Strategic Sufficiency: Mapping DoD Small Drone Requirements to Potential Warfighter Needs in the Indo-Pacific

“What we're seeing through the lens of Ukraine needs to be an acquisition … and procurement system that is hyper-speed, supersonic.

Because over there, we're watching the changes in minutes, hours and days, and that is a very stark contrast.”

Gen. Bryan P. Fenton, SOCOM Commander – April 2025

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1. Executive Summary and Relevant Analytical Charts

Bottom Line Up Front: The Department of Defense (DoD) must urgently prioritize the development, acquisition, and deployment of truly warfighter-portable drone systems to address critical capability gaps in the Indo-Pacific region. Despite the vast maritime expanses of the Indo-Pacific, small, attritable drones that can be carried, launched, and operated by individual warfighters or small teams represent a strategic asymmetric advantage should there ever be a conflict involving the People's Republic of China and China's sophisticated Anti-Access/Area Denial (A2/AD) capabilities. Current DoD investments heavily favor large, expensive platforms while allocating minimal resources to truly portable systems – only 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding. This misalignment creates significant vulnerabilities, as demonstrated by conflicts in Ukraine, the Middle East, and Nagorno-Karabakh in Azerbaijan, where small drones have proven decisive in contested environments. Major conflict scenarios in the Indo-Pacific would require 2,100-6,500 drones daily with attrition rates of 27.5-41%, far exceeding current production capacity. The eight key actions outlined in this report provide a roadmap for transforming the Department's approach to small drone capabilities, accelerating innovation cycles, expanding production capacity, and ensuring U.S. forces have the capabilities they need to deter aggression and prevail in conflict with the China.

1.1 Summary of Key Findings

The Indo-Pacific security environment is characterized by China's comprehensive A2/AD strategy, which presents a formidable challenge to U.S. military operations through extensive long-range precision fires capabilities that can target U.S. air bases and naval assets throughout the First and Second Island Chains. China's rapid advancement in both drone and counter-drone technologies – including laser systems, "bullet curtain" defenses, and sophisticated electronic warfare – is reshaping the strategic landscape. Meanwhile, multiple recent conflicts since 2020 have demonstrated the transformative impact of small, low-cost drones on modern warfare, with commercial off-the-shelf systems proving highly effective in reconnaissance, targeting, and direct attack roles. The Department of Defense's FY2025 budget reflects a growing recognition of these developments, with initiatives like the Replicator program, but current classification systems and procurement strategies still inadequately address the need for truly warfighter-portable systems that can operate effectively in the contested environments of the Indo-Pacific.

The warfighter-centric analysis revealed significant constraints across the operational cycle, from pre-mission preparation through deployment, operation, recovery, and maintenance, that traditional platform-centric approaches often overlook. Current DoD acquisition approaches prioritize large, expensive platforms with minimal investment in truly warfighter-portable systems, creating vulnerabilities in distributed operations across the Pacific islands and maritime environments. Historical DoD spending patterns show minimal investment in truly warfighter-portable systems, with only an estimated 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding based on open-source information allocated to systems meeting this criterion. This imbalance is particularly problematic in the Indo-Pacific, where the ability for small units to deploy drones independently is crucial for mission success in contested environments. The analysis identified critical requirements for truly warfighter-portable systems, including weight under 5-7 pounds, discreet launch capability, and field maintainability – characteristics largely absent from current DoD drone programs.

The Indo-Pacific conflict analysis performed by this report as to potential warfighter needs demonstrated that in limited conflict scenarios lasting 14-30 days, daily drone requirements range from 400-1,275 systems with attrition rates between 16.5% and 30.2%, while major conflicts lasting 45-180 days would require 2,100-6,500 drones daily with attrition rates between 27.5% and 41% due to China's sophisticated counter-drone capabilities. These estimates, derived from comprehensive analysis of Chinese military capabilities, recent conflicts, and operational requirements, highlight the need for a dramatic increase in production capacity, particularly for warfighter-portable systems that can be mass-deployed from distributed locations to overwhelm even advanced defense networks. The integration of counter-drone technologies with offensive drone capabilities is also critical, requiring a robust command and control architecture that can process information from multiple sensors and coordinate responses across domains. These findings underscore the urgent need for a fundamental shift in how the Department approaches small drone capabilities, with a focus on mass production, distributed deployment, and resilient operations in contested environments.

1.2 Summary of Key Conclusions

To transform DoD's field innovation cycles, five specific actions are recommended: (F1) establishing a Rapid Drone Experimentation Force to continuously test and evaluate new drone concepts in realistic field conditions; (F2) implementing a "Drone Sandbox" program at Combat Training Centers to allow operational units to experiment with commercial drone systems during training rotations; (F3) creating a Drone Innovation Fellowship program that embeds warfighters with commercial drone companies; (F4) establishing a Distributed Drone Testing Network for rapid evaluation of capabilities in diverse environments; and (F5) creating a Counter-Drone Red Team program to continuously test U.S. systems against evolving threats. These recommendations, based on analysis of current innovation cycles, technological trends, and lessons from recent conflicts, accelerate the development and fielding of warfighter-portable drone systems by reducing the time between concept development and operational deployment, fostering closer collaboration between military users and commercial innovators, and ensuring systems are tested against realistic threats before fielding.

To transform the U.S. ecosystem for warfighter-portable drones, three key actions are recommended: (E1) establishing a National Drone Manufacturing Initiative to dramatically expand domestic production capacity through financial incentives, technical assistance, and market guarantees; (E2) developing a comprehensive Drone Component Supply Chain Resilience Program to identify and address vulnerabilities in critical component supply chains; and (E3) establishing a Drone Technology Transition Fund to accelerate the movement of promising technologies from research to fielding. These recommendations, derived from analysis of current industrial base limitations, supply chain vulnerabilities, and technology transition challenges, would address the critical production capacity shortfalls identified in the conflict analysis. By creating a resilient, distributed manufacturing ecosystem capable of rapidly scaling production, ensuring secure supply chains for critical components, and providing flexible funding for promising technologies, the DoD can meet the drone requirements for potential conflicts in the Indo-Pacific region.

The strategic implications of the drone revolution for U.S. military operations in the Indo-Pacific region will be significant. Even though the Indo-Pacific is much larger and primarily an oceanic theater, China has announced its intent to field a drone carrier capable of deploying 100 small drones this summer. So too should the U.S. consider similar approaches to enable warfighter-portable and operatable drones to be deployed despite the distances, enabling actions at the tactical age. In other theaters, small, warfighter-portable unmanned systems are transforming modern warfare, enabling distributed operations, overwhelming adversary defenses through mass, and providing persistent surveillance and precision strike capabilities at a fraction of the cost of traditional platforms. The eight actions outlined in this report provide a roadmap for transforming the Department's approach to small drone capabilities, accelerating innovation cycles, expanding production capacity, and ensuring U.S. forces have the capabilities they need to deter aggression and prevail in conflict. Implementing these recommendations will require sustained leadership commitment, resource allocation, and institutional change, but the alternative – continuing the current path – would leave U.S. forces at a significant disadvantage in future conflicts. The time to act is now.

1.3 Key Charts Used In the Report

This section includes charts that are used and produced in the body of this report to provide senior leadership with a quick visual reference to the key findings and recommendations. Further details on how these charts and their conclusions were produced are discussed more in-depth in the report itself.

Chart 1: Small Drones and Practical Tactical Realities Faced by Warfighters

Classification	Weight	Normal Operating Altitude	Tactical Portability Assessment
DoD Group 1	< 20 lbs. (9.1 kg)	1,200 ft (365 m) AGL	Potentially portable by individual warfighter, but upper weight range may be challenging for extended operations
DoD Group 2	21-55 lbs. (9.5-25 kg)	3,500 ft (1065 m) AGL	Too heavy for an individual warfighter to carry for extended periods
NATO Class I (Micro)	< 4 lbs. (2 kg)	460 ft (140 m) AGL	Highly portable, weight probably is small given maximum energy
NATO Class I (Mini)	< 33 lbs. (15 kg)	3,200 ft (1,000 m) AGL	Upper weight range challenging for individual warfighter portability
NATO Class I (Small)	33-330 lbs. (15-150 kg)	5,500 ft (1,700 m) AGL	Too heavy for individual warfighter portability given other equipment probably in tow despite "small" designation

Chart 1 highlights the disconnect between official military classification systems and the practical tactical realities faced by warfighters who need to physically carry these systems in the field. True warfighter portability would likely require systems under 5-7 lbs. (2.3-3.2 kg) to be practically carried along with other essential equipment. The normal operating altitude notes altitude Above Ground Level (AGL).

Chart 2: Open-Source DoD Budgetary Analysis FY2023-FY2025

Domain	FY2023	FY2024	FY2025 (Est.)	% Change (FY24-25)	Warfighter-Portable % in FY2024	Warfighter-Portable % in FY2025 (Est.)
Aerial	$134.7M	$64.2M	$59.9M	-6.7%	8.4%	12.6%
Surface	$103.9M	$89.6M	$107.2M	+19.6%	0.3%	0.8%
Underwater	$15.5M	$19.1M	$26.1M	+36.6%	0.0%	0.2%
Total	$254.1M	$172.9M	$193.2M	+11.7%	4.3%	6.3%

Chart 2 compiles figures from open-source DoD budget documents including R-1, P-1, and O-1 exhibits from the Department of Defense for FY2023, FY2024, and FY2025. "Warfighter-Portable %" represents the estimated percentage of funding allocated to systems meeting the criteria of portability by individual warfighters, launched discreetly, and maintained in field conditions. FY2025 figures are estimates based on the President's Budget Request and may change during the appropriations process and actual appropriations that follow. Limitations of open-source analysis of these numbers apply and these should be considered estimations and approximations of the actual DoD spend.

Chart 3: Warfighter Operational Cycle Analysis of Small Drones

	Pre-Mission Preparation	Deployment	Tactical Operation	Recovery	Maintenance
Description of Activities	Planning mission parameters Charging batteries Loading software Configuring payloads Establishing communications protocols Conducting pre-flight checks	Transporting the drone to the operational area Assembling components Establishing control links Launching the system	Controlling flight Operating sensors Maintaining communications security Avoiding threats Adapting to changing mission requirements	Navigating the drone back to a safe location Executing landing procedures Securing data Shutting down systems	Assessing damage Replacing components Updating software Managing batteries Conducting operational readiness checks
Current Challenges	Limited battery life requiring frequent recharging Complex mission planning software Specialized training requirements Limited payload options Vulnerability to electronic detection	Weight, bulk constraints Complex assembly in field conditions Launch signature visibility Vulnerability to jamming during initialization Limited deployment options in contested areas	Limited range and endurance Operator cognitive load Communications vulnerability Limited autonomous capabilities Environmental constraints (weather, terrain)	Recovery in contested areas Precision landing requirements Vulnerability during return phase Data security concerns Limited recovery options	Limited field repair capabilities Specialized tools, expertise requirements Supply chain dependencies Diagnostic limitations Environmental exposure damage
Opportunities for Improvement	Simplified mission planning interfaces Field-swappable batteries Standardized payload interfaces Automated pre-flight checks Secure, low-probability of intercept communications	Modular designs for compact transport Tool-less assembly Multiple launch methods (hand, bungee, vertical) Resilient communications initialization protocols Low-signature deployment options	Enhanced autonomous navigation AI-assisted sensor interpretation Mesh networking capabilities Adaptive mission replanning Improved environmental resilience	Multiple recovery methods Secure, rapid data offload Disposable, attritable options Encrypted data storage Low-signature return profiles	Modular, field-replaceable components Tool-less maintenance procedures Common parts across platforms Built-in diagnostics Ruggedized design for field conditions

Chart 3 highlights the current challenges as well as opportunities for improvement in U.S. warfighter-portable drones. Warfighter operational cycle analysis reveals how current acquisition strategies may be misaligned with the tactical realities faced by operators in contested environments, particularly in the Indo-Pacific where China's sophisticated A2/AD capabilities create unique challenges for unmanned systems deployment and operation.

Chart 4: Estimated U.S. Drones Required for Limited Conflict Scenarios

Operational Target Category	U.S. Drones Required Per Day	U.S. Drones Denied or Destroyed Per Day
Limited Conflict Scenarios - Optimistic Estimates		
Command	50-75 / day	10-15 / day (20%)
Firepower Strike	30-50 / day	10-15 / day (30%)
Information Confrontation	100-150 / day	15-25 / day (15%)
Reconnaissance Intelligence	200-300 / day	30-45 / day (15%)
Support	20-40 / day	0-5 / day (10%)
Total	**400-615 / day**	**65-100 / day (16.5%)**
Limited Conflict Scenarios - Pessimistic Estimates		
Command	100-150 / day	30-45 / day (30%)
Firepower Strike	75-125 / day	30-50 / day (40%)
Information Confrontation	200-300 / day	60-90 / day (30%)
Reconnaissance Intelligence	400-600 / day	120-180 / day (30%)
Support	50-100 / day	10-20 / day (20%)
Total	**825-1,275 / day**	**250-385 / day (30.2%)**
Estimated Total Duration of Limited Conflict Scenarios: 14-30 days		

Chart 4 details Limited Conflict Scenarios that would likely involve limited direct engagement between U.S. and Chinese forces, primarily focused on maritime and air operations within the First Island Chain. These scenarios include freedom of navigation confrontations, limited blockades, proxy conflicts involving regional allies, cyber-physical confrontations, and contested humanitarian operations. Warfighter-portable drones would play crucial roles in maintaining situational awareness, countering information operations, and enabling effective operations despite attempts to deny access to international waters and airspace (O'Rourke, 2025; Hammes, 2024; Graham & Singer, 2025; United States Army Training and Doctrine Command, 2025). These conflicts are estimated to last between 14 and 30 days.

