&D efforts and unequivocally communicate (up to Congress and down to the Joint Force) the non-climate impetus for hybrid-electrification.[42] Today, no one would reasonably question the Army's historic shift from horses to motor vehicles in the interwar years leading up to WWII. However, after more than 3,500 years of armies relying on horses and other beasts of burden to fight wars, the comparative advantages of vehicles were less obvious than they were in hindsight.[43] Before WWII, many in Congress and the Army's own ranks still distrusted vehicles in combat. However, US Army Chief of Staff General George Marshall coordinated large field exercises with what would now be called "low-rate initial productions" of their new motor vehicles to demonstrate their advantages to Congress for additional funding and to operational units to build trust and identify issues before use in combat. Similarly, today's Army leaders must realize and intentionally communicate the need for HED to power autonomy and realize its many other warfighting advantages. They can do so by following General Marshall's example of coordinating major field exercises, perhaps with some units propelled by hybrid-electrified platforms and autonomous systems fighting against units powered solely by legacy, engine-only vehicles.

Additionally, Army leaders must publish an updated "Tactical Wheeled Vehicle Strategy." Although other types of platforms—like aircraft and surface ships—regularly release such strategies, the last one for tactical ground vehicles was over 13 years ago and made no mention of hybrid-electric power. Continually releasing these strategies helps clarify the long-term, strategic vision for the ground fleet for Congress, the acquisitions workforce, and the defense industry.

Second, on the procedural front, the DoW requires a more comprehensive and modern HE TWV acquisition strategy that resolves contracting inefficiencies while better leveraging industry and in-house military innovation. Acquisition leaders achieve this by integrating commercial development and hardware acquisitions as two new "Adaptive Acquisition Framework" pathways, streamlined processes to more effectively acquire unique types of capabilities or systems.[44] To protect future funding and technology obsolescence for these vulnerable ground vehicle programs, leaders must also demand MOSA design in future development contracts. This crucial technical design tool will enable future integration of both commercial advances in vehicle battery technology and rapidly evolving innovation in autonomous systems and AI-enabled decision support. By mandating MOSA, acquisition leaders can ensure that the electrical capacity and reduced signatures provided by HED can be fully leveraged to support successive generations of autonomous hardware and software architecture. Focusing on modularity and power is paramount to "future-proofing" US ground forces.

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[42] [Army Climate Advisor saying these are not climate initiatives so any previous budget justification books were inaccurate].
[43] Lauren Feldman, "Horses of War," *American Cowboy*, May 27, 2022, https://americancowboy.com/people/history-archive/horses-war-23983.
[44] US Department of Defense, Instr. 5000.02, *Operation of the Adaptive Acquisition Framework* § 1.3, 23 Jan. 2020, (C1, 8 June 2022), 4.

The threats US ground forces face in future armed conflicts will continue to be hybrid; how the Army moves and sustains itself across tomorrow's changing battlefields must be hybrid as well. That means that the military must remain agile and adaptable in how it propels itself forward, while still not trading in one addiction to a single fuel source for another.[45] By maneuvering past policy gridlock and creatively utilizing defense acquisition procedures, Army leaders can better leverage industry innovation and internal R&D efforts to acquire HED capabilities for both its manned and unmanned tactical vehicles. In doing so, as they've done before past global armed conflicts, they can "future-proof" US ground forces in time to fight *and win* the wars of tomorrow. It's time to get moving.

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[45] Eric Tegler, "The Army Should Diversify Its Vehicle Fuels But Not Rely On Electricity Or EVs, A DoD-Sponsored Report Says," *Forbes*, June 23, 2021, https://www.forbes.com/sites/erictegler/2021/06/23/the-army-should-diversify-its-vehicle-fuels-but-not-rely-on-electricity-or-evs-a-dod-sponsored-report-says/.

Joint Terminal Attack Controllers in the Autonomous Age

Eric Sanderson and Aaron Hinton

ABSTRACT: As autonomous technologies increasingly shape modern warfare, the role of the Joint Terminal Attack Controller (JTAC) must evolve to maintain effective coordination between ground forces and airpower. This article examines how emerging systems—particularly small unmanned aerial systems (sUAS) equipped with laser target designators and agentic artificial intelligence—can enhance JTAC effectiveness in contested environments. Future conflicts against near-peer adversaries will feature dense airspace, electronic warfare, and sophisticated air defenses, complicating traditional close air support operations. While small drones expand tactical lethality at the unit level, they cannot replace the destructive power of manned aircraft delivering precision-guided munitions, ensuring the continued relevance of JTACs. The article proposes integrating an "Artificial RTO," an AI-enabled software agent embedded in the JTAC's communications architecture, to process voice traffic, geospatial data, and doctrinal references in real time. By automating data management and targeting calculations while preserving human decision authority, these technologies can reduce risk to operators, improve targeting accuracy, and enable JTACs to orchestrate increasingly autonomous air-ground operations

Autonomous technologies underpin the United States Air Force's preparation against near-peer adversaries. To reduce risk to pilots facing integrated air defense systems (IADS), drones ranging from small quadcopters to unmanned fighter jets increasingly supplant manned assets. Some suggest unmanned systems should replace fighter jets,[1]whereas others foresee a future with manned aircraft through the end of the century.[2] This debate typically concentrates on pilots and the manned-unmanned teaming in the sky. Often absent from this discussion is the future role of the Joint Terminal Attack Controller (JTAC), the critical link between ground forces and air assets. The following analysis explores the potential for autonomous technology to reduce risk to ground units and enhance the JTAC's decision-making in the next era of warfare. Ultimately, this article highlights recent developments in airborne laser target designators and recommends incorporating a specialized artificial intelligence (AI) agent into the JTAC's communication system. With these technologies, JTACs will better navigate an increasingly complex battlefield and more seamlessly orchestrate the autonomous systems proliferating above them.

As robotic autonomy defines the future of warfare, JTACs, those authorized to direct the action of military aircraft in offensive operations,[3] must adapt to keep pace. During the Global War on Terror, these operators enjoyed air superiority and permissive airspace, enabling rapid responsiveness from aircraft overhead.[4] Against near-peer adversaries, air support operations

[1] David Hambling, "Elon Musk Calls F-35 Builders 'Idiots,' Favors Drone Swarms," Forbes, November 26, 2024, https://www.forbes.com/sites/davidhambling/2024/11/26/elon-musk-calls-f-35-builders-idiots-favors-drone-swarms/.

[2] Brian Moscioni, "Autonomous Drones Will Not Replace Fighter Pilots, They Will Be Their Wingmen" (Belfer Center for Science and International Affairs, June 2025), https://www.belfercenter.org/sites/default/files/2025-06/AutonomousDrones%2C%20Moscioni%2C%20DETS.pdf.

[3] Secretary of the Air Force, Air Force Manual 10-3505, Volume 1: Joint Terminal Attack Controller (JTAC) Training Program (Washington, DC: Department of the Air Force, 2023), https://static.e-publishing.af.mil/production/1/af_a3/publication/afman10-3505v1/afman10-3505v1.pdf.

[4] Jeff Szczechowski, "JTAC Airman Vital in War on Terrorism," Air Force News, April 5, 2004, https://www.af.mil/News/Article-Display/Article/137232/jtac-airman-vital-in-war-on-terrorism/.

will face a myriad of new challenges. These include surface-to-air threats, electromagnetic interference, and airspace congestion due to the ubiquity of small unmanned aerial systems (sUAS).

One potential response to this dilemma is to fundamentally change the structure of air operations. As seen in Ukraine, thousands of small aircraft democratize air-to-ground lethality. With a gaming controller and a few weeks of training, a soldier can guide a munition with high precision dozens of kilometers away.[5] This paradigm shift[6] means that portable strike aircraft can be transported, assembled, and launched from within a single ground unit[7]—they do not necessarily need to rely on external support from combat jets to deliver ordnance.

However, as noted by the Center for a New American Security (CNAS), this development represents an evolution, but not a revolution in warfare.[8] An FPV drone carrying a standard RPG warhead is effectively a precision mortar, but mortar rounds do not replace 250- or 500-pound bombs. Particularly against fortified positions or high-value radar systems, guided bomb units (GBUs) deliver effects significantly greater than small drones. Since sUAS have yet to replace the destructive capacity of a fighter or bomber jet, ground forces still benefit from the air and ground domains' interlocutor, the JTAC.

As long as commanders need high-performance aircraft to achieve particular effects, the requirement for a qualified member to control them remains. However, the tyranny of distance in large-scale combat operations[9] demands extended reconnaissance and communications capabilities to effectively direct combat jets. To help achieve this capability, the Air Force recently procured C100s, medium-range quadcopter drones, for JTAC teams known as the Tactical Air Control Party (TACP).[10] Fitting within a standard rucksack, these C100 drones can carry a gimbal with a laser target designator (LTD) to guide bombs with a laser guidance kit.

Laser guidance remains a reliable way to direct precision weapons amid GPS jamming. However, maintaining a continuous laser on a target requires an uninterrupted line of sight. By flying a portable, semi-autonomous platform with a laser-designating payload, JTACs can illuminate targets far beyond the frontline from concealed locations, reducing operator exposure while expanding designation range and survivability.

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[5] Maibutnie Fund, "FPV Drone Pilots School," Maibutnie Fund, 2025, https://maibutniefund.org/en/projects/fpv-drone-pilots-school-en/.
[6] Christopher Woody, "Fighter Jets Unable to Provide Close Air Support over Ukraine," Business Insider, March 16, 2023, https://www.businessinsider.com/fighter-jets-unable-to-provide-close-air-support-over-ukraine-2023-3.
[7] Kyiv Post, "FPV Drone Launch," Kyiv Post, 2025, video, https://www.kyivpost.com/videos/55999.
[8] Stacie Pettyjohn, "Evolution Not Revolution: Drone Warfare in Russia's 2022 Invasion of Ukraine" (Center for a New American Security, February 8, 2024), https://www.cnas.org/press/press-release/new-cnas-report-evolution-not-revolution-drone-warfare-in-russias-2022-invasion-of-ukraine.
[9] Grant Georgulis, "Winning in the Indo-Pacific Despite the Tyranny of Distance," Journal of Indo-Pacific Affairs, August 1, 2022, https://www.airuniversity.af.edu/JIPA/Display/Article/3111131/winning-in-the-indo-pacific-despite-the-tyranny-of-distance-the-necessity-of-an/.
[10] Sebastien Roblin, "Key Air Force Unit Buys the Army's New Heavy Quadcopter Drone," Forbes, October 8, 2025, https://www.forbes.com/sites/sebastienroblin/2025/10/08/key-air-force-unit-buys-the-armys-new-heavy-quadcopter-drone/.

LTD-equipped drones solve some constraints of terminal guidance, but the procedural overload of the JTACs' varying responsibilities remains. Routing, safety of flight, and airspace management are still manual burdens growing more complex as robots clutter the airspace and jammers flood the frontline. To more rapidly process data and make decisions, the JTAC should utilize software capable of handling the evolving fight. Agentic AI technology offers one potential solution.

In technical terms, agentic AI is software that perceives its environment and executes tasks to achieve specific goals without constant human intervention. Unlike a chatbot that waits for a prompt, an agent operates continuously in the background. To characterize the agent's support to the JTAC, consider the relationship between a commander and their communications team. Traditionally, the Radio Telephone Operator (RTO) is the commander's communications expert. The RTO monitors the radio, logs traffic, and maintains standardized coordination between their team and other units. While RTOs do not issue orders, they ensure the fidelity of the data so the commander can issue orders effectively.

Looking forward, current AI technology offers the technical foundations for an "Artificial RTO." The Artificial RTO would serve as a passive AI assistant while the JTAC remains the authority for clearing the release of ordnance. To build this program into the JTAC's radio and end-user device (EUD), the agent would need three specific technical layers: monitoring, processing, and referencing. The "monitoring" layer would enable the Artificial RTO to gather both auditory and geospatial data. As the JTAC corresponds with the pilot or other ground teams, the program would transcribe voice traffic using automatic speech recognition (ASR) software.[11]Simultaneously, the Artificial RTO would ingest map data by subscribing to the JTAC's Tactical Assault Kit (TAK) event feed. TAK is the primary geospatial situational awareness tool for ground forces and creates a unified picture of friendly locations, target marks, and airspace graphics. By ingesting the audio information and map data, the "Artificial RTO" would possess the information necessary to develop a synchronized view of the evolving battlespace.

After the program transcribes audio and ingests mapping data, the system would require a "processing" layer. To achieve this, a locally-run small language model (SLM) would interpret the data from the monitoring layer, parse pertinent details, and route information appropriately. Importantly, these local models are now compact enough[12] to reside on a tactical smartphone while having the necessary reasoning[13] to understand the context of an air support attack brief such as the Close Air Support 9-line. To ensure accuracy, the architecture would adopt a hybrid, neuro-symbolic approach. [14]The SLM would parse intent, but it would not perform calculations. Instead, it would route mathematical tasks such as coordinate conversions or danger close

[11] Daniel Jurafsky and James H. Martin, Speech and Language Processing, 3rd ed. draft (Stanford, CA: Stanford University, 2024), https://web.stanford.edu/~jurafsky/slp3/.
[12] Peter Belcak et al., "Small Language Models are the Future of Agentic AI," arXiv preprint arXiv:2506.02153 (June 2025), https://arxiv.org/abs/2506.02153.
[13] Zixu Hao et al., "Scaling LLM Test-Time Compute with Mobile NPU on Smartphones," arXiv preprint arXiv:2509.23324 (September 2025), https://arxiv.org/abs/2509.23324..
[14] Orestis Oikonomou et al., "Neuro-Symbolic AI for Analytical Solutions of Differential Equations," arXiv preprint arXiv:2502.01476 (February 2025), https://arxiv.org/abs/2502.01476.

estimates to deterministic math modules. This would create a guardrail against the hallucinations inherent in all language models.

Finally, the system would require a "referencing" layer to remain doctrinally current without constant model retraining. Retrieval-augmented generation (RAG) offers a solution by decoupling the reasoning model from its knowledge base. This architecture would treat doctrine as an updatable component. When tactical standards evolve or new munitions are fielded, the local vector database is updated, analogous to loading a data package in TAK. This ensures the artificial RTO can reference the most current doctrinal requirements, airspace control orders (ACOs), special instructions (SPINs), and weapon safety measures.

The following vignette illustrates this capability. In this scenario, a JTAC utilizes a C100 drone to designate a target for a fighter jet in a GPS-denied battlespace. In this environment, munitions from the jet must rely on the C100's laser for terminal guidance rather than a GPS location. The JTAC verbally requests a strike utilizing a GBU-12, a 500-lb laser-guided bomb. The Artificial RTO cross-references this verbal data stream with the geospatial database and the active No Strike List (NSL) derived from the Special Instructions (SPINs). The program detects a protected civilian structure 250 meters from the desired point of impact. Ultimately, the system calculates that the GBU-12's collateral effects radius exceeds this distance, posing a risk to the protected structure. The Artificial RTO immediately flags the issue on the end-user device and proposes an alternative pairing with an GBU-53 (a 250-lb small-diameter bomb), calculating that the bomb's lower explosive yield mitigates the risk to the NSL site. The JTAC accepts the recommendation and requests the GBU-53. This correction occurs rapidly, demonstrating how the agent assists in real-time while increasing the efficiency of execution.

Over time, as the Artificial RTO matures, it could evolve from passively catching errors to proactively offering solutions. By migrating this software from the JTAC's EUD directly onto a sUAS airframe, the system could utilize onboard computer vision to independently identify and track targets. This would transform the platform into a semi-autonomous JTAC capable of generating its own targeting data. Rather than relying on a human operator to fixate on a video feed to derive coordinates and formulate an attack plan, the agent would detect the enemy, calculate attack geometry, and automatically draft the complete attack briefing. In this architecture, the human operator shifts from a single controller to a coordinator of multiple autonomous assets. Instead of manually building 9-lines, the JTAC would review the system's proposed plan, validate the solution, and provide the final clearance to release ordnance. By delegating the mechanical processes of targeting to software, the JTAC would remain the primary authority for air-to-ground integration in an increasingly autonomous combat environment.

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The Pentagon Says It's Using Generative AI—But It's Not Ready

Jordan Kane and Hamza Chaudhry

ABSTRACT: The Pentagon announced $800 million in frontier AI contracts with Anthropic, Google, OpenAI, and xAI—but has funded only $8 million. This article examines why generative AI poses integration challenges fundamentally different from the narrow AI systems the military has deployed for years, and identifies the reforms in workforce capacity, computing access, testing and evaluation, authority to operate, and data infrastructure required to move these partnerships from symbolic pilots to operational scale.

The Pentagon announced $800 million in frontier AI contracts in the summer of 2025 but has funded only $8 million so far.[1] This gap between ambition and execution reveals the deeper challenge facing military AI adoption.

The US military is in the midst of a critical competition with China for supremacy in the AI era. History shows that this competition will be decided not by cutting-edge technology but by systematic integration at scale.[2] The Allied victory in World War II was the result not of superior technology but rather mass production and effective combined arms doctrine.[3]

Each of the four contracts, with Anthropic, Google, OpenAI, and xAI, carries a $200 million ceiling but has been funded only to its $2 million floor. The floor is the minimum the federal government can fund, while the ceiling is the maximum. Final Pentagon funding will fall somewhere between these bounds. These investments were on top of previously existing vehicles that give the US military access to frontier systems through subcontracts. For example, Anthropic is a subcontractor to Palantir.[4] The Pentagon's decision-making process for choosing

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[1] Chief Digital and Artificial Intelligence Office, "CDAO Announces Partnerships with Frontier AI Companies to Address National Security Challenges," US Department of War, https://www.ai.mil/latest/news-press/pr-view/article/4242822/cdao-announces-partnerships-with-frontier-ai-companies-to-address-national-secu/; David Ingram, "Musk's xAI Was a Late Addition to the Pentagon's Set of $200 Million AI Contracts, Former Defense Employee Says," NBC News, July 22, 2025, http://www.aol.com/musks-xai-addition-pentagons-set-090000065.html; Maggie Gray, "How Accurate Were My 2025 NatSec Tech Predictions? A Year-End Review," maggiegray.us (newsletter), https://maggiegray.us/p/grading-my-2025-national-security.

[2] Stephen Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton, NJ: Princeton University Press, 2004), https://files.core.ac.uk/download/pdf/36730773.pdf; Tyler Hacker, *Beyond Precision: Maintaining America's Strike Advantage in Great Power Conflict* (Washington, DC: Center for Strategic and Budgetary Assessments, 2023), https://csbaonline.org/uploads/documents/Beyond_Precision_Report_CSBA8355_FINAL_web.pdf.

[3] Jeremy Hsu, "Good Enough Tanks Won WWII," Discover, October 15, 2014, https://www.discovermagazine.com/good-enough-tanks-won-wwii-1472; Richard Overy, Why the Allies Won (New York: W. W. Norton & Company, 1995).

[4] "Anthropic and Palantir Partner to Bring Claude AI Models to AWS for US Government Intelligence and Defense Operations," Palantir Technologies Inc., press release, April 9, 2024, https://investors.palantir.com/news-details/2024/Anthropic-and-Palantir-Partner-to-Bring-Claude-AI-Models-to-AWS-for-US-Government-Intelligence-and-Defense-Operations/; Brian Merchant, "OpenAI, Google, and Perplexity near approval to host AI directly for the US government (exclusive)," Fast Company, February 18, 2026, https://www.fastcompany.com/91494829/openai-google-perplexity-hosting-ai-us-government-exclusive.

frontier partners has been ambiguous.[5] Without rapid reforms in workforce capacity, computing access, testing and evaluation frameworks, authority to operate, and data infrastructure, these partnerships will remain largely symbolic: pilot projects that demonstrate possibilities but never achieve operational scale.

Generational reforms are already underway, driven by President Donald Trump, Secretary Peter Hegseth, and Congress. In April 2025, an executive order streamlined acquisition by mandating preference for commercial solutions and creative contracting approaches such as Other Transaction Authorities. It also authorized new investments in acquisition workforce training.[6] Then, in July 2025, the AI Action Plan provided a clear political mandate for aggressive AI adoption in national security, describing this as essential to "maintain[ing] . . . global military preeminence."[7] For example, it announced new investments in AI interpretability (understanding how systems reach conclusions), control (ensuring systems behave as intended), and robustness (maintaining performance across varied conditions).[8] Most recently, Secretary Hegseth's January 2026 AI Strategy directed the Chief Digital and Artificial Intelligence Office (CDAO) to deploy the latest frontier models within 30 days of public release and ordered a "wartime approach to blockers" across authorities to operate, testing and evaluation (T&E), data sharing, and hiring.[9]

The Pentagon, led by Secretary Hegseth, has embraced this mandate. The secretary scrapped the Joint Capabilities Integration and Development System, the primary process for defining and validating capability requirements, to reduce the time from the identification of need to

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[4] David Ingram, "Musk's xAI Was a Late Addition to the Pentagon's Set of $200 Million AI Contracts, Former Defense Employee Says," NBC News, July 22, 2025, http://www.aol.com/musks-xai-addition-pentagons-set-090000065.html; Dave Lawler, Maria Curi, and Mike Allen, "Pentagon Threatens Anthropic Punishment," Axios, February 16, 2026, https://www.axios.com/2026/02/16/anthropic-defense-department-relationship-hegseth.
[5] David Ingram, "Musk's xAI Was a Late Addition to the Pentagon's Set of $200 Million AI Contracts, Former Defense Employee Says," NBC News, July 22, 2025, http://www.aol.com/musks-xai-addition-pentagons-set-090000065.html; Dave Lawler, Maria Curi, and Mike Allen, "Pentagon Threatens Anthropic Punishment," Axios, February 16, 2026, https://www.axios.com/2026/02/16/anthropic-defense-department-relationship-hegseth.
[6] Donald J. Trump, "Modernizing Defense Acquisitions and Spurring Innovation in the Defense Industrial Base," Executive Order, April 9, 2025, https://www.whitehouse.gov/presidential-actions/2025/04/modernizing-defense-acquisitions-and-spurring-innovation-in-the-defense-industrial-base/.
[7] The White House, "Winning the Race: America's AI Action Plan" (Washington, DC: The White House, July 2025), p. 11, https://www.whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf.
[8] The White House, "Winning the Race: America's AI Action Plan" (Washington, DC: The White House, July 2025), 23–24, section "Invest in AI Interpretability, Control, and Robustness Breakthroughs," https://www.whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf; Dario Amodei, "The Urgency of Interpretability," blog post, https://www.darioamodei.com/post/the-urgency-of-interpretability; Ryan Greenblatt, "An Overview of Areas of Control Work," AI Alignment Forum, March 24, 2025, https://www.alignmentforum.org/posts/Eeo9NrXeotWuHCgQW/an-overview-of-areas-of-control-work; Mireia Yurrita et al., "A.I. Robustness: A Human-Centered Perspective on Technological and Human Factors," ACM Computing Surveys 57, no. 6 (February 2025): article 141, , https://doi.org/10.1145/3665926.
[9] Department of War, *Artificial Intelligence Strategy for the Department of War* (Washington, DC: January 9, 2026), https://media.defense.gov/2026/Jan/12/2003855671/-1/-1/0/ARTIFICIAL-INTELLIGENCE-STRATEGY-FOR-THE-DEPARTMENT-OF-WAR.PDF.

acquisition.[10] Emil Michael, Undersecretary for Research and Engineering and the Pentagon's Chief Technology Officer, described the approach as taking a "wrecking ball" to old processes to enable innovation at speed.[11] At the same time, Under Secretary Michael Duffy is leading an ongoing process to reduce the Defense Acquisition Regulations System to its statutory minimum, as part of the administration's broader Revolutionary Federal Acquisition Regulation Overhaul.[12] These institutional changes signal commitment to the AI mission—but the test remains implementation at operational scale.

Meanwhile, the reforms enacted in the FY26 NDAA, including the SPEED and FoRGED Acts, constitute the biggest overhaul of the Pentagon in a generation.[13] However, broad and swift adoption of generative AI will require a long list of additional reforms to accommodate its unique characteristics. In short, the Pentagon still has significant work ahead to accelerate and deepen its partnerships with frontier AI companies.

Generative AI Poses Unique Integration Challenges

Generative AI presents integration challenges fundamentally different from the narrow AI systems the Pentagon has deployed for years.[14] Unlike narrow AI designed for specific tasks, large language models are general-purpose systems that are constantly updated, rendering the traditional "test once, field indefinitely" approach obsolete.[15] Their reliability varies wildly:

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[10] Greg Hadley, "Hegseth Cuts JCIDS in Move to Speed Weapons Development," *Air & Space Forces Magazine*, September 2, 2025, https://www.airandspaceforces.com/pentagon-leaders-requirements-reform-jcids/.
[11] Josh Luckenbaugh, "JUST IN: Military Must Innovate at Speed, Pentagon CTO Says," *National Defense Magazine*, August 7, 2025, https://www.nationaldefensemagazine.org/articles/2025/8/7/just-in-military-must-innovate-at-speed-pentagon-cto-says.
[12] Michael P. Duffey, letter to Defense Industrial Base and Acquisition Stakeholders: "Seeking Revolutionary FAR Overhaul Phase 2 Input," Department of War, February 10, 2026, https://media.defense.gov/2026/Feb/13/2003875628/-1/-1/1/LETTER-TO-DEFENSE-INDUSTRIAL-BASE-AND-ACQUISITION-STAKEHOLDERS-SEEKING-REVOLUTIONARY-FAR-OVERHAUL-PHASE-2-INPUT.PDF; Office of Federal Procurement Policy, "Revolutionary FAR Overhaul (RFO)," Acquisition.gov, https://www.acquisition.gov/far-overhaul.
[13] US Congress, S.1071, National Defense Authorization Act for Fiscal Year 2026, 119th Cong., 1st sess., enacted December 18, 2025, https://www.congress.gov/bill/119th-congress/senate-bill/1071/text; Madeline Field, "The SPEED and FoRGED Acts Compared," War on the Rocks, July 1, 2025, https://warontherocks.com/2025/07/the-speed-and-forged-acts-compared/; Federal News Network, 'Key SPEED and FoRGED Act Reforms,' August 18, 2025, https://federalnewsnetwork.com/congress/2025/08/key-speed-and-forged-act-reforms-moving-forward-in-2026-defense-bill/.
[14] Benjamin Jensen and Yasir Atalan, "The Pentagon's AI Problem Isn't Algorithms, It's Evaluation," Center for Strategic and International Studies, December 18, 2025, https://www.csis.org/analysis/pentagons-ai-problem-isnt-algorithms-its-evaluation; Lauren Kahn, "The Practical Role of 'Test and Evaluation' in Military AI," Lawfare, July 9, 2025, https://www.lawfaremedia.org/article/the-practical-role-of–test-and-evaluation–in-military-ai; "Innovating Defense: Generative AI's Role in Military Evolution," Army.mil, June 30, 2025, https://www.army.mil/article/286707/innovating_defense_generative_ais_role_in_military_evolution.
[15] Zoe Brammer and Owen Daniels, *Codifying and Expanding Continuous AI Benchmarking*, Federation of American Scientists, June 10, 2025, https://fas.org/publication/codifying-expanding-continuous-ai-benchmarking/; Brandi Vincent, "Defense Intelligence Agency Seeks AI Validation Tools as Hegseth Pushes 'AI-First' Strategy," DefenseScoop, January 16, 2026, https://defensescoop.com/2026/01/16/hegseth-dia-ai-capability-test-evaluation-

hallucination rates range from 1.5 percent to over 90 percent depending on task complexity and whether the scenario is adversarial, among other factors.[16] This falls far short of the 99.999 percent reliability standard required for critical infrastructure, like nuclear power.[17] Recent evaluations of frontier models nonetheless find substantial reductions in hallucination rates across many benchmarks, suggesting that technical progress is real even if performance remains highly context dependent.[18]

Explainability poses a critical challenge for legal compliance.[19] International Humanitarian Law and the Law of Armed Conflict require human judgment informed by contextual understanding and ethical reasoning.[20] The Pentagon's Directive 3000.09 similarly mandates "appropriate levels of human judgment over the use of force." Large language models, however, generate outputs through billions of weighted parameters—making it effectively impossible to trace precisely why a system produced a specific recommendation. This opacity creates accountability gaps when decisions must be legally defensible.[21]

Some of these limitations can be mitigated through technical safeguards. For example, accuracy can be increased through retrieval augmented generation, which grounds model responses in an organization's own data rather than relying on general training data.[22] Ultimately, these

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validation-verification/; Benjamin Jensen and Yasir Atalan, "The Pentagon's AI Problem Isn't Algorithms, It's Evaluation," Center for Strategic and International Studies, December 18, 2025, https://www.csis.org/analysis/pentagons-ai-problem-isnt-algorithms-its-evaluation.

[16] Clear progress is being made on accuracy. Benchmarks like HalluLens find that some of the newest models (e.g., GPT-4-class and Llama 3.1-405B) achieve substantially lower hallucination rates and better precision than earlier generations, especially on structured QA, even though rates can still be high on difficult prompts. Stephanie Lin et al., "TruthfulQA: Measuring How Models Mimic Human Falsehoods," arXiv preprint, version 3, September 27, 2022, https://arxiv.org/abs/2109.07958; Jiayang Cheng et al., "Survey and Analysis of Hallucinations in Large Language Models," npj Digital Medicine (2025); Yejin Bang et al., "HalluLens: LLM Hallucination Benchmark," arXiv preprint, version 1, April 24, 2025, 2026, https://arxiv.org/html/2504.17550v1; Julien Dubois et al., "Hallucination Rates and Reference Accuracy of ChatGPT and Bard for Generating Scientific References: Experimental Study," Journal of Medical Internet Research 26, no. 1 (2024): e53164, https://www.jmir.org/2024/1/e53164/.

[17] US Nuclear Regulatory Commission, Regulatory Guide 1.152: "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," updated July 2011, https://www.nrc.gov/docs/ml1028/ml102870022.pdf; US Nuclear Regulatory Commission, "Elevation of the Core Damage Frequency Objective to a Fundamental Safety Goal," SECY-98-101, memorandum to the Commissioners, May 4, 1998, https://www.nrc.gov/docs/ML9929/ML992930056.pdf.

[18] Stephan Rabanser et al., "Towards a Science of AI Agent Reliability," arXiv preprint, version 2, February 23, 2026, https://arxiv.org/abs/2602.16666.

[19] Scott Sullivan, "Targeting in the Black Box: The Need to Reprioritize AI Explainability," *Articles of War* (Lieber Institute, West Point), September 15, 2024, https://lieber.westpoint.edu/targeting-black-box-need-reprioritize-ai-explainability/.

[20] Human Rights Watch and Harvard Law School International Human Rights Clinic, A Hazard to Human Rights: Autonomous Weapons Systems and Digital Decision-Making, April 28, 2025, https://www.hrw.org/report/2025/04/28/hazard-human-rights/autonomous-weapons-systems-and-digital-decision-making.

[21] US Department of War, DoD Directive 3000.09: Autonomy in Weapon Systems, January 25, 2023, https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodd/300009p.pdf.

[22] IBM Research, "What Is Retrieval-Augmented Generation (RAG)?" IBM, February 8, 2021, https://research.ibm.com/blog/retrieval-augmented-generation-RAG; Zoe Brammer and Owen Daniels, *Codifying*

limitations force difficult triage decisions: which applications can tolerate current reliability levels with human oversight, and which demand technological breakthroughs before fielding?

In August 2025 the Pentagon demoted its AI czar, the CDAO, from reporting to the Deputy Secretary of Defense, the Pentagon's number two official, to the Under Secretary of Defense for Research and Engineering (USD(R&E)), it's number three. This raises questions about which office will provide guidance and create policies to address these challenges.[23] The reorganization is also likely to undermine CDAO's ability to coordinate across services and combatant commands and reframe AI as a research challenge, rather than an operational integration problem.[24]

Critical Reforms Required

Workforce

The Pentagon faces a multi-layered AI talent crisis requiring machine learning engineers to adapt and integrate pre-trained models; data specialists to curate, validate, and secure the datasets those systems rely on; acquisition officers fluent in consumption-based pricing; operators with AI literacy; and security personnel who understand AI-specific threats.[25] AI talent is difficult to retain.[26] Security clearances take the better part of a year, and mission onboarding adds further

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and Expanding Continuous AI Benchmarking, Federation of American Scientists, June 10, 2025, https://fas.org/publication/codifying-expanding-continuous-ai-benchmarking/.

[23] Sydney J. Freedberg Jr., "Pentagon Moves AI Office Under R&D, Raising Fears It's 'Demoting AI,'" *Breaking Defense*, August 18, 2025, https://breakingdefense.com/2025/08/pentagon-moves-ai-office-under-rd-raising-fears-its-demoting-ai/.

[24] When DIU was first established and reported to the Pentagon's head of research and engineering, senior leaders said that the construct impeded its influence. Congress ultimately codified DIU's direct-report status in the FY2024 NDAA. Congressional Research Service, "Realignment of DOD's Chief Digital and AI Officer (CDAO)," In Focus IN12615, updated 2025, https://www.congress.gov/crs-product/IN12615; Courtney Albon, "Pentagon CTO Says Defense Innovation Unit Will Remain Independent," *Defense News*, August 27, 2025, https://www.defensenews.com/pentagon/2025/08/27/pentagon-cto-says-defense-innovation-unit-will-remain-independent/.

[25] Kelley M. Sayler, Realignment of DOD's Chief Digital and AI Officer (CDAO), IN12615 (Washington, DC: Congressional Research Service, December 1, 2025), https://www.congress.gov/crs-product/IN12615; Sydney J. Freedberg Jr., "Pentagon Moves AI Office Under R&D, Raising Fears It's 'Demoting AI,'" Breaking Defense, August 18, 2025, https://breakingdefense.com/2025/08/pentagon-moves-ai-office-under-rd-raising-fears-its-demoting-ai/.

[26] Diana Gehlhaus et al., "The DoD's Hidden Artificial Intelligence Workforce," Center for Security and Emerging Technology, July 30, 2023, https://cset.georgetown.edu/publication/the-dods-hidden-artificial-intelligence-workforce/; Molly Weisner, "DoD Hindering Recruitment of Tech-Savvy Workers, Warfighters: Report," Federal Times, October 25, 2023, https://www.federaltimes.com/management/career/2023/10/26/pentagon-practices-harm-recruitment-of-tech-savvy-workers-warfighters/.

delay.[27] Technical talent leaves for predictable reasons: bureaucratic friction that prevents meaningful work, career paths that stagnate without technical leadership tracks, compensation that lags the private sector, and restricted access to frontier models and computing.[28]

Retention requires structural change, not just higher pay. Management responsibility is currently the most common way to reach seniority in the department, leaving technical experts without a pathway to advance beyond a certain point. The Pentagon should create a promotion pathway based on technical AI expertise. These technical leadership AI roles should come with clear authority (chief machine learning engineer for a combatant command), promotion criteria based on technical contributions (successful deployments, reusable frameworks), and compensation comparable to management positions.

Historically, the Pentagon's pay structure, like that of the overall civil service, has rewarded tenure instead of impact.[29] However, the Pentagon announced a reformed pay structure in October 2025 that emphasizes performance and in-demand skills like AI expertise.[30] To adopt the tech industry ethos of "fail fast," which Secretary Hegseth endorsed in his 2025 Warfighting Acquisition System memo, personnel evaluations should be rewritten to explicitly value experimentation.[31] The Pentagon should also conduct annual compensation reviews to better approximate parity with industry.

The Pentagon also urgently needs to invest in upskilling its broader workforce. According to a June 2025 report by the Industrial Base Policy office, the scale of the need is so vast that it requires partnerships with "academia, industry, and other government partners."[32] For example, investing in operators' AI literacy and understanding of accuracy rates and likely failure scenarios will be critical to reducing their tendency to over-trust the system, also known as

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[27] Jared Serbu, "DCSA Backlog of Security Clearance Investigations Down 24%," Federal News Network, May 9, 2025, https://federalnewsnetwork.com/defense-main/2025/05/dcsa-backlog-of-security-clearance-investigations-down-24/.

[28] Dave Nyczepir, "Sherman Questions Ability of IC, DoD to Retain Tech Talent," MeriTalk, October 29, 2025, https://meritalk.com/articles/sherman-questions-ability-of-ic-dod-to-retain-tech-talent/; Lauren Kahn, "How DoD Can Remedy the Talent Deficit Harming US Technological Competitiveness," Council on Foreign Relations, February 22, 2022; Dakota Cary et al., "DoD's Emerging Digital Workforce," Center for Security and Emerging Technology, October 19, 2023.

[29] Kiran Ahuja, "Show Me the Incentive and I'll Show You the Outcome," Secrets of OPM (blog), US Office of Personnel Management, August 12, 2024, https://www.opm.gov/news/secrets-of-opm/show-me-the-incentive-and-i-ll-show-you-the-outcome/.

[30] Jackson Barnett, "DoD Civilian Workforce to See New Bonuses, Performance Incentives under Hegseth-Tata Memos," DefenseScoop, October 1, 2025, https://defensescoop.com/2025/10/01/dod-civilian-workforce-bonuses-performance-incentives-hegseth-tata-memos/.

[31] Pete Hegseth, "Transforming the Defense Acquisition System into the Warfighting Acquisition System to Accelerate Fielding of Urgently Needed Capabilities to Our Warriors," memorandum, November 8, 2025; Dakota Cary, "DoD's Emerging Digital Workforce," Center for Security and Emerging Technology, October 20, 2023, https://cset.georgetown.edu/publication/dods-emerging-digital-workforce/.

[32] Department of War, AI and the Defense Industrial Base Roadmap, June 2025, https://www.businessdefense.gov/ibr/pat/docs/AI-and-the-DIB-Roadmap.pdf.

automation bias.[33] More generally, training is necessary to ensure that operators are prepared to work on AI-enabled systems.[34] Readiness is, in turn, critical to mitigating the challenge of a lack of explainability. Training can ensure operators understand systems well enough to use them appropriately, building trust calibrated to limitations rather than demanding perfect explainability.

The Pentagon should also expand the use of the Intergovernmental Personnel Act (IPA), which enables federal agencies to borrow expertise from universities and research labs for up to four consecutive years. IPAs create rotation pathways between operational assignments and research positions that maintain cutting-edge skills and retain top talent.[35] The Pentagon should also scale proven exchange models like the Public-Private Talent Exchange, which Congress expanded in the FY26 NDAA, and the Army's new Detachment 201 "Executive Innovation Corps to strengthen the acquisition workforce.[36] Finally, as the Institute for AI Policy and Strategy has suggested, the Pentagon should create a surge capacity of cleared AI experts who can be activated during a crisis.[37]

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[33] Nathan K. Finney and Travis A. Sharp, "Trusting AI: Integrating Artificial Intelligence into the Army's Future," US Army War College Strategic Studies Institute, June 21, 2023, https://press.armywarcollege.edu/monographs/959/; John Christianson, "Miscalibration of Trust in Human-Machine Teaming," War on the Rocks, March 7, 2023, https://warontherocks.com/2023/03/miscalibration-of-trust-in-human-machine-teaming/; Tilman Rodenhäuser and Mauro Vignati, "The Risks and Inefficacies of AI Systems in Military Targeting Support," International Committee of the Red Cross, September 3, 2024, https://blogs.icrc.org/law-and-policy/2024/09/04/the-risks-and-inefficacies-of-ai-systems-in-military-targeting-support/.

[34] Thomas G. Mahnken et al., "Trusting AI: Integrating Artificial Intelligence into the Army's Future Force" (Washington, DC: Center for Strategic and Budgetary Assessments, 2023), https://press.armywarcollege.edu/monographs/959/; Balázs Fehér, "Rethinking Technological Readiness in the Era of AI Uncertainty," arXiv preprint, version 1, June 16, 2025, https://arxiv.org/html/2506.11001v1.

[35] US Office of Personnel Management, "Intergovernmental Personnel Act (IPA) Mobility Program," https://www.opm.gov/policy-data-oversight/hiring-information/intergovernment-personnel-act/; National Security Commission on Artificial Intelligence, "Chapter 6: Growing and Sustaining the AI Workforce," in Final Report, 2021, https://reports.nscai.gov/final-report/chapter-6; Partnership for Public Service, "How Congress Should Shape AI Implementation in Federal Agencies" (Washington, DC, 2026), https://ourpublicservice.org/wp-content/uploads/2026/01/How-Congress-Should-Shape-AI-Implementation-in-Federal-Agencies.pdf.

[36] Same with the Defense Innovation Unit fellowships such as the DAU-DIU Immersive Commercial Acquisition Program. Defense Civilian Personnel Advisory Service, "Public Private Talent Exchange Program," https://www.dcpas.osd.mil/learning/broadening/publicprivatetalentexchange; Streamlining Procurement for Effective Execution and Delivery (SPEED) and National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 831 (2025); US Army, "Army Launches Detachment 201: Executive Innovation Corps to Drive Tech Transformation," December 14, 2025, https://www.army.mil/article/286317/army_launches_detachment_201_executive_innovation_corps_to_drive_tech_transformation; Defense Innovation Unit, "Immersive Commercial Acquisition Program (ICAP)," https://www.diu.mil/work-with-us/immersive-commercial-acquisition-program-icap.

[37] Institute for AI Policy and Strategy, "Building AI Surge Capacity in Government," November 2025, https://www.iaps.ai/research/building-ai-surge-capacity.

Computing Access

The Pentagon cannot currently provide sufficient computing capacity at appropriate classification levels to support even modest AI experimentation, much less operational deployment at scale. In December 2024, Task Force Lima, an initiative to accelerate AI adoption, identified this problem, but it endures in the Pentagon's FY26 technology strategy.[38] The AI Action Plan also calls for increased investments in high-security, classified computing environments.[39] Even with budget available, deployment depends on accreditation processes that often last a year or more.[40]

The commercial cloud providers (AWS, Azure, Google Cloud) through which the Pentagon accesses AI expertise do not own the classified data centers required for national security work. Instead, they rent space in facilities compliant with the Pentagon's requirements for storing classified information, ICD-705, which are owned by specialized providers.[41] This creates split accountability: neither party can unilaterally guarantee computing availability, and deployment depends on twelve to eighteen-month ICD-705 accreditation processes.[42] Recent updates to accreditation standards threaten to extend these timelines further.[43]

Classification challenges multiply the problem. AI infrastructure is fractured across multiple operationally distinct classification tiers, each requiring separate physical environments, network connections, and authorization processes. DISA's Cloud Computing Security Requirements

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[38] Task Force Lima, "Executive Summary," TAB A, Department of Defense Chief Digital and AI Office, December 2024, https://techwww.ai.mil/Portals/137/Documents/Resources%20Page/2024-12-TF%20Lima-ExecSum-TAB-A.pdf; US Department of War, Artificial Intelligence Strategy for the Department of War (Washington, DC: US Department of War, January 8, 2026), 4–6; Nooree Lee et al., "Pentagon Releases Artificial Intelligence Strategy," Inside Government Contracts (blog), February 3, 2026, https://www.insidegovernmentcontracts.com/2026/02/pentagon-releases-artificial-intelligence-strategy/; David Jeans and Deepa Seetharaman, "Exclusive: Pentagon Pushing AI Companies to Expand on Classified Networks, Sources Say," Reuters, February 11, 2026, https://www.reuters.com/business/pentagon-pushing-ai-companies-expand-classified-networks-sources-say-2026-02-12/.

[39] The White House, "Winning the Race: America's AI Action Plan" (Washington, DC: The White House, July 2025), https://www.whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf.

[40] Holland & Knight, "Leasing SCIF Space: How the New ICD-705 Affects Leases," October 29, 2025, https://www.hklaw.com/en/insights/publications/2025/10/leasing-scif-space-how-the-new-icd-705-affects-leases; John Morris, "Navigating the New Era of SCIF Construction," Area Development, First Quarter 2025, https://www.areadevelopment.com/business-climate/q1-2025/navigating-the-new-era-of-scif-construction.shtml.

[41] Office of the Director of National Intelligence, "IC Tech Specs for the Construction and Management of Sensitive Compartmented Information Facilities (SCIFs), Version 1.5," March 13, 2020, https://www.dni.gov/files/Governance/IC-Tech-Specs-for-Const-and-Mgmt-of-SCIFs-v15.pdf.

[42] Holland & Knight, "Leasing SCIF Space: How the New ICD 705 Affects Leases," October 30, 2025, https://www.hklaw.com/en/insights/publications/2025/10/leasing-scif-space-how-the-new-icd-705-affects-leases.

[43] John Morris, "Navigating the New Era of SCIF Construction," Area Development, First Quarter 2025, https://www.areadevelopment.com/business-climate/q1-2025/navigating-the-new-era-of-scif-construction.shtml.

Guide defines multiple impact levels from unclassified through Top Secret, each operationally isolated.[44] However, so far, only a few LLMs have been granted permission to operate on classified systems at the Secret, or IL6 level. These include Anthropic's Claude, OpenAI's Chat GPT, and Meta's Llama.[45] Of these, Claude was the first to be approved and has been used the most extensively. Workloads cannot move between these tiers without separate accreditation, forcing the Pentagon to maintain parallel, inefficient infrastructure stacks at each level.[46]

The Pentagon's own January 2026 AI Strategy implicitly acknowledges this reality: it directs military departments to establish data catalogs exposing "system interfaces, data assets, and access mechanisms across all classification levels," a directive whose qualifier reveals that such cross-level access does not yet exist and requires deliberate effort to build.[47] According to Glenn Parham, the Pentagon's first generative AI lead, government clouds sometimes contain shockingly little computing capacity.[48]

In the short term, the Pentagon should take several steps to increase access to computing and allocate it more strategically. There are major inefficiencies at the moment, whereby one office may have idle capacity while another waits months.[49] First, the secretary should appoint an official with the authority to reallocate computing across portfolios during contingencies or major operations.[50] The Pentagon is currently establishing a mesh architecture that will facilitate

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[44] Department of Defense, Defense Information Systems Agency, Cloud Computing Security Requirements Guide (CC SRG), 2024, https://public.cyber.mil/dccs/.

[45] DoD Chief Information Officer, DoD Cybersecurity Reciprocity Playbook (Washington, DC: US Department of Defense, January 2, 2024), https://dodcio.defense.gov/Portals/0/Documents/Library/(U)%202024-01-02%20DoD%20Cybersecurity%20Reciprocity%20Playbook.pdf; Anthropic, "Claude in Amazon Bedrock: Approved for Use in FedRAMP High and DoD IL4/5 Workloads," November 2, 2023, https://www.anthropic.com/news/claude-in-amazon-bedrock-fedramp-high; "Microsoft Azure OpenAI Service Gets IL6 Authorization," ExecutiveBiz, April 16, 2025, https://www.executivebiz.com/articles/microsoft-azure-openai-il6-authorization; "Where Does the Cyber Arms Race Lead to in the Age of Artificial Intelligence," Army.mil, https://www.army.mil/article/288851/where_does_the_cyber_arms_race_lead_to_in_the_age_of_artificial_intelligence; Ian Carlos Campbell, "White House Officials Reportedly Frustrated by Anthropic's Law-Enforcement AI Limits," Ars Technica, September 19, 2025, https://arstechnica.com/ai/2025/09/white-house-officials-reportedly-frustrated-by-anthropics-law-enforcement-ai-limits/.

[46] Department of Defense, Chief Information Officer, *Software Modernization Implementation Plan: Fiscal Years 2025–2026* (Washington, DC: Department of Defense, May 2025).

[47] Department of War, *Artificial Intelligence Strategy for the Department of War* (US DoD, Washington, DC: January 9, 2026), https://media.defense.gov/2026/Jan/12/2003855671/-1/-1/0/ARTIFICIAL-INTELLIGENCE-STRATEGY-FOR-THE-DEPARTMENT-OF-WAR.PDF.

[48] Defense Acquisition University, "AI Testing and Evaluation for the DoD," YouTube video, 04:18, April 10, 2024, https://www.youtube.com/watch?v=1Cq995oNgIE.

[49] Ibid.

[50] US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, §§ 1531, 1534, 119th Cong., 1st sess. (2025), https://www.govinfo.gov/app/details/BILLS-119s1071enr; Senate Armed Services Committee, Fiscal Year 2026 National Defense Authorization Act Passage Executive Summary (Washington, DC: Senate Armed Services Committee, 2025), https://www.armed-services.senate.gov/imo/media/doc/passage_fy26_ndaa_executive_summary.pdf; US DoD, Chief Information Officer, DoD Cloud FinOps Strategy (Washington, DC: US Department of Defense, 2024), https://dodcio.defense.gov/Portals/0/Documents/Library/DoDCloudFinOpsStrategy.pdf; FinOps Foundation,

this.[51] Section 1531 of the FY26 NDAA supports this direction by requiring the Pentagon to develop a roadmap of high-performance computing capability encompassing both government-owned assets and commercially procured cloud and infrastructure-as-a-service—a prerequisite for the kind of strategic allocation proposed here.[52] Second, the deputy secretary should establish baseline computing guarantees for INDOPACOM, the Pentagon's designated priority theater, Cyber Command, and other organizations with critical AI initiatives, sized to realistic operational requirements.[53] The deputy secretary should also create a "computing exchange" where commands temporarily access unused capacity from other organizations with resource brokering and accounting mechanisms.

In the medium term, the Pentagon is working toward an open hybrid cloud that will enable workloads to move freely between government and commercial infrastructure.[54] Continued investment in modernizing government-owned computing facilities will ensure sufficient operational security and resilience and protect its most sensitive data on sovereign infrastructure.[55] The AI Action Plan and associated Executive Order call for constructing data centers on military bases.[56] Accordingly, in November 2025, the Pentagon announced an almost billion-dollar contract to modernize existing Pentagon-owned data centers.[57] The Pentagon also

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"Federal Budgeting for Cloud Spending Variability," https://www.finops.org/wg/federal-budgeting-for-cloud-spending-variability/.

[51] DoD, Chief Information Officer, *Software Modernization Implementation Plan: Fiscal Years 2025–2026* (Washington, DC: DoD, May 2025); AFCEA, "Department of Defense Hybrid Cloud Strategy: A Quick Look," May 2021, https://www.afcea-qp.org/wp-content/uploads/2021/05/DOD-Hybrid-Cloud.pdf; Secretary of the Air Force Public Affairs, "DoD to Establish AI Battle Labs in EUCOM, INDOPACOM," October 25, 2023, https://www.af.mil/News/Article-Display/Article/3540446/dod-to-establish-ai-battle-labs-in-eucom-indopacom/.

[52] US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 1531, https://www.congress.gov/bill/119th-congress/senate-bill/1071/text.

[53] Secretary of the Air Force Public Affairs, "DoD to Establish AI Battle Labs in EUCOM, INDOPACOM," US Air Force, October 25, 2023, https://www.af.mil/News/Article-Display/Article/3540446/dod-to-establish-ai-battle-labs-in-eucom-indopacom/.

[54] Congress has signaled its support for this vision: Section 1531 of the FY26 NDAA requires a computing roadmap that treats government-owned and commercially procured capacity as a unified portfolio, reflecting recognition that the Department cannot plan its AI compute future without first understanding what it has across both domains. US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, §§ 1531, 1534, 119th Cong., 1st sess. (2025), https://www.govinfo.gov/app/details/BILLS-119s1071enr; AFCEA, Department of Defense Hybrid Cloud Strategy: A Quick Look, May 2021, https://www.afcea-qp.org/wp-content/uploads/2021/05/DOD-Hybrid-Cloud.pdf.

[55] Defense Information Systems Agency, "DISA Awards $931 Million Other Transaction Agreement for Data Center Modernization and Cloud Instance Initiative," press release, November 20, 2025, https://dodcio.defense.gov/In-the-News/Article/4367354/disa-awards-931-million-other-transaction-agreement-for-data-center-modernizati/.

[56] The White House, "Winning the Race: America's AI Action Plan" (Washington, DC: The White House, July 2025), https://www.whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf; The White House, "Accelerating Federal Permitting of Data Center Infrastructure," Presidential Action, July 29, 2025, https://www.whitehouse.gov/presidential-actions/2025/07/accelerating-federal-permitting-of-data-center-infrastructure/.

[57] Defense Information Systems Agency, "DISA Awards $931 Million Other Transaction Agreement for Data Center Modernization and Cloud Instance Initiative," press release, November 20, 2025, 2026,

needs the ability to surge computing access rapidly, as Ukraine and Israel have demonstrated.[58] The AI Action Plan directs the department to negotiate priority access with cloud providers.[59]

In this timeframe, the Pentagon also has work to do to implement the consumption-based computing access authorized in the FY26 NDAA by creating contract vehicles that permit variable spending, financial systems that can handle metered billing, and acquisition officer training on cloud cost management.[60] Congress should go further with multi-year approval for three to five year consumption agreements, funding for three to four additional major classified data centers in strategic locations, and a dedicated computing budget line separate from general IT spending.

Testing and Evaluation

The Pentagon lacks strong systems for determining whether generative AI is safe, effective, and suitable for specific military purposes, known formally as T&E.[61] A false assumption pervades: that reducing testing accelerates adoption. In reality, adoption depends on trust, which testing enables.[62] This has been referred to as "the speed of trust."[63] Yet the Hegseth AI Strategy memo's "Barrier Removal Board," the institutional expression of that "wartime approach to blockers,"

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https://dodcio.defense.gov/In-the-News/Article/4367354/disa-awards-931-million-other-transaction-agreement-for-data-center-modernizati/.

[58] Mahmoud Javadi, "Infrastructural Entanglement and Cloud Hyperscalers in Contemporary Warfare: Insights from Ukraine, Israel and Taiwan," *Contemporary Security Policy* 23, no. 4 (2025), https://doi.org/10.1080/13523260.2025.2593247.

