AY 2024-2025

Ground Combat Systems Industry Study

The Future of U.S. Ground Combat Systems: Maintaining Overmatch Amid Strategic Transition

15 May 2025

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Word Count: 8553

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EXECUTIVE SUMMARY

The United States Ground Combat Systems (GCS) industrial base is at a critical crossroads. Strategic competitors are rapidly modernizing and expanding their capabilities, while the U.S. Department of Defense focuses on a multi-domain operational environment centered on the Indo-Pacific. This paper assesses the current state of the U.S. GCS industrial base, examines the domestic and international trends shaping its future, and provides policy recommendations to help the United States retain overmatch in the land domain.

The U.S. has long maintained ground combat superiority through cutting-edge technology, experienced and well-trained personnel, and an industrial base capable of producing world-class platforms. However, the global security environment, defined by peer competition, constrained and unreliable budgets, and accelerating technological disruption, demands a new approach. The enduring principles of the GCS Iron Triangle—mobility, protection, and firepower—remain foundational, but they are increasingly constrained by platform age, evolving threats, and industrial vulnerabilities.

Emerging operational requirements, particularly in the Indo-Pacific region, call for lighter, modular, and more rapidly deployable systems. The pacing adversary of China is leveraging vertically integrated industrial models and state-driven innovation to field modern GCS platforms at scale. This highlights the imperative for the U.S. to innovate and scale simultaneously capabilities that remain out of reach for the current defense industrial base without deliberate, sustained reform.

There are several systemic issues constraining GCS modernization and surge readiness. First, the acquisition system is fragmented, slow, and risk averse. Legacy platforms dominate requirements and funding priorities, leaving limited space for disruptive innovation or new entrants. Second, the supply chain is increasingly fragile, with critical materials like rare earth elements and lithium overwhelmingly sourced from China, exposing the U.S. to coercion or disruption during crisis or conflict. Third, industrial capacity is insufficient to meet the demands of large-scale mobilization. The defense workforce faces persistent shortages in engineering and skilled trades, while key manufacturing infrastructure has become underutilized or outdated. Finally, inconsistent demand signals and budget uncertainty impede long-term planning and investment from industry.

Despite these challenges, there are encouraging developments that could transform the GCS industrial base if properly resourced and scaled. Expanding Modular Open Systems Architecture enables faster integration of emerging technologies and supports coalition interoperability. Hybrid-electric propulsion and unmanned systems are advancing rapidly, offering enhanced operational range, reduced noise and heat signatures, and new tactical options. Artificial Intelligence is revamping logistics, predictive maintenance, targeting, and command and control, creating opportunities for more agile, data-driven operations. International partnerships with allies such as Germany, South Korea, and Australia provide access to innovative platforms and can mitigate supply chain vulnerabilities.

To ensure the U.S. GCS industrial base remains capable of maintaining U.S. dominance in future conflicts, this report offers 10 strategic, actionable policy recommendations:

1. Accelerate Modular and Scalable GCS Designs.
2. Drive Innovation Through Long-term Planning and Integration.
3. Form a Resilient, Surge-ready U.S. GCS Industrial Base.
4. Integrate Technologies and Co-develop with Allied Partners.
5. Make Digital Engineering the Foundation of GCS Programs.

6. Optimize the GCS Sustainment Model.

7. Streamline Acquisition with Other Transaction Authorities.

8. Focus on Human Capital for Emerging Technology.

9. Deploy Additional Land-Based Missiles to the Indo-Pacific.

10. Accelerate the Development and Deployment of RCVs.

The United States cannot afford to assume continued superiority in the ground combat domain. Modernizing the GCS industrial base is a national security imperative. With effective and focused leadership, sustained investment, and collaborative innovation, the United States can revitalize its ground combat capabilities and maintain overmatch in the coming decades.

INTRODUCTION

THE FUTURE OF U.S. GROUND COMBAT SYSTEMS: MAINTAINING OVERMATCH AMID STRATEGIC TRANSITION

The U.S. Department of Defense (DoD) and the U.S. defense industrial base (DIB) have long maintained dominance in land warfare by excelling in the three cornerstones of the GCS Iron Triangle – Mobility, Protection, and Firepower. At the center of success is the renowned M1 Abrams main battle tank (MBT), the epitome of focused engineering and sustained modernization sought by allies and partners around the globe. However, evolving battlefield threats as highlighted in the Ukraine-Russia war, global economic challenges, a weakening industrial base, supply chain vulnerability, and hostile acts by adversaries have dramatically changed the global environment and exposed risk to this decades-long U.S. supremacy. During a time when national and global security are vulnerable and the DoD reorients its focus toward the Indo-Pacific and the People's Republic of China (PRC), the relevance of present-day GCS platforms and their survivability in future conflicts is in question.

The cost-effective and productive government-industry partnership for innovation, research, and development to maintain overmatch is needed more than ever across the Services, particularly in the GCS industry, as resources are shifting to an Asia focus. To sustain decisive ground combat superiority amid intensifying strategic competition and a shifting global security environment, the United States must modernize its GCS industrial base through innovation-driven approaches, including modular open systems, digital engineering, and allied collaboration. This transformation requires comprehensive acquisition reform, stable and predictable fiscal planning, fortified supply chains, and a revitalized workforce to ensure scalable production capacity and technological overmatch in contested environments.

Although China remains the pacing threat, as prioritized in the 2022 National Defense Strategy (NDS), the U.S. must also deter aggression from Russia, North Korea, Iran, and their proxies.[1] This requires a resilient and focused U.S. industrial base, supported by a consistent U.S. government signal and budget, aligned with global allies. It includes secure supply chains with access to rare earth minerals and microelectronics, a skilled workforce capable of increased surge capacity and operational adaptability, and a focus on research and development (R&D) to maintain a technological advantage.

As early as 2020, the Army Science Board warned DoD and the DIB that "The M1 will not be effective on the 2040 battlefield," citing deficiencies in protection, lethality, mobility, and Command and Control (C2).[2] This should have been a vulnerability warning across the GCS industry. Nonetheless, five years later, DoD and industry are still determining how to evaluate the viability of current GCS platforms and the requirements of emerging systems to prepare for the future fight. The Marine Corps has restructured to meet the NDS requirements for the Indo-Pacific. However, ascertaining future Army GCS needs while staying ready is especially challenging given the Indo-Pacific's focus on maritime operations. Meanwhile, the PRC continues accelerating and expanding its state-directed industrial capability and capacity, concentrating on multi-domain warfare, long-range fires, and cutting-edge technology. As the threat increases, the U.S. and its allies must rise to the challenge to thwart aggression and ensure global security.

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[1] "2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.Pdf," accessed April 17, 2025, https://apps.dtic.mil/sti/trecms/pdf/AD1183514.pdf.
[2] "ASB FY 20 BF2040 ExSum.Pdf," accessed April 29, 2025, https://asb.army.mil/Portals/105/Reports/2020s/ASB%20FY%2020%20BF2040%20ExSum.pdf?ver=vxXNwQxDxPOLZE73KMlGqg%3d%3d.

This paper evaluates the U.S. GCS industrial positioning, supply chain security, and explores relationships that promote innovation and mobilization preparedness. It addresses the need to balance scalable, cost-effective platforms with exquisite systems to counter peer adversaries. Such a balance becomes especially important as global priorities shift. The focus is on unmanned systems, Modular Open System Architecture (MOSA), Artificial Intelligence (AI)-enabled integration, and command-and-control (C2) mesh networks. Finally, actionable, achievable, resource-informed policy recommendations grounded in strategic analysis are provided. Despite the evolving battlefield, debate on required platforms and systems, and the uncertainty of the next conflict, one constant remains unwavering: GCSs are essential in seizing and holding terrain, a fundamental requirement in winning wars!

THE STRATEGIC ENVIRONMENT

The PRC has drastically enhanced its military capabilities in the Indo-Pacific, particularly with next-generation aircraft, aircraft carriers, submarines, and amphibious ships. The PRC now possesses a substantial inventory of ballistic missiles and has expanded its nuclear forces that threaten U.S. bases in the region and U.S. allies. The PRC has also conducted regular military exercises around Taiwan to block commercial routes. Additionally, it has steadily expanded its maritime claims in the South China Sea and the East China Sea.

CURRENT INDUSTRY STATUS

The U.S. government's strategic pivot to the Indo-Pacific raises questions about the DoD's continued investment in large numbers of GCSs. The Navy and Air Force would play a dominant role compared to other services in any regional conflict. The GCS industry recognizes the current U.S. posture and anticipates reduced Army and Marine Corps procurement. Reflecting this shift, the Department of the Army recently halted further production of the Joint Light Tactical Vehicle (JLTV) and the M10 Booker Infantry Support Vehicle programs. In the Pacific theater, the Army is expected to prioritize lighter, more mobile vehicles suited to agile operations and land-based, long-range missile platforms.

However, GCSs remain relevant because of persistent threats from Russia, North Korea, and evolving challenges in the Middle East. The GCS industry will continue to manufacture platforms including MBTs, infantry fighting vehicles (IFVs), armored personnel carriers (APCs), reconnaissance and light armored vehicles, amphibious combat vehicles (ACVs), artillery systems, combat support vehicles, and unmanned ground vehicles (UGVs) / robotic combat vehicles (RCVs). The GCS industry has cooperated across multinational research, development, production, and sustainment enterprises to produce highly specialized systems tailored to specific combat roles.

The GCS industry is rapidly advancing with innovative trends, particularly modularity, which plays a crucial role in developing RCVs that reduce the risk to human soldiers.[3] The modular design allows a single vehicle chassis to be reconfigured with different payloads or systems, enabling adaptability to various mission requirements. For example, the Estonian Milrem THeMIS can be modified for logistics transport, direct combat, intelligence gathering, or ordnance disposal simply by adjusting its modular architecture.[4] This flexibility enhances operational readiness, allowing for rapid adaptation to dynamic battlefield conditions.

The GCS industry is a globalized oligopolistic structure with intense rivalry among existing firms and high barriers to entry. Several military production-focused firms with strengths and strategic priorities have dominated it. General Dynamics Land Systems (GDLS), BAE, Oshkosh Defense, and AM General broadly define the U.S. GCS industry primes. Germany's Rheinmetall, the Franco-German company KNDS, and the United Kingdom's BAE Systems are leaders in the European GCS industry. South Korea has emerged in the Asian market, particularly with Hyundai Rotem and Hanwha developing amphibious vehicles, RCVs, and other specialized GCS platforms.[5] South Korea possesses a robust and innovative DIB, driven by strong government support and a focus on technological innovation.

U.S. adversaries also compete with advanced GCSs and technology in the international market. Russia's largest tank manufacturer, Uralvagonzavod, produces large quantities of

[3] Congressional Research Service, *The Army's Robotic Combat Vehicle (RCV) Program,* 16 January 2025, https://www.congress.gov/crs-product/IF11876 accessed on 29 April 2025.
[4] Milrem Robotics, "Milrem Robotics Delivers the THeMIS UGV to Ukraine," September 6, 2022, Accessed on 29 April 2025, https://milremrobotics.com/milrem-robotics-delivers-the-themis-ugv-to-ukraine/.
[5] The Business Research Company, Military Land Vehicles Global Market Report 2025- *Military Land Vehicles Global Market Report 2025*, January 2025, https://www.thebusinessresearchcompany.com/report/military-land-vehicles-global-market-report accessed on 30 April 2025.

relatively simple but effective armored vehicles, such as the T-72 and T-90 tanks.[6] China is rapidly emerging as a significant player in the GCS industry, with firms like China's North Industries Group Corporation (NORINCO) developing MBTs, IFVs, and RCVs, incorporating advanced technologies such as AI and sensors.[7]

INDUSTRY ISSUES

The GCS industry must adapt to evolving conditions and enhance GCS mobility, protection, and firepower. The DoD faces maneuver challenges of armored forces on the battlefield in engines and fuel that power GCSs. Vehicles can drastically improve mobility by avoiding detection with electric or hybrid engines. Commercial vehicles use alternative technology engines, but military vehicles have not fully integrated them. Government-industry collaboration can drive the military to adopt alternative technology engines. Extended range capabilities and reduced dependency on fuel delivery will significantly enhance operational scope and resilience in contested environments.

Also, the GCS industry must better protect GCSs to ensure crew survivability and mission superiority. The conflict in Ukraine and the rise of drone warfare have highlighted the need for enhanced 360-degree protection. They also show that a more advanced, AI-enabled active protection system (APS) would effectively counter drone threats. The increased integration of passive and APS will be critical to countering loitering munitions and top–attack threats. However, GSC designs in the future must prioritize a balance between protection with less weight and improved mobility to support quick deployment with maneuverability in

[6] Ibid.
[7] Ibid.

evolving and dispersed operations. The DoD and other countries are also advancing unmanned GCS platform technology as another option to preserve personnel safety.

Although mobility and survivability are important, a GCS must inflict damage on the enemy as firepower is key on the battlefield. The slow production of the 155mm rounds has affected the effectiveness of the defense of Ukrainian territory. This highlights the necessity of funding R&D to maintain superiority in firepower.