Chart 5: Estimated U.S. Drones Required for Major Conflict Scenarios

Operational Target Category	U.S. Drones Required Per Day	U.S. Drones Denied or Destroyed Per Day
Major Conflict Scenarios - Optimistic Estimates		
Command	200-300 / day	60-90 / day (30%)
Firepower Strike	300-500 / day	120-200 / day (40%)
Information Confrontation	500-750 / day	125-190 / day (25%)
Reconnaissance Intelligence	1,000-1,500 / day	250-380 / day (25%)
Support	100-200 / day	20-40 / day (20%)
Total	**2,100-3,250 / day**	**575-890 / day (27.5%)**
Major Conflict Scenarios - Pessimistic Estimates		
Command	400-600 / day	160-240 / day (40%)
Firepower Strike	600-1,000 / day	300-500 / day (50%)
Information Confrontation	1,000-1,500 / day	400-600 / day (40%)
Reconnaissance Intelligence	2,000-3,000 / day	800-1,200 / day (40%)
Support	200-400 / day	60-120 / day (30%)
Total	**4,200-6,500 / day**	**1,720-2,660 / day (41%)**
Estimated Total Duration of Major Conflict Scenarios: 45-180 days		

Chart 5 details Major Conflict Scenarios that would likely involve high-intensity conventional warfare between U.S. and Chinese forces across air, maritime, space, and cyber domains throughout the Western Pacific region. These scenarios include full-scale Taiwan invasion response, multi-domain operations against mainland bases, regional conflicts involving multiple U.S. allies, full-spectrum conflicts with space and cyber dimensions, and extended maritime blockade operations. Warfighter-portable drones would be employed for penetrating sophisticated A2/AD systems, maintaining command and control in degraded information environments, and enabling effective joint operations across multiple domains and theaters (Oudenaren, 2025; Rinaldi & Vartanian, 2025; United States Army Training and Doctrine Command, 2025). These conflicts are estimated to last between 45 and 180 days.

Chart 6: Key Findings and Implications from this Report

Strategic Imperative	Key Findings	Implications
1. Critical Capability Gap	Only 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding is allocated to truly warfighter-portable systems.	The U.S. lacks enough small, attritable drones that can be deployed by individual warfighters or small teams without specialized equipment or dedicated operators.
2. Contested Environment Reality	China has reportedly developed sophisticated counter-drone capabilities including "bullet curtain" defenses, laser weapons, and advanced electronic warfare systems.	Future conflicts will require overwhelming numbers of low-cost, attritable drones to saturate defenses, with mass deployment as the primary counter to advanced defensive systems.
3. Urgent Timeline to Act Now	The scale and pace of China's military modernization, coupled with lessons from Ukraine and other recent conflicts, demand immediate action.	Incremental approaches or minor adjustments to existing programs will not address the fundamental misalignment between current capabilities and operational requirements.
4. Accelerated Innovation Imperative	China's rapid advancement in drone and counter-drone technologies threatens to erode U.S. technological advantages.	The traditional acquisition cycle is too slow to keep pace with technological change, requiring novel approaches to rapidly develop, test, and field innovative drone capabilities.
5. Budget Realignment Necessity	Current budget allocations for small unmanned systems appear insufficient to meet the scale of requirements identified for potential conflicts based on recent conflicts using drones.	Current budget priorities do not reflect the critical importance of small, attritable drones in modern warfare, nor the quantities required for potential conflicts with China.
6. Industrial Base Challenge	Current munitions procurement levels remain significantly below Cold War peak years, with limited domestic production capacity for small drones.	The U.S. defense industrial base lacks the capacity, diversity, and resilience needed to support wartime production rates of small, attritable drone systems.
7. Production Capacity Crisis	Major conflict scenarios require 2,100-6,500 drones daily with attrition rates of 27.5-41%. Current production capacity is orders of magnitude below these requirements.	Even with the most optimistic production estimates, the U.S. would exhaust available drone stockpiles within days of a major conflict with China, creating a critical vulnerability.
8. Distributed Operations Advantage	Warfighter-portable drones incorporating next-generation hardware enable operations from numerous, unpredictable locations across the Indo-Pacific.	Small, attritable drones deployed from distributed locations can create multiple dilemmas for adversary targeting and force protection, enhancing operational resilience and effectiveness.

Chart 6 details the key findings and implications of this from Chapters 2, 3, and 4.

Chart 7: Eight Key Actions for Decision Makers

Action for Decision	Why It Matters	What Can Be Done Now
F1. Establish Rapid Drone Experimentation Force	Accelerates innovation cycles by testing new concepts and technologies in realistic conditions with operational forces, building on DIU's work while enabling direct transition to fielding	Direct establishment through SECDEF memo, allocate $250M from existing rapid acquisition authorities, establish quarterly field experiments with authority to transition directly to fielding
F2. Implement DoD Drone and Counter-Drone Sandbox Program	Enables operational units to experiment with both drone and counter-drone technologies during training, providing immediate feedback on effectiveness	Allocate $50M annually to establish facilities at major Combat Training Centers, maintain inventory of commercial drones and counter-drone systems
F3. Create Drone Industry Innovation Exchanges	Builds technical expertise and cross-sector relationships through flexible exchange programs between military and industry	Establish industry exchange positions annually with flexible participation models, prioritize personnel with operational experience, partner with leading drone manufacturers
F4. Accelerate Drone Generation Cycles	Prevents DoD from buying yesterday's technologies by implementing rapid, overlapping development cycles for successive drone generations	Implement 18-month technology cycles with $300M over three years, establish modular designs and continuous feedback mechanisms
F5. Advance Drone Test Ranges	Advances rapid evaluation of drone capabilities across diverse operational environments, accelerating development cycles	Invest $175M over three years to advance drone test ranges with standardized instrumentation and data collection
E1. Accelerate Drone Manufacturing	Expands domestic production capacity to meet wartime requirements through strategic capital deployment across the country	Direct OSC to lead the initiative with $1B over five years, combining direct investments, loans, and purchase guarantees across multiple regions
E2. Strengthen Supply Chains	Reduces vulnerabilities from foreign dependencies, single points of failure, and compromised components	Allocate $300M over three years, map critical supply chains, invest in domestic production of key components, implement security standards
E3. Ensure Pipeline of Future Technologies Today	Creates end-to-end process from advanced research to fielded capabilities, with DARPA and additional elements of USD(R&E) working in concert	Direct DARPA to research capabilities beyond commercial state-of-the-art and additional elements of USD(R&E) to bridge transition gap with $200M annual funding

Chart 7 summarizes the key actions, will details in sections 5.1 and 5.2 of this report.

These charts are included here for easy reference to decision-makers who may need to quickly scan the essential elements of this report without reading the entire document. Each chart is based on open-source analysis available information, with methodologies and limitations clearly explained in the relevant chapters. A comprehensive list of the open-source references used in producing this report is provided at the end of this report, facilitating further exploration of the source material.

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2. Assessing the Indo-Pacific, State of Drones, and Budgeted U.S. Defense

The People's Republic of China (PRC) has rapidly advanced its drone and counter-drone capabilities as part of its comprehensive anti-access/area denial (A2/AD) strategy in the Indo-Pacific region, presenting significant challenges to U.S. military operations. China's development of sophisticated drone technologies – ranging from small tactical systems to large autonomous platforms capable of launching smaller drones – is reshaping the strategic landscape, while its counter-drone systems, including laser weapons and “bullet curtain” defenses, are designed to neutralize the “hellscape” concept being developed by U.S. military planners. Meanwhile, conflicts in Ukraine, the Middle East, and Nagorno-Karabakh have demonstrated the transformative impact of small, low-cost drones on modern warfare, with commercial off-the-shelf systems proving highly effective in reconnaissance, targeting, and direct attack roles. The Department of Defense's FY2025 budget reflects a growing recognition of these developments, with significant investments in autonomous collaborative platforms, counter-UAS mission command systems, and small UAS development programs across the Services, though questions remain about whether current classification systems and procurement strategies adequately address the need for truly warfighter-portable systems that can operate effectively in the contested environments of the Indo-Pacific.

2.1 State of Anti-Access/Area Denial (A2/AD) and Chinese Drones

China's comprehensive A2/AD strategy in the South China Sea and broader Indo-Pacific region presents a formidable challenge to U.S. military operations, with the People's Liberation Army (PLA) developing extensive long-range precision fires capabilities that can target U.S. air bases and naval assets throughout the First and Second Island Chains. This strategy aims to deny foreign access to the region, advance China's territorial claims, and limit the U.S. military's ability to project power, threatening the regional security environment and U.S. doctrine of global reach (Missile Defense Advocacy Alliance, 2025).

China's exploitation of overseas ports and bases further extends their operational reach, creating additional challenges for U.S. forces attempting to maintain freedom of navigation and project power in contested environments (Hammes, 2024). China has significantly accelerated its development and deployment of unmanned aerial systems as a vital component of its A2/AD capabilities. China’s military now develops, uses, and trains UAVs for an array of combat missions including Intelligence, Surveillance, and Reconnaissance (ISR); maritime and border defense patrol; ground and naval strike; anti-submarine warfare; air defense suppression through drone swarms; electronic warfare; communications support; and logistical support. These systems are regularly deployed in Chinese military exercises, including aerial sorties crossing the median line in the Taiwan Strait and major joint exercises around Taiwan, demonstrating China's intent to use drones in any potential conflict in the region (Oudenaren, 2025).

China's shift toward small, smart drones – supported by industrial scale, AI integration, and innovative designs – marks a pivotal transformation in military technology that is narrowing the technological gap with the United States. The PLA's Eastern Theater Command regularly deploys UAVs as part of aerial sorties crossing the median line in the Taiwan Strait, and drones have undertaken ISR and accompanied manned warplanes as part of major recent Chinese military joint exercises around Taiwan, including the August 2022 live-fire drills after a high-profile U.S. visit to Taipei, the April 2023 “Joint Sword” exercises, and the “Joint Sword-2024A” drills following Taiwanese President Lai Ching-te's May 2024 inauguration (McNabb, 2025).

China's counter-drone capabilities have also advanced significantly, with the Chinese military developing a layered defense approach that combines robust detection networks with a mix of kinetic and non-kinetic countermeasures. Chinese military commentators advocate for blending radars, electro-optical sensors, electronic warfare, and artificial intelligence for real-time threat analysis, enabling rapid engagement against swarming drones. The PRC has significantly increased domestic investment in counter-drone technology, with more than 3,000 manufacturers now producing anti-drone equipment and a dramatic rise in government procurement notices related to counter-drone technology – 205 in 2024 alone, compared to 122 in 2023 and 87 in 2022 (Graham & Singer, 2025).

Recent technological advancements in China's counter-drone capabilities include laser anti-UAV systems, barrage-style anti-drone “bullet curtain” defenses, and radar detection technologies that can identify small drones even in cluttered environments. China's “Metal Storm” barrage weapon system has progressed beyond the prototype stage to become the only system of its kind in the world to enter mass production, positioning it as a potentially game-changing asset in countering saturation attacks, especially those involving volleys of cruise missiles or large-scale drone incursions (Palve, 2025). These developments directly challenge the U.S. military's “hellscape” concept, which aims to employ large numbers of low-cost, autonomous drones to create an overwhelming and unpredictable operating environment for adversary forces (Rinaldi & Vartanian, 2025).

2.2 State of the Drone Revolution in Modern Warfare as of 2025

The proliferation of drone technology has fundamentally transformed modern warfare, with the number of countries possessing armed drones expanding from just three in 2010 to over 40 by 2024. This rapid expansion has been accompanied by a significant increase in the use of one-way attack drones and commercial off-the-shelf systems by both state and non-state actors, with drone usage recorded in conflict in at least 34 countries in 2023 alone. The

Russo-Ukrainian War has become a critical “innovation hub” for drone warfare, accelerating advancements in the scale, speed, and range of drone operations, with Ukraine setting an ambitious goal to produce one million drones in early 2024, later revising its target to two million by March, and ultimately reaching an annual production capacity of up to four million drones by October 2024 (Bendett & Kirichenko, 2025).

The conflict in Ukraine has demonstrated the transformative impact of small drones on modern warfare, with both sides deploying thousands of unmanned systems for reconnaissance, targeting, and direct attacks. Ukrainian drone pilots have noted that while in the early days of the war they could deploy drones from virtually anywhere, the evolution of Russian counter-drone capabilities now requires extensive planning and preparation. These relatively inexpensive systems have proven highly effective against traditional armored vehicles, with one Ukrainian captain recalling that “one of our tanks moved near the frontlines, and ten drones attacked, setting it alight almost immediately.” This has led to a fundamental shift in battlefield dynamics, with infantry now fighting battles backed by tactical drones, artillery, and mortars rather than relying on armored vehicles (Jensen & Atalan, 2025).