[59] The White House, "Winning the Race: America's AI Action Plan" (Washington, DC: The White House, July 2025), 32–33, "Defense and National Security," https://www.whitehouse.gov/wp-content/uploads/2025/07/Americas-AI-Action-Plan.pdf.

[60] US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 1825, 119th Cong., 1st sess. (2025), https://www.govinfo.gov/app/details/BILLS-119s1071enr; Senate Armed Services Committee, Fiscal Year 2026 National Defense Authorization Act: Passage Executive Summary (Washington, DC: Senate Armed Services Committee, December 16, 2025), https://www.armed-services.senate.gov/imo/media/doc/passage_fy26_ndaa_executive_summary.pdf; US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, 119th Cong., 1st sess., §§ 1511–1513, https://www.govinfo.gov/app/details/BILLS-119s1071enr; FinOps Foundation, "Federal Budgeting for Cloud Spending Variability," https://www.finops.org/wg/federal-budgeting-for-cloud-spending-variability/; US DoD, *DoD Cloud FinOps Strategy* (Washington, DC: US Department of Defense, October 2024), https://dodcio.defense.gov/Portals/0/Documents/Library/DoDCloudFinOpsStrategy.pdf.

[61] Benjamin Jensen and Yasir Atalan, "The Pentagon's AI Problem Isn't Algorithms, It's Evaluation," Center for Strategic and International Studies, December 18, 2025, https://www.csis.org/analysis/pentagons-ai-problem-isnt-algorithms-its-evaluation.

[62] Michael C. Horowitz and Radha Iyengar Plumb, "Is the Pentagon Slowing Artificial Intelligence Adoption?," Council on Foreign Relations, August 21, 2025, https://www.cfr.org/articles/pentagon-slowing-artificial-intelligence-adoption; Thomas Keller, "DoD Has Embraced AI. Now What?," RealClearDefense, October 9, 2024, https://www.realcleardefense.com/articles/2024/10/09/dod_has_embraced_ai_now_what_1063913.html.

[63] James N. Mattis and Bing West, *Call Sign Chaos: Learning to Lead* (New York: Random House, 2019), 156.

and its insistence that "the risks of not moving fast enough outweigh the risks of imperfect alignment" risk deepening this dynamic.[64]

The Pentagon's "one and done" testing approach was designed for hardware with updates that take place over months and years.[65] This approach does not work for frontier models that are continuously improved with changes to weights, capabilities, behaviors, knowledge bases, and security patches. Each update can alter performance on specific tasks and introduce new failure modes.[66] Multiple commentators and policy documents have suggested that T&E should be continuous, though not constant, since rigorous evaluation requires expensive red teaming, subject matter expert panels, and delaying fielding by operational units.[67]

Instead, the Pentagon must shift to a hybrid approach: continuous monitoring combined with intensive evaluation at key decision points. The new system should consist of continuous monitoring for performance drift and security indicators, intensive evaluation at major decision points such as initial fielding and deployment to new classification levels, triggered evaluation when model versions change significantly or monitoring detects degraded performance, and scheduled evaluation at time-based intervals for operational systems.

The Pentagon lacks the institutional capacity to conduct testing and evaluation of generative AI for its specific use cases and operational environments at the necessary scale. Furthermore, it cannot generate its own benchmarks.[68] Benchmarks are expensive to develop because they rely

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[64] Department of War, Artificial Intelligence Strategy for the Department of War (Washington, DC: US Department of War, January 8, 2026), https://media.defense.gov/2026/Jan/12/2003855671/-1/-1/0/ARTIFICIAL-INTELLIGENCE-STRATEGY-FOR-THE-DEPARTMENT-OF-WAR.PDF.

[65] Defense Innovation Board, *Building a DoD Data Economy* (Washington, DC: Department of Defense, January 2024), https://innovation.defense.gov/Portals/63/20240118%20DIB%20Data%20Economy%20Study_Approved-compressed.pdf.

[66] Patrick Lewis et al., "Retrieval-Augmented Generation for Knowledge-Intensive NLP Tasks," in Advances in Neural Information Processing Systems 33 (2020), https://arxiv.org/abs/2005.11401; Tim G. J. Rudner and K. J. Holstein, "Miscalibration of Trust in Human-Machine Teaming," War on the Rocks, March 14, 2024, https://warontherocks.com/2024/03/miscalibration-of-trust-in-human-machine-teaming/.

[67] Megan Lamberth, "Military Artificial Intelligence Test and Evaluation: Model Practices," Center for a New American Security, July 27, 2022, https://www.cnas.org/publications/commentary/military-artificial-intelligence-test-and-evaluation-model-practices; Senate Armed Services Committee, Advance Policy Questions for Alexandra Henninger, September 2025, https://www.armed-services.senate.gov/imo/media/doc/henninger_apq_responses.pdf; IBM Research, "What Is Red Teaming in GenAI?," IBM Research Blog, September 12, 2023, 2026, https://research.ibm.com/blog/what-is-red-teaming-gen-AI.

[68] Evaluations are methods for assessing capability while benchmarks are standardized measurement tools for comparing performance across models. National Telecommunications and Information Administration, "Purpose of Evaluation," in *AI System Evaluations: Developing Accountability Inputs—A Deeper Dive, AI Accountability Policy Report*, https://www.ntia.gov/issues/artificial-intelligence/ai-accountability-policy-report/developing-accountability-inputs-a-deeper-dive/ai-system-evaluations/purpose-of-evaluation; Matthew Mittelsteadt and Marie Bate, *Codifying and Expanding Continuous AI Benchmarking,* Federation of American Scientists, October 2024, https://fas.org/publication/codifying-expanding-continuous-ai-benchmarking/; Shaun Waterman, "Military AI Will Mean Overhauling Test as Well as Tactics: DOD's First AI Chief," Air & Space Forces Magazine, April 9, 2025, https://www.airandspaceforces.com/military-ai-overhauling-test/.

heavily on human annotators and domain expertise.[69] At the moment, evaluations are developed ad-hoc across the department, resulting in duplicative effort, inconsistent standards, and an inability to reuse AI systems across components without relitigating testing and evaluation requirements.[70]

The Pentagon has contracted with ScaleAI for LLM testing capabilities since 2024.[71] However, reliance on such proprietary tools prevents reuse across programs and impedes the development of a shared evaluation infrastructure.

The FY26 NDAA establishes a cross-functional team for AI model management, oversight, and assessment to build a standardized framework for model lineage, evaluation, and governance across the Pentagon.[72] The Federation for American Scientists has suggested a promising approach, arguing that the Pentagon should create an AI Benchmarking Initiative: a centralized repository of standardized and enforceable benchmarks, metrics, and performance results shared across commands and programs.[73] This should build on existing commercial frameworks by adapting them for military purposes and creating simulation-based, theater-specific, adversarial stress-testing, and human-AI teaming metrics.

Operator trust is the ultimate metric and determinant of adoption.[74] For this reason, operators should be incorporated into the T&E process (in addition to the development process) as early as possible.[75] Ideally, staff developing benchmarks would co-create them in partnership with operators. The FY26 NDAA also requires the integration of commercial AI into at least two logistics exercises, creating near-term opportunities for frontier model providers to demonstrate capabilities in operational contexts.[76]

The Pentagon's existing academic and research partners, such as university-affiliated research centers (UARC), federally-funded research and development centers (FFRDC), and the new

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[69] Yunfan Zhao et al., "ElaipBench: A Benchmark for Expert-Level Artificial Intelligence Performance," arXiv preprint, 2025, https://arxiv.org/abs/2510.10549.
[70] Matthew Mittelsteadt and Marie Bate, *Codifying and Expanding Continuous AI Benchmarking,* Federation of American Scientists, October 2024, https://fas.org/publication/codifying-expanding-continuous-ai-benchmarking/.
[71] Brandi Vincent, "Scale AI to Help Pentagon Test, Evaluate Large Language Models," DefenseScoop, February 20, 2024, https://defensescoop.com/2024/02/20/scale-ai-pentagon-testing-evaluating-large-language-models/.
[72] US Congress, National Defense Authorization Act for Fiscal Year 2026, S.1071, 119th Cong., 1st sess., § 1533, https://www.congress.gov/bill/119th-congress/senate-bill/1071/text.
[73] Matthew Mittelsteadt and Marie Bate, *Codifying and Expanding Continuous AI Benchmarking*, Federation of American Scientists, October 2024, https://fas.org/publication/codifying-expanding-continuous-ai-benchmarking/.
[74] Paul Scharre, "Warfighters, Not Engineers, Decide What AI Can Be Trusted," War on the Rocks, November 18, 2025, https://warontherocks.com/2025/11/warfighters-not-engineers-decide-what-ai-can-be-trusted/.
[75] Thomas G. Mahnken et al., Trusting AI: Integrating Artificial Intelligence into the Army's Future Force (Washington, DC: Center for Strategic and Budgetary Assessments, 2023), https://press.armywarcollege.edu/monographs/959/.
[76] US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 328, 119th Cong., 1st sess. (2025), https://www.govinfo.gov/app/details/BILLS-119s1071enr.

National Security and Defense AI Institute, make obvious partners for this work.[77] UARCs often invent new evaluation methods that are later adopted by industry, while FFRDCs offer cleared staff, institutional continuity, and independence from the programs they evaluate.[78] Benchmark development is particularly urgent for warfighting-adjacent use cases like decision support, where existing benchmarks are low-quality, generally proprietary, and expensive.[79]

Authority to Operate

The Pentagon's ATO process—how it certifies that systems meet security requirements—has historically created major deployment bottlenecks.[80] Recent analysis shows ATOs typically require six to eighteen months, while complex systems exceed two years.[81] For static software that updates annually, this delay is manageable.[82] For frontier AI models that are constantly updated, it's paralyzing.

The Pentagon made significant progress in 2025. The National Institute of Standards and Technology created standardized AI-specific security controls so that individual programs no longer have to design them from scratch..[83] The Chief Information Officer (CIO) also issued updated guidance streamlining AI authorization processes, enabling the Pentagon to grant provisional ATOs for major frontier models—OpenAI, Anthropic, and Meta—on government-accredited platforms.[84] Then-acting CIO Katie Arrington went further, launching the Software

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[77] US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 224 ("Growing University AI for Defense (GUARD) Act"), 119th Cong., 1st sess. (2025), incorporating S. 3454, Growing University AI for Defense (GUARD) Act of 2025, 119th Cong., 1st sess., https://www.congress.gov/bill/119th-congress/senate-bill/3454.

[78] Percy Liang et al., "Holistic Evaluation of Language Models," arXiv preprint, 2022, https://arxiv.org/abs/2211.09110; Institute for Defense Analyses, "About IDA," https://www.ida.org/about-ida.

[79] Matthew Mittelsteadt and Marie Bate, *Codifying and Expanding Continuous AI Benchmarking*, Federation of American Scientists, October 2024, https://fas.org/publication/codifying-expanding-continuous-ai-benchmarking/; Percy Liang et al., "Holistic Evaluation of Language Models," arXiv:2211.09110, https://arxiv.org/abs/2211.09110.

[80] Sadia Afreen, "The Pentagon's Software Approval Process Is Broken. Here's How to Fix It," *New Atlanticist,* The Atlantic Council , April 8, 2024, https://www.atlanticcouncil.org/blogs/new-atlanticist/the-pentagons-software-approval-process-is-broken-heres-how-to-fix-it/; Matthew Mittelsteadt and Marie Bate, *Codifying and Expanding Continuous AI Benchmarking*, Federation of American Scientists, October 2024, https://fas.org/publication/codifying-expanding-continuous-ai-benchmarking/.

[81] Sadia Afreen, "The Pentagon's Software Approval Process Is Broken. Here's How to Fix It," Atlantic Council New Atlanticist, April 8, 2024, https://www.atlanticcouncil.org/blogs/new-atlanticist/the-pentagons-software-approval-process-is-broken-heres-how-to-fix-it/.

[82] Douglas C. Schmidt and Nickolas H. Guertin, "The Pentagon's Software Revolution and Its Testing Dilemma," War on the Rocks, September 3, 2025, https://warontherocks.com/2025/09/the-pentagons-software-revolution-and-its-testing-dilemma/.

[83] National Institute of Standards and Technology, Cybersecurity Framework Profile for Artificial Intelligence (NIST Interagency or Internal Report 8596, Initial Public Review Draft), December 15, 2025, 36, https://nvlpubs.nist.gov/nistpubs/ir/2025/NIST.IR.8596.iprd.pdf; Cloud Security Alliance, "NIST Publishes Cybersecurity Control Overlays for AI Development and Deployment," August 21, 2025, https://cyberpress.org/nist-publishes-cybersecurity-control-overlays/.

[84] Defense Acquisition University, "AI Testing and Evaluation for the DoD," YouTube video, 06:34, April 10, 2024, https://www.youtube.com/watch?v=1Cq995oNgIE.

Fast Track initiative in April 2025 to replace the legacy ATO process entirely with AI-enabled continuous compliance built around software bills of materials.[85] Meanwhile, the government-wide FedRAMP 20x initiative is pursuing a parallel shift from static, document-based authorization to continuous automated validation using Key Security Indicators.[86] If successful, 20x could compress civilian cloud authorization timelines from over a year to weeks—and its approach to continuous monitoring aligns with the Pentagon's own continuous ATO ambitions.[87] However, federal funding cuts and staff shortages have delayed FedRAMP 20x standards development into at least mid-2026, underscoring how dependent these reforms are on sustained resourcing.[88]

Yet three critical challenges remain that threaten to bottleneck adoption even with these gains.

First, traditional ATO assumes static software; AI models update continuously. The Army pioneered continuous ATO, which maintains authorization through ongoing monitoring rather than periodic recertification. When monitoring detects significant performance drift or security indicators, it triggers an intensive review.[89] The secretary should mandate department-wide adoption of continuous ATO for all AI systems over the next three to five years, establishing lightweight monitoring protocols and clear thresholds for triggered reviews. It should not, however, mandate standardization of the Army's approach. Instead, it should set high-level criteria through an evaluation guide to nudge convergence. The FY26 NDAA, which requires a department-wide AI cybersecurity governance policy within 180 days, provides statutory backing for this convergence.[90]

Second, cross-service ATO acceptance remains inconsistent despite congressional mandates. This shortfall is especially acute for generative AI, whose rapid updates make cross-service ATO reuse seem risky. The FY25 NDAA required the Pentagon CIO to create a policy mandating that the

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[85] Katie Arrington, "Accelerating Secure Software to the Warfighter through the Software Fast Track (SWFT)," memorandum, US Department of Defense Chief Information Officer, April 24, 2025, https://dodcio.defense.gov/Portals/0/Documents/Library/Memo-AcceleratingSecureSoftware.pdf.
[86] "FedRAMP 20x Overview," Federal Risk and Authorization Management Program, https://www.fedramp.gov/20x/.
[87] Anna Fitzgerald, "FedRAMP 20x: Here's What We Know About the Goals, Timeline & Results to Date," Secureframe, September 8, 2025, https://secureframe.com/blog/fedramp-20x.
[88] Irina Denisenko and Carrie Lee, "Navigating FedRAMP 20x and the Continuous Compliance Imperative," *Nextgov/FCW*, February 10, 2026, https://www.nextgov.com/ideas/2026/02/navigating-fedramp-20x-and-continuous-compliance-imperative/411300/; "FedRAMP 20x Phase Two," Federal Risk and Authorization Management Program, https://www.fedramp.gov/20x/phase-two/.
[89] US DoD Chief Information Officer, *Continuous Authorization to Operate (cATO): Evaluation Criteria*, Washington, DC, https://dodcio.defense.gov/Portals/0/Documents/Library/cATO-EvaluationCriteria.pdf; Advanced Technology Academic Research Center (ATARC), *Continuous Authorization to Operate (cATO) Implementation Playbook*, April 2025, https://atarc.org/wp-content/uploads/2025/04/atarc_cato-working-group_white-paper_continuous-authorization-to-operate-implementation-playbook.pdf.
[90] US Congress, National Defense Authorization Act for Fiscal Year 2026, Public Law 119-___, 119th Cong., 1st sess. (enacted December 18, 2025), sec. 1512, "Artificial Intelligence and Machine Learning Security in the Department of War," https://www.congress.gov/bill/119th-congress/senate-bill/1071/text.

services honor each other's ATO decisions.[91] However, implementation has been uneven, and programs still face months of delay as each service relitigating security requirements already validated elsewhere.[92] Section 1521 of the FY26 NDAA strengthens enforcement by requiring mandatory cloud ATO timelines, expedited review guidance within 180 days, and an appeals process for delays.[93] The secretary should issue implementing guidance requiring services to accept other services' ATOs within 30 days unless they can document specific security concerns.

Third, the provisional authorizations under which LLMs are currently operating lack clear pathways for conversion to full approvals. Organizations operating under provisional ATOs face uncertainty about timelines and criteria, and this uncertainty limits investment in scaling systems that might lose authorization. The CIO should publish explicit conversion criteria and default to full authorization after 12 months, in the absence of identified issues.

The FY26 NDAA provides additional infrastructure to accelerate this process by directing the Pentagon to establish a joint CDAO-CIO task force by April 2026 to develop secure digital sandboxes, isolated computing environments where AI systems can be tested and evaluated before deployment.[94] Currently, each program builds its own ad-hoc testing environment, duplicating effort and delaying fielding. If implemented with standardized security controls and monitoring, these sandboxes could allow programs to inherit common authorization artifacts rather than building bespoke security architectures, compressing the path from pilot to operational use.[95] The task force should prioritize combatant commands with urgent operational requirements.

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[91] US Congress, Servicemember Quality of Life Improvement and National Defense Authorization Act for Fiscal Year 2025, Pub. L. No. 118-159, § 1522, 138 Stat. 1773 (2024), https://www.congress.gov/bill/118th-congress/house-bill/5009/text; Katie Arrington, remarks at the Defense Information Systems Agency Forecast to Industry event, December 8, 2025, as reported in Jory Heckman, "Industry Flags DOD's Lack of Standardized Software Attestation Processes," Federal News Network, December 18, 2025, https://federalnewsnetwork.com/defense-main/2025/12/industry-flags-dods-lack-of-standardized-software-attestation-processes/.

[92] GovCIO Media & Research, "DOD Advances DevSecOps, ATO Reform to Speed Mission-Ready Software," October 2025, https://govciomedia.com/dod-advances-devsecops-ato-reform-to-speed-mission-ready-software/.

[93] National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 1521, 139 Stat. (2025); Venable LLP, "NDAA 2026: The Next 180 Days Will Shape How Defense Agencies Award Contracts and Spend $900 Billion on New Priorities," January 2026, https://www.venable.com/insights/publications/2026/01/ndaa-2026-the-next-180-days-will-shape-how.

[94] National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 1534, 139 Stat. (2025).

[95] Advanced Technology Academic Research Center (ATARC), *Continuous Authorization to Operate (cATO) Implementation Playbook*, April 2025, https://atarc.org/wp-content/uploads/2025/04/atarc_cato-working-group_white-paper_continuous-authorization-to-operate-implementation-playbook.pdf; Department of Defense, Chief Information Officer, Software Modernization Implementation Plan: Fiscal Years 2025–2026 (Washington, DC: Department of Defense, May 2025), Tasks 2.6 and 3.4.

Data Infrastructure

LLMs are fundamentally limited by the quality and accessibility of the data they ingest; without a robust pipeline, even the most advanced models remain functionally inert.[96] The Pentagon maintains vast repositories of operational data that remain isolated within incompatible systems, disparate classification tiers, and aging legacy formats across the various services.[97] While a primary utility of LLMs lies in their ability to synthesize and harmonize information across these fragmented programs, the Pentagon currently lacks the unified data architecture necessary to bridge these gaps.[98] Consequently, the practical application of LLMs for real-world military workflows is often hindered by an inability to access the very data required to make the tools effective.[99]

Data fragmentation is pervasive, including between services. Classification barriers are another challenge. For example, LLMs may leak classified or sensitive data.[100] Legacy systems come with data locked in decades-old formats that cannot be easily exported.[101] Unclear data rights also stop the Pentagon from using data generated by contractor-operated systems to train its own AI models.[102] The Pentagon's acquisition regulations are not fit-for-purpose for generative AI, and many AI contracts use Other Transaction Authorities not subject to these regulations and lack

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[96] Brandi Vincent, "Pentagon's AI Chief Says 'Data Readiness' Is the Biggest Hurdle for Generative AI," *DefenseScoop*, June 15, 2023, https://defensescoop.com/2023/06/15/pentagons-ai-chief-says-data-readiness-is-the-biggest-hurdle-for-generative-ai/.

[97] US DoD, *Data, Analytics, and Artificial Intelligence Adoption Strategy: Accelerating Decision Advantage* (Washington, DC: Office of the Chief Digital and Artificial Intelligence Officer, 2023), 14-18, https://media.defense.gov/2023/Nov/02/2003333300/-1/-1/1/DOD_DATA_ANALYTICS_AI_ADOPTION_STRATEGY.PDF.

[98] Thomas Meagher, "Generative AI and the Future of Defense Data Interoperability," *Joint Force Quarterly* 112, no. 1 (1st Quarter 2024): 45-51.

[99] Shaun Waterman, "Military AI Will Mean Overhauling Test: DOD's First AI Chief," *Air & Space Forces Magazine*, April 9, 2025, https://www.airandspaceforces.com/military-ai-overhauling-test/.

[100] Brandi Vincent, "CDAO Developing 'Classification Guide' for Large Language Models," DefenseScoop, February 21, 2024, https://defensescoop.com/2024/02/21/cdao-classification-guide-large-language-models-lugo/; Department of the Navy Chief Information Officer, "Department of the Navy Guidance on the Use of Generative Artificial Intelligence and Large Language Models," 2023, https://www.doncio.navy.mil/ContentView.aspx?ID=16442; Carnegie Mellon University Software Engineering Institute, *Artificial Intelligence (AI) and Machine Learning (ML) Technology and Policy Implications for the Department of Defense* (Pittsburgh, PA: Software Engineering Institute, 2020), https://apps.dtic.mil/sti/trecms/pdf/AD1122292.pdf.

[101] Defense Innovation Board, *Building a DoD Data Economy* (Washington, DC: Defense Innovation Board, January 2024), https://innovation.defense.gov/Portals/63/20240118%20DIB%20Data%20Economy%20Study_Approved-compressed.pdf.

[102] Edward Graham, "All Pentagon Contracts Should Secure Data Rights, Says Advisory Board," *Defense One*, February 6, 2024, https://www.defenseone.com/policy/2024/02/defense-innovation-board-looks-lock-data-access-all-vendor-agreements/393930/.

OTA-specific data guidance, forcing programs to write bespoke intellectual property and data rights terms from scratch.[103]

The FY26 NDAA addresses these issues by creating an Ontology Governance Working Group to develop a common data ontology and governance structure, which is foundational for interoperability.[104] To be effective, its agenda should encompass common data standards enabling cross-service AI interoperability, cross-classification processing technology, modernization of legacy data extraction, contractual guidance ensuring government retains data rights for AI training, and transition to modular open systems architecture that conditions portfolio approvals on demonstrated data portability.

Conclusion

The $800 million in frontier AI contracts represents a critical first step, but without solving computing access, workforce retention, evaluation capacity, and data infrastructure challenges, these partnerships cannot scale beyond symbolic pilots. The reforms outlined above are not aspirational. They are prerequisites for maintaining military advantage in an AI-enabled era.

China is investing aggressively in AI military applications. Every month of delay degrades our strategic position. The good news: Secretary Hegseth and Congress have already begun transformational reforms through EO 14265, the AI Action Plan, Warfighting Acquisition System, and the FY26 NDAA.[105] The bad news: generative AI's unique characteristics—continuous updates, unpredictable failure modes, massive computing requirements, and dependency on high-quality data—require additional targeted actions beyond general technology adoption reforms.

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[103] Azza Jayaprakash, "Decoding AI Acquisitions and Data Rights," *Defense Acquisition Magazine* (Defense Acquisition University), May–June 2024, https://www.dau.edu/library/damag/may-june2024/decoding-ai-acquisitions; Jeremy Burkhart, "Protecting IP, Data Rights in Other Transaction Agreements," *National Defense Magazine*, July 15, 2025, https://www.nationaldefensemagazine.org/articles/2025/7/15/viewpoint-protecting-ip-data-rights-in-other-transaction-agreements.

[104] US Congress, National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, § 1504 (Department of Defense Data Ontology Governance Working Group), 139 Stat. ___ (2025); Joshua A. Geltzer et al., "What the NDAA Means for AI and Cybersecurity," WilmerHale client alert, December 19, 2025, https://www.wilmerhale.com/en/insights/client-alerts/20251219-what-the-ndaa-means-for-ai-and-cybersecurity.

[105] Exec. Order No. 14265, "Modernizing Defense Acquisitions and Spurring Innovation in the Defense Industrial Base," April 9, 2025, https://www.whitehouse.gov/presidential-actions/2025/04/modernizing-defense-acquisitions-and-spurring-innovation-in-the-defense-industrial-base/; The White House, "America's AI Action Plan," July 23, 2025, https://www.whitehouse.gov/ostp/ai-action-plan/; Pete Hegseth, "Transforming the Defense Acquisition System into the Warfighting Acquisition System to Accelerate Fielding of Urgently Needed Capabilities to Our Warriors," memorandum, Secretary of War, November 7, 2025; National Defense Authorization Act for Fiscal Year 2026, Pub. L. No. 119-60, 139 Stat. (2025), https://www.congress.gov/bill/119th-congress/senate-bill/1071/text.

It is clear what needs to happen. The question is whether the Pentagon can execute such major changes at the necessary speed.

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Celestial Resupply: Enabling Sustainment in Contested Environments via Orbital Prepositioned Stockage

Austin Moore

ABSTRACT: This article argues that the joint force must expand sustainment beyond traditional ground, sea, and air lines of communication to meet the demands of near-peer conflict in the Indo-Pacific. As China's anti-access/area denial capabilities and the region's "tyranny of distance" threaten conventional logistics networks, it contends that current improvements to terrestrial distribution systems are necessary but insufficient. The article proposes the development of low Earth orbit (LEO) constellations comprising precision resupply payloads—orbital prepositioned stocks capable of rapid, on-call deorbit and delivery into contested or denied environments. Leveraging commercially available space-to-ground technologies, the Department of War could prototype this capability in the near term, initially supporting high-demand, low-density formations such as special operations forces. It analyzes the classic orbital elements to propose an orbital constellation and evaluates the concept against the Army's principles of sustainment, concluding that celestial resupply enhances responsiveness, survivability, operational reach, and flexibility. Orbital stockage is ultimately presented as a complementary, rapidly achievable capability aligned with strategic guidance focused on deterring aggression along the first island chain.

General Charles Hamilton, the former commander of the Army Materiel Command, authored an article titled "Prepare to be Contested, Period" in late 2024, concluding with the thought that the Army must be poised to "sustain multidomain operations against near-peer competitors in a contested environment."[1] His assessment presented a drastic shift in how sustainment forces were arrayed throughout the counterinsurgency (COIN) focused operations of the early 2000s. Shifting postures from a COIN-focused approach to supporting large-scale combat operations requires an overhaul of the joint-sustainment enterprise, one that incorporates novel sustainment capabilities to overcome the expected obstacles present in nonpermissive operating environments.

Responding to the shifting sustainment paradigm, the services are actively working to address these obstacles as evidenced by a renewed emphasis on dispersed operations and the establishment of entities such as the Contested Logistics Cross-Functional Team within the Army's Transformation and Training Command.[2] Despite these efforts, the strategy to date has been to improve existing sustainment methodologies within the ground, air, and sea lines of communication (LOC). In addition to these terrestrial LOC improvement initiatives, the Department of War (DoW) should develop complementary space-based sustainment capabilities.

A low earth orbit (LEO) constellation of precision resupply payloads provides resources to the warfighter and opportunities to the combatant commander that are relevant to the military's principles of sustainment and supportive of both conventional and clandestine operations. A prototype of this capability is achievable today with existing commercial technologies. In developing this prototype, efforts should focus on demonstrating success within the US Indo-

[1] Charles R. Hamilton, "Prepare to be Contested, Period." *Army Sustainment*, Winter 2024, 4-5.
[2] Zachary S. Hughes, "Giving Our "Paper Tiger" Real Teeth: Fixing the US Military's Plans for Contested Logistics Against China." *Joint Force Quarterly*, 4th Quarter 2024, 28-41; Jones, Amy. "Army Futures Command's Contested Logistics Cross-Functional Team: Transforming for Future Sustainment." Army Sustainment, Spring 2025, 94-97.

Pacific Combatant Command (INDOPACOM), thereby aligning with published US strategic documents and introducing another capability to overcome the theater's "tyranny of distance."

The People's Republic of China & Focus on the Indo-Pacific

The US 2025 National Security Strategy and 2026 National Defense Strategy (NDS) prominently feature China as the subject of significant interest and identify the objective to "build, posture, and sustain a strong denial defense along the first island chain."[3] By mentioning the first island chain explicitly, the NDS clarifies the area in which the joint force must be prepared to defend and therefore sustain ("island chains" referring to areas of increasing distance from mainland China formed by groupings of islands throughout the Pacific Ocean – reference Figure 1 below for a visualization). Accomplishing this task across the Pacific is complicated by the unique geographic challenges within the INDOPACOM area of responsibility. INDOPACOM encompasses more than 50% of Earth's surface, with sustainment LOCs measuring in the thousands of miles, mostly over ocean, resulting in a heavy reliance on sea and air transportation capabilities – hence "the tyranny of distance."[4]

In addition to the distance challenge, the People's Republic of China (PRC) developed a robust anti-access/area denial (A2/AD) capability throughout its last 30 years of military modernization and now fields near-peer level "sensor and shooter" capabilities.[5] Through a mixture of coastal, sea, air, and space-based assets, the PRC employs systems capable of sensing the entirety of the Indo-Pacific and kinetically engaging targets beyond the second island chain, thereby denying theater freedom of maneuver. Figure 1 depicts the island chain concept below.

Figure 1 Visualizing China's Island Chain Strategy.

Source: *Learn from the Fall of the Philippines: Prepare the Third Island Chain* (US Naval Institute, Proceedings – Dec 2024 Vol 150)

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[3] Secretary of War. *National Defense Strategy*. Washington, DC: Department of Defense, 2026. https://media.defense.gov/2026/Jan/23/2003864773/-1/-1/0/2026-NATIONAL-DEFENSE-STRATEGY.PDF.
[4] "About USINDOPACOM," *USINDOPACOM,* accessed August 5, 2025. https://www.pacom.mil/About-USINDOPACOM/.
[5] Olli Soursa, "Attaining All-Domain Control: China's Anti-Access/ Area Denial (A2/AD) Capabilities in the South China Sea," Working Paper, Honolulu: Pacific Forum International, HI, February 2025. https://pacforum.org/wp-content/uploads/2025/02/Olli-Soursa-Issues-and-Insights.pdf.

The PRC's A2/AD capabilities enable it to rapidly engage targets beyond the second island chain, creating a nonpermissive, contested environment for US forces to operate in. As previously introduced, the joint force is taking steps to overhaul and improve capabilities to mitigate the impact of the PRC's A2/AD strategy and overcome the challenges presented by the tyranny of distance; however, they are inadequate to address the urgency of the threat. In a May 2025 speech, the Secretary of War claimed: "It's public that Xi [Jinping, President of the PRC] has ordered his military to be capable of invading Taiwan by 2027" – a timeline that demands immediate capabilities able to sustain a near-peer conflict in a contested environment.[6]

Celestial Lines of Communication & Orbital Pre-Positioned Stocks

Existing sustainment doctrine provides insight into currently employed methods to mitigate the impacts of a contested environment, specifically the use of prepositioned stocks. Army doctrine describes the purpose of such stocks as providing "the capability to rapidly supply and resupply forces until air and sea lines of communication are established."[7] Further, the doctrine highlights the importance of locating such stocks at, or near, the point of use thereby limiting the assets necessary to prepare the theater. The challenge of this strategy within the Indo-Pacific again returns to one of geography as visualized above in figure 1: there is a significant amount of ocean between small amounts of land upon which to pre-stage stockage. Any transportation of materiel from the prepositioned stocks must also occur within a contested environment, increasing the operational risk for a commander to consider. How can the DoW approach this problem and create opportunities to overcome the significant challenges presented by distance and A2/AD capabilities? An answer lies within the space domain and the opening of celestial LOCs.

While the concept of space-to-ground sustainment is often found in science fiction—relevant examples include the 1950s book Starship Troopers and the more modern image of Iron Man donning armor delivered from space—it can also find parallels in current technologies. As an example, the commercial company Varda Space Industries currently operates its own small payload satellites in LEO, where they perform their on-orbit mission, and then return to ground with their payload intact, as shown in Figure 2.[8]

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[6] Pete Hegseth, "Remarks by Secretary of Defense Pete Hegseth at the 2025 Shanri-La Dialogue in Singapore." *Department of Defense*, May 31, 2025, https://www.defense.gov/News/Speeches/Speech/article/4202494/remarks-by-secretary-of-defense-pete-hegseth-at-the-2025-shangri-la-dialogue-in/.

[7] Department of the Army, *Sustainment*, Army Doctrine Publication (ADP) 4-0. Washington, DC: Department of the Army, 2019, 3-4, https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN18450_ADP%204-0%20FINAL%WEB.pdf.

[8] Varda Space Industries, accessed August 5, 2025, https://www.pacom.mil/About-USINDOPACOM/.

Figure 2: Varda Space Industries Winnebago 2 Capsule Successfully Returned to Earth

Leveraging existing space-to-ground technologies, such as the Varda platform, would allow the DoW to rapidly realize capabilities to address the sustainment challenges presented within Indo-Pacific. Strategic sustainment enablers such as the Defense Logistics Agency and the US Transportation Command, in partnership with the US Space Force, could direct the launch of predetermined sustainment packages from within the United States into orbit. These on-orbit payloads would then be available for on-call usage in theater, like prepositioned stocks. Once called for, the sustainment package deorbits and reenters for precision delivery to the warfighter in need, even in a contested or denied battlespace.

Defining Orbital Constellations to Support the Indo-Pacific

The development of a space-based constellation capable of delivering commodities within the Indo-Pacific must first consider which orbit to employ. Building on analyses of others who have contemplated this problem, a LEO-based sustainment constellation is the most advantageous, both in terms of timing and energy-to-orbit requirements.[9] LEO offers the quickest revisit time from a ground perspective and requires less energy to achieve than higher orbits, yielding greater payload mass. Accepting LEO, the design of a constellation begins with a physics problem: unlike terrestrial platforms, objects in orbit have limited maneuverability and generally do not allow deviation from their fixed path through space. This path – orbital plane – through space has a corresponding "ground trace" or the points on the ground over which the satellite passes throughout its orbit, as visualized in Figure 3 below. Related to ground trace, a satellite's inclination determines what the possible points on the ground can be – if a satellite is launched into a 0-degree inclination orbit, its ground trace will only pass over the equator.

[9] Brian Hamel, "Supporting Warfare in the Indo-Pacific Through Space-Based Sustainment," *Army Sustainment*, Winter 2024, 63-65. https://asu.army.mil/alog/ARCHIVE/PB7002401FULL.pdf.

Given this relation of ground trace and inclination, a reasonable inclination to cover INDOPACOM could be 50 degrees, which generates a ground trace covering latitudes south of of Australia to the Aleutian Islands. In addition to the possible ground trace, the trace's timing is just as important. As the satellite orbits and the Earth rotates, each orbit yields a different trace. To address this, the constellation needs to consider the right ascension of the ascending node (RAAN). The RAAN of an orbit determines where over the equatorial plane the orbit passes as it ascends from its closest point to the Earth, its perigee, as compared to a fixed celestial point. Knowing this, two satellites with the same inclination and different RAAN values can effectively be "spaced out" into different orbital planes, generating additional opportunities for coverage over a given area despite the Earth's rotation. Considering Figure 3, each orbit of the referenced satellite's ground trace is offset by approximately 23 degrees. Using this to visualize RAAN: if the lower portion of the visual depicted a constellation of satellites rather than the path of one over 24 hours, all satellites in the constellation would have an inclination of 51.6 degrees and RAAN values offset by approximately 23 degrees.

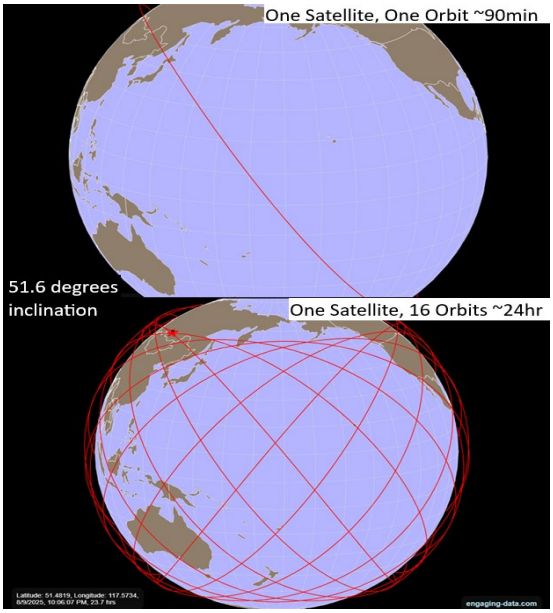

Figure 3 Ground Trace and Inclination

Continuing with the reference orbit from Figure 3, 23 degrees of longitudinal separation at the equator equals approximately 1,500 miles of separation as perceived from the ground. Given the limitation of orbits generally remaining fixed, thereby also fixing the satellite's possible reentry points, this amount of planar separation would increase the wait time for a sustainment satellite to align with a specific point-of-need on the ground. For a unit on the ground in need of supplies, an orbital offset of 23 degrees results in wait times that are too long to facilitate a rapid request-to-response cycle. Determining a better orbital offset that enables a more rapid response requires a rough understanding of how much the payload can offset its projected landing zone. Returning to the Varda Space Industries example, based on prompts proposed to the Gemini AI model to help calculate fuel costs associated with an on-orbit maneuver, it is reasonable to assume an on-orbit maneuver capability of a +/- 100mi offset to the projected landing zone relative to the existing ground trace.[10] Noting this offset capability, a resulting constellation delivering revisit wait times within hours could utilize a RAAN offset of 10 degrees (representing ~700mi longitudinal separation), requiring 36 orbital planes for continual coverage.

[10] Gemini, response to "What type of orbital maneuver would be best to reenter the satellite to splash down 100 miles off the coast of Guam in any direction," *Google*, August 5, 2025.

Evaluating Orbital Stockage Against the Principles of Sustainment

Evaluating this suggested constellation against the problem set presented within the Indo-Pacific requires additional consideration to answer the question: when would a commander operationally employ this sustainment capability? To help answer this, Joint doctrine provides a useful definition of sustainment: "Sustainment in joint operations provides the joint task force flexibility, endurance, and the ability to extend operational reach."[11] Army doctrine presents eight principles of sustainment providing a lens for evaluating the proposed constellation's ability to enable the commander's operational flexibility, endurance, & reach:

- Integration: synchronization & coordination across capabilities & levels of sustainment
- Anticipation: ability to foresee sustainment requirements prior to their tasking
- Responsiveness: ability to generate the right support, at the right place, at the right time
- Simplicity: minimizing complexity
- Economy: efficient application of sustainment resources
- Survivability: enabling the protection of sustainers, their cargo, and the operation
- Continuity: enabling uninterrupted sustainment via integrated sustainment networks
- Improvisation: ability to adapt to unexpected circumstances[12]

In evaluating the celestial resupply capability against the principles, groupings emerge. Considering anticipation, responsiveness, and improvisation: positioning sustainment assets in the space equivalent of intermediate staging bases (anticipation) enables quick employment (responsiveness) of prepackaged resupply mission-configured loads, colloquially referred to as "speedballs," similar to those used in aerial resupply missions (improvisation). Significant consideration must be given to what each mission-configured load should contain for celestial resupply, and it should be driven by the anticipated types of supported missions.

The celestial resupply concept initially seems to violate the next grouping of principles, simplicity and economy, given the high monetary cost and inherent complexity of integrating the space domain; however, compliance becomes evident when compared to the other existing initiatives within the DoW. The Army's Contested Logistics Cross-Functional Team is placing heavy emphasis on unmanned capabilities to mitigate the risks posed by the contested environment.[13] These capabilities have the potential to redefine terrestrial sustainment within a new paradigm, removing the sustainer from harm's way and leveraging AI to decrease decision-making time. However, realizing this benefit requires a corresponding shift in command-and-control (C2) capabilities and the deployment of new hardware. In contrast, celestial resupply is possible today with existing hardware and C2 systems, thus decreasing both comparative complexity and cost. Given this disparity in complexity and development costs, celestial resupply demonstrates compliance with the sustainment principles of simplicity and economy.

When considering celestial resupply against the last principles: integration, survivability, and continuity, it's important to consider the capability as one tool among many. Integrating this tool

[11] Joint Chiefs of Staff. Joint Logistics. Joint Publication (JP) 4-0. Washington, DC: Joint Chiefs of Staff, 2025, I-1, https://jdeis.js.mil/jdeis/new_pubs/jp4_0ch1.pdf.
[12] Department of the Army, *Sustainment,* 1-2 – 1-4.
[13] Jones, "Logistics Cross-Functional Team."

into the theater's sustainment posture presents another avenue to further extend the commander's operational reach and complement other sustainment methods within the existing network. Additionally, employing this capability increases survivability at both ends of the spectrum: both delivering supplies to the point of need, thereby enabling operations, while also removing sustainers from harm in a contested environment.

The Use Case and Proof-of-Concept Prototype for Orbital Stockage in the Indo-Pacific

Transitioning from the conceptual to considering practical examples of celestial resupply requires a return to the Varda example. Varda's platform is a "ready-today" capability, making it relevant to the urgency of the DoW's need to overcome contested environments, as established by the 2027 timeframe. Available prototypes of this platform would realize payload limitations measured in hundreds of pounds.[14] Payloads of this size suggest use cases supporting smaller units of action, such as special operations forces (SOF). Army SOF units "rely on air LOCs for rapid resupply," forecast high consumption rates while operating in denied areas, and may require emergency resupply to enable operational capability and survivability.[15] Operating in a contested environment hinders reliance on air LOCs for rapid resupply and underscores the need to consider celestial LOCs as an alternative capability to ensure continuity of SOF operations.

As the space-based sustainment concept matures, payload growth will follow, enabling the consideration of additional use cases to support conventional operations. However, even with expected payload increases, this concept does not lend itself well to accommodating the celestial pre-positioning of major end items, due to the vast payload requirements needed to support them. Alternative approaches, such as the Air Force Research Laboratory's Rocket Cargo program, may be better suited to addressing the need to rapidly transit major end items; however, they are outside the scope of this argument.[16]

Generating capability growth to enable uninterrupted sustainment within contested environments is vital to the DoW's capacity to succeed in the potential near-term conflicts against near-peer adversaries. Nowhere is this more prevalent than in the Indo-Pacific, where the tyranny of distance and the PRC's robust A2/AD capabilities strongly suggest the joint force will operate through a highly contested environment. The DoW's efforts to date are insufficient in scope to address this mounting challenge and therefore should consider non-terrestrial, space-based sustainment capabilities and the opening of CLOCs. The celestial resupply concept is complementary with existing sustainment methodologies delivered via ground, sea, and air lines of communication while also remaining compliant with the Army's principles of sustainment. The addition of this capability furthers the joint commander's operational flexibility, endurance, and reach.

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[14] Varda Space Industries. "Summary of Capabilities," accessed August 5, 2025. https://www.varda.com/government#summary-of-capabilities.

[15] Headquarters, Department of the Army, Special Operations Forces Sustainment. Army Techniques Publication (ATP) 3-05.40, Washington, DC: Department of the Army, 2013, 2-5, https://armypubs.army.mil/epubs/DR_pubs/DR_c/pdf/web/atp3_05x40.pdf.

[16] Air Force Research Lab, "Rocket Cargo For Agile Global Logistics," accessed August 5, 2025, https://afresearchlab.com/technology/successstories/rocket-cargo-for-agile-global-logistics/.

Prototypes of this capability could be rapidly realized by leveraging commercial examples, such as the Varda Space Industries Winnebago series vehicle, launching on the existing DoW-contracted launch providers, Rocket Lab and SpaceX. Prototype platforms would be limited in payload, making them best suited to enabling SOF operations in the near-term. As the capability matures, so too would the portfolio of supported operations. Evolving this concept from theory to reality presents an exciting opportunity to open a new domain for military sustainment capabilities and meet General Hamilton's challenge to "Prepare to be contested, period."

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Shaping the Warfighter: Why Innovation Must Include Mental Readiness

Matt Meeks

ABSTRACT: Rapid advances in artificial intelligence, autonomy, and precision weapons are transforming the character of warfare, but technological superiority alone does not guarantee battlefield success. The argument of this piece is that the decisive advantage in future conflict will depend on the cognitive and psychological readiness of the warfighter. Drawing on military doctrine, recent research, and operational examples from modern conflicts, the article highlights how mental resilience directly affects decision-making, performance under stress, and the effective use of advanced systems. While the US military has invested heavily in physical readiness and crisis-response infrastructure, Meeks identifies a critical gap in continuous, integrated mental readiness support. Evidence from the Army's Holistic Health and Fitness (H2F) program demonstrates measurable readiness gains when embedded support structures are implemented, yet cognitive readiness remains largely unmeasured and underdeveloped. The article concludes that integrating AI-enabled tools, digital support systems, and readiness-focused infrastructure can close this gap and strengthen the human dimension of combat power.

The future fight is being shaped by autonomy, AI, and advanced weapons. These systems are rewriting the character of war. But every technological edge still depends on one thing: a warfighter mentally ready to use it. Mental readiness is the force multiplier we continue to overlook. The question is no longer whether to invest in it; it is whether we are willing to apply the same innovation discipline to the human mind that we apply to every other warfighting domain.

What We Already Know

The United States has built the most capable fighting force in history. AI-enabled targeting, autonomous reconnaissance, precision fires, and kill-chain compression from hours to minutes are not theoretical – they are operational realities.

We also know mental readiness sits at the core of combat effectiveness. Army Field Manual 7-22, *Holistic Health and Fitness*, identifies mental readiness as one of its essential pillars.[1] The Army's Ready and Resilient program reinforces that mental resilience is "the backbone of strength that allows individuals to navigate uncertainty with confidence and maintain cognitive clarity under pressure."[2] And for decades, special operations formations have integrated psychological resilience into training because performance under stress depends not only on tactical competence, but on cognitive endurance and emotional regulation.[3]

We now have quantified proof that embedded readiness infrastructure works. A peer-reviewed evaluation of H2F Performance Teams - published in Sports Medicine in 2026 - studied fifty-six

[1] US Department of the Army, *Army Field Manual 7-22: Holistic Health and Fitness* (Washington, DC: Headquarters, Department of the Army, 2020), 1-3 to 1-7.
[2] US Army Ready and Resilient, "Mental Readiness," accessed November 25, 2025, https://www.armyresilience.army.mil/ard/r2-home.html.
[3] Ana Starcevic et al., "Psychological Resilience in the Military: Perspectives on Coping and Adaptation," Military Psychology 35, no. 4 (2023): 287-302.

matched brigades across more than one million soldiers over five years. Brigades with embedded teams reversed every major readiness disadvantage, reduced behavioral health profiles by forty-four percent, cut substance abuse profiles by seventy-nine percent, and restored 37,484 duty days per brigade annually. The return on investment was over eight to one. Every dollar invested in embedded readiness infrastructure returned more than eight dollars in value. The Army has already proven the model works for the physical and behavioral domains. The question is why we have not extended it to cognitive readiness.[4]

The doctrine is sound. The research is clear. The operational demand signal is incontestable. Yet we still treat mental readiness as an adjunct-important, but not integrated, measured, or innovated with the same rigor as every other capability.

The Gap Appears After the Fight

We have engineered systems that keep warfighters alive in the most extreme environments on earth. Counter-IED technology, rapid medical evacuation, and world-class trauma care have driven survival rates to levels previous generations would consider impossible.

And then we lose them.

Not to enemy action, but to isolation, disconnection, and the absence of a continuity system built to sustain them once they return home. In 2022, 6,407 veterans died by suicide.[5] In 2023, the active-duty force lost 523 service members to suicide.[6] More than half of the veterans who died had zero contact with the Department of Veteran Affairs (VA) in the preceding five years.[7] They were not rejecting care – they never entered the system.

This is not a failure of commitment. It is an integration failure. We have a strong crisis-response infrastructure and a massive clinical enterprise. What we do not have is a continuous, stigma-free, culturally credible support layer that operates in the space between no care and healthcare – the "prevention zone" where most warfighters actually live.

This is the capability gap. And the gap can be closed.

Mental Readiness is Combat Power

Recent conflicts show that cognitive resilience is inseparable from the effective employment of advanced systems.

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[4] A.G. Thompson, M. Subedi, A.E. Morrow et al., "Evaluating the Return on Investment of US Army Holistic Health and Fitness Performance Teams: A Matched Difference-in-Differences Study of Readiness and Economic Outcomes," Sports Medicine, 2026, https://doi.org/10.1007/s40279-026-02399-3, abstract, 1; table 4, 17.
[5] US Department of Veterans Affairs, 2023 National Veteran Suicide Prevention Annual Report (Washington, DC: Office of Mental Health and Suicide Prevention, 2023), 12-15.
[6] Ibid., 12-13.
[7] Ibid., 28.

Ukrainian forces operating TB2s and US-supplied HIMARS demonstrated that autonomy still demands sharp human judgment under pressure.[8] Israeli researchers documented cognitive overload and decision degradation among operators of AI-assisted targeting systems during Gaza operations.[9] Research on special forces personnel during ninety-six-hour sustained combat exercises demonstrates that fatigue significantly increases risk-taking behaviors and degrades cognitive self-control – a validation of what special operations units have known for decades: close combat is as much a cognitive contest as a physical one.[10]

We give elite athletes evidence-based tools for sleep, stress, and recovery. Warfighters deserve the same.

The data on the back end is equally clear. The same H2F evaluation that quantified physical readiness gains found that embedded behavioral health support drove a forty-four percent reduction in long-duration behavioral health profiles and a seventy-nine percent drop in substance abuse profiles - outcomes directly linked to reduced separation risk, improved retention, and lower suicide risk in longitudinal Army research. But the next meaningful reduction in suicide will come not from new clinical access, but from what happens before the crisis call – and what happens after the appointment.[11]

Technology can close this continuity gap. Not as therapy. Not as diagnosis. As private, culturally aligned, real-time support available as stress emerges, long before it becomes clinical. This is the layer that traditional models cannot reach.

Proven Demand, Disconnected Systems

Veterans and service members already engage digital tools at scale. VA apps such as PTSD Coach, Mindfulness Coach, and Virtual Hope Box demonstrate high adoption, but it's episodic, with limited continuity.[12] The 988 Suicide and Crisis Lifeline showed a 1,135 percent increase in text traffic in its first year, demonstrating extraordinary demand for simple, immediate support pathways.[13] Telehealth adoption is strong: eighty-eight percent of veterans are online, and sixty-five percent are open to online mental health assessment.[14] In 2024, Community care covered

[8] Mykhaylo Zabrodskyi et al., Preliminary Lessons in Conventional Warfighting from Russia's Invasion of Ukraine: February-July 2022 (London: Royal United Services Institute, 2022), 34-38.
[9] Yuval Abraham, "Lavender: The AI Machine Directing Israel's Bombing Spree in Gaza," *+972 Magazine*, April 3, 2024, https://www.972mag.com/lavender-ai-israeli-army-gaza.
[10] David Erez et al., "Ad Libitum Caffeine Consumption, Cognitive Performance, and Sleep in Special Forces Soldiers During a 96-h Combat Exercise," *Frontiers in Neuroscience* 18 (2024): 1419181, https://doi.org/10.3389/fnins.2024.1419181.
[11] Thompson et al., "Evaluating the Return on Investment," 13, 20.
[12] US Department of Veterans Affairs, National Center for PTSD, "Mobile Apps for PTSD," accessed November 25, 2025, https://www.ptsd.va.gov/appvid/mobile.
[13] Ramchand, Rajeev. "Suicide Among Veterans: Veterans' Issues in Focus." *Rand Health Quarterly* 9, no. 3 (June 30, 2022): 21. PMCID: PMC9242579.
[14] Pew Research Center, "Veterans and Digital Health: Attitudes and Adoption" (Washington, DC: Pew Research Center, 2024).

approximately forty-two percent of all VA-funded appointments, expanding access but fragmenting continuity.[15]

The pattern is unmistakable: veterans engage when support is accessible, confidential, and culturally attuned. What is missing is the connective tissue – a continuity layer – that binds these systems into a coherent readiness experience.

The Technology Exists

AI-enabled prevention tools now being piloted across the DoD and the VA demonstrate that non-clinical, privacy-protected, culturally informed digital companions can sustain engagement for months – far longer than traditional models.[16] Adoption is driven by four well-understood dynamics:

- Cultural fluency in military experience and language
- Uncompromising privacy with no command visibility
- Continuous engagement across chat, voice, and low-connectivity modalities
- Readiness-based framing rather than medical labeling

This is not speculative technology. It is operational today. The limiting factor is integration – not capability.

The Army's Wearable All-hazard Remote-monitoring Program (WARP) is a perfect example. We are investing millions to sense physiological readiness through wearables, but we still treat cognitive readiness as intangible. We would never field an autonomous system blind to its own sensor telemetry. Yet we routinely put warfighters into high-tempo, high-tech environments without any equivalent cognitive instrumentation.