All three components of the GCS Iron Triangle are affected by the DoD's fragmented acquisition and sustainment process, which delays the requirement, design, and delivery of GCSs. The acquisition and sustainment process delays produce obsolete and ineffective GCSs that do not meet the needs on the battlefield. The DIB should improve its R&D procedures, enhance readiness and resilience, and mitigate risks threatening the land domain's mobility, protection, and firepower. The DoD's lack of centralized modernization requirements and inconsistent demand signals negatively impact the DIB and create obstacles to innovation and flexible adaptation.

SUPPLY CHAIN CHALLENGES

The U.S. requires secure, reliable, resilient supply chains to sustain technological superiority. One of the most significant challenges is the U.S. DIB's reliance on sole foreign sources for many critical GCS materials, creating supply chain vulnerabilities. Critical materials such as rare earth elements are primarily sourced from overseas, particularly China.[8] China controls 70 percent of the rare materials and owns 90 percent of the global market share.[9] China

[8] "Critical Materials: Action Needed to Implement Requirements That Reduce Supply Chain Risks, GAO-24-107176, September 10, 2024," accessed April 30, 2025, https://www.gao.gov/assets/gao-24-107176.pdf.
[9] "China Trade War Poses Threat to US Arms Firms' Rare Earths Supply, Analysts Warn," inkl, April 16, 2025, https://www.inkl.com/news/china-trade-war-poses-threat-to-us-arms-firms-rare-earths-supply-analysts-warn.

dominates the global supply of lithium, cobalt, and other rare earth elements, creating vulnerabilities in the U.S. industrial base and affecting battery production.[10] China also leads lithium refining and battery cell manufacturing, controlling over 60 percent of global lithium processing capacity.[11]

This reliance extends past raw materials to electronic systems for several other GCS areas, including next-generation technologies such as APS components, lightweight armor components, and batteries. For batteries specifically, reliance on foreign suppliers imposes a significant risk to the U.S. DIB, potentially hindering mass production of hybrid GCSs in times of crisis.[12] Similarly, most of the semiconductors used in diesel engine electronic systems are either foreign-made or made from foreign materials and components.[13]

Some original equipment manufacturers (OEMs) have found it beneficial to vertically integrate, especially for parts and components that are more specialized or are not needed in large quantities, which helps reduce supply chain dependencies and costs. Vertical integration can help with surge capacity and eliminate supply chain vulnerabilities in the short run, but it could limit innovation for those parts and hinder supply chain diversification. Large defense contractors, including Boeing and Airbus, have recognized the importance of vertical integration. For example, they split the purchase of the key supplier Spirit AeroSystems.[14]

[10] "Manufacture - the Challenge to the DoD," accessed April 30, 2025, https://www.ndia.org/-/media/sites/ndia/meetings-and-events/2024/5/419a-may-manufacturing/speaker-presentations/1-al-shaffermanufacture-pitch-29-april.pdf.
[11] "SHIELDS-Strategic-DoD-Battery-Initiatives-Final-MPSC.Pdf," accessed April 30, 2025, https://milpwr.org/wp-content/uploads/2022/12/SHIELDS-Strategic-DoD-Battery-Initiatives-Final-MPSC.pdf.
[12] Britt Ashcraft, "The Future of Military Mobility: Why the Defense Industry Is Shifting to Hybrid Powertrains," Hypercraft, February 5, 2025, https://hypercraftusa.com/the-future-of-military-mobility-why-the-defense-industry-is-shifting-to-hybrid-powertrains/.
[13] "General Lecture in Industrial Mobilization and Competition Course, Topic-20: Supply Chain Case Studies: Semiconductors and Rare Earths, National Defense University."
[14] Michael Bruno and Ben Goldstein, "Why Vertical Integration Remains Popular in Aerospace," *Aviation Week*, July 11, 2024, https://aviationweek.com/shownews/farnborough-airshow/why-vertical-integration-remains-popular-aerospace.

While integrating supply chains with allies will help with surge capacity, vulnerabilities exist if domestic capabilities in critical areas do not exist. Foreign reliance exposes the U.S. to coercion, delays, or resource denial. The U.S. also risks falling behind in defense battery innovation and growing more dependent on foreign suppliers. With reliance across much of the GCS industry, it could present challenges to the U.S. in the event of a war. These dependencies could negatively affect modernization efforts and sustainment, risking U.S. military readiness and strategic autonomy.

PRODUCTION FACTOR CONDITIONS

There are several factors influencing GCS production beyond supply chain challenges. First, policy and bureaucratic processes determine GCS production. The complexity of the Defense Federal Acquisition Regulation supplement may slow the adoption of cutting-edge commercial technologies or create barriers for non-traditional suppliers.[15] As a result, the DIB delays adopting the best available global technology and experiences slow production.[16]

Second, the DoD's demand signal is another key factor influencing production. GCS manufacturers seek reliable demand signals from the DoD for capability requirements.[17] Without government contracts, firms interpret what business intelligence they can gather and extrapolate to determine research, development, and production plans. Industry days, trade shows like the Association of the U.S. Army annual meeting and exposition, and users' groups (such as those

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[15] "Challenges Facing Non-Traditional Contractors | Www.Dau.Edu," accessed May 1, 2025, https://www.dau.edu/library/damag/march-april2020/challenges-facing-non-traditional-contractors.
[16] "How Biden's 'Buy American' Is Undermining the Arsenal of Democracy," *American Enterprise Institute - AEI* (blog), accessed April 30, 2025, https://www.aei.org/op-eds/how-bidens-buy-american-is-undermining-the-arsenal-of-democracy/.
[17] "Technology Limitations Stall Military Hybrids," accessed April 30, 2025, https://www.nationaldefensemagazine.org/articles/2006/9/1/2006september--technology-limitations-stall-military-hybrids.

for Rheinmetall and KNDS products) are inexpensive ways for governments and industry to discuss capability needs, understand emerging technologies, and collaborate on funding for capability needs. Firms must invest capital in R&D to remain competitive with rivals and to keep participating in the market.

Third, quantity is the other key factor influencing GCS production.[18] In Europe, increased demand drives capital investments in new and repurposed production facilities. Low production rates for exquisite systems limit the cost-effectiveness of automation in manufacturing. Mass production of smaller, less expensive systems, such as RCVs, may be more conducive to automation in manufacturing. In the U.S., reduced demand for GCS has discouraged capital investments in new and existing facilities, with limited exceptions (e.g., for ammunition).

Fourth, the DIB needs sufficient specialized labor to sustain and surge production. Development of GCSs requires engineers from a variety of disciplines, including systems, industrial, mechanical, electrical, data, and computer (software, AI/automation). Engineering disciplines and skilled trades require years of education, certifications, and experience. Production also requires many people in skilled trades, such as welders, machinists, and electricians. The skills involved are also perishable, requiring continuous learning to keep pace with changing technology and industry standards. In the U.S. and EU, critical shortages in key engineering fields (such as computer and data sciences) and skilled trades (welders and machinists) stem from aging workforces and declining interest among younger generations.

Lastly, apprenticeship programs provide effective workforce pipelines and should be encouraged. In the EU, initiatives like ASSETs+ (Alliance for Strategic Skills Addressing

[18] "Technology Limitations Stall Military Hybrids," accessed April 30, 2025, https://www.nationaldefensemagazine.org/articles/2006/9/1/2006september--technology-limitations-stall-military-hybrids.

Emerging Technologies in Defence) and the EU Defence Challenge focus on recruitment, training, and upskilling for critical defense industry roles.[19] One successful model in the U.S. is the Navy's Talent Pipeline Program, which addresses skilled labor shortages in the shipbuilding industry.[20] A broader DIB workforce strategy, modeled on these programs, should be implemented to tackle workforce gaps and ensure near- and long-term readiness.

Currently, gaps exist in surge production capacity and technology transition timelines.[21] The DoD also lacks clear timelines, a stable budget, a plan for surge production requirements, and a solid plan to modernize existing inventory. Without addressing these key factors, the DIB would not scale its production. Further, it will not make long-term investments to handle scale in a time of need.

STRATEGIC COMPETITION

Strategic competition in GCS is a key factor that shapes the national security strategy's operational planning. Near-peer adversaries, particularly China and Russia, continue expanding their military-industrial capabilities and ability to produce more and better GCSs. The U.S.'s ability to balance superior technology with scalable production will be critical for maintaining battlefield effectiveness in a prolonged competition.

China poses a threat to the U.S.'s GCS dominance. China's centralized defense industry has enabled it to mass-produce armored vehicles at an unparalleled rate. Estimates suggest China has fielded between 1,000 and 1,300 Type 99 MBTs since 2001, averaging 50–100 tanks per

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[19] "Alliance for Strategic Skills Addressing Emerging Technologies in Defence (ASSETs+)," accessed April 30, 2025, https://assets-plus.eu/about-the-project/.
[20] "US Navy Talent Pipeline Program," U.S. Navy Talent Pipeline Program, April 24, 2025, https://dibtalentpipeline.com.
[21] "National Defense Industrial Association (NDIA), Vital Signs 2023: Posturing the U.S. Defense Industrial Base for Great Power Competition, February 2023," accessed April 30, 2025, https://www.ndia.org/-/media/sites/ndia/policy/vital-signs/2023/ndia_vitalsigns2023_final_v3.pdf?download=1?download=1.

month.[22] China's production contrasts with U.S. Abrams production, which peaked at 75 tanks per month during the Cold War but has dropped to roughly one per month.[23] While the Type 99 may not match the Abrams in capability, mass production can often overmatch technological superiority, a historical reality demonstrated in WWII from the greater numbers of the U.S. Sherman tank versus the technologically superior German Tiger tank.

Russia has a slightly different approach to mass production, prioritizing cost-effective battlefield adaptability over high-tech exclusivity. Russia has attempted to increase production of the T-90M MBT, BMP-3 IFV, and T-14 Armata (next-generation MBT), but production numbers remain lower than expected, specifically for the T-14 Armata MBT. Russia has struggled with economic instability, aging industrial infrastructure, and wartime supply chain vulnerabilities, limiting its ability to sustain mass production at scale.[24] The ongoing Ukraine war has resulted in Russia losing a significant number of MBTs, and Russia has had a difficult time replenishing them.

U.S. allies are critical in augmenting the U.S. force structure or production capability to counter adversarial mass production. Defense firms, including Rheinmetall (Germany), KNDS (a Franco-German consortium headquartered in the Netherlands), and Hanwha Defense (South Korea), provide key advancements in next-generation GCSs.[25] In response to the U.S. Army's

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[22] The International Institute for Strategic Studies (IISS), The Military Balance 2024 (London: Routledge, 2024), accessed April 30, 2025, https://www.iiss.org/publications/the-military-balance

[23] Congressional Research Service, "Army Modernization Strategy," R44741 (2024). Accessed April 30, 2025, https://crsreports.congress.gov/product/details?prodcode=R44741

[24] A. A. Shirov, "Development of the Russian Economy in the Medium Term: Risks and Opportunities," *Studies on Russian Economic Development* 34, no. 2 (2023): 159–166. Accessed April 30, 2025, https://pmc.ncbi.nlm.nih.gov/articles/PMC10116463/.

[25] Noealt Corporate Services, *Comparative SWOT & Strategy Focus – 2023–2027 – Global Top 7 Armored Vehicles Manufacturers – GDLS & GDELS, BAE Systems, Oshkosh Defense, Rheinmetall, KNDS, Iveco Defense, Hanwha Defense* (April 2023), Accessed April 30, 2025, https://marketpublishers.com/report/company_reports/comparative-swot-strategy-focus-2023-2027-global-top-7-armored-vehicles-manufacturers-gdls-gdels-bae-systems-oshkosh-defense-rheinmetall.html.

Extended Range Cannon Artillery program, different countries, including South Korea, demonstrated its K9 Thunder self-propelled howitzer (SPH). This is a prime example of an allied system that the U.S. could rapidly incorporate into its force structure.[26]

The development of autonomous systems is also shaping the future of military operations. China, Russia, and multiple North Atlantic Treaty Organization (NATO) countries are actively developing UGVs for reconnaissance, logistics, and combat. Russia's Marker UGV, China's Sharp Claw series, and NATO's Milrem Robotics programs illustrate advancements in AI-enabled ground combat.[27] The U.S. has also invested in prototypes of both light and medium RCV programs, such as the Ripsaw M5, which features hybrid-electric propulsion for improved stealth and endurance, but is not low cost or attritable, which are emerging requirements.[28]

While attritable GCSs would likely play a bigger role in the future, protection and survivability would remain essential in manned GCSs as forces need to take territory. China's Type 99 MBT has integrated APS technology, though its effectiveness in real-world engagements remains debated.[29] Russia's T-14 Armata features Afghanit APS, but production

[26] Christopher F. Foss, "AUSA 2023: Hanwha K9 Thunder becomes 'best-selling' 155mm SP artillery system," Shephard Media, October 18, 2023, Accessed April 30, 2025, https://www.shephardmedia.com/news/landwarfareintl/ausa-2023-hanwha-k9-thunder-becomes-best-selling-155mm-sp-artillery-system/.