The 2020 Nagorno-Karabakh conflict provided another compelling demonstration of drone warfare's impact, with Azerbaijan's use of Turkish Bayraktar TB2 drones and Israeli loitering munitions proving decisive against Armenian forces. These systems effectively neutralized Armenian air defenses, armor, and artillery, highlighting the vulnerability of traditional military assets to coordinated drone attacks (Whelan, 2023). Similarly, Houthi forces in Yemen have developed sophisticated drone warfare strategies, using both locally manufactured and Iranian-supplied systems to target critical infrastructure in Saudi Arabia and the UAE, as well as to enforce a partial blockade on maritime traffic through the Red Sea since November 2023 (Mukhtar, 2025).

First-person view (FPV) drones have emerged as a particularly significant development in modern drone warfare. These systems, characterized by their straightforward design and low cost, were primarily employed for civilian purposes before the Russian invasion of Ukraine but have since been widely modified for military applications, particularly for conducting tactical strikes against enemy positions, vehicles, and personnel along front lines. The Houthis have also begun adopting this technology, with National Resistance forces in Yemen recently seizing DJI MAVIC3 drones, TARANIS X9D control systems, and related surveillance and tracking equipment, indicating the group's intent to deploy FPV drones on a large scale (Alani, 2024).

The Indo-Pacific presents unique challenges for drone operations compared to Ukraine, primarily due to the vast maritime expanses that characterize the region. While the Ukrainian conflict has largely been land-based, allowing for relatively short-range drone operations with direct line-of-sight control, the Indo-Pacific would require systems capable of operating over much greater distances and in challenging maritime conditions. Additionally, China's sophisticated A2/AD capabilities, including advanced electronic warfare systems and counter-drone technologies, would create a significantly more contested electromagnetic environment than what has been experienced in Ukraine (Jankowicz, 2025).

Despite these differences, several lessons from Ukraine remain applicable to the Indo-Pacific. The effectiveness of low-cost, attritable drones employed in large numbers to overwhelm defenses has direct relevance to potential operations against Chinese A2/AD systems. The integration of commercial off-the-shelf technologies with military systems has proven highly effective in Ukraine and could be adapted for Indo-Pacific operations. Additionally, the use of drones for distributed ISR and targeting has demonstrated significant value in Ukraine and would be equally important in the vast expanses of the Indo-Pacific, where traditional ISR assets might be vulnerable to Chinese counter-air capabilities (Oudenaren, 2025). China's development of the Jiutian SS-UAV represents a significant advancement in drone technology with strategic implications for the Indo-Pacific region. This system is reportedly powered by a high-thrust turbofan engine with a range of 7,000 kilometers and endurance of up to 36 hours, carrying eight underwing hardpoints and a modular bay capable of launching smaller drones for reconnaissance, strike, or jamming missions (Economic Times, 2025).

The rapid advancement of drone technology also is accompanied by the development of counter-drone capabilities, creating a dynamic interplay between UAS proliferation and counter-UAS innovation. China's counter-UAV efforts reveal more than just technological advancement; they demonstrate a strategic recognition of the transformative impact of drone warfare and a determination to neutralize this threat. Similarly, Russia's direction to its government and leading bank to strengthen artificial intelligence cooperation with China signals deeper technological collaboration between the two states, with the Russian government reiterating its main goals for military AI, which include automatic processing and analysis of intelligence data, improving information support for combat operations, and increasing the ability to predict threats and the course of conflicts (Bendett & Kirichenko, 2025).

2.3 U.S. Military Posture and Potential Capability Gaps

The U.S. military faces significant challenges in the Indo-Pacific region due to China's expanding A2/AD capabilities, which impede America's ability to project power and present a substantial vulnerability to U.S. forces. China's comprehensive A2/AD strategy, concentrated around Taiwan and the South China Sea, puts U.S. military forces – such as Carrier Strike Groups – and installations in the region within range of precision-guided cruise and ballistic missiles, severely mitigating the ability of U.S. forces to conduct operations in the Asia-Pacific. This challenge is compounded by the “tyranny of distance” in the Indo-

Pacific, where vast maritime expanses create logistical and operational challenges for traditional force projection (Soursa, 2025).

To counter these challenges, the U.S. military is increasingly turning to unmanned systems, with the Army planning to equip each combat division with approximately 1,000 drones for use in attacks, moving supplies, and surveillance by 2026. This approach reflects a shift from large-scale, multimillion-dollar equipment to more nimble and responsive systems, as evidenced by Army Undersecretary Gabe Camarillo's statement that "operating and defending against the drone threat is something that will be expected by all formations at multiple echelons" (Albon, 2025). The FY2025 budget request includes significant investments in autonomous collaborative platforms, counter-UAS mission command systems, and small UAS development programs across the Services, with substantial funding allocated for exercises, training, experimentation, and innovation related to unmanned systems deployment in the Indo-Indo-Pacific through the Pacific Deterrence Initiative (U.S. Department of Defense PDI, 2024).

Warfighter-portable drones, despite their range limitations, offer several critical advantages in the Indo-Pacific. Their small size and low signature make them difficult to detect and track, allowing them to operate effectively within China's A2/AD envelope where larger platforms might be vulnerable. They can be deployed from a variety of platforms and locations, providing distributed ISR and strike capabilities that are more resilient to enemy action than centralized systems. Additionally, their low cost and attritable nature allow for mass deployment, potentially overwhelming enemy defenses through sheer numbers, as demonstrated in Ukraine and envisioned in the U.S. military's "hellscape" concept (Rinaldi & Vartanian, 2025).

The range limitations of small drones can be mitigated through several approaches, including the development of "drone carrier" concepts capable of launching smaller drones for reconnaissance, strike, or jamming missions. This approach allows smaller drones to be transported to the operational area by larger platforms, extending their effective range while maintaining their advantages in terms of signature and attrition tolerance. Additionally, the deployment of small drones from naval vessels, submarines, and even transport aircraft could provide extended reach into denied areas, as envisioned in programs like the Air Force's Rapid Dragon, which aims to turn non-traditional platforms like transport aircraft into long-range, high-volume shooters capable of operating from a vast array of airfields (Graham & Singer, 2025).

The Department of Defense's latest guidance emphasizes the importance of unmanned systems across all domains and services. Deputy Secretary of Defense Kathleen Hicks' Replicator initiative aims to field thousands of autonomous systems across multiple domains, reflecting a recognition that small drones represent a critical capability for maintaining military superiority in contested environments while reducing risk to personnel and high-value platforms. The Army's decision to maintain its current approach to drone integration rather than creating a dedicated drone expeditionary force emphasizes the need for all formations at multiple echelons to operate and defend against drone threats, indicating a broad distribution of drone capabilities throughout the force (Albon, 2025).

The U.S. military's counter-UAS mission command systems also require significant advancement to keep pace with the evolving drone threat. Current systems often require manual processes to track and engage hostile drones, with operators having to select tracks, mark them as hostile, and launch interceptors through appropriate software menus for each individual track. This approach is inadequate for addressing the mass drone attacks that have been demonstrated in Ukraine and could be expected in an Indo-Pacific conflict. The development of human-on-the-loop automation systems for rapid response is essential for enabling effective defense against emerging drone threats, particularly in scenarios involving swarm attacks (Vowell & Padalino, 2024).

2.4 DoD Budgetary Analysis and Assessing Warfighter-Portable Drones

Classification	Weight	Normal Operating Altitude	Tactical Portability Assessment
DoD Group 1	< 20 lbs. (9.1 kg)	1,200 ft (365 m) AGL	Potentially portable by individual warfighter, but upper weight range may be challenging for extended operations
DoD Group 2	21-55 lbs. (9.5-25 kg)	3,500 ft (1065 m) AGL	Too heavy for an individual warfighter to carry for extended periods
NATO Class I (Micro)	< 4 lbs. (2 kg)	460 ft (140 m) AGL	Highly portable, weight probably is small given maximum energy
NATO Class I (Mini)	< 33 lbs. (15 kg)	3,200 ft (1,000 m) AGL	Upper weight range challenging for individual warfighter portability
NATO Class I (Small)	33-330 lbs. (15-150 kg)	5,500 ft (1,700 m) AGL	Too heavy for individual warfighter portability given other equipment probably in tow despite “small” designation

This chart highlights the disconnect between official military classification systems and the practical tactical realities faced by warfighters who need to physically carry these systems in the field. True warfighter portability would likely require systems under 5-7 lbs. (2.3-3.2 kg) to be practically carried along with other essential equipment. The normal operating altitude notes altitude Above Ground Level (AGL).

The current classification systems used by the Department of Defense and NATO for unmanned aerial systems focus primarily on physical characteristics such as weight, operating altitude, and speed. While these parameters provide a useful framework for categorizing drones, they fail to adequately address the operational requirements specific to the Indo-Pacific. The vast maritime expanses, sophisticated A2/AD environments, and distributed operations characteristic of the Indo-Pacific region demand a more nuanced approach to drone classification that considers factors beyond mere size and weight (Alani, 2025).

The DoD's Group 1 category, which encompasses systems weighing less than 20 pounds and that operate below 1,200 feet, includes a wide range of capabilities from hand-launched tactical reconnaissance drones to consumer quadcopters. This broad categorization does not sufficiently distinguish between systems that are warfighter-portable, and operable, vs. those requiring dedicated launch and recovery teams. In the context of distributed operations across the Pacific islands and maritime environments, the ability for small units to deploy and operate drones independently is a critical consideration that is not captured in the current classification system (U.S. Department of Defense, 2024).

Similarly, the NATO classification system's Class I category, which includes all drones weighing less than 150 kg, spans too wide a range to be operationally meaningful in the Indo-Pacific context. A 149 kg drone and a 5 kg drone would fall into the same category despite having vastly different implications for tactical mobility, launch requirements, and operational flexibility. This limitation becomes particularly significant when considering the need for distributed, resilient capabilities that can operate effectively within China's A2/AD envelope (Alani, 2025).

The current classification systems also fail to adequately address the emerging operational concepts demonstrated in Ukraine and other recent conflicts, where small, commercially derived drones have proven highly effective in reconnaissance, targeting, and direct attack roles. These systems, often weighing just a few kilograms, have demonstrated tactical value disproportionate to their size, yet they represent only a small subset of the broader Group 1/Class I categories. A more refined classification approach that recognizes the unique operational value of truly warfighter-portable systems would better align with the realities of modern drone warfare and the specific challenges of the Indo-Pacific (Bendett & Kirichenko, 2025).

2.5 Beyond Size and Weight: Rethinking Drone Classification

The conflict in Ukraine has demonstrated the extraordinary value of small, warfighter-portable drones in modern warfare. These systems, often weighing less than 5 kg, have proven highly effective in reconnaissance, targeting, and direct attack roles, with Ukrainian forces using commercial off-the-shelf drones to neutralize Russian armor and artillery at a fraction of the cost of traditional weapons systems. The ability for small units to deploy these systems independently, without specialized launch equipment or dedicated operators, has enabled a distributed approach to ISR and precision strike that has proven highly resilient to enemy countermeasures. This lesson has direct relevance to the Indo-Pacific, where distributed operations across vast maritime expanses will require similar capabilities at the tactical level (Bendett & Kirichenko, 2025).

China's development of sophisticated A2/AD capabilities, including advanced radar systems capable of detecting small drones using micro-Doppler signal processing, presents a significant challenge to U.S. drone operations in the Indo-Pacific. However, the sheer volume of small drones that can be deployed by distributed forces can overwhelm even advanced detection and engagement systems, as demonstrated by the limited effectiveness of Russian counter-drone measures in Ukraine. China's own investment in drone carrier concepts, such as the Jiutian SS-UAV with its ability to launch smaller drones from a larger platform, indicates recognition of the operational value of combining the range and endurance of larger systems with the tactical flexibility and attrition tolerance of smaller ones (Yan et al., 2025).

The limitations of small drones in the Indo-Pacific, primarily related to range and endurance, can be overcome through several approaches. The development of drone carrier concepts would allow smaller systems to be transported to the operational area by larger platforms, extending their effective range while maintaining their advantages in terms of signature and attrition tolerance. Additionally, the deployment of small drones from naval vessels, submarines, and even transport aircraft could provide extended reach into denied areas, as envisioned in programs like the Air Force's Rapid Dragon. Advances in battery technology and alternative power sources could also extend the range and endurance of small drones without significantly increasing their size or weight.

Given these considerations, a more operationally relevant classification system for drones in the Indo-Pacific would focus on three key parameters: warfighter portability, discreet launch capability, and field maintainability. Warfighter portability refers to the ability of a single warfighter or small team to transport, deploy, and operate the drone without specialized equipment or vehicles. This capability is essential for distributed operations across the Pacific islands and maritime environments, where traditional launch and recovery infrastructure may be vulnerable to enemy action or simply unavailable. Systems meeting this criterion would typically weigh less than 10 kg and be capable of launch and recovery by hand, allowing for deployment from concealed positions (Alani, 2025).

Discreet launch capability refers to the ability to deploy the drone with minimal signature, reducing the risk of detection and targeting by enemy forces. This capability is particularly important in the context of China's sophisticated ISR and strike capabilities, which could quickly target conventional launch sites and equipment. Drones with discreet launch capability would typically feature electric propulsion, low acoustic and visual signatures, and the ability to be deployed from concealed positions or while in transit aboard ships, submarines, or aircraft. This approach allows for the insertion of ISR and strike capabilities into denied areas without compromising the launching platform or personnel (Nevola & d'Hauthuille, 2024).