WARP can show when a soldier's heart rate spikes; it cannot show when cognitive overload, emotional drift, or decision fatigue are degrading judgment. This is not a technology limitation - it is a measurement gap we have not chosen to close. The H2F ROI study, which remains the most rigorous large-scale readiness evaluation the Army has produced, measured physical fitness, injury profiles, marksmanship, and body composition across seven outcome domains and more than a million soldiers. It measured nothing in the cognitive domain. The authors acknowledge psychological and cognitive workloads as an emerging operational pressure in their introduction, but then they produce thirty pages of data that never quantify a single cognitive outcome.[17] That is not a criticism of the study. It is the clearest possible evidence of where the measurement architecture ends and where our next investment must begin.

Imagine if we fused the two. Physiological sensing paired with real-time cognitive telemetry gives commanders a full picture of readiness instead of half of one. This is the next logical step

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[15] US Department of Veterans Affairs, Veterans Health Administration, *Community Care Annual Report FY 2024* (Washington, DC: VHA, 2024), 18.
[16] Matthew Goldberg et al., *Artificial Intelligence in Veteran Suicide Prevention Programs: Current Applications and Future Directions* (Santa Monica, CA: RAND Corporation, 2024), 23-26.
[17] Thompson et al., "Evaluating the Return on Investment," 2, 11, 23.

in building a force that can operate advanced autonomous systems under real combat stress.

The Strategic Imperative

Congress has made historic investments in veteran mental health: $17.1 billion in Fiscal Year 2025, including $583 million for suicide prevention.[18] The VA has modernized digital pathways. Crisis-response infrastructure is world-class. Clinical tools continue to evolve.

What the enterprise lacks is the continuity layer that makes these investments effective upstream of a crisis.

The Army has already demonstrated that embedding readiness infrastructure into the force generates measurable, defensible, quantifiable returns: 8.15 dollars for every dollar invested, billions in force-wide savings, and a reversal of adverse trends across every domain measured. The case for applying that same ROI logic to cognitive readiness is not theoretical. It is the natural extension of a framework that the Army has already validated and funded.[19]

The future fight will reward the force that pairs advanced technology with human beings mentally prepared to employ it. Autonomy, AI, and robotics increase reach and tempo, but mental readiness determines whether those systems succeed under real combat conditions.

Mental readiness is operational readiness. We have already shown that we can innovate our way to battlefield dominance. Now we must bring that same rigor to the decisive weapon system in every future conflict – the warfighter's mind!

The capability gap is clear. The technology exists. The opportunity is immediate. The only question is whether we choose to close it.

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[18] US Department of Veterans Affairs, *FY 2025 Budget Submission: Volume II - Medical Programs and Information Technology Programs* (Washington, DC: VA, 2024), 1A-23.
[19] Thompson et al., "Evaluating the Return on Investment," 17, 19, 24.

Seeking Allied Integration: Reimagining the Arsenal of Freedom

Matthew Revels and Eric Uribe

ABSTRACT: Great-power war in the era of "precise mass" will test not only battlefield adaptation but the industrial depth and alliance structures that sustain it. The diffusion of drone-centric and attritional warfare from the Russo-Ukrainian conflict highlights a stark reality: the United States lacks the manufacturing resilience, supply chain redundancy, and sealift capacity to sustain prolonged conflict alone. Drawing on Michael Horowitz's adoption-capacity theory, this article evaluates America's ability to implement major military innovations under conditions of high financial intensity and contested logistics. While organizational reform within the services is necessary, the decisive constraint lies in resource mobilization across time and distance. Historical and contemporary cases reinforce this conclusion. Britain's industrial integration with the United States during World War II, Ukraine's externally balanced drone ecosystem, and Russia's centralized but bottlenecked mobilization model demonstrate that states facing high innovation costs must combine domestic investment with external balancing. Rebuilding the "arsenal of freedom," therefore, cannot mean reshoring production alone. Instead, the United States must integrate more deeply with European and Indo-Pacific allies to secure critical minerals, expand drone and decoy coproduction, and restore sealift capacity. Leveraging allied proximity and capacity will reduce logistical fragility, build redundancy into supply networks, and strengthen the credibility of deterrence.

Introduction

Hope and wishful thinking have long plagued the US military's mobilization of resources for great-power conflict. Following the end of the Cold War, the Department of Defense consolidated the defense industrial base and reduced production to reap the benefits of the peace dividend.[1] America's pacing challenge, China, exploited the complacency of a distracted hegemon—closing key capability gaps through military-civil fusion and vast investments in industrial capacity. Meanwhile, Russia's war in Ukraine and the coordination of other powers in an emerging "axis of autocracies" illustrate how adaptive adversaries can harness industrial ecosystems to leverage relative advantages in modern warfare.

Despite renewed attention to rebuilding the defense industrial base as the "arsenal of freedom," US initiatives to expand production remain narrowly focused on domestic capacity.[2] This inward focus ignores America's strategic geography and its industrial fragility. The United States cannot sustain large-scale conflict alone—its supply lines are long, its factories too few, and its adversaries' arsenals too deep.

The Department of Defense must therefore move beyond tactical adaptation and pursue strategic innovation. The US Army's way of war and its organizational culture are likely incompatible with some of the drone innovations diffusing from the Russo-Ukrainian War, limiting the likely success of their implementation. may stymie the diffusion of drone innovations from the Russo-Ukrainian War.[3] Assuming that the US military ignores these words of caution and continues to

[1] Nicholas Hooper, "Another Last Supper and a New Era of Defense Giants," *War on the Rocks,* May 5, 2025, https://warontherocks.com/2025/05/another-last-supper-and-a-new-era-of-defense-giants/.
[2] Department of War, *Acquisition Transformation Strategy* (Department of War, 2025), 7-9.
[3] Matthew Revels and Eric Uribe, "Drones Won't Save Us: Learning the Wrong Lessons from Ukraine Will Cost the US Army its Edge in Maneuver Warfare," Modern War Institute, November 5, 2025,

adopt a drone-centric approach to war, each military service will face the challenge of sustaining an attritional war across vulnerable lines of communication. The central issue is that the United States lacks the manufacturing depth and raw materials to sustain a prolonged, drone-centric attritional war without allied industrial coordination.

To endure in this era of "precise mass," the United States must pursue two complementary lines of effort: internal capacity building and external balancing with allies.[4] By partnering with Indo-Pacific and European allies to secure stable supplies of critical minerals and co-produce drones, munitions, and naval platforms, while simultaneously revitalizing domestic production, the United States can build redundancy into its supply chains, reduce the tyranny of distance, and sustain its forward-deployed forces. America's industrial advantage lies not in isolation but in leveraging its global alliances to share burdens, shorten production timelines, and strengthen deterrence capability and credibility.

Innovation Decisions: The Impact of Adoption-Capacity on State Responses

Understanding the United States' ability to implement drone and precise mass innovations stemming from the Russo-Ukrainian War requires an examination of how military power diffuses from one state to another. Michael Horowitz's adoption-capacity theory provides a useful model for understanding state innovation choices and why states pursue external and internal responses to the demonstration of a major military innovation. Horowitz defines major military innovations as "major changes in the conduct of warfare, relevant to leading military organizations, designed to increase the efficiency with which capabilities are converted to power."[5] Focusing on major military innovations is useful for this essay because it shifts from a broad approach that examines technological inventions across all powers to a narrower one that examines how leading military organizations adapt their doctrine, strategy, or operational concepts to generate greater levels of power. Doing so enables an in-depth assessment of whether the United States, a prominent military power, has the capacity to adopt the precise mass innovation.

According to the adoption-capacity theory, states can integrate new military technologies only if they possess the requisite organizational capital and financial intensity.[6] Organizational capital is the more complex of the two variables because it's an intangible asset that requires an intimate knowledge of an organization's self-perception and culture. The concept represents a theoretical stockpile of change assets that a military organization possesses to respond to shifts in the character of warfare.[7] Because of the difficulty of clearly defining organizational capital, Horowitz separates it into three components: critical task focus, experimentation, and organizational age. First, critical task focus denotes an organization's primary purpose. If an organization narrowly defines its critical task focus, it is less likely to adopt an innovation

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https://mwi.westpoint.edu/drones-wont-save-us-learning-the-wrong-lessons-from-ukraine-will-cost-the-us-army-its-edge-in-maneuver-warfare/.

[4] For more information on precise mass, please see: Michael Horowitz, "Battles of Precise Mass" Technology is Remaking War—and America Must Adapt," Foreign Affairs, October 22, 2024, https://www.foreignaffairs.com/world/battles-precise-mass-technology-war-horowitz.

[5] Michael Horowitz, The Diffusion of Military Power: Causes and Consequences for International Politics (Princeton University Press, 2010), 22.

[6] Horowitz, The Diffusion, 30.

[7] Ibid., 32-33.

because such a focus filters out changes that do not align with its primary purpose. Meanwhile, organizations that possess a broad critical task focus will find it easier to implement changes because they are less likely to link specific methods of power generation with their identity. To illustrate his point, Horowitz compares the US Army and Marine Corps, showing that the Marine Corps broadly defines its focus, whereas the Army narrowly defines it, thereby limiting its ability to implement innovations.[8]

The remaining components of organizational capital—experimentation and age—are easier to define and quantify. Experimentation refers to an organization's commitment to, or willingness to experiment with, new technology, methods, and approaches. External audiences can infer an organization's ability to innovate from its investment in experimentation or the establishment of subunits responsible for overseeing experimental efforts.[9] A recent example of subunits responsible for experimentation is the establishment of innovation cells within the Army's combat divisions.[10]

Lastly, organizational age refers to the length of service of a military unit. Based on the concept of age, one would expect older military services to be more resistant to change due to their established cultures, bureaucratic processes and politics, and budgets. Under these conditions, older organizations have less organizational capital than younger ones.[11] Although organizations cannot directly change their age, Horowitz's research implies that they can replicate the conditions of youth under certain circumstances. Conditions that would likely enable a simulated reset of an organization's age include major shocks, such as catastrophic defeat, the creation of a new organization, leadership intervention or firing, and shifts in the organization's composition. Relevant historical examples that demonstrate shocks and revitalize organizational age include the radical transformations that took place before and after the French Revolution and the establishment of the United States Air Force.[12]

For the United States, this framework suggests that, even with abundant resources, innovation will stall unless leaders overcome bureaucratic inertia and the limits on organizational capital posed by services with entrenched cultures and established norms. Yet theory and history show that when power balances shift and the threat of conflict grows, even rigid institutions can reform under pressure. According to Barry Posen, though military organizations are typically resistant to change, leaders are more willing to consider transformation when the balance of power shifts.[13] Thus, the general consensus within the US national security community on a shift in the global

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[8] Ibid., 35-36.
[9] Horowitz, *The Diffusion,* 37.
[10] Sam Skove, "How innovation cells in Army combat units are harnessing soldiers' ideas," *Defense One,* August 17, 2023, https://www.defenseone.com/threats/2023/08/how-innovation-cells-army-combat-units-are-harnessing-soldiers-ideas/389518/.
[11] Horowitz, *The Diffusion*, 37-38.
[12] For more information regarding the French Army's transformation during the French Revolution, see: Jean Paul Bertaud, *The Army of the French Revolution: From Citizen-Soldier to Instrument of Power*, trans. R.R. Palmer (Princeton University Press, 1988), 9-11. For more information on the impact of the Air Force on the national security establishment, see: Arlene Lazarowitz, "Promoting Air Power: The Influence of the US Air Force on the Creation of the National Security State," *The Independent Review,* vol. 9, no. 4, 2004, 477-99, https://www-jstor-org.usmalibrary.idm.oclc.org/stable/24562080?sid=primo&seq=15.
[13] Barry Posen, *The Sources of Military Doctrine: France, Britain, and Germany Between the World Wars* (Cornell University Press, 1984), 59-61.

balance of power and the looming military threat posed by the People's Liberation Army suggests that civilian and military leadership will be more receptive to change.[14] When considering this willingness to change in light of the DoD's current agenda, which prioritizes overcoming bureaucratic and organizational inertia, we must assume that the military's leadership will seek to address the problem of limited organizational capital—in particular, critical task focus—at any cost.[15] Therefore, the changing character of warfare and shifts in the international balance of power have fostered the conditions for the military to overcome its typically stagnant nature and pursue the necessary innovations.

Removing organizational impediments leaves only one critical factor that the US military must overcome: financial intensity. On the surface, this should be a relatively easy innovation obstacle for the United States to overcome, given its status as the world's largest defense spender.[16] Unfortunately, financial intensity encompasses not only production cost but also the mobilization of resources across time and space.[17] This means that the United States must assess its capacity to repurpose or rebuild substantial portions of the defense industrial base to produce the required quantities of systems at a sustainable price point.

Resource mobilization also entails sustaining forward operations across contested supply lines. In a future conflict, the US joint force's lines of communication will be susceptible to interdiction and the development of bottlenecks. The attrition of sea and airlift assets will slow the delivery of vital systems and reduce the speed of friendly adaptation.[18] Thus, relying on mass places a long-distance force projector like the United States at a severe disadvantage and raises the second- and third-order costs associated with adopting the innovation. High financial intensity, therefore, does not merely slow innovation—it reshapes strategic behavior, nudging states toward coalition-based or external responses.

Because high financial intensity raises the costs of independent innovation, dominant powers should seek to balance internal efforts with external balancing, combining the two innovative responses available to states. As the dominant military power within its alliance system and the world's largest arms exporter, the United States has historically preferred to act independently, wary of relying too heavily on its allies' capabilities.[19] Yet, as Horowitz notes, states facing prohibitive adoption costs must consider three external responses—neutrality, balancing, or bandwagoning.[20] In direct competition with Russia and China, the United States cannot credibly choose neutrality or bandwagoning. Instead, recognizing that it will not achieve the economies of scale necessary to rival the integrated industrial networks of an adversary like China, the United

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[14] Noah Robertson, "'Imminent Threat? Hegseth escalates tone on China in key Asia speech," *Defense News,* May 30, 2025, https://www.defensenews.com/pentagon/2025/05/31/imminent-threat-hegseth-escalates-tone-on-china-in-key-asia-speech/.
[15] Department of War, *Acquisition,* 1-3.
[16] Xiao Liang et al., "Trends in World Military Expenditure, 2024," *SIPRI,* April 2025, https://www.sipri.org/sites/default/files/2025-04/2504_fs_milex_2024.pdf, 2.
[17] Horowitz, *The Diffusion*, 30-31.
[18] Zachary S. Hughes, "Giving our 'Paper Tiger' Real Teeth: Fixing the US Military's Plans for Contested Logistics Against China," *Joint Forces Quarterly* 115 (2024), 32-33, https://digitalcommons.ndu.edu/cgi/viewcontent.cgi?article=1148&context=joint-force-quarterly.
[19] Mathew George et al., "Trends in International Arms Transfers, 2024," *SIPRI,* March 2025, https://www.sipri.org/sites/default/files/2025-03/fs_2503_at_2024_0.pdf, 2.
[20] Horowitz, *The Diffusion*, 26-27.

States should pursue a hybrid innovation strategy: rebuilding domestic capacity while coordinating with allies to pool industrial and logistical resources.

Seeking External Responses: Resource Mobilization in the Twentieth and Twenty-First Centuries

History provides precedent for the salience of Horowitz's idea of financial intensity and the need to seek external responses. During World War II, Britain relied on US industrial power through the Lend-Lease program, Liberty ship production, and the coproduction of vital equipment such as microwave radar—demonstrating how great powers can overcome resource mobilization shortfalls through allied industrial integration. Additionally, the divergent wartime industrial behaviors of Russia and Ukraine illustrate how financial intensity and strategic industrial balancing determine resilience and innovation capacity in prolonged, high-attrition conflict. Russia's approach is anchored in centralized, authoritarian-style mobilization, while Ukraine has pursued a distributed production and external balancing strategy. Each case provides crucial evidence for the United States as it faces its own industrial limitations in a European or Indo-Pacific conflict.

Great Power External Response: The British During World War II

Before examining the contemporary case study of the Russo-Ukrainian War, it is useful to draw on a historical analogy for today's arsenal of freedom: the establishment of the "special relationship" and the solidification of the United States as the arsenal of democracy. After France's defeat in May 1940, the United Kingdom found itself unable to meet the material and resource requirements for its defense. In response, Winston Churchill sought to meet the demands of wartime production by building redundancy into his supply networks through a combination of internal and external responses. Although the adoption-capacity theory focuses on the diffusion of major military innovations among states, it is important to examine the United Kingdom's efforts to secure external assistance from the United States across all facets of the defense industrial base.

Over the course of the war, the two allies collaborated on numerous innovations, but the relationship initially focused on the procurement of raw materials and equipment. Recognizing this, it is important to note that a precondition for acquiring the resources to adopt major military innovations, as defined by Horowitz, is that the state in question possesses a reliable supply of military equipment to either maintain the status quo in peacetime or sustain an ongoing conflict. From this baseline assumption, we can infer that major military powers reflect the underlying logic of Maslow's hierarchy of needs.[21] In the context of the British, the major military power had to satisfy its basic needs for ammunition, naval assets, and ground-force equipment before it could expend financial resources on adopting innovations. From 1940 until the end of the conflict, the British exhibited these characteristics, enabling the strategic innovation of integrating the allies' wartime economies, fully integrating the state's available internal and external responses.

[21] University of Central Florida, "Maslow's Hierarchy of Needs," *General Psychology,* accessed February 6, 2026, https://pressbooks.online.ucf.edu/lumenpsychology/chapter/maslows-hierarchy-of-needs/.

Cooperation between the Americans and the British initially focused on the existential necessity of protecting convoys and defending the English Channel. Winston Churchill's initial requests for 50 American destroyers in May 1940 were rebuffed by the Roosevelt administration because of the impact on the American Navy. In response, Churchill sought another external partner to satisfy its basic needs, namely the French Navy, and to prevent the fleet from being turned over to the Germans. Churchill's effort largely failed at the Battle of Mers-el-Kebir, but it led to the Destroyers-for-Bases agreement with the United States. Though the United States sent 50 outdated destroyers to the British, the agreement laid the foundation for increased cooperation, leading to the passage of the Lend-Lease Act in 1941.[22]

After the passage of Lend-Lease and the United States' entry into the war, the British received over half of the $50 billion in aid, enabling the country to sustain its war effort, surge its forces onto the continent, and focus on co-innovation efforts.[23] By the end of the war, the United States delivered 27,571 tanks, 25,870 aircraft, and 39 escort carriers to the British, a small sample of the materiel and equipment provided.[24] Increasing cooperation between the two major military powers enabled the adaptation of merchant shipping and the rapid production of Liberty Ships. During the war, American shipyards produced approximately 2,700 of the British-designed Liberty Ships and allocated hundreds of them to the British.[25] Both powers built on their integrated industrial bases to pursue scientific and technological endeavors after the Tizard Mission.[26] By balancing its approach to wartime innovation, the United Kingdom overcame the limitations of its industrial base to co-develop vital technologies, including microwave radar, proximity fuses, and atomic energy. Britain's example during World War II demonstrates how major military powers that lack industrial autarky can successfully integrate with allied or partner states.

The Ukrainian Example: External Balancing and Supply Chain Flexibility

Shifting forward to contemporary examples, Ukraine demonstrates how adaptation occurs when external integration fails to meet the basic needs of the state. As a response to a lack of artillery rounds and an increasing need to conduct lethal strikes on armored targets with less resources, the Ukrainians increasingly relied on drones.[27] Shifting its focus to drones enabled the Ukrainians to remain integrated with partner supply networks, but it also enabled them to build

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[22] Jeffrey Rigdon Teter, "Destroyers-for-Bases: A Win-Win for Allied Maritime Superiority," *US Naval Institute,* April 2021, https://www.usni.org/magazines/naval-history-magazine/2021/april/destroyers-bases-win-win-allied-maritime-superiority.
[23] Council on Foreign Relations, "Best Decision 5: Lend-Lease Act," accessed February 6, 2026, https://www.cfr.org/ten-best-ten-worst-us-foreign-policy-decisions/lend-lease-act/.
[24] Office of the Chief of Military History, *The United States Army in World War II: Lend-Lease* (Department of the Army, 1952), 23-38, https://permanent.fdlp.gov/gpo122005/2410.PDF. Tony Drury, "Escort Carriers," *Royal Navy Research Archive,* accessed February 6, 2026, https://www.royalnavyresearcharchive.org.uk/ESCORT/About.htm.
[25] Kathryn Miles, "on the Prow of Liberty," *Bowdoin Magazine,* March 19,2021, https://www.bowdoin.edu/news/2021/03/on-the-prow-of-liberty.html.
[26] Roger Connor, "The Tizzard Mission—75 Years of Anglo-American Technical Alliance," *National Air and Space Museum,* November 17, 2015, https://airandspace.si.edu/stories/editorial/tizard-mission-%E2%80%93-75-years-anglo-american-technical-alliance.
[27] Bill Murray, "Beyond the Hype: Why Drones Cannot Replace Artillery," *Small Wars Journal,* May 5, 2025, https://smallwarsjournal.com/2025/05/05/beyond-the-hype-why-drones-cannot-replace-artillery/#:~:text=As%20many%20reports%20open%2Dsource,warfare%20capabilities%20to%20counter%20them.

redundancy by leveraging the reliability of domestic production capacity. In 2022, Ukraine managed an industrial complex inherited from the Soviet Union, relying on large state monopolies and legacy technology ill-suited for the rapid attrition of modern warfare. Despite its short interior lines, high financial intensity, and a contested logistics environment, Ukraine turned to multinodal production, private-sector investment, and external balancing to compensate for its initial industrial limitations.[28]

The centerpiece of this approach is the Brave 1 innovation cluster. This public-private ecosystem, primarily optimized for drone procurement, attracts angel investors, venture capital, and private corporations that shoulder the financial risk typical of government-led research and development. The success of Brave 1 and its ability to mitigate the financial intensity burden on the state is evident in the growing number of foreign investors and the increase in average amount of investment startups raise, from $500,000 to between $1 million and $3 million as of 2024.[29]

However, the key to its resilience and quick reconstitution is a strategic focus on "Lego-style" modularity and an integrated, multinational supply chain. Ukrainian defense startups may drive design and development, but these products remain highly dependent on foreign commercial components such as US and Taiwanese semiconductors, European optics, and even Chinese motors and batteries, much like Russia.[30] This reliance on the global commercial off-the-shelf market and decentralized assembly enables adaptation and innovation cycles comparable to or faster than Russia, while maintaining high resilience under attrition despite limited central capability. This successful use of partners to facilitate production demonstrates Horowitz's idea that high financial intensity pushes states toward a need to balance externally.

The Russian Example: Internal Bottlenecks and Mitigation

From the outset of the invasion, the Russian government favored a centralized approach to military-industrial production, adapting its economy to wartime conditions starting in July 2022. This included mobilizing facilities, imposing labor controls, and redirecting over four thousand enterprises and more than 10 percent of the Russian population—many of whom were subordinated to state conglomerates such as Rostec—to fulfill state defense orders.[31] Security

[28] Kateryna Bondar, "How Ukraine Rebuilt its Military Acquisition System Around Commercial Technology," *Center for Strategic and International Studies,* January 13, 2025, https://www.csis.org/analysis/how-ukraine-rebuilt-its-military-acquisition-system-around-commercial-technology.
[29] Olena Bilousova et al., "Ukraine's Drones Industry: Investments and Product Innovations," *Kyiv School of Economics,* October 4, 2024, https://kse.ua/wp-content/uploads/2024/10/241004-Brave1-report-v.1.pdf, 3.
[30] Aosheng Pusztaszeri, "Why China's UAV Supply Chain Restrictions Weaken Ukraine's Negotiating Power," *Center for Strategic and International Studies*, December 16, 2024, https://www.csis.org/analysis/why-chinas-uav-supply-chain-restrictions-weaken-ukraines-negotiating-power#:~:text=On%20September%201%2C%202024%2C%20China,radio%20modules%2C%20and%20navigation%20cameras.
[31] Oleksandr V Danylyuk and Jack Watling, "Winning the Industrial War: Comparing Russia, Europe and Ukraine, 2022-24," *Royal United Services Institute*, April, 2025, https://static.rusi.org/winning-the-industrial-war-comparing-russia-europe-ukraine-2022-24.pdf, 6-11.

and defense spending now account for over 8 percent of GDP and 40 percent of all federal expenditure as the Kremlin attempts to adopt a "fortress nation" posture.[32]

Yet, this centralized model faces two critical limitations: bottlenecks caused by component dependencies and rigidity that hinders qualitative innovation. First, the lack of domestically produced, sophisticated components for drones and missiles has forced reliance on external suppliers. This resulted in the formation of a critical arms supply partnership with Iran, evolving from a monthly transfer of 200–600 drones of the Shahed 136/Geran-2 type to the establishment of a production facility at Alabuga capable of producing over five thousand drones monthly, with the airframes and major components now produced on site.[33] Early limitations in mass production were also seen in conventional munitions stocks, forcing Russia to rely on its own "arsenal of autocracy" ally, North Korea, for shipments totaling upward of 5.8 million rounds, or potentially 40 percent of all Russian artillery shells, to meet expenditure demands.[34]

Second, the rigid structure of centralization has stressed Russia's defense-industrial complex, leaving it barely able to fulfill orders with anything other than mass-produced legacy equipment using more dual-use technology.[35] This has resulted in Russia standardizing its drone production around a limited set of legacy models, in contrast to Ukraine's use of dozens of, different platforms.[36] While Russia's move to largely centralize its military production has increased its ability to produce mass quantities, the bottlenecks created by critical foreign dependencies and the focus on quantity over research and development investment leave its industrial base ultimately vulnerable.

Strategic Innovation: Building Redundancy in Allied Industrial Integration

History and contemporary events show the value of external responses to offset the burdens of resource mobilization. The United States must recognize that the strategic circumstances that enabled it to become the arsenal of democracy no longer exist. Although it remains an industrial power, it no longer enjoys vast production advantages over its rivals. China now surpasses the United States in the processing of critical inputs, manufacturing, and the rapid mobilization of

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[32] Alexandra Prokopenko, "Russia's Economic Gamble: The Hidden Costs of War-Driven Growth," *Carnegie Politika,* December 20, 2024, https://carnegieendowment.org/russia-eurasia/politika/2024/12/russia-economy-difficulties?lang=en.
[33] Johanna Moore, "Adversary Entente Cooperation at Russia's Shahed Factory Threatens Global Security," November 21, 2025, https://understandingwar.org/research/adversary-entente/adversary-entente-cooperation-at-russias-shahed-factory-threatens-global-security/.
[34] Sam Cranny-Evans, "Brothers in Arms: Assessing North Korea's Contribution to Russia's War in Ukraine," *Royal United Services Institute,* May 6, 2025, https://www.rusi.org/explore-our-research/publications/commentary/brothers-arms-assessing-north-koreas-contribution-russias-war-ukraine.
[35] Mathieu Boulegue, "Russia's Stuggle to Modernize its Military Sanctions: How Sanctions, War and 'Innovation Stagnation are weakening Moscow's Capabilities," *Chatham House,* July 2025, https://www.chathamhouse.org/sites/default/files/2025-07/2025-07-21-russia-struggle-modernize-military-industry-boulegue.pdf, 10-11.
[36] Mick Ryan, "Seven Contemporary Insights on the State of the Ukraine War," *Center for Strategic and International Studies,* November 17, 2025, https://www.csis.org/analysis/seven-contemporary-insights-state-ukraine-war.

resources near flashpoints.[37] To compete, the United States must expand domestic production while deepening allied industrial cooperation.

Drawing on concepts such as expeditionary advanced basing and agile combat employment, the Department of Defense must prioritize decentralizing manufacturing and critical input procurement through allied regional integration. Allied integration should initially focus on three areas essential to sustaining the precise mass innovation: initial critical mineral inputs, drones, decoys, and ships. Doing so enables the United States to leverage allied proximity and capacity to close the gap between production and employment, keeping pace with the rapid adaptation cycles of modern warfare.

Critical Minerals

The United States currently faces challenges stemming from upstream and downstream vulnerabilities in its defense procurement and supply chain. Preparing for a future large-scale conflict will require the United States to address vulnerabilities in both areas; however, it should first follow the logic of Maslow's hierarchy. Doing so will require us to identify supply chain vulnerabilities regarding the critical minerals and rare earth elements that are vital to the production of technologies on which we currently rely. The People's Republic of China's weaponization of its dominance over rare earth processing laid bare the United States' exposure when it announced restrictions on its export in 2025.[38] In recognition of this, the Department of Defense announced a public-private partnership with the sole domestic producer of rare earth elements, MP Materials, which included a $150 million loan.[39] Unfortunately, relying on domestic producers is unlikely to meet the demand of the commercial and defense sectors because the United States maintains only a modest reserve of rare earth elements and lacks an adequate supply of other critical minerals.[40] Ensuring a reliable and sustainable supply of critical inputs will require the United States to seek external assistance from its allies and partners.

Upstream supply chain vulnerabilities are not new for the United States. In every major conflict in the past two centuries, defense manufacturers have faced persistent challenges in maintaining adequate stocks of critical minerals. The lesson from these conflicts is that the United States cannot simply rely on stockpiles to meet demand; rather, it must build a robust domestic mining and processing capacity coupled with allied integration. Domestic reserves and processing capacity of critical minerals are unable to meet peacetime, let alone wartime, demand. Thus, to manage the United States' critical input vulnerability, it must diversify its supply chain across its

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[37] World Bank, "Manufacturing, value added," https://data.worldbank.org/indicator/NV.IND.MANF.CD?end=2024&start=1960&view=map.
[38] Ayesha Perera, "Why the US needs China's rare earths," *BBC,* October 16, 2025, https://www.bbc.com/news/articles/c1drqeev36qo.
[39] https://mpmaterials.com/news/mp-materials-announces-transformational-public-private-partnership-with-the-department-of-defense-to-accelerate-u-s-rare-earth-magnet-independence/
[40] United States Geological Survey, "Rare Earths," accessed February 6, 2026, https://pubs.usgs.gov/periodicals/mcs2026/mcs2026-rare-earths.pdf. Council on Foreign Relations, "The US Critical Minerals Dilemma: What to Know," July 30, 2025, https://www.cfr.org/articles/us-critical-minerals-dilemma-what-know .

allies and build redundancy into its minerals strategy.[41] Currently, the United States is attempting to build a minerals trading bloc with its allies, but doing so will require persistent engagement to ensure that supply chains do not atrophy.[42]

Addressing these chokepoints effectively will enable the US military and its allies to expand production of new and adaptive technologies, such as drones, which require large quantities of these initial inputs. Transitioning to a more drone-centric force introduces more fragility into America's industrial supply chain because the downstream product requires inputs that we simply lack in large quantities.[43] No single ally holds all the resources required, but across a diversified supply chain, the United States can bolster the collective security of initial inputs. Only through external balancing and integration can the United States build a sustainable supply of critical inputs and enable future technological adaptation.

Drones and Loitering Munitions

Drones and loitering munitions are the centerpiece of ongoing innovations diffusing from Russia and Ukraine. Successfully adopting the innovation requires the United States not only to scale production rapidly but also to minimize the lag between production and delivery to the front. The war in Ukraine shows that shortened feedback loops between producers and warfighters are essential.[44] Domestic investment alone cannot overcome these logistical limits. No amount of domestic investment will solve this challenge or overcome the resource mobilization challenges of a long-distance force projector. Treating drones as expendable munitions will encourage their tactical use, but it will not sufficiently replenish them when relying on domestic producers.[45] Instead, the Department of Defense needs to collaborate deliberately with its allies and partners to increase drone production and minimize the vulnerability of the US joint force's lines of communication.

Drone production capability among US allies and partners is uneven. In Europe, countries like France and Turkey have growing production capacities.[46] In the Indo-Pacific, by contrast, America's allies lack a robust drone infrastructure to challenge China's drone production

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[41] Gracelin Baskaran, "Minerals at War: Strategic Resources and the Foundations of the US Defense Industrial Base," *Center for Strategic and International Studies,* January 14, 2026, https://www.csis.org/analysis/minerals-war-strategic-resources-and-foundations-us-defense-industrial-base#h2-enduring-lessons-from-twentieth-century-minerals-policy.

[42] Didi Tang, Josh Funk, and Matthew Lee, "US wants to create a critical minerals trading bloc with its allies to counter China," *AP,* February 5, 2026, https://apnews.com/article/trump-china-rare-earths-critical-minerals-tariffs-aa82fd4c065c9b62300ff7834b660cfb.

[43] Morgan Bazilian, Jahara Matsiek, and Katrina Schweiker, "The Drone Supply Chain War: Identifying the Chokepoints to Making a Drone," *Center for Strategic and International Studies,* December 9, 2025, https://www.csis.org/analysis/drone-supply-chain-war-identifying-chokepoints-making-drone.

[44] Jorge Rivero, "Innovating Under Fire: Lessons from Ukraine's Frontline Drone Workshops," *Modern War Institute,* March 25, 2025, https://mwi.westpoint.edu/innovating-under-fire-lessons-from-ukraines-frontline-drone-workshops/.

[45] Zachary Griffiths and Jeff Ivas, "The Case for Treating Drones as Ammunition," *War on the Rocks,* November 21, 2025, https://warontherocks.com/2025/11/the-case-for-treating-drones-as-ammunition/.

[46] Christina Mackenzie, "France Makes new 'pact' with industry to speed small drone production, acquisition," *Breaking Defense,* June 17, 2024, https://breakingdefense.com/2024/06/france-makes-new-pact-with-industry-to-speed-small-drone-production-acquisition/.

dominance. Defense planners and policymakers should coordinate with their allies in Europe and the Indo-Pacific not only to transfer drones, but also to develop coproduction initiatives. For instance, the United States should replicate its 2025 coproduction agreement with Australia—originally for 155-millimeter and Guided Multiple Launch Rocket System munitions—to expand drone manufacturing with allies, building regional depth and complicating adversary targeting.[47]

Decoys

Second, the war in Ukraine underscores the value of decoys, which absorb enemy fire and drones, but must be produced in high volumes with increasing sophistication. Much like loitering munitions, decoys serve as single-use systems that are meant to draw enemy fire and increase the survivability of one's forces. Decoys will need to be mass-produced and integrate increasing levels of complexity to complicate adversary targeting. As the US military increasingly deploys decoys in its tactical formations, it can tap allied domestic manufacturing to maintain pace with battlefield adaptations and integrate the sophisticated capabilities needed to deceive the adversary.[48]

Sealift Capacity

Lastly, coproduction initiatives involving drones and decoys can help accelerate equipment delivery, but maintaining supply network redundancy through robust sealift is necessary because future conflicts will increasingly put industry at risk. Over 90 percent of US military supplies still move by sea, yet the nation accounts for just 0.1 percent of global shipbuilding, while China accounts for 53 percent.[49] Unfortunately, the US military's Sealift Command is unprepared for the bulk transportation requirements needed to sustain the mass employment of drones and loitering munitions. In addition to atrophying capabilities, the United States also lacks the shipbuilding infrastructure to bolster capacity or reconstitute losses. To close this gap and ensure consistent resource mobilization, the United States must partner with allies like South Korea and Japan, whose combined production can rival China and enable the US military to build the sealift capabilities it needs to sustain redundant supply systems. Domestic infrastructure investments are admirable and necessary, but they will take far too long to deliver the required capabilities over the next few decades. Joint production of crewed and uncrewed vessels with Japan and South Korea offers near-term redundancy and shared risk, while domestic efforts mature.

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[47] US Army Public Affairs, "United States and Australia ink historic defense manufacturing agreements," *US Army,* March 19, 2025, https://www.army.mil/article/283837/united_states_and_australia_ink_historic_defense_manufacturing_agreements.
[48] Brian Strohmaier, "Sustainment Survivability: Incorporating Deception at the Tactical Level in the Brigade Support Area," *US Army,* August 1, 2023, https://www.army.mil/article/267685/sustainment_survivability_incorporating_deception_at_the_tactical_level_in_the_brigade_support_area.
[49] Military Sealift Command, "Sealift Program (PM5)," *US Navy,* accessed February 4, 2026, https://www.msc.usff.navy.mil/Ships/Sealift-Program-PM5/. Matthew P. Funaiole, Brian Hart, and Aidan Powers-Riggs, "China Dominates the Shipbuilding Industry," *Center for Strategic & International Studies,* March 25, 2025, https://www.csis.org/analysis/china-dominates-shipbuilding-industry.

Overcoming the Resource Mobilization Gap

A single-track, internal innovation response will only further disadvantage the United States. The US military's supply system is overstretched, vulnerable, and falling behind. As the Department of Defense seems apt adopt the precise mass innovation diffusing from Ukraine, it is prudent to consider whether the US military possesses the resources to implement it. Due to its geography and the deindustrialization of its economy, the United States may be unable to serve as the sole source of production in the arsenal of freedom. To successfully implement the innovation, the United States must develop a dual-track strategy that prioritizes domestic investment and allied coproduction. Though too much reliance on allies risks reducing US strategic autonomy and raising the potential for coercive leverage, it enables the United States and its allies to build a responsive defense supply network that matches the challenges of the modern battlefield. Additionally, it bolsters deterrence by reassuring allies of the credibility of American commitment, enables the mobilization of resources near potential flashpoints, and enhances allied capabilities.[50] Expanding our conception of the arsenal of freedom can build a lasting advantage that addresses the burden-sharing gap that has long plagued allied relations. The rapid advancement of battlefield technologies necessitates that the United States broaden its conception of available state responses to innovate before, not during, the next conflict.

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[50] Trevor Phillips-Levine and Andrew Tenbusch, "Allied Arsenal: Building Strength Through Shared Production," *War on the Rocks,* July 22, 2025, https://warontherocks.com/2025/07/allied-arsenal-building-strength-through-shared-production/.

Piercing the Kill Zone: How a Ukrainian Drone Blitz Can Defeat Russian Mass

Illya Sekirin

ABSTRACT: This article postulates that Ukraine can counter Russia's numerical and material advantages by adopting a modernized version of the classical strategy of defeat in detail, centered on the massed employment of unmanned systems. Drawing on historical examples—from Napoleon's 1814 campaign to Stonewall Jackson's Shenandoah Valley operations and Germany's armored concentration in 1940—the author contends that the decisive principle remains the concentration of combat power against dispersed enemy forces. In the contemporary battlefield, however, the most lethal instrument is no longer the tank but the drone. The article proposes a "drone blitz" in which Ukraine secretly concentrates a large portion of its unmanned aircraft systems and electronic warfare assets along a narrow sector of the front. By overwhelming Russian counter-drone defenses and achieving localized air and electromagnetic dominance, Ukrainian forces could rupture Russian lines, enable maneuver operations, and sequentially defeat Russian formations. Ultimately, the article argues that institutional adaptation and operational innovation—rather than sheer resources—may determine Ukraine's ability to regain the initiative in the war.

Suffering from a significant numerical disadvantage and having lost most of Pokrovsk and Myrnohrad, the Armed Forces of Ukraine entered 2026 on the defensive. Along other sectors of the approximately 1,200-kilometre front line, Russian forces have been on the offense. They have seized Siversk and captured large portions of Kupiansk and Huliaipole.

The Russian war effort appears to be exerting sustained pressure on outgunned and outnumbered Ukrainian defenders in what has become an attritional struggle—one in which Ukraine faces long odds of winning. Russia's larger and better-equipped force risks overwhelming Ukrainian defensive capacity and achieving a breakthrough at the tactical or even operational level. Such a development could enable a broader offensive, potentially allowing Moscow to seize extensive territory, including—most notably—the remainder of the Donbas region, a publicly stated objective of the Kremlin.

Beyond Ukraine, the implications of such an outcome would be geopolitical. A successful Russian campaign could embolden Moscow to pursue more aggressive ambitions elsewhere, including renewed pressure on NATO's eastern flank. At the same time, other authoritarian states—including China, North Korea, and Iran—are closely observing the conflict for indications of Western resolve or hesitation. Perceived weakness in support for Ukraine could have cascading effects, increasing risks in other flashpoints such as Taiwan, the Korean Peninsula, or the Middle East.

While this trajectory remains a real possibility—particularly should Western support for Ukraine falter—it is not inevitable. A distinct operational approach, rooted in a time-tested framework pioneered by Napoleon Bonaparte and adapted for twenty-first-century weapons and tactics, offers Ukraine a means to arrest the Russian advance using capabilities already at its disposal. If successfully implemented, such a strategy could shift the balance of the campaign, rendering Western assistance a vital enabler rather than an existential prerequisite for Ukraine's survival as an independent, democratic state.

The Logic of Defeat in Detail

One of the most influential developments in Western military thought in recent years has been the growing recognition that warfare is undergoing profound technological change, while its fundamental nature remains constant.[1] Contemporary military scholarship has increasingly emphasized that although new technologies transform how wars are fought, enduring principles of war—articulated most clearly by Clausewitz—retain their relevance. *On War* remains as relevant today as it was when first published in 1832.

Following this logic, it should be possible to identify the nature of the Russia–Ukraine hostilities as they stand in 2026 and, abstracting from the specific context of modern weapons and technology, determine the overarching strategy the defending side—Ukraine—should adopt when facing a numerically and qualitatively superior adversary advancing along multiple axes.

The current stage of the Russia–Ukraine conflict bears a noteworthy resemblance to the strategic predicament Napoleon Bonaparte faced at the beginning of 1814, when the armies of much of Europe converged on France from several directions: south (Wellington), south-east (Bellegarde), east (Blücher and Schwarzenberg), and north-east (Bernadotte)[2] (see Figure 1).

Figure 1. Situation in France at the beginning of 1814 vs. the situation in Ukraine at the beginning of 2026

[1] Mark A. Milley, "Strategic Inflection Point: The Most Historically Significant and Fundamental Change in the Character of War Is Happening Now—While the Future Is Clouded in Mist and Uncertainty," Joint Force Quarterly, no. 110 (3rd Quarter 2023): 6–15.
[2] Frederic Natusch Maude, "Napoleonic Campaigns," in Hugh Chisholm, ed., Encyclopædia Britannica, 11th ed., vol. 19 (Cambridge: Cambridge University Press, 1911), 232.

Napoleon's situation was even more dire than Ukraine's today. In addition to Russian forces, he confronted the combined armies of Austria, Prussia, the United Kingdom, Spain, the Netherlands, Denmark, Sweden, and other European powers. Moreover, after the destruction of much of his veteran army in the campaigns of Russia (1812) and Germany (1813), Napoleon was forced to rely largely on newly raised recruits,[3] rendering his forces inferior in quality as well as quantity.

The campaign that followed this convergence of overwhelming force has since been regarded as one of the most brilliant defensive campaigns in military history and was highly praised by Clausewitz and other theorists.[4] At its core, it represented a textbook application of the strategy known as defeat in detail.

Clausewitz observed that "…because Bonaparte, by thus throwing his concentrated force first upon one opponent, then upon another, made a brilliant use of the mistakes which his adversaries had committed in dividing their forces."[5]

Napoleon concentrated the bulk of his army—approximately 80,000 men[6]—under his direct command east of Paris, while leaving only minimal screening forces to delay and avoid decisive engagement with the vastly larger allied armies, which numbered between 370,000 and 405,000 troops in northeastern France alone[7]. Through rapid and often unpredictable maneuver, he engaged and defeated individual allied army groupings in a series of separate battles, frequently achieving local numerical superiority despite his overall inferiority. Ultimately, the allied powers prevailed, due in large part to political betrayal by Napoleon's foreign minister Talleyrand[8][9] and adverse circumstances, rather than a decisive defeat of Napoleon's field army.

The strategy of defeat in detail has, of course, been successfully employed by other commanders. A notable example is Thomas "Stonewall" Jackson's 1862 campaign in the Shenandoah Valley, in which Jackson exploited interior lines and rapid movement to defeat three Union armies totaling approximately 52,000 men with a mobile force of just 17,000. His success rested on exploiting the separation of opposing forces in space and time—an essential condition for any defeat in detail strategy. [10]

A more modern illustration can be found in Erich von Manstein's 1940 plan for the invasion of France. This approach relied on concentrating the Wehrmacht's principal striking power—its Panzer divisions—in a "surprise thrust through the Ardennes, across the Meuse to the Somme estuary and ultimately against the Channel harbors," as Manstein later described in his

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[3] Jean-Marc Largeaud, "Autour des 'Maries-Louises'," Le Télémaque, no. 43 (2012/2): 42–60.
[4] Carl von Clausewitz, *On War* (Ware, UK: Wordsworth Editions, 1997), 119.
[5] Ibid.
[6] Ibid., 2.
[7] Ibid., 2.
[8] Epic History TV, "Napoleonic Wars: Battle for France 1814," YouTube video, 22:30, accessed 15 January 2026, https://www.youtube.com/watch?v=l0zRU35sovQ
[9] Edo Rizky Fauzy, "The Diplomat's Dilemma: Why Talleyrand Betrayed Napoleon," Medium, 3 April 2023, accessed 15 January 2026, https://medium.com/@edorizkyfauzy/the-diplomats-dilemma-why-talleyrand-betrayed-napoleon-26fdce44174d
[10] David J. Eicher, James M. McPherson, and Alan R. James, *The Longest Night: A Military History of the Civil War* (New York: Simon & Schuster, 2001), 208; John S. Salmon, The Official Virginia Civil War Battlefield Guide (Mechanicsburg, PA: Stackpole Books, 2001), 32.

memoirs.[11] Despite Anglo-French numerical superiority in tanks—many of which were superior in armor and firepower, according to General Guderian[12]—the Allies dispersed their armored forces among infantry formations. The Germans, by contrast, concentrated theirs. This enabled them to penetrate the French defensive lines in the Ardennes and then execute a sickle-like maneuver to the Channel coast, encircling the main French armies and the British Expeditionary Force in the Low Countries. The result effectively removed France from the war and placed the United Kingdom in immediate peril of invasion.

With the advent of mechanized warfare—and the immense logistical demands it entails—defeat in detail strategies place particular emphasis on severing enemy supply lines. Ideally, this involves encircling enemy formations, depriving them of fuel, ammunition, and reinforcements, and ultimately breaking their will to fight. A modern commander, therefore, need not defeat every enemy unit individually. Rather, it is sufficient to destroy or dislocate those forces whose defeat enables a breakthrough, through which maneuver formations can envelop remaining enemy units from the rear and flanks (see Figure 2).

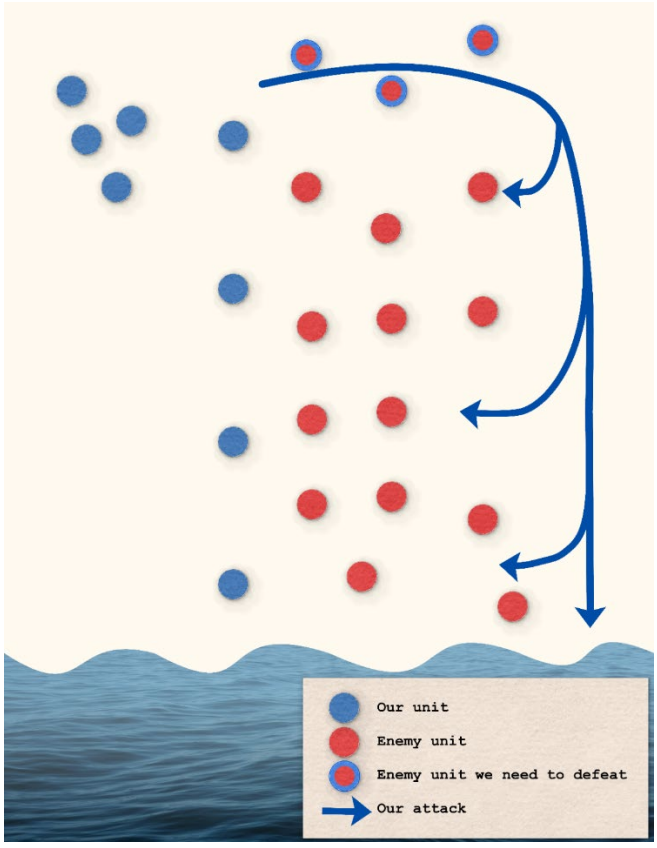

Figure 2. In mechanized warfare, only a limited number of enemy forces must be defeated to enable maneuver formations to envelop and defeat the enemy force as a whole.

[11] Erich von Manstein, *Lost Victories*, trans. Anthony G. Powell (Novato, CA: Presidio Press, 1982; originally published in German in 1955), 124.
[12] Heinz Guderian, *Panzer Leader*, trans. Constantine Fitzgibbon (Cambridge, MA: Da Capo Press, 2002; originally published in German in 1952), 94.

Yet while historical analogies provide valuable insight, contemporary warfare imposes distinct constraints and opportunities. Any strategy adopted must reflect not only the enduring nature of war, but also its modern character.

Pursuing Defeat in Detail on the Contemporary Battlefield

Exactly 212 years after Bonaparte's exemplary defensive campaign of 1814, the nature of that armed struggle is repeating itself in the form of the current stage of the Russia–Ukraine war. To emulate the spirit of Napoleon's operational art, the Ukrainian army would need to concentrate a large portion of its best forces into a single strike group. Russian troops are currently dispersed along seven distinct axes of advance (see Figure 1). These axes often do not mutually support one another, presenting Ukraine with a clear opportunity to defeat Russian forces piecemeal.

However, Ukraine's current strategy represents the opposite of such a concentration of effort. It can best be described as a "hold the line" approach, in which military resources are spread relatively evenly along an extended front line, leaving little in the way of operational or strategic reserves.

Ukrainian commanders have also demonstrated rigidity in defense, remaining reluctant to withdraw from positions where their forces are clearly disadvantaged. This reluctance was evident during the final stages of the battles for Bakhmut and Avdiivka. Similarly, at the time of writing, there appears to be little military logic in maintaining the bridgehead south of Kupiansk. In this sector, Ukrainian units are surrounded on three sides and sustaining heavy casualties for minimal operational gain; a similar situation developed in Myrnohrad. If an army cannot exploit a bridgehead or saliant in the foreseeable future, it should evacuate it; otherwise, such positions become sources of attrition with little to show for the losses incurred. Forces freed from these positions could instead be redeployed as reserves elsewhere.

The reasons Ukraine has not massed its forces are twofold. First, both Russian and Ukrainian forces have suffered heavy losses when attempting to concentrate ground formations, as such groupings were quickly detected by enemy drones. Second, the Ukrainian General Staff does not appear to possess the level of operational sophistication required to conduct complex maneuver warfare on the scale of commanders such as Napoleon, Jackson, or Manstein. Nevertheless, both of these challenges can be addressed.

It is true that Russian sensors would easily detect a large concentration of armor, artillery, and infantry. However, another form of concentration—if executed correctly—would remain undetectable until the attack was well underway, thereby delivering a decisive shock. Ukraine should therefore concentrate its most lethal and feared capability: its unmanned aircraft systems (UAS) and counter-UAS forces, including electronic warfare (EW) units.

Between thirty to fifty percent of Ukraine's drone and counter-drone systems should be secretly amassed and deployed along a narrow sector of the front. This mass would create an overwhelming drone strike force capable of destroying Russian counter-UAS defenses and local UAS forces. With Ukrainian UAS supremacy established over the battlefield, elite Ukrainian ground assault and engineer units, spearheaded by unmanned ground vehicles (UGVs), would advance under direct fire support from tens of thousands of drones, annihilating any remaining Russian resistance. Within a matter of days, Russian defensive lines would be breached to a depth of tens of kilometers and a width of ten to twenty kilometers. Maneuver units, supported

by the same concentrated drone force, could then exploit the breach, attacking Russian positions from the rear and capturing key transportation nodes and bridges further inland. Above all, such an operation would generate chaos and panic among Russian soldiers and commanders alike.

Ukraine's limited experience in conducting complex combined arms operations could be mitigated through the provision of high-quality advisory support. The Ukrainian General Staff and subordinate formations should be assisted by experienced advisors from willing NATO countries. At the same time, a new generation of Ukrainian commanders with deep expertise in drone warfare should be entrusted with the planning and execution of such an operation. On the operational level, the attack should come against an overextended flank of one of Russian advancing groups of forces; the farther Russian units advance into Ukraine, the more vulnerable they become to a drone-centered counteroffensive.

Ultimately, the success or failure of this approach would hinge on Ukraine's ability to plan and execute an unprecedented drone blitz as an integral component of a broader combined arms offensive aimed at defeating Russian advancing groups of forces in detail.

Using a Drone Blitz to Pierce the Enemy Kill Zone

A drone blitz is best understood by comparison with attacks by massed armored formations during the Second World War, most notably those employed by Germany during the Battle of France in 1940. At the time, the tank—then the most lethal weapon on the battlefield—was typically used in a dispersed infantry-support role. The Germans, however, concentrated tanks into large Panzer formations (divisions), thereby achieving decisive local superiority in firepower and maneuver, particularly when these formations were employed together as a unified strike force (for example, Panzergruppe Guderian in 1940).

The same logic applies to the drone, which has emerged as the most lethal and influential weapon of the Russia–Ukraine war and is likely to shape future conflicts of the twenty-first century. When employed en masse along a narrow sector of the front and designed to evade and suppress enemy counter-UAS (C-UAS) defenses, a concentrated drone force can overpower the enemy. Integrated into a combined arms operation with ground forces, such a drone mass can rupture the front line and enable subsequent maneuver warfare, rolling up enemy defenses once a breach has been achieved.