[27] "Marker Anti-Tank Robotic Unmanned Ground Vehicle, Russia," *Army Technology*, February 14, 2023, Accessed April 30, 2025, https://www.army-technology.com/projects/marker-anti-tank-ugv-russia/.;
Manel Bernadó, "The Re-Emergence of Unmanned Ground Vehicles in Army Modernisation Efforts," *Finabel InfoFlash* IF-22.08, August 2022, Accessed April 30, 2025, https://finabel.org/wp-content/uploads/2022/08/IF-22.08-new.pdf.;
"Milrem Robotics' Advanced Combat Support UGV Showcased at Defense Services Asia," *Business Wire*, May 1, 2024, Accessed April 30, 2025, https://www.businesswire.com/news/home/20240501367206/en/Milrem-Robotics-Advanced-Combat-Support-UGV-Showcased-at-Defense-Services-Asia.

[28] Andrew Feickert, "The Army's Robotic Combat Vehicle (RCV) Program," *Congressional Research Service*, IF11876, July 23, 2024, Accessed April 30, 2025, https://sgp.fas.org/crs/weapons/IF11876.pdf.

[29] Fabrice Wolf, "With the GL-6 Hard Kill APS, Chinese Tanks Are Also Equipped with Anti-Missile and Anti-Drone Protection," *Meta-Defense*, February 10, 2025, Accessed April 30, 2025, https://meta-defense.fr/en/2025/02/10/aps-hard-kill-gl-6-chars-chinois/.

setbacks have hindered widespread deployment.[30] European allies, particularly Germany, have developed modular armor solutions, with the Leopard 2A7 featuring advanced composite armor.[31] The M1 Abrams utilizes reactive armor and APS developed from the Israeli Trophy system, providing an excellent defense against anti-tank threats.[32]

Lethality remains a decisive factor in ground combat superiority. Each MBT has selected a specific cannon for various threats and has different targeting systems for accuracy and a faster reaction time for the first shot. The M1 Abrams features a 120mm smoothbore cannon, capable of firing advanced kinetic and explosive rounds with a cutting-edge fire control system comprised of thermal imaging. The Army is testing AI-assisted targeting, and once fielded, it would allow for rapid target acquisition and engagement.[33]

In contrast, China's Type 99 MBT demonstrates its approach to lethality by integrating a 125mm gun, optimized for enhanced armor penetration, with a digital fire control system and laser range-finding.[34] Russia's T-14 Armata employs a 125mm autoloading cannon, designed for high-speed engagements with modern fire control systems, but their effectiveness is unknown because it has not been deployed.[35] The Leopard 2 has the Rheinmetall 120mm smoothbore gun

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[30] Isaac Seitz, "T-14 Armata: Russia's Tank Nightmare That Just Won't End," *National Security Journal*, April 23, 2025, Accessed April 30, 2025, https://nationalsecurityjournal.org/t-14-armata-russias-tank-nightmare-that-just-wont-end/.

[31] Rolf Hilmes and Christian Thoss, "Protection Enhancements in the Leopard 2A7 Main Battle Tank," *International Journal of Armored Vehicle Systems* 12, no. 3 (2024): 145–162.

[32] U.S. Army Deploys in Germany M1A2 SEP V2 Main Battle Tanks Fitted with Trophy APS Active Protection System," *Army Recognition*, July 18, 2020, Accessed April 30, 2025, https://www.armyrecognition.com/news/army-news/army-news-2020/us-army-deploys-in-germany-m1a2-sep-v2-main-battle-tanks-fitted-with-trophy-aps-active-protection-system.

[33] Howard Altman, "M1 Abrams Tank Tested with Artificial Intelligence Targeting System," *The War Zone*, January 30, 2024, https://www.twz.com/m1-abrams-tank-tested-with-artificial-intelligence-targeting-system.

[34] "ZTZ99 Main Battle Tank," *Army Technology*, August 10, 2009, Accessed April 30, 2025, https://www.army-technology.com/projects/type99chinese-main/.

[35] Sebastien Roblin, "Russia's T-14 Armata Tank: What It Gets Right and Wrong," *The National Interest*, October 15, 2020, Accessed April 30, 2025, https://nationalinterest.org/blog/reboot/russias-t-14-armata-tank-what-it-gets-right-and-wrong-191762.

with advanced optics and fire control systems, ensuring quick target acquisition and high first-shot accuracy.[36] The Leopard 2 has one of the most effective tank cannons today.

In future acquisitions, the DoD faces challenges balancing innovation, production capability, and technological superiority.[37] It isn't easy to achieve these feats simultaneously due to high costs. However, strategic competition in GCS is not solely about technological advancements or production numbers. It is also about the ability to field and sustain armored formations at scale and having the best-trained soldiers to exercise mission command. These are the areas where the U.S. military has a considerable advantage.

FUTURE FORECAST

GCS should continually transform to meet evolving threats, including deploying more land-based, longer-range missiles, adopting modular architectures, integrating AI-enabled systems, employing hybrid-electric propulsion, and advancements in munitions. A significant factor that would drastically improve the development of GCS is designing software-centric vehicles.[38] Such a practice would drastically reduce the time needed to develop, test, field, and maintain new vehicles.[39] Future systems must also be designed modular or variant, attritable, and scalable through mass production at a lower cost per unit.

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[36] Encyclopedia MDPI, "Rheinmetall 120mm Gun," 2024. https://encyclopedia.pub/entry/31513.
[37] U.S. Government Accountability Office, *DoD Acquisition Reform: Military Departments Should Take Steps to Facilitate Speed and Innovation*, GAO-25-107003 (Washington, D.C.: Government Accountability Office, December 12, 2024), Accessed April 30, 2025, https://www.gao.gov/products/gao-25-107003.
[38] Lauren Williams, "What the Army Learned from Its First All-Digital Ground Vehicle Design," Defense One, November 6, 2024, https://www.defenseone.com/defense-systems/2024/11/what-army-learned-its-first-all-digital-ground-vehicle-design/400857/?utm_source=chatgpt.com.
[39] Lauren Williams.

For the Army to be more relevant in the Indo-Pacific, it must have the ability to rapidly deploy Multi-Domain Task Force (MDTF) units that possess land-based, longer-range missiles.[40] The MDTF uses land-based Precision Strike Missiles, the Typhon (SM-6 and Tomahawk), Long-Range Hypersonic Weapons, the Terminal High Altitude Area Defense, and the Patriot.[41] The MDTF provides several layers of defense protection and can intercept incoming PRC missiles, destroy amphibious ships, protect U.S. naval assets and aircraft, and conduct anti-access and area-denial missions.[42] Such capability would complement the strike capability of aircraft and ships in the region. To counter evolving threats, the U.S. Army must lead these technological efforts to maintain a decisive battlefield advantage.

As one of the key GCS trends, MOSA would play a critical role in the future of GCS. MOSA would diversify the supply chain and facilitate the transition to software-centric vehicles. The DoD could improve, change, or compete for subsystems without impacting the platform, saving costs. MOSA facilitates the DoD to rapidly adapt to changing missions and incorporate technological updates with operational requirements.[43] For example, the Army could employ MOSA subsystems of various weapon systems and APSs for missions in different theatres while avoiding higher investments in significant acquisitions. The Army can reduce costs by competitively acquiring various subsystems from multiple firms.

Another promising innovation trend is the increasing use of RCVs, ranging from small autonomous support vehicles to optionally manned combat vehicles. These systems use AI,

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[40] Jen Judson, "US Army Aims to Complete Multidomain Task Force Structure by FY28," *Defense News*, April 18, 2024, https://www.defensenews.com/land/2024/04/18/us-army-aims-to-complete-multidomain-task-force-structure-by-fy28/?utm_source=chatgpt.com.
[41] Andrew Feickert, "The U.S. Army's Typhon Mid-Range Capability (MRC) System," Library of Congress, April 22, 2025, https://www.congress.gov/crs-product/IF12135.
[42] Feickert.
[43] "Implementing a Modular Open Systems Approach in Department of Defense Programs" (Office of Systems Engineering and Architecture Office of the Under Secretary of Defense for Research and Engineering, February 2025), 1.

sensor technology, and robotics to operate in dynamic battlefields, reducing the risk to human soldiers and enhancing operational effectiveness.[44] RCVs are also leading the way in integrating advanced electric and fuel-efficient propulsion systems, critical for improving operational range, reducing logistical burdens, and optimizing overall vehicle performance.[45] RCVs offer operational flexibility because they can support other manned vehicles or conduct independent operations.[46]

AI will play a critical role in coordinating unmanned systems, managing energy use, targeting, and increasing the survivability of vehicles through formation-based protection. AI classifies, evaluates, and prioritizes large amounts of sensor data for human controllers, enabling the use of swarms of unmanned aerial systems. For example, Anduril's Lattice Software AI mesh network can link several unmanned systems to enhance real-time coordination and autonomous decision-making on the battlefield.[47]

On the mobility side, hybrid-electric technology offers many benefits, including fuel efficiency, quiet tracking capabilities, increased onboard power generation for other systems, and lower thermal and acoustic signatures.[48] Also, a GCS would weigh less. Recent emerging technology integrates the hybrid-electric technology into a Bradley Hybrid-Electric vehicle[49] and

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[44] Yasmin Tadjdeh, *Army Giving Robotic Combat Vehicles More Firepower,* National Defense Magazine, 5 February 2021, https://www.nationaldefensemagazine.org/articles/2021/2/5/army-giving-robotic-combat-vehicles-more-firepower accessed on 29 April 2025.
[45] Paul Boyce, "Army Unveils First Hybrid-Electric Propulsion System for New Combat Vehicles," U.S. Army, August 15, 2007, https://www.army.mil/article/4424/army_unveils_first_hybrid_electric_propulsion_system_for_new_combat_vehicles accessed on 29 April 2025.
[46] "Army Giving Robotic Combat Vehicles More Firepower," accessed May 1, 2025, https://www.nationaldefensemagazine.org/articles/2021/2/5/army-giving-robotic-combat-vehicles-more-firepower.
[47] "Anduril," accessed May 1, 2025, https://www.anduril.com/anduril-s-lattice-a-trusted-dual-use-commercial-and-military-platform-for-public-safety-security/.
[48] Walker Mills, "The Lethality Case for Electric Military Vehicles - Modern War Institute," December 1, 2022, https://mwi.westpoint.edu/the-lethality-case-for-electric-military-vehicles/, https://mwi.westpoint.edu/the-lethality-case-for-electric-military-vehicles/.
[49] Matthew Beinart, "BAE Systems Planning To Design Hybrid-Electric AMPV," Defense Daily, April 10, 2023, https://www.defensedaily.com/bae-systems-planning-to-design-hybrid-electric-ampv/army/.

the Abrams M1E3 tank.[50] However, the industry still faces challenges in battery life and durability, as well as making available charging infrastructure on a harsh battlefield.[51]

Future gun weapon systems would be fully automated and have AI-assisted fire control for rapid target acquisition and increased accuracy, including autonomous engagement capability. Also, ammunition would possess fuses with guided and loitering capabilities. Barrel size could increase to 130mm and 140mm guns to improve lethality, but that would limit the number of rounds carried due to the increased size and weight.[52] Similarly, APS designs include directed energy weapons and counter-drone technologies to counter loitering munitions and Unmanned Aerial Systems (UAS).

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[50] Pranshu Verma, "The next U.S. Battle Tank Could Use AI to Identify Targets," *The Washington Post*, October 12, 2022, https://www.washingtonpost.com/technology/2022/10/12/abramsx-ai-hybrid-military-battle-tank/.

[51] "Technology Limitations Stall Military Hybrids," accessed April 30, 2025, https://www.nationaldefensemagazine.org/articles/2006/9/1/2006september--technology-limitations-stall-military-hybrids.

[52] "Panther KF51 – Rheinmetall's New Main Battle Tank," Rheinmetall, accessed May 1, 2025, https://www.rheinmetall.com/en/products/tracked-vehicles/tracked-armoured-vehicles/panther-kf51-main-battle-tank.;
"KNDS Group," KNDS Group, accessed May 1, 2025, https://knds.com/en/towards-mgcs-knds-details-the-future-of-main-battle-tanks.

STAKEHOLDER INTEREST

STATE OF BUSINESS-GOVERNMENT RELATIONS

Procurement

The business-government relationship in the GCS sector has experienced some challenges. The friction largely stems from shifting requirements, uncertain funding and timelines, and the lack of competition. These factors have complicated long-term planning for both parties. Manufacturers face risk when requirements evolve after development has started and often after they have already made substantial R&D investments. The integration of various platforms has usually been slowed by the absence of a unified requirement across the overall capability, contributing to increased cost and testing delays.