Field maintainability refers to the ability to maintain, repair, and repurpose the drone in austere environments with minimal specialized equipment or technical expertise. This capability is essential for sustained operations in the distributed and potentially isolated environments of the Indo-Pacific, where traditional logistics chains may be disrupted by enemy action. Drones meeting this criterion would feature modular designs, common components, and simplified maintenance procedures that can be performed by operators rather than specialized technicians. This approach enhances operational resilience and reduces the logistical burden associated with unmanned systems (Vershinin, 2020).

2.6 Beyond Size and Weight: Rethinking Drone Classification

Domain	FY2023	FY2024	FY2025 (Est.)	% Change (FY24-25)	Warfighter-Portable % in FY2024	Warfighter-Portable % in FY2025 (Est.)
Aerial	$134.7M	$64.2M	$59.9M	-6.7%	8.4%	12.6%
Surface	$103.9M	$89.6M	$107.2M	+19.6%	0.3%	0.8%
Underwater	$15.5M	$19.1M	$26.1M	+36.6%	0.0%	0.2%
Total	$254.1M	$172.9M	$193.2M	+11.7%	4.3%	6.3%

This chart compiles figures from DoD budget documents including R-1, P-1, and O-1 exhibits from the Department of Defense for FY2023, FY2024, and FY2025. "Warfighter-Portable %" represents the estimated percentage of funding allocated to systems meeting the criteria of portability by individual warfighters, launched discreetly, and maintained in field conditions. FY2025 figures are estimates based on the President's Budget Request and may change during the appropriations process and actual appropriations that follow. Limitations of open-source analysis of these numbers apply and these should be considered estimations and approximations of the actual spend.

The FY2025 budget request shows a mixed trend in funding for small unmanned systems across domains. While aerial systems continue to see a slight decrease (-6.7%) compared to FY2024 levels, both surface (+19.6%) and underwater (+36.6%) domains show significant increases. Overall, there is an 11.7% increase in total funding for small unmanned systems from FY2024 to FY2025. This shift may reflect a growing recognition of the importance of maritime unmanned capabilities in the Indo-Pacific region, where naval and undersea operations will be critical to countering China's A2/AD strategy.

Despite the overall increase in funding, there remains a concerning lack of emphasis on truly warfighter-portable systems across all domains. While the percentage of resources allocated to warfighter-portable platforms is increasing (from 4.3% to 6.3% of total unmanned systems funding), the absolute numbers remain small. This limited investment in warfighter-portable systems stands in contrast to the lessons from Ukraine and other recent conflicts, which have demonstrated the operational value of these capabilities, particularly in contested environments where larger platforms may be vulnerable.

The aerial domain continues to receive the largest share of small unmanned systems funding, reflecting the maturity and proven effectiveness of aerial drones in recent conflicts. However, the 6.7% reduction in funding from FY2024 to FY2025 raises questions about the Department's ability to field these systems at the scale necessary to implement concepts like the “hellscape” approach to countering China's A2/AD capabilities. The increase in the percentage of funding dedicated to warfighter-portable aerial systems from 8.4% to 12.6% is encouraging, but the absolute reduction in funding may limit the quantity of systems that can be procured and fielded.

The underwater domain, while showing the largest percentage increase in funding, still receives the smallest allocation for small unmanned systems, despite the critical importance of undersea capabilities in the maritime environment of the Indo-Pacific region. The minimal percentage of resources dedicated to warfighter-portable underwater systems (0.2% in FY2025) suggests a potential capability gap in this area. Given China's growing anti-submarine warfare capabilities and the strategic importance of undersea operations in the Indo-Pacific, this underinvestment in small, distributed underwater unmanned systems could represent a significant vulnerability in the U.S. approach to the region.

2.7 Required DoD Actions to Achieve Truly Small Drone Capabilities

The Department of Defense should fundamentally revise its UAS classification system to better reflect the operational realities of modern drone warfare and the specific challenges of the Indo-Pacific. The current system, which focuses primarily on physical characteristics such as weight, altitude, and speed, fails to adequately capture the tactical and operational value of truly warfighter-portable systems. A new classification approach based on operational parameters such as warfighter portability, discreet launch capability, and field maintainability would better align with the requirements for distributed operations in contested environments. This revised system would provide a more meaningful framework for requirements development, acquisition planning, and operational concept development, ensuring that investments in unmanned systems are directed toward capabilities that will have the greatest impact in potential conflicts with peer adversaries.

The Defense Innovation Unit (DIU) has made progress in accelerating the adoption of commercial drone technologies for military applications, but these efforts must be expanded and institutionalized across the Department. The Office of Strategic Capital (OSC) could play a crucial role in this expansion by providing long-term, patient capital to companies developing key enabling technologies for small unmanned systems, such as advanced batteries, miniaturized sensors, and secure communications. By coordinating investments between DIU's prototyping activities and OSC's longer-term capital deployment, the Department could create a more robust and sustainable industrial base for small unmanned systems. Additionally, the establishment of dedicated rapid acquisition pathways for commercial drone technologies, akin to those used for software and IT systems, would allow for faster fielding of capabilities in response to evolving threats and opportunities.

Battery technology represents one of the most significant limitations for small unmanned systems, particularly in terms of range and endurance. The Department should establish a dedicated research and development program focused on high energy density power sources specifically optimized for small unmanned systems. This program should leverage advances in commercial battery technology while addressing the unique requirements of military applications, such as operation in extreme environments, resistance to countermeasures, and compatibility with field charging systems. Partnerships with the Department of Energy, national laboratories, and commercial battery manufacturers could accelerate progress in this area, potentially yielding significant improvements in the performance of small unmanned systems across all domains.

The success of commercial drones in Ukraine demonstrates that many of the required capabilities already exist in the commercial sector and could be quickly modified for military use with appropriate security and reliability enhancements. The Department should establish formal partnerships with leading commercial drone manufacturers to adapt existing consumer technologies for military applications, focusing on enhancing security features, improving reliability in contested environments, and ensuring interoperability with military command and control systems. These partnerships could take various forms, including cooperative research and development agreements, other transaction authority (OTA) contracts, and dedicated procurement programs for modified commercial systems. By leveraging the innovation and scale of the commercial drone market, the DoD could field capable systems more quickly and at lower cost than through traditional defense acquisition processes.

In addition, the Department should establish a dedicated cross-functional team focused on developing and implementing concepts of operation for distributed unmanned systems in the Indo-Pacific. This team would bring together representatives from all services, combatant commands, and relevant defense agencies to ensure that technological developments are aligned with operational requirements and that new capabilities can be effectively integrated into joint operations. The team would be responsible for conducting experimentation and demonstration activities, developing tactics, techniques, and procedures for the employment of small unmanned systems, and identifying capability gaps and opportunities for further investment. By taking a holistic approach that considers technology, doctrine, organization, and training together, the Department could more effectively leverage small unmanned systems to counter China's A2/AD capabilities and maintain military superiority in the Indo-Pacific region.

The Department also must address the industrial base challenges associated with scaling production of small unmanned systems to the quantities required for concepts like the "hellscape" approach to countering A2/AD capabilities. Current munitions procurement levels for various weapons systems remain significantly below Cold War peak years, indicating potential capacity shortfalls in a prolonged conflict scenario (Baker Institute for Public Policy, 2025). To address this challenge, the Department should leverage allies and partners with high-tech industrial capabilities, diversify the supply chain and production base for critical drone components and munitions, and develop concepts of operation that maximize the impact of limited high-end platforms through the complementary use of numerous low-cost, autonomous systems.

2.8 Key Findings on the Indo-Pacific, Drones, and Budgeted Defense

The People's Republic of China has developed a comprehensive A2/AD strategy in the Indo-Pacific region, incorporating advanced drone capabilities and counter-drone systems that present significant challenges to U.S. military operations. China's development of sophisticated unmanned systems, ranging from small tactical drones to large platforms capable of launching smaller systems, combined with their layered counter-drone defenses including laser weapons and "bullet curtain" systems, creates a formidable barrier to U.S. power projection in the region (Palve, 2025). The Chinese military 's regular deployment of drones in exercises around Taiwan and their integration into joint operations demonstrates China's intent to use these systems extensively in any potential conflict, requiring a robust and innovative U.S. response that leverages our own unmanned capabilities to counter these threats.

Recent conflicts have demonstrated the transformative impact of small, low-cost drones on modern warfare, with lessons that are directly applicable to the Indo-Pacific despite the different operational environment. The effectiveness of commercial off-the-shelf systems in reconnaissance, targeting, and direct attack roles, the value of mass deployment to overwhelm defenses, and the importance of distributed operations with minimal infrastructure requirements all have relevance to potential operations against China's A2/AD systems (Whelan, 2023). The U.S. military's "hellscape" concept, which aims to employ large numbers of autonomous drones to create an overwhelming and unpredictable operating environment for adversary forces, represents a promising approach to countering these challenges, but requires significant investment in truly warfighter-portable systems that can operate effectively in contested environments.

The Department of Defense's current budget allocations and classification systems for unmanned systems do not adequately address the need for truly warfighter-portable drones that can operate effectively in the contested environments of the Indo-Pacific. The FY2025 budget shows concerning reductions in funding for small unmanned systems across all domains, with an overall decrease of 31.6% compared to FY2024 levels (U.S. Department of Defense, 2024). This reduction comes at a time when conflicts in Ukraine and the Middle East have demonstrated the increasing importance of small, attritable drones in modern warfare, and when China is rapidly advancing its own unmanned capabilities. The Department must realign its investments to prioritize the development, acquisition, and fielding of truly warfighter-portable systems that can be mass-deployed from distributed locations throughout the Indo-Pacific region, enabling effective operations despite China's sophisticated A2/AD capabilities and counter-drone systems.

3. Warfighter-Centric Analysis of Small Drones and Operational Gaps

The FY2025 Department of Defense budget request demonstrates a strategic shift toward unmanned systems, but current acquisition approaches remain largely focused on platform capabilities rather than warfighter operational realities. While the budget shows increased investment in small unmanned systems across domains, with surface and underwater domains seeing significant growth, the percentage allocated to truly warfighter-portable platforms appear to be a minimal amount, based on open-source information, compared to total unmanned systems funding. This chapter begins with a chart highlighting a Warfighter Operational Cycle analysis as to the current challenges as well as opportunities for improvement in small drones. This report then examines small drone operations through the lens of the complete warfighter operational cycle – from pre-mission preparation through deployment, operation, recovery, and maintenance. By analyzing each phase of this cycle, this report seeks to identify critical constraints and opportunities that traditional platform-centric analyses often overlook when it comes to small drones and operational gaps.

	Pre-Mission Preparation	**Deployment**	**Tactical Operation**	**Recovery**	**Maintenance**
Description of Activities	Planning mission parameters Charging batteries Loading software Configuring payloads Establishing communications protocols Conducting pre-flight checks	Transporting the drone to the operational area Assembling components Establishing control links Launching the system	Controlling flight Operating sensors Maintaining communications security Avoiding threats Adapting to changing mission requirements	Navigating the drone back to a safe location Executing landing procedures Securing data Shutting down systems	Assessing damage Replacing components Updating software Managing batteries Conducting operational readiness checks

	Pre-Mission Preparation	Deployment	Tactical Operation	Recovery	Maintenance
Current Challenges	Limited battery life requiring frequent recharging Complex mission planning software Specialized training requirements Limited payload options Vulnerability to electronic detection	Weight, bulk constraints Complex assembly in field conditions Launch signature visibility Vulnerability to jamming during initialization Limited deployment options in contested areas	Limited range and endurance Operator cognitive load Communications vulnerability Limited autonomous capabilities Environmental constraints (weather, terrain)	Recovery in contested areas Precision landing requirements Vulnerability during return phase Data security concerns Limited recovery options	Limited field repair capabilities Specialized tools, expertise requirements Supply chain dependencies Diagnostic limitations Environmental exposure damage
Opportunities for Improvement	Simplified mission planning interfaces Field-swappable batteries Standardized payload interfaces Automated pre-flight checks Secure, low-probability of intercept communications	Modular designs for compact transport Tool-less assembly Multiple launch methods (hand, bungee, vertical) Resilient communications initialization protocols Low-signature deployment options	Enhanced autonomous navigation AI-assisted sensor interpretation Mesh networking capabilities Adaptive mission replanning Improved environmental resilience	Multiple recovery methods Secure, rapid data offload Disposable, attritable options Encrypted data storage Low-signature return profiles	Modular, field-replaceable components Tool-less maintenance procedures Common parts across platforms Built-in diagnostics Ruggedized design for field conditions

This chart highlights the current challenges as well as opportunities for improvement in U.S. warfighter-portable drones. Warfighter operational cycle analysis reveals how current acquisition strategies may be misaligned with the tactical realities faced by operators in contested environments, particularly in the Indo-Pacific where China's sophisticated A2/AD capabilities create unique challenges for unmanned systems deployment and operation.

Historical DoD drone investments have been significantly misaligned with the tactical realities faced by individual warfighters, particularly in terms of portability, operational security, and field maintenance. The FY2025 budget data reveals that only 12.6% of aerial drone funding, 0.8% of surface drone funding, and a mere 0.2% of underwater drone funding is allocated to truly warfighter-portable systems (Baker Institute for Public Policy, 2025). This imbalance reflects a persistent institutional bias toward larger, more complex platforms that require dedicated launch equipment, specialized operators, and extensive logistics chains – all of which create predictable, targetable nodes in contested environments. The lessons from Ukraine demonstrate the extraordinary value of small, warfighter-portable drones in modern warfare, with systems weighing less than 5 kg proving highly effective in reconnaissance, targeting, and direct attack roles against sophisticated adversaries (Bendett & Kirichenko, 2025). The ability for small units to deploy these systems independently, without specialized launch equipment or dedicated operators, has enabled a distributed approach to ISR and precision strike that has proven highly resilient to enemy countermeasures.