For illustrative purposes—and without disclosing actual production figures, which fluctuate over time—it is reasonable to assume that Ukrainian drone production and expenditure amount to approximately 200,000 UASs per month, predominantly disposable first-person-view (FPV) kamikaze drones. Russian production is comparable. Spread across a front line exceeding 1,200 kilometers, this density equates to an average daily drone expenditure of roughly fifty-five Ukrainian and Russian drones per ten kilometers of frontage.. If Ukraine were to assemble a force of 200,000 drones, with 50,000 committed to the initial massed drone attack on the first day of the counteroffensive (with perhaps 5,000 drone and EW operators involved), this would produce a crushing correlation of unmanned forces of approximately 50,000 Ukrainian drones to fifty-five Russian UASs over a ten-kilometre sector—a 900-to-1 advantage. Such overwhelming UAS superiority would suppress Russian C-UAS defenses, neutralize enemy electronic warfare assets, and enable the systematic destruction of targets to depths of up to 100 kilometers using FPV kamikaze drones, bomber UASs, and long-range fires.

In practical terms, Ukrainian drone and EW forces would dominate the near-surface and electromagnetic spectrum domains, hovering above every Russian trench, foxhole, and defensive position, delivering precise direct fires whenever enemy soldiers or vehicles exposed themselves. Predictably, Russian forces would seek refuge in underground fortifications. For this reason, any massed drone attack must be accompanied by a limited but deliberate ground assault. The primary purpose of this force would not be immediate defeat of the enemy, but rather to compel Russian troops to emerge from cover to fight. They would then be destroyed from the air by UASs. Waves of UGVs would attack the enemy on land, while under continuous cover of drones from above.

Once Russian forces begin maneuvering to counter the Ukrainian assault, tens of thousands of drones would strike the Russian reserves from above, preventing them from sealing off Ukraine's breakthrough. Ukrainian assault units, including engineer elements and UGVs, would then seize dominant terrain features—such as high ground—clear mines and obstacles, and continue advancing. Mobile UAS and UGV units would be positioned in captured Russian defensive areas to provide closer support for advancing Ukrainian ground forces.

While such a drone blitz would likely destroy the majority of Russian tactical drone control centers and launch sites, anti-tank guided missiles (ATGMs), artillery, and armored vehicles, Russian forces would probably retain some medium- and long-range strike capabilities, including aviation (glide bombs), medium-range drones, rocket artillery, and ballistic missiles. Ukrainian ground forces should therefore remain dispersed, armored, mechanized, and well-concealed .

Conducting the operation at night would further enhance Ukrainian advantages. Russian forces lack comprehensive night-fighting capabilities at scale across the entire front. Concentrating Ukraine's night-vision assets in support of such an operation, including drones equipped with infrared sensors, would therefore confer a significant advantage. Russian units would confront not only a massed drone threat but also a concentration of night-fighting capability.

Meticulous planning would be essential. Ukraine's 2023 counteroffensive exposed shortcomings in operational planning and command execution. Ideally, NATO countries would provide their most capable officers and specialists to work alongside Ukrainian drone experts in planning and executing the drone blitz as part of a combined arms operation. Operational details would, by necessity, be tightly compartmentalized, with deliberate deception measures employed to mislead Russian intelligence.

Finally, the technical and tactical aspects of the massed drone attack would require rigorous preparation, particularly with respect to harmonizing radio frequencies to prevent mutual interference when large numbers of drones are deployed in a narrow sector. Fiberoptic-controlled drones, satellite communications, and mesh networks can all play a role. Suppression of enemy C-UAS capabilities must be prioritized during the initial phase of the operation. Ukrainian electronic warfare radars—already in service—should be massed and integrated with drone units, detecting Russian EW emissions and cueing EW-resistant drones and artillery to neutralize those systems.

Ukrainian Drone Blitz as Part of a Broader Defeat in Detail Strategy

A massed drone attack should not be expected to produce miracles—no single system can do so. Nor would it fully compensate for deficiencies currently affecting the Ukrainian army, including

shortages of well-trained infantry, limitations in weapons and ammunition, command-and-control challenges, and other structural constraints. Once a drone blitz creates penetrations in the front line, Ukrainian forces would still require sufficient infantry and artillery to secure the flanks against anticipated Russian counterattacks. The deeper and more ambitious the penetration, the greater the demand for infantry strength, coordination, and sustainment.

That said, Ukraine already possesses a substantial drone force and several well-trained, well-equipped, and competently led ground assault brigades capable of conducting operations that could defeat one or potentially two Russian groups of forces in succession. Following such an operation, the Russian General Staff would likely concentrate most available reserves in the affected sector, halting the Ukrainian advance after perhaps one to two weeks of fighting. At that point, Ukrainian drone and elite ground assault units would need to disengage and withdraw to rear areas, where they could be replaced along the front line by regular infantry formations.

Because drone units are inherently mobile—owing to the small size and ease of transport of their systems—and elite ground assault units are limited in number, Ukraine could then initiate another drone blitz at an unexpected location. By repeating this process, Ukrainian forces could defeat Russian formations sequentially, retain operational initiative, and progressively stretch Russian reserves to the breaking point.

Over time, Russian advancing groups of forces could be defeated one by one, creating the conditions for a decisive operation for which the Russian General Staff would lack sufficient reserves to respond effectively. At that stage, a relatively small but highly capable Ukrainian force—centered on large drone formations and elite ground assault units—could trigger the collapse of Russian forces in Ukraine and enable the liberation of occupied territories, including Crimea.

Why Ukraine is Not Conducting Such a Drone Blitz

If a drone blitz strategy is so promising, why have the Ukrainians not implemented it? After conducting UAS operations on the front lines and providing advice on drone strategy and UAS employment to senior Ukrainian military and government leaders, I have reached a straightforward conclusion: institutional inertia.

Resistance to innovation of this kind is hardly unprecedented. In Germany during the 1930s, opposition to the employment of large armored formations was as strong as contemporary resistance in Ukraine to concentrated use of large drone formations. In 1932, after observing armored maneuvers, German Field Marshal Paul von Hindenburg remarked, “In war only what is simple can succeed… What I saw there was not simple.”[13]

In Ukraine, drones initially emerged as a bottom-up innovation, driven by soldiers and civilian enthusiasts who recognized the military potential of commercially available systems. As a grassroots initiative, drone warfare was for a long time neglected—or actively dismissed—by the upper echelons of the Ukrainian armed forces. Numerous Ukrainian generals, and even the Minister of Defense for much of the war, Oleksii Reznikov, ridiculed militarized commercial

[13] Ibid., 29.

drones such as the DJI Mavic 3 as mere "toys," failing to take them seriously until roughly the second half of 2023.[14]

This short-sightedness has cost the Ukrainian armed forces dearly. Nevertheless, Ukraine's senior leadership has at last begun to recognize drones as a central weapon system in the conduct of the war. What remains lacking, however, is an appreciation of the operational potential inherent in concentrating drone forces along a narrow sector of the front line to achieve decisive defensive or offensive effects. Should Ukrainian commanders come to understand that drones can be employed in much the same way that Napoleon, Jackson, or Manstein used concentrated mobile forces, victory over Russian forces could become a realistic prospect.

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[14] Reznikov, "'Mavics' Are 'Wedding Drones'; the Military Does Not Order Them," LB Live (in Ukrainian), YouTube video, accessed 15 January 2026, https://www.youtube.com/shorts/p20QpLQHneM?feature=share

The Drone War in Ukraine: Evolution, Adaptation, and the Emerging Logic of Industrialized Attrition

Treston Wheat and David Kirichenko

ABSTRACT: The Russo-Ukrainian War represents the first large-scale interstate conflict in which inexpensive, proliferated, and increasingly autonomous unmanned systems have reshaped warfare across tactical, operational, and industrial levels. Pre-2022 Western doctrine largely treated drones as precision strike and surveillance enablers operating in permissive environments, emphasizing endurance, connectivity, and centralized employment. The war in Ukraine instead demonstrates a different model: massed, continuously iterated, and widely distributed unmanned systems embedded in human–machine networks that impose persistent surveillance and rapid strike cycles across the battlefield. Drawing on battlefield reporting and emerging analytical literature, this article argues the conflict has produced a form of industrialized autonomous attrition in which adaptation speed, production capacity, and integration of civilian and military innovation ecosystems determine effectiveness more than platform sophistication. The article shows how drone proliferation created layered "kill zones," compressed technological life cycles, and forced both Russia and Ukraine into iterative cycles of innovation and countermeasure. Ukraine's decentralized development networks increased tactical responsiveness, while Russia pursued centralized scale, producing competing pathways to battlefield effectiveness. These dynamics complicate maneuver warfare without eliminating it. The emerging model suggests future conflicts will be shaped by battlefield pressures that reward adaptable organizational structures over exquisite platforms. The central implication for Western militaries will likely be that success will depend on building forces capable of continuously integrating new technologies across distance and echelon, balancing decentralized innovation with operational coherence in wars of automated attrition.

Introduction

The Russo-Ukrainian War has become the first large-scale conflict in which cheap, abundant, easily modified, and increasingly autonomous unmanned systems have reshaped the conduct of war. Rather than serving as niche tools for reconnaissance or precision strikes, drones have become the dominant feature of the battlefield, redefining survivability, maneuver, logistics, and even industrial mobilization. The war has functioned as both a showcase of emerging technologies and as a stress test for the assumptions that shaped Western drone doctrine in the two decades preceding 2022. It has revealed how autonomy, mass production, and rapid adaptation determine battlefield advantage far more than high-end platforms or long-cycle acquisition programs.

This article argues that Ukraine represents the world's first experience with industrialized autonomous attrition warfare with human–machine teams, decentralized innovation, and high-volume production cycles that displace traditional paradigms. To understand how transformative this is, it is necessary to assess the doctrine that dominated Western and international strategic thought prior to the invasion. That doctrine assumed a largely offensive, precision-strike role for drones, underestimated the importance of mass and attrition, and misunderstood the conditions under which autonomy and counter-autonomy evolve. The Russia-Ukraine conflict has fundamentally challenged prewar assumptions, revealing that unmanned systems have shifted from a supporting role to a defining element of contemporary military operations.

Drones also illustrate how the cost curve of warfare is shifting. Ukraine and Russia are locked in a race to develop cheap unmanned systems at scale and use them to overwhelm air defenses, clearing the way for more expensive systems, such as missiles, to deliver decisive strikes. However, drones are not a substitute; they complement and enhance conventional operations. Ukrainian drone pilots hunting Russian soldiers often prefer combining artillery and drones to maximize lethality and precision. Drones also struggle in poor weather, whereas artillery remains effective regardless of conditions. However, Ukraine is also attempting to evolve industrial attrition to not only drones, but also cheap cruise missiles.[1]

It is becoming apparent that Western nations, including the United States, have absorbed some of these lessons. During Operation Absolute Resolve in Venezuela, videos suggested the US employed long-range one-way attack drones, likely as part of a broader effort to suppress and dismantle air defenses before inserting helicopters.[2]

Pre-2022 Drone Warfare Doctrine: Assumptions and Failures

Before Russia's full-scale invasion of Ukraine in 2022, Western thinking on drone warfare reflected the operational contexts in which unmanned systems had been used for nearly two decades: counterterrorism campaigns, targeted killings, and low-intensity conflicts in permissive air environments. Core US doctrinal documents, such as the *Unmanned Aircraft Systems Flight Plan 2009–2047*, envisioned future unmanned systems as increasingly capable ISR (Intelligence, Surveillance, and Reconnaissance) and strike platforms, designed for long-endurance surveillance, precision targeting, and integration with joint air operations.[3] These documents emphasized improvements in persistence, sensor fusion, and connectivity, but they presupposed air superiority and did not contemplate the massed employment of disposable drones in high-intensity ground combat. The doctrine reflected the environments in which systems like the MQ-1, MQ-9, and RQ-4 had operated, characterized by permissive airspace, low attrition rates, and highly centralized mission planning.

Analytical work from this period reinforced the same assumptions. RAND's studies of Operation Inherent Resolve, for example, highlighted remotely piloted aircraft as high-demand enablers within a manned airpower enterprise rather than as independent instruments capable of reshaping ground maneuver or attrition dynamics.[4] Drone capabilities were understood primarily in terms of improving the efficiency of existing strike-and-surveillance functions rather than transforming the character of conventional war. As a result, doctrinal expectations centered on precision,

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[1] Jake Epstein, "Ukraine Wants to Build a Missile Market Like It Did with Drones, Top Tech Official Says." *Business Insider*, November 13, 2025. https://www.businessinsider.com/ukraine-wants-to-build-missile-market-like-with-drones-2025-11.

[2] Joseph Trevithick, "Did The US Use Kamikaze Drones To Strike Venezuela?" *The War Zone*, January 5, 2026. https://www.twz.com/air/u-s-kamikaze-drones-look-to-have-been-used-in-strikes-on-venezuela.

[3] US Air Force. "Unmanned Aircraft Systems Flight Plan 2009–2047". Washington, DC: Department of the Air Force, 2009. https://apps.dtic.mil/sti/pdfs/ADA505168.pdf.

[4] Becca Wasser, Stacie L. Pettyjohn, Jeffrey Martini, Alexandra T. Evans, Karl P. Mueller, Nathaniel Edenfield, Gabrielle Tarini, Ryan Haberman, and Jalen Zeman. The Air War Against the Islamic State: The Role of Airpower in Operation Inherent Resolve. Santa Monica, CA: RAND Corporation, February 5, 2021. https://www.rand.org/pubs/research_reports/RRA388-1.html.

endurance, and selective application of force, not on saturation, ubiquity, or industrial-scale employment.

Pre-2022 doctrinal framework within the American context (e.g., the DOD's framework and RAND's research) also underestimated the operational implications of low-cost, high-volume unmanned systems. The emphasis remained on technologically sophisticated designs rather than mass procurement of inexpensive platforms. Even after conflicts such as the 2020 Nagorno-Karabakh War, where loitering munitions and drones played a decisive role in shaping battlefield outcomes, debate in Western policy circles often focused on the role of specific high-end systems rather than the broader implications of cheap, proliferated capabilities. Analysts did note the battlefield impact of loitering munitions and persistent ISR, but they tended to treat these as important tactical evolutions rather than indicators of a coming shift toward industrialized drone attrition.[5] However, Western drone doctrine did not fundamentally change after the 2020 Nagorno-Karabakh War because analysts concluded the conflict demonstrated a situational advantage, not a universal transformation of warfare. Azerbaijan's success depended heavily on Armenian weaknesses, such as outdated Soviet-era air defenses, poor integration, limited electronic warfare capability, and lack of a layered defense network.[6] In effect, drones exploited a specific vulnerability rather than rendering traditional forces obsolete. One study noted that conventional elements such as artillery, armor, infantry maneuver, and combined-arms coordination remained decisive, and many casualties still came from those systems.[7] The war therefore reinforced an existing lesson in Western doctrine, that unmanned systems are enablers within a broader reconnaissance-strike complex rather than independent war-winning weapons.

The United States' experience in Iraq, Afghanistan, and Syria emphasized precision strikes against irregular forces, reinforcing the belief that drones were most useful in identifying and engaging discrete targets within a permissive or semi-permissive battlespace. Even the Nagorno-Karabakh War was often framed in Western analysis as a showcase for precision strikes using advanced systems, rather than as a warning of what pervasive ISR and low-cost loitering munitions could do to maneuver warfare.[8] The full implications of constant surveillance, rapid target acquisition, and cheap attrition weapons were therefore underappreciated. After decades of counterinsurgency, many analysts in the United States and other Western countries were slow to draw lessons from the Nagorno Karabakh War. The conflict was widely seen as a regional fight,

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[5] Ben Ho, *The Second Nagorno-Karabakh War: Takeaways for Singapore's Ground- Based Air Defense*, Journal of Indo-Pacific Affairs, 2021, https://media.defense.gov/2021/Aug/24/2002838133/-1/-1/1/Ho%20-%20Nagorno-Karabakh%20War.PDF.

[6] Ron Synovitz, "Technology, Tactics, And Turkish Advice Lead Azerbaijan To Victory In Nagorno-Karabakh," *Radio Free Europe/Radio Liberty*, November 13, 2020. https://www.rferl.org/a/technology-tactics-and-turkish-advice-lead-azerbaijan-to-victory-in-nagorno-karabakh/30949158.html.

[7] Antonio Calcara, Andrea Gilli, Mauro Gilli, Raffaele Marchetti, and Ivan Zaccagnini, "Why Drones Have Not Revolutionized War: The Enduring Hider-Finder Competition in Air Warfare," *International Security* 46, no. 4 (Spring 2022): 130–171. https://direct.mit.edu/isec/article/46/4/130/111172/Why-Drones-Have-Not-Revolutionized-War-The.

[8] Andrew Roe, "'Bugsplat' and Fallible Humans: The Hi-Tech US Drone Campaign over North-West Pakistan," *Air Power Review* 15, no. 2 (2012): 65-82. https://www.raf.mod.uk/what-we-do/centre-for-air-and-space-power-studies/aspr/apr-vol15-iss2-5-pdf/; Alexander Farrow, "Drone Warfare as a Military Instrument of Counterterrorism," *Air & Space Power Journal* 28, no. 4 (2016): 4-12. https://www.airuniversity.af.edu/Portals/10/ASPJ_Spanish/Journals/Volume-28_Issue-4/2016_4_02_farrow_s_eng.pdf.

and there was a belief that major military innovation was unlikely to come from smaller powers. As a result, Azerbaijan's effective use of Turkish Bayraktar TB2 drones was treated as a local success rather than a sign of broader change.[9]

Yet those same Turkish drones proved highly effective for Ukraine in the first weeks of Russia's full-scale invasion, striking Russian convoys and exposing weaknesses in conventional forces. Even then, it took several years of Ukraine scaling up drone production and eventually manufacturing millions per year for the West to begin taking these systems more seriously. The shift became clearer once Russia adapted as well, using fiber-optic drones and drawing on Chinese support to regain advantages on the battlefield.[10] The warning signs were visible in 2020. It simply took a larger war and sustained industrial scale for Western governments to recognize how much the cost curve of warfare had changed.

One area that pre-2022 doctrine accurately anticipated was the increasing importance of human–machine collaboration in modern warfare. For instance, *Unmanned Systems Integrated Roadmap 2017-2042* published by the US Department of Defense emphasizes that once interoperability is established, integrating human operators with autonomous systems will allow operations in which machines are treated as essential partners rather than mere tools. This recognition reflected a correct insight that the future battlefield would depend less on purely human or purely autonomous systems and more on tightly integrated human–machine teams, a trend borne out in recent drone-enabled operations.

The Russo-Ukrainian War: A Case of Drone Walls and Attrition

The war in Ukraine quickly became an incubator for the idea of that machines would be treated as essential partners. Moscow has been drawn into a battlespace defined by dense drone use, where cheap unmanned systems impose high costs on any attempted advance. Over the course of the war, drones have become central to Ukraine's defense and have reshaped long-standing assumptions about modern warfare. At sea, they have constrained Russian naval operations; on land, they have forced tanks, infantry, and logistics into a posture of constant caution.[11, 12] What began as a small-scale improvisation has matured into what will highly likely be a defining feature of modern conflict, even if its precise role over the remainder of the twenty first century cannot yet be fully predicted.

As US military aid to Kyiv declined in late 2023, Ukraine accelerated its shift toward affordable unmanned platforms that could substitute for dwindling artillery shells and traditional munitions. Frontline units were already using cheap drones for surveillance and strike missions, and

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[9] Paul Iddon, "Turkey Transfers Drone Warfare Capacity to Its Ally Azerbaijan." Eurasia Daily Monitor Volume 17, No. 144 (2020). Jamestown Foundation. https://jamestown.org/turkey-transfers-drone-warfare-capacity-to-its-ally-azerbaijan/.

[10] David Kirichenko, "How Russia and China Technologically Enable Authoritarian Partners." *The Strategist (Australian Strategic Policy Institute)*, October 9, 2025. https://www.aspistrategist.org.au/how-russia-and-china-technologically-enable-authoritarian-partners/.

[11] David Kirichenko, "Ukraine's Drone War Over the Black Sea Is Heating Up." *The National Interest*, October 14, 2025. https://nationalinterest.org/feature/ukraines-drone-war-over-the-black-sea-is-heating-up.

[12] David Kirichenko, "The Era of the Cautious Tank." *Center for European Policy Analysis (CEPA)*. https://cepa.org/article/the-era-of-the-cautious-tank/.

Ukrainian commanders embraced these tools as a necessary "poor man's solution."[13] This bottom-up adaptation evolved into a formidable "drone wall" spanning the front, supported by the mass production of millions of drones.[14] With movement under continuous aerial observation, the concentration of large Russian formations became prohibitively costly.[15] By 2025, some Ukrainian assessments suggested that drones accounted for roughly 80 percent of Russia's battlefield equipment losses, highlighting the degree to which unmanned systems now shape the attrition calculus.[16]

Robert Brovdi, known as "Magyar," commander of Ukraine's Unmanned Systems Forces, has likened this drone wall to a barrier "taller than the Great Wall of China."[17] On a visit to a NATO base, he noted that as few as four Ukrainian crews could strike a high-value site from ten kilometers away using commercially accessible systems.[18] The strategic signal is that drone technology is so cheap and widely available that any fixed position, however well defended, is vulnerable. This cost asymmetry is particularly consequential for smaller states, allowing them to inflict disproportionate losses on more heavily resourced adversaries.[19] Operation Spiderweb illustrated this dynamic vividly when Ukrainian teams used inexpensive drones hidden in wooden supply trucks to strike bomber bases deep inside Russia, causing damage far out of proportion to the systems used.[20]

Ukraine's naval drones have also reinforced this trend. Unmanned maritime platforms have disabled Russian ships, destroyed infrastructure, and even shot down helicopters and fighter aircraft worth tens of millions of dollars.[21] In one reported case, Magura-7 drones costing roughly $300,000 apiece downed two Russian Su-30 fighters valued around $50 million each,

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[13] David Kirichenko, "Russia's Running Out of Men and Money to Crack Ukraine's 'Drone Wall.'" *New York Post*, October 20, 2025. https://nypost.com/2025/10/20/opinion/russias-running-out-of-men-and-money-to-crack-ukraines-drone-wall/.
[14] David Kirichenko, "Ukraine's Drone Wall Is Europe's First Line of Defense Against Russia." *Atlantic Council*, July 2, 2025. https://www.atlanticcouncil.org/blogs/ukrainealert/ukraines-drone-wall-is-europes-first-line-of-defense-against-russia/.
[15] Sahaidachnyi Security Center, "Фортифікаційне обладнання рубежів оборони у 'війні дронів'." *Militarnyi*, November 12, 2025. https://militarnyi.com/uk/blogs/fortyfikatsijne-obladnannya-rubezhiv-oborony-u-vijni-droniv/.
[16] "Strike Drones Cause Nearly 80% of Battlefield Losses — Ukrainian Former Top Commander." *Espreso*, September 24, 2025. https://global.espreso.tv/strike-drones-cause-nearly-80-of-battlefield-losses-ukrainian-former-top-commander.
[17] Olena Mukhina, "Everyone Who Wanted to Fight Is Already Fighting: Top Ukrainian UAV Commander Prepares for War with Drones, Not People." *Euromaidan Press*, July 19, 2025. https://euromaidanpress.com/2025/07/19/everyone-who-wanted-to-fight-is-already-fighting-top-ukrainian-uav-commander-prepares-for-war-with-drones-not-people/.
[18] Oleksandr Yan, "Robert Brovdi Tells European Generals Their Countries Are Unprepared for Modern Warfare." *Militarnyi*, July 21, 2025. https://militarnyi.com/en/news/robert-brovdi-tells-european-generals-their-countries-are-unprepared-for-modern-warfare/.
[19] David Kirichenko, "Ukraine's Battlefield Drone Innovations Are Influencing Europe's Militaries." *Small Wars Journal*, June 11, 2025. https://smallwarsjournal.com/2025/06/11/ukraines-battlefield-drone-innovations/.
[20] David Kirichenko, "After Ukraine's Innovative Airbase Attacks, Nowhere in Russia Is Safe." *Atlantic Council – UkraineAlert*, June 3, 2025. https://www.atlanticcouncil.org/blogs/ukrainealert/after-ukraines-innovative-airbase-attacks-nowhere-in-russia-is-safe/.
[21] Reuters, "Ukraine Says Naval Drone Destroys Russian Helicopter for First Time." *Reuters*, December 31, 2024. https://www.reuters.com/world/europe/ukraine-says-naval-drone-destroys-russian-helicopter-first-time-2024-12-31/.

firing AIM-9 Sidewinder missiles from small, agile unmanned boats.[22] This represents one of the most dramatic reversals of cost-exchange ratios in the history of naval warfare.

However, Russia has adapted in its own way. Supported by Iranian and Chinese engineers, Moscow established domestic Shahed-production facilities and rapidly iterated on imported designs.[23] By 2024, Russia fielded increasingly sophisticated strike drones capable of overwhelming Ukrainian air defenses. During operations around Kursk, Russia became the first state to employ fiber-optic–guided drones at scale, systems largely immune to Ukrainian electronic warfare.[24] These platforms targeted Ukrainian logistics, contributing to the destruction of trucks and supply vehicles on both sides as attempts to reinforce forward positions came under consistent attack.[25]

The frontline soon transformed into a layered kill zone.[26] The act of reaching the battlefield became one of the most dangerous aspects of the war, as fiber-optic drones lay in ambush along approach routes, striking supply convoys the moment they appeared. Ukraine responded by increasing its use of ground robotics for resupply and casualty evacuation.[27] Meanwhile, Russia's Rubicon formation, a growing networked drone unit, extended its reach 10 to 20 kilometers behind Ukrainian lines, widening the depth of the kill zone and forcing Ukraine to reroute or delay resupply.[28] Ukrainian soldiers reported that Rubicon's tactics, first honed in Kursk, shaped Russian operations along the Donetsk front, and the unit's training mission is enabling Russia to expand drone formations from company to battalion scale.[29] In contested sectors like Pokrovsk, Russia reportedly enjoys a ten-to-one numerical advantage in drones.[30]

The divergence in approach between Russia and Ukraine reflects a deeper strategic contrast. The Kremlin has bet on mass and centralized production, seeking to overwhelm Ukraine's edge in innovation with sheer scale. Kyiv relies on a decentralized ecosystem of volunteers, startups, and

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[22] Daniel Kosoy, "Ukraine's Magura Sea Drone, the Last Thing a Russian Warship Wants to See." *United24 Media*, October 17, 2025. https://united24media.com/war-in-ukraine/ukraines-magura-sea-drone-the-last-thing-a-russian-warship-wants-to-see-12586.
[23] David Kirichenko, "Russia Is Closing in on Ukraine's Tech Advantage." *The National Interest*, May 31, 2025. https://nationalinterest.org/feature/russia-is-closing-ukraines-technological-advantages.
[24] David Kirichenko, "Fiber Optic Drones Could Play Decisive Role in Russia's Summer Offensive." *Atlantic Council*, May 29, 2025. https://www.atlanticcouncil.org/blogs/ukrainealert/fiber-optic-drones-could-play-decisive-role-in-russias-summer-offensive/.
[25] Oleksandr Miasyshchev, "The Unsexy Tech Ukraine Desperately Needs." *Counteroffensive.pro*, June 14, 2025. https://counteroffensive.pro/p/the-unsexy-tech-ukraine-desperately-needs-8591.
[26] Veronika Melkozerova, "Surviving the Killzone: How Drones Erased Frontline and Changed War in Ukraine." *POLITICO Europe*, November 18, 2025. https://www.politico.eu/article/surviving-the-killzone-how-drones-erased-frontline-and-changed-war-in-ukraine/
[27] David Kirichenko, "Mechanical Medics Transform Ukraine's Frontline." *CEPA* (Europe's Edge), August 26, 2025. https://cepa.org/article/mechanical-medics-transform-ukraines-frontline/.
[28] David Kirichenko, "Russia's Growing Rubicon Drone Force Is a Major Threat to Ukraine." *Forbes*, September 3, 2025. https://www.forbes.com/sites/davidkirichenko/2025/09/03/russias-growing-rubicon-drone-force-is-a-major-threat-to-ukraine/.
[29] Charles Clover and Fabrice Deprez, "The Elite Russian Unit Hunting Ukraine's Drone Warriors." *Financial Times*, November 13, 2025. https://www.ft.com/content/05ca82cc-2613-4144-a4e0-fd595246df8e.
[30] Ian Lovett and Nikita Nikolaienko, "Russian Forces in Ukraine Near First Major Conquest in More Than Two Years." *The Wall Street Journal*, November 6, 2025. https://www.wsj.com/world/russian-forces-in-ukraine-near-first-major-conquest-in-more-than-two-years-ee29de51.

workshops, enabling rapid adaptation but producing uneven standards and integration challenges.[31] Russia, in turn, appropriates the most successful Ukrainian innovations and reproduces them at industrial scale. The result is a relentless cycle of innovation and countermeasure. Early in the war, a new drone design might remain effective for seven months, but by 2023, the window had shrunk to five or six months. By 2024, to three or four, and by early 2025, breakthroughs were often rendered obsolete in as little as four to six weeks.[32] This accelerating cycle has few historical parallels and adds unpredictability to a conflict already defined by rapid technological exchange.[33]

However, despite this pace of innovation, drone advances have not fundamentally shifted the balance of power between the two sides. Michael Horowitz's adoption capacity theory helps explain why, as he argues that dual-use technologies that are relatively cheap and commercially derived tend to diffuse quickly, limiting the duration and scale of any advantage they provide.[34] Drones fit this pattern. Their low cost and dual use origins make them accessible, but also easy to copy. As a result, innovation yields short term tactical gains rather than enduring strategic superiority. Both sides are now racing to build cheap systems at scale, and each breakthrough quickly triggers countermeasures that blunt its effectiveness.[35]

Importantly, Ukrainian volunteers remain central to this adaptation ecosystem, creating feedback loops between frontline needs and engineering solutions. Within this framework, Vitaliy Goncharuk, former head of Ukraine's AI Committee, argues that innovation is only strategically meaningful when it can be scaled.[36] Moscow has internalized this lesson, recognizing that the economics of drone warfare favor mass production of cheap unmanned systems over expensive defensive platforms. As a result, Russia leverages its advantage of time. Essentially, the longer the conflict continues, the more data it gathers, the more lessons it absorbs, and the faster its production capacity expands. Moscow can now manufacture hundreds of drones per day, from expendable decoys to Shahed-type strike systems costing tens of thousands of dollars, creating strategic and economic dilemmas for Ukraine and its Western partners. This evolution has pushed Ukraine to develop its own arsenal of long-range capabilities, recognizing that Western systems will remain limited and conditional. Looking ahead, Kyiv is likely to continue building

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[31] Vitaliy Goncharuk, "Ukraine Isn't the Model for Winning the Innovation War." *War on the Rocks*, August 12, 2025. https://warontherocks.com/2025/08/ukraine-isnt-the-model-for-winning-the-innovation-war/.
[32] Howard Altman, "Critical Weapons Development Lessons from Ukraine Are Not Being Learned by the West." *The War Zone*, July 30, 2025. https://www.twz.com/news-features/critical-weapons-development-lessons-from-ukraine-are-not-being-learned-by-the-west.
[33] David Kirichenko, "Ukraine's Drone Revolution Is Forcing Europe to Rethink the Economics of War." *United24 Media*, October 30, 2025. https://united24media.com/war-in-ukraine/ukraines-drone-revolution-is-forcing-europe-to-rethink-the-economics-of-war-12911.
[34] Michael C. Horowitz, "Artificial Intelligence, International Competition, and the Balance of Power." Texas National Security Review 1, no. 3 (May 2018). https://repositories.lib.utexas.edu/items/21863960-3ffa-4899-98ff-d834df888a4c
[35] David Kirichenko, "A Desperate Race for Drone Defenses." Center for European Policy Analysis (CEPA), October 7, 2025. https://cepa.org/article/a-desperate-race-for-drone-defenses/
[36] David Kirichenko, "Ever-Faster Weapon Cycles: Innovation and Economics in the War in Ukraine." *The Strategist (ASPI)*, September 16, 2025. https://www.aspistrategist.org.au/ever-faster-weapon-cycles-innovation-and-economics-in-the-war-in-ukraine/.

more automated layers of drone defense, integrating increasingly autonomous platforms into its defensive lines.[37]

Comparative Assessments and the Broader Debate on Drone Warfare

The dynamics described above are increasingly reflected in a growing body of post-2022 analytical literature, which both affirms and complicates the picture emerging from Ukraine. Many external assessments converge with the above analysis on the transformative impact of drones, while also situating these developments within a broader debate about the character of contemporary warfare.[38]

Some analysts frame the drone war as a potential revolution in military affairs. Vincent Tourret at the French Institute of International Relations argues that mass drone warfare has altered the relationship between firepower, mobility, and survivability in ways that could rival historical turning points.[39] Others, such as Jan Joel Andersson and Sascha Simon,[40] and Jonathan P. Wong et al.,[41] portray current trends as an accelerated evolution in which drones amplify long-standing characteristics of modern conflict (precision, ISR dominance, dispersion, and attrition) rather than replacing combined-arms doctrine outright. Our analysis draws on elements of both perspectives. By emphasizing the drone wall, the expansion of kill zones, and the shrinking of technological life cycles, we suggest that the Russo-Ukrainian War has introduced unprecedented battlefield dynamics. At the same time, the centrality of artillery, logistics, and industrial capacity remains implicit throughout, aligning with those who see a reshaping, not a replacement, of conventional warfighting principles.

External assessments also reinforce the depiction of battlefield transparency and the dangers of movement under drone surveillance. Assorted scholars, such as Andersson, Simon, and Delaporte, describe a battlespace in which concealment and maneuver have become extraordinarily difficult.[42] Darragh McGovern highlights how drones have driven the adoption of

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[37] David Kirichenko, "The Next Evolution in Ukraine's Drone Defense." *The National Interest*, January 4, 2026. https://nationalinterest.org/feature/the-next-evolution-ukraines-drone-defense.
[38] Alex Vershinin, "The Attritional Art of War: Lessons from the Russian War on Ukraine," Royal United Services Institute (RUSI), March 18, 2024, https://www.rusi.org/explore-our-research/publications/commentary/attritional-art-war-lessons-russian-war-ukraine.
[39] Vincent Tourret, *Design, Destroy, Dominate: The Mass Drone Warfare as a Potential Military Revolution* (Paris: Institut français des relations internationales, June 2025), https://www.ifri.org/en/papers/design-destroy-dominate-mass-drone-warfare-potential-military-revolution.
[40] Jan Joel Andersson and Sascha Simon, *Minding the Drone Gap: Drone Warfare and the EU* (Paris: European Union Institute for Security Studies, October 11, 2024), https://www.iss.europa.eu/publications/briefs/minding-drone-gap-drone-warfare-and-eu.
[41] Jonathan P. Wong, Alexander C. Hou, Michael Miller, Katie A. Wilson, Emily Lathrop, Sydney Kessler, Sam Wallace, and Emily Yoder, *One Team, One Fight: Volume I, Insights on Human-Machine Integration for the US Army*, Research Report RRA-2764-1 (Santa Monica, CA: RAND Corporation, June 2, 2025), https://www.rand.org/pubs/research_reports/RRA2764-1.html.
[42] Murielle Delaporte, "Ukraine as a Crucible of Innovation: How War Reversed the Roles in Military Training (II of III)," *Eurosatory*, September 9, 2025, https://www.eurosatory.com/en/ukraine-as-a-crucible-of-innovation-how-war-reversed-the-roles-in-military-training-ii-of-iii/.

motorcycles and small vehicles to reduce exposure,[43] and Kevin Tebbe, Robert Pommeranz, and Gerd Scholl emphasize the return of classical fieldcraft as a necessary adaptation to near-constant ISR.[44] Our analysis aligns closely with this picture but adds depth by examining Russian tactical formations such as Rubicon, and the operational use of fiber-optic drones.

Industrial capacity is another area of strong convergence. Andersson and Simon, Wong et al., and Sean Harper[45] all emphasize that the war has become a contest of production systems, with Ukraine's rapid innovation pitted against Russia's centralized scale. Our analysis parallels these insights, but those authors assess that Russia's current advantage is conditional, not inherent. Both sides remain dependent on global supply chains, especially Chinese electronics, and the ability to convert industrial intent into battlefield effect remains uneven. The broader literature also stresses the limitations of counter-drone systems. Mohamed Zied Chaari's analysis of anti-drone technologies shows that expensive air defenses cannot keep pace with mass attacks, reinforcing the point about unfavorable cost-exchange ratios.[46] However, these studies also emphasize the importance of low-tech defenses like cages, nets, and multispectral camouflage, which, when combined with EW, form a layered response to drone threats.

Toward a Model of Autonomous Warfare and the Future of Military Innovation

The experience of Ukraine demonstrates that autonomous and semi-autonomous weapons do not function in war as many pre-2022 theorists assumed. Rather than appearing as fully independent systems executing pre-programmed missions, drones have evolved into adaptable, networked tools embedded within human-organized ecosystems of innovation, logistics, and tactical decision-making. Their battlefield role is neither purely autonomous nor purely controlled.[47] Instead, it follows a distinct operational logic that blends automation with human creativity and industrial capacity. From this conflict, a model emerges that clarifies how autonomous weapons are truly employed, and how they are likely to shape the next generation of warfare.[48]

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[43] Darragh McGovern, "Drones Drive Battlefield Motorcycle Tactical Shift," Royal United Services Institute (RUSI), August 21, 2025, https://www.rusi.org/explore-our-research/publications/commentary/drones-drive-battlefield-motorcycle-tactical-shift.

[44] Kevin Tebbe, Robert Pommeranz, and Gerd Scholl, "From An Engineering Perspective: Small Drones Affecting The Course Of Warfare," *The Defense Horizon Journal*, accessed November 24, 2025, https://tdhj.org/blog/post/small-drones-warfare/.

[45] Sean Harper, "Factory-to-Frontline Pipeline: How Ukraine's 2025 Drone Surge Is Reshaping the Battlefield," *WarQuants*, March 17, 2025, https://www.warquants.com/p/factory-to-frontline-pipeline.

[46] Mohamed Zied Chaari. 2025. "Analysis of the Power of Drones and Limitations of the Anti-Drone Solutions on the Russian-Ukrainian Battlefield." *Security and Defence Quarterly* 51 (3): 38–73. https://securityanddefence.pl/Analysis-of-the-power-of-drones-and-limitations-of-the-anti-drone-solutions-on-the,208347,0,2.html

[47] David Kirichenko, "Ukraine's AI Drones Hunt the Enemy." *Center for European Policy Analysis (CEPA)*, October 3, 2025. https://cepa.org/article/ukraines-ai-drones-hunt-the-enemy/.

[48] David Kirichenko, "The Rush for AI-Enabled Drones on Ukrainian Battlefields." *Lawfare*, December 5, 2024. https://www.lawfaremedia.org/article/the-rush-for-ai-enabled-drones-on-ukrainian-battlefields.

1. Autonomous Systems Amplifies Existing Tactical Realities Rather Than Replacing Them

Ukraine shows that autonomous systems do not substitute for combined-arms warfare but transform the conditions under which it operates. Drones impose near-total transparency, compress decision-making timelines, and erode the survivability of traditional platforms, yet but they remain dependent on artillery, logistics, communications, and infantry maneuver. The lesson is that autonomy accelerates war, but it does not simplify it. Future conflicts will likely be dominated by human-machine teams that multiply the speed and lethality of familiar instruments of war.

2. The Real Power Lies in Distributed Human–Machine Networks

The most successful drone applications in Ukraine emerged from decentralized, interoperable ecosystems in which operators, engineers, software developers, and logisticians formed continuous feedback loops. These innovation networks allow forces to iterate designs in weeks rather than years and to tailor drones to hyper-local tactical needs. This suggests that future military advantage will depend less on possessing the single most advanced autonomous platform and more on maintaining a fast, adaptable, and resilient system-of-systems that links production, experimentation, and combat employment. Importantly, the Ukrainian case does not imply that distributed human–machine networks require geographic co-location of industry and frontline forces. Rather, it demonstrates the operational necessity of shortening the feedback cycle between battlefield observation and technical modification. For expeditionary Western militaries, the equivalent mechanism will be architecture. Forward repair cells, deployable fabrication and software teams, modular open-systems hardware, and continuous reach-back to stateside production lines can replicate the same innovation loop across distance. Instead of shipping finished platforms, forces would deploy adaptable baselines and update them through rapid software iteration, component swaps, and small-batch manufacturing supported by digital engineering and secure logistics pipelines. The relevant shift is therefore institutional rather than geographic as success depends on whether a military organizes acquisition, sustainment, and deployment as a continuous operational process rather than as sequential peacetime phases. Ukraine showed a compression of the cycle through proximity, but expeditionary forces will likely need to compress it through design.

3. Cost Asymmetry, Not Technological Sophistication, Determines Battlefield Impact

The Ukraine war decisively demonstrates that cheap autonomous systems—rather than exquisite, highly advanced ones—have among the greatest operational effects. The primary value of drones lies in the ability to generate persistent surveillance, continuous attrition, multi-layered strike pressure, logistical interdiction, and tactical paralysis at a scale that expensive platforms cannot match. This dynamic suggests that future warfare will be defined by mass, attrition, and automation, not by a handful of ultra-sophisticated autonomous systems. Industrial capacity will matter more than tactical brilliance, production lines will matter more than cutting-edge research, and quantity will challenge quality in ways reminiscent of earlier industrial wars, now magnified through automation. At the same time, these trends are most visible in long duration wars of attrition. It would be premature to assume that all future conflicts will follow this pattern. Short, decisive campaigns or conflicts involving overwhelming conventional superiority may still

reward high end systems and rapid maneuver. The Russo-Ukrainian War is only the first major case of drones in a prolonged interstate war.

4. Countermeasures Drive the Evolution of Autonomy Faster Than Designers Do

The Ukraine conflict reveals a conspicuous pattern in which drones evolve primarily in response to enemy countermeasures, not independent technological breakthroughs. Electronic warfare spurred the development of fiber-optic drones. Air defense pressure encouraged ultra-low flight profiles, kamikaze First-Person-View (FPV) drones, and naval drones with organic missile capability. Attrition at the front accelerated rapid prototyping and decentralized manufacturing. Autonomy, therefore, evolves according to the logic of the battlefield, not according to laboratory ideal types. Under this model, autonomy is less a static capability and more a dynamic, co-evolving relationship between offense and defense.

5. Industrialized, Automated Attrition Will Define the Next Era of War

The most important strategic lesson emerging from Ukraine is that the impact of autonomy is inseparable from mass production under conditions of persistent surveillance and dense strike capability. Autonomous weapons become decisive because they can be built cheaply, iterated rapidly, and deployed in overwhelming volume, making exposure progressively more costly than expenditure. As states adopt automation throughout the production and logistics chain from "factory-to-frontline" pipelines to AI-enabled planning and distribution, campaigns conducted against defended and continuously observed forces will tend to gravitate toward sustained contests of material depletion regardless of initial operational intent. In such environments, human decision-making remains essential but is increasingly mediated through automated systems that determine tempo, targeting opportunities, and survivability.

Implications for Innovation and Transformation

These dynamics point to several far-reaching implications for how militaries will innovate and transform in the years ahead. The center of gravity in modernization will shift away from acquiring fully finished, high-end platforms and toward building adaptive ecosystems capable of absorbing rapid technological change. Future militaries will require software development hubs, battlefield repair and modification workshops, and training systems that support tactical autonomy while preserving operational integration across formations. Evidence from Ukraine suggests that decentralized innovation can enhance small-unit effectiveness but also creates coordination challenges for multi-echelon and joint operations unless data, targeting, and communications architectures are standardized.[49] The emphasis will likely need to rest on integrating new technologies rapidly within a coherent command framework rather than on

[49] Jack Watling and Nick Reynolds, *Stormbreak: Fighting Through Russian Defences in Ukraine's 2023 Offensive*, Royal United Services Institute (RUSI), September 4, 2023, https://www.rusi.org/explore-our-research/publications/special-resources/stormbreak-fighting-through-russian-defences-ukraines-2023-offensive.

acquiring a fixed set of capabilities, which is likely why Ukraine needed to create a command group to handle the unmanned forces coordination.[50]

In addition, Western forces will need to reexamine long-held assumptions about survivability, basing, logistics, and mass. Autonomous systems favor dispersed postures and resilient supply chains, as well as rapid-repair capacity and a far greater tolerance for attrition than pre-2022 doctrine anticipated. These shifts suggest that large, static bases and highly centralized supply networks will become progressively less viable in future conflicts. Command structures will also need to evolve toward more distributed forms of control, enabling local units to experiment, improvise, and exploit rapid technological cycles without waiting for top-down approval. Tactical autonomy will increasingly determine an operational unit's ability to adapt and survive.

Crucially, this rise of autonomy will not diminish the role of human judgment. Instead, the human element will be elevated. As automation accelerates decision cycles and increases the pace of battlefield change, success will depend on the creativity, adaptability, and intuition of human operators who can integrate machines into coherent and continuously evolving systems. The decisive advantage in future conflict will rest with the side that best combines human decision-making with scalable, flexible, and resilient technological ecosystems.

The Emerging Model of Autonomous Conflict

The lessons offered in this article reveal a new model of autonomous warfare characterized by pervasive unmanned systems across all domains, rapid countermeasure-driven evolution, mass production and automated attrition, distributed human–machine teams, and compressed decision cycles. This model relies on decentralized innovation loops and exposes the increasing fragility of large, expensive platforms that cannot adapt quickly enough to survive. Ukraine has shown that autonomy does not replace existing paradigms, but it does offer tools to reshape them from within, accelerating the tempo of conflict and transforming both the opportunities available to militaries and the vulnerabilities they must now manage. As states internalize these lessons, future wars will be defined by the capacity to iterate, scale, and integrate autonomy faster than an adversary.

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[50] Kateryna Hodunova, "Ukraine Unites Unmanned Systems Forces with Top 'Drone Line' Units Under New Command Group," *The Kyiv Independent*, June 20, 2025. https://kyivindependent.com/ukraine-creates-new-grouping-of-unmanned-systems-forces/.

Autonomy as an Operational Necessity: How Autonomous AI Will Protect Civilian and Military Space Infrastructure

Alexander Anderson

ABSTRACT: Space infrastructure has become a critical foundation for both civilian society and modern military operations, yet it faces growing threats from counterspace capabilities, orbital debris, and cyber vulnerabilities. This article argues that autonomous artificial intelligence (AI) is an operational necessity for protecting civilian and military space assets in an increasingly contested orbital environment. The accelerating tempo of space conflict and the vast volume of orbital data exceed the capacity of traditional human-centered decision processes. Autonomous AI systems can enhance space situational awareness by rapidly detecting, tracking, and assessing threats while enabling faster collision avoidance and defensive responses. At the same time, the integration of autonomy raises significant legal, ethical, and strategic challenges, particularly regarding compliance with international humanitarian law, cybersecurity vulnerabilities, and escalation risks. Effective implementation, therefore, requires carefully bounded autonomy, federated data-sharing networks, and explainable AI systems integrated within clear doctrinal and regulatory frameworks. When properly governed, autonomous AI offers a critical capability for safeguarding space infrastructure and maintaining stability in the increasingly congested and contested space domain.

Introduction

"The access to and use of space is of vital national interest"[1] is a statement that applies to the United States, its allies, and adversaries.[2] For these nations, military, scientific, and commercial activities in space are increasingly interlinked.[3] Even ostensibly civilian space systems, such as commercial constellations and scientific satellites, can provide critical support for military operations, from communications and navigation to intelligence gathering, making their protection a matter of national security. Two key examples exist: the militarization of commercial constellations in the war in Ukraine[4] and the importance of dual-use systems to the development of military systems in space.[5]

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[1] United States Space Force, "Space Threat Fact Sheet," United States Space Force, 2025, https://www.spaceforce.mil/About-Us/Fact-Sheets/Fact-Sheet-Display/Article/4297159/space-threat-fact-sheet/.
[2] US Department of Defense, "Military and Security Developments Involving the People's Republic of China 2024," US DOD, 2024, https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF?.
[3] Kevin Pollpeter et al., "China's Space Narrative: Examining the Portrayal of the US-China Space Relationship in Chinese Sources and Its Implications for the United States," Dtic.mil, 2020, https://apps.dtic.mil/sti/html/trecms/AD1145676/.
[4] Brian Weeden, "Starlink Militarization: Challenges and Responses to Space Intelligence and Information Security - Interpret: China," Interpret: China, August 29, 2024, https://interpret.csis.org/translations/starlink-militarization-challenges-and-responses-to-space-intelligence-and-information-security/.
[5] US Department of Defense, "Military and Security Developments Involving the People's Republic of China 2024," US DOD, 2024, https://media.defense.gov/2024/Dec/18/2003615520/-1/-1/0/MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA-2024.PDF?.

Space infrastructure is increasingly critical for both civilian life and military operations. Satellites and their ground segments form a global socio-economic backbone that adversaries can contest through jamming, cyber intrusions, co-orbital maneuvers, or direct-ascent anti-satellite (ASAT) attacks.

This article argues that autonomy, narrowly bounded, doctrinally integrated, and ethically constrained, is an operational necessity for defending both civilian and military space infrastructure. Autonomous systems can detect, adjudicate, and act on high-tempo space threats in ways human-only chains cannot, but they must be embedded within carefully defined command, legal, and escalation frameworks.

Analysis

The ubiquitous nature of space assets in military contexts from nuclear early warning to GPS makes them attractive targets.

Direct threats to space assets can manifest in multiple ways:[6]

- Counter-ISR
- Electronic Warfare (EW)
- Cyber Warfare
- Jamming
- DEW (Directed-Energy Weapons), Orbital and Direct Ascent ASAT

Adversaries have increasingly shown the ability to deploy counterspace measures to either deter and counter US military capabilities or to support their own warfighting abilities.[7] In order to defend space assets against such kinetic threats, there is a demand for increased space domain awareness (SDA). The UK Government defines SDA as "understanding of the congested, complex, critical and contested space domain is achieved through space surveillance and tracking (SST) and space situational awareness (SSA)."[8] SDA is a daily necessity against deliberate counterspace operations or debris. The latter is a risk in peacetime as well. The Russian test of an ASAT weapon in 2021 caused thousands of pieces of space debris.[9] A 2007 Chinese ASAT weapons test caused 35,000 pieces of debris larger than 1cm. A single piece of

[6] UK Ministry of Defence, "Defence Space Strategy: Operationalising the Space Domain," 2022, https://assets.publishing.service.gov.uk/media/61f8fae7d3bf7f78e0ff669b/20220120-UK_Defence_Space_Strategy_Feb_22.pdf p.10.
[7] United States Space Force, "Space Threat Fact Sheet," United States Space Force, 2025, https://www.spaceforce.mil/About-Us/Fact-Sheets/Fact-Sheet-Display/Article/4297159/space-threat-fact-sheet/.
[8] Development, Concepts and Doctrine Centre, UK Ministry of Defense, "Joint Doctrine Publication 0-40 UK Space Power," September 2022, https://assets.publishing.service.gov.uk/media/653a5261e6c968000daa9b8a/JDP_0_40_UK_Space_Power_web.pdf.
[9] Cerutti-Maori et al., "Observation of COSMOS-1408 Debris Cloud with the Tracking and Imaging Radar (TIRA) System," European Space Agency, esa.int, 2023, https://conference.sdo.esoc.esa.int/proceedings/neosst2/paper/38.

debris of such size can disrupt and damage satellites.[10] The debris from one such satellite could theoretically threaten thousands of satellites in nearby orbits. Even a near-miss can cause economic costs, as satellites need to maneuver to avoid debris, if miss distances are below acceptable thresholds.[11]. Beyond economic costs, these near-misses could directly impact military readiness, as satellites supporting missile warning, reconnaissance, or communications may be forced to perform unscheduled maneuvers, reducing their availability and reliability for defense operations.

Despite the vitality of SDA in everyday operations of space assets, US and allied SDA is lagging behind the rapid growth in dangers in the space environment.[12] Its current approach is reminiscent of a space as benign environment rather than an active warfighting one. Shaw and Kirkpatrick advocate for the fusion of data from traditional and commercial sources as well as enable continuous tracking and real-time fire-control updates.[13]

But how does this imply that the role of autonomous artificial intelligence (AI) is a necessity in space operations?