Also, uncertain funding and timelines represent another challenge to acquisition. OEMs and suppliers operate on multiyear investment cycles that require predictability. However, the DoD often adjusts acquisition priorities due to evolving threats, funding disruptions, or leadership transitions. Such misalignment creates a problematic environment for DIB innovation and investment. If future funding is predictable, the GCS industrial base would be more incentivized to invest in new infrastructure and innovation.

Additionally, the lack of competition has prevented some companies from entering the GCS market. The DoD has historically acquired bespoke, monolithic programs like Abrams and Bradley. It has led to vendor lock and reduced competition over the multi-decade lifespan of these platforms. Further, when the government calls for competition in key capability areas such as hybrid-electric propulsion and APS, single-supplier dominance remains a structural feature because the vendor becomes locked in after the award. The lack of competition has limited innovation as vendors have provided incremental improvements based on the original design rather than wholesale changes. Without deliberate positive changes to the procurement process, the government and industry will continue to delay modernization and limit innovation. Given these challenges, GCS modernization depends on sustained cooperation between the government and private sector OEMs and suppliers.

Public-Private Collaboration Opportunities

The government and industry have gradually shifted toward modularity, rapid prototyping, and lifecycle-based sustainment, a positive development. The shift is bringing earlier involvement of OEMs and subsystem providers into the design process to speed delivery and reduce risk. Furthermore, the government's push for plug-and-play modularity has challenged long-standing contractor preferences for vertically integrated, proprietary systems. That challenge has had a positive effect by creating more opportunities for companies to enter the GCS market. The modular strategy supports public-private alignment and strengthens lifecycle models by enhancing availability and upgradeability.

Moreover, government and industry cooperation could enhance acquisition and sustainment processes, such as when the DoD procures GCS capabilities through lifecycle-based service agreements rather than traditional full-system buys. These processes build on the principles of Performance Based Logistics and the Power by the Hour models that focus on vendor performance outcomes. Under a new construct, vehicle manufacturers and sustainment providers deliver capability outcomes based on supply availability, upgradability, and performance over time, leveraging modular designs and plug-and-play architectures with planned technology refresh.

International Partnerships

International collaborations enhance the resiliency of the U.S. GCS industry. For example, international partners improve the viability of modular collaboration. Rheinmetall's Type-X and Hanwha's scalable RCV platforms demonstrate how governments and industry can co-develop systems built for rapid adaptation and mission-specific modularity with plug-and-play functionality. Further, Joint NATO initiatives on open vehicle architectures would streamline modular design standards across allied firms and increase the opportunity for efficiency gains for users and suppliers. Supply chain vulnerabilities are potentially at risk when working with foreign companies, but dangers could be mitigated through the strength of these international partnerships.

21st CENTURY MOBILIZATION PREPAREDNESS

Emerging Strengths

The recent defense manufacturing agreements between the U.S. and Australia significantly strengthen military collaboration and regional security.[53] In March 2025, the U.S. and Australia entered into two Memoranda of Understanding (MOUs) to advance collaborative defense manufacturing to strengthen military interoperability and regional security in the Indo-Pacific.[54] The first MOU commits to co-producing 155mm artillery ammunition, which enhances

[53] "Breaking News : US and Australia Strengthen Defense Ties with New 155mm Munitions and HIMARS Missile Production Agreements," Global Defense News, March 9, 2024, https://www.armyrecognition.com/news/army-news/2025/breaking-news-us-and-australia-strengthen-defense-ties-with-new-155mm-munitions-and-himars-missile-production-agreements?utm_source=chatgpt.com.

[54] "Breaking News : US and Australia Strengthen Defense Ties with New 155mm Munitions and HIMARS Missile Production Agreements," Global Defense News, March 9, 2024, https://www.armyrecognition.com/news/army-news/2025/breaking-news-us-and-australia-strengthen-defense-ties-with-new-155mm-munitions-and-himars-missile-production-agreements?utm_source=chatgpt.com.

Australia's defense manufacturing capabilities and ensures a steady supply of munitions.[55] The second MOU agrees to a co-assembly of the Guided Multiple Launch Rocket System (GMLRS) for the High Mobility Artillery Rocket System (HIMARS), bolstering Australia's capacity to produce advanced long-range precision strike capabilities while enhancing operational integration with U.S. forces. The Australian Defense Department and Lockheed Martin Australia will initially test an Australian-assembled GMLRS in 2025.[56] When the missile is in full production for the Australian Army, Australia could supply the U.S.[57] and contribute to the global munitions supply chain.

Challenges

One of the central questions facing the GCS DIB is whether it can rapidly scale and surge production in the event of large-scale mobilization operations. The reality of near-peer competition and the hard lessons learned from Ukraine have refocused attention on the importance of wartime production readiness and sustainment. The U.S. lacks the strategic depth the defense industry needs to surge production to meet the latest NDS requirements. The U.S. ground vehicle sector is structured for steady-state production, not wartime surges, because extra capacity carries a cost that the private DIB shareholders and the U.S. Government are unwilling to bear. Even systems seen as transformative, such as hybrid-electric vehicles and autonomous platforms, remain difficult to scale due to dependencies on rare materials, labor bottlenecks, and fragmented production networks.

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[55] "Breaking News : US and Australia Strengthen Defense Ties with New 155mm Munitions and HIMARS Missile Production Agreements."

[56] Gregor Ferguson, "Test-Firing a Crucial Step on the Road to a Local Missile Industry," The Australian, September 10, 2024, https://www.theaustralian.com.au/special-reports/testfiring-a-crucial-step-on-the-road-to-a-local-missile-industry/news-story/2b007032a2b4fefc78c094d1f0929df0.

[57] Ferguson.

The GCS industrial base lacks the resources and structure to sustain high-rate output supporting large-scale operations. Specialized labor remains in short supply, particularly in welding, armor integration, and engine manufacturing. Workforce shortages in engine assembly and armor welding are a significant chokepoint in scaling GCS output and would require time and resources to recruit and train to mitigate the constraint.

Even if production capacity and the workforce existed, key subsystems, like lithium-ion batteries, depend on foreign suppliers, often concentrated in geopolitical flashpoints. This foreign dependency on critical and rare earth elements could impede production timelines during crisis demand surges. Compounding these challenges is that U.S. suppliers often lack dual-use commercial lines to fall back on during peacetime, further complicating the difficulty of scaling up quickly.

Adding to the complexity, peer competitors such as China and Russia are structurally better positioned to surge based on their command economies. China's NORINCO, for example, has vertically integrated production capabilities across its entire defense vehicle portfolio. Vertically integrated production in adversary nations gives them a surge advantage. NORINCO's structure, comprising over 300 subsidiaries including manufacturing plants, R&D centers, and trading arms, enables rapid mobilization and scaling of production capacity in response to government demand.[58]

Meanwhile, the U.S. DIB remains largely fragmented across primes, subcontractors, and regional suppliers competing for limited contracts, making surge synchronization difficult without significant government intervention like the Defense Production Act. Additive

[58] Lima, Michael (Mike). *China Analysis: Logistics of Ammunition*. LinkedIn. Last modified January 30, 2020. Accessed May 8, 2025. https://www.linkedin.com/pulse/china-analysis-logistics-ammunition-michael-mike-lima-dba-.se

manufacturing and advanced robotics offer long-term potential, but their adoption remains piecemeal and, for the most part, untested. Additive manufacturing provides a partial fix for some parts, but current defense adoption remains limited and unproven at a scale that would be relevant to meet surge requirements.

Opportunities

Several efforts offer promising paths to strengthen mobilization preparedness. First, GOCO facilities remain underutilized but could serve as surge hubs for GCV modular integration or final assembly under the Arsenal Act authorities. They could also support modular GCS recapitalization. Second, allied firms, particularly Hanwha, Renk, and Rheinmetall, have begun establishing U.S.-based manufacturing capabilities, contributing to industrial surge expansion. Third, NATO partnerships offer mutual benefits through co-production, pooled logistics, or pre-negotiated industrial surge agreements. Lastly, Army-sponsored technical apprenticeships and STEM-aligned trade programs are beginning to address the shortfalls of skilled artisan labor. New Army apprenticeships for vehicle system technicians may reduce workforce vulnerabilities over the long term, but these investments will take time to bear fruit.

INDUSTRY ANALYSIS

PORTER'S FIVE FORCES ANALYSIS

The U.S. and allied GCS market is strategically critical, encompassing MBTs, IFVs, APCs, SPHs, reconnaissance vehicles, amphibious vehicles, and emerging robotic and autonomous platforms. With the added complexity of diverse propulsion systems (diesel, electric, and hybrid), this industry exists at the intersection of military necessity, technological innovation, and industrial capacity. Applying Porter's Five Forces reveals the unique structural dynamics shaping its competitive environment.

Threat of New Entrants - Low

The GCS market presents formidable barriers to entry, rendering the threat of new entrants relatively low. First, the capital intensity required to develop, prototype, test, and certify military-grade armored vehicles is immense.[59] Production facilities must be secure, robust, and capable of fabricating platforms that meet extreme durability and survivability standards.[60] Moreover, vehicles must pass rigorous testing for thermal signature, blast resistance, electronic hardening, and cross-domain interoperability, adding years and tens of millions to development costs.[61]

Second, the regulatory environment is too complex. New firms must navigate a labyrinth of compliance protocols, export control regulations (e.g., International Traffic in Arms Regulations and Export Administration Regulations), and defense acquisition frameworks that

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[59] Technavio - Global Industry Research, "Global Military Armored Vehicles and Counter-IED Vehicles Market 2025-2029" (Elmhurst, IL: Infiniti Research Limited, March 1, 2025), 160, https://www-emis-com.nduezproxy.idm.oclc.org/v2/documents/report/877395701.
[60] G. Khalil, "Electric/Hybrid Electric Drive Vehicles for Military Applications: Promises and Challenges," *Military Technology* (Monch Publishing Group, September 1, 2007), 135, Gale Academic OneFile.
[61] Saffet Uyanik, "Enhancing Military Capabilities with Hybrid-Electric Propulsion Technologies," Defence Turkey, June 2024, https://www.defenceturkey.com/en/content/enhancing-military-capabilities-with-hybrid-electric-propulsion-technologies-6008.

strongly favor incumbents with existing contracts and cleared personnel.[62] Furthermore, prime contractors (General Dynamics, BAE Systems, Rheinmetall, Hanwha, and others) maintain embedded relationships with national governments and defense procurement authorities, offering historical credibility and logistical advantages.[63]

Finally, adapting commercial innovations into military platforms is technically nontrivial. For example, while electric vehicle technologies have surged in the civilian market, military-grade hybrid powertrains must withstand shock, vibration, electromagnetic pulses, and battlefield degradation, conditions for which commercial systems are not designed.[64] Together, these factors suppress the likelihood of new entrants in the short to medium term. However, global firms such as Rheinmetall and Hanwha have successfully entered the U.S. defense market by acquiring U.S. defense firms and establishing them as subsidiaries. They are not" new" in the traditional sense, but they are firms that can compete for GCS contracts and reshape the defense industry environment.

Bargaining Power of Suppliers - Moderate to High

Suppliers in the GCS market wield moderate to high bargaining power, particularly in areas involving specialized subsystems. Critical supply dependencies include rare earth elements for electric drives and sensors, lithium-ion cells for hybrid batteries, high-strength composite materials for lightweight armor, and AI processors for autonomous navigation. A limited pool of qualified vendors supplies these components, raising their leverage in contract negotiations. Moreover, many of the suppliers for propulsion and protection subsystems are small, highly

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[62] Technavio - Global Industry Research, "Global Military Hybrid Electric Vehicle (HEV) And Electric Vehicle (EV) Market 2024-2028" (Elmhurst, IL: Infiniti Research Limited, June 12, 2024), 123, https://www-emis-com.nduezproxy.idm.oclc.org/v2/documents/report/847597936/.
[63] Technavio - Global Industry Research, "Global Military Hybrid Electric Vehicle (HEV) And Electric Vehicle (EV) Market 2024-2028."
[64] G. Khalil, "Electric/Hybrid Electric Drive Vehicles for Military Applications: Promises and Challenges," 135.

specialized firms lacking large-scale defense production capabilities. This asymmetry can delay integration and surge capacity. Prime contractors sometimes respond by vertically integrating key capabilities, such as Rheinmetall's internal production of APS components[65] or BAE's in-house ceramic and reactive armor module production for the Armored Multi-Purpose Vehicle (AMPV) platform.[66]

Despite efforts to standardize modular architecture like MOSA, the bespoke nature of GCS subsystems, including sensors, fire control, and electronic warfare suites, ensures supplier influence remains high. Strategic minerals remain particularly vulnerable to geopolitical disruptions, especially given Chinese dominance in rare earth processing.