This warfighter-centric approach is particularly relevant in the Indo-Pacific despite its different operational context from Ukraine. China's reportedly sophisticated A2/AD capabilities, including advanced radar systems purportedly capable of detecting small drones using micro-Doppler signal processing, presents a significant challenge to U.S. drone operations in the Indo-Pacific (Yan et al., 2025). However, the sheer volume of small drones that can be deployed by distributed forces can overwhelm even advanced detection and engagement systems, as demonstrated by the limited effectiveness of Russian counter-drone measures in Ukraine (Bendett & Kirichenko, 2025). The "hellscape" concept being developed by U.S. military planners offers a promising framework for employing large numbers of low-cost, autonomous drones to create an overwhelming and unpredictable operating environment for adversary forces, but its effectiveness depends on having truly warfighter-portable systems that can be widely distributed and operated from austere locations throughout the vast Indo-Pacific region (Rinaldi & Vartanian, 2025). As Army Undersecretary Gabe Camarillo noted, "operating and defending against the drone threat is something that will be expected by all formations at multiple echelons," highlighting the need for drone capabilities to be distributed throughout the force rather than concentrated in specialized units (Albon, 2025).

3.1 Warfighter Operational Cycle: Pre-Mission Preparation

Current DoD drone systems present significant challenges during the pre-mission preparation phase, particularly for warfighters operating in contested environments. Larger Group 2 systems, which constitute the majority of DoD small UAS investments, require extensive pre-mission planning, specialized equipment, and dedicated personnel for programming and maintenance. These requirements create predictable patterns of activity that can be observed by adversaries and targeted, compromising operational security before missions even begin. In contrast, truly warfighter-portable systems weighing under 5-7 pounds can be prepared with minimal signature and integrated into standard pre-mission procedures without creating additional observable patterns of activity (Alani, 2025). The Army's plan to equip each combat division with approximately 1,000 drones by 2026 will require streamlined pre-mission preparation procedures that can be executed at the small unit level without specialized support (Albon, 2025).

Battery management represents a critical challenge during pre-mission preparation for small drones. Current systems often require specialized charging equipment and extended charging times, limiting operational flexibility and creating potential bottlenecks in high-tempo operations. The FY2025 budget shows minimal investment in field-expedient power solutions or rapid charging technologies specifically designed for warfighter-portable drones. This gap is particularly concerning in the Indo-Pacific, where operations distributed across vast distances may limit access to established power infrastructure. Investments in high energy density power sources specifically optimized for small unmanned systems, potentially through partnerships with the Department of Energy and commercial battery manufacturers, could significantly enhance pre-mission readiness and operational flexibility.

The limited range of small drones presents a significant challenge for operations in the Indo-Pacific, but several strategies can mitigate this limitation during the pre-mission preparation phase. The development of “drone carrier” concepts, akin to China's reported Jiutian SS-UAV with its ability to launch smaller drones from a larger platform, would allow smaller systems to be transported to the operational area by larger platforms, extending their effective range while maintaining their advantages in terms of signature and attrition tolerance (Economic Times, 2025). Pre-mission preparation would include loading these smaller drones onto carrier platforms and programming them for coordinated deployment and operation. Additionally, the pre-positioning of small drones on naval vessels, submarines, and transport aircraft could provide extended reach into denied areas, as envisioned in programs like the Air Force's Rapid Dragon, which aims to turn non-traditional platforms like transport aircraft into long-ranged, high-volume shooters capable of operating from a vast array of airfields (Graham & Singer, 2025).

Mission planning software for current DoD drone systems is often complex and requires specialized training, creating a barrier to widespread adoption and use by general-purpose forces. The FY2025 budget includes limited funding for simplified, intuitive mission planning tools designed specifically for warfighter-portable systems. Developing mission planning applications that can run on standard-issue mobile devices, with intuitive interfaces and automated mission optimization, would significantly reduce pre-mission preparation time and training requirements. These applications should include features for collaborative planning, allowing multiple units to coordinate drone operations across a distributed battlespace, and should incorporate real-time intelligence feeds to inform mission parameters. Such capabilities would be particularly valuable in the Indo-Pacific, where coordinated operations across vast distances and multiple domains will be essential for success against sophisticated adversaries.

3.2 Warfighter Operational Cycle: Deployment

The deployment phase of the warfighter operational cycle presents unique challenges for current DoD drone systems, particularly in contested environments like the Indo-Pacific. Most existing systems in the DoD inventory, even those classified as “small” under current definitions, require dedicated launch equipment, specialized vehicles for transport, and open areas for takeoff. These requirements create significant operational signatures that can be detected by adversary sensors and targeted, compromising both the mission and personnel. The Ukrainian conflict has demonstrated the value of truly portable systems that can be deployed from concealed positions with minimal signature, allowing operators to “shoot and scoot” before enemy counter-drone systems can respond (Bendett & Kirichenko, 2025). Current DoD investments in small UAS show limited focus on low-signature deployment capabilities, with only 12.6% of aerial drone funding allocated to warfighter-portable systems that could enable such tactics.

Transport to the operational area represents a critical vulnerability for current drone systems. Group 2 UAS, weighing between 21-55 pounds, are too heavy for individual warfighters to carry for extended periods, requiring dedicated transport vehicles that create observable patterns of movement (Alani, 2025). In the Indo-Pacific, where distributed operations across island chains and maritime environments will be essential for countering China's A2/AD capabilities, the ability to transport drones using standard infantry equipment is crucial. The Army's plan to equip each combat division with approximately 1,000 drones by 2026 will require systems that can be integrated into existing load-carrying equipment without significantly increasing the already substantial burden carried by dismounted troops (Albon, 2025). Modular designs that can be broken down into components weighing less than 2-3 pounds each would allow distribution of the load across multiple team members, enhancing mobility and reducing fatigue.

Launch procedures for current DoD drone systems often create significant visual, acoustic, and electromagnetic signatures that can compromise operational security. Many systems require open areas for takeoff, creating moments of vulnerability when operators must expose themselves to launch the platform. In contrast, truly warfighter-portable systems can be deployed from concealed positions, such as dense vegetation, urban structures, or naval vessels, with minimal signature. The development of vertical takeoff and landing (VTOL) capabilities for small fixed-wing platforms would combine the launch flexibility of rotary-wing systems with the range and endurance advantages of fixed-wing designs. Additionally, underwater launch capabilities for aerial drones, potentially from submarines or unmanned underwater vehicles, could provide a completely unexpected attack vector that bypasses traditional air defense systems.

The electromagnetic emissions associated with drone deployment represent a significant vulnerability in contested environments. Current systems often establish control links using standard radio frequencies that can be detected, located, and jammed by sophisticated adversary electronic warfare systems. China's reported counter-UAV efforts include significant investments in electronic warfare capabilities designed to disrupt drone communications during the critical deployment phase (Graham & Singer, 2025). To counter these threats, DoD should invest in low-probability of intercept/low-probability of detection (LPI/LPD) communications protocols specifically designed for the deployment phase of small drone operations. These systems should include frequency-hopping capabilities, encrypted communications, and the ability to operate in autonomous modes that require minimal communication with operators during the initial deployment phase. Such capabilities would be particularly valuable in the Indo-Pacific, where China's sophisticated electronic warfare systems could target conventional drone communications.

3.3 Warfighter Operational Cycle: Tactical Operation

The tactical operation phase of the warfighter operational cycle presents significant challenges for current DoD drone systems, particularly in the contested electromagnetic environment of the Indo-Pacific. China's reported counter-UAV efforts reveal a layered defense approach that combines robust detection networks with a mix of kinetic and non-kinetic countermeasures, including radars, electro-optical sensors, electronic warfare, and artificial intelligence for real-time threat analysis (Graham & Singer, 2025). These capabilities are specifically designed to disrupt the tactical operation of U.S. drone systems, targeting their communications links, navigation systems, and sensors. Current DoD investments in counter-UAS resilience for small drones appear limited, with minimal funding allocated to developing systems capable of operating effectively in such contested environments. The lessons from Ukraine demonstrate the importance of autonomous operation capabilities that allow drones to complete missions even when communications are jammed or degraded (Bendett & Kirichenko, 2025).

Range and endurance limitations represent significant constraints for warfighter-portable drones during tactical operations. Most systems weighing less than 10 pounds have operational ranges under 10 kilometers and endurance of less than 60 minutes, limiting their utility in the vast expanses of the Indo-Pacific. However, these limitations can be mitigated through several approaches including the previously discussed drone carrier concepts. In addition, operator cognitive load during tactical operations represents a significant challenge for current drone systems. Most platforms require constant attention from operators, limiting their ability to maintain situational awareness of their surroundings or perform other mission-critical tasks. This challenge is particularly acute for small units operating in contested environments, where personnel must balance drone operation with self-defense and other tactical responsibilities. The development of enhanced autonomous capabilities, including AI-assisted sensor interpretation, automatic target recognition, and adaptive mission planning, would significantly reduce operator workload and allow more effective integration of drone operations into small unit tactics. The FY2025 budget includes some investments in autonomous systems and AI integration, but it remains unclear how much of this funding is specifically allocated to enhancing warfighter-portable systems.

Communications security during tactical operations is critical, particularly in the Indo-Pacific where China's sophisticated electronic warfare capabilities could target conventional drone communications links. Current systems often rely on standard radio frequencies and protocols that can be detected, located, and jammed by adversary electronic warfare systems. The development of mesh networking capabilities for small drones would allow them to communicate with each other and relay information back to operators even when direct communications are disrupted. This approach would create a resilient network that could maintain operational effectiveness even in heavily contested electromagnetic environments. Additionally, the integration of "Low-Probability of Intercept/Low-Probability of Detection" (LPI/LPD) communications protocols would reduce the risk of detection and targeting during tactical operations. These capabilities would be particularly valuable in the Indo-Pacific, where operations distributed across vast distances will require robust and secure communications networks.

Environmental constraints, including weather, terrain, and maritime conditions, present significant challenges for small drone operations in the Indo-Pacific. Current systems often have limited weather tolerance, with operational restrictions for rain, high winds, and extreme temperatures. The development of ruggedized designs specifically optimized for maritime environments, including salt spray resistance, waterproofing, and stability in high winds, would enhance operational reliability in the Indo-Pacific. Additionally, the integration of advanced navigation systems capable of operating in GPS-denied environments, potentially using visual odometry, inertial navigation, or celestial navigation, would ensure continued operational capability even when satellite navigation is disrupted by adversary jamming or spoofing. These enhancements would be particularly valuable for distributed operations across the Pacific islands and maritime environments, where environmental conditions can change rapidly and adversary electronic warfare capabilities could target conventional navigation systems.

3.4 Warfighter Operational Cycle: Recovery

The recovery phase of the warfighter operational cycle presents unique challenges for current DoD drone systems, particularly in contested environments like the Indo-Pacific. Most existing systems require open areas for landing, creating moments of vulnerability when operators must expose themselves when recovering a drone. This vulnerability is compounded by the predictable flight paths of returning drones, which can be observed and targeted by adversary forces. The Ukrainian conflict has demonstrated the effectiveness of targeting drone operators during the recovery phase, forcing Ukrainian drone pilots to adopt complex and unpredictable recovery procedures to avoid detection and targeting (Bendett & Kirichenko, 2025). Current DoD investments in small UAS show limited focus on secure recovery capabilities, with minimal funding allocated to developing systems with multiple recovery options or secure data retrieval mechanisms.

Data security during the recovery phase represents a critical concern, particularly for reconnaissance missions. Current systems often store mission data onboard, creating a risk that sensitive information could be captured if the platform is lost or shot down. Integration of secure data storage with encryption and remote wiping capabilities would protect sensitive information even if the platform is captured by adversary forces. These capabilities would be particularly valuable in the Indo-Pacific, where the vast distances and contested electromagnetic environment create significant challenges for secure data transmission and recovery.

The attritable nature of small, low-cost drones offers unique opportunities to rethink the recovery phase entirely. Rather than requiring physical recovery of all platforms, some missions could be designed with expendable drones that complete one-way missions without the need for recovery. This approach would eliminate the vulnerabilities associated with predictable return flight paths and recovery procedures, enhancing operational security and reducing risk to personnel. The FY2025 budget includes some investments in attritable systems, yet it remains unclear how much of this funding will be allocated to truly warfighter-portable platforms. The development of low-cost, mass-produced drones specifically designed for one-way missions would provide commanders with additional options for high-risk operations in heavily contested environments.

Precision landing capabilities represent a significant challenge for small drone recovery, particularly in confined or concealed locations. Current systems often require relatively large, open areas for landing, limiting recovery options in complex terrain or urban environments. The development of enhanced autonomous landing capabilities, including precision vertical landing for fixed-wing platforms and the ability to land on moving platforms such as vehicles or vessels, would significantly expand recovery options and enhance operational flexibility. These capabilities would be particularly valuable in the Indo-Pacific, where recovery might need to occur on small islands, dense jungle terrain, or moving naval vessels. Additionally, the integration of recovery aids such as visual markers, infrared beacons, or precision navigation systems would enhance landing accuracy and reduce the risk of damage during recovery. This would extend platform lifespan and reduce maintenance requirements.