Autonomous AI is an operational necessity, because of two main features of modern space combat. Firstly, the tempo and time compression limits to respond to threats. Direct-Ascent ASATs (surface-launched satellite weapons) provide a window of 6 hours (Geosynchronous Orbit - GEO) to 6 minutes (Low Earth Orbit - LEO).[14] However, prepositioning co-orbital ASATs would drastically reduce that window to "comparatively instantaneous."[15]

The second feature is the quantity of data that needs to be processed. In 2016, the orbital debris environment was estimated to include ~34,000 objects > 10 cm, ~900,000 objects 1–10 cm, and ~128 million objects between 1 mm and 1 cm.[16] However, space is not static. A more-recent

[10] Union of Concerned Scientists, "Debris in Brief," Union of Concerned Scientists, 2025, https://www.ucs.org/resources/space-debris-anti-satellite-weapons.
[11] Nicholas L. Johnson et al., "The Characteristics and Consequences of the Break-up of the Fengyun-1C Spacecraft," *Acta Astronautica* 63, no. 1 (July 1, 2008): https://ntrs.nasa.gov/api/citations/20070007324/downloads/20070007324.pdf p. 7
[12] John Shaw and Sean Kirkpatrick, "Future Space Domain Awareness Needs for National Security Space," csis.org, 2024, https://www.csis.org/analysis/future-space-domain-awareness-needs-national-security-space.
[13] Ibid.
[14] Phillip Swarts, "Space Wars: The Air Force Awakens," Air Force Times, February 15, 2016, https://www.airforcetimes.com/news/your-air-force/2016/02/15/space-wars-the-air-force-awakens/.
[15] Michael B. Cerny et al., "Countering Co-Orbital ASATs: Warning Zones in GEO as a Lawful Trigger for Self-Defense," 2020, p. 5-6 https://npolicy.org/article_file/Countering_Co-Orbital_ASATs-_Warning_Zones_in_GEO_as_a_Lawful_Trigger_for_Self-Defense_.pdf.
[16] IADC Working Group 2 , "Research on Space Debris, Safety of Space Objects with Nuclear Power Sources on Board and Problems Relating to Their Collision with Space Debris," *Committee on the Peaceful Uses of Outer Space Scientific and Technical Subcommittee Sixtieth Session*, January 2023, https://doi.org/10.1016/0265-9646(85)90050-5.

estimate (2024) puts the > 10 cm population at ~50,000; the ≥1 cm population at over 1.2 million, and the 1 mm–1 cm population at ~140 million.[17]

Objects in the 1–10 cm size range are widely regarded as able to cause 'crippling or mission-ending' damage if they collide with a satellite, and even sub-cm debris can damage subsystems or degrade performance.

Because only the larger objects are routinely catalogued/tracked, the vast majority of smaller but still hazardous debris is not individually monitored - creating a large "invisible" population. This includes debris described as "lethal."[18]

Given the size, diversity, and uncertain orbital/fragmentation status of debris, especially after bursts of fragmentation (e.g., collisions, explosions, ASAT events), the volume and complexity of data needed for real-time conjunction analysis and risk assessment is enormous, which motivates the use of machine-learning or AI-based orbit estimation and debris-tracking approaches.[19]

Autonomous AI can enhance space situational awareness (SSA), including detection, tracking, classification, and decision-making, which are critical for both civilian and military space infrastructure. AI has unique advantages in transfer learning (allowing AI to apply lessons from one scenario to another) lifelong learning, and multi-agent approaches (for example, enabling coordinated responses across satellites) that allow rapid response to complex, dynamic space problems[20] The sustained increase in launch traffic, deployment of large constellations, and the ever-growing population of space debris are placing significant strain on Space Situational Awareness (SSA) and collision avoidance (CA) operations. Currently, CA procedures involve high levels of human interaction and cross-entity coordination. Space surveillance and tracking are normally performed by organizations separate from the satellite operator, and even if automated initial screening is performed, final decisions on potentially dangerous close approaches remain human-dependent.[21] For instance, the potential conjunction between ESA's *Aeolus* and SpaceX's Starlink 44 satellites on 2 September 2020 demonstrated the complexities of manual coordination.

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[17] European Space Agency, "Space Environment Statistics," sdup.esoc.esa.int, March 31, 2025, https://sdup.esoc.esa.int/discosweb/statistics/.
[18] Mark A Foster, "Practical System to Remove Lethal Untracked Orbital Debris," *Journal of Aerospace Information Systems* 19, no. 10 (May 9, 2022), https://doi.org/10.2514/1.I010985.
[19] Francisco Caldas and Cláudia Soares, "Machine Learning in Orbit Estimation: A Survey," *ArXiv (Cornell University)*, April 7, 2024, https://doi.org/10.48550/arxiv.2207.08993.
[20] Pengrong Hou et al., "Research Advancements in Artificial Intelligence for Space Situational Awareness," in 13th International Conference on Information Science and Technology (ICIST) (13th International Conference on Information Science and Technology (ICIST), IEEE, 2023), 568–77, https://doi.org/10.1109/icist59754.2023.10366521
[21] Juan Gonzalo and Camilla Colombo, "On-Board Collision Avoidance Applications Based on Machine Learning and Analytical Methods," ESA, 2021, https://conference.sdo.esoc.esa.int/proceedings/sdc8/paper/293/SDC8-paper293.pdf.

To address these challenges, initiatives like ESA's Collision Risk Estimation and Automated Mitigation (CREAM) have explored on-board CA capabilities that include autonomous decision-making without reliance on the ground segment.[22] However, key technological advances remain necessary to enable reliable autonomy in operational space environments.

Autonomous systems such as the Manoeuvre Intelligence for Space Safety (MISS) software tool demonstrate the potential for integrating analytical, semi-analytical, and machine learning-based decision-making for collision avoidance.[23] MISS separates the optimal maneuver design from the decision-making process: the former uses highly efficient semi-analytical models suitable for on-board execution, while the latter leverages machine learning algorithms trained on synthetic datasets to compensate for limited historical data. The proposed approach also assumes federated SSA services, providing spacecraft with data about nearby objects in near-real time. Federated SSA systems would use a decentralized collaborative network of multiple inputs (sensors, satellites) to share and compile data. When fully implemented, this system could dramatically reduce reaction times and improve decision quality, overcoming the latency limitations of human-in-the-loop processes.

AI-enabled SSA offers additional advantages beyond collision avoidance. Its ability to perform transfer learning, lifelong learning, and multi-agent reasoning allows for adaptive responses in dynamic orbital environments.[24] Distributed machine learning and knowledge graph integration provide a framework to synthesize heterogeneous sensor data, improving both detection and predictive capabilities. This is particularly critical given the rapid proliferation of LEO satellites, CubeSats, and large constellations, as well as the stochastic and non-linear behavior of debris populations[25]

Economic imperatives also reinforce the need for AI integration. The space industry is projected to reach $1 trillion by 2040, with the SSA market alone contributing $1.5 billion[26] Satellite operators already face tangible costs from orbital debris, including maneuver fuel, service interruptions, and insurance premiums. From a military perspective, the same risks to commercial assets translate into vulnerabilities for critical support infrastructure, as the armed forces rely increasingly on privately-operated satellite systems for operational effectiveness. In the absence of scalable autonomous systems, these costs, and their associated risks to national security, are likely to grow exponentially.

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[22] Ibid.
[23] Ibid.
[24] Pengrong Hou et al., "Research Advancements in Artificial Intelligence for Space Situational Awareness," in 13th International Conference on Information Science and Technology (ICIST), IEEE, 2023, 568–77, https://doi.org/10.1109/icist59754.2023.10366521
[25] Alinda K Mashiku, Lauri K Newman, and Dolan E Highsmith, "NASA Conjunction Assessment Risk Analysis (CARA) Compendium for Artificial Intelligence and Machine Learning for Satellite Collision Avoidance," NASA.gov, September 16, 2025, https://ntrs.nasa.gov/citations/20250008251.
[26] Chiara Manfletti, Marta Brito Guimarães, and Cláudia Soares, "AI for Space Traffic Management," Journal of Space Safety Engineering 10, no. 4 (2023), https://doi.org/10.1016/j.jsse.2023.08.007.

The integration of autonomous AI in space operations raises profound legal, ethical, and strategic challenges. International Humanitarian Law (IHL) principles, particularly distinction and proportionality, must guide the design and deployment of autonomous space systems[27] While quantitative measures may allow AI to discriminate between civilian and military targets, proportionality assessments remain inherently qualitative, requiring careful oversight and doctrinal guidance[28].

Autonomous weapons systems (AWS) research suggests that fully autonomous systems could lower the political and human cost of military operations, potentially destabilizing strategic balances by encouraging low-intensity conflicts or accelerated escalation[29]. Such risks highlight the necessity of transparency, regulatory frameworks, and ethical constraints in developing autonomous SSA and CA systems.

Alongside AI-specific risks, satellites also face significant vulnerabilities to cyber and supply chain threats. These risks could be exacerbated in autonomous or semi-autonomous satellites. For example, reliance on commercial off-the-shelf (COTS) components expands the attack surface (how an asset could be attacked), as auxiliary hardware often has privileged access to telemetry, system calls, and software buses yet lacks robust assurance, making them potential vectors for malware such as SpyChain, which can exfiltrate data, disrupt operations, and evade monitoring.[30] Satellites and space infrastructure are thus susceptible to both conventional cyberattacks (such as data theft or corruption) and sector-specific threats, including cyber-jamming, spoofing, and hijacking, with implications for critical infrastructure such as communications, energy, transport, and financial systems[31] To address these risks, industry-led, multi-stakeholder approaches should emphasize secure design, defense-in-depth, supply chain verification, redundancy, graceful degradation, and continuous monitoring, while fostering collaboration between manufacturers, operators, regulators, and international partners.[32] [33] These efforts should be accompanied by stronger regulation of the civilian satellite sector, including the enforcement of minimum encryption and cybersecurity standards.

Existing research emphasizes that autonomy in civilian space operations provides a reference for military applications. Unmanned vehicles have proven highly effective in complex, hazardous

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[27] Markus Wagner, "Taking Humans out of the Loop: Implications for International Humanitarian Law," Journal of Law, Information & Science 21, no. 2 (2011), https://doi.org/10.5778/jlis.2011.21.wagner.1.
[28] Ibid.
[29] Riley Simmons-Edler et al., "AI-Powered Autonomous Weapons Risk Geopolitical Instability and Threaten AI Research," arxiv.org, May 3, 2024, https://arxiv.org/html/2405.01859v1.
[30] Jack Vanlyssel et al., "SpyChain: Multi-Vector Supply Chain Attacks on Small Satellite Systems," *arXiv.org*, 2025, https://arxiv.org/abs/2510.06535.
[31] David Livingstone and Patricia Lewis, "Space, the Final Frontier for Cybersecurity?," Chatham House – International Affairs Think Tank, October 23, 2025, https://www.chathamhouse.org/2016/09/space-final-frontier-cybersecurity-0/.
[32] PricewaterhouseCoopers, "Satellite Cybersecurity | PwC," PwC, 2025, https://www.pwc.com/gx/en/issues/cybersecurity/satellite-cybersecurity.html.
[33] Rachel McAmis et al., "Unencrypted Flying Objects: Security Lessons from University Small Satellite Developers and Their Code," *arXiv* (Cornell University), May 14, 2025, https://doi.org/10.48550/arxiv.2505.09038

environments and civilian AI-driven SSA programs could provide templates for safe, ethical, and reliable operational design. Nonetheless, the ethical and legal challenges are amplified in military contexts, where errors or misjudgments can have strategic and political consequences.

Despite the clear operational advantages, autonomous AI in space remains subject to significant challenges:

1. Data Scarcity and Quality – High-quality training data for machine learning algorithms is often limited, necessitating synthetic dataset generation for orbit prediction and CA modeling[34]
2. Complex Orbital Dynamics – Non-linear orbital mechanics, debris fragmentation events, and multi-satellite interactions require robust algorithms capable of rapid adaptation[35]
3. Interoperability and Federation – Autonomous SSA depends on federated networks of sensors and data providers, which introduces coordination, standardization, and trust issues between governmental and commercial actors[36]
4. Explainability and Human Oversight – AI/ML tools must provide explainable outputs for operators and decision-makers to ensure accountability and compliance with legal and ethical standards[37]
5. Strategic Risks – Rapid AI deployment can accelerate an arms race in space, creating potential instability between peer and non-peer actors.[38] Moreover, it could lead to the use of AI more directly in spaceborne weapons systems.

Conclusion

Autonomous AI is an operational necessity for the protection of both civilian and military space infrastructure. It is indispensable for managing the sheer volume of data, high operational tempo, and rapid response requirements inherent to modern space operations. AI-driven SSA and collision avoidance can serve as force multipliers, enhancing situational awareness and response time while mitigating risks posed by debris, co-orbital threats, and direct-ascent ASATs.

However, the adoption of autonomous systems must be tempered by legal, ethical, and doctrinal safeguards to prevent destabilization and ensure compliance with IHL. Moving forward,

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[34] Juan Gonzalo and Camilla Colombo, "On-Board Collision Avoidance Applications Based on Machine Learning and Analytical Methods," ESA, 2021, https://conference.sdo.esoc.esa.int/proceedings/sdc8/paper/293/SDC8-paper293.pdf.

[35] Pengrong Hou et al., "Research Advancements in Artificial Intelligence for Space Situational Awareness," in 13th International Conference on Information Science and Technology (ICIST), IEEE, 2023, 568–77, https://doi.org/10.1109/icist59754.2023.10366521.

[36] Chiara Manfletti, Marta Brito Guimarães, and Cláudia Soares, "AI for Space Traffic Management," Journal of Space Safety Engineering 10, no. 4 (2023), https://doi.org/10.1016/j.jsse.2023.08.007.

[37] Alinda K Mashiku, Lauri K Newman, and Dolan E Highsmith, "NASA Conjunction Assessment Risk Analysis (CARA) Compendium for Artificial Intelligence and Machine Learning for Satellite Collision Avoidance," NASA.gov, September 16, 2025, https://ntrs.nasa.gov/citations/20250008251.

[38] Riley Simmons-Edler et al., "AI-Powered Autonomous Weapons Risk Geopolitical Instability and Threaten AI Research," arxiv.org, May 3, 2024, https://arxiv.org/html/2405.01859v1.

federated SSA networks, explainable AI, and rigorous testing will be critical to integrating autonomous systems into national and allied space operations. Near-future AI capabilities offer a compelling opportunity to protect strategic space assets, but only within a framework that balances operational necessity with international law, ethics, and global security considerations.

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AI in Fires and C2: Humans in the Kill Chain

Christine Hogestyn

ABSTRACT: Advances in artificial intelligence are transforming command and control and accelerating the fires process on the modern battlefield. Here, the author examines how emerging systems such as the Army's Next Generation Command and Control (NGC2) architecture and the Artillery Execution Suite (AXS) are dramatically reducing technical delays in fire direction and targeting. As these systems compress the sensor-to-shooter timeline, the primary bottleneck increasingly shifts from computation to human approval processes embedded within the traditional kill chain. Drawing lessons from the war in Ukraine and broader trends in AI-enabled warfare, the article argues that the Army must reconsider how humans and machines collaborate in fires-related decision-making. Rather than removing human oversight, the author proposes an AI-assisted model in which automation processes targeting data, prioritizes fires, and recommends solutions while humans retain final authority. Integrating AI in this manner can increase speed, preserve accountability, and allow commanders to focus on judgment and operational art in large-scale combat operations.

During Exercise Ivy Sting at Fort Carson this past fall, an M777 crew using the new AI-enabled Artillery Execution Suite (AXS) received accurate firing data before the gun's spades were even set.[1] This represented a dramatic break from legacy digital fire direction, which often delays units for extended periods during troubleshooting. The new software promises to bring groundbreaking improvements to artillery operations. AXS is an application inside of the Army's Next Generation Command and Control (NGC2) prototype. It is designed to collapse friction in targeting and fire direction and accelerate combat decision-making, meeting the Army's efforts to modernize network technologies and to better enable units to manage information and C2.[2][3] AXS and NGC2 promise the most responsive fires process the US Army has ever fielded. But as software shortens the technical portion of the kill chain, the slowest step increasingly becomes the human approval process itself. This article argues that, in preparing for peer conflict, the Army must examine where human control adds value—and where it unnecessarily slows fires in a target-saturated environment.

The Battlefield Problem

The evolution of artillery tactics over the course of the Russo-Ukrainian war has shed light on the growing need for condensed kill chains in meeting a fast-paced operational environment against a peer adversary. Tactics have evolved to meet a sensor-saturated environment. Practices vary across different units, areas of the front, and periods in the war, but recently, analysts have observed that Ukrainian guns are typically dug in, well-hidden and camouflaged, and separated by at least 500m. They displace after firing about 10 rounds, at which time their firing point is

[1] Jen Judson, "Early Drops of New Army Command Software Delight Artillerists in Drill," *Defense News*, October 14, 2025, https://www.defensenews.com/land/2025/10/14/early-drops-of-new-army-command-software-delight-artillerists-in-drill/.
[2] Mark Pomerleau, "Here's How the Army Is Scaling Its Next Gen C2 Platform to an Entire Division," *Breaking Defense*, October 03, 2025, https://breakingdefense.com/2025/10/heres-how-the-army-is-scaling-its-next-gen-c2-platform-to-an-entire-division/.
[3] US Department of the Army, *2019 Army Modernization Strategy: Investing in the Future* (Washington, DC: US Department of the Army, 2019), 6.

compromised, and artillerymen scan to ensure they are not observed by ISR before firing.[4] The US Army's own 2024 primer on Russian tactics states that since the modernization ground forces with automated C2, sensor-to-shooter times have been reduced by up to half from the former minimum of 3-7 minutes between target detection and fire.[5] Different units have varied their kill chains; formations with their own UAVs are capable of rapid fires, while a more centralized sensor-to-shooter system incorporating a fire-control headquarters takes closer to 20-30 minutes.[6]

Other nations are also adapting to this new reality. China is fielding its own next-generation weapons using DeepSeek AI to analyze targeting data and assess battlefield scenarios to assist with planning.[7] The PLA reportedly seeks to apply AI to command and control and military decision-making.[8] In the near term, China aims to incorporate machine-led tactical decision-making and giving machines input into operational and strategic decisions.[9] Taken together, these adaptations reflect an increased acceptance of AI on the battlefield and a shared imperative to accelerate sensor-to-shooter chains under combat conditions.

Advances in AI and tech have added risks to the targeting cycle. Improved and ubiquitous ISR has made a unit's ability to hide and reduce its signature more important than ever.[10] A slow sensor-to-shooter system with fully manual command and control systems increases the risk of target decay—a unit that fires too slowly and with poor effects on the target risks exposing the firing unit while also wasting valuable munitions. The war in Ukraine has highlighted the importance of dispersion and mission command approaches; however, overly decentralized kill chains often result in poor prioritization of targets, leading to poor utilization of munitions and unnecessary stress on supply chains. AI systems, furthermore, run the risk of adversarial manipulation or unpredictable responses to novel situations that were not represented in training data, stressing the need for continued human oversight.[11]

Adding Speed to the Artillery Kill Chain

The NGC2 and AXS are applied in the fires domain to solve the problems of slow, unresponsive targeting, poor prioritization in the targeting cycle, and siloed information between warfighting functions. The NGC2 is an AI-powered ecosystem that brings disparate warfighting functions

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[4] Jack Watling, "Emergent Approaches to Combined Arms Manoeuvre in Ukraine" (London: Royal United Services Institute, October 23, 2025), 7.
[5] US Department of the Army, *Army Techniques Publication 7-100.1, Russian Tactics* (Washington, DC: Headquarters, Department of the Army, February 29, 2024), 5-13.
[6] Jack Watling and Nick Reynolds, "Ukraine: Preliminary Lessons in Combined Arms Warfare February–July 2022" (London: Royal United Services Institute, 2022), 38.
[7] Reuters, "Robot Dogs and AI Drone Swarms: How China Could Use DeepSeek for an Era of War," *Reuters*, October 27, 2025.
[8] US National Bureau of Asian Research, *China's Military Decision-making in Times of Crisis and Conflict* (Seattle, WA: NBR, September 2023), 9.
[9] Ibid., 73–74.
[10] RAND Corporation, "Willing Russian Aggression? Assessing Russia's Future Military Power and Intent for War with Ukraine and NATO," WRA-4004-1 (Santa Monica, CA: RAND Corporation, 2025), 9.
[11] Zachary Burdette et al., *An AI Revolution in Military Affairs? How Artificial Intelligence Could Reshape Future Warfare*, WR-A4004-1 (Santa Monica, CA: RAND Corporation, 2025), 12–13.

(intelligence, logistics, fires, etc.) into the same interface and applications[12]; AXS constitutes a single "app" within the larger NGC2 ecosystem.[13] The software is easy to use and shares information across units. This enables commanders to make better decisions and, as importantly, focus on the most pertinent and demanding problems at the right time. NGC2 will replace a swathe of legacy systems, with AXS displacing the existing tactical fire direction software[14] which often demands manual calculations and input as well as troubleshooting that significantly slows the targeting process.

The introduction of AXS has ushered in welcome improvements to fire direction and targeting within the existing kill chain. The system and software itself are orders of magnitude more user-friendly than its less intuitive antecedent, making it easier to train every individual soldier in an fire direction center (FDC) to use it.[15] It automates elements of fires coordination and mission processing, reducing friction that slows units as they occupy and receive targets.[16] The system's architecture also creates space for future enhancements, such as more routine incorporation of real-time meteorological inputs at the battery level, which would further improve the guns' speed and accuracy.

The New Bottleneck

As AXS resolves the technical and computational delays of fire direction, the primary source of friction migrates upstream to the approval architecture itself. Existing surface-to-surface kill chains route targets through the fire support element at the supported headquarters' command post, where the staff conducts target vetting, deconfliction, and clearance before the mission is passed to the firing unit.[17] The more centralized the kill chain, the slower the response of the firing unit; this trade-off is necessary to share information across headquarters within a unit and reduce the risk of threats to friendly units or airspace.

In an Army division with division artillery (DIVARTY) functioning as a field force artillery headquarters, for example, a target within the division area of operations might be sent from a division-level sensor to the division fires cell, to the joint air-ground integration cell (JAGIC) to manage air-space risks, then to the DIVARTY fire controle (FCE) for manual vetting, down to the battalion FDC before being sent to the battery to engage. Many DIVARTY functions could be automated, such as consolidating targets, avoiding target duplication, and recommending the firing unit and attack guidance.

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[12]PEO C3N Public Affairs, "Army Announces Next Generation Command and Control (NGC2) Prototype Award," *US Army*, July 18, 2025, https://www.army.mil/article/287180/army_announces_next_generation_command_and_control_ngc2_prototype_award

[13] Mark Pomerleau, "In NGC2 First, Army Uses Beta Artillery Data Tool in Howitzer Strike at Ivy Sting 1," *Breaking Defense*, October 2, 2025, https://breakingdefense.com/2025/10/in-ngc2-first-army-uses-beta-artillery-data-tool-in-howitzer-strike-at-ivy-sting-1/.

[14] This system is the Advanced Field Artillery Tactical Data System (AFATDS).

[15] Danielle Kress and Maj. Henry Castillo, "AFATDS Gets an Upgrade," *Army AL&T Magazine*, Winter 2025, 43.

[16] Mark Pomerleau, "In NGC2 First, Army Uses Beta Artillery Data Tool in Howitzer Strike at Ivy Sting 1," *Breaking Defense*, October 2, 2025, https://breakingdefense.com/2025/10/in-ngc2-first-army-uses-beta-artillery-data-tool-in-howitzer-strike-at-ivy-sting-1/.

[17] US Department of the Army, *FM 3-09, Fire Support and Field Artillery Operations* (2020), paras. 2-29–2-32; 3-44–3-50.

A large number of targets must be manually processed through the JAGIC and FCE, which slows the fires process and consumes a lot of bandwidth. Fires elements within division and brigade staffs will be overwhelmed in a target-saturated large scale combat environment. Furthermore, munition availability places a higher premium on accuracy, which is a function of decreased target decay—and that, in turn, requires more responsive fires. An overwhelmed staff might make poor decisions due to cognitive strain or may deliberate too long while the targets accumulate, compounding the problem. Either outcome presents risks to the ground force.

AI is very well-suited to integrate into a data-rich system that has long required manual processing. In theory, the NGC2 infrastructure, by collecting data across warfighting functions, is well positioned to process massive amounts of targeting data, sort it based on a unit's HAT[18] and raise alarms based on fires asset location data and ammunition data from firing and logistics units. Therefore, the Army fires enterprise should enable AXS to send data to prioritize and deprioritize targets it sends through the kill chain and recommend weaponeering solutions based off the existing fires plans and other battlefield considerations such as ammunition supply and locations of logistics nodes.

An AI supported targeting system will become more sophisticated as it gains information and feedback through repeated iterations, reacting faster than human subject matter experts in the targeting process without reducing accuracy. Just as deep-learning systems can already outperform clinicians on specific diagnostic imaging tasks, a well-trained AXS-enabled targeting agent could eventually outperform human processors on speed, sorting, and pattern recognition without reducing accuracy.[19]

This suggestion for increased automation into the targeting and fire direction processes uses AI and machine learning and advocates for an L2 agentic approach, with users as collaborators. Under an L2 agentic model, AI handles multi-step workflows autonomously but always presents outputs to a human for approval, and there is a mechanism for the user to take over or edit the agent's outputs.[20]

Risks and Limitations

No amount of automation comes without risk. Automating part of the sensor-to-shooter chain shifts analysis burden onto systems that are not legally liable for loss of life, while introducing risks of automation bias, adversary exploitation, and long-term skill atrophy. Any suggestion to automate a process in combat elicits the inevitable question: Who is liable when an AI system makes or contributes to a decision to destroy or kill an unintended target? What constitutes a decision, and what type of decision is "above the pay grade" of a machine? How should we legally differentiate between an error made by AI software in the targeting cycle and a

[18] High priority target list (HPTL), attack guidance matrix (AGM), and target selection standards (TSS).
[19] Xiaoxuan Liu et al., "A Comparison of Deep-Learning Performance Against Health-Care Professionals in Detecting Diseases from Medical Imaging: A Systematic Review and Meta-analysis," *The Lancet Digital Health* 1, no. 6 (2019).
[20] K. J. Kevin Feng, David W. McDonald & Amy X. Zhang, *Levels of Autonomy for AI Agents* (Knight First Amendment Institute / University of Washington, July 28, 2025), https://knightcolumbia.org/content/levels-of-autonomy-for-ai-agents-1.

malfunctioning machine gun or a faulty parachute? Is it morally appropriate to increase the role of AI if it proves effective in our C2 processes—for example, if NGC2 is a resounding success, one might eventually posit whether it could replace an entire staff function? And if, for example, AXS were tasked to perform air clearance, who would be liable for the casualties that emerge from a mistake it may make?

Humans are less tolerant of AI errors than human errors. Case in point: self-driving cars have been proven to cause fewer fatalities than human drivers, and yet a majority of surveyed Americans report hesitation and mistrust of autonomous cars.[21] This skepticism is understandable, but should not prevail over rational decision-making that could, at a large scale, outcompete adversaries and preserve American and allied lives. AI should be prepared to replace human functions once it has a much smaller error rate in training than human counterparts. At that point, errors originating from autonomous functions will be acceptable to a commander in large-scale combat operations, where risk acceptance rises to meet the urgency of the combat situation. This is not a novel introduction to the battlefield: our digital systems already process and transmit firing data entirely computed by machines. Allowing AI assistance in targeting would free human bandwidth to think more critically and focus on the "art" of fire support through oversight rather than the "science" of processing targets.

Several known problems with all AI systems present great risks when applied to the targeting cycle. Automation bias is a risk for any system incorporating AI. If agents are given too much cognitive load and create a reliance, and humans become merely approvers, then humans may fail to identify or override system errors or make poor decisions. The alignment problem presents another major risk among all AI systems. Under this problem, the agent is so narrowly focused on achieving its programmed objective that it inadvertently delivers outcomes that do not align with the human's intent. For example, a system instructed to optimize for speed might incidentally cut corners and disregard logistical constraints. A system instructed to prioritize a given set of rules during training might behave in unintended ways in a new battlefield environment. Both automation bias and the alignment problem can be mitigated with a system that is well tested and encompasses a large number of rules to fit all imaginable scenarios; beyond that, the system should be programmed to be flexible and to check in with the human counterpart. Ample training data will improve its accuracy and reduce the risk of unknown outcomes.

Adoption of new technological systems exposes the military to interference from our adversaries. Once these new systems encounter jamming or deception operations, artillerists' ability to return to their core competencies will be tested. Servicemembers and contractors share concerns over vulnerabilities and security risks in existing and new communications platforms and are wary of the risks of adversaries gaining undetectable access to the NGC2 system.[22] Adversarial jamming

[21] Mark MacCarthy, "The Evolving Safety and Policy Challenges of Self-Driving Cars," *Brookings Institution*, July 31, 2024. https://www.brookings.edu/articles/the-evolving-safety-and-policy-challenges-of-self-driving-cars/.
[22] Mike Stone, "Anduril and Palantir Battlefield Communication System Has Deep Flaws, Army Memo Says," *Reuters*, October 3, 2025, https://www.reuters.com/business/aerospace-defense/anduril-palantir-battlefield-communication-system-has-deep-flaws-army-memo-says-2025-10-03/.

or deception operations against our AI-enabled or communications systems will jeopardize their analytical or decision-support benefits.[23]

The risk of skill atrophy rightfully emerges every time the military adopts new technology or automates a process. [24] Adopting and maintaining digital capabilities is essential to increasing a unit's lethality, but it does not remove the onus on members of the military to maintain degraded capabilities. The importance of the fundamentals, particularly manual gunnery and manually laying howitzers, is well-trodden ground for artillerymen. In an era where communications loss, jamming, and other reductions in our capabilities present great risks, maintaining these core competencies remains important. The adoption of AXS may lead to a reduction in time lost performing troubleshooting procedures but need not detract from degraded training—air assault operations, hip shoots, and other manual missions remain a fundamental part of artillery training that each unit masters.

Conclusion

The Army should pursue AI-enabled targeting that accelerates the process without removing human approval, and should focus on integrating AI into the kill chain so that humans remain responsible for the critical decisions, and AI handles the processing that consumes time without adding sufficient value. In the high-tempo, attrition-based fight the US anticipates, the winning force will be the one that makes faster, better decisions—not simply the one with more munitions or longer-ranging weapons.

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[23] Burdette, *An AI Revolution in Military Affairs?* 3.
[24] Joe Kwon, "AI Agents: Governing Autonomy in the Digital Age," Center for AI Policy, May 22, 2025.

We See AI Everywhere but in Military Decision-Making: How to Make AI Useful for MDMP

Robert Rose

ABSTRACT: Despite claims that artificial intelligence will transform military decision-making, there is little evidence of it. Without an approach to AI that is grounded in understanding its limitations, AI risks being a costly placebo that fails to cure our slow decision-making processes. It may make them worse. AI can reduce productivity with unreliable "slop," could prevent commanders from developing mental models, and lacks quality data on the contexts in which we would fight. For AI to enhance productivity, we need to conduct realistic exercises that will produce quality data, to develop narrow agents to assist with repetitive staff tasks, and to reinforce the tenets of mission command.

We see the computer age everywhere but in the productivity statistics.
-Robert Solow[1]

When will we see productivity gains from artificial intelligence (AI) in the military decision-making process (MDMP)? In breathy articles, I read how "orders flow, algorithms assess terrain, readiness, doctrine, and historical cases to generate engagement area options."[2] I am told that "[t]he consequences of the coming military AI revolution are enormous. If developed effectively, AI will permeate across all military systems and processes." AI will be "conducting the full MDMP near continuously, without fatigue, incorporating every new development..."[3]

I hear that AI will accelerate warfare: "AI-enabled decision-making is an inevitable feature of future warfare. Military operations in modern warfare are increasing in speed and complexity."[4] It will "quickly push relevant data from sensor to commander. Speed is paramount, as the modern battlefield is dynamic and commanders in MDO need to be able to access multidomain data quickly and in real time."[5] And, woe to those who fall behind in AI: "Those with the best AI tools will be constantly exploiting the initiative, while those without will struggle to make sense of what is happening."[6]

Selflessly ensuring that we are not left behind, industry leaders call for investments in AI. They provide helpful theories of agentic warfare for the Army to purchase.[7] They warn that "the first

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[1] Paul A. David, "The Dynamo and the Computer: An Historical Perspective on the Modern Productivity Paradox," *The American Economic Review* 80, no. 2 (1990): 355–61, http://www.jstor.org/stable/2006600.
[2] Benjamin Jensen and Jake S. Kwon, "The US Army, Artificial Intelligence, and Mission Command," War on the Rocks, March 2025, https://warontherocks.com/2025/03/the-u-s-army-artificial-intelligence-and-mission-command/.
[3] Joshua Glonek, "The Coming Military AI Revolution," *Military Review*, May-June 2024, https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/May-June-2024/MJ-24-Glonek/.
[4] Andrew A. Hill and Dustin Blair, "Alien Oracles: Military Decision-Making with Unexplainable AI," *War on the Rocks*, September 26, 2025, https://warontherocks.com/2025/09/alien-oracles-military-decision-making-with-unexplainable-ai/.
[5] Thomas D. Richardson, "Data Centricity and the 1st Cavalry Division's 'Speed of Relevance' during Warfighter 23-04," *Military Review* (September-October 2023), https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/September-October-2023/Data-Centricity/.
[6] Glonek, "The Coming Military AI Revolution."
[7] Benjamin Jensen and Dan Tadross, "Agentic Warfare Is Here. Will America Be the First Mover?" *War on the Rocks*, April 23, 2025, https://warontherocks.com/2025/04/agentic-warfare-is-here-will-america-be-the-first-mover/.

nation to fully incorporate AI into military decision-making will shape the history of the 21st century. Humanity is entering a new era of 'agentic warfare.'"[8]

So, where are these gains to the planning process? In all these articles, I have never seen an author cite data from a combat training center (CTC) demonstrating that units have employed AI to increase the speed of their decisions. During my time serving at the CTCs, I did not observe any units employing AI for MDMP. In an accompanying article in this edition of the Modern War Journal, Johnathan Pan observed ten US Army brigades that had been provided with AI software and found that all still relied on analog tools.[9]

I want to be clear. I am not saying AI has no place in war. It has myriad proven uses, whether for targeting, intelligence collection, or autonomous vehicles. It is important to recognize that discriminative AI, which categorizes and is used for intel and targeting, has yielded more military applications than headline-grabbing generative AI, which would serve as the basis for decision-making tools.[10]

We should temper the hyperventilating of prognosticators about AI's role in decision-making with a deep breath of historical context. Information has been moving at the speed of light since the telegraph. Artillery rounds fly faster than drones. Decision-making was quicker before digitalization.[11] During World War II, German division commanders issued orders within two hours of receipt.[12] Gen. George S. Patton's and Field Marshall William Slim's staffs regularly produced daily orders to maintain a rapid tempo of operations.[13] As Army-level headquarters, they employed staffs similar in size to a modern brigade staff.[14] In Slim's 14th Army fighting in Burma, brigade staffs operated with just a major, a captain, a few clerks, and some liaisons.[15] Now with larger staffs and increased digitalization, brigades struggle to issue orders in twenty-four hours.[16]

Without an approach to AI that is grounded in understanding its limitations, AI risks being a costly placebo that fails to cure our slow decision-making processes or even makes them worse. Other organizations have struggled to make AI useful. In a 2024 survey of businesses, less than

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[8] Alexandr Wang, "Alex Wang on Why China Can't Be Allowed to Dominate AI-Based Warfare," *The Economist*, March 4, 2025, https://www.economist.com/by-invitation/2025/03/04/alex-wang-on-why-china-cant-be-allowed-to-dominate-ai-based-warfare.

[9] Johnathan Pan, "Achieving Decision Advantage for the Army through Spatial Reasoning and Machine-Readable Worlds," Modern War Journal (Winter 2026).

[10] C. Anthony Pfaff and Christopher John Hickey, *Integrating Artificial Intelligence and Machine Learning Technologies into Common Operating Picture and Course of Action Development* (Carlisle Barracks, PA: US Army War College Press, 2025), https://press.armywarcollege.edu/monographs/980.

[11] Jim Storr, *Something Rotten: Land Command in the 21st Century* (Shrivenham, UK: Howgate Publishing Limited, 2015).

[12] Richard F. Timmons, "Lessons from the Past for NATO," in *The Parameters of War*, *Military History Journal of the US Army War College* 45, no. 3 (Washington, D.C.: Pergamon-Brassey's International Defense Publishers, 1987), 272.

[13] William Slim, *Defeat into Victory: Battling Japan in Burma and India*, 1942-1945 (New York: Cooper Square Press, 2000).

[14] Oscar W. Koch, *G-2: Intelligence for Patton* (Atglen, PA: Schiffer Military History, 1999).

[15] John Masters, *The Road Past Mandalay* (London: Orion Books: 2002), 114.

[16] Robert Rose, "Preventing a Short Jump across a Wide Ditch," *Military Review* (January–February 2019).

thirty percent of AI leaders reported that their executives were content with the return on AI investments.[17] In 2025, after thirty to forty billion dollars of AI investments, ninety-five percent of organizations reported zero return.[18]

To make AI useful for Army staffs, we must not gamble on a breakthrough in super-intelligence, which may not come. Instead of seeking technological silver bullets, militaries that successfully innovate pursue iterative improvements.[19] We should treat AI as a normal technology with strengths and limitations.[20] We must recognize that it can slow down staff processes by producing slop, by preventing staff from developing the mental models to recognize slop, and by creating overly centralized processes that put onerous requirements of data collection on subordinates. To make it effective, we need to provide it with better data, apply it to staff work most suited to its strengths, and remember the fundamentals of mission command.

The Slop Problem

To understand AI's limitations in decision-making, we must first recognize that even in ideal use cases, AI does not necessarily increase productivity. In 2025, Model Evaluation & Threat Research (METR) studied AI's impact on coding. Coding is widely considered one of the most mature applications for AI. METR provided a series of complex, realistic programming tasks to experienced software developers. With each task, coders were either allowed to use Cursor Pro and Claude Sonnet, the latest coding AI tools, or not. Before the experiment, METR asked the coders to predict how much AI tools would reduce completion time. They estimated AI availability would reduce completion time by twenty-four percent. METR also had economics and machine-learning experts predict how much faster AI would make coding tasks. They were more optimistic about AI’s effects than the specialists in the field. They forecasted thirty-eight to thirty-nine percent reductions. After the experiment, METR found that AI use actually increased coding time by nineteen percent.

AI reduced the coders’ productivity because they had to invest an inordinate amount of time cleaning up the code. They had to closely review the generated code to find mistakes, but these investigations were difficult; the AI employed different mental models than the coders. They accepted just forty-four percent of the AI-generated code. The coders did not even recognize how much extra work AI added. After completing the tasks, they estimated that the AI had improved their speed by twenty percent.[21]

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[17] Haritha Khandabattu, “Latest Hype Cycle for Artificial Intelligence Goes Beyond GenAI,” *Gartner*, July 8, 2025, https://www.gartner.com/en/articles/hype-cycle-for-artificial-intelligence

[18] Aditya Challapally et al., *The GenAI Divide: State of AI in Business* (Cambridge, MA: MIT Nanda, July 2025), https://www.artificialintelligence-news.com/wp-content/uploads/2025/08/ai_report_2025.pdf.

[19] Robert G. Rose, “Army Innovation: Lessons from 250 Years of Army Innovation,” *Land Warfare Paper* 169 (Arlington, VA: Association of the United States Army, June 26, 2025), https://www.ausa.org/publications/land-warfare-paper/army-innovation.

[20] Arvind Narayanan and Sayash Kapoor, “AI as Normal Technology: An Alternative to the Vision of AI as a Potential Superintelligence,” Knight First Amendment Institute at Columbia University, April 15, 2025, https://knightcolumbia.org/content/ai-as-normal-technology.

[21] Joel Becker et al., “Measuring the Impact of Early-2025 AI on Experienced Open-Source Developer Productivity,” METR, July 10, 2025, https://metr.org/blog/2025-07-10-early-2025-ai-experienced-os-dev-study/.

One of the participants examined his misplaced confidence in AI productivity: "The necessity of auditing the agent's code for mistakes created two major sources of friction: the cognitive drain of 'babysitting' the AI and the time spent waiting for and reviewing its output... It's the digital equivalent of shoulder-surfing an overconfident junior developer who has memorized everything there is to know about programming but cannot be trusted and who will make subtle mistakes that are hard to spot."[22]

He was experiencing AI slop. AI can confidently produce seemingly authoritative results, but in many industries, AI creates "content that is actually unhelpful, incomplete, or missing crucial context... requiring the receiver to interpret, correct, or redo the work... it transfers the effort from creator to receiver."[23]

We should also remember that coding is an ideal test of AI's capabilities. AI coding tools have been trained on nearly limitless amounts of coding data, and they have clear benchmarks for task completion. For tasks that AI is less suited for, it can produce shocking slop. For example, AI struggles with poker, even though traditional software has long been effective at poker. In a 2025 experiment with ChatGPT, AI confidently pursued poor strategies, consistently lost track of players' money, and improperly assessed winning hands.[24] The last failing is particularly galling because of poker's well-defined rules. In warfare, conditions for victory are much less clear. The AI pursued poor strategies due to "fuzzy" contextual factors, which, when the AI misread them, led to cascading deviations from an optimal strategy. The fog of war is even fuzzier. When dealing with such fuzziness, AI would produce slop that would cripple staffs and confound subordinates.

The Mental Model Problem

Some leaders have argued that AI can allow leaders to skip immersing themselves in data and focus on higher-cognitive tasks: "For instance, in intelligence preparation of the operational environment, AI can instantly fuse terrain analysis, enemy order of battle, and doctrinal templates to develop several threat courses of action (COAs)... Leaders must validate AI outputs, stress-test systems, and retain the ability to override automated processes when necessary."[25] But how can you validate AI outputs if you do not have a deep understanding of the context you need to assess?

If we attempt to use AI to abbreviate mission analysis, the critical first step of MDMP, commanders and their staff will not have wrestled with the information required to develop mental models necessary to assess AI. As one software programmer worried, "[b]y using the AI

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[22] Philipp Burckhardt, "Using AI in the Development of stdlib: A Reflection on stdlib's Participation in the 2025 METR Study on AI's Impact on Open-Source Developer Productivity," stdlib, July 17, 2025, https://blog.stdlib.io/reflection-on-the-metr-study-2025/.
[23] Kate Niederhoffer et al., "AI-Generated 'Workslop' Is Destroying Productivity," *Harvard Business Review*, September 22, 2025, https://hbr.org/2025/09/ai-generated-workslop-is-destroying-productivity.
[24] Nate Silver, "ChatGPT Is Shockingly Bad at Poker," *Silver Bulletin*, Substack, May 21, 2025, https://www.natesilver.net/p/chatgpt-is-shockingly-bad-at-poker.
[25] James Mingus and Zak Daker, "Ascend the Cognitive Hierarchy—Don't Waste Time in the Data Layer," *Modern War Institute* (West Point), February 10, 2026, https://mwi.westpoint.edu/ascend-the-cognitive-hierarchy-dont-waste-time-in-the-data-layer/.

agent, one may bypass all the little steps which are necessary in the process of building that mental model. But does it matter? When working on a crucial piece of a larger, complex system, it definitely does, and I would be hesitant with generative AI."[26] The programmers in the METR study offloaded that initial work to AI, which prevented them from developing a mental model based on the context of their task. It was difficult for them to reverse-engineer that mental model after being presented with finished code by the AI.

Consider a battalion staff creating a plan for a breach. AI could confidently provide a seemingly feasible plan. But if you are not immersed in the data, how could you assess if the plan for obscuration would be effective? Based on terrain, obstacles, and friendly engineering capabilities, how long would you have to obscure the breach? How many smoke rounds does your supporting artillery battery have on hand? Does the enemy have a counterfire radar in a position that could detect your battery based on the intervening terrain? What would be the response time of their counterfire? Is the risk of losing that battery worth a successful breach based on your other tasks and potential future missions? If a commander and staff have not fully wrestled with this information during mission analysis, they will have no idea if they can trust the AI's outputs.

A leader's primary value comes not just from making decisions; it comes from their evolving mental model of war. AI risks undermining that mental model. As one officer wrote: "AI makes it incredibly easy to avoid having to think... Once you experience the ability to no longer think, it becomes addicting, and an easier alternative than spending time in critical thought."[27] To make effective decisions, just as programmers do, leaders need to take the mental model that they have developed over years of study and experience and consistently add new information to adapt it to their specific context. It is impossible to predict which pieces of information will prove essential for forming that mental model. Only after this labor can they make an effective decision. Shortcutting the process risks slower, worse decisions.

The Data Problem

AI is at its worst when dealing with novel, context-dependent problems. In its nature, war is context-dependent. What works in one context would fail in another. An AI model trained on the open battlefields of the Russo-Ukrainian War in 2022 would have been counterproductive in the context of the positional war that occurred a year later. Furthermore, such a model would be useless in a war between the United States and China. We simply do not have the data to train AI for such a war.

[26] Philipp Burckhardt, "Using AI in the Development of stdlib," *Numerical Bits* (blog), July 17, 2025, https://blog.stdlib.io/reflection-on-the-metr-study-2025/.
[27] Amanda Collazzo, "Warfare at the Speed of Thought: Balancing AI and Critical Thinking for the Military Leaders of Tomorrow," Modern War Institute, February 21, 2025, https://mwi.westpoint.edu/warfare-at-the-speed-of-thought-balancing-ai-and-critical-thinking-for-the-military-leaders-of-tomorrow/.

Existing data on war is problematic.[28] War data has been questionable since Herodotus inflated the Persian Army to 1,700,000 infantry and 80,000 horsemen.[29] Even as comprehensive a work as the Strategic Bombing Survey of World War II resulted in internal divisions.[30] Today, both sides in the Russo-Ukrainian War inflate their success. Within the US Army, we produced overly optimistic assessments of progress in Vietnam and Afghanistan. In those wars, we struggled to even define success.

Even more problematic than existing data sources, the Army may turn to synthetic data to train AI models. War is not like chess, which allows AI to train on millions of iterations with clear rules and defined victory conditions. In training military AI, synthetic data risks reinforcing bias in underlying assumptions, making the resulting model completely inappropriate.[31] For example, the Army may turn to division and corps Warfighter Exercises to build decision-making models. It would be easy to collect seemingly authoritative datasets from those exercises, but it would produce useless models. Such simulations are based on unproven assumptions and absurd abstractions. For example, logistics are abridged, soldiers do not sleep, and subordinate units do not need to plan or rehearse.

The Army could use data from CTCs, real-world training exercises that most closely replicate how we would fight, but that data has a host of problems. While CTCs might provide a few decent data sets on maintenance or fires responsiveness, they do not systemically collect and store data for wider analysis. Traditionally, CTCs have existed for rotational brigades to meet their training objectives. While CTCs each contain a Center for Army Lessons Learned representative, the observer, coach/trainers have viewed providing trends to the wider Army as an extracurricular activity.

For the data that does exist, it would be difficult to use because it lacks a clear benchmark of success. CTCs do not provide an objective grade to training units. Each rotation is a unique training scenario with opposing forces calibrated to ensure the rotational brigade achieves its training objectives.

Finally, rotations only provide a veneer of a fight against China or Russia. The scenario, enemy, and terrain do not accurately align with potential conflicts with our most capable adversaries. Instead, units train to fight the North Torbians, a bizarre enemy based in northern Luzon.[32]

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[28] Ben Connable, "War Stats Do Not Measure Up: Exploring the Limits of Knowledge with Military Casualty Statistics in Ukraine and Other Wars, and What We Can Do to Manage Uncertainty," Battle Research Group, October 15, 2025, https://battleresearchgroup.org/publications/war-stats/.
[29] Herodotus, *The Persian Wars*, trans. A. D. Godley, 4 vols. (Cambridge, MA: Harvard University Press, 1920).
[30] Franklin D'Olier et al., *The United States Bombing Surveys (European War; Pacific War)*, (Montgomery, AL: Air University Press, October 1987), https://www.airuniversity.af.edu/Portals/10/AUPress/Books/B_0020_SPANGRUD_STRATEGIC_BOMBING_SURVEYS.pdf
[31] Ilia Shumailov, Zakhar Shumaylov, Yiren Zhao, Nicolas Papernot, Ross Anderson, and Yarin Gal, "AI Models Collapse When Trained on Recursively Generated Data," *Nature* 631 (July, 2024): https://www.nature.com/articles/s41586-024-07566-y.
[32] US T2COM G-2, "North Torbia," ODIN, December 17, 2025, https://odin.tradoc.army.mil/DATE/0cc7bfac94a8f19e5fbef401fb034da0.

We should question whether such data would produce a useful AI model. Data needs to be in sufficient quantity and appropriate quality for the specific context of the employment of a model. It has taken two decades and millions of miles to get reasonably safe robo-taxis, but only in the select cities where they have trained.

How to Make AI Work

Fix the Data Problem

We will not have useful AI for military decision-making until we fix the data problem. However, we can hope for change. The Army recently realigned its CTCs under Transformation and Training Command (T2COM). This change will support a culture shift within CTCs. No longer will they see their remit as narrowly focused on training the rotational units. Now, they will work to transform how the Army fights.

Under T2COM, the Combined Arms Center (CAC) can specify the data that CTCs need to provide. CAC can provide guidance to better align CTCs with the contexts in which we may fight our most dangerous adversaries.[33] By making training scenarios better replicate the terrain and the enemy we would face, they would start producing data that could effectively update planning factors for a fight against China or Russia. Those scenarios should align with how we would actually fight according to our operational plans, thereby providing units with realistic metrics of success or failure. AI models would then have benchmarks for creating neural networks to predict how different factors contribute to battlefield effectiveness in realistic contexts.

Fix the Hype

Once we have the data to build models, we will likely find that the most productive use for them is in mundane staff work, rather than in higher faculties of military decision-making. We should learn from private enterprises that have successfully employed AI. Businesses that succeed with AI use it for narrow workflows, such as contract review, rather than for core functions, like procurement decisions.[34] They employ it for simple, repetitive, low-risk tasks like drafting emails, but find it counterproductive for complex, context-dependent tasks. Even leading tech companies like Amazon and Google do not discuss using AI for operational decision-making. They employ it for analysis and research.[35] They have access to near-endless data and operate in contexts free of the fog and friction of war, yet they still do not use AI for decision-making. Why would we gamble on using it for military decision-making?

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[33] Robert Rose, "To Train as We Fight, We Need to Train on the Land We Will Fight," *Landpower Essay* 25-1 (April 8, 2025), Association of the United States Army, https://www.ausa.org/publications/landpower-essays/to-train-as-we-fight.

[34] Aditya Challapally et al., *The GenAI Divide: State of AI in Business* (Cambridge, MA: MIT Nanda, July 2025), https://www.artificialintelligence-news.com/wp-content/uploads/2025/08/ai_report_2025.pdf.

[35] Avi Goldfarb and Jon R. Lindsay, "Prediction and Judgment: Why Artificial Intelligence Increases the Importance of Humans in War," *International Security* 46, No. 3 (Winter 2021/22), https://www.belfercenter.org/sites/default/files/pantheon_files/files/publication/003-isec_a_00425-Goldfarb_Lindsay.pdf.

Instead of grandiose visions of decision dominance and accelerating the OODA-loop,[36] we should develop AI agents for filling out staff products. Commanders can make decisions in seconds, but staffs spend hours creating briefing tools and publishing fighting products. If AI could produce drafts of these products, it would greatly speed up MDMP.

For example, an intelligence team in the 11th Airborne Division created a tool to quickly reprioritize collection assets by drafting Intel Collection Synchronization Matrices (ICSM).[37] Creating an ICSM is time-consuming. A commander may quickly recognize that battlefield conditions have altered and, in response, provide guidance to adjust reconnaissance assets. However, to operationalize his guidance, an intel team may need well over an hour to realign all the assets on an ICSM. If the team could simply instruct an AI to move all those boxes and then check its work, the headquarters could rapidly distribute the new ICSM to subordinates to align with the new plan. With an easy-to-assess output, the intel team could constantly improve this AI agent and tailor it to their specific context.

The Army needs to provide clear guidance to software developers to create such tools. We could produce an agent for an S3 Air that uses a unit's personnel status report and tactical standard operating procedures to rapidly produce manifests for an air assault, an otherwise laborious process. Eventually, we could create a tool that allows an S3 to input products from mission analysis, a commander's intent, a decisive point, and decisive and shaping operations to produce a draft synchronization matrix. Synchronization matrices are another time-intensive product. To produce one, AI would need reliable data on triggers, movement rates, consumption rates, and other planning factors from an accurate dataset. The staff could then wargame the synchronization matrix to validate it. The idea is not to replace decision-making or shortcut the development of staff members' mental models. Instead, AI should minimize the time that staff waste on spreadsheets.[38]

Fix Mission Command

To prevent AI adoption from slowing decision-making, we need to embrace mission command and avoid the techno-optimism of ideas like "decision dominance." Although the Army promotes mission command in doctrine, it struggles to implement it in practice.[39] Mission command employs decentralized decision-making to allow rapid adaptations during operations. Outside of CTCs, units rarely conduct large-scale force-on-force exercises, which train units to use mission

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[36] John Boyd developed the Observe, Orient, Describe, Act (OODA) Loop from his experience as a fighter pilot to describe how iterations of decision-making and execution that were more rapid than your opponent would put them in an unwinnable position. While he is often cited, his ideas were not novel. Other military leaders had previously expressed similar concepts, such as George S. Patton, Hans von Seeckt, or Nikolai Petrovich Mikhnevich.

[37] Wesley Wood and Derrion Robinson, "Adding Artificial Intelligence to the Team," *Military Intelligence Professional Bulletin*, April 10, 2025, https://mipb.ikn.army.mil/issues/continuous-transformation-2025/adding-artificial-intelligence/.

[38] Generative AI seems strangely bad at spatial precision and military symbology, which means much work will have to be done before AI can reduce staff time in PowerPoint; Tyler Schroder et al., Understanding LLM Limitations in Tactical Mission Planning," SSRN, December 6, 2025, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5862344.