Bargaining Power of Buyers - High

Government buyers exercise tremendous bargaining power in this industry. As monopsonistic purchasers, the DoD and allied defense ministries (e.g., UK MoD, Bundeswehr) define all technical requirements and acquisition timelines. This grants them control over contract structuring, down-selection, and milestone payments. Furthermore, buyers are highly risk-averse. Adopting next-generation systems, especially unmanned or hybrid-electric platforms, is contingent upon extensive validation through multi-year trials and limited field testing. For example, despite technical readiness, no nation has fielded a hybrid GCS in combat formation, mainly due to cautious procurement practices.[67]

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[65] "StrikeShield – Active Protection System," Rheinmetall, n.d., https://www.rheinmetall.com/en/products/protection-systems/protection-systems/protection-systems-land/active-protection-systems.

[66] "AMPV Armored Multi-Purpose Vehicle," October 28, 2024, https://armyrecognition.com/military-products/army/armoured-personnel-carriers/tracked-vehicles/ampv-armored-multi-purpose-vehicle-bae-systems-technical-data-sheet-specifications-pictures-video-12112166.

[67] Matthew Beinart, "Army RCCTO Has Completed Testing with Hybrid-Electric Bradley Prototypes," Defense Daily, August 25, 2023, https://www.defensedaily.com/army-rccto-has-completed-testing-with-hybrid-electric-bradley-prototypes/army/.

Budgetary constraints further empower buyers. Flat or declining defense budgets in many NATO countries, including the U.S., force acquisition offices to prioritize affordability, lifecycle costs, and sustainment over sheer performance.[68] This allows governments to pressure contractors to absorb risk, accept fixed-price contracts, or make unsolicited R&D investments in anticipation of future procurements.

Threat of Substitutes - Low to Moderate

While few platforms can fully substitute for heavily armored, crewed combat vehicles, some threat of substitution is emerging. RCVs, optionally manned systems, loitering munitions, and advanced drone swarms offer capabilities that could diminish demand for traditional platforms in select roles.[69] Nonetheless, no current technology fully replaces manned platforms for core roles like direct fire, sustained maneuver under armor, and integrated combined-arms operations. Substitution is also unlikely for artillery systems, where lethality, rate of fire, and survivability in contested terrain remain paramount.

Industry Rivalry - High

The GCS market is characterized by a highly competitive rivalry, especially among U.S. allies and strategic partners. A limited number of programs, such as the U.S. XM30, UK Boxer variants, and NATO-standard APCs, are heavily contested by global primes like General Dynamics, BAE Systems, KNDS, Rheinmetall, and Hanwha Defense. Innovation races are intense, where companies differentiate their offerings via hybrid powertrains, lightweight

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[68] Technavio - Global Industry Research, "Global Military Armored Vehicles and Counter-IED Vehicles Market 2025-2029" (Elmhurst, IL: Infiniti Research Limited, March 1, 2025), 160, https://www-emis-com.nduezproxy.idm.oclc.org/v2/documents/report/877395701.
[69] Halna du Fretay, "Autonomous Warriors: How Next-Gen Robotic Combat Vehicles Are Shaping Ground Warfare," November 25, 2024, https://armyrecognition.com/focus-analysis-conflicts/army/analysis-defense-and-security-industry/autonomous-warriors-how-next-gen-robotic-combat-vehicles-are-shaping-ground-warfare.

composite armor, advanced APS, and integrated AI-based diagnostics and navigation.[70] The shift toward MOSA and digital backbone architecture allows primes to propose highly modular vehicles and intensifies feature-based competition.

Export rivalry also fuels this competitive environment. With many Western countries reducing domestic orders, firms look to the Middle East, Eastern Europe, and Southeast Asia for growth. This has led to aggressive bidding, strategic partnerships, and licensed production agreements.[71] Competition has also spread to emerging areas like electric RCVs, with Milrem Robotics (Estonia), Hanwha (South Korea), and Elbit Systems (Israel) vying for early dominance. Overall, rivalry is exacerbated by slow procurement cycles, long platform lifespans, and the winner-take-all structure of many government contracts. Once selected, a platform can dominate procurement for decades, incentivizing aggressive bidding and extensive lobbying.

POLITICAL, ECONOMIC, SOCIAL, TECHNOLOGY (PEST) ANALYSIS

Political Factors

GCS modernization is shaped by changing political environments, especially in the democratic countries of the U.S. and its allied nation partners. A recurring challenge has been legislative delays, which result in budget uncertainty. This adversely affects R&D funding and timely acquisition. International political challenges also exist in the form of export regulations. Most democratic countries have an export-control regime that requires license approval for country-to-country collaboration in developing advanced systems like APS and robotic combat

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[70] Technavio - Global Industry Research, "Global Armored Vehicles Market 2025-2029" (Elmhurst, IL: Infiniti Research Limited, March 6, 2025), 98, https://www-emis-com.nduezproxy.idm.oclc.org/v2/documents/report/878987466.

[71] "Hanwha Aerospace and Milrem Robotics Sign MoU for Robotic Combat Vehicles," Hanwha, February 24, 2025, https://www.hanwha.com/newsroom/news/press-releases/hanwha-aerospace-and-milrem-robotics-sign-mou-to-advance-global-ground-robotics-initiatives.do.

platforms. Understandably, these countries prioritize national security over innovation.[72] As a result, there is a potential delay in collaborating in research and intellectual property (IP) exchange, hindering improvements in interoperability between allies. However, unlike the U.S., European countries have a mechanism to collaborate in long-term GCS programs. They have the European Defence Agency and NATO's Defence Innovation Accelerator for the North Atlantic fund to "financially support multinational hybrid GCS projects and public-private cooperation."[73]

Economic Factors

Several persistent constraints to GCS innovation include inflation, defense budget amounts, budget uncertainty, possible trade war, and rising debt, which contribute to economic challenges. New systems are expensive, and while hybrid-electric vehicles provide long-term savings in fuel efficiency and maintenance costs, the industry needs robust upfront financing for R&D and battery advancements. Supply chain dependence on China is a vulnerability for the U.S. defense industry base, and materials need to be reshored or friend-shored to provide ready and reliable access.

Social Factors

Social trends affect the modernization of GCS. The most urgent issue is the shortage of skilled labor in defense industry-based firms. This talent gap adversely impacts GCS production rates, quality assurance, and sustainment capabilities. The U.S. industrial base firms need a ready supply of workers and workers with specialized skills in STEM fields and welding. The labor shortages prevent production from keeping up with demand. The U.S. risks losing its

[72] "Beyond Defense: Vital Scope of ITAR Compliance Spelled Out." EE Times. Accessed April 30, 2025. https://www.eetimes.com/beyond-defense-vital-scope-of-itar-compliance-spelled-out/.
[73] Vestbee. "NATO Innovation Fund: Interview with Andrea Traversone, NIF Managing Partner." *Vestbee*, January 10, 2024. https://www.vestbee.com/blog/articles/nato-innovation-fund-interview.

competitive advantage without procurement improvements and adequate, reliable funding to maintain output and modernization during peace and conflict.

Public expectations regarding electric hybrid vehicles have increased over the past two decades. While fuel efficiency and environmental impact are essential to the public, military use is more concerned with stealth abilities and lethality. As the GCS seminar learned in their visit to the Congress, as political actors change, so do priorities. There has been a recent shift away from the importance of green technology and more of a focus on lethality. There is a growing ethical debate on autonomous systems that centers on the kill chain and whether a human is making the lethal decision or an AI-assisted autonomous system.

Technology Factors

Technological innovation has long been transformative for the GCS industrial base and the U.S. military. Several transformative advances are being designed and tested, including hybrid-electric propulsion vehicles, autonomous vehicles, and MOSA. Hybrid-electric vehicles provide lower noise and heat signatures, making them stealthier and more lethal. RCVs are making rapid progress and have been seen in the Russia-Ukraine War. Rheinmetall in Germany and Hanwha in South Korea have made systems advancements in modularity and autonomy. These new systems have capabilities in loitering munitions, remote weapons stations, and new modes of ISR. MOSA development allows for plug-and-play capabilities, which provide interoperability between systems. NATO and the EU use MOSA standards to standardize and implement equipment across all member nations.

POLICY RECOMMENDATIONS

Recommendation 1 – Accelerate modular and scalable GCS designs

To maintain technological superiority and anticipate evolving threats in the Indo-Pacific, the DoD should expand MOSA development across the GCS industry. MOSA will enable faster adaptation to emerging operational requirements, improve coalition interoperability, and accelerate the adoption/integration of improved mission modules. Also, MOSA will reduce lifecycle costs through flexible design and sustainment. MOSA utilization as depicted in the FY21 National Defense Authorization Act (NDAA) section 802 and Title 10 USC 2446a.(b) (renumbered §4401) should be reviewed and expanded to include acquisitions below the Title 10 §2430 major defense acquisition program threshold for quicker development and less decision-making bureaucracy. MOSA offers another unique advantage in helping smaller companies enter the defense market by working on mission modules with prime contractors. As a result, the DoD can further expand the GCS ecosystem and bolster the industrial base. MOSA provides long-term cost savings and operational flexibility, and the DoD can minimize integration risks by fostering collaboration among industry stakeholders and foreign partners.

The DoD can expedite the adoption of MOSA by incorporating best practices from the "Boxer" modular 8x8 vehicle manufactured by KNDS and Rheinmetall of Germany. These companies have built modular, interoperable platforms supporting U.S. foreign military sales (FMS) programs. Since the Boxer uses the same chassis, it offers many advantages. The Boxer reduces logistics costs, shares parts, configures easily to meet different missions, deploys readily, and eases training requirements. To gain further insight into MOSA implementation, the DoD should examine the Boxer mission systems pursued by eight nations to learn how they meet their unique needs. The DoD could leverage MOSA principles in other GCS developments and reduce costs. For example, the DoD could pursue a single APS solution that fits multiple vehicle types rather than vehicle-specific systems. The DoD should successfully adopt MOSA through long-term planning and resourcing commitments from Congress to support growth, prevent fluctuations, and provide financial security for industry.

Recommendation 2 – Drive innovation through long-term planning and integration

To promote innovation within the industry, the DoD must develop and share its long-term GCS planning with the industry. The DoD should establish an Army and Marine Corps long-term GCS platform modernization plan (similar to the Navy's 30-year shipbuilding plan), including next-generation mission command systems, with sustained funding through the Planning, Programming, Budgeting, and Execution process. Nearly all vehicle defense contractors requested funding predictability from the DoD to sustain collaboration, innovate new technologies, and invest in advanced manufacturing. The DoD must provide long-term procurement commitments and resource-informed decisions to reduce industry risk.

The DoD can further strengthen collaboration with industry and drive innovation by integrating vendors early. For instance, the DoD should involve subcomponent manufacturers (e.g., engine and transmission firms) early in the design process to solicit their feedback and improve the design of a vehicle. As engines and transmissions are significant components of a vehicle, vendors may offer new technology innovations or ideas to advance the vehicle's capability. The DoD could form user groups to solicit vendor feedback, such as how KNDS and Rheinmetall formed groups to receive recommendations on enhancing their GCSs, particularly MBTs.

The DoD can foster innovation by leveraging academia, national labs, and Federally-Funded Research and Development Centers (FFRDCs). The DoD should create joint research vehicle programs and consortia with national labs and universities. The research should focus on advanced batteries, material science, hybrid tech, RCVs, and advanced manufacturing, including robotic welding and additive manufacturing. The DoD should treat hybrid engine vehicles as a strategic priority for the future of GCSs, as they would reduce heat signatures on the battlefield. Once these technologies are viable for commercial or military applications, the DoD should create smooth mechanisms, through its FFRDCs, to transfer promising lab technologies to private-sector firms for commercialization.

The DoD can also encourage innovation by incentivizing private sector investment. The DoD should increase direct funding for GCS R&D by targeting key technical challenges, including making attritable and affordable RCVs and introducing advanced manufacturing methods to reduce the time to manufacture MBTs. The U.S. government could further fuel innovation by offering targeted tax incentives to companies investing in key GCS technologies and components in the U.S. These incentives can help offset the high initial development costs, bridge the "valley of death" in the development cycle, and encourage greater private-sector participation. The DoD may face high initial costs in innovation, and without consistent funding, it risks setbacks in developing more capable GCSs.

Recommendation 3 – Form a resilient, surge-ready U.S. GCS industrial base

To maintain a robust GCS industrial base capable of developing advanced vehicles for future conflicts and ensuring surge capacity, the DoD should introduce a national resilience strategy integrating defense, energy, and industrial priorities. The DoD should provide guidance to ensure industrial investments align with military energy resilience objectives. For instance, to advance hybrid technology, the DoD could promote standardization of military battery designs for cost savings and interoperability. Also, the DoD should introduce its strategy for reshoring or diversifying critical inputs to GCSs, which include electronics, rare earths, and energy storage components. The DoD may provide targeted subsidies, strategic stockpiling, and international industrial base agreements to secure supply chains.