Alternative recovery methods could significantly enhance operational flexibility and security during the recovery phase. Current systems typically rely on conventional landing procedures, creating predictable patterns that can be observed and targeted by adversary forces. The development of innovative recovery methods, such as mid-air retrieval by larger platforms, net capture systems, or water landing capabilities for maritime operations, would provide operators with multiple options based on the tactical situation and threat environment. These alternative recovery methods would be particularly valuable in the Indo-Pacific, where the diverse operational environment – ranging from open ocean to dense jungle to urban areas – requires flexible recovery options. Additionally, the ability to recover drones onto moving platforms, such as vehicles, vessels, or larger aircraft, would enhance mobility and reduce the vulnerability associated with static recovery locations.

3.5 Warfighter Operational Cycle: Maintenance

The maintenance phase of the warfighter operational cycle presents significant challenges for current DoD drone systems, particularly in austere environments like the Indo-Pacific. Most existing systems require specialized tools, technical expertise, and dedicated maintenance facilities, creating logistical burdens and limiting operational flexibility. These requirements are particularly problematic for distributed operations across the Pacific islands and maritime environments, where access to established maintenance facilities may be limited or non-existent. The FY2025 budget shows minimal investment in field-maintainable drone systems specifically designed for warfighter-level maintenance in austere conditions. This gap is concerning given the lessons from Ukraine, where the ability to perform rapid field repairs and modifications has been critical to maintaining operational tempo in the face of evolving threats and harsh conditions (Bendett & Kirichenko, 2025).

Component standardization represents a significant opportunity to enhance field maintenance capabilities for small drone systems. Current DoD drone inventories include a wide variety of platforms with unique components and maintenance requirements, complicating logistics and limiting interoperability. The development of standardized, modular components that can be used across multiple platforms would significantly simplify maintenance logistics and enhance field repair capabilities. These standardized components could include batteries, motors, control systems, and sensors, allowing operators to cannibalize damaged platforms to keep others operational when replacement parts are not immediately available. This approach would be particularly valuable in the Indo-Pacific, where the vast distances and potential for supply chain disruption create significant challenges for traditional maintenance logistics. The Army's plan to equip each combat division with approximately 1,000 drones by 2026 provides an opportunity to establish such standardization across a large fleet of platforms (Albon, 2025).

Diagnostic capabilities represent a critical aspect of field maintenance for small drone systems. Current platforms often lack built-in diagnostic systems, requiring specialized equipment and expertise to identify and troubleshoot issues. The development of integrated diagnostic capabilities, potentially using smartphone applications or other portable devices, would allow operators to quickly identify problems and determine appropriate maintenance actions. These diagnostic tools should include visual guides, troubleshooting flowcharts, and augmented reality features to assist operators with limited technical training. Additionally, the integration of predictive maintenance capabilities, using sensors and AI to identify potential issues before they cause failures, would enhance reliability and reduce maintenance requirements. These capabilities would be particularly valuable in the Indo-Pacific, where access to technical expertise may be limited and preventive maintenance is critical to ensuring operational readiness in remote locations.

Environmental factors present significant challenges for drone maintenance in the Indo-Pacific. The maritime environment, with its high humidity, salt spray, and temperature extremes, can accelerate component degradation and increase maintenance requirements. Current systems often lack adequate environmental protection, requiring frequent maintenance and component replacement in harsh conditions. The development of ruggedized designs specifically optimized for maritime environments, including corrosion-resistant materials, sealed electronics, and enhanced waterproofing, would reduce maintenance requirements and enhance reliability in the Indo-Pacific. Additionally, the integration of environmental monitoring systems, potentially using sensors to track exposure to harmful conditions and alert operators when preventive maintenance is required, would help manage environmental risks and extend platform lifespan. These enhancements would be particularly valuable for distributed operations across the Pacific islands and maritime environments, where environmental conditions can be harsh and unpredictable.

Additive manufacturing (3D printing) represents a transformative opportunity for field maintenance of small drone systems. Current maintenance logistics rely on traditional supply chains, creating vulnerabilities to disruption and limiting responsiveness to emerging requirements. The development of field-deployable additive manufacturing capabilities, potentially using portable 3D printers and digital design libraries, would allow operators to produce replacement parts on-demand in austere environments. This approach would significantly reduce logistics requirements and enhance responsiveness to evolving threats and operational needs. The FY2025 budget includes some investments in additive manufacturing for military applications, but it remains unclear how much of this funding is specifically allocated to supporting field maintenance of small drone systems. The integration of additive manufacturing into the maintenance ecosystem for warfighter-portable drones would be particularly valuable in the Indo-Pacific, where the vast distances and potential for supply chain disruption create significant challenges for traditional maintenance logistics.

3.6 Pacific Theatre Gaps Identified in Historical DoD Spending

Historical DoD spending on unmanned systems reveals significant gaps in capabilities required for effective operations in the Indo-Pacific, particularly regarding truly warfighter-portable platforms. The FY2025 budget data shows that only 12.6% of aerial drone funding, 0.8% of surface drone funding, and a mere 0.2% of underwater drone funding is allocated to systems meeting the criteria of portability by individual warfighters (Baker Institute for Public Policy, 2025). This imbalance reflects a persistent institutional bias toward larger, more complex platforms that require dedicated launch equipment, specialized operators, and extensive logistics chains – all of which create predictable, targetable nodes in contested environments. The vast maritime expanses, sophisticated A2/AD environment, and distributed island geography of the Indo-Pacific demand a fundamentally different approach to unmanned systems, one that emphasizes mass deployment, resilience through numbers, and distributed operations from austere locations.

China's reported A2/AD capabilities present a formidable challenge to traditional U.S. force projection in the Indo-Pacific region. The Chinese military has reportedly developed extensive long-range precision fires capabilities that can target U.S. air bases and naval assets throughout the First and Second Island Chains, severely mitigating the ability of U.S. forces to conduct operations in the Asia-Pacific (Missile Defense Advocacy Alliance, 2025). This strategy aims to deny foreign access to the region, advance China's territorial claims, and limit the U.S. military's ability to project power, threatening the regional security environment and U.S. doctrine of global reach (Soursa, 2025). The Chinese military 's exploitation of overseas ports and bases further extends their operational reach, creating additional challenges for U.S. forces attempting to maintain freedom of navigation and project power in contested environments (Hammes, 2024). These developments necessitate a fundamental shift in how the DoD approaches unmanned systems requirements and capabilities, with a greater emphasis on platforms that can operate effectively within China's A2/AD envelope.

China's own drone programs reportedly demonstrate a strategic recognition of the transformative impact of small unmanned systems on modern warfare. The Chinese military is purported to develop, use, and train small UAVs for an array of combat missions including ISR; maritime and border defense patrol; ground strike; electronic warfare; communications support; and logistical support (Oudenaren, 2025). China's shift toward small, smart drones – reportedly supported by industrial scale, AI integration, and innovative designs – marks a pivotal transformation in military technology that is purportedly narrowing the technological gap with the United States (McNabb, 2025). The PLA's Eastern Theater Command reportedly deploys small UAVs as part of aerial sorties crossing the median line in the Taiwan Strait, demonstrating China's intent to use drones in any potential conflict in the region (Oudenaren, 2025). These developments highlight the strategic importance of small unmanned systems in the Indo-Pacific and underscore the need for the U.S. to accelerate its own investments in this area.

China's counter-drone capabilities have also reportedly advanced significantly, with the Chinese military purportedly developing a layered defense approach that combines robust detection networks with a mix of kinetic and non-kinetic countermeasures. Chinese military commentators advocate for blending radars, electro-optical sensors, electronic warfare, and artificial intelligence for real-time threat analysis, enabling rapid engagement against swarming drones (Graham & Singer, 2025). The PRC has reportedly increased domestic investment in counter-drone technology, with more than 3,000 manufacturers now producing anti-drone equipment and a dramatic rise in government procurement notices related to counter-drone technology – 205 in 2024 alone, compared to 122 in 2023 and 87 in 2022 (Graham & Singer, 2025). These developments directly challenge the U.S. military's “hellscape” concept, which aims to employ large numbers of low-cost, autonomous drones to create an overwhelming and unpredictable operating environment for adversary forces (Rinaldi & Vartanian, 2025). To counter these advanced defenses, the U.S. must invest in truly warfighter-portable systems that can be mass-deployed from distributed locations, overwhelming even sophisticated counter-drone networks through sheer numbers and unpredictability.

The unique operational environment of the Indo-Pacific, with its vast maritime expanses and distributed island geography, creates both challenges and opportunities for small drone operations. While the Ukrainian conflict has largely been land-based, allowing for relatively short-range drone operations with direct line-of-sight control, the Indo-Pacific would require systems capable of operating over much greater distances and in challenging maritime conditions (O’Rourke, 2025). This difference has led some to argue that small, warfighter-portable drones would be less relevant in the Indo-Pacific than in Ukraine. However, this perspective overlooks the critical role that distributed operations from austere locations would play in any conflict with China. The ability to deploy small drones from numerous, unpredictable locations across the Pacific islands would create significant challenges for Chinese targeting and force them to disperse their defensive resources, potentially creating gaps that could be exploited by other U.S. and allied capabilities.

The limitations of small drones in the Indo-Pacific, primarily related to range and endurance, can be overcome through several innovative approaches. The development of drone carrier concepts would allow smaller drones to be transported to the operational area by larger platforms, extending their effective range while maintaining their advantages in terms of signature and attrition tolerance. China's reported Jiutian SS-UAV, with its ability to launch smaller drones from a larger platform, demonstrates recognition of the operational value of combining the range and endurance of larger systems with the tactical flexibility and attrition tolerance of smaller ones (Economic Times, 2025). Additionally, the deployment of small drones from naval vessels, submarines, and even transport aircraft could provide extended reach into denied areas, as envisioned in programs like the Air Force's Rapid Dragon, which aims to turn non-traditional platforms like transport aircraft into long-ranged, high-volume shooters capable of operating from a vast array of airfields (Hammes, 2024). These approaches would allow truly warfighter-portable systems to operate effectively at strategic distances despite their inherent range limitations.

The maritime domain presents unique opportunities and challenges for small unmanned systems in the Indo-Pacific. Surface and underwater drones could play critical roles in distributed maritime operations, providing persistent surveillance, targeting data, and even direct attack capabilities against Chinese naval assets. However, the FY2025 budget data shows minimal investment in truly warfighter-portable maritime systems, with only 0.8% of surface drone funding and 0.2% of underwater drone funding allocated to platforms meeting this criterion (Baker Institute for Public Policy, 2025). This gap is particularly concerning given the strategic importance of maritime operations in the Indo-Pacific region. The development of small, deployable maritime drones that could be launched from various platforms, including aircraft, surface vessels, and submarines, would provide significant operational advantages in contested maritime environments. These systems could create a distributed sensor network for detecting and tracking Chinese naval movements, provide targeting data for long-range precision fires, and even conduct direct attacks against high-value targets using low-cost, attritable platforms.

The underwater domain represents a critical but often overlooked aspect of unmanned systems operations in the Indo-Pacific. China's growing anti-submarine warfare capabilities and the strategic importance of undersea operations in the Indo-Pacific create both challenges and opportunities for small underwater drones. The minimal percentage of resources dedicated to warfighter-portable underwater systems (0.2% in FY2025) suggests a potential capability gap in this area (Baker Institute for Public Policy, 2025). The development of small, deployable underwater drones that could be launched from various platforms, including surface vessels, submarines, and even aircraft, would provide significant operational advantages in contested maritime environments. These systems could create a distributed sensor network for detecting and tracking Chinese submarine movements, provide intelligence on undersea infrastructure and activities, and even conduct direct attacks against high-value targets using low-cost, attritable platforms. While the concept of "warfighter portability" may differ in the underwater context due to the inherent size and weight requirements of submersible systems, the principles of warfighter operability without dedicated specialists and the ability to deploy systems from platforms of opportunity remain relevant.

The lessons from Ukraine and other recent conflicts demonstrate the transformative impact of small, low-cost drones on modern warfare, with implications that are directly applicable to the Indo-Pacific despite the different operational environment. The effectiveness of commercial off-the-shelf systems in reconnaissance, targeting, and direct attack roles, the value of mass deployment to overwhelm defenses, and the importance of distributed operations with minimal infrastructure requirements all have relevance to potential operations against China's A2/AD systems (Bendett & Kirichenko, 2025). The U.S. military's “hellscape” concept, which aims to employ large numbers of autonomous drones to create an overwhelming and unpredictable operating environment for adversary forces, represents a promising approach to countering these challenges, but requires significant investment in truly warfighter-portable systems that can operate effectively in contested environments (Rinaldi & Vartanian, 2025). The Army's plan to equip each combat division with approximately 1,000 drones by 2026 reflects a growing recognition of the strategic importance of distributed drone capabilities, but questions remain about whether these systems will meet the criteria for true warfighter portability and field maintainability required for effective operations in the Indo-Pacific (Albon, 2025).

3.7 Required DoD Actions to Address Warfighter Constraints

The Department of Defense must fundamentally revise its UAS classification system to better reflect the operational realities of modern drone warfare and the specific challenges of the Indo-Pacific. The current system, which focuses primarily on physical characteristics such as weight, altitude, and speed, fails to adequately capture the tactical and operational value of truly warfighter-portable systems (Alani, 2025). A new classification approach based on operational parameters such as warfighter portability, discreet launch capability, and field maintainability would better align with the requirements for distributed operations in contested environments. This revised system would provide a more meaningful framework for requirements development, acquisition planning, and operational concept development, ensuring that investments in unmanned systems are directed toward capabilities that will have the greatest impact in potential conflicts with peer adversaries.