[39] Robert Rose, "Preventing a Short Jump across a Wide Ditch: Fully Embracing Mission Command to Avoid a Multi-Domain Disaster," *Military Review* 102, no. 2 (March–April 2022): 41–53, https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/March-April-2022/Rose/.

command to respond to a thinking enemy. Instead, units focus on live fires, which train detailed, synchronized, centralized planning to defeat unthinking targets. Simulations like Warfighter Exercises further reinforce centralization; centralization works well in computer games that lack thinking subordinates.[40] Along with these deficiencies in how we train, ever since the "Revolution in Military Affairs" (RMA), new technologies have hampered mission command by providing headquarters with the sense that they have access to data to peer through the fog of war and micromanage subordinates.[41]

Authors pushing "agentic," "mosaic," or "data-centric" warfare are continuing RMA thinking. They see a single headquarters making all decisions in a war. They worry about a flood of data producing "cognitive overload." They fail to understand mission command. Each echelon takes a share of the cognitive load. We employ squads, platoons, companies, battalions, brigades, divisions, corps, and theater armies to each make decisions. This decentralized structure ensures rapid, effective decisions by those with the proper context.

Scant information needs to pass to higher echelons due to the use of commander's critical information requirements (CCIR). With CCIR, a commander defines the specific information required to make a decision. During planning, these decisions are captured in a decision support matrix (DSM). If information is not CCIR aligned with the DSM, it is superfluous. Unfortunately, many prognosticators push for more data to flow to higher headquarters.

For example, one author wrote "a data-centric Army enables its commanders to make informed decisions by putting in place... systems required to quickly push relevant data from sensor to commander. Speed is paramount, as the modern battlefield is dynamic and commanders in MDO need to be able to access multidomain data quickly and in real time."[42] Tellingly, he explains that "Warfighter 23-04 prove[s] this is not a theoretical postulation but a validated reality..." He confuses a simulation with reality. In reality, lower echelons should be making decisions based on those sensors. Minimal data needs to reach a division headquarters. Headquarters that feel the need for extraneous data doubly slow operations. They overwhelm themselves with useless information, and they straddle their subordinates with onerous reporting requirements.

When headquarters correctly throttle data, they avoid cognitive overload. If a commander is facing cognitive overload, he is a poor leader. He has failed to develop his subordinates and has not produced effective fighting products to inform them of what information matters. Too many commanders want to be omnipotent conductors of a battle. Commanders who have created a DSM have little to do during a fight. We should remember Moltke reading a book during the critical movements of the Franco-Prussian War, or Slim, who ordered his staff never to wake him up from his eight hours of sleep. They trusted their subordinates and conserved their minds for the rare decision that they needed to make.

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[40] Ibid.
[41] Robert Bateman, "Force XXI and the Death of Auftragstaktik," Armor 105, no. 1 (January-February 1996): 16–20, https://www.benning.army.mil/armor/eARMOR/content/issues/1996/JAN_FEB/ArmorJanuaryFebruary1996web.pdf.
[42] Richardson, "Data Centricity."

Conclusion

I am pessimistic about how AI will impact decision-making. We have long known how to improve units' decision-making speed: repetitions, standard operating procedures, long-term unit cohesion, and realistic force-on-force exercises.[43] However, we have not taken those steps. Placing our hope in AI will provide an excuse to continue to avoid reforming how we train decision-making. AI risks being snake oil that we hope will cure our decision-making malaise. AI could prove an expensive and counterproductive nostrum.

However, if we understand its limitations, it could greatly reduce the time spent on staff work. We need to temper the hype around AI and treat it as a normal technology. If it will be at all useful, we need quality data from contexts that approximate how we would fight our most dangerous adversaries. We need to understand effective use cases for AI to make mundane staff work more efficient, and then we may start to see AI's productivity.

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[43] Rose, "Preventing a Short Jump across a Wide Ditch."

Deterrence by Design: The First Battle Is Identity

Jerae Perez

ABSTRACT: Autonomous systems will not determine the advantage in the future fight. The people trusted to employ them will. If the Army wants formations capable of disciplined initiative in a machine-accelerated battlespace, it must cultivate alignment and autonomy at the first touchpoint with the profession, not years after accession. The current enlisted MOS selection model, centered primarily on Armed Services Vocational Aptitude Battery line scores and seat availability, was designed for a different era and does not fully reflect the demands of modern, human-centered, distributed operations. Transformation succeeds when the Army measures how well Soldiers are matched to their military occupational specialties from the start. Tracking identity alignment at reception, MOS school, and the first unit would close the gap between intention and identity. Talent stewardship is not a recruiting enhancement. It is a deterrence function. By building Soldiers for initiative and purpose, the Army can field units that deny adversaries confidence in disruption. The decisive edge in the next conflict will not come from what the Army equips. It will come from who the Army builds.

The First Fight

The character of warfare is changing faster than human systems can adapt, driven by autonomous technologies, accelerated decision cycles, and distributed operations, yet its nature remains fundamentally human. Technology expands reach, but identity determines resolve. The Army will not prevail through numbers or machines alone. It will deter through people who out-think and out-decide the enemy before the first shot is fired.

Transformation will not be proven in laboratories or wargames. It will be proven in how effectively the Army turns potential into purpose at the point of accession by aligning knowledge, skills, abilities, and purpose to assignment. The future of readiness begins at the door. The moment a Future Soldier meets a recruiter is the moment the profession either builds identity or bureaucracy. If that interaction centers on compliance, the Army inherits hesitation. If it begins with meaning, the Army inherits adaptability.

Recruiting is not administrative intake. It should include strategic design. It is the first opportunity to shape the human dimension of the force and the identity from which initiative grows.

This is not a call for a new policy. It is a recommendation to execute the Army's existing precision talent acquisition intent and the vision of the Army People Strategy through alignment practices that connect purpose to Military Occupational Specialty (MOS) at accession.[1] The first interaction does more than fill a position. It shapes what a Soldier believes the Army stands for.

[1] Headquarters, Department of the Army, *Army People Strategy* (Washington, DC: Department of the Army, 2019).

Alignment as a Deterrent Function

Talent alignment is sometimes framed as consideration for the individual, but alignment is an operational requirement. Soldiers misaligned with their MOS often become future Soldiers the Army must re-motivate, reassign, or replace, each outcome draining readiness and affecting cohesion. The Army has historically treated attrition as a downstream issue, but misalignment is not discovered at separation. It is created at accession.

Research confirms this. RAND linked job satisfaction and fit to early separation.[2] The Government Accountability Office reported that one-third of enlistees did not complete their first term.[3] RAND's 2021 study found early losses stemmed from poor organizational fit rather than combat exposure.[4] A 2024 Line of Departure study shows nearly thirty percent of Soldiers separate within three years of enlistment.[5] Misalignment is not a recruiting problem. It is a readiness problem.

The enlisted MOS assignment process was designed for a legacy operating environment. It relies primarily on Armed Services Vocational Aptitude Battery (ASVAB) line scores and available training seats, which measure qualification but not identity, temperament, or purpose. This model does not account for the human demands of mission command, distributed operations, or the cognitive and emotional resilience required in modern conflict. In contrast to recent officer accession reforms, the enlisted system has not evolved at the same pace as the operating environment, leaving alignment limited to capability rather than character.

To counter this, the Army should track MOS intent and satisfaction at reception, upon completion of MOS school, and after arrival at the first unit. These touchpoints would reveal where alignment breaks down and how to correct it before future leaders are lost.

Early in my career, I enlisted a young man who was motivated to serve. I assumed willingness equaled alignment and never asked why he wanted to join. He separated two years later because he never connected to a mission that aligned with who he was. Another applicant wanted to be a medic to save lives. Once we explored his motivation, it became clear he was drawn to trust and responsibility. Nursing aligned better with his identity, which eventually led him to becoming an enlisted nurse. The Army provided an opportunity for him to be a flight nurse. He later told me that the moment his aircraft lifted with a patient aboard was when his service felt like becoming rather than belonging. He is now currently serving as an Army Aviator.

This mismatch between identity and assignment is not an anomaly. It is a predictable outcome of a model built primarily around cognitive line scores rather than purpose. When alignment is

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[2] RAND Corporation, *Analysis of Early Military Attrition Behavior* (Santa Monica, CA: RAND, 1979).
[3] United States Government Accountability Office, *Military Attrition: DOD Could Save Millions by Reducing Attrition* (Washington, DC: GAO, 1997).
[4] RAND Corporation, *Organizational and Cultural Causes of Army First-Term Attrition* (Santa Monica, CA: RAND, 2021).
[5] *Line of Departure Journal*, "Addressing the Recruitment and Attrition Challenges in the US Army," July 2024.

accidental, motivation must be rebuilt one counseling statement at a time. When alignment is intentional, identity sustains itself under pressure and ambiguity.

Mission requirements and MOS seats will always matter, but alignment strengthens performance within those constraints.

Recruiting as the First Line of Deterrence

If initiative is the currency of future war, recruiting is the mint. The Army cannot mass autonomy downstream if it designs compliance upstream. Authentic autonomy in battle depends on shaping identity at entry. Recruiters are the first architects of that autonomy.

Quantity fills ranks. Alignment wins wars.

The war in Ukraine illustrates this. Russia generated output. Ukraine generated ownership. Ukrainian junior leaders maintained tempo when isolated, acting without waiting for permission, while Russian formations often stalled because output without ownership could not adapt under friction.[6] Deterrence belongs to the force that adapts faster.

Recent operations continue to show that autonomous decision-making is already a requirement on today's battlefield. In the Red Sea, US naval forces defending commercial vessels from Houthi drone and missile attacks operated under degraded communications and rapidly changing threats. In one January 2024 incident, watchstanders on a US destroyer executed multiple intercepts in minutes as data links flickered under strain, forcing junior leaders to make rapid decisions without waiting for direction.[7] In the Indo-Pacific, US forces routinely train across vast maritime spaces where the tyranny of distance disrupts centralized control. Distributed Marine Littoral Regiments and Army watercraft crews often conduct operations where bandwidth is constrained, and time-sensitive decisions fall to the lowest level.[8] These conditions mirror the same demands observed in Ukraine and reinforce that autonomy is not a future requirement. It is already shaping modern operations.

This is not a technology gap. It is an initiative gap. China seeks to reduce the need for battlefield autonomy through centralized control. The United States must counter by cultivating autonomy and purpose through alignment at accession.

Identity alignment at entry is one of the strongest predictors of commitment. Soldiers who feel connected to their role and purpose show higher confidence, deeper engagement, and stronger intent to remain in the profession.

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[6] Michael Kofman and Rob Lee, "Not Built for Persistence," *War on the Rocks,* July 2023.
[7] US Navy Central Command, "Red Sea Engagements Summary," 2024; Middle East Institute, "The Houthis' Red Sea Missile and Drone Attack," 2023.
[8] Michael J. Mazarr et al., US Major Combat Operations in the Indo-Pacific (Santa Monica, CA: RAND, 2023).

The Army Human Dimension Concept and the Army People Strategy emphasize that human capability, not automation, underwrites decisive advantage. Alignment builds that capability before a Soldier ever enters a formation.

Lessons from Experience

The United States has relearned the cost of misalignment across major conflicts. World War II demanded initiative because commanders could not supervise every fight. Vietnam exposed the consequences of fractured identity and disconnected purpose. The post-9/11 force demonstrated tactical brilliance but often strained under missions that outpaced meaning.

The Army recently enacted officer accession reforms addressing similar challenges. Talent Based Branching at West Point and ROTC now blends performance, assessments, preferences, and branch requirements to strengthen identity and occupation fit.[9] Emerging research suggests that these reforms may improve long-term commitment. A recent West Point study found that among the academy's highest-performing cadets, those who branched into roles aligned with their aptitudes and preferences were more likely to remain beyond the ten-year mark than peers who did not.[10] Likewise, the Talent Based Branching redesign explicitly cites increased officer retention as one of its institutional objectives.[11] These early indicators reinforce the broader principle. When identity and occupation align, commitment deepens.

Allies have reached similar conclusions. Scholars of the Israel Defense Forces highlight that building purpose before specialization strengthens adaptability under ambiguity. British Army leadership doctrine emphasizes early formation of mission-oriented identity as a foundation for distributed leadership.[12] Leaders who do not assume initiative will appear later must design for it early.

The next generation of Soldiers will operate in contested, dispersed environments where degraded communication is the norm. No system can substitute for the human sense of belonging that sustains will. Machines extend reach. People preserve resolve.

Designing for Transformation

Transformation begins with people. It is cultural before it is technical. *TRADOC Pamphlet 525-3-1* states that dispersed, contested operations require Soldiers capable of independent action.[13]Achieving that begins with recruiting and continues through every developmental step.

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[9] Army University Press, "West Point Talent Based Branching Program," Journal of Military Learning, 2025.
[10] M. A. Schaub and C. Mullins, "Do the Best and Brightest West Point Officers Stay in or Leave the Army?" USMA, 2023.
[11] Orrison, Remorino, and Zhou, "Redesigning the US Army's Branching Process," ACM, 2021.
[12] Israel Defense Forces, "Mission Command in the IDF," 2016; British Army, *Army Leadership Doctrine*, 2016.
[13] TRADOC, *The US Army in Multi-Domain Operations 2028* (TRADOC Pamphlet 525-3-1), 2018.

A Future Soldier's first interaction with a recruiter communicates what the Army values. Well-aligned accessions become multipliers. Misaligned ones often become retention fights. Repairing is costlier than design. The Army cannot modernize formations without modernizing how it forms people.

Alignment at scale strengthens Army Total Force readiness across the Active, Reserve, and National Guard components.

Bridging Officer Talent Based Branching and Enlisted Alignment

The officer corps has already undergone significant alignment reform. West Point once assigned branches primarily by class rank. Today, the Talent Based Branching model integrates academic performance, cognitive assessments, personality and trait measures, preferences, and branch requirements.[14] ROTC followed with its Talent Assessment Battery and structured branching interviews.[15] Early indicators from West Point's longitudinal studies show that officers who enter branches aligned with their strengths and preferences demonstrate stronger performance and higher indications of long-term service.[16]

Officers benefit from four years of structured observation, assessment, and counseling before branching decisions are finalized. Enlisted accessions do not have that luxury. Many applicants move from first contact to shipping in a matter of weeks. This difference argues for a lighter, faster alignment model for enlisted Soldiers, not for abandoning the principle altogether.

The enlisted force, which constitutes the majority of the Army, has no comparable model. Enlisted MOS selection still relies on ASVAB line scores, mission requirements, and time-constrained counseling. This measures capability but not identity.

This gap is significant. Questions about identity alignment, scalable data integration, and institutional incentives belong in the same intellectual space explored by West Point's military innovation and organizational research programs. These are not recruiting questions. They are force design questions**.**

The Case for a Data Driven Enlisted Alignment Model

The Army already possesses key components of an enlisted alignment system. The Tailored Adaptive Personality Assessment System (TAPAS) measures temperament, persistence, and work style. The ASVAB test measures cognitive ability. Recent Army Research Institute studies indicate that combining personality, vocational interest, and cognitive data improves job fit,

[14] Army University Press, "West Point Talent Based Branching Program."
[15] US Army Cadet Command, *Talent Based Branching Handbook*, 2021.
[16] Schaub and Mullins, "Do the Best and Brightest Officers Stay in or Leave the Army?"

satisfaction, and MOS-specific performance beyond cognitive ability alone.[17, 18] Additional research shows that personality traits predict attrition and job knowledge in military contexts.[19]

A modern enlisted alignment model could integrate these components to generate an alignment profile that blends cognitive potential, temperament, purpose, and interest. This would shift alignment from qualification to identity and would reinforce the human-centered requirements outlined in modern doctrine.

Enlisted Soldiers benefit directly from identity-based alignment. Soldiers who understand their roles and feel connected to their occupational identity demonstrate higher confidence, stronger motivation, and deeper commitment to the profession. Alignment increases job satisfaction, supports psychological resilience, and accelerates the type of mission command competence that *ADP 6-0* describes as grounded in trust, understanding, and disciplined initiative.[20]

Some critics argue that MOS seat constraints and accession timelines prevent deeper alignment. Yet misalignment produces far greater friction downstream. Training failures, early separation, reduced morale, and lost leadership potential cost more over time than the deliberate alignment of a Future Soldier at entry. Importantly, implementing an alignment model does not require new systems or large investment. It reorganizes existing tools, such as ASVAB line scores, TAPAS data, and interest inventories, into a coherent recommendation system.

FM 3-0 affirms that war is fundamentally a human endeavor.[21] This aligns with the Clausewitzian concept that while the character of warfare evolves, its nature remains unchanged. Alignment is therefore not an administrative improvement. It is a requirement for warfighting adaptability.

Implementation Pathways and Institutional Considerations

Expanding enlisted talent alignment does not require a complete redesign of the accession system. Meaningful progress can begin with pilot programs that integrate MOS interest inventories, TAPAS insights, and ASVAB line-score data to generate an alignment profile within existing Military Entrance Processing Stations and recruiting timelines. The Army could test small cohorts to assess satisfaction, performance, and attrition against alignment variables.

This approach aligns with the Army People Strategy's model of acquiring, developing, employing, and retaining talent. By capturing identity and preference data earlier, commanders at basic training, MOS school, and first-unit assignment would receive Soldiers whose strengths are more visible, allowing for more targeted development and improved retention.

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[17] US Army Research Institute, "Adaptive Vocational Interest Diagnostic," ARI, 2020.
[18] C. D. Nye et al., "Examining Personality for the Selection and Classification of Soldiers," *Military Psychology* 32, no. 2 (2020).
[19] A. K. Coombs, "Modeling Attrition in a Military Selection Context," PhD diss., Virginia Tech, 2020.
[20] Headquarters, Department of the Army, *ADP 6-0*: *Mission Command*, 2022.
[21] Headquarters, Department of the Army, *FM 3-0: Operations*, 2022.

Data governance considerations would be modest. Identity-alignment data could be hosted within existing personnel systems using controlled access, similar to how officer branching inputs are stored today. A longitudinal assessment cycle at reception, MOS school, and six months post-arrival would provide leaders with actionable insights without adding administrative burden.

These steps would not only improve individual outcomes but would strengthen formation-level readiness by reducing misalignment friction and building Soldiers who can contribute earlier and more confidently.

Implications for the Future Fight

The next fight will not wait for the Army to relearn initiative after contact. It will reward the nation that built it before contact. Deterrence is no longer the promise of overwhelming firepower. It is proof that US formations will continue to think, maneuver, adapt, and reconstitute even when communications collapse and structure fractures. Adversaries are betting they can break tempo before the United States can regain it. The counter is not a platform. It is a person. That person is first shaped by the recruiter, not by the battlefield.

The Army cannot claim to be transformed if it has not transformed the way it forms its people. The nation that wins the next war will not be the one with the most exquisite systems. It will be the one with Soldiers most able to act without permission when the moment arrives. Deterrence is not a promise of future strength. It is proof of present readiness.

China is watching to see whether the United States is building a force that can continue fighting after disruption, not whether it can perform optimally under ideal conditions. A nation that builds initiative at the point of accession signals that its formations will remain cohesive even when cut off, isolated, or operating without guidance. That is the deterrent power of alignment. It denies the adversary's belief in paralysis.

The first battle is identity, and identity begins at the door. In an era of intelligent machines, the Army's advantage will always be the intelligent Soldier.

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Building the Warfighter's Edge: Training and Educating Officers for Modern War

Mark Federovich, Jessica Caddell, and Jeffrey Scott

In the summer of 1927, Major Dwight D. Eisenhower arrived at the Army War College in Washington, D.C., after recently completing a year at the Command and General Staff School at Fort Leavenworth. World War I had ended less than ten years earlier, and its lessons were clear: the next conflict would be won through massed firepower, static defenses, and the strategic use of industrial strength. However, Eisenhower and others recognized that something else was changing. Mechanization, air power, and radio communication were transforming not only the tools of war but also its pace and geography. Military academics at these schools needed to decide whether to educate officers for the last war or prepare them for the next conflict.

The Army's schools chose the harder path—to prepare officers for the next war rather than the last one. At Leavenworth, instructors introduced map exercises that required students to make decisions under time pressure with incomplete information.1 At the War College, officers studied not just tactics but strategy, logistics, and the integration of emerging technologies into operational art.2 The training was demanding, iterative, and designed to cultivate adaptability rather than rote memorization of doctrine.3 When war came in 1941, the officers who had passed through those classrooms, such as Eisenhower, Patton, Bradley, and Marshall, were not overwhelmed by its complexity. They had spent time wrestling with ambiguous problems in the classroom, and that preparation gave them the intellectual agility to adapt when the battlefield did not conform to doctrine.

Today's military educators face the same dilemma, but earlier in an officer's education and at far greater speed. The character of war is shifting again, and the pace of change has accelerated.4 The conflict in Ukraine, once compared to the trench warfare of 1914, has instead become a battlefield for semi-autonomous drones, electronic warfare, and AI-enabled targeting.5 Skies swarm with unmanned systems conducting surveillance and precision strikes; even momentary exposure has become a lethal risk.6 Meanwhile, the growing strategic alignment among Russia, Iran, North Korea, and China is internationalizing conflict and accelerating the diffusion of advanced military technologies across theaters. This growing array of state-level threats represents the most significant challenge to American interests in sixty years, and it demands a generation of officers who can think critically across geographic, technological, and doctrinal boundaries.7

At West Point, we are responding to that challenge by adapting our curricula to educate our future leaders for the next conflict.8 In a recent essay, the Dean of the Academic Board described how the Academy produces both "timeless" and "timely" leaders of character—officers grounded in enduring values but educated in disciplines of strategic importance to the current moment.9 The academic program teaches cadets to think, analyze, and solve problems, while the military program teaches them to do so while tired, cold, uncertain, and responsible for the soldiers to their left and right. Just as the Dean has described West Point's historic obligation to provide professional military expertise in areas of strategic importance, the Department of Military

Instruction (DMI) ensures that expertise integrates into the operational and tactical domains where our graduates will first lead.

DMI and the Defense and Strategic Studies (DSS) Program are educating and training our future lieutenants using a framework built on four pillars drawn from the interwar experience. First, we ground cadets in theory—a deep understanding of how the United States, its partners, and its adversaries think and fight. Second, we provide rigorous practice—controlled environments where cadets can fail, adapt, and build the cognitive agility that combat demands. Third, we connect learning to application—exposing cadets to real operational complexity before they assume their first leadership roles. And fourth, we cultivate inspiration—the conviction that learning does not end at graduation but defines a career of service. As the Class of 2030 arrives this summer, they will join an Army transforming to meet an expanding list of threats operating across different geographic regions.10 Our job is to ensure that when the moment of crisis comes—as it came for Eisenhower's generation—our officers are ready not just to fight, but to think, adapt, and win.

Theory: Understanding How Adversaries Fight

First, the interwar reformers understood that adaptation begins with knowledge. Before officers could integrate tanks into combined-arms formations or coordinate air support with ground maneuver, they had to understand the capabilities and limitations of those systems, and how potential adversaries might employ them. Education preceded application.

The Department of Military Instruction follows a similar approach. Both the DSS and Military Science Programs revised curricula to cover not only US strategy, tactics, and doctrine, but also the Chinese way of war, including PLA doctrine, force structure, and strategic culture. Cadets learn operational concepts such as multi-domain operations and information dominance. These curricular changes reflect guidance from the 2023 China Military Power Report and the Army's requirement to understand and prepare for the full range of potential adversaries, with particular emphasis on near-peer competitors.11 Cadets graduate with a solid understanding of how America's main competitor thinks about and prepares for conflict.

Studying doctrine is just the beginning. Cadets must apply that knowledge under pressure. To this end, DMI and DSS have expanded the use of experiential learning tools: wargaming, simulations, red teaming, and Fiction Intelligence (FICINT).12 These methods push future leaders beyond memorization into repeated decision-making under stress. A cadet who has war-gamed a Taiwan Strait scenario numerous times, testing different assumptions, watching plans fall apart, adjusting on the fly, develops intuitions that no lecture can provide.

The Department has aligned its curriculum with how today's tactical leaders must operate: integrating effects across domains, anticipating enemy disruptions, and learning to lead when communications are degraded or manipulated. Cadets are not just studying how future adversaries fight; they are learning how to counter them using everything from emerging artificial intelligence tools to drones. We are training them to test concepts in controlled environments, so they develop the adaptability, improvisation, and resilience that combat will demand.

Practice: Learning Through Controlled Failure

Second, the interwar schools did something else that proved essential: they created environments where officers could fail without catastrophic consequences. The map exercises at Leavenworth were designed to be difficult. Officers made mistakes, received feedback, and tried again. By the time they commanded divisions, they had already confronted some of the problems they would face and learned how to recover from errors.

This principle—that failure in training improves leader agility—guides our approach at the West Point Simulation Center and in Cadet Summer Training. Cadets train with drones, virtual and augmented reality systems, and immersive synthetic environments that replicate the complexity of the modern battlefield, increasing the lethality of new lieutenants from day one. Situational training exercise lanes and battle drill training in the woodline remain foundational, but we now owe our cadets a richer environment than the one available during junior officer development in the counterinsurgency era. Through a partnership between DMI and the Robotics Research Center—one of several collaborations linking the military program to the Academy's broader research enterprise—cadets now experience a quality and density of drone employment that have not previously been present in their training.

Immersive environments allow cadets to rehearse decision-making under conditions of uncertainty, speed, and information overload. Equally important, they enable us to study the information demands placed on leaders and identify where to leverage technology in support of soldiers rather than burden them. Simulations are traditionally used to reduce cost and risk, but DMI has expanded their purpose: they now give cadets space to experiment, fail, and learn in a full, multi-domain, combined-arms context before they are expected to lead in it. These environments allow DMI to replicate operational problems that are otherwise impossible to train at the cadet level, such as coordinating maneuver across branches, synchronizing effects across domains, and integrating joint and enabling capabilities in support of tactical objectives. By confronting cadets with these complex coordination challenges early, the military program accelerates their ability to understand how their decisions contribute to larger operational effects.

We are also enabling cadets to build their own virtual environments for applied research and training. They can isolate specific elements of the contemporary operating environment, study them, develop solutions, rehearse responses, and then integrate those lessons into the fuller tactical, operational, or strategic picture. The goal is to ensure that future leaders do not merely understand modern war but can anticipate it, adapt within it, and shape its outcomes.

The selective Vanguard Initiative exemplifies this philosophy.13 Beginning with field-based skills, Vanguard grows into a rich live-virtual training experience that offers cadets challenging, mission-relevant scenarios and opportunities to reflect on the profession of arms. Cadets interested in infantry operations conduct live field training while cadets in branches such as aviation, armor, and engineers participate virtually, creating a combined-arms environment that surrounds the live exercise with simulated enablers and joint effects. Each Vanguard cohort operates within a single overarching campaign framework, where individual missions are nested within a larger operational scenario. This design ensures that cadets experience both the

autonomy and friction of tactical leadership and the necessity of coordinating actions across multiple units and domains. While individual missions remain resilient to disruption, their integration within a broader campaign forces cadets to anticipate dependencies, communicate across elements, and adjust to evolving operational triggers, mirroring the realities of modern warfare. The live-virtual construct not only generates enthusiastic buy-in across Army combat operations but also builds an early appreciation for convergence and operational synchronization before cadets ever reach their first unit.

Application: Connecting Learning to Operational Reality

The interwar reformers recognized a third truth: that classroom learning alone, however rigorous, was insufficient preparation for the demands of conflict. Promising officers needed exposure to the problems they may face—the ambiguity, the competing priorities, and the friction of operating within complex organizations. Eisenhower's education continued long after he left the War College, through assignments that brought him into contact with strategic planning, military operations, and national policy.

Beyond Cadet Troop Leader Training, the Academy has expanded opportunities for cadets to gain operational exposure. Through internships with combatant and subordinate commands—opportunities coordinated across the Academy's academic departments, centers, and institutes alongside DMI—cadets engage with the challenges faced by junior and senior leaders at units such as the United States Indo-Pacific Command, United States European Command, and the Special Assistance Group-Ukraine. Future leaders encounter contemporary challenges ranging from theater posture and influence operations to contested logistics and multinational coordination. These experiences provide more than exposure to operational problems; they offer cadets insight into how tactical actions support strategic objectives. By observing initiatives such as Pacific Pathways, which expands the Army’s engagement with partner nations in the Indo-Pacific region, and other theater posture campaigns, cadets begin to understand how clearly articulating purpose, intent, and effects enables coordination across formations and contributes to larger operational and strategic outcomes. This exposure strengthens their ability to think beyond immediate tasks and lead with an understanding of how their unit contributes to broader campaigns.

The goal is to ensure that our graduates arrive at their first units as officers who have already grappled with some of the complexities of modern operations. They will have seen the integration of kinetic and non-kinetic fires. They will have trained against a thinking enemy in synthetic environments. They will have seen how strategic decisions translate into operational effects. None of this replaces the learning that occurs in units, but it provides new lieutenants with a foundation that accelerates their development and deepens their contributions from day one.

Inspiration: Cultivating the Will to Keep Learning

There is a fourth and final element of the interwar story that is easy to overlook. The officers who helped transform the Army's schools in the 1920’s and 1930’s were motivated by a belief that change was necessary. Patton was a cavalryman who became an evangelist for armor: he

commanded the first American tank units in combat during the Great War, and in the interwar years, he wrote about mechanized warfare, arguing that tanks should operate not as infantry support but as an independent striking force.14 Marshall championed officers who would argue with him—and modeled that behavior himself, most famously when, as a newly minted one-star general in 1938, he was the only official in a White House meeting to disagree with President Roosevelt's defense plan.15 The reformers succeeded not just because they had good ideas, but because they were inspired to pursue them.

Inspiration is the often-overlooked foundation of enduring learning. Application-based education has its greatest impact when cadets believe in its purpose and are motivated to continue their development long after graduation.

Cadets are inspired by leaders who model critical thinking, engage with difficult questions, and demonstrate the humility to continue learning. Across the Academy, uniformed instructors who have recently returned from operational assignments bring the credibility of lived experience into the classroom and training environment. When a major who led a battalion staff through a contested logistics problem in the Pacific teaches cadets how to plan under uncertainty, the lesson carries a weight that no textbook can replicate. Through the MWI Speaker Series, War Council Panels, and mentorship from USMA staff and faculty, cadets encounter leaders, policymakers, strategists, and innovators who embody the truth that leadership is as much about the warrior ethos as it is about intellectual competence.

Beyond mentorship, West Point cultivates inspiration through writing, research, and publication. The Modern War Journal, thesis projects, capstone research, and presentations at the West Point Projects Day Research Symposium give cadets the opportunity to work with stakeholders across the Department of War and other government organizations. They contribute to defense debates, publish their insights, and see their work connected to real outcomes. When cadets understand that their ideas matter and that their thinking can inform solutions, they begin to view learning not as a requirement to complete but as a lifelong responsibility of leadership.

Conclusion: Ready for the Moment

We face an inflection point. The character of war is changing faster than at any time since the interwar period. Autonomous systems, artificial intelligence, electronic warfare, and the weaponization of information are reshaping what it means to fight and win. The adversaries our cadets will face are closely studying these developments and adapting their forces. We must do the same, and faster.

At West Point and within the Department of Military Instruction, we are answering that call. We are building officers who can outfight, outthink, and out-adapt our adversaries.16 We are training them not just to execute doctrine but to recognize when doctrine might need to change. We are teaching them to fail in controlled environments so they can later succeed. And we are cultivating in them the conviction that learning does not end at graduation but defines a career—because the lethality of our future force depends not only on the systems we field but on the leaders who employ them. The interwar generation did not know what was coming, but they were ready when it arrived. Our task is to ensure this generation is ready too.

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In the Age of AI, Why the Spirit of the Bayonet Still Matters

Connor Lister

What makes the grass grow?

"*Blood. Blood. Blood*."

As today's conflicts evolve into the wars of tomorrow, the age of artificial intelligence and autonomous warfare has arrived. Lethality can now be deployed with unprecedented precision. The proliferation of uncrewed systems, autonomous sensors, and smart munitions has fundamentally changed the character of war and the way military formations operate. The scale and precision of these threats across all domains compel militaries worldwide to adapt their doctrine, formations, and capabilities or to fail.

In this new age, it is tempting to believe that war itself is becoming mechanized, sanitized, and detached from the human element. Yet standing on the field at West Point, looking into the eyes of cadets who will one day lead soldiers into harm's way, we are reminded that no algorithm can replace what our doctrine has long called the spirit of the bayonet.

What is the spirit of the bayonet?

"*To kill*."

The cadets roared in unison, their faces streaked with sweat and dirt. Bayonets fixed, they stood ready to advance. They had begun their induction into the simplest yet most demanding weapon system. The 1.5 pounds of rolled steel at the end of their rifles would have been familiar to Achilles' Myrmidons, known to Wolfe's Grenadiers, and wielded by the youth on the Somme. Cadets specializing in advanced robotics, nuclear sciences, and future Rhodes Scholars shared a moment of grit and drive that transcends time. An epitome of the warrior ethos that has changed the world and one day will change it again.

In October 2025, cadets belonging to West Point's Vanguard Initiative took to the field to imbue themselves with that ethos. Forgoing one of their precious weekends to air assault into a mountainous objective. While their classmates slept these cadets conducted mock offensive operations through freezing rain and snow. Though physically beaten, they mustered as a platoon for their final objective. Tucked into the woods they were drilled in the stances and techniques of employing the bayonet. By day's end, each cadet had assaulted through a bayonet lane to engage enemy targets as the guns of the support-by-fire rattled around them.

For many of these cadets, it was the first time they had experienced training of this kind. Each cadet must turn emotion into will, push beyond their own perceived physical limits to achieve the mission and defeat the foe. The objective of the training was simple: expose the cadets to stressors and force them to persevere through willpower. The bayonet itself is just a ve

As each cadet reached their limit of exertion, the final and perhaps most important portion of the training began: reflection. As their blood cooled, they rested and discussed their individual reactions to the training. Who lost control? Who struggled to push through exhaustion? Who is prepared to go again?

The Modern War Institute's own Dr. Charles Faint led the reflection. Sitting alongside the cadets, he discussed the evolving realities of conflict, matching their emotions to his own experiences and arming them with tools to clarify what they had just endured and, more importantly, how they could better shape their reactions in the future.

The US Army codified the "spirit of the bayonet" as far back as the Second World War. The Department of War's Field Manual 23-25 (June 1943) defined it as: "the will to meet and destroy the enemy in hand-to-hand combat." As the world fought bitterly to overthrow tyranny, the spirit of the bayonet was not about the weapon; it was about the will.

With notable exceptions in moments of courageous desperation, few modern soldiers use bayonets for anything outside of ceremonial drill (and opening MREs). A prevailing sentiment holds that bayonet training has no place in a modern military. That other robust training events can emulate the intended objectives. That the AI empowered battlefield has no requirement for metal to be thrust into meat. Many critics focus on the weapon's role in warfare and not on the outcome of the training.

Many critics fail to understand that the bayonet is the embodiment of raw will. Will is the determination to close with and defeat an adversary despite fear, exhaustion, and uncertainty. It is the belief that victory ultimately belongs not to the side with the most advanced tools, but to the side whose soldiers refuse to break. It is courage distilled into action.

For generations, we've taught cadets that war is fundamentally a contest of opposing human wills. Clausewitz knew it; Marshall emphasized it; Liddell Hart preached it; and every veteran understands it in their bones. Technology amplifies capabilities, but it does not replace the warrior's mindset. Even the most advanced systems require humans to interpret ambiguous environments, make moral decisions, and maintain cohesion under conditions that no machine will ever fully comprehend.

Future conflicts—messy, urban, fast-paced, and influenced by non-state actors and asymmetric threats—will demand more fighting spirit, not less. AI may help us sense and shoot, but it cannot persevere. It cannot improvise when the plan collapses or rally a platoon when chaos engulfs the mission. The enemy gets a vote, and that vote often comes in the form of friction, confusion, and emotional shock, conditions only resilient, disciplined humans can overcome.

This is why we still teach, in spirit if not always in form, the ethos behind the employment of the bayonet. It builds confidence. It steels resolve. It reminds future officers that when everything else fails, whether communications, drones, GPS, or even the vaunted "AI-enabled kill chain"

what remains is the character, training, and determination of the soldier. The bayonet, like the fighting spirit it represents, endures.

As long as war involves human beings, the spirit of the bayonet will matter. AI may shape the next fight, but it will not win it alone. That responsibility, and that honor, still belongs to the soldier who refuses to yield; to those who embody, and inspire, the spirit of the bayonet.

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Technology and the New Paradigm of Deterrence in the Indian Subcontinent

Ravi Murugan

State vs. State conventional conflicts are here to stay. The expectation that globalization and an interconnected world will lead to more peaceful ways of settling inter-state disputes has not been met. Our experience in the first two decades of the 21st century indicates that the use of military force remains a viable go-to option in the quiver of Comprehensive National Power (CNP) for protecting and furthering national interests. While inter-state conflict has decreased significantly since the 20th century, they continue to be a possibility, especially in regions where disputed borders, historical fault lines, and legacy differences persist.

In the Indian context, the sub-continent is a troubled neighborhood with active borders, both to the west and the north, and a history of past conflicts. In ensuring national security and protecting sovereignty, the need for a strong and capable military is *sine qua non*. A military capability will *ipso facto* need to secure a nation's land, sea, space, borders, and deter the threat of adversary use of force, allowing the safeguarding of national interests. Therefore, considering local dynamics, any force capability must be premised on a threat with force application calculus.

A clear-eyed look at the major conventional threats India faces on its borders indicates:

- A hostile near-peer nuclear adversary in Pakistan on its western border with whom it has fought five wars and continues to have unresolved active borders, along with near numerical equivalence and near technological parity in battle systems.
- To the north, it shares a long and disputed border with an unfriendly nuclear power in China, with whom it has fought one war and multiple skirmishes. This security environment has been further vitiated by China's newfound assertiveness backed by greater numbers, a distinct technology edge, and a growing indigenous military manufacturing base.

Thus, the conventional threat environment on the Indian borders can be summed up as: a near-peer overtly hostile nuclear adversary on the western border and a superior, coercive nuclear power on India's northern border.

The Shifting Paradigm of Conventional Conflict

In the information age and the communication revolution that has underpinned it, technology has become an integral part of CNP, both from an economic perspective and in developing information-age military capability. The singular overarching reach of technology and intellectual property that pervades every aspect of our lives today has become, possibly, a main driver of a nation's influence, impacting both its capability to create wealth and its effectiveness in waging war. Towards this end, precision, long-range offensive systems like missiles, rockets, artillery guns, and drones are providing militaries with options that do not involve the use of troops to cross into adversary territory.

Traditional peer wars in the 20th century were organized around maneuver, massed formations, and territorial seizure. However, in the current battlefield milieu, modern defenses with ubiquitous surveillance & battlefield transparency seem to be exponentially raising the cost of combined arms maneuver. The emergent pattern today is what can be termed a mid-spectrum stand-off paradigm, characterized by controlled effects delivered at ranges beyond conventional front lines and at tempos dominated by autonomous or semi-autonomous precision systems.

Combatants aim to inflict operationally relevant effects (sensor nodes, air defenses, logistics hubs, command nodes) using missiles, rockets, artillery, loitering munitions, and drones rather than attempting concentrated physical offensives into enemy depth. This approach reduces the conventional utility of massed armor and sustained ground offensives while placing a premium on sensors, networked fire delivery, logistics survivability, and layered air and missile defenses.

Over the past half-decade, conflicts from Nagorno-Karabakh to Ukraine and the wider Middle East have shown a discernible shift from classic massed physical offensives between peer or near-peer adversaries, toward limited engagements dominated by stand-off fires: long-range cruise and ballistic missiles, massed and precision guided loitering munitions and drones, and integrated effects using electronic warfare (EW), cyber, and space assets. This has led to two paradoxical outcomes in recent years:

(a) The threshold of conflict has been lowered by technology in both asymmetric and near-peer conflicts. Asymmetric conflicts follow the Thucydides dictum of "The strong do what they can and the weak suffer what they must." The strong deliver punishment using standoff systems without putting personnel or equipment at risk, and the weak respond or act with the technology at their disposal. While in near-peer conflicts, any escalation to the high end of the conflict spectrum invariably results in the perceived winner suffering as much as the loser. Here, standoff attacks satisfy the need and effectiveness of response while reducing the risk of escalation.

(b) Notwithstanding the above, while the threshold of conflict has been lowered due to the proliferation of stand-off weapon systems, new technologies have also made war more lethal, which deters mass, full-spectrum conflicts between states. In recent conflicts, technology and geopolitics limit war aims between near-peers, and all parties are liable to seek to contain fighting rather than climb the escalatory spectrum. In effect, warfare is now being conducted through limited campaigns with the support of autonomous systems, long- range fires, and sensor dominance.

(c) What has thus become evident in recent years is that the standoff mode of waging contact war, made easy by information age technology, is becoming the preferred form of engagement in both asymmetrical and near-peer conflicts.

Why this Shift, and Inferences for the Indian Subcontinent

Certain drivers possibly explain the move to mid-spectrum standoff engagements in state vs state conflicts:

(a) Risk Aversion and Escalation Control.

(i) Peer states typically seek to achieve tactical and operational objectives while minimizing the political risks and escalation of damage linked to occupying enemy territory. Long-range strikes and precision fires enable them to satisfy the need for response with a lower risk of escalation.

(ii) States can pursue coercive objectives without committing large forces across borders, which is especially useful where escalation thresholds are sensitive.

(b) Affordability and Proliferation of Capability. The cost curve for effective standoff weapons, small cruise missiles, loitering munitions, and armed UAVs has fallen. Cheaper, mass-producible attack drones and guided munitions allow state and non-state actors to field large salvos that complicate a defender's air defense calculus.

(c) Technology Convergence. Improvements in ISR (intelligence, surveillance, reconnaissance), targeting databases, secure datalinks, autonomous navigation, and precise last mile targeting enable distributed, networked fires to achieve high and visible effects on the battlefield, without needing to close the distance. Electronic warfare and cyber provide force multipliers to disrupt enemy sensors and command networks, creating windows for stand-off attacks.

In the Indian subcontinent, use of force is likely to transit the path of low-spectrum border skirmishes to mid-spectrum standoff "duels," at least in the near to mid-term, for the following reasons:

(a) On the western borders, neither country possesses a clear combat advantage to achieve effective "compellence," providing no strong justification for escalating the conflict to a high intensity, with its attendant destruction, casualties, and risk of a prolonged stalemate. Moreover, the impetus for military response is primarily shaped by domestic considerations, which can be satisfactorily addressed through visible stand-off strikes employing advanced, information-age weapon systems. It also bears consideration that between near-peer adversaries, the bigger country with greater endurance and capacity to absorb the costs of a limited conflict can impose a significant penalty on a weaker adversary through a continuum of multiple recurring stand-off engagements, contributing to deterrence when viewed as a whole.

(b) On the northern borders, while China enjoys a clear multi-domain advantage, any high-intensity conventional conflict would result in significant losses in the high mountains and the maritime domain for both sides, without any reasonable assurance of achieving strategic objectives. Consequently, there is little military justification for either party to escalate the conflict. In this context, hostilities are most likely to remain at the lower end of the conflict spectrum in the form of skirmishes, with any escalation confined primarily to limited standoff exchanges.

(c) Lastly, while recent events demonstrate that limited conventional conflict is possible even between nuclear-armed adversaries, escalation to the high-intensity spectrum carries substantial deterrent risks and offers no clear strategic benefits. These factors should serve to limit the escalatory spiral, keeping it within controllable, mid-level thresholds.

As being witnessed, the mid-spectrum becomes both a battlefield and a zone of persistent political coercion, a low to medium intensity, "neither hot war, nor peace," posture where periodic standoff strikes shape behavior without declaring wars. Advances in information age weaponry, such as cruise missiles, loitering munitions, and drones, allow for calibrated retaliation and signaling. Modular, rapid response standoff capabilities enable leaders to scale strikes up or down, maintaining flexibility and avoiding commitment to costly ground mobilizations.

How the Paradigm Has Worked in Recent Conflicts Across Shared Borders

Nagorno-Karabakh (2020) and the TB2 Effect. Azerbaijan's 2020 campaign demonstrated how relatively low-cost, armed tactical UAVs (notably the Turkish Bayraktar TB2) can impose disproportionate effects on adversary combined arms units, air defenses, and artillery when integrated into a comprehensive fire plan. By spotting, targeting, and delivering guided micro-munitions, the TB2 helped disable enemy air defense systems and armor at standoff ranges. Azerbaijan collapsed Armenian defensive belts without mass ground advances typical of earlier eras. This conflict provided a pivotal demonstration that drones could shape operational outcomes in a short, sharp campaign.

Russia–Ukraine (2022–2025) and Drone saturation, Layered Effects, and Cruise Missiles. The Ukraine war has become the most vivid laboratory of mid-spectrum warfare. Two features stand out:

(a) **Drone and Loitering Munitions Saturation**. Russia's large-scale use of Iranian-origin Shahed series attack drones and indigenously produced variants illustrated how massed low-cost loitering munitions can be used to wear down air defenses, disrupt logistics and attack infrastructure. Over 2024–2025, Russian Shahed campaigns produced waves of launches in intensive episodes, forcing Ukraine to reconfigure defensive priorities and resilience measures. In turn, innovative use of First Person View (FPV) drones, at scale, by Ukraine has converted defensive lines into static 'no move' zones, while completely negating concentration and maneuver of mechanized forces.

(b) **Long Range Precision Fires for Operational Reach**. Western-supplied long-range cruise missiles like the Storm Shadow and US long-range artillery and rocket effects changed the depth at which targets could be held at risk. Kyiv's limited authority to strike into Russian territory with long-range munitions (and its actual use) underlines how stand-off weapons extend battlefield geometry beyond front-line contact.

(c) Combined, massed loitering munitions and precision long-range strikes have forced both sides to invest heavily in layered air defenses, EW, mobile dispersal, and passive hardening, which are classic adaptations to a standoff environment.

Operation Sindoor: India-Pakistan (2025). The India–Pakistan conflict in May 2025 illustrates the emerging paradigm among near-peer adversaries: a clear preference for stand-off exchanges over large-scale close combat. Both sides employed advanced precision munitions, drones, cruise missiles, and layered air defense systems, conducting strikes against key selected objectives, while deliberately avoiding a broader ground offensive. In essence, this was in a similar vein as the standoff exchanges post the terrorist strike in Pulwama in 2019.

The Middle East and the Asymmetric Dynamic (2023-25). The October 2023 Hamas assault and subsequent operations showcased two central dynamics. First, inexpensive rocket and drone salvos continue to be used for area effects and attrition, pressuring urban infrastructures. Second, Israel's reliance on layered missile defense systems (Iron Dome, David's Sling, Arrow), paired with deep-strike standoff options, shows an asymmetric interplay of massed low-cost attacks against expensive layered defense and selective long-range counterstrikes. The 2024–25 period also showed how regional actors like the Houthis project standoff effects beyond immediate borders via drones and missiles, blurring geographic thresholds for conflict.

Lessons for Indian Security: Doctrine and Procurement

India faces a uniquely complex neighborhood: two nuclear-armed neighbors on different flanks, increasing great power competition in the Indian Ocean, and non-state threats. The standoff paradigm has profound implications across deterrence, force posture, doctrine, and the industrial base.

Deterrence: Integrating Conventional and New Technology Domains.

(a) As posited, if conflict is most likely to manifest in the low to mid-level of the conflict spectrum, the following appears axiomatic:

(i) Large combined arms forces will remain a potent "threat in being" to deter motivation for any adversary to escalate to the high end of the conflict spectrum.

(ii) If operational maneuver is unlikely to be the primary resort in the use of force, tactical dominance of the battle space becomes critical, for which:

- Advantage in drones and robotic systems, and long-range indirect fires capability would form the backbone of the "shooter" ecosystem to deter adversary forces. In the unmanned platforms domain, scalability and affordability will be critical in massing effect.

- Layered and networked air defense architecture will be needed to mitigate the impact of a similar enemy.

- Dominating the electromagnetic spectrum to ensure sensor superiority for battlefield transparency and robust networks for

data transmission will provide the “information” necessary for denial of surprise and precision targetting.

- Embedding of artificial intelligence for sensor data fusion and decision support systems would be necessary for rapid orientation, decision making, and decisive action.

(b) Thus, any deterrence calculus must expand beyond nuclear signals and large conventional formations to include:

(i) Demonstrated resilient capacity to absorb and respond to massed standoff attacks by hardening critical infrastructure, having reserve stockpiles, resilient command and control, and civil-military coordination. At the tactical level, a robust and effective counter-UAS network with a sustainable cost per kill becomes essential to retain freedom of operational and logistic movement in a drone dominated nonlinear battle space.

(ii) Credible counter strike options at operational depth to include land, air, and sea-based cruise and anti-ship missiles, air-launched standoff munitions, and long-range UAS that can impose costs on adversary critical points.

(c) In sum, the following warfighting categories will need to be bolstered for effective tactical overmatch in the low to mid spectrum of conventional conflict:

i. Attack systems.

- Loitering munitions & kamikaze drones. Cheap to produce and often expendable, these can be massed in salvos to overwhelm point defenses and create denial. Affordable scalability will decide tactical superiority.

- Tactical armed UAVs. Systems like TB2 demonstrated that medium-endurance UAVs with guided munitions can serve both ISR and strike roles effectively.

- Stand-off cruise and ballistic missiles. Weapon systems such as Storm Shadow and indigenous BrahMos cruise missiles provide mission planners with options to deliver precision effects from well beyond the frontline at operational depth.

  - 155mm howitzers and multiple launch rocket systems. Precision guidance kits and sensor fused munition value add traditional artillery and provide the capability to inflict significant damage, deter movement, and shape the battle space in the tactical domain.

(ii) Enablers: C4ISR, autonomy and production.

- Persistent ISR and targeting. Space and airborne sensors providing sensor dominance and sensor data fusion produce the target tracks needed for engagement.

- AI. AI in navigation, target recognition, decision support, last mile targetting and swarm algorithms allow precise and coordinated strikes.

- Mass production and supply chains. The ability to produce hundreds or thousands of inexpensive systems (engines, sensors, warheads) changes strategic calculus: quantity can be a form of qualitative advantage.

(iv) Countermeasures.

- Layered air and missile defenses. Point, short-range, and mid-range interceptors combined with soft-kill measures (jamming, spoofing) form the backbone of defense. Against drones and drone swarms, effectiveness and cost per kill will dictate the defensive architecture.

- Electronic warfare (EW) and cyber. EW can blind, confuse, or seize control of networked UAS while impacting effective use of the electromagnetic spectrum to the adversary; cyber effects can disrupt targeting chains.

- Resilience and dispersal. Hardened, dispersed logistics and redundancy (alternate supply nodes, mobile command and control) blunt the operational effect of a successful standoff strike.

Risks and Limits of the Stand-Off Paradigm

There are risks and limits to repeated standoff campaigns:

- Escalation unpredictability. Precision and perceived just cause do not eliminate escalation risk. Cumulative strikes on infrastructure can force disproportionate responses, especially when the scope of targeting increases with each response.

- Defense improvements will erode advantage over time. As layered air defenses, EW, and counter-UAS / missile systems improve, the operational cost of massed indirect strikes rises.

- Civilian harm and political blowback. Attacks on adversary homelands can trigger international backlash, diminishing the political utility of standoff campaigns.

Thus, while mid-spectrum standoff gives tempting operational options, it must be paired with strict political-strategic judgement and calibrated escalation management.

Conclusion

The mid-spectrum standoff paradigm is not simply a technological trend; it restructures the political and military contest between peers and near-peers. Recent conflicts have demonstrated that affordable drones, loitering munitions, and stand-off missiles can impose operational effects previously achievable only with large, conventional campaigns. For India, the implications are profound; deterrence now depends as much on resilience, industrial surge capacity, and integrated ISR as on mechanized forces and heavy formations.

The Army's path should be pragmatic, investing in layered defense, expanding indigenous standoff strike options, building robust counter-UAS and anti-missile systems, and rewriting doctrine to operate in an environment where the first meaningful blows may come from hundreds of kilometers away, delivered by machines.

The good news is that much of what is required is within reach, namely, a vibrant defense industry, an active R&D base (DRDO, private sector), and a political willingness to invest in both hard and soft resilience. The harder tasks are institutional; joint doctrine reform, legal diplomatic playbooks for ambiguous coercion, and cultural adaptation to distributed operations.

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Achieving Decision Advantage for the Army through Spatial Reasoning and Machine-Readable Worlds

Jonathan Pan

In 2006, I was a young infantry platoon leader using whiteboards, maps, acetate, and markers to plan. Nearly twenty years later, the platoon leaders, company commanders, and staff officers I have met across the Army at bases like Fort Campbell and Fort Bragg are still relying on those same analog tools. The reason they are going analog is because of AI fatigue across the force. Innovation teams at every echelon are pushing "AI" software that is often AI in name only. The soldiers tasked with trying this software belong to a digitally savvy generation. They are not sold on the hype.

Since the launch of ChatGPT in 2022, there has been a massive push across the Department of War to leverage AI for decision dominance. Yet, despite significant financial investment, the tactical edge still runs on acetate and whiteboards. Surmounting AI fatigue is only the first step; three specific technical and operational hurdles continue to block the path to genuine decision dominance at the edge.

First, the Army and the defense industrial base frequently treat command and control (C2) as a synonym for C5ISR (the tools for C2), neglecting to integrate the philosophies behind mission command. One underappreciated Army document would help them understand the distinction between key terms like decision support, decision advantage, and decision dominance. The Army Futures Command (AFC) – now the Army Transformation and Training Command – Pamphlet 71-20-9: *AFC Concept for Command and Control 2028: Pursuing Decision Dominance* defines the terms as follows:

1. **Decision dominance:** The desired end-state, "in which commanders sense, understand, decide, act, and assess faster and more effectively than their adversaries."

2. **Decision advantage**: A repeatable condition or step that leads to the cumulative effect of decision dominance. It is achieved by knowing ourselves, our adversaries, and the operational environment faster and more accurately than the enemy.