The DoD can collaborate with the GCS industrial base by quickly transitioning to advanced manufacturing, particularly maximizing robotic welding where appropriate and enhancing additive manufacturing to reduce lifecycle costs, increase production efficiency, improve surge capacity, and reduce obsolescence. It takes too long to manufacture MBTs because manufacturing is labor-intensive. Much of the manufacturing is done through welding by humans, making it challenging to scale, resulting in an expensive, exquisite system. While there will be high initial costs in investing in robotic welding machines and 3-D printing, the DoD will save costs in the long run because these machines are reprogrammable to build different GCSs. 3-D printing is beneficial in rapidly developing prototypes by reducing time and costs. Additionally, the DoD could save significantly from training and having fewer welders in the long run. A firm stated that one of the most significant expenses in the cost of GCSs stems from high labor costs.

Moreover, the DoD could enhance the GCS industrial base and reduce supply chain risks by requiring critical GCS components, including engines, transmissions, hybrid tech, and AI autonomy, to be developed in the U.S. Such a strategy would further strengthen domestic manufacturing capabilities. Companies such as Rheinmetall, Renk, and KNDS are increasing their footprint in the U.S. by acquiring U.S. companies and investing in them. The DoD should encourage other foreign companies to invest and establish subsidiaries in America to grow the industrial base and secure supply chains. The DoD could also strengthen its ecosystem by including non-traditional and dual-use firms in developing hybrid-electric propulsion, RCV, and AI autonomy, as they possess more expertise in these technologies.

Moreover, the DoD can leverage the international supply chain to mitigate risks in the manufacturing and sustainment of GCSs. International industry could support the surge during coalition operations. The DoD could reduce manufacturing costs by having domestic and international suppliers. Having reliable international partners would enable the DoD to access critical technologies.

The DoD can strengthen the GCS industrial base by leveraging GOCO and arsenal facilities. The DoD should allow firms, universities, and labs focused on GCS modular recapitalization, digital integration, and specialized manufacturing to use these government facilities to innovate and experiment with innovative ways of designing and manufacturing vehicles. They should improve the GCS design process and enhance manufacturing capability and capacity. Specialized manufacturing is expensive, so the DoD could offer a place to manufacture that would incentivize firms and universities to take risks without worrying about the high costs of maintaining a manufacturing facility. Overall, the DoD must increase spending to enhance manufacturing infrastructure and may face risks in accurately prioritizing emerging GCS technologies, such as RCVs and hybrid systems.

Recommendation 4 – Integrate technologies and co-develop with allied partners

The DoD can enhance GCS development by incorporating allied capabilities and expanding international partnerships. Such a strategy would also strengthen defense coordination and collaboration with allies. The U.S. should build bilateral and multilateral frameworks with trusted allies (e.g., Australia, the UK, Germany, South Korea, and Japan) to co-develop and co-produce GCS subsystems. These countries already possess advanced vehicle technology and could contribute to further advancements of GCS. Also, these partnerships would help distribute manufacturing risks, especially development costs, and increase innovation. The partnerships promote economic and political synergies because they provide financial benefits to participating nations by increasing industrial participation. Examples of collaborative development include the F-35 Lightning II and the Australia, United Kingdom, and United States agreement to build nuclear-powered attack submarines and collaborate on developing advanced technologies.

Co-development with international partners would support interoperability and coalition logistics. The DoD could promote shared open standards and interface designs to facilitate the co-production of GCSs. For instance, in Europe, eight countries are acquiring the Boxer and are incorporating their mission systems with the standard chassis to ensure interoperability. The DoD could expand foreign comparative testing to expedite the qualification of GCS vehicles and parts. The U.S. should also be open to evaluating already developed allied systems for purchase. Recently, the U.S. Army has shown interest in assessing the capability of South Korea's K9 Thunder SPH.

Moreover, the DoD should fast-track FMS and expedite the release of vehicle-related technology and ITAR export licenses to improve integration of U.S. and European systems. Further, the U.S. GCS industrial base should adopt international subsystem standards that meet U.S. performance requirements to promote interoperability and reduce development time and cost. The DoD would incur resource costs in coordinating and facilitating co-development and co-production efforts. Additionally, it faces challenges in resolving intellectual property concerns among industry stakeholders and assisting them in navigating export control regimes to ensure proper licensing for technology exchange.

Details on the following recommendations can be found in Appendix C

CONCLUSION

The Ground Combat Systems industry continues to be a pillar of U.S. national security but is encountering unprecedented challenges in a quickly changing strategic and technological environment. The long-held principles of the Iron Triangle, mobility, protection, and firepower, are being tested by emerging threats, adversary overmatch in production and scale, and industrial vulnerabilities. As international attention shifts toward the Indo-Pacific, the United States must ensure its ground combat capabilities remain lethal, adaptable, and sustainable for joint and coalition warfare.

Although technologically advanced, the current GCS industrial base is constrained by supply chain dependencies, workforce challenges, low surge capacity, and fragmented acquisition policies and processes. Adversaries like China and Russia are increasing their armored vehicle production and autonomy capabilities, taking advantage of command economies and vertically integrated supply chains. The U.S. cannot depend on its decades-long technological dominance. It must build a flexible and scalable industrial base capable of sustained readiness and rapid mobilization.

This analysis highlights several strategic priorities. Modernization efforts must include enhancing MOSA, which can improve interoperability, reduce lifecycle sustainment costs, and support defense industry innovation. Long-term visionary planning and reliable demand signals from the DoD are necessary to foster private sector investment in advanced manufacturing, hybrid-electric propulsion, digital engineering, and AI-enabled systems. Finally, the GCS industrial base must be resourced to fund exquisite platforms and attritable, scalable solutions that meet operational requirements in contested environments.

The role of international partners will continue to be critical. U.S. collaboration with stalwart allies through co-development programs, technology and IP sharing, and FMS can ensure collective capacity, distribute risk, and enhance coalition interoperability. Such interoperability is already evident among European Union member states. These valuable relationships and domestic investments in talent development, GOCO facility utilization, and acquisition reform are essential to restoring surge readiness and defense industry resilience.

The GCS industrial base is not yet prepared for the scale and pace of conflict projected in future operational environments. However, there is an achievable path forward. Success will depend on deliberate policy implementation, coordinated government-industry collaboration, and consistent investment in innovation to maintain overmatch in ground combat power and ensure U.S. forces remain dominant across all domains. The U.S. GCS industry is at a strategic inflection point. As global threats emerge and the focus shifts to Indo-Pacific deterrence, modernizing and adapting the GCS industrial base has become a strategic imperative. Sustained commitment now will determine whether the United States retains decisive ground combat advantage in the conflicts of tomorrow.

APPENDIX A: Artificial Intelligence Analysis

AI possesses the potential to transform the GCS industries through UGVs, command and control (C2) applications, predictive maintenance, and other yet unimagined functions. UGVs comprise an emerging industry undergoing rapid advancement, innovation, and transformation. Advances in private-sector AI primarily drive the industry's rapid evolution and U.S. Army-led exploration of future combat systems for the next generation of combat formations. The industry is broad; UGV applications range from combat to logistics, reconnaissance, transport, obstacle breaching, and reduction. Estonian defense firm MILREM Robotics' Tracked Hybrid Modular Infantry System (THeMIS) vehicle, for instance, is a modular platform whose finalized models include combat, intelligence, and logistics configurations[74]. While a combat-configured THeMIS is outfitted with a Kongsberg RX6 30mm cannon and anti-tank missile, a reconnaissance-configured THeMIS Observe includes a camera for day and night operations, an acoustic gunshot detector, smoke screen generation, and a ground surveillance radar[75]. AI remains the critical driver of the UGV industry, enabling critical features such as autonomous navigation, obstacle detection and avoidance, the execution of assigned missions (e.g., logistics, transport, reconnaissance), and target recognition.

The Ukraine battlefield gave rise to the Replicator Initiative—a Defense Innovation Unit (DIU) project designed to deploy large numbers of attritable, mostly aerial autonomous systems (unmanned systems designed to be cost-effective and expendable)[76] linked by AI-enabled C2 mesh networks. The Replicator Initiative became a key element in Indo-Pacific wartime contingencies, supplementing more expensive and less available armaments such as Long-Range

[74] "THeMIS - Milrem," Milrem, April 8, 2025, https://milremrobotics.com/themis-family/.
[75] "THeMIS OBSERVE Tactical UGV with Multi-Sensor Intelligence Capabilities," Edge Group, accessed April 19, 2025, https://edgegroup.ae/solutions/themis-observe.
[76] Defense Innovation Unit, "The Replicator Initiative," https://www.diu.mil/replicator.

Anti-Ship Missiles. Critical to Replicator's success is the ability of attritable platforms to feed into AI-enabled C2 mesh networks. Sensor data from Replicator UAVs must integrate with joint C2 systems, which simultaneously integrate fires, aerial platforms, common operational picture (COP) data, and targeting information, among other information streams. AI provides potential applications for manned systems as well, including targeting and fire control solutions for long-range precision fires, even if true autonomy is limited by human-in-the-loop requirements.

AI-driven predictive maintenance uses machine learning algorithms to analyze sensor data and technical specifications from military equipment to identify failures before they occur and prioritize maintenance efforts. However, AI incorporation into defense logistics poses several challenges, such as balancing AI-driven predictive maintenance and experience-driven human expertise, addressing cybersecurity vulnerabilities, and adapting the vast breadth and width of joint processes and training to incorporate AI efficiencies. In keeping with this concept, AI's transformative power in significantly enhancing supply chain management within the DoD is indisputable. Predictive analytics may ensure critical supplies reach their destinations at the exact time and place of need, anticipate supply chain-driven shortages or second-tier vulnerabilities, and even identify secondary sources of supply.[77]

[77] www.army.mil. "Future of Army Logistics | Exploiting AI, Overcoming Challenges, and Charting the Course Ahead," August 1, 2023. https://www.army.mil/article/267692/future_of_army_logistics_exploiting_ai_overcoming_challenges_and_charting_the_course_ahead.

APPENDIX B: Wargaming Analysis

In 2018, after observing a wargame at the Naval War College in Newport, Rhode Island, former U.S. Marine Corps Commandant General David Berger determined that Marine forces needed to be lighter, more mobile, and positioned closer to possible conflicts in INDOPACOM. The INDOPACOM-focused wargame revealed vulnerabilities in traditional heavy armor and artillery, highlighting the need for lighter, more agile forces with long-range precision strike capabilities. The following year, Gen Berger devoted three of the 23 pages of text within his Commandant's Planning Guidance (CPG) to wargames.[78] Though the burgeoning Marine Corps strategic concepts demanded repeated wargame validation, the resulting data points required corroboration through the demonstrable, repeatable, and defensible results produced by real field experiments with opposing forces and actual equipment.

The results of these experiments require service-level examination to determine whether to transform the force or its capabilities; enter the Marine Corps Warfighting Laboratory (MCWL). The MCWL plans, executes, and reports the results of threat-informed, live-force experiments that advance future warfighting capabilities, with direct implications for strategy and acquisitions.[79] The service's dogmatic focus on wargames since 2019—validated or refuted by many large-scale exercises at the Marine Air Ground Task Force Training Center (MAGTFTC) at 29 Palms, California—directly resulted in Force Design 2030: a Marine Corps restructuring initiative to prepare the service for a conflict with China by 2030, including the reshaping of strategy, formations, and major combat platforms and capabilities.

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[78] Loewenson, Irene. "Marine Wargames Offer a Look at the Future — and Fuel Dissent." Marine Corps Times, March 22, 2024. https://www.marinecorpstimes.com/news/your-marine-corps/2024/03/21/marine-wargames-offer-a-look-at-the-future-and-fuel-dissent/.
[79] Marine Corps Association. "The Marine Corps Warfighting Lab - Marine Corps Association," n.d. https://www.mca-marines.org/gazette/the-marine-corps-warfighting-lab/.

In the same manner that wargaming and live-force experiments drove the Marine Corps' Force Design's divestments, reinvestments, and reshaping of the force, the U.S. Army is beginning transformative efforts to validate or invalidate its current acquisition strategies of future ground combat systems. On May 1, 2025, Secretary of the Army Dan Driscoll and U.S. Army Chief of Staff Gen. Randy A. George published a joint "Letter to the Force: Army Transformation Initiative" outlining their intent and strategy for doing so. The Army Transformation Initiative ATI) pledges to:

> …reexamine all requirements and eliminate unnecessary ones, ruthlessly prioritize fighting formations to directly contribute to lethality, and empower leaders at echelon to make hard calls to ensure resources align with strategic objectives. ATI comprises three lines of effort to deliver critical warfighting capabilities, optimize our force structure, and eliminate waste and obsolete programs.[80]

Practical cornerstones of ATI include introducing long-range missiles and modernized UAS into Army formations, fielding the M1E3 MBT, developing the Future Long-Range Assault Aircraft, developing counter-small UAS (C-sUAS) capabilities, and integrating AI into C2 nodes. The ATI additionally aims to optimize force structure, reduce the size of active component aviation, and render ground formations lighter and more mobile. Suggesting a revised acquisition strategy, the Army intends to cancel the procurement of outdated crewed attack aircraft such as the AH-64D, excess ground vehicles (HMMWV and JLTV), and obsolete UAVs such as the Gray Eagle.[81] The ATI emerged primarily from Secretary of Defense mandates and directives from Army higher headquarters, rather than from large-scale, service-driven wargames. Only one day prior to the "Letter to the Force," SECDEF Hegseth published a "Memorandum for Senior

[80] "Letter to the Force: Army Transformation Initiative," www.army.mil, May 1, 2025, https://www.army.mil/article/285100/letter_to_the_force_army_transformation_initiative.
[81] Ibid

Pentagon Leadership" in which he issued direct guidance very similar to language used in the ATI:

> To build a leaner, more lethal force, the Army must transform at an accelerated pace by divesting outdated, redundant, and inefficient programs and restructuring headquarters and acquisition systems. Simultaneously, the Army must prioritize investments in accordance with the Administration's strategy, ensuring existing resources are prioritized to improve long-range precision fires, air and missile defense, including through the Golden Dome for America, cyber, electronic warfare, and counter-space capabilities.[82]

Though the ATI is a centrally planned redesign of the force, the Army now requires concerted wargaming, field experimentation, and validation of concepts to fine-tune the future force outlined in SECDEF and service chief guidance.