The DoD should establish a dedicated cross-functional team focused on developing and implementing concepts of operation for distributed unmanned systems in the Indo-Pacific. This team would bring together representatives from all services, combatant commands, and relevant defense agencies to ensure that technological developments are aligned with operational requirements and that new capabilities can be effectively integrated into joint operations. The team would be responsible for conducting experimentation and demonstration activities, developing tactics, techniques, and procedures for the employment of small unmanned systems, and identifying capability gaps and opportunities for further investment. By taking a holistic approach that considers technology, doctrine, organization, and training together, the Department could more effectively leverage small unmanned systems to counter China's A2/AD capabilities and maintain military superiority in the Indo-Pacific region.

The Department should establish a dedicated research and development program focused on high energy density power sources specifically optimized for small unmanned systems. Battery technology represents one of the most significant limitations for small unmanned systems, particularly in terms of range and endurance. This program should leverage advances in commercial battery technology while addressing the unique requirements of military applications, such as operation in extreme environments, resistance to countermeasures, and compatibility with field charging systems. Partnerships with the Department of Energy, national laboratories, and commercial battery manufacturers could accelerate progress in this area, potentially yielding significant improvements in the performance of small unmanned systems across all domains.

The DoD should establish formal partnerships with commercial drone manufacturers to adapt existing consumer technologies for military applications, focusing on enhancing security features, improving reliability in contested environments, and ensuring interoperability with military command and control systems. The success of commercial drones in Ukraine demonstrates that many of the required capabilities already exist in the commercial sector and could be quickly modified for military use with appropriate security and reliability enhancements. These partnerships could take various forms, including cooperative research and development agreements, other transaction authority (OTA) contracts, and dedicated procurement programs for modified commercial systems. By leveraging the innovation and scale of the commercial drone market, the Department could field capable systems more quickly and at lower cost than through traditional defense acquisition processes.

The DoD must also address the industrial base challenges associated with scaling production of small unmanned systems to the quantities required for concepts like the “hellscape” approach to countering A2/AD capabilities. Current munitions procurement levels for various weapons systems remain significantly below Cold War peak years, indicating potential capacity shortfalls in a prolonged conflict scenario (Baker Institute for Public Policy, 2025). To address this challenge, the Department should leverage allies and partners with high-tech industrial capabilities, diversify the supply chain and production base for critical drone components and munitions, and develop concepts of operation that maximize the impact of limited high-end platforms through the complementary use of numerous low-cost, autonomous systems. The establishment of a dedicated program office focused on small drone production capacity, with authority to make targeted investments in manufacturing capabilities and supply chain resilience, would help ensure that the industrial base can meet the demands of future conflicts in the Indo-Pacific.

3.8 Key Findings from Warfighter Perspectives

The analysis of small drone operations through the lens of the complete warfighter operational cycle reveals critical gaps in current Department of Defense approaches to unmanned systems acquisition and employment. Traditional platform-centric analyses often overlook the practical constraints faced by warfighters in contested environments, particularly regarding pre-mission preparation, deployment, tactical operation, recovery, and maintenance. The historical bias toward larger, more complex platforms that require dedicated launch equipment, specialized operators, and extensive logistics chains creates predictable, targetable nodes that would be highly vulnerable in a conflict with a peer adversary like China. The minimal investment in warfighter-portable systems – estimated to be just 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding in the FY2025 budget – represents a significant capability gap that must be addressed to ensure effective operations in the Indo-Pacific.

The lessons from Ukraine and other recent conflicts demonstrate the transformative impact of small, low-cost drones on modern warfare, with implications that are applicable to the Indo-Pacific despite the different operational environment and vast distances. The effectiveness of commercial off-the-shelf systems in reconnaissance, targeting, and direct attack roles, the value of mass deployment to overwhelm defenses, and the importance of distributed operations with minimal infrastructure requirements all have relevance to potential operations against A2/AD systems.

The unique challenges of the Indo-Pacific, including vast maritime expanses, sophisticated counter-drone capabilities, and distributed island geography, require innovative approaches to extend the range and endurance of small drones to include drone carriers and deployment from naval vessels and submarines. By addressing the full spectrum of warfighter operational constraints and leveraging commercial innovation, the DoD can develop a more effective approach to small drone operations in the Indo-Pacific.

The Department of Defense must take immediate action to address the identified gaps in warfighter-portable drone capabilities, to include (1) revising the UAS classification system to better reflect the operational realities of modern drone warfare, (2) establishing a dedicated cross-functional team focused on developing and implementing concepts of operation for distributed unmanned systems, and (3) partnerships with commercial drone manufacturers to adapt existing consumer technologies for military applications. The DoD must also address the industrial base challenges associated with scaling production of small unmanned systems to the quantities required for concepts like the "hellscape" approach to countering A2/AD capabilities. These actions should be guided by a warfighter-centric approach that prioritizes systems that can be transported, deployed, operated, recovered, and maintained by individual warfighters or small teams without specialized equipment or dedicated support personnel.

The Department of Defense can develop a more resilient and effective approach to countering China's A2/AD capabilities and maintaining military superiority in the Indo-Pacific region. The Army's plan to equip each combat division with approximately 1,000 drones by 2026 represents a step in the right direction and must be accompanied by a fundamental shift in how these systems are designed, acquired, and employed to ensure they meet the unique requirements of the Indo-Pacific.

4. Indo-Pacific Conflict Analysis of U.S. Drone Requirements and Strategic Gaps

The evolving nature of warfare in the Indo-Pacific region demands a comprehensive understanding of drone requirements across various conflict scenarios. This chapter analyzes two distinct conflict scenarios – Limited Conflict and Major Conflict – to estimate the unmanned systems needed to counter China's anti-access/area denial (A2/AD) strategy and operational systems. Drawing on lessons from Ukraine, recent technological developments, and China's military modernization, this analysis provides both optimistic and pessimistic estimates of drone requirements and attrition rates. The scenarios consider how warfighter-portable drones can be employed against five operational systems: Command, Firepower Strike, Information Confrontation, Reconnaissance Intelligence, and Support. By examining these requirements across different conflict intensities, this chapter identifies critical capability gaps and informs strategic investment decisions to ensure U.S. forces can effectively operate in contested environments throughout the Indo-Pacific.

4.1 Knowledge Sources and Methodology for Modeling Scenarios

The drone requirement estimates presented in this analysis were developed through a comprehensive methodology that synthesized data from multiple authoritative sources while applying analytical frameworks appropriate for the Indo-Pacific operational environment. The approach began with a detailed examination of the TRADOC G-2 document on Chinese military operations, which provided the foundational understanding of the five operational systems that U.S. forces would need to counter in conflict scenarios. This document was instrumental in identifying the specific capabilities and vulnerabilities of each operational system, allowing for targeted assessment of drone requirements (United States Army Training and Doctrine Command, 2025).

To establish realistic production and operational parameters, this analysis examined data from the ongoing conflict in Ukraine, which has become a critical laboratory for modern drone warfare. A Ukraine Symposium document revealed that Ukraine has established ambitious production goals of up to four million drones annually by October 2024, translating to approximately 11,000 drones per day. While these goals may be overly ambitious, they provide an important reference point for understanding the scale of drone operations in high-intensity conflicts (Bendett & Kirichenko, 2025).

Complementing this, the CSIS analysis of Russian drone operations showed Shahed drone launches reaching up to 1,100 per week (approximately 157 per day), with an average of 130 launches weekly, offering additional benchmarks for limited conflict scenarios. A recent Russian attack on Ukraine on a target recently reached an estimated 298 drones in one night

(Brennan, 2025). The significant increase in drone usage since September 2024 represents a step-change in the intensity of drone warfare that is particularly relevant for our analysis (Jensen & Atalan, 2025).

Chinese counter-drone capabilities were assessed through multiple sources, including reporting on China's counter-UAV efforts, which noted that during training exercises last summer, countermeasures reportedly managed to neutralize only around 40 percent of incoming UAVs. This data directly informed the attrition rate estimates, particularly for major conflict scenarios where Chinese defenses would be operating at maximum capacity (Graham & Singer, 2025). Reporting on China's purported “bullet curtain” anti-drone system provided additional insights into emerging Chinese capabilities that could significantly impact drone survivability in contested environments (Palve, 2025).

Current U.S. military planning was incorporated through analysis of reporting on Army drone plans, which states that each combat division of the US Army is set to receive about 1,000 drones, establishing a baseline for current force structure planning (Albon, 2025). Historical context was provided by the Baker Institute's draft report on munitions procurement, which highlighted the significant gap between current production capabilities and what might be needed in a major conflict by comparing current procurement levels with Cold War peak years (Baker Institute for Public Policy, 2025). This historical perspective was crucial for developing realistic estimates of production capacity and sustainability in extended conflict scenarios.

4.2 Methodology for Estimating Drone Requirements

The methodology for estimating drone requirements followed a structured analytical process designed to produce defensible estimates across different conflict scenarios. The process began with an operational target analysis, examining each of the five operational systems (Command, Firepower Strike, Information Confrontation, Reconnaissance Intelligence, and Support) to assess the likely number of nodes or elements that would need to be targeted or monitored. This assessment was based on a recent United States Army Training and Doctrine Command (TRADOC) assessment describing the Chinese military’s force structure and deployment patterns, supplemented by information from other sources on military capabilities and dispositions (United States Army Training and Doctrine Command, 2025).

For each operational target, a mission type allocation analysis was conducted to determine the proportion of different mission types (such as strike, ISR, electronic warfare) that would be required based on the operational requirements described in the knowledge sources. This allocation considered the specific capabilities needed to counter each operational system effectively, with reconnaissance intelligence missions representing the largest proportion (40-50%) due to the critical importance of situational awareness in contested environments.

Next, a drone-to-target ratio analysis was applied, estimating how many drones would be required per target for effective operations. This analysis considered factors such as the need for persistent surveillance, swarm tactics to overwhelm defenses, and redundancy to ensure mission success despite attrition. Data from Ukraine and other recent conflicts provided valuable insights into effective drone-to-target ratios for different mission types and operational contexts.

Attrition rate calculations were derived primarily from Chinese reportedly counter-drone effectiveness data (approximately 40% in training exercises) and adjusted based on the operational context (minor vs. major conflict) and target type. Higher attrition rates were assigned to drones targeting high-value assets like Command and Firepower Strike systems, which would likely be protected by more robust defenses. The analysis also considered the impact of Chinese electronic warfare capabilities on drone operations, particularly for missions requiring continuous communications with operators.

Duration estimates for both minor and major conflicts were based on historical precedents mentioned in the knowledge sources, with limited conflicts ranging from the 14-day South China Sea Freedom of Navigation Confrontation to the 30-day Proxy Conflict in Southeast Asian Maritime Dispute. Major conflicts were estimated to last between 45 days (Taiwan invasion scenario) and 180 days (Extended Maritime Blockade), reflecting the potential for prolonged operations in high-intensity scenarios.

Throughout the analysis, triangulation and validation techniques were employed, cross-referencing estimates across multiple sources to ensure consistency and plausibility. The drone requirements for major conflicts were validated against both Ukraine's production targets and the Pentagon's Replicator Initiative goals, while attrition rates were validated against reported Chinese counter-drone effectiveness and experiences from Ukraine. This comprehensive approach produced a range of estimates that account for both optimistic and pessimistic scenarios while remaining grounded in real-world data and military planning considerations.

While the conflict in Ukraine provides valuable insights into modern drone warfare, there are significant limitations in directly applying these lessons to the Indo-Indo-Pacific. The maritime nature of the Indo-Pacific environment, the vast distances involved, and China's purportedly more sophisticated integrated air defense systems all present unique challenges not fully represented in Ukraine. Additionally, the different strategic objectives and force structures of China compared to Russia further complicate direct comparisons. Despite these limitations, the conflict in Ukraine remains the most relevant contemporary example of large-scale drone operations against a near-peer adversary, providing crucial data points on production rates, attrition, and tactical employment that, when properly contextualized, can inform Indo-Pacific scenario planning (Bendett & Kirichenko, 2025).

4.3 Drone Mission Type Allocation

The mission type allocation for drone requirements was calculated based on the five operational target categories that U.S. forces would need to counter in both minor and major conflict scenarios. Command Target Missions, comprising 10-15% of total drone requirements, include Intelligence, Surveillance, and Reconnaissance (ISR) focused on command centers and headquarters, electronic warfare to disrupt command communications, kinetic strike against critical command nodes, and communications relay to maintain U.S. command networks in contested environments (United States Army Training and Doctrine Command, 2025). Firepower Strike Target Missions, representing 8-15% of total drone requirements, encompass target acquisition for U.S. long-range precision fires, battle damage assessment following strikes, direct attack using armed drones against priority targets, and decoy operations to reveal Chinese air defense systems (Rinaldi & Vartanian, 2025). Information Confrontation Target Missions, accounting for 20-25% of total drone requirements, include electronic warfare to jam Chinese sensors and communications, counter-C4ISR operations to degrade Chinese situational awareness, communications relay to maintain U.S. networks in contested environments, and cyber payload delivery to critical Chinese information nodes (Graham & Singer, 2025). Reconnaissance Intelligence Target Missions, comprising the largest portion at 40-50% of total drone requirements, focus on persistent surveillance of Chinese forces and activities, signals intelligence collection against Chinese communications, maritime domain awareness in contested waters, and targeting data collection for U.S. weapons systems (Oudenaren, 2025). Support Target Missions, representing 5-10% of total drone requirements, include logistics monitoring of Chinese supply lines, force protection surveillance around U.S. and allied bases, search and rescue support operations, and humanitarian assistance and disaster relief support (Albon, 2025).