3. **Decision support tools**: Capabilities that enable increased speed and accuracy of achieving a decision advantage.

Second, the current obsession with Large Language Models (LLMs) is a dead end for tactical echelon planning. Tactical planning requires precise spatial and temporal reasoning. LLMs can predict the next word in an Army Commendation Medal recommendation form, but they do not "understand" the battlefield. They cannot generate a feasible course of action. They cannot generate a spatially accurate MCOO because it lacks world models.

Third, the demand signal for AI-enabled decision support software is inverted. The push has largely come from operational and theater-level organizations like combatant commands. These organizations have fundamentally different demands than the tactical edge, where the friction of terrain and time is most acute.

Outpacing Near-Peer Adversaries Through Spatial Reasoning and Machine-Readable Worlds

Decision advantage and decision dominance are, by definition, relative concepts; we must achieve them *over* someone else. Near-peer competitors now match the US across many domains and capabilities. The remaining lever for advantage may seem mundane, but it is critical: analyzing the "neutral" data of the operational environment—terrain, weather, and time—better and faster than the adversary.

Achieving spatial reasoning for the operational environment is the practical next step the Army must take. When warfighters understand *where* things are, *how* they are moving, and *what* will happen next, true decision advantage emerges. The technical architecture required to achieve this involves using neutral operational environment data to create machine-readable worlds that AI agents can exploit.

1. Data for World Models. Text—operations orders, reports, and chat—powers military operations, but text alone cannot represent how the world actually works. To reason about military operations, we need systems with spatial awareness and world models that can ingest the raw data of the operational environment—slope, soil composition, visibility, and weather effects—and translate them into constraints that a computer can understand. These are the areas where better modeling and better reasoning create disproportionate impact.

Many outputs that leverage this data are the "fighting products" commanders are asking for, such as the modified combined obstacle overlay, synchronization matrices, decision support templates, and more. After working with over ten Army brigades this year, the primary demand from the tactical edge is not for better text generation but for the ability to produce these spatially derived products faster and more accurately.

2. Building Machine-Readable Worlds. To enable spatial reasoning, we must first turn maps and geospatial data into machine-readable worlds. This is done using navigation meshes, or "navmeshes"—data structures popularized by the commercial video game industry. Navmeshes allow AI agents (like non-player characters in a game) to understand where they can move within a complex environment.

Once the environment is mesh-mapped, we integrate it with world models. A world model is a structured internal representation that allows an AI system to predict the consequences of actions

or events. Correlation of force and means models, weather models, and humanoid robot simulation models are all examples of world models that must be layered onto the navmesh.

3. Moving from "Chatbot AI" to "Spatial AI." The primary focus of AI agent development in the Department of War to date has been training agents on a corpus of documents: doctrine, manuals, and so on. These agents can answer questions like, "What is the maximum road speed of an M1 tank according to ATP 2-01.3?" or, "What is the fuel capacity of an M1 tank according to the OPLOG Planner?"

This is insufficient. We need AI agents that can navigate machine-readable worlds and apply underlying world models to dynamic situations. Instead of reciting a manual, a Spatial AI agent must be able to calculate exactly how a specific vehicle will perform on a specific sector of road with a fourteen percent soil California Bearing Ratio and 0.2mm of hourly rainfall, all while avoiding known enemy artillery range rings.

Conclusion

The path to decision dominance does not lie in building better chatbots, but in building spatial reasoning and world models. To win against a near-peer adversary, the Army must pivot from AI that merely reads doctrine to Spatial AI that understands the battlefield. By treating the operational environment as a machine-readable asset—leveraging navmeshes and physics-based world models—we can finally retire the acetate and give commanders the automated, spatially accurate fighting products they need.

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Reasoning in the Absence of Input: Expanding the Cognitive Frontier of Autonomous Systems

James Sturim

Future military operations will increasingly depend on autonomous and semi- autonomous systems capable of acting independently in complex, contested environments.

Autonomous systems today—whether based on deterministic logic, machine learning, or reinforcement learning (RL)—primarily operate on stimulus-response cycles. They are designed to detect, classify, and act upon observed changes in their environment. This architecture, while effective for well-structured tasks, assumes that meaningful events are *always observable*. Yet on the battlefield, absence can carry as much information as presence.[1]

Human cognition routinely interprets silence, missing signals, and deviations from expectation as indicators of change. The cinematic quip from *The Lucky Texan*—"I don't like it. It's too quiet."—captures this intuition.

Translating that instinct into machine reasoning represents a frontier in autonomous design. Doing so would enable future systems not only to respond to data but to reason about the lack thereof—a leap toward cognitive autonomy.[2]

Reasoning About What Is Missing

Current autonomous architectures typically fail to process "non-events." In deterministic systems, no trigger means no action; in learning systems, the model lacks the negative

reinforcement loop needed to interpret null results. This creates blind spots that can degrade mission performance.[3]

Consider an unmanned system designed to infer enemy proximity through radio-frequency (RF) emissions. If anticipated RF activity does not occur, several interpretations are possible:

1. The enemy is not present.

[1] Defense Science Board, *Autonomy and Artificial Intelligence in Defense Systems* (Washington, DC: Office of the Under Secretary of Defense for Research and Engineering, 2023).
[2] Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (New York: W. W. Norton & Company, 2018).
[3] United States Department of Defense, *DoD Artificial Intelligence Strategy: Harnessing AI to Advance National Security and Defense* (Washington, DC: United States Department of Defense, 2021).

2. The enemy is present but maintaining communication discipline or operating on unexpected frequencies.

3. The RF sensor itself is degraded or malfunctioning.

Each possibility requires a different reasoning path and operational response. A conventional system—awaiting explicit input—would remain idle. A more advanced, reasoning-capable system would interpret *silence* as an anomaly and initiate diagnostics, broaden its frequency scan, or fuse other sensor inputs (e.g., infrared, radar) to resolve uncertainty. This represents a shift from *reactive autonomy* to *reflective autonomy*: the ability to hypothesize about unseen conditions, test alternative explanations, and act accordingly within rules of engagement and mission parameters.

Human–Machine Teaming and Cognitive Inference

The challenge of interpreting absent information is particularly relevant in human–machine teaming environments. Consider an autonomous system awaiting a "go" signal from a human operator before advancing to the next mission phase. If the message never arrives, conventional logic dictates a halt. However, the absence of communication could signal several contingencies—equipment failure, operator incapacitation, or unexpected engagement.[4]

A reasoning-capable system would evaluate these hypotheses, perform internal diagnostics, attempt alternate communication paths, or reposition to maintain situational awareness—all while adhering to pre-defined operational constraints. This mirrors the initiative expected of trained soldiers who act within intent rather than awaiting explicit instruction. Cognitive autonomy thus augments human decision-making and preserves operational tempo even under degraded conditions.[5]

Inverse Target Recognition: Interpreting Negative Evidence

A related challenge is *Inverse Automatic Target Recognition* (IATR)—the capacity to identify not only active targets but destroyed or disabled ones. Traditional ATR algorithms focus on detecting positive indicators such as heat, motion, or emissions. IATR demands fusion of both *positive* and

[4] K. Bryant, L. Sanders, and C. Wu, *Human–Machine Teaming Under Degraded Communications: Emerging Patterns in Joint Operations* (Santa Monica, CA: RAND Corporation, 2023).
[5] Defense Advanced Research Projects Agency, *OFFSET Program Overview: Cognitive Autonomy for Swarm Systems* (Arlington, VA: Defense Advanced Research Projects Agency, 2020).

negative data streams: absence of movement, cooling thermal patterns, or cessation of radio activity.[6]

Integrating these negative indicators with residual evidence—such as deformation, debris, or human interaction—could allow autonomous systems to assess the combat viability of targets and dynamically adjust engagement decisions. Developing IATR capabilities would improve battle damage assessment, reduce redundant fires, and enhance mission efficiency.[7]

Toward a New Paradigm of Cognitive Autonomy

Reasoning from absence requires rethinking both algorithmic design and system architecture.

Rather than focusing solely on pattern recognition from data abundance, future autonomy

research should embrace an *information theory of absence*—modeling uncertainty, expectation, and missingness as meaningful data.

Potential approaches include:

- **Probabilistic reasoning frameworks** that explicitly model absence as a variable within Bayesian or belief networks.
- **Hybrid learning architectures** combining deterministic logic (for safety and compliance) with adaptive inference engines (for contextual reasoning).
- **Cognitive simulation environments** that expose systems to degraded, missing, or deceptive data scenarios.[8]

Such advances would move autonomy from reaction to cognition—aligning machine behavior more closely with the adaptive reasoning that characterizes human operators.

Conclusion: Innovating the Cognitive Edge

Innovation in autonomy is not merely about faster sensors or more powerful algorithms—it is about cultivating *awareness*. Machines must learn to interpret what they do not see, hear, or

[6] M. Hughes and D. Hall, "Inverse Recognition in Multi-Spectral Target Identification," *Journal of Defense Modeling and Simulation* 19, no. 4 (2022): 521–534.
[7] Office of Naval Research, *Autonomous Perception and Decision-Making: Future Naval Capabilities Program Brief* (Arlington, VA: Office of Naval Research, 2021).
[8] RAND Corporation, *Building Cognitive Autonomy: Artificial Reasoning for Next-Generation Decision Support* (Santa Monica, CA: RAND Corporation, 2024).

sense. Recognizing absence as a form of presence—silence as signal—will define the next frontier of military AI.

As defense research invests in autonomy and human–machine collaboration, the development of negative reasoning, inverse recognition, and absence-based decision models will prove essential.

These capabilities will allow autonomous systems to evolve from reactive tools to intelligent partners—helping warfighters not just perceive the environment, but *understand the silence.*

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The 1st Center of the Unmanned Systems Forces: The Evolution of Drone Warfare

Boris Martynenko and Curry Wright

The evolution of the 1st Center of the Unmanned Systems Forces (USF) offers one of the most relevant current examples of how wartime innovation can be institutionalized into enduring combat power. The Center's commander, callsign "Charlie," describes the unit's operating philosophy by quoting President Theodor Roosevelt: *"*Do what you can, with what you have, where you are*."*

This principle captures how the 1st Center approaches warfare. In daily combat, it prioritizes agile iteration and disciplined adaptation. The unit evolved out of operational necessity. Starting as a separate unmanned systems battalion, it added a battalion to form the 14th Separate Unmanned Aerial Systems Regiment. The battle-hardened 14th Regiment and their leadership became the cornerstone of the Ukrainian USF. The USF has since further evolved. It redesignated the 14th Regiment as the 1st Center of the Unmanned Systems Forces and formed a service-level organization designed to scale unmanned warfare across the Russo-Ukraine War. The story of the 1st Center of the USF matters beyond Ukraine. Their success illustrates how a plucky force of innovators can transition from ad hoc experimentation to an operational force delivering lethal effects across the battlespace. For militaries grappling with the integration of attritable unmanned systems, including the US Army, the unit offers practical lessons on organization, learning, and partnership with industry.

Wartime Origins: From frontline experiment to 14th Regiment

The lineage of the 1st Center goes back to Ukraine's early wartime drone ecosystem: volunteer operators, civilian engineers, and small military teams improvised both short-range and long-range precision strike solutions while in constant contact with Russian forces. These efforts gradually grew into more formalized formations within the Armed Forces of Ukraine as Ukrainian senior leaders recognized the utility and impact of unmanned systems.

Operational Necessity and Experimentation in Contact

The emergence of the drone ecosystem in Ukraine was not accidental; it was the result of combat experience, the strategic vision of key leaders, and constant iteration. Borys Martynenko, callsign "Fidel," founded and commanded the first separate drone element responsible for deep strikes and strategic effects. While serving at the front in September 2022, Borys recognized that drones could enable democratized precision strike and create strategic-level effects. Borys envisioned the need for a separate drone-focused element with its own Research, Development, Test & Evaluation (RDT&E) capability. The RDT&E element would employ a team of agile thinkers who could shape continuous iteration and integration of drone capabilities while in continuous contact with Russian forces. By 2025, this model had become standard for most units operating unmanned systems in the air, on land, or at sea. Back in 2022, this concept was merely an idea that involved significant risk from both the adversary and the legacy bureaucratic systems within the Armed Forces of Ukraine's hierarchy.

In 2022, this new separate element emerged through a deliberate campaign of controlled military experiments, each building on the validated success of the previous one. The first experiment began in September 2022 with the creation of the world's first experimental long-range unmanned deep-strike battalion, formed under the 190th Training Center. Its purpose was explicit: to test whether unmanned systems could independently plan and execute strikes at operational depth, up to 500 kilometers, without reliance on traditional artillery or missile command chains. It was only after the deep-strike experiment successfully demonstrated consistent operational success that a second broader experiment was authorized.

In December 2022, the Armed Forces of Ukraine established the world's first experimental tactical-level unmanned systems battalion, also under the 190th Training Center. This sequential approach was intentional. Tactical employment was not treated as a prerequisite for deep-strike; rather, it was developed afterward to complete a vertically integrated unmanned capability across echelons in Ukraine. These formations were not conceived as conventional "drone units." They were designed to validate a new operational design: unmanned systems as a new domain of warfare, capable of full-cycle operations that included planning, strike execution, and battle damage assessment, occurring outside of existing AFU fires (artillery-centric) frameworks.

The formal establishment of the 14th Separate Unmanned Aerial Systems Regiment in 2023 marked a critical step in the evolution of the USF. The 14th Regiment was designed for missions at operational depth with a mandate that created a Ukrainian version of an intelligence, surveillance, and reconnaissance-enabled (ISR) strike capability similar to the approach pioneered by the United States at the end of the Cold War. The Ukrainian version emphasizes reconnaissance and strike, with missions beyond conventional artillery reach, and the integration of multiple unmanned platforms into coordinated campaigns.

2023: Scaling to a Regiment as an Organizational Imperative

By mid-2023, the experimental framework had reached its limits. The growing scale of missions, the depth of strikes, and the number of crews involved made battalion-level command difficult and structurally insufficient. The transition to the 14th Separate Unmanned Aerial Systems Regiment was therefore not just symbolic. It was a management-driven necessity aimed at sustaining operational tempo and unity of effort. The regiment became the first military formation in the world to consolidate all available unmanned platforms, tactical and deep-strike, under a single operational command. This consolidation significantly increased effectiveness but also revealed a systemic deficiency: unmanned warfare lacked a dedicated institutional owner within the Armed Forces of Ukraine. This observation proved decisive and drove additional evolution.

Open-source reporting and Ukrainian statements consistently associated the regiment with strikes against logistics nodes, air-defense systems, and energy-related targets well beyond the front line. More importantly, the regiment demonstrated an ability to scale effects, not merely conducting isolated attacks, but executing repeatable missions that forced Russian forces to divert air-defense assets, harden infrastructure, and adapt logistics patterns. For the Center's leadership, this evolution carries significance beyond operational metrics. As first detachment commander, callsign "Casper," explains: *"*We are creating the modern history of Ukraine. That

gives hope to the nation – and hope gives people the strength to keep moving forward with their heads held high." In this prolonged, large-scale combat operation, this belief contributes directly to the institutional endurance of both the 1st Center and the USF.

Institutionalizing Success: From 14th Regiment to 1st Center

2023: Institutionalization- Separation from the Ukrainian Artillery Corps

The institutional separation of unmanned systems from subordination to the Ukrainian Artillery Corps did not occur in parallel with establishing the regimental command. Recognizing that this transition required continuity and growth at the unit level, a deliberate decision was made to transfer the position of regimental commander to "Charlie", who was identified as the best-suited leader to develop the unit into a regiment. Following this planned handover, Borys transitioned to the general staff, where he worked tirelessly to institutionalize unmanned systems as an independent military force. His vision was clear: unmanned systems could not remain subordinated to the Ukrainian Artillery Corps. If it did, the true combat power of unmanned systems could never be realized or employed. This reform was not just about organizational bureaucracy or personal preference; it was about operational necessity.

Artillery operates within a fires-centric paradigm, enabling maneuver and shaping conditions through massed fires. Unmanned systems operate through what Ukraine refers to as "campaign logic," providing integrated reconnaissance, strike, and assessment across time and depth in a precise manner. The Ukrainian Artillery Corps can mass fires on targets of strategic value, but the USF takes a more precision approach that matches unmanned systems to specific targets. This phase represented the most challenging period of transformation for both Borys and the USF, defined less by technological hurdles and more by internal bureaucratic resistance and the inertia of legacy command structures.

While at the general staff, Borys and his teammates:

- Worked closely with key partners and allies to lock in support from abroad;
- Influenced the establishment of a new Central Directorate of Unmanned Systems;
- Designed and implemented the subsequent evolution from the Central Directorate into the Main Directorate of Unmanned Systems;
- Laid the institutional foundation for the USF as a separate service branch.

By mid-2023, US policy on personnel present in Ukraine relaxed enough to allow an American advisor to establish in-person liaison and expanded partnership. Collaboration between the US and the 14th Regiment (eventually the 1st Center) and the USF was meaningful. The team of American advisors grew within the USF. They were able to provide support to the USF via Presidential Drawdown (PD) and the Ukraine Security Assistance Initiative (USAI). Braving regular missile and drone attacks, the ambassador and her country team worked closely with the Security Assistance Group-Ukraine (SAG-U) to deliver critical capabilities to Ukraine. As threats

evolved, the United States benefited from candid exchanges of information on tactics and technology performance. Starting during the evolution of the 14th Regiment to the 1st Center, Industry and academic relationships continue today. Shared information has informed US modernization and has driven allied capability development.

2024-2025: Structural, Non-Combat Challenges

By early and mid-2024, the regiment's most significant challenges were no longer kinetic risks. It had shortfalls in analytical and targeting capacity. It had commanders who were overloaded by operational information. It lacked standardized monitoring and evaluation mechanisms for battle damage assessment and drone performance. Finally, it suffered organizational inertia following its rapid growth. During this phase, the "Project Team" shifted focus from reactive problem-solving to organizational redesign and process formation. As the war progressed, Ukraine moved to consolidate unmanned warfare and build an institutional capacity for unmanned systems. In early 2024, Kyiv formally established the USF, signaling a recognition that drones, across the air, sea, and land, had become a dominant feature of modern combat.

According to Borys, the redesignation reflected a deliberate strategic choice rather than a symbolic rebranding: "The objective is not to fight longer, but to fight smarter. Precision, structure, and engineering thinking allow us to exhaust the enemy faster than they can adapt."

By 2025, the 14th Regiment was expanded and reflagged as the 1st Center of the USF. The shift from "regiment" to "center" was more than a nominal change. It reflects a broader mission set and a new role within the USF. It helped reframe unmanned warfare from episodic strikes into a system of sustained operational pressure that continued through 2025. The 1st Center was designed not only to conduct combat operations but also to serve as a hub for experimentation, training, and doctrinal refinement. In effect, it became a bridge between frontline innovation and institutional learning, an organization capable of translating battlefield insights into scalable practices across the USF. This dual role helps explain the unit's continued effectiveness. Ukraine currently produces eighty to ninety percent of the drones used by the 1st Center that are employed against targets up to 1000 kilometers deep into Russia. By retaining combat focus while assuming responsibility for integration and adaptation, the 1st Center has avoided the common pitfall of innovation units becoming detached from operational reality.

2026 Strategic Outlook from the 1st Center

Looking ahead to 2026, the 1st Center's main challenge is not a lack of technology or ability to generate strike sorties. Its main challenge is the continued transformation into an expanded command capable of generating sustained strategic effects across the battlespace. This transition requires expanded capacity and capabilities for command and control, battle damage assessment, and continued experimentation, while continuing to inflict heavy damage on the adversary. Its principal concern is institutional drift; the 1st Center cannot become disconnected from combat realities. The core objective is to remain an agile, combat-effective organization that shapes capability development and doctrine through practice.

What Makes the 1st Center Distinctive

The 1st Center is distinctive from other unmanned formations in Ukraine. First, mission orientation over platform specialization. The center is not organized around a single drone type. Instead, it fields a diverse portfolio of unmanned aerial systems tailored to specific mission effects, which include long-range strike, reconnaissance, battle damage assessment, and electronic warfare resilience. This approach allows rapid iteration and adaptation as Russian countermeasures evolve. Second, operational effects in-depth are a daily objective. The center routinely operates beyond the frontline, targeting nodes that shape Russian sustainment, air defense, electronic warfare, and other key enablers. These missions achieve attritable precision. Third, integration is a core competency of the 1st Center. While capable of independent operations, the 1st Center coordinates with other elements of Ukraine's defense forces and aligns unmanned effects with broader campaign objectives.

Collectively, these characteristics point to the emergence of a highly intellectual force that prioritizes design thinking, analytical rigor, and organizational agility to inflict extreme losses on a numerically superior adversary.

This approach intuitively echoes thoughts articulated by Martin van Creveld as early as 1990:

- Technology alone does not determine victory;
- Complex, high-tech systems often underperform;
- Less technologically advanced actors can win by demonstrating organizational flexibility, legitimacy, and adaptability.

Ukraine's experience in unmanned warfare has reinforced the relevance of these ideas and demonstrated them in practice. Dominance on the battlefield is increasingly determined not by the complexity of a platform but by the speed of adaptation, the quality of employment, and the ability to turn inexpensive, attritable technologies into sustained operational pressure. Ukrainian success transformed drones from a tactical novelty into a democratized, precision strike system capable of decisive effects in the battlespace. These data points align with broader observations on the Russo-Ukraine conflict: Drone effectiveness depends less on any single technology and more on the institutional capacity to iterate, integrate, and adapt while in contact.

An Agile Learning Organization

The center continues to collaborate closely with industry and academia on emerging technologies of interest. This collaboration allows for near-real-time iteration, a unique feature of the USF, which allows drone operators and engineers to work on emergent problems. Engineers respond with design changes within hours or days, while Western systems often take months or years. The center then tests these modifications in combat, completing a cycle of continuous improvement. From an operational studies perspective, the most important feature of the 1st Center may be its function as an agile learning organization. Ukraine's adaptation throughout the

war has relied on rapid feedback and small elements experimentation. Successful practices and technology are diffused into the force; ineffective technology and practices are discarded.

Equally critical was the realization of the need for direct, unfiltered communication with manufacturers. In Ukraine, units do not have the ability to contract systems directly with industry, which is an issue when the battlefield evolves faster than contracting mechanisms. To negate this shortfall, the Ukrainian Armed Forces and the Government of Ukraine have encouraged direct industry contact with the USF. Technology demonstrations occur regularly. Technical data and combat lessons learned are shared directly with manufacturers to influence industry offerings. It is not uncommon to see Ukrainian industry partners embedded with the USF to facilitate rapid iteration at the point of need. Due to operational needs, the logic of integrating industry has become an accepted practice and is now integral to the development of Ukraine's defense industry. This process is a reality of the war in Ukraine that the West has not fully realized.

Implications for Partner Militaries and Industry

The 1st Center's operational model includes opportunities for partnership with industry, academia, and allied militaries, including the US Army. For industry and academia, Ukraine continually demonstrates the value of agile iteration and operator-engineer relationships. The 1st Center's willingness to partner, experiment with emerging technologies, and provide immediate candid feedback offers a valuable template for accelerating defense innovation. This approach contrasts sharply with traditional acquisition timelines and highlights the benefit of closer civil–military integration. For the US Army, the Center provides a concrete case study in scaling unmanned warfare beyond experimentation.

As the Army explores how to integrate drones at every echelon, Ukraine's experience underscores several lessons: the importance of mission-focused organization, the necessity of electronic warfare resilience, and the value of treating unmanned systems as consumable enablers rather than exquisite assets. Combined experimentation, exchanges, and analytic collaboration allow the US Army to absorb these lessons without paying in blood and treasure by relearning them in a future conflict.

Conclusion

The 1st Center of the Unmanned Systems Forces represents a modern combat formation built around attritable precision. Its success stems not from any single technology, but from an ability to learn, adapt, and scale under the pressures of Large-Scale Combat Operations. Strategically, the 1st Center operates at the intersection of tactical innovation and operational impact. Ukraine's long-range unmanned strikes have challenged Russian assumptions about sanctuary, forcing adaptations in air defense and infrastructure protection.

While drones alone cannot determine the outcome of the war, their employment by organizations like the 1st Center has a significant impact on the conflict and illustrates how modern militaries can harness unmanned systems to achieve desired effects. For Ukraine, the center has become the cornerstone of a greater unmanned effort. For partner militaries and industry, the center offers

rare, real-world examples of how innovation and technology can reshape the character of war. These examples can be found on the 1st Center's webpage. In Ukraine, as in future wars, victory relies on a disciplined sequence of actions, executed at a tempo the adversary cannot match.

Borys "Fidel" Martynenko, founder and first Commander of the 14th UAS Regiment, is the deputy of the 1st detachment, 1st UAS Center. Curry Wright is an Army Civilian who spent two years deployed to Operation Atlantic Resolve with over eighteen months in Ukraine.

AI Academy: The Danger of an Artificial Institution, A Cadet Philosophy

Peter Connelly

> *At the Egyptian city of Naucratis, there was a famous old god, whose name was Theuth… he was the inventor of many arts, such as arithmetic and calculation and geometry and astronomy and draughts and dice, but his great discovery was the use of letters. Now in those days the god Thamus was the king of the whole country of Egypt… To him came Theuth and showed his inventions… when they came to letters, This, said Theuth, will make the Egyptians wiser and give them better memories; it is a specific both for the memory and for the wit. Thamus replied: O most ingenious Theuth, the parent or inventor of an art is not always the best judge of the utility or inutility of his own inventions to the users of them. And in this instance, you who are the father of letters, from a paternal love of your own children have been led to attribute to them a quality which they cannot have; for this discovery of yours will create forgetfulness in the learners' souls, because they will not use their memories; they will trust to the external written characters and not remember of themselves. The specific which you have discovered is an aid not to memory, but to reminiscence, and you give your disciples not truth, but only the semblance of truth; they will be hearers of many things and will have learned nothing; they will appear to be omniscient and will generally know nothing; they will be tiresome company, having the show of wisdom without the reality*.
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> -Socrates to Phaedrus, "*Phaedrus,"* A Platonic Dialogue

What is the light that drives the profession?

While we may be hard pressed to identify a student today hellbent on the prospect of paper as a poor and limiting invention – the concept stands. As we adopt tools to facilitate human advancement, so too do we, in some respects, lose the ability to perform where the machine can do so faster. Nowhere is a man's intellect more in danger than with the reliance upon a tool that not merely supplements but inevitably replaces thinking and thought itself.

I do not mean to suggest the military conform to the role of the ostrich and bury our heads in the sand amidst a global surge of artificial intelligence. In fact, the effective operability of AI as a tool is a reality of the contemporary battlefield. Soldiers ought to be able to navigate that reality. However, AI must be severely censored if not eliminated at entry-level professional education.

As defined in the guidance provided by West Point's "Documentation and Acknowledgment of Academic Work," The current policy of the United States Military Academy concerning the acceptable use of artificial intelligence is:

> *Advancements in artificial intelligence (AI), particularly generative AI, have introduced unprecedented capabilities and opportunities. With the capacity to generate human-like text, computer code, and unique imagery, this technology is transforming professional methodologies, frequently expediting workflows and enhancing productivity. The Department of Defense is actively leveraging AI technologies to support warfighters and thus we need to prepare our graduates for their future in the Army. Nevertheless, certain applications of generative AI may circumvent Cadets' development of essential critical thinking faculties and fundamental composition skills or potentially lead to erroneous understanding of material. Faculty members and Cadets must therefore approach this technology with thoughtful consideration and commit to continuous reflection and adaptation.*

The policy provides guidance for faculty on implementing AI into the classroom:

> *Faculty must provide guidance to Cadets on how generative AI can be used in their courses. Rather than course-wide policies banning use, a course must state explicitly at the assignment level if there are restrictions on the use of generative AI based on learning objectives of the assignment. For example, the course syllabus or assignment description might say: "For the final research paper in this course, students are expected to critically engage with the course material and present their own analysis and interpretation. Therefore, the use of generative AI tools for writing or developing arguments in this assignment is not permitted. This assignment is designed to assess your ability to independently synthesize and articulate complex ideas, and the use of AI would compromise the evaluation of these skills." Alternatively, when allowed, the statement may say: "Generative AI is welcome for use but assistance must be acknowledged according to the DAAW." Faculty allowance of generative AI usage does not waive the Cadet's requirement to acknowledge the usage and does not excuse the student from submitting false information, such as false citations.*

Accordingly, a large portion of AI's application rests upon the judgement of the individual course. There are even classes whose entire curriculum relies on some form of AI use, again with the noble end of cultivating a more rounded and able officer for the modern battlefield but at what cost? Its use on the battlefield is important but, in the classroom, severely limiting.

Proponents of AI usage would suggest that if an officer means to lead a unit in an environment where AI is prevalent, ought they not train with such a tool and gain familiarity as early as possible? Are they not limited or stunted by the prohibition of AI in their education amidst the transition from civilian to officer?

In response, I would echo Karen Thornber's sentiment in her description of "taking shortcuts without knowing the map" by stating that AI does not train the intellect, but may turn out to be

the end of the intellect for those not properly reared and ordered to thinking without AI. The calculator, for instance, is a tool of efficiency that supplements mathematical analysis. It achieves a different end than competence in mathematics itself. In learning the algebraic method, the student should be kept from such a device until he or she masters the fundamentals of algebra. In an instance where the student becomes accustomed to the calculator prior to mastery of basic arithmetic, the student's knowledge becomes instead mastery in inputting the proper buttons to achieve a desired response. The gift that the calculator provides to he or she who does not prioritize the process but places primacy only on the produced solution mirrors the Platonic dialogue of Socrates and Phaedrus at the onset of this obituary of thought. AI becomes a tool not of thought, but of needing to be thought for.

Artificial intelligence then is a tool for the trained on the process it is replacing. For the student who does not know what right looks like and has not had the process of working to achieve the solution hammered in to the point where the analytical becomes the instinctual, as Thornber states, the use of AI will undoubtedly compromise the intellect. For the officer candidate who has not developed mental models through countless repetitions of course of action development, the use of AI will blunt their development. They will simply be inputting data into a calculator and have no understanding if the output is feasible, suitable, and acceptable.

The cultivation of intellect is the very light that drives the profession, not to be improperly delegated to the machine but properly wrought and ordered in the struggle of both the individual and the collective. AI reliance, particularly for the student, is analogous to the Platonic Cave. We are building the cave and perhaps now, so close to its opening and onset, we can still see the true light of that which is without. Tomorrow, however, what is true–thought devoid of AI–will assuredly be an impossibility in a society that prefers the accessibility and efficiency of shadows on the wall, rather than the climb to the true light, to what is real, right, and raw. If our society means to not merely to survive but strive in principle and form, it cannot be by replacing the light with the shadow, the mind with the machine. In thought, philosophy, discussion, and thereby growth, our potential is infinite and our destiny limitless – our duty is discernment, and ideas have consequences.

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Defense Innovation in Ukraine: Observations and Opportunities

Curry Wright

Introduction

The war in Ukraine is reshaping the role of defense innovation in conflict. In Ukraine ideas move from concept to combat in hours or days, compared to a western system that measures progress in months or years. The ecosystem in Ukraine is much bigger and more diverse than most outside observers realize and includes hundreds of companies, thousands of volunteers, military personnel, and civil servants who are all iterating simultaneously in a wartime environment. Innovation is happening at scale in Ukraine, from bunkers in the trenchline at the front, to distributed operating locations in every major city. This ecosystem works because Ukraine has embraced an approach to wartime innovation that encourages iteration, rewards agility, and enables rapid integration at the tactical edge. Innovation in Ukraine is not just a plucky determination to resist Russian aggression, it is a system of systems that fuses urgency with talent, leveraging technology to offset Russian mass and gain battlefield advantage.

Writing about defense innovation in Ukraine is difficult for a couple of reasons. First, Operational Security (OPSEC) and the safety of our team and our partners remain paramount. Second, the lessons available are raw and have the potential to be painful and messy from our perspective, but provide a unique opportunity to learn without high risk to US personnel. Defense innovation in Ukraine also merits deeper research and I hope to contribute to that scholarship and publication in the future. Finally, the ecosystem has continued to evolve since I departed Kyiv, but my experience there offers insights that I believe can help shape our own modernization efforts. Ukraine is demonstrating the potential of defense innovation, if we are serious about maintaining our advantage, we should expand our partnership with Ukraine and adopt both lessons learned and technologies of interest.

Ukraine's Defense Innovation Ecosystem: Agility is the Advantage

Ukraine's defense innovation success is not an accident. It is the product of deliberate policy decisions, empowered leaders, and a national culture of rapid iteration that treats agility as an imperative to survive. Since 2022, Ukraine has fused government direction, private-sector ingenuity, and civilian volunteer talent into a fast-moving innovation engine that now shapes the character of the war. RAND researchers describe this system as one defined by "a decentralized decision structure and a deeply mobilized civilian tech sector" that enables adaptation at a pace foreign to most Western institutions (Reference).

The impact of the innovation ecosystem is visible in every domain of the conflict. Drone manufacturers routinely push new firmware, navigation updates, and counter-jamming solutions to frontline units in hours, not months, often in response to emerging Russian EW signatures observed that same day (Reference). Ukraine's air and missile defense enterprise operates with similar speed. RUSI has documented how Ukrainian air defenders, engineers, and industry iterate constantly collaborate to refine sensor capabilities, integrate disparate systems, and harden critical infrastructure against Russian strikes (Reference). This integration of commercial technologists, government authorities, and military operators is a core competitive advantage.

Ukraine intentionally decentralized authority and execution for innovation. Units work directly with industry and are encouraged to test new systems in combat. The Ministry of Digital Transformation and Ministry of Defense streamlined acquisition pathways to accelerate procurement, while volunteer technical communities, such as the Army of Drones and Brave1 clusters, supply the talent and problem-solving capacity that keeps innovation continuous (Reference). This is not just a strength; it is a strategic asymmetric advantage.

The United States has the technological base, industrial depth, and talent to operate at similar speed as Ukraine, but we rarely do so absent of crisis. Ukraine offers a unique opportunity to accelerate our own learning, strengthen technology cooperation, and build the institutional knowledge to innovate while engaged in a LSCO fight. We can learn these lessons now, through partnership and shared experimentation, or we can relearn them later under far less forgiving circumstances.

Drone Warfare: How Defense Innovation Changed Modern Combat

The most recognizable example of defense innovation in Ukraine is the drone revolution. Countless videos now show how Ukrainian units have turned small Unmanned Aerial Systems (sUAS) into a new form of precision strike at the squad and platoon level. In early 2024, Ukraine went a step further and established the Unmanned Systems Force, a dedicated branch of the Ukrainian Armed Forces focused on employing uncrewed systems (Reference). This was not just a change in the force structure, it was an acknowledgement that uncrewed systems are no longer niche technology, but are a core enabler of maneuver across land, sea, and air.

Enabling the drone evolution the Ukrainian defense innovation ecosystem surged from a handful of domestic drone manufactures at the start of the conflict to hundreds of drone producers today and over a thousand defense tech companies. Acquisition and production of drones initially grew with the "Army of Drones" effort started in 2022, expanded with the 2024 "million drone plan" and grew to millions of drones produced domestically today. More than 90 percent of drones used at the front currently come from domestic manufactures. Government initiatives like the Army of Drones and the Brave1 technology accelerator have enabled rapid prototyping, measured in weeks, not years, channeling grants and pairing industry with procurement teams to iterate fast against Russian EW and air defenses (Reference). In the battlespace, this innovation resulted in "drone stacks" cheap attritable systems for Intelligence Surveillance and Reconnaissance (ISR), kamikaze drones for precision strike, and long-range one-way attack systems that can strike critical infrastructure deep inside Russia. CNAS analysis concludes that Ukraine has so far consistently out-innovated Russia with commercial and domestically designed drones, and that the volunteer networks have been key to acquiring, modifying, and fielding these systems at scale (Reference).

The creation of the USF and the innovation ecosystem that provides enabling technology is a good lesson in the institutionalization of innovation. Doctrine, Organization, and Training were all developed while in contact, in close coordination with the innovation ecosystem. The lesson for our military is blunt, drones are an important enabler for maneuver and protection cannot be taken for granted. We currently lack a warfighting concept that guides the development, procurement, and integration of drones at the tactical level. We are gaining momentum thanks to

senior leader emphasis on drone technology, but we should develop a concept that empowers and resources leadership at the lowest level to employ and iterate on drone employment.

Countering Unmanned Systems: Key Component of Protection

Protection is one of the Army's six warfighting functions, and its purpose is clear: preserve combat power by safeguarding the force, critical infrastructure, and freedom of action across all domains. Ukraine has demonstrated that Countering Unmanned Systems (C-UAS) capabilities are required at every level to protect the force. Ukraine faces the highest density of drones ever seen in a contemporary conflict. The battlefield is saturated with uncrewed systems employed by both sides (Reference). The result is a unique battlespace, where every unit is vulnerable to precision attack and protection is more important than ever. Ukrainian Commanders repeatedly stress that survivability now depends on the ability to defeat drones through a layered approach that includes early warning, camouflage and deception, kinetic interceptors, electronic warfare, dispersed formations, and continual movement (Reference).

The drone threat has forces Ukraine to focus a significant amount of its innovation prowess on Countering-UAS. Defense innovation in Ukraine is involved in developing and testing CUAS capabilities that range from handheld anti-drone guns, to the incredible nationwide acoustic sensor system, and uncrewed air defense gun systems that protect critical infrastructure. The United States has world class CUAS capabilities, but most of our capabilities are exquisite high-cost systems developed for previous conflicts. We have also never faced the mass of UAS threats currently faced in Ukraine. Collaboration in Ukraine, where they are adapting to UAS threats daily, offers a unique opportunity. We have the ability to co-develop CUAS capabilities in Ukraine that will help protect Ukrainian forces and civilian population centers, but also adopt future capabilities to protect our own forces. Air and missile defense against cruise missiles, ballistic missiles, and fixed-wing aircraft are separate topics worthy of research and publication by the experts who have spent years supporting Ukraine's integrated air defense enterprise. But when it comes to protecting the force from unmanned systems, Ukraine is already showing us the future and inviting us to collaborate on solutions.

Electronic Warfare: Highly Contested Electromagnetic Spectrum

Electronic Warfare (EW) is one of the areas where we can learn the most from Ukraine. Over the past two decades US forces exercised relative freedom in the electromagnetic environment. In Ukraine every emission becomes a vulnerability and every signature can be targeted. In Ukraine, EW is organic, down to the company level, where spectrum agility matters more than spectrum dominance. As our Ukrainian EW counterparts often explained, units must constantly shift frequencies, power levels, and waveforms to survive.

The front is saturated with jammers, decoys, spoofers, direction finding systems, and collection platforms hunting for EW emitters. Colonel Ivan Pavlenko, Chief of the General Directorate of Electronic and Cyber Warfare, describes EW cycles measured in hours, with new frequencies, emissions, and countermeasures constantly rotating in response to Russian detection (Reference). Drones remain high interest to US and allied leaders, but EW is perhaps the most undeveloped

relationship and opportunity for collaboration. Our counterparts in Ukraine are willing to share their lessons learned and have offered additional collaboration on capability development. We should absolutely make this relationship a priority.

Additional Recommendations

The following are strategic recommendations to expand the Defense Innovation partnership with Ukraine:

Collaboration in Ukraine: Opportunities exist to expand our relationships in Ukraine, but Defense Advising is more art than science and we need send the right people, with the right skills, for at least twelve to eighteen months to Ukraine. The two most talented Defense Advisors in Ukraine while I was there worked in the Office of Defense Cooperation (ODC). The first, a Government Service Civilian, retired senior Foreign Area Officer who spoke both Russian and Ukrainian. The second, a Defense Contractor, Army Reserve Foreign Area Officer, who spoke Georgian, Russian, and Ukrainian. Both had worked for years in and around Ukraine and developed key relationships with Ukrainian leaders. We recognized the value of our ODC teammates and did everything we could to leverage their talent to understand the Ukrainian defense innovation ecosystem. Thanks to their help we eventually developed meaningful productive relationships with our Ukrainian counterparts but it took time. In Ukraine the relationships matter, and it was not long before our counterparts (always appreciative) trusted us enough to point out they had shared their thoughts and requests with a number of other Americans who blew into town for a visit, took copious notes, never to be heard from again. We should expand the technology and innovation focused team in Ukraine with hand selected personnel who are backed up with technical expertise when needed.

Collaboration outside Ukraine: Despite the operational tempo, our counterparts are gracious with their time and make themselves available to collaborate both virtually and in some cases in-person. Our team was able to help facilitate exchanges between our Ukrainian partners and Defense Agencies, other Combatant Commands, and key allies during my tour. We should expand this effort, improve information sharing agreements and dedicate resources to ensure collaboration happens outside of Ukraine as well. This should not be confined to conferences or warfighter forums, but should be deliberately planned and executed to ensure all parties involved benefit from the collaboration.

Industry Partnerships: We should absolutely find a way to partner with Ukrainian industry, but we also need to find a way to enable Western and European industry partner collaboration with Ukraine. Initially, during my tour our team was prohibited from interacting with any US industry partners who made their way to Ukraine. This policy eventually loosened and we were able to interact with and in some cases provide critical introductions to Ukrainian partners. However, there is no dedicated US innovation funding available to align resources to support western industry succeed in Ukraine. The closest we got was working with our Ukrainian partners to establish opportunities to test and evaluate western industry capabilities in Ukraine. Western and European industry partners continue traveling to Ukraine on their own funding, accept personal risk, and the potential loss of Intellectual Property (IP) because they recognize the value of Research, Development, Test & Evaluation (RDT&E) at the edge. We have to find a

way to enable more of this officially so we can also benefit from the evolution of technology and the lessons learned in Ukraine.

Leverage US Experience: Only a small number of US personnel have served in Ukraine have embedded in or partnered with the Ukrainian Defense Innovation ecosystem. The insight gained and relationships developed are priceless but remain underrepresented in academic or defense literature. OPSEC is clearly a concern and we do not want to put any US or partner force personnel at risk, but we also seem to lack appetite for the practitioner viewpoint. In my time at Senior Service College for example, we have sat through at least a dozen discussions that reference how technology is reshaping warfare as we know it in Ukraine. The College has called upon academic and industry experts to discuss their viewpoints, some of which included visits to Ukraine or relationships with Ukrainian partners, but we haven't leveraged expertise from practitioners. This includes practitioners with significant experience who are currently students at the College (which include a senior Diplomat who led the Econ Section of the Embassy Staff, a special operations officer who worked closely with Ukraine on drone acquisition, or the Army Civilian who stood up and led the first US team focused on technology collaboration in Ukraine).

Conclusion

The war in Ukraine offers the United States a rare, and urgent, opportunity to collaborate on, learn from, and rapidly adapt battlefield innovation for the next conflict. Ukraine's defense innovation ecosystem is agile out of necessity, but successful under sustained pressure. Ukrainian military and civilian technologists have compressed development cycles from years to weeks, sometimes hours, producing a battlefield laboratory unlike anything the US military has seen in decades. The rapid evolution of FPV drones, Counter-UAS capabilities, and pervasive employment of electronic warfare have not only reshaped the character of contemporary combat but demonstrated how bottom-up innovation can become a decisive operational advantage. For the United States, the opportunity space is clear. If we intend to maintain our competitive edge against determined adversaries, we must expand our partnership with Ukraine, accelerate technology collaboration, and build the institutional capacity to innovate at scale while in contact. Ukraine has already shown us what future conflict will demand: operating through a contested electromagnetic spectrum; a compressed kill chain enabled by small, uncrewed and semi-autonomous systems; and defending against relentless waves of aerial threats that challenge conventional air-defense capabilities. The question now is whether we will act with urgency, embrace the opportunity, and modernize our force, or if we will be forced to relearn these lessons at far greater cost in a future fight.

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Projecting Lethality with the AI-Enabled Officer

an interview with Brigadier General Shane Reeves

by Emily Wilczek

Editor's Note: Brigadier General Shane Reeves is the Dean of the United States Military Academy at West Point. This interview is part of the cadet-run Five Questions for a General podcast series and took place in the Class of 1974 Recording Studio inside the Modern War Institute at West Point. It was edited for clarity, brevity, and flow. The interview was conducted by Emily Wilczek. You can listen to the full podcast at our website, mwi.westpoint.edu.

MWI: Ladies and gentlemen, welcome back to the West Point Class of 1974 recording studio and the *Five Questions for a General* Podcast. I am Cadet Emily Wilczek, your host, and it is my pleasure to be here today with the dean of the United States Military Academy at West Point, Brigadier General Shane Reeves. General Reeves is a West Point graduate and was commissioned as an armor officer before transitioning to the Judge Advocate General Corps. He served in Iraq with the Joint Special Operations Command before joining the law department at West Point, and he is now the 15th Dean of West Point's academic board. General, welcome to the show.

Reeves: Thank you. It's great to be here.

MWI: General Reeves, you currently serve as the dean of the United States Military Academy at West Point. What was your path to joining the Army, and what does a dean's job entail?

Reeves: So my path to joining the Army is not unique, but it's actually a combination of two things. One is that I have a family history in the military. My family's been serving in the military for probably a couple of hundred years. And a number of them had come to West Point, starting with my great-grandfather in the class of 1892, and a number of other family members throughout that period. And so I truly loved my grandfather, who was a member of the class of 1939. He was a retired colonel. And I thought he was just the most noble and amazing person. And I enjoyed it in my grandparents' home because they had all the accoutrements of living a military life. They had things from when they were stationed in Naples, or when he had been in combat in World War II, or when they lived in Japan. And I was like, how do I get to have that type of life? Because it looks like a great adventure.

The other part, though, is that I'm from Wyoming, and I thought, what's the best way to get an education? Of course I knew West Point through my family, but it was not lost on me that West Point was free education at an elite institution. And so I was like, these come together. I have a

family history of military service. It was intriguing to me. And this is a great way to get an education at an elite school.

MWI: Now, going more extensively on education, you've written extensively on professional military education, and you lead West Point's academic mission. How do you balance the demands of academic rigor with the need to develop adaptable leaders ready for the complex realities of modern warfare?

Reeves: I don't really think it's a balance. I think that you can't have adaptable, creative, and successful leaders if they don't have an intellectual foundation. So one of the questions you asked me previously is what my job is as the dean? if I was going to put it succinctly, my job is to create an intellectual foundation so that our cadets can successfully navigate the complexities, the uncertainties, the ambiguities of the modern and future battlespace, while also creating within all cadets a passion for lifelong learning.

And it's to prompt intellectual curiosity, because all that leads to this: creating innovative, adaptable, creative thinking. And that is the path to the United States Army being successful. Having these young entrepreneurial and creative officers who are connected to a very powerful non-commissioned officer is probably our greatest advantage when we think about warfare. And my example would be in 2022, when the Russians went into Ukraine, they were surprised-they shouldn't have been, but they were—surprised by the resistance that they ran into, and they froze when they hit the resistance, and when their plan didn't succeed after 72 hours, they froze, and they didn't know what to do. And that's because they don't have officers who are able to think their way through what is the proverbial fog of war. And in freezing, they started to call up higher. And then you started to see these senior commanders, these colonels and generals from the Russian military, trying to come out to regain momentum.

And now compare that to the United States Army. We would simply tell a lieutenant and their NCO, "Hey, figure it out." Yes, you've hit an obstacle. You should expect to hit that obstacle now. Find a way to navigate your way around it. And that really is driven by the intellectual ability of our officers and how our young officers know how to think their way through a problem. And they're expected to be able to think their way through a problem. In fact, if they can't, they're in the wrong army. And so I don't think it's so much a balance. I think it's inextricably linked to the intellectual development of an officer and their ability to practically and pragmatically operate in a military space.

MWI: Thank you, sir. Focusing more on West Point's academic mission. This year's academic theme for West Point is projecting lethality and addressing the multidimensional challenges in the Indo-Pacific. Why did you choose that theme, and how can West Point contribute to projecting lethality in the Indo-Pacific region?

Reeves: So every year we try to pick an academic year theme that allows the academic program, whether it's at the, at the dean's level, at the department level, at the center's level, to, to tether themselves, tether those organizations that are part of the, you know, part of the bigger enterprise into an idea or a concept so that that shapes capstones and who they bring to speak and all those various other ways that we, that we support the cadets educational experience.

So we picked this one for the obvious reasons. We have moved out of an era that's focused on addressing the non-state ideologically motivated terrorist groups, I would say, and moved, and not that threat is completely gone, but we have moved our focus and shifted our focus to peer-to-peer conflict and particularly focused in Asia.

I don't think it's a surprise that perhaps the greatest geopolitical threat the United States has faced since the end of World War II is the rise of China, both economically and militarily. And they have very different views on the world than the United States and the broad liberal order that was established post-World War II. And so we decided to focus the academic year theme on looking at that challenge and how that challenge may play out.

Now to your second part of your question about how West Point contributes to lethality. It really is three ways. One is by developing our cadets to be the officers that are capable of winning in the modern battle space. It's also about developing our faculty so that the faculty are working on relevant and contemporary topics that help the army solve some of their bigger problems. And really it's connecting ourselves to the Army and the bigger department of war enterprise so that our cadets education, our faculty work with the cadets, all working on projects on behalf of the army either is addressing some of the army's bigger problems or our faculty are being developed so that there's actually a bench of experts who happen to have security clearances that have either a technical or some sort of background that the army needs. And then of course, the cadets when they graduate, have that sophistication of thinking so that they can do the things that we talked about.

MWI: Now, sir, short term, in the next, say, five years. What does winning in a contemporary space look like to West Point?

Reeves: Well, West Point is, of course, just one pillar of the broader Army, and we're a commissioning source as well as a place that produces intellectual capital on behalf of the Army. And so I think winning is whatever challenge may come that faces the Army. West Point needs to be contributing. And that contribution comes through, of course, commissioning 1,000 great new lieutenants every year. But it's also through the great work that's done through our 27 centers of excellence or our 13 academic departments, or through the West Point Works Innovation Hub, which has broken down the silos between many of those departments and those centers so that

we're really doing some interdisciplinary work on behalf of the Army to solve some of their problems. So I think it's. I think it's contributing in multiple ways to the Army's mission and whatever mission the Army is given.

MWI: Shifting gears slightly now. Your scholarship on the law of armed conflict emphasizes ethical conduct in warfare. How should future Army leaders be prepared to make ethical decisions under pressure, especially in ambiguous operational environments?

Reeves: Well, one is you have to just live in the world that you have to understand the world you live in, and not the world you want to live in. You are going to face ambiguous and uncertain circumstances. There's this, almost, over-reliance or a belief that technology is going to solve many of our problems. And there's the risk of over-reliance on technology to clear away, again, that fog of war. And that there's going to be complete clarity, whether it's air superiority or the ability to process voluminous amounts of data to tell us everything that's going on. That's just not the case. War is always going to be confusing. It's always going to be uncertain, there's always going to be complications, and there's always going to be some very difficult decisions to make. So I think the law, as well as ethical reasoning, remain incredibly important for giving the left and right limits for an officer's behaviors in warfare. And I think that the expectation is that we will make the right decision and we'll make those decisions grounded in both the legal framework that underlies how we conduct our operations and armed conflict, as well as having the underlying character to make the right ethical decision when the time comes. But some things had been talked about at West Point for a long time that I think are informative:

Doing the harder right over the easier wrong.

Don't take a half-truth. You can find the full truth.

We pride ourselves on doing the right thing in the toughest of circumstances.

We take an oath to the Constitution because we understand the importance of the rule of law. I mean, all of those things that inform how we develop officers, it all comes down to this: we produce leaders of character. And character matters, especially when faced with very, very difficult circumstances.

MWI: Sir, we've spoken previously with Lieutenant General Joseph Berger on the importance of understanding the rules of engagement, or ROEs, at every level. Could you speak a little bit to that and how completely understanding not only the ROEs themselves, but where they come from, changes your strategic thinking?

Reeves: Yeah, so it's a great question because there's oftentimes a little bit of confusion about the rules of engagement in comparison to the law of armed conflict. Right. So the rules of engagement are US policy, which means that they can never be broader than what the law allows. So if you want to think of it, the law has, you know, if it's a football field, it's 100 yards. The rules of engagement can never be more than 100 yards. They might be 80 yards or 70 yards. But the rules of engagement are how commanders communicate to their subordinates what you can and can't do. And embedded in that and infused throughout the rules of engagement is the law of armed conflict. But there's also going to be some other things that might be placed in there. There might be, hey, we're not going to, we're not going to go into, I'm just making this up, but we might not go into a house at night. Why would we not go into a house at night? Because that might actually be detrimental to our long-term operational success. Because you're going to irritate the local population by going at night. So we're not going to do that. Yeah, but there's good reasons to go at night. And so the commander gets to make that decision and weigh the pros and cons, and then put that in the policy. So understanding the rules of engagement means that if you're following the rules of engagement and they're properly written and constructed, you can have confidence that you're following not just the law, but also the policies that are being directed by the commander. So it's very, very important that everybody at every echelon understands what the ROE says.

MWI: Thank you, sir. Moving into more technology, on your podcast, *Inside West Point Ideas that Impact*, you've highlighted topics from AI to global security to mentorship. What is one idea from that series that you believe all military leaders should hold front of mind today? And why?

Reeves: I think there are a couple, actually.

I do think we've moved into a new era when you talk about the technology and the integration into military operations and really the integration with humans. And it's important for anyone who's listening to recognize that technology is going to be a component of what we do going forward. So, for example, there are reports that in 2025 the Russians had 416,000 casualties, something like that in Ukraine. A shocking number. Maybe the Ukrainians are reporting that the numbers could be as high as 1.2 million Russian casualties in that conflict so far. But what's more shocking to me is that over 70% have been done by drones, 28% roughly indirect and other means, and 2% direct. So war has changed, right?