National Defense University Wargame

On May 5, 2025, students from the Eisenhower School of National Security and Resource Strategy at National Defense University conducted a wargame focused on acquiring ground combat systems to meet 2027, 2035, and 2049 joint force requirements, respectively. The students were split into three teams and concentrated on one of the assigned target dates. Teams described the joint force required to meet the anticipated geostrategic challenges of their target dates. Descriptions could include (but were not limited to) the joint force's expected capabilities, operational requirements, technologies driving military innovation, theaters of operation, anticipated bilateral or multilateral alliances with allies/partners, and/or anticipated adversaries

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[82] U.S. Secretary of Defense. "MEMORANDUM FOR SENIOR PENTAGON LEADERSHIP: SUBJECT: Army Transformation and Acquisition Reform." Media.Defense.Gov. U.S. Department of Defense, April 30, 2025. https://media.defense.gov/2025/May/01/2003702281/-1/-1/1/ARMY-TRANSFORMATION-AND-ACQUISITION-REFORM.PDF.

and their capabilities. Teams were then asked to describe how the DoD should transform the current GCS into a coherent portfolio that addresses the corresponding operational environment.

<u>Initial Analysis: Team 2027</u>

The joint force of 2027 is expected to conduct synchronized, multi-domain warfare in a contested environment. “Multi-domain” includes land, sea, and air (to include autonomous systems), cyberspace, the electromagnetic spectrum, space, and the information space. Combat platforms within these domains, long-range precision fires, and force protection measures must be synchronized with the assistance of AI and function in a communications-degraded battlespace. This joint force will fight from installations within the borders of partner nations located within the weapons effects zone of the People’s Liberation Army (PLA). Thus, an Indo-Pacific conflict will be fought by, with, and through regional partners, including Japan, Philippines, Australia, and others, which requires whole-of-government partnerships, alliances, and cooperation.

With 2027 looming, the DoD must focus resources on GCS platforms and capabilities already fielded or in the acquisition process, whose fielding could be expedited. The Marine Corps' ACV was first fielded in 2022, though currently not all Assault Amphibious Vehicle (AAV) Battalions possess their allocated vehicles. The Marine Corps must expedite ACV fielding to ensure it is prepared for littoral warfare in the Indo-Pacific by 2027. Small UGVs focused on reconnaissance and surveillance must become a priority for development. They should be equipped with “bolt-on” sensors and cameras that are inexquisite, truly attritable, and producible at scale. Medium UGVs focused on transportation, APS, and logistics (such as the Rheinmetall Mission Master) are already fielded in Europe and in development in the United

States and can be quickly integrated into formations. Finally, the DoD should leverage defense firms such as Anduril, Forterra, and Textron to integrate small and medium UGVs via Lattice software into C2 systems.

<u>Initial Analysis: Team 2035</u>

Team 2035 levied their initial analyses under the assumption that war had not broken out in the Indo-Pacific by 2035 and that the joint force continues to organize and equip with the PRC as the pacing threat. The team also assumed the Army and Marine Corps remain involved in homeland defense missions at the U.S.-Mexico border. The 2035 joint force fields an Army focused on air defense, theater sustainment/logistics, and long-range precision fires. Mobile Brigade Combat Teams will be the primary formation for maneuver and air defense.

The 2035 DIB can likely support the continued and simultaneous production of the ACV, Infantry Squad Vehicle (ISV), M1E3 MBT, and additional investments in UGVs. RCVs must be fully integrated with manned systems in the Army and Marine Corps by 2035. Examples include the XM30 and ARV. With JLTVs no longer in production, the ISV and remaining legacy tactical vehicle stocks will enable regional mobility. Finally, the GCS industry must at least be IOC in the networking of GCS vehicles by 2035, with the ability to share targeting data wirelessly across platforms.

Unless the DoD provides a clear, long-term signal to the DIB to produce the requisite capabilities, the 2035 joint force accepts risk in meeting acquisition goals. Further, the DIB's ability to surge capacity depends on diversified supply chains and the force's ability to preposition supplies and conduct forward repairs and maintenance effectively. However, opportunities exist if currently evolving technologies in automation increase the DIB’s capacity and throughput, especially if the U.S. government encourages foreign direct investment in U.S.-based defense manufacturing and the leveraging of the international DIB.

Initial Analysis: Team 2049

A successful 2049 joint force dedicates the long-term programming of funds toward long-range precision fires, UGVs, C-UAS, improved cyber defense for AI-enabled C2 mesh networks, and third-party targeting systems that incorporate GCS, air, ISR, and C2. All programs must utilize MOSA and digital engineering. In addition to ATI-derived force restructuring and acquisitions, the joint force must examine the role of amphibious ground combat vehicles such as the Marine Corps' ACV. Given the increased emphasis on littoral combat, fording and swimming capabilities for GCS, to include Army platforms, require due consideration. Finally, the joint force must ensure dedicated programming for naval and aerial heavy lift transport, such as roll-on/roll-off ships, and Navy amphibious ships required to support Amphibious Ready Groups.

Risks of such long-range planning include the difficulty of sustained Congressional and DoD focus on acquisition programs over multiple FYDPs. Accordingly, the divestment of legacy platforms will likely generate Congressional resistance to cuts that affect large constituent bodies. Such volatility prevents the consistent signaling to defense firms that facilitates CAPEX in production capabilities and Research, Development, Test & Evaluation (RDT&E). As these aspects of the Iron Triangle are persistent and often insurmountable, friend sharing and shoring to produce GCS and MOTS purchases has become a much-needed supplementation for FYDPs.

Revised Analysis

Teams were asked to re-evaluate their analyses by including a series of hypothetical geostrategic events affecting the DIB and global force posture over the next ten years. Specifically, teams re-evaluated the DIB's ability to produce GCS systems that adequately address target date joint force requirements, with the additional DIB/resourcing/operational burdens leveraged on DoD because of the events below:

1. January 2026 – After Syrian Democratic Forces (SDF) cede control of Northeast Syria to the transitional government of "New Syria," Islamic State resurgences in Ar Raqqa and the Middle Euphrates River Valley (MERV) result in regular attacks against the Al Hol and Al Internally Displaced Persons (IDP) Camps, as well as Syrian prisons in Hasakah and Dayrick, resulting in thousands of IS fighters fleeing captivity. IS re-occupies parts of Raqqah and numerous villages in NE Syria. U.S. forces in Iraq and Jordan begin airstrikes against known IS targets. Israeli Defense Forces begin airstrikes in NW Syria. The U.S. reconstitutes previously redeployed forces from Special Operational Joint Task Force – Operational INHERENT RESOLVE (SOJTF-OIR), sending an additional 2,000 U.S. special operators, air support, and logistics support to Iraq and Syria. OWUAS attacks attributed to Iran increase, resulting in the deployment of a PATRIOT battalion to Iraq.

2. February 2026 – Two Carrier Strike Groups–the USS Harry S. Truman (CVN-75) CSG and the USS Dwight D. Eisenhower CSG (CVN-69)—remain in the Red Sea. The CSGs conduct strikes against Houthi forces in Yemen, and counter-OWUAS/missile attacks by Houthi forces against Israel, commercial shipping, and U.S. forces.

3. The U.S. Army plans to produce approximately 1,200 M1E3 Abrams tanks over the next decade: 2026-2027 projected prototype testing and early production phases, and 2028-2029 for full operational deployment across armored formations. The program is expected to cost $6.8 billion over the next 5 years to produce 1,200 M1E3 tanks over the next decade, not including sustainment costs.[1]

4. Between January and September 2026, SOJTF-OIR expends 40,000 Joint Direct Attack Munitions (JDAM) in Iraq and Syria, reallocates 200 JLTVs from the U.S. Army to SOJTF-OIR, and registers a UON for 30 additional Pandurs. For reference, U.S.-led coalition aircraft used approximately 112,458 JDAMs against IS between 2014 and 2019. It took 5 years before the JDAM War Reserve Material inventory reached "acceptable levels."[2]

5. In October 2026, Russia, Ukraine, and the U.S. negotiate a peace agreement wherein Crimea and parts of the Donetsk Region remain under Russian control, Ukraine pledges not to join NATO, certain U.S. and international sanctions are lifted against Russia, and Ukraine agrees not to pursue war reparations claims against Russia. Ukraine agrees to immediately transfer key natural resources/minerals to the U.S. in exchange for assistance in reconstituting its decimated military and rebuilding its cities and infrastructure. Ukraine separately pays Europe for military arms transfers/investment through a combination of loans from the European Commission, defense industry investments (Ukraine produces its own armaments and repays through military exports), and mixed aid.

6. In January 2027, the administration announces a $1 billion allocation to the establishment of a Center of AI Government Excellence (CAGE), a R&D center whose purpose is to leverage AI to synergize C5ISR and warfighting across all domains. Using lessons learned in Ukraine and through DIB/DIU/DARPA advances in AI technology, the DoD hopes to accelerate throughput of compute during multi-domain warfare in contested environments, reduce risk to force using AI-enabled unmanned air, ground, and sub-surface vehicles, and enable expedited targeting by leveraging the petabytes of disconnected government databases.

7. Between October 2028 and February 2029, the PRC Maritime Militia sinks two Philippine fishing vessels and one Philippine Natural Resource Exploration Vessel "Albatross" operating in international waters in the South China Sea (SCS). China stated the vessels were operating in China's EEZ near the contested Spratly Islands. In March 2029, at the invitation of the Philippine government, the U.S. sends a Marine Expeditionary Unit to the former site of U.S. Naval Base Subic Bay, where it will conduct 60 days of bilateral military exercises. The administration additionally sends a team of advisors to discuss the potential establishment of a permanent U.S. base at the Second Thomas Shoal, located in the South China Sea just west of the Philippines' Palawan Islands.

8. March 2029 - SECDEF orders the joint force to integrate targeting and sensor data on all ground, air, and naval platforms. The Army Futures, Training and Doctrine Command (AFTDC) estimates a price tag of $70-100 billion over 10 years to design and upgrade existing platforms, and re-issue requirements on programs currently in acquisition.

9. January 2030 - The U.S. and the Philippines agree to restore Subic Bay Naval Base to serve as a hub for U.S. Navy 7th Fleet, including Carrier Strike Groups, Submarines and elements from III Marine Expeditionary Force. To maintain a persistent presence, the Marine Corps will own a portion of Subic Bay for rotational operational units. The cost of rebuilding Subic Bay is estimated at $15 billion over 5 years.

Revised Analysis: Team 2027

A resurgence of IS in Syria would likely result in the re-establishment of the 2019-2020 era Iraq/Syria counterterrorism platform, resulting in a re-posturing of U.S. special operators, aerial platforms, and installation defense assets. As the U.S. and allied response grows, as it did in INHERENT RESOLVE, significant expenditures of munitions will take years to restore. Keeping INDOPACOM in mind, the DoD would require CENTCOM to execute deliberate weaponeering in the execution of the C-ISIS campaign, not expending excessive amounts of munitions that would be critical to a contingency in the Indo-Pacific. Also under likely consideration would be multilateral agreements with Iraq and Turkey to secure Northeast Syria and corresponding IS detainees.

A Russia-Ukraine peace agreement and corresponding rebuilding of Ukraine’s DIB is also potentially consequential to the U.S. and European DIB. The rebuilding of Ukraine's defense capacity requires investment by U.S. and European defense companies. Many of the resources the U.S. desires remain in conflict zones that require securing. Furthermore, a portion of Ukraine’s rebuilt defense capability will stem from direct foreign investment from Europe, who Ukrainian defense exports will pay back once factories come online. Europe will likely provide FMS and mixed aid, detracting from its own DIB capacity.