How the world is conducting their operations and fighting each other is just as lethal, it's just as deadly, but it's changed in how they're using the means to do it and maybe even some of the methods on how they're doing it, too. And so I think the takeaway from my podcast is that warfare is not static. We cannot be looking backwards. We need to be proactive. We need to be. We need to be proactive in looking forward or we're going to lose. We're going to lose the days

of the United States being, you know, being broken out of its slumber because it finally gets punched, and then we're going to turn on the arsenal of democracy to go and fight and win our wars. I just don't think that's the case any longer. I think we moved into an era where warfare is moving too quickly. I think that the war could be over before we even know it. I think that there's a spectrum in the conflict.

If you're looking at conflict in terms of whether it's binary or there's a range of it, I think there's a range of conflicts. There's a spectrum of operations that are taking place in the cyber realm, in space or elsewhere. And so I think we need to recognize that warfare has become incredibly sophisticated, incredibly advanced. Technology is changing so much on how we fight, and we need to understand that new world. However, there are parts about warfare that are never changing.

It's still a struggle between two states at its core, struggle between people, as Clausewitz said, further, their political agenda through these means. It's about still seizing space. And so some of those intangibles about war remain the same. It's how states resolve their conflicts. Oftentimes they resolve their disagreements, but they might use economic sanctions, and then sometimes they may do this.

So there's this interesting part. When you look at warfare right now, there's a regressive point to it. Like, we're back to this state when we're back to a point where one state will try to seize territory from another state through a military means. But we're also into a new era when technology is informing so much about how the, the. How warfare is being conducted. And so I think that's the intent of the podcast, to do that, but also more. More superficially, it is to highlight the incredible faculty and people that are at West Point. It's one of the things that has been. When I became the dean, I was constantly blown away. No matter where I go around West Point, I'm like, oh my goodness. That guy that, you know, he's awesome, or she's awesome. I mean, oh, that's, that's an expert on undirected energy. I don't know if people understand that we have the world's leading expert on micro nukes or, or, oh, wow. We are looking very carefully on how to process data in such a way that can be applied quickly. Or I could just keep going right from autonomy to cyber to you. There are experts at West Point. It's an incredibly powerful faculty, and they're all here as a resource for the Army. And so I wanted to highlight the excellence of the faculty that reside at West Point.

MWI: Hopefully there'll be some crossovers between the viewership now, sir.

Reeves: I hope so. That'd be great. That'd be great.

MWI: Now, quickly calling back to a previous point where we said there might be an over-reliance that is developing on technology in this ever-changing sphere of modern warfare. How will we know if we've hit that point of overreliance, if we will at all?

Reeves: Yeah, it's a really good question.

We're probably there now. We probably have hit an over-reliance, but it doesn't mean we won't be successful. Because I think this is where both education and training come into play. Education is focused on preparing a person for dealing with uncertainty. Training is where you are doing things repetitively so that you get good at it. So you may have an M4 and you can clean it in the dark. That's because you've been trained really well.

But your education prepares you for when you've lost your M4, or when it's broken, but you still have to accomplish the mission. Now you have to get creative, right? And when you put those together, that's what we're trying to produce. And I think that if technology goes down, and it will, I think that's probably a great vulnerability. When technology goes down, we're going to all be shocked because we have become so reliant on our phones, our electricity, and our ability to navigate through computers with access to GPS and almost our ability to communicate with impunity through various means that will break when the time comes. And that over-reliance may shock us, but it doesn't mean that we're not resilient or capable of being successful in those environments. And that's why, again, I hearken back to teaching people how to think and not what to think, while also training them to be proficient in a number of things. You put those two together means that we will be successful. But my instinct tells me we are already over-reliant on technology.

MWI: How do we see human judgment and our ethical reasoning playing alongside these new technologies as we advance in both the technology itself and our education as well?

Reeves: Great question. So when you talk about, say, artificial intelligence, right? If I talk to a firstie (senior) and a plebe (freshman), they have different views on the use of AI and at all, really, there's an inflection point, and someday someone will write on this. But there was an inflection point, I think probably September 2023, when ChatGPT and those systems became widely distributed and widely used. And so they're awesome. I mean, if you use AI, you see how quickly you can do things. You're just like, I cannot believe how quickly it can process all this information and be able to succinctly create something that's usable and workable. It makes you so much more efficient.

So the technology is something that is here. Technology always wins.

There have been many efforts to try to ban technology. I mean, I could go back to a story I like to tell is Pope Urban II. Crossbows had been created, and the crossbows were really effective at piercing armor, and they were upsetting the social hierarchy at the time. And so Pope Urban II said, "Okay, anyone who uses a crossbow, you're excommunicated." So what did everybody do? They went, "Let's go get a bunch of crossbows." Why? Because they were effective. And if you look at warfare, there have been efforts to ban the use of balloons, airplanes, submarines, and nuclear weapons. It just doesn't happen. Technology always wins. So artificial intelligence is here, and it's a tool that is going to be critical to gaining an advantage.

So your question is, what about human judgment? What I worry about is as we over, as we more and more rely on artificial intelligence and, and the, the great advantages it produces, that in that reliance, we start to lose the critical thinking skills that were actually necessary to create that system. And then when those critical thinking skills atrophy, we lose our ability to make decisions. We lose our ability to make those calls and use our judgment because we're just deferential to the machine or whatever it spits out, which, by the way, makes us very easy to manipulate it. It means that we're not great discriminators of fact.

And it means that we don't have the level of cynicism. And I'm not saying that in a derogatory way, but I want our leaders to have enough of a cynical view to go, I don't think that's right. I'm going to double-check that. And so we have to be very careful that we don't have those critical thinking skills and that sophistication of thinking atrophy or go away because of our over-reliance on the technology. So my job right now, and it's something we're trying to figure out here, is how do I create in cadets what I call the AI-enabled officer?

An AI-enabled officer understands how to use AI for advantage and understands how to use it in such a way that it creates the efficiencies to allow you to go do those things that only humans can do. Go see your soldiers and look them in the eye, get to know them, talk to them, give them the personal touch, lead them. That's what I think the technology should be used for. Not the over-reliance on telling me how I should engage with a human. Because the machine can't tell you that.

MWI: Sir, is there a tactic that you use personally to kind of fight back against the urge to just throw everything into ChatGPT or another AI that is like, wait a minute, I need to do this myself. Is there that urge?

Reeves: I wonder if maybe I'm not trying to make it a generational thing. I wonder if it's a little bit easier for me because I'm old and I understand the world. I mean, I remember the world before there were cell phones, right? Like there was, there was a time period when I liked to joke with cadets. I'm like, oh, by the way, there used to be a cord like hooked to a phone. You put it to your ear and you couldn't walk away. I don't think I rely on the technology as much as I

should because my background and my understanding and how I've been developed was not to do that. Which was mine was to. Is to, you know, read a couple of things and come up with a decision based on that.

But I can see the, the temptation of doing that very. It's. It's just so easy. It's so easy to put it all in the gonculator, and something comes out, and you're like, "That's really good!" And it's just going to get better and better and better to where it's going to be very difficult to discern between what a human's done and what the machine is, is popping out.

So the answer to your question is that it's probably easier for me than others, but I would say for anyone who listens, you have to be disciplined enough to do certain things. I have found that when I watch myself, for example, my attention span is not as long as it used to be. It's harder for me just to sit down and watch a two-hour movie or even a 30-minute show without picking up my phone and looking at it because my attention span is getting shorter and shorter and shorter. And I don't think you can do deep thinking in that, in that space. So I try very hard to go quiet at certain parts of my day or my night without any electronics around me. And I do certain things like read an actual book. Not scroll through something, but read an actual book. You know, I just, I just finished a great, extremely long two-volume set on the rise and fall of the Japanese Empire from 1933 to 1945, and I found it really satisfying to read an entire book. And I came away thinking I have a much better perspective on that time period.

I also read like old school newspapers. Like I take out the paper of choice and I take it out and I read it versus on my phone because I just don't want the electronic piece of it. So I try to discipline myself, to be careful on how much I rely on the technology and then understand when it's actually a good use and when it might be a harmful use.

MWI: Sir, I will gladly join your crusade against eBooks! They are the worst. They're the worst. (laughs) Many leaders at West Point and in the operational Army often talk about preparing leaders in conditions of volatility, uncertainty, complexity and ambiguity, or VUCA. What is one key practice or mindset that you think makes the biggest difference in leaders thriving, not just surviving, when faced with uncertainty?

Reeves: I don't think this will surprise you: education, like developing yourself intellectually. I mean, there when I think about it, I'm biased, I'm the dean, but obviously as an officer you have to be physically proficient, right? And you have to have the military competencies to be successful. But if you want to be successful in uncertainty, especially in a competitive environment, it's going to be your brain that gets you through that. And so you have to be challenging yourself all the time. And it's something I say to faculty here consistently, which is we don't want the West Point graduate, when the time comes, and it's so confusing and so uncertain, to freeze because they don't know how to think their way out of it. And so our job is to

push to, again, not intellectually coddle, to try our very hardest to make sure that you're gaining those intellectual skills to be able to do that. So I would tell you if you want to be successful in an uncertain environment, and it's going to be complex, and it's going to be weird, and there's going to be something that you, you know, maybe no one's ever seen before.

It's going to be ingenuity, it's going to be creativity, it's going to be teamwork, it's going to be physical stamina. But at the end of the day, it's going to be, do you have the intellectual skills to do it?

MWI: Thank you, sir. Now on to our final question.

Reeves: Sure.

MWI: Knowing what you know now, what advice would you offer your younger self?

Reeves: Good question. Time goes fast. Don't rush through it. Stop to smell the roses before you're going to become president of the United States or whatever your plan is. Enjoy being a platoon leader. It's fun. I mean, being a lieutenant is fun. The Army is a blast. Embrace the adventure that the Army provides for you.

Don't be too worried about the next step all the time. I mean, it sounds counterintuitive, but live a little bit in the moment and just be really good at what you're doing at that time.

And I think that is something that I worry about a little bit with cadets, is that they're so talented. I mean, you all are so talented. You're so capable, you're so physically fit, but you're also so driven that you're thinking, well, I've got to do this, then this, to this, to this, to this. Like, no, stop. Just go off the hip, platoon, and have a blast, and the rest of it will come or not. And then just pivot. You have all the skill sets to pivot and be successful in life and have confidence that you can do that. But just enjoy it a little bit more than I think sometimes we do.

MWI: That is amazing advice. General Reeves, thank you for your time today, and for this excellent discussion about professional education, military strategy, ethical reasoning, and preparing for tomorrow's wars.

Reeves: Thanks for having me today. I would like to tell you that you're a much better podcast host than I am. You are now top of the heap. You are top of the heap at the academy, Emily.

MWI: I take that amazing praise and I'm going to put it in my back pocket and tell my mom later.

Reeves: Good. I don't know how many podcasts are at the Academy. There's probably two. You're number one, maybe I'm two. There's more than I don't know. You're still better than whoever else is out there.

MWI: We got a few from MWI sprinkled in the mix there. I can't say that I am top of the heap in those, but, sir, I will take that to heart. Sir, on behalf of Colonel Pat Sullivan, the director of the Modern War Institute, and Dr. Charlie Feint, the director of this podcast series, it is my pleasure to present you with this rare and coveted MWI coin.

Reeves: Ah, thank you. I appreciate it. Thanks for your hosting and thanks to the great MWI leadership. Of course, thanks to the West Point Class of 1974 for all the effort they put into supporting this effort. This is wonderful. So thanks for having me.

MWI: Thank you for coming, sir.

The Promise of Artificial Intelligence

an interview with retired General Joe Votel

by Zach Olson

Editor's Note: Retired General Joseph Votel commanded US Central Command, US Special Operations Command, and the Joint Special Operations Command. This interview is part of the cadet-run Five Questions for a General podcast series and took place in the Class of 1974 Recording Studio inside the Modern War Institute at West Point. It was edited for clarity, brevity, and flow. He was interviewed by Zach Olson. You can listen to the full podcast at our website, mwi.westpoint.edu.

MWI: Ladies and gentlemen, welcome back to the West Point Class of 1974 recording studio, and the *Five Questions for a General* podcast. I'm Zach Olson, your host, and it is my pleasure to be here today with retired General Joe Votel. General Votel is a West Point graduate and was commissioned in 1980 as an infantry officer. Over the course of his career, he commanded the 75th Ranger Regiment, the Joint Special Operations Command, US Special Operations Command, and US Central Command. He joins us today for a discussion about coalition building, great power competition, and decentralized leadership. General, welcome to the show.

Votel: Hey, Zach. It's great to be here. Looking forward to it.

MWI: General Votel, what led you to decide to join the Army, and why did you decide to attend West Point and branch into Infantry?

Votel: Well, interestingly, I didn't decide to go to West Point. My first exposure to a service academy was to the Naval Academy down in Annapolis. And I went there when I was ten years old. My brother lived in Baltimore, and he took us out there. It was right after Martin Luther King had been assassinated, so there were curfews in place. But you'd go out during the day, and one of the day trips we took was out to Annapolis, and I went out there with my parents and my brother and some of my siblings, and we looked around and watched it, and I was amazed. I was just a kid from Minnesota. I'd never seen anything like this.

And I remember that I turned to my dad and said, "Hey, this is where I want to go to school." And so that was kind of what I was thinking about them. And as I kind of got into high school and started the application process, somebody suggested applying for West Point as well. And I thought, "Oh, West Point. I don't know about that." But I applied, and I ended up getting into West Point and not getting into the Naval Academy. And so I literally showed up here, Zach, sight unseen, and having never been here, never seen the campus.

I got off the bus at Michie Stadium on a very warm July morning and had instant buyer's remorse, but got over pretty quickly and then really grew up to like it. You know, interestingly, about 6 or 7 years after I was commissioned, I actually was doing an exercise and I was out on a Navy ship as part of the exercise, and I instantly knew that I'd made the right choice in, in, in coming to the Army and being in the Army. So, um, you know, I don't know, it kind of happened by accident, but I loved it. I loved it, and I loved my whole experience here at West Point. I loved being around troops. I thought there was a very personal aspect to leadership in the Army, and I really, really liked that. And it just kind of kept me going.

MWI: Sir, as a former commander of US SOCOM, you emphasized the importance of professionalizing that SOF experience to meet emerging threats. What did you believe that special operations forces must evolve to remain relevant in the next era of great power competition?

Votel: Yeah. I think one of the things we did really well during the global war on terrorism with special operations forces was becoming much more integrated with conventional forces. And this was not always the case. And really well into the global war on terror, I'm talking years into the global war on terror, we still really had two kinds of separate organizations. I mean, they were friendly and everything else, but we were not completely synchronized with that. And over time, you know, the trust that is necessary between, you know, two different parts of the military, I think really improved.

We had SOF officers who were going over into more senior leadership positions, General McChrystal being a good example of that, on the conventional side. And we had much more exposure, and there was a much greater appreciation for what each side could do for the other. So the conventional force side appreciated what SOF could do in helping shape the battlefield and create effects out there, and the SOF community appreciated that a lot of what they were doing had to be enabled by conventional forces. So there was this symbiotic relationship between them. So it's kind of a long answer to kind of tell you that. I think as we move forward, we've got to maintain that. We've got to be we've got to be well linked. We've got to be integrated. We have to be synchronized between the two forces. And I think that SOF officers and SOF operators appreciating how they contribute to conventional force campaigns is really critical. So, you know, as we I think as we've kind of pivoted more towards China, I think there's actually been a greater realization for how SOF can, you know, help shape. Partnerships out in the Asian Pacific. How we can do things to help the Indo-PACOM commander, things like that. I think those are really the most important things.

And it's critical, I think, for going forward for SOF and conventional forces to have a high level of trust and confidence between each other. Are they prepared for a conflict operational

perspective, where right now they're operating, they're engaging in partnership building and coalition building, if we get into a conflict, is SOF ready to support the conventional force in maybe a different way or in the same way it is right now? I think they are. I think one of the things that you find in the SOF community, one of the really great attributes that the SOF community has, is adaptability, and it is being able to morph and become what the nation needs you to be. So, after we got involved in Afghanistan and then Iraq, we needed a force that could go out and really hammer the networks. And that's what we needed to do. That wasn't necessarily a natural inclination. When we first went to Afghanistan in 2001, we were a good force, but a different force than what we eventually became just a couple of years after that. So the adaptability aspect of it is really important. And of course, all the traditional things that special operations forces do in terms of building partnerships and developing relationships and gaining an understanding of the area of operations and doing kind of economy of force efforts where you can use a few people to do things as opposed to large formations. I think all of these will be critical going forward. So I have pretty high confidence in the SOF community to do what is needed.

In the future, I think the challenge is going to be policy and authorities. You know, what's happening out in the Pacific now is different than what we did during the Global War on Terrorism. We were actively involved in combat operations. We're not actively involved in combat operations out in the Pacific. And as a result, the authorities and rules of engagement and other things are different. And that means that we can't do everything we'd like to do. So we have to really be inventive about it. And we have to be prepared for when things do change. We do get the authorities and policies that allow us to now to be more fully engaged, kind of going with those forces and policies.

MWI: Do you see a major internal threat to that symbiotic relationship between SOF and the conventional force? And then also kind of actively, what do you see as the biggest external threat to that relationship?

Votel: Well, I don't I don't necessarily see a huge internal threat. Something I've begun to see this since I've been out of the military a little bit is as we have come out of kind of these areas of constant combat in the Middle East and other places, Afghanistan, Iraq and Syria, the dependencies and the trust that was built between conventional forces and SOF is that it becomes a little more sporadic. So I think one of the one of the biggest concerns I have would be losing that trust, losing the relationships, losing the confidence that we that we have in each other going forward. I would hate to see us have to go through a period where we have to rebuild all that. It's likely that we might have to. I think that could be a challenge.

The other thing is, I think what you find in kind of the what I would describe is kind of the inter-war years, where you come out of a war and you're preparing for another, is there is a tendency

for the services in particular really focus on themselves and to be less concerned with other elements like SOF formations. And I think we've seen that. So a little bit of that in, in the Army today where there's been some reductions in the SOF, especially the Army component of special operations, that have been difficult, I think, for people in the SOF community. But, they may have been necessary from an Army standpoint. And my point is that when you don't have, like, a war in this particular country where people are dying and you're having to fight and you're having to do things, people have a tendency to go back and protect their base. And in some cases that's protecting your budgets, protecting the development that needs to take place on the services. And sometimes that causes the trust, the confidence, the partnerships, other things to take a little bit of a backseat. I think we've got good muscle memory from our previous time together, but I think it's something we always have to be cognizant of.

MWI: So one of the hallmarks of your leadership has been empowering subordinates and decentralizing decision making in an era of increasingly rapid information flow and constant surprises. How can leaders be balanced? How can leaders balance mission command with the demands of accountability and precision?

Votel: Yeah, I think this is a real challenge for military leaders today because the information environment is so dynamic, it's moved so quickly, and people have the ability to know everything all the time right now. And that goes up and down the chain of command. So I think there really a premium on that. Going forward, I think the basics of leadership really, really matter. You know, I kind of started developing this early when I was at JSOC, but it really came home to me when I was a CENTCOM commander, was how you really have to enable decision-making at the lowest competent level. And that doesn't necessarily mean that the lowest level means the lowest *competent* level.

Sometimes it's the people directly below me, sometimes it's people way, way down the chain of command. And I think you enable that by building trust, by promoting what I kind of call a feedback culture, where people feel comfortable sharing information up and down the chain of command. One of the great things you learn from working with a guy like General McChrystal or Admiral McRaven is that they really put a premium on sharing information, almost to the point of being uncomfortable with that. But you know, what? You find that when you do that, when you enable people with information, they have a tendency to protect that. And they have they appreciate that and they want to they want that to continue because they understand what's happening. And so then in turn, when people feel comfortable providing feedback up the chain of command, then I think that makes it easier to push decision making down to the lowest competent level. And that that was that was my experience at CENTCOM was we I think we felt very, very confident that we had a very good feedback loop. People felt confident sharing information, they could deliver bad news. They weren't going to get shot in the face for doing it. We were going to accept that and move on from there and really try to empower decision

making, again at the lowest competent level, to that leader that's in the best position, that has the resources, has the right communication tools to let people know what's going on. That, to me, was the critical thing. And I don't think it changes with the information environment. I think it might be a little more difficult because people can step in and know what's going on. But I think leaders have to enforce that as they go forward. They have to have to enforce allowing people at the right level to make the decisions and exercise the initiative that they that they have.

MWI: Are there any enduring principles from the lieutenant level leadership to, say battalion commander or brigade command, when you need to create that sense of that feedback culture, how do you create that?

Votel: Yeah, I think one of the things you do is you focus on building relationships. Relationships are really, really important. Relationships give way to building trust, and when you have a good relationship with somebody, the more you understand where they're coming from, you understand what their motivations are, and you have much more trust, much more confidence in them. So I think that's a really, really critical, critical aspect of it. Also, being a good communicator and emphasizing good communication techniques both up and down the chain command are really, really important. And one of the things I learned is, as I kind of went through my career, is that oftentimes you have to adjust your communication styles to the people that are that are above you, that you're working for.

You know, it's our job oftentimes to comport to those above us. And so you have to be flexible. You have to be adaptable in terms of how you communicate. One of the big things we've learned out of all this is the is the importance of flat, fast, proactive communication. I think you want to prevent people from guessing about what you're doing. I never wanted people to guess what we were what was happening at CENTCOM. I wanted them to know what we are doing, and if they didn't understand it, we'd help explain it. Or if it's not in accordance with your guidance or whatever, that will make changes to it. But I want you to know what's going on. Sometimes we have a tendency, I think, and I think is a mistake for leaders, is to is to protect information and not share it and not let people know what's going on. Because I think when you don't fill in the gaps for people, guess what happens? They're going to fill in the gaps themselves. And in most cases they're going to they're going to always assume the worst about what your intentions are or what you're doing or how you're approaching things.

And I just I think that's a waste of time. It's a waste of effort, especially when you when it's so easy just to share information with people. So this idea of relationships, leading the trust, communication, between all levels of command, creating these feedback loops that move information up and down and creating this idea of shared awareness. It's a shared understanding of what the threat is, what the risks are, what the actions are. We're going to take those kinds of things I think are critical now, and I think they will be critical in future conflict. They've been

very critical to us in the past. And I think it's I think those are the kinds of things leaders need to be focused on developing.

MWI: Sir, the reading list you published with the Modern War Institute in 2017 included five books in five different categories: leadership, managing complexity, strategy, regional understanding, and innovation. Your list clearly emphasizes the importance of broad intellectual participation. How have you translated the importance of being a well-read leader to your formations?

Votel: Well, I think one of the things by always talking about one of the one of the officers that I served under multiple times was Marine Corps General Jim Mattis, I last served under him when he was a secretary of defense. But you know what he exhibited through his leadership style, especially when I was in uniform, was that he is a student and an advocate of history. And so he could tie things that we were doing back to historical examples and talk about them. And he emphasized the importance of reading, being curious about your own profession. And so I think one of the things that I tried to do was really promote kind of professional curiosity about the things we were doing. I mean, I think you can look in a variety of different things and find the lessons learned. One of the really good books that I recently featured on my LinkedIn page was a book called *Endurance*, which is about Ernest Shackleton. Now, Shackleton was not a military leader. But I've got to tell you something. Talk about a guy who overcame adversity in something. I mean, he literally took his crew of 30 down to South America with a plan to go to the South Pole. It almost immediately went wrong. He spent 18 months. His whole ship was crushed. He was left on an ice floe. He had to work his way through all of that and brought everybody back alive and figured it out. So, talk about leadership and pulling things out of that.

So I think what you have to do is you have to look for. You have to look for opportunities in leadership and in a variety of resources and try to share those with people and encourage people to read widely and to absorb the lessons, not just military lessons, but lessons that come from other places. When I retired, my first job was running a nonprofit organization that worked with business people who shared their expertise in the national security enterprise. And one of the things I really learned is that sometimes you begin to think the leadership is the domain of those in uniform or the domain of the military. It's really not.

I'll tell you something. I met dozens and dozens of business leaders who had never served in the military, but yet they internalized all the same things. The things that you or I were taught right here at West Point about leadership? They understood taking care of people and understood setting an example. And they understood the importance of culture, and they understood leading by example. Those kinds of things. So I think you have to look at those kinds of things. And I always wanted to talk about those. Of course, you got to try to demonstrate that with your own actions as well.

MWI: Do you see the role of podcasts differently than the role of books, or do you think they are about one and the same in terms?

Votel: I like podcasts, and I routinely listen to to to podcasts. I try to vary my diet of podcasts. So I get a little bit on different sides of the perspective. I get different political views on things. And you can hear about how people are thinking about relevant topics. That's the value in my view. That's the importance of podcasts. And at least as, as I kind of as I kind of look at them, is that people are talking about things that are happening right now, and you're getting a different perspective on it. And I think it kind of causes you to think of them. I think one of the skills you have to develop as a leader in all of this, and maybe it goes back to the last question you asked, is the ability to hold two competing ideas in your head at the same time.

Sometimes in an information environment that's very polarized, like right now, it would be very easy to say, "Hey, this is where I am. I'm very certain about this." But the fact of the matter is, one of the things you have to be able to do as a leader is be able to hold competing ideas in your head at the same time, and not everybody's going to be completely aligned. You have to have a perspective of that. As a senior officer, I was oftentimes advising our civilian leadership. They oftentimes had a different view on things. So being able to kind of wrestle in your own mind with competing ideas and try to find opportunities to move forward in that and to understand how people are looking at things, I think, is really important. Reading does that, listening to podcasts does that, other programming that's out there I think helps broaden your perspective and develop this capacity to hold a couple of different ideas in your head at the same time.

MWI: So during the Peace and Dialogue Leadership Initiatives conference last March, you characterized the Middle East as "chaos and opportunity." Has that characterization changed, and if so, why?

Votel: No, it hasn't changed at all. And I think I think we're now beginning to see the opportunities that that exist there. A couple of weeks ago, I led a delegation from the Middle East Institute to Damascus, Syria, and I never I'd never been to Damascus. I've been to Syria, of course, the part of Syria that we were fighting ISIS, many, many times. But I'd never actually been to Damascus. But we took a group to Damascus. We did it in conjunction with our government and with the support of them, to make contact to introduce some prominent American citizens to people in the new Syrian government. I think this is Exhibit A in terms of the opportunity, right here. I mean, it's extraordinary. We met with people who are ministers, but, you know, a year ago, were on the target list. They had been associated with extremist organizations, but they've kind of migrated over. And you do have to build trust and confidence as you move through these negotiations. I mean, they're saying a lot of the right things, and they have the ability to create some stability in a place like Syria, which is so critical to the region.

I think there are three big things we ought to be thinking about in the Middle East. We've got to be thinking about what's how we how we work through this Gaza situation. We've got to think about what happens with Iran, and we've got to think about Syria. Those three things I think could really help. Those are the opportunities right there for us to really move forward. You've got to you've in order to seize opportunities, you've got to start grabbing onto things. I think the area is ripe for opportunity and for us to move forward on. It's not going to be easy. It's going to be difficult. They're probably going to be setbacks. It's probably not going to be as perfect as we want it to be, but there really are ways to move forward. So yeah, I, I think it's all about chaos and opportunity.

MWI: Sir, how is emerging technology such as AI going to affect warfare, especially as it relates to decision making?

Votel: Well, theoretically, it's going to make it easier, faster and more comprehensive for leaders and the staffs and those that are supporting them to be able to understand what is happening out there and be able to process large amounts of information that are germane to the decisions that that they making. I think that's the promise of artificial intelligence. And I actually see some examples of that. Look at kinds of the things we're doing for Ukraine. I think we're beginning to use some of these tools to help understand complex environments where you've got drones, you've got missiles, you've got sophisticated air defense systems, you've got electronic warfare and helping people parse through all that information to make really good decisions. So I think that's kind of the promise of technology there. I think there could be a limit to this as well. Ultimately, people have to decide. And so all the things that we talked about before. Remain very critical. Good judgment, good wisdom, feedback from people, getting decisions at the right level, where people have the best situation. All of those things still matter. But I think things like artificial intelligence can really help with, if nothing else, just processing the information and understanding the environment and putting it together in a more rapid, comprehensive way for leaders to absorb. I think that's the promise of it.

MWI: Do you see AI as a possible way to enhance the development of a leader's ability to make good decisions? Or is it more of a possible detriment where it might start to take over some of those decision-making faculties and we might lose things that we prefer?

Votel: Yeah, I mean, I'm kind of an old dog here, so I do have some concerns about it taking over. I appreciate the promise of artificial intelligence, but I am not yet there in terms of artificial intelligence, being able to do a lot of decision making and take things over and use machine learning associated with it to actually do things. I am still very much a human not only in the loop, a human at the top of the loop. So I do have some I do have some concerns about that. But I also, you know, and that's why I think we, you know, the fundamentals still matter. The

fundamentals of leadership still matter. I mean, people still have to be competent. They still have to understand the capabilities of their systems. You can't just put somebody in a position and say, “Oh, don't worry about this person's experience or judgment or things that he's done he or she has done in the past,” because we've got artificial intelligence to cover all that, that that would be disastrous. So, I have a tendency to look at it as a tool. Another way that we that enhances the ability to make good decisions, to help another, you know, tangent on the feedback loop, so to speak, that that's the way I look at it now. That might change over time as I become more comfortable.

I use artificial intelligence. I use it for things I'm doing, I use it for my own research and all the things that I'm going to speak or write or do things on. And I've become pretty comfortable with that. And I've learned how to fact-check and look at sources and things like that. Those are the things I normally would have done, so I begin to be more confident in it. But ultimately, I think, people have to decide, leaders have to decide. And so there are some other innate skills that contribute to that beyond ChatGPT or Perplexity or Grok or whatever it is that you're using.

MWI: You've described the counter ISIS fight as one of the most complex operations of your career. What are some aspects of that operation that you'd think AI could not have completed, and you needed that human element for?

Votel: Yeah. So as we were moving into the later phases of campaign, particularly as in Syria, as we were moving back down the Euphrates Valley, away from the traditional areas where the Syrian Democratic Forces, our partners, our Kurdish and Arab partners on the ground, had their sources of strength. We were we were making decisions on the pace of the campaign and how we moved from village to village as we went on was based on human dynamics. We were meeting with local tribal leaders, who were very concerned about us coming in and destroying their villages and leaving a, ruin in the wake of our destruction of ISIS. And so we frequently stopped and looked for other ways to get ISIS out of these villages so we didn't have to go in and destroy them. We had to take a much more patient approach, and that required people communicating, understanding, and seeing things on the ground that could not have been done by artificial intelligence. Too me that that was the quintessential example.

Now, I'll give you another example where I think artificial intelligence could have really helped us in the early phases of it. We had foreign fighters coming in, ISIS, they were coming from well over 100 different countries around the world. They were making use of social media, Facebook, Twitter at the time, Telegram, all these other things that were out there. Artificial intelligence could have really helped us there, helped us look for the right things, developed the algorithms, looked for the right things to help us understand what was happening there. Ultimately, we did, but it took it took a while to do that. That's an area where I think technology, in particular artificial intelligence, could have helped. So, I think the challenge for leaders is going to be what

are the things that, you know, that are innately, innately require the human touch, human connection, human eyeballs, human brains looking at things? And what are the things that can be done by artificial intelligence that can help us move through masses of information quickly and arrive at conclusions that can make our decision making sharper, more accurate and more on target with our campaign objectives.

MWI: Sir, knowing what you know now, what advice would you offer to Cadet Votel or to Second Lieutenant Votel?

Votel: Be patient. As a senior officer, when you get out to the different organizations you're leading, you'd sit down and talk to a young officer or a young lieutenant, and they'd immediately be focused on what was next. You know, "How do I get to the Ranger Regiment? I'm in this battalion, but how do I get to the Ranger Regiment?" My response over time would be, "Well, first of all, don't worry about that. You really need to concentrate on doing a good job right where you are." So I guess the thing I would emphasize to myself, and I found myself that being that way, is that you're always kind of plotting about what you're doing next. And I think, I think the idea is to be wholly into whatever it is you're doing right now, and do as good a job in that. Learn. Suck as much as you can out of that learning experience, and then you know use that to go forward.

I found over time that good people that did well in whatever positions, they created their own opportunities to move forward. People took notice of that. And you recognize that the chain of command appreciated it. They knew this person was reliable. We can move him or her forward. They're going to do great stuff. And so I think the idea of just being patient and learning as much as you can, just extract as much as you can on every experience that you that you have and, and each one of those, and get you ready for the next one. So that's what I'd tell Cadet Votel

MWI: General Votel, thank you for your time today and for this great conversation about curiosity, great power, competition, and patience. On behalf of Colonel Pat Sullivan, the director of the Modern War Institute, and Doctor Charlie Faint, the director of this podcast series, it's my pleasure to present you with this rare and coveted MWI coin.

Votel: Thank you Zach, I appreciate it. Wow. That's great. Now I know I've made it. Thank you.

“Sharpen the Saw”: Using AI to Enhance Leadership

an interview with former VA Secretary Robert McDonald

by Charles Faint

Editor’s Note: Robert McDonald is the former Secretary of Veterans Affairs and the former chief executive officer of Procter & Gamble. This interview is part of the Key Leader Engagements podcast series and was recorded in the Class of 1974 Recording Studio at the Modern War Institute at West Point. It was edited for brevity, clarity, and flow. He was interviewed by Dr. Charles Faint from the Modern War Institute.

MWI: Welcome back to the *Key Leader Engagements* podcast! I'm Doctor Charlie Faint, your host, and today's guest is former Secretary of Veterans Affairs Bob McDonald. Bob, welcome to the show.

McDonald: Thank you. Charlie, great to be with you.

MWI: Bob, you graduated from West Point and served in units like the 82nd Airborne Division before going into the business world and eventually becoming the Secretary of Veterans Affairs. What prompted you to join the Army, and why did you choose West Point?

McDonald: That's a very interesting story. I grew up in Gary, Indiana, and then we moved when I was in elementary school to a suburb of Chicago. And I was always intrigued about West Point. I wanted to live a life that was different than everyone else. The Vietnam War was going on, and I thought that I could serve other people by leading soldiers in the Army. So I first applied to West Point in sixth grade. I was 11 years old, and my congressman, who was terrific at the time, said, “You can't go now, you’re not ready. But keep applying. Send me all the newspaper articles from your sporting activities and other things. And I'll keep a file on you. And West Point will keep a file on you.” And so from sixth grade until I was admitted, this congressman encouraged me. And his name was Don Rumsfeld.

I had the opportunity to meet Secretary Rumsfeld later, when I was Secretary of the VA, before he passed away. And I met with him several times. And every time I thanked him for encouraging a young person to go for their dream without discouraging them. And I've tried to I've tried to live my life that way as well.

MWI: You've held important leadership roles in the military, in the private sector, as CEO of Procter and Gamble, and in government, as Secretary of the VA. What leadership principles proved consistent across all three arenas, and which one or where did you have to adapt the most?

McDonald: I think the principles of leadership are the same. I always say that leadership is the most scarce resource in the world. So if you, as a CEO or as a cabinet secretary, are not working on developing leadership in your organization, you're wrong. As a CEO of P&G, I would spend 35- 40% of my time on leadership. And it's my deep belief that given the scarcity of the resource, you as a company need to create a culture that focuses on leadership development. So in every organization I've led, we've developed a leadership model, and then we make that model ubiquitous or pervasive, and everything we do from who we recruit to how we train, how we develop, and who we promote.

And in the case of the Procter and Gamble company leadership model we developed, we call the Five E model: envision, create a vision for the organization; engage, so we engage people in that vision; energize, get them excited about that vision; enable, meaning build the organization's capability to achieve that vision. And of course, perhaps the most important E is execute, because no strategy is any good unless you're actually executing it. And so we turn those five E's into a collective set of behaviors. And basically what I would tell people is I can train you on the behaviors, which when viewed, are labeled leadership. And we turned it into an interactive, computer-based program. So as an employee, you can send it out to your subordinates, to your superiors, to your peers, ask them to rate you. And it could be part of your development program.

When it comes to leadership, I'm very focused on behaviors. There was a book written called, I think, *Managing Behavior by Consequences*, I can't remember exactly. But it caused me to believe that leadership is about behaviors. So each one of these E's had, let's say, five to 6 to 7 behaviors underneath them. And so the query we sent out to the workforce would ask, "Did you see this person do this?" It was very action-oriented. I was a Boy Scout, but I'm not a huge believer in the creed theories of leadership. You know, friendly, courteous, kind, clean, reverent, like in scouting.

MWI: Well, speaking of culture, when you took over the Department of Veterans Affairs, the organization was facing some significant public scrutiny and institutional challenges. How do leaders restore trust, both internally, within the workforce and externally with stakeholders after a crisis?

McDonald: I think culture is perhaps the most underestimated leadership activity. And it's also the least worked on, compared to what it should be. I knew right away I had a culture problem. I knew right away I had a trust problem. And I knew that trust is the oil of leadership. And you have to develop trust by creating intimacy. So we actually turned trust into a measurement that we used at the VA. We put in a program called Human Centered Design where we journey-map the experience of the veteran from the day they raise their hand and are sworn in, to the day we bury them in a VA cemetery. We get scores for all those that we call "moments that matter," the

interfaces between the VA and the veteran. Uh, we work to reengineer those touchpoints so that we get those scores up, and then the overall score we get is efficiency, effectiveness, and not the least of which is trust.

In the fall of 2014 or so, when I did my first national press conference, I gave out my cell phone number. The Washington Post published it for me. It's still on the Internet, and it's still my cell phone number. And I did that because I wanted veterans to know that if even the Secretary would give out his cell phone number, that they had a place of last resort to go to, while if they needed help. Now, obviously that was a big cultural intervention for the organization, because what I was saying, everybody who worked for me, all 400,000 people, is if I'm willing to give out my cell phone number, you should give out yours.

And that came from the fact that when I first got to the VA, the IT people came to me and said, "Don't worry, we'll change your email address frequently, so people can't figure out how to reach you." And I said that's insane. This is a customer oriented business. I want people to reach me. It's about culture.

MWI: In today's environment, leaders are expected to navigate rapid technological change like AI while maintaining human connection. How should senior leaders balance innovation with the need to remain grounded in a people-first style of leadership?

McDonald: I think that innovation is incredibly important. So let's go back to Procter and Gamble. Our purpose is to improve the lives of the world's consumers. Well, the way we improve lives is through innovation, by designing new products that make people's lives better. So you've got to be innovative. You've got to be innovating all the time. And technology is a way to do that. So I think as long as you stay focused on your purpose of improving lives, as long as you stay true to your strategies, then the issue becomes, what do you do organizationally? But then also what do you do personally to make sure you're up on the latest technology, which can enable you to be better at what you do?

MWI: Bob, reflecting on your military background, how did your time at West Point as an Army officer influence your approach to strategy and decision-making later as a corporate executive?

McDonald: Well, I think I think a couple of things there. Certainly as you go through the leadership development program at West Point, you learn a lot about the importance of things like strategy, tactics, execution. Making sure you have the order of those things right and making sure your priority is to focus on them in order. And I can't tell you the number of business situations I've been in where business leaders had confused execution with strategy, or strategy with tactics. And if you operate at the wrong level, you're going to end up with a bad

outcome. And so that's been very helpful. And of course, the study of warfare and other leadership studies helps you see mistakes have been made by other people, and they help you understand how you can apply that in your life.

I was remembering last week about a discussion we once had about who we were going to select to be the next leader for something. There weren't bad leaders and good leaders. There were leaders for certain situations. And so the question became, "How do I find that right leader for that right situation?" And it always goes back to that.

There's a wonderful story we have in the military of General Patton and how he wasn't the right guy to rally the Allies to invade Europe. Eisenhower was the right guy. But when it came to driving the troops across Europe, that was Patton. One leader is not bad. One leader is not good. It's how do you choose the leader. And I guess George Marshall deserves the credit by identifying the strengths of each leader in terms of what situations would make them successful.

MWI: I think that's such an important point. And we can see that in the Army and in the business world, people are successful in Job A, and too many times we think they're automatically going to be successful in Job B, and we find out that often too late that that's not the case.

McDonald: You're right. It works laterally and it also works vertically, where somebody performs well in the job they're in. And then you promote them and they're a disaster. It's because you haven't properly understood what's required in the job and gotten them ready for it.

MWI: That's right. We don't prepare them adequately. A lot of times we just assume they're going to be okay with it, and they get in those jobs and flounder right here. So, Bob, you spent a career leading large institutions and working with thousands of people. When you think about the leaders who influenced you most, what qualities did they have that stayed with you?
McDonald: Well, I think I'll talk the positive and the negative here. The positive leadership aspect that has influenced me most is watching leaders of character. And I love how West Point articulates that. We create leaders of character. I often say that to me, character is the most important trait of a leader, and I define you can define character in a number of ways. We define it very well here at West Point. But I think of character as the person who puts the needs of the organization above themselves.

Throughout my careers, I've always tried to put the organization before myself. Also, the second part of character, I think about the Cadet Honor Code; lying, cheating, stealing, or tolerating people who do. That's an essential part of character. And, in all of your organizations, you want to create a community of people who understand the necessity of that kind of

character, because you don't want somebody who's going to put that at risk. And you can't take it for granted.

I remember when I got to the Department of Veterans Affairs and that time there was a crisis in Phoenix. And everybody said to me, “Well, you got a problem with scheduling, you've got a problem with factors. You got a problem with nurses, you got a problem with clinical hours.” And I stepped back from it and I said, “No, I have a problem and purpose and values,” because some of the VA employees were lying. Why were employees lying to the secretary? The secretary had given them an objective that every veteran should get an appointment 14 days from their call, and they were incapable of delivering that. They would write the person's name down, and then call them back 14 days before they had an available appointment.

So it looked like it looked like they're getting an appointment for 14 days. But the reality was they're getting appointment of 45, 50, 60 days. So you can see how people say, “Well, you have a scheduling problem, you have all kinds of problems.” And to me, I had a fundamental problem. If I want a high-performance organization, I have to have an organization rooted in purpose, principles, and values. And so the first thing I did was I when I discovered does our VA have a purpose? Do they have values? When was the last time they trained them? Well guess what. They hadn't trained them.

At the Procter and Gamble Company we train purpose values and principles frequently, we don't assume them. And then we not only train them but we recruit for them. We talk about them in people's promotion reviews. They're pervasive across the entire activity system for individuals. They didn't have that to VA. In fact, ironically, they had a great set of values. They the acronym was ICARE: integrity, commitment, advocacy, respect, and excellence. So a great a wonderful set. They even had pins that had ICARE on them. But you know what? Nobody was wearing the pins. Nobody had been trained in the values. And so all I did was stand on the shoulders of the giants who came before me, and we got it out. We did the training. People started wearing the pins. Now in the beginning, because the previous Secretary had resigned, they would argue that they were ashamed of wearing the pin. And so we had to build back that pride, sure that what we were doing was important. And if you if you live consistently with ICARE, veterans will be well served and everything will be all right.

MWI: When you were talking about the situation when you took over the VA just now, it reminded me of something we talked about often here at West Point. And that's the manuscript *Lying to Ourselves* by Leonard Wong. Are you familiar with that one?

McDonald: I'm not, but I can certainly identify with this idea of lying and lying to yourself.

MWI: Based on your experience, not only the VA, but as a veteran, and an Army officer,

you would recognize immediately what he's diagnosing. And it was very similar to what you're describing at the VA: people falsely reporting or skirting the system and never having the guts and the values and the character as you express to make the changes. People were lying about everything. And because there was never any demand signal for change, the higher leadership, even if they weren't aware of it, thought everything was fine.

McDonald: I discovered that as leaders, you've got to be cognizant of where your weak points are. And maybe I've not been as good at this as I should have been. But I think if you asked me what's my weakness as a leader, I think I assume everyone has the same values I do and they have the same purpose I have. My wife and I donated the statue of Ulysses Grant that's now here at West Point. The way something like this works is, the authorizing committee passes the law, and the appropriating committee appropriates the money for it. Oftentimes what happens is the law is passed, but they never give you the money to do it, and you're expected to somehow figure it out. So what happened was the National Defense Authorization Act had a line in it that Congress would like West Point to put a statue of Ulysses Grant on The Plane.

Now, arguably, from a historic standpoint, Ulysses Grant was an outstanding general. Outstanding leader. A graduate of West Point. Became president and served two terms. But for various reasons, Grant was maligned. Historians have had now talking more positive aspects of Grant, but the one aspect of Grant that I could identify with was he trusted people, and that got him into trouble. It got him into trouble with his cabinet, where he had some people who lacked integrity. And it got him in trouble later in his life when he went into business with his son and basically invested all of his retirement savings with his son. And his son was tricked, or somehow his partner absconded with all the money. So Grant at the end of his life was literally penniless. And it was Mark Twain who suggested to Grant that he write his memoirs. And of course, Grant said, "Nobody's going to be interested." He started suffering from throat cancer, which eventually took his life. But he wrote his memoirs. And then Mark Twain did a very incredible thing. He gave Julia Grant, his wife, uh, a huge check and a huge advance because he knew they had no money. Now, as it was, that advance was not very large compared to how many books he sold. But Twain actually used his own publishing company to publish the book. The books. It's two volumes. Anyway, Grant's from Cincinnati. That's the home of Procter and Gamble now. And since no money was forthcoming, my wife and I, who both identify with Grant, we invested in the statue. And I'm very happy with the way it turned out.

MWI: It's interesting you mentioned this issue of trust. I sometimes think that's a common problem or failing with military veterans, because we operate in such a high-trust environment. And we don't always realize that just because someone's on your team doesn't mean they're on your side. And I think that's something that we struggle with sometimes. We are so good in the Army at talking about trust and values and putting people in.

McDonald: I'm a huge believer in Stephen Covey's *Seven Habits of Highly Effective People*. I took the training from Stephen in 1983, and he tells the story of the two men sawing wood. I can't remember sawing wood or chopping wood. I don't know if you've heard the story, but the one guy saw, and his pile keeps getting higher and higher. The other guy saws too, and his pile is getting higher, but this guy sits down every once in a while. Yet for some reason, his pile is getting higher than the guy who doesn't stop. And so Stephen went up to him and said, "What's what's going on here?" And the guy said, "Well, I'm stopping to sharpen my saw." And too many of us don't take time to sharpen our saws. Well, people have to sharpen their saws. Organizations have to sharpen their saws. And we, as the leaders, are responsible for that.

MWI: Well, speaking of trying new things, how can leaders use technological developments like AI to help sharpen the saws for themselves and their organizations in ways that can be beneficial to themselves, organizations, and the people that they lead?

McDonald: Well, I've read so many articles written by people who think that the world is going to end, because AI is going to take over the world. Some are informed, some are not informed. I studied computer science when I was here at West Point. I took every software and hardware course that existed at West Point at the time. I wrote an assembly program for the Honeywell mainframe computer we had at the time, and I was just intrigued by it. So I think you have to be intellectually curious. You've got to want to learn new things. AI is one of them. And then you have to be willing to look for applications and no, you might not succeed. You might fail. But you might succeed spectacularly.

Doctor David Feigenbaum, who is the founder of Every Cure, was dying of Castleman disease. The doctors literally told him to get his will in order. He died five times, literally. And he went, and he sat down, and he figured it out by trying different drugs that he knew would suppress his immune system. He tried different drugs, trial and error, to see what would work. Well, the beauty of that is you don't have to do trial and error anymore. You can now use AI to get the information from all these clinical studies that have already been published. That can give us indications at something like a power of ten.

We once had this artificial intelligence algorithm. It would take 17, 18 hours to run it because it was so complex. Well, today we can run in, like six. And it just shows you how the advance of technology and the advance of fine-tuning the algorithm. David ended up saving his own life, but then his uncle came down with cancer, and David discovered a drug to that put his uncle's cancer mission.

MWI: Bob, looking back at your time leading the VA, what reforms do you believe made the most lasting difference for veterans?

McDonald: A couple of things, First, I think the biggest thing we did, and I give the team credit for this, this is not me personally, is we got focused on the veteran at the center of everything we do. Now, I know that sounds simplistic and sounds obvious, but in a bureaucracy, it's very easy, particularly in crisis, to lose track of who your customer is. If an organization is in crisis, then general human psychology is close the windows drop the drawbridges, say "Please stop hitting me," and become internally focused. And what you have to do when your organization in crisis is open the windows a little. Get out and see your customer. And so that was that was number one was putting a veterans center of everything we do.

Number two would be providing some technology training and some human-centered design technology. Number three, we put back in place training. As often happens when organizations in crisis, sometimes they cancel all training. That's what was done in VA. We put training back in place.

And then we did all the things we had to do. We went to Congress for more money. We expanded the clinic hours. We expanded clinics with community-based outpatient clinics, hired more doctors. I went recruiting the secretary of VA had never gone recruiting before. Yet when I was at the company, I was chief recruiter. I would go to every university, speak to students.

MWI: Bob, the cadets here are, of course, at the beginning of their lifetime of service at the VA. You largely handled people at the end. Looking back at the accomplishments at the VA when you were secretary, what, if anything, do you think that the country still needs to understand better about the needs of veterans transitioning back into civilian life?

McDonald. Oh, that's a great question. When I was the VA Secretary, and still today, there's this great controversy in the country about whether or not we need a VA or whether or not we can just send veterans to private sector doctors. And I'm here to tell you that we need a VA. We need a VA not only for veterans, but we need a VA for American medicine. Let me explain.

So we need a VA because if you've been blown up by a roadside bomb, if you had post-traumatic stress, if you have a brain injury, you want a doctor working with you who knows what needs to be done for that. Private sector doctors don't. And that's why it's so critical for veterans. Omar Bradley is the guy I credit with setting up the VA, at least the way we have it today. Imagine this. After World War II, President Truman goes to General Eisenhower and says, "I'd like you to be Chief of Staff of the Army." And then he goes to Omar Bradley and says, "I'd like you to run the VA." Bradley was very bright. He got together a bunch of doctors, and he made the decision that the VA would be integrally linked with American medicine.

So now, most of your very best VA hospitals are located next to medical schools. For example, the Duke Medical School is right across the street from the VA. And the Cincinnati Medical School University is a medical school right near the VA. And we just built one in Orlando, Florida, right next to brand new University of Central Florida medical school. Now, the reason for that is. The medical schools and the VA share doctors. Doctors divide their time in the eighths. They spend some of those aids at the VA. They spend some of those eighths at the medical school. Covey said if you want to learn something, teach it. What better doctor could you have than somebody who's teaching what they're doing?

Secondly, the VA spends over $2 billion a year on research, and most of that research has advanced American medicine. Do you know about all the hard research done by Michael DeBakey in Houston? What's the name of the Houston VA hospital now? It's a Michael DeBakey hospital. He was a VA doctor who did the first liver transplant in this country. Tom Stahl, University of Pittsburgh, was a VA doctor who invented the shingles vaccine. A VA doctor came up with the idea that he used a barcode on medicine and an electrical on medical records. A VA doctor who is most knowledgeable about prosthetic devices. VA you know, they have to be. They have to be. And then that information goes to the American medical community. So not only can veterans not do without a VA, but also American medicine can't do without the VA. We just talked about how difficult it is to develop a drug efficiently for a rare disease. There's no way you're going to have a for-profit system do that. So it’s helpful that the VA is there.

The VA does a lot of that research. And 70% of the doctors in the country are trained in the VA. 70%. This is the largest employer of nurses in the country. So when I have people come to me, and I often did um, and say I would, I think we should privatize the VA. I say, well, no.

MWI: Well, Bob, I know we have to get you out of here shortly, so one final question for you. A lot of people listening to this podcast are going to be junior leaders here at West Point, or maybe they did ROTC as I did, or maybe they’re already out in the operational force. What advice would you offer these young people listening to the show about how to be a good leader right from the beginning?

McDonald: Earlier, we talked about my belief that leadership is a collective set of behaviors that, when observed, are labeled leadership. And I talked about the fact that those behaviors can be categorized by one of five E's: envision, engage, energize, enable, execute. So I can teach anyone all the behaviors of leadership, and people will look at them and say they think they're a leader. The single thing I struggled to teach in business that you automatically get in the Army, because of the in extremis circumstances, is the love of the people. If you don't have that love,

if you truly don't love the people you're serving with, all of those behaviors are going to ring hollow.

I'm a huge believer in Bill George's work on authenticity. And for those behaviors to be authentic, they've got to be backed up with that love. And so, on day one with every soldier, get to know them, know their birthdays, know their families, know what you can do with them. The beauty of the leadership and military is that it's 24/7. That's the way you're trained. In business, it's not necessarily that way. And as a result, the leadership is not as committed, I guess I would say so.

It's a real opportunity, particularly as a platoon leader, it's a great opportunity to develop the habit of learning and loving the people that you serve with, and then taking that with you no matter what organization you run. And obviously, if you're if you're running the VA and there's 400,000 people, it's a little bit difficult to get to know every single person personally. But if that's your goal, you can develop techniques to do that, whether it's town hall meetings, whether it's walking around, or celebrating people's birthdays, or whatever.

MWI: Well, Secretary McDonald, thank you so much for your time today. On behalf of Colonel Pat Sullivan, the director of the Modern War Institute, it's my pleasure to present you with this rare and coveted MWI coin. Thank you for a great episode and good luck with the rest of your visit!

McDonald: Thank you, Charlie, for the coin. Lovely. Thank you, it's been fun.

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