While the 2027 force's ability to respond to a PLA invasion of Taiwan is limited, the team maintains the U.S., alongside partners and allies, would ultimately prevail in such a conflict, albeit with significant personnel and materiel losses. The U.S.'s ability to produce precision munitions past the first 30 days remains limited. AI-enabled integration of attritable unmanned systems into C2 networks and the COP of the joint force has not yet materialized. The ACV has not been completely fielded to the Marine Corps, and the Navy has yet to produce a solution to the lack of Landing Ship Mediums. However, the as-is joint force remains the most professional military force in history and the world leader in multi-domain warfighting. The preceding 25 years of warfare in the Middle East, while limited in scale, resulted in immense advances in the development and refinement of precision fires and helpful introspection on warfighting, the defense acquisitions process, and the DIB. Also to the advantage of the joint force is the PLA's vast inexperience in joint warfighting, power projection, and contested logistics, all aggravated by the Chinese Communist Party's (CCP) ingrained distrust of the military and tendency to centralize decision-making at the Party level.

Revised Analysis: 2035

What remains clear (through both the provided vignettes and real-world events) is that state and non-state actors within CENTCOM will remain a consistent genesis of contingency operations requiring troop deployments, valuable precision munitions, and DoD focus. Those personnel, munitions, and focus will accordingly be unavailable for use in an INDOPACOM large-scale contingency operation. The PRC will continue to conduct gray zone tactics in the South China Sea, which may or may not lead to flash points resulting in regional escalatory countermeasures. Bearing these two realities in mind, the DoD must now incentivize the DIB to increase production capabilities for the munitions and systems required for 2035. Forward-deployed forces will require GCS logistics and rapid replenishment and must be able to repair vehicles in-theater. Should the U.S. markedly expand its forward-deployed presence in the Indo-Pacific, akin to re-establishing a 7th Fleet footprint at Subic Bay, this could present an opportunity to establish a regional logistics and depot maintenance hub.

To prepare for 2035 (and providing due consideration to the geostrategic possibilities laid out in the vignettes), the DoD must ensure the GCS programs currently in the acquisitions process are fielded on time with the agreed-on capabilities. ACVs must be fielded in totality. ARVs must also be fielded to Marine Corps Light Armored Reconnaissance (LAR) battalions, and they must truly serve as a central coordinator of sensors. Accordingly, the DoD must invest now in small and medium UGVs that will carry these sensors. These UGVs apply to the total force and could be integrated with XM-30s and AI-enabled C2 mesh networks currently in development. The fielding of the XM-30 and M1E3 remains essential for the U.S. Army's ATI but can be slowed or expedited accordingly to allow defense firms to respond to UON requests for INDOPACOM.

Revised Analysis: 2049

The 2049 joint force requires a whole-of-government, synergistic effort to address shortcomings in the current GCS inventory. The elimination of platforms that are unneeded, costly, not "born digital," or not designed with MOSA requires Congressional concurrence. Current examples include the HMMWV, M10 Booker, and JLTV. While a significant cost savings to DoD and a potential reinvestment opportunity for much-needed capabilities, the cancellation of these programs affects the employment of thousands of Americans in

Congressional districts nationwide. The DoD and Congress must implement a clear-eyed approach to reinvestment that includes joint force requirements and political realities. Concerning future capabilities, DoD must provide clear demand signals with multi-year (5+) procurements to industry using streamlined MDAP procedures, while also providing DPA III funding to modernize critical production facilities. Finally, DoD must identify insufficient procurement quantities across the force and pursue friend-shoring to address deficiencies.

APPENDIX C: Additional Recommendations

Recommendation 5 – Make Digital Engineering the Foundation of GCS Programs

Digital engineering enables the DoD to promptly design timely, tailored GCS platforms for specific mission needs. The approach also facilitates the DoD in determining realistic requirements for testing and developing prototypes and field vehicles. Digital engineering could incorporate a higher share of commercial, non-lethal components, which greatly assist in manufacturing vehicles on a mass scale. Digital engineering can simulate aggregate sustainment strategies to platoon, company, and battalion levels to maximize the battle formation concept instead of focusing on individual vehicles. Given these benefits, the DoD should adopt a 20-year vehicle refresh cycle using digital engineering to reduce obsolescence and long-term sustainment costs.

Recommendation 6 – Optimize the GCS Sustainment Model

To improve readiness, efficiency, and modernization across the Ground Combat Systems (GCS) portfolio, the Department of Defense should adopt a Ground Combat Vehicles as a Service (GCVaaS) approach as part of its broader acquisition and sustainment strategy. This model enhances traditional full-system procurement by incorporating lifecycle-based service agreements that deliver greater operational availability, predictable costs, and a continuous modernization path for large, multi-decade GCS contracts. This is accomplished by linking acquisition and sustainment program managers through an integrated Portfolio Program Management Office (PPMO), which manages and synchronizes the organic and private industrial bases from acquisition and manufacturing through sustainment, enabling more coherent decision-making across the lifecycle.

For decades, the DoD has relied on incremental upgrades to platforms such as the Abrams and Bradley, resulting in vendor lock, reduced competition, and a pace of innovation that lags behind emerging requirements. GCVaaS addresses these challenges by tying contractor performance to platform availability, adaptability, and long-term value rather than one-time delivery. It capitalizes on modular designs, plug-and-play architectures, and routine technology refresh cycles to reduce lifecycle costs and accelerate modernization timelines.

Building on established concepts like Performance-Based Logistics and Power by the Hour,[83] GCVaaS shifts the sustainment model from reactive maintenance to proactive capability delivery. Pre-negotiated support agreements and clearly defined performance benchmarks help ensure GCS platforms remain aligned with changing operational demands and emerging threats. Beyond cost and readiness, GCVaaS strengthens public-private collaboration by enabling earlier industry involvement in system design, improving supply chain stability, and supporting long-range planning for OEMs and suppliers. The model may also lower entry barriers for non-traditional vendors, encouraging broader participation and innovation across the defense industrial base.

Additionally, under the GCVaaS model, the DoD could authorize the maximization underutilization of GOCO facilities by making excess capacity available to private-sector participants. This reduces barriers to entry, provides the surge capacity that industry is typically reluctant to fund independently, and allows commercial firms to reallocate capital toward research and development. Leveraging Modular Open Systems Architecture (MOSA), the model further supports modularity, ease of integration, and plug-and-play component upgrades,

[83] "Performance Based Logistics (PBL) Overview," DAU, accessed April 30, 2025, https://www.dau.edu/acquipedia-article/performance-based-logistics-pbl-overview?utm_source=chatgpt.com.

enabling faster technology refresh cycles for an expanded pool of vendors at lower cost while promoting vendor competition across a common technical framework.

Implementing GCVaaS would enhance the DoD's ability to maintain a ready and modernized force, reduce long-term sustainment costs, and build industrial resilience. By leveraging MOSA and integrating private-sector partners through a unified PPMO, GCVaaS enables closer alignment between acquisition and sustainment functions. This alignment increases the predictability of depot workloads, supports more efficient planning and workforce management, and improves throughput across both public and private maintenance ecosystems. GCS platforms must be adaptable, supportable, and delivered at the speed of relevance - this model helps move the Department in that direction.

Recommendation 7 – Streamline Acquisition with Other Transaction Authorities

It must improve its acquisition practices to ensure the DoD develops and acquires GCSs on time. To achieve this, the DoD should expand and institutionalize Other Transaction Authorities, 10 USC § 4021 (Research Projects), 10 USC § 4022 (Prototype Projects), and 10 USC § 4023 (Procurement for Experimental Purposes) to streamline acquisitions and attract non-defense companies to GCS contracts.[84] Such an approach also enables rapid prototyping and potentially creates technology incubators because more firms would be interested in competing for GCS contracts. The DoD should also align acquisition requirements with commercial standards, such as Society of Automotive Engineers (SAE) International, to reduce development

[84] "Procurement for Experimental Purposes (10 USC §4023) | Adaptive Acquisition Framework," DAU, accessed April 30, 2025, https://aaf.dau.edu/aaf/contracting-cone/10usc2373/; "10 USC 4021: Research Projects: Transactions Other Than Contracts and Grants," April 29, 2025, https://uscode.house.gov/view.xhtml?edition=prelim&num=0&req=granuleid%3AUSC-prelim-title10-section4021; "10 U.S. Code § 4022 - Authority of the Department of Defense to Carry Out Certain Prototype Projects," Cornell Law School, accessed April 30, 2025, https://www.law.cornell.edu/uscode/text/10/4022.

and manufacturing costs, promote interoperability, and encourage more firms to enter the military vehicle market, ultimately lowering costs for the DoD.

Recommendation 8 – Focus on Human Capital for Emerging Technology

Services should invest in workforce and training to ensure DoD's commitment to GCS development and fielding. The U.S. Army and U.S. Marine Corps should signal their focus and investment in RCVs by creating new military occupational specialties (MOS) for unmanned and remote platforms incorporated into next-generation platforms and collaborative combat systems. The DoD should invest in educational and training programs, particularly in digital engineering, hybrid tech, RCVs, critical trades, and advancing manufacturing for GCS development. The DoD should create U.S. initiatives like ASSETs+ (Alliance for Strategic Skills Addressing Emerging Technologies in Defence) and the EU Defence Challenge focus on recruitment, training, and upskilling for critical defense industry roles. The Army should develop a program for GCS that follows lessons learned from the Navy's Talent Pipeline Program.

Recommendation 9 – Deploy Additional Land-Based, Longer-Range Missiles to the Indo-Pacific

To enhance anti-access and area-denial capabilities in the Indo-Pacific, the U.S. Army should deploy additional land-based, longer-range missiles. Towed by heavy military trucks, these missile systems provide several key advantages. They are more mobile and difficult to detect, easier to maintain, and can be effectively concealed. They also allow for quicker resupply and reloading. Additionally, the Army can spread more missiles throughout the region, enhancing survivability and operational effectiveness.

Recommendation 10: Accelerate the Development and Deployment of RCVs

RCVs provide new operational capabilities on the battlefield. RCVs are desirable because they can perform various missions without causing human casualties. The DoD should initially focus on building light RCVs for reconnaissance and counter-UAV missions to win early success in establishing a baseline for future development and deployment. Also, the Army and Marine Corps should be able to carry or toll RCVs in multiple vehicles for rapid deployment. RCVs must be attritable and should cost less than $150,000, ensuring wide use by the military. The DIB must effectively scale production to reduce costs. The RCV control unit must be portable; most military vehicles can carry it. Such a setup offers soldiers flexibility in controlling RCVs from various places without being restricted to a control vehicle. The Army and Marine Corps should fully integrate RCVs with manned systems by 2030.

APPENDIX D: Bibliography

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APPENDIX E: Acronyms

ACV	Amphibious Combat Vehicle
AI	Artificial Intelligence
AMPV	Armored Multi-Purpose Vehicle
APC	Armored Personnel Carrier
APS	Active Protection System
BAE	British Aerospace (now BAE Systems)
C2	Command and Control
CCP	Chinese Communist Party
CFACC	Coalition Forces Air Component Command
CFLCC	Coalition Forces Land Component Command
CFMCC	Coalition Forces Maritime Component Command
COP	Common Operational Picture
DEVCOM	Development Command (U.S. Army)
DIU	Defense Innovation Unit
DIB	Defense Industrial Base
DoD	Department of Defense
DoS	Department of State
EAR	Export Administration Regulations
EU	European Union
FFRDC	Federally Funded Research and Development Centers
FMS	Foreign Military Sales
GAO	Government Accountability Office
GCS	Ground Combat Systems
GCV	Ground Combat Vehicle
GCVaaS	Ground Combat Vehicles as a Service
GDLS	General Dynamics Land Systems
GOCO	Government-Owned, Contractor-Operated
HQDA	Headquarters, Department of the Army
IFV	Infantry Fighting Vehicle
INDOPACOM	Indo-Pacific Command
ISR	Intelligence, Surveillance, and Reconnaissance
ITAR	International Traffic in Arms Regulations
JLTV	Joint Light Tactical Vehicle
LSMO	Large-Scale Mobilization Operations
MAGTFTC	Marine Air Ground Task Force Training Center
MBT	Main Battle Tank

MCWL	Marine Corps Warfighting Laboratory
MOSA	Modular Open System Architecture
MRAP	Mine-Resistant Ambush Protected
MDTF	Multi-Domain Task Force
NATO	North Atlantic Treaty Organization
NDAA	National Defense Authorization Act
NDS	National Defense Strategy
NORINCO	China North Industries Group Corporation
NSS	National Security Strategy
OEM	Original Equipment Manufacturer
OMFV	Optionally Manned Fighting Vehicle
PEO	Program Executive Officer
PLA	People's Liberation Army
PMO	Program Management Office
PRC	People's Republic of China
R&D	Research and Development
RCV	Robotic Combat Vehicle
RDT&E	Research, Development, Test & Evaluation
SAE	Society of Automotive Engineers
SECDEF	Secretary of Defense
SPH	Self-Propelled Howitzer
STEM	Science, Technology, Engineering, and Mathematics
SWOT	Strengths, Weaknesses, Opportunities, and Threats
UAS	Unmanned Aerial System
UGRV	Unmanned Ground Reconnaissance Vehicle
UGV	Unmanned Ground Vehicle