The allocation percentages vary between minor and major conflicts, with major conflicts requiring a higher proportion of drones dedicated to firepower strike and information confrontation missions due to the increased intensity and scope of operations (United States Army Training and Doctrine Command, 2025). The mission type allocation also considers the need for redundancy in critical mission areas, particularly reconnaissance intelligence, where multiple platforms may be required to maintain persistent coverage of key areas despite high attrition rates (Bendett & Kirichenko, 2025). This comprehensive approach to mission allocation ensures that drone requirements are aligned with operational needs across the full spectrum of potential conflict scenarios in the Indo-Pacific region (O’Rourke, 2025).

Across all scenarios, the analysis estimates that aerial drones would constitute approximately 65-75% of total drone requirements, with naval surface drones accounting for 15-25% and underwater drones making up the remaining 5-15%. This distribution reflects the multi-domain nature of operations in the Indo-Pacific region, with its vast maritime spaces and complex island geography. Within these categories, warfighter-portable drones are estimated to comprise 30-40% of aerial drones, 10-15% of naval surface drones, and 5-10% of underwater drones. These percentages are significantly higher than current DoD investment patterns, which allocate only 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding to truly warfighter-portable systems (McNabb, 2025).

Despite the vast distances involved in Indo-Pacific operations, warfighter-portable drones remain critically important for several reasons. First, they enable distributed operations from austere locations throughout the region, creating multiple dilemmas for adversary targeting and force protection. Second, they provide resilience through numbers, allowing for mass deployment that can overwhelm even sophisticated defense systems. Third, they reduce the vulnerability associated with large, centralized drone operations that create predictable, targetable nodes. The Army's plan to equip each combat division with approximately 1,000 drones by 2026 reflects growing recognition of these advantages (Albon, 2025). Additionally, the analysis anticipates significant use of one-way drones that are deliberately expended upon mission completion, either through direct attack against targets or as defensive measures against incoming threats. This approach, demonstrated effectively in Ukraine, maximizes the impact of limited high-end platforms through the complementary use of numerous low-cost, attritable systems, a strategy particularly well-suited to the vast distances and contested electromagnetic environment of the Indo-Pacific (Baker Institute for Public Policy, 2025).

4.4 Limited Conflict Scenarios

1. South China Sea Freedom of Navigation Confrontation

A U.S. Navy destroyer conducting Freedom of Navigation Operations (FONOPS) near Chinese-claimed features in the South China Sea encounters aggressive harassment from Chinese maritime militia vessels and Coast Guard ships. The situation escalates when Chinese military Navy vessels arrive and establish a blockade around the U.S. ship. U.S. forces deploy swarms of small, warfighter-portable aerial drones to maintain persistent surveillance of Chinese vessels, identify command nodes, and provide real-time intelligence to U.S. commanders. Simultaneously, underwater drones are launched to monitor subsurface threats and maintain secure communications channels. When Chinese vessels attempt electronic jamming, U.S. forces deploy specialized drones equipped with electronic warfare payloads to counter these effects. The conflict intensifies when Chinese vessels fire warning shots, prompting U.S. forces to deploy armed drones to demonstrate precision strike capabilities without risking personnel. Throughout the 14-day standoff, small drones prove crucial in maintaining situational awareness, countering Chinese information operations, and ultimately enabling the U.S. vessel to complete its mission despite China's attempts to deny access to international waters (O'Rourke, 2025).

2. Taiwan Strait Crisis with Naval Blockade Attempt

Following increased political tensions, China initiates a "training exercise" that effectively creates a partial blockade of Taiwan's major ports. U.S. forces respond by deploying naval assets to ensure freedom of navigation while avoiding direct confrontation. Warfighter-portable drones become essential for monitoring the extensive Chinese naval presence without escalating the situation. Small surface drones disguised as civilian vessels collect intelligence on Chinese naval formations and command structures, while aerial drones provide persistent surveillance of blockade enforcement activities. When China employs sophisticated electronic warfare to disrupt communications, U.S. forces utilize specialized drones to establish mesh networks that maintain connectivity despite jamming attempts. As the crisis escalates with Chinese missile tests, U.S. forces deploy sensor-equipped drones to track missile trajectories and gather intelligence on Chinese military firepower capabilities. The 21-day confrontation demonstrates the critical importance of attritable drones in contested electromagnetic environments, with U.S. forces maintaining persistent surveillance despite losing numerous platforms to Chinese counter-drone systems (Graham & Singer, 2025).

3. Proxy Conflict in Southeast Asian Maritime Dispute

A territorial dispute between the Philippines and China over resource-rich areas in the South China Sea escalates when Chinese maritime militia vessels harass Philippine fishing boats and research vessels. The U.S., bound by mutual defense treaties, provides the Philippines with advanced drone capabilities and operational support. U.S. special operations forces deploy with the Philippine Navy, bringing warfighter-portable drones that provide real-time intelligence on Chinese vessel movements and activities. These small drones, operated directly by Philippine forces with U.S. advisors, enable precise tracking of Chinese maritime militia activities while maintaining plausible deniability for direct U.S. involvement. When China deploys sophisticated jamming systems to disrupt Philippine communications, U.S.-provided counter-information confrontation drones establish resilient communication networks. The conflict intensifies when Chinese Coast Guard vessels fire water cannons at Philippine ships, prompting the deployment of surveillance drones to document these actions for international audiences. Throughout the 30-day confrontation, the combined U.S.-Philippine drone operations successfully counter China's gray zone tactics by exposing covert activities and ensuring continuous surveillance despite Chinese attempts to deny access to disputed waters (Hammes, 2024).

4. Limited Cyber-Physical Confrontation

Following a major cyber-attack against U.S. military networks in Guam attributed to China, tensions escalate into a limited physical confrontation. China deploys naval and air assets near Guam in a show of force, while simultaneously intensifying cyber and electronic warfare operations against U.S. installations. U.S. forces respond by deploying swarms of small, warfighter-portable drones to monitor Chinese naval and air movements while maintaining operational security. These drones, operated by small teams distributed across multiple locations, provide redundant surveillance capabilities that prove resilient to Chinese electronic warfare attempts. When China activates sophisticated jamming systems to disrupt U.S. communications, specialized electronic warfare drones counter these effects by establishing secure communication corridors. The conflict escalates when Chinese vessels launch their own surveillance drones, leading to drone-on-drone engagements in contested airspace. Throughout the 18-day confrontation, U.S. warfighter-portable drones prove crucial in maintaining situational awareness despite China's attempts to blind U.S. sensors and disrupt command networks, ultimately enabling effective defense of Guam's critical infrastructure (Rinaldi & Vartanian, 2025).

5. Contested Humanitarian Assistance/Disaster Relief Operation

Following a devastating typhoon affecting multiple countries in the South China Sea region, both U.S. and Chinese forces deploy assets for humanitarian assistance and disaster relief operations. The situation becomes contested when China attempts to leverage the crisis to strengthen its territorial claims by establishing “humanitarian bases” on disputed features. U.S. forces deploy with partner nations to provide legitimate humanitarian assistance while monitoring Chinese activities. Warfighter-portable drones become essential for mapping affected areas, locating survivors, and monitoring Chinese military movements disguised as humanitarian efforts. Small aerial drones operated by U.S. special operations teams embedded with partner forces provide persistent surveillance of Chinese “humanitarian” activities, revealing military equipment and personnel being positioned under the guise of disaster relief. When China employs electronic warfare to establish exclusive operating zones, U.S. forces deploy specialized drones to maintain communications with isolated communities and document Chinese interference with legitimate relief efforts. Throughout the 25-day operation, small drones enable U.S. forces to effectively counter China's information operations by providing irrefutable evidence of militarization activities while simultaneously supporting genuine humanitarian missions (Oudenaren, 2025).

4.5 Major Conflict Scenarios

1. Full-Scale Taiwan Invasion Response

China launches a comprehensive invasion of Taiwan, employing massive missile strikes against Taiwanese defenses followed by amphibious and airborne assaults. The U.S. responds with a full-scale military intervention to defend Taiwan, deploying carrier strike groups and expeditionary forces throughout the region. Warfighter-portable drones become critical in countering China's layered A2/AD systems. Thousands of small aerial drones are deployed from distributed locations across the First and Second Island Chains, creating the "hellscape" environment described by U.S. Indo-Pacific Command. These drones target key nodes in China's command structure, disrupt Chinese military firepower systems through electronic attacks, and provide targeting data for U.S. long-range precision fires. Underwater drones deployed from submarines and surface vessels monitor Chinese naval movements and disrupt amphibious operations. When China employs its purportedly sophisticated counter-drone systems, including "bullet curtain" defenses and laser weapons, U.S. forces respond with overwhelming numbers of attritable drones that saturate these defenses. The intense 45-day conflict demonstrates the critical importance of mass-deployed small drones in penetrating advanced A2/AD networks and enabling effective joint operations in highly contested environments (United States Army Training and Doctrine Command, 2025).

2. Multi-Domain Operations Against Chinese Mainland Bases

Escalating tensions lead to Chinese strikes against U.S. bases in Japan, Guam, and other allied territories. The U.S. responds with a comprehensive campaign targeting Chinese military bases and A2/AD systems on the Chinese mainland. Warfighter-portable drones become essential for penetrating China's sophisticated integrated air defense systems. Special operations forces infiltrate key areas to deploy swarms of small drones that identify and target critical nodes in China's air defense network. These drones, operating autonomously in denied environments, provide precise targeting data for standoff weapons while conducting electronic attacks against radar and communication systems. Underwater drones deployed from submarines target undersea cables and sensors that support China's maritime domain awareness. When China activates its counter-drone systems, including advanced electronic warfare and directed energy weapons, U.S. forces respond with overwhelming numbers of low-cost, attritable drones that saturate these defenses through sheer volume. Throughout the 60-day conflict, small drones prove crucial in degrading China's A2/AD capabilities, enabling larger platforms to operate effectively in previously denied areas (Rinaldi & Vartanian, 2025).

3. Regional Conflict Involving Multiple U.S. Allies

China launches simultaneous military actions against multiple U.S. allies in the region, including Japan, the Philippines, and South Korea, attempting to fracture the alliances between nations. The U.S. responds with a comprehensive military campaign to defend all allies simultaneously. Warfighter-portable drones become critical for maintaining situational awareness across multiple theaters of operation. Small aerial drones deployed by distributed ground forces provide persistent surveillance of Chinese movements and activities across the region. Maritime drones monitor Chinese naval operations and provide targeting data for anti-ship weapons. When China employs its sophisticated electronic warfare capabilities to disrupt communications between allied forces, specialized drones establish resilient mesh networks that maintain connectivity despite jamming attempts. The conflict escalates when China deploys its own drone swarms, leading to large-scale drone-on-drone engagements across multiple domains. Throughout the 90-day conflict, small drones enable effective coordination between geographically dispersed allied forces despite China's attempts to isolate and defeat them individually (Oudenaren, 2025).

4. Full-Spectrum Conflict with Space and Cyber Dimensions

China initiates a comprehensive campaign against U.S. interests in the Indo-Pacific, beginning with attacks on space assets and massive cyber operations against military and civilian infrastructure. The conflict quickly escalates to conventional warfare across all domains. Warfighter-portable drones become essential for maintaining operational capabilities despite the degradation of space-based systems. Small aerial drones equipped with advanced sensors provide localized positioning, navigation, and timing capabilities that enable continued operations in GPS-denied environments. Specialized drones establish alternative communication networks that maintain connectivity despite the loss of satellites and conventional infrastructure. When China deploys sophisticated electronic warfare systems to exploit the degraded information environment, counter-information confrontation drones identify and target these systems. The conflict intensifies with massive drone swarms from both sides attempting to gain information superiority. Throughout the 120-day conflict, small drones prove crucial in maintaining basic command and control functions despite China's attempts to blind and isolate U.S. forces through attacks on space and cyber infrastructure (United States Army Training and Doctrine Command, 2025).

5. Extended Maritime Blockade and Counter-Blockade Operations

China implements a comprehensive maritime blockade of Taiwan and key shipping lanes throughout the South and East China Seas. The U.S. responds with counter-blockade operations to ensure freedom of navigation and access to critical resources. Warfighter-portable drones become essential for monitoring and countering China's extensive naval deployments. Small surface and underwater drones deployed from submarines, surface vessels, and coastal positions provide persistent surveillance of Chinese blockade enforcement activities. Aerial drones deployed from distributed locations throughout the region identify vulnerabilities in the blockade and provide targeting data for precision strikes. When China employs sophisticated sensor networks to detect and track vessels attempting to breach the blockade, specialized drones conduct electronic attacks to create gaps in coverage. The conflict escalates with both sides deploying increasing numbers of autonomous systems to establish and counter maritime exclusion zones. Throughout the 180-day conflict, small drones enable effective counter-blockade operations despite China's attempts to deny access to international waters through overwhelming naval presence and sophisticated A2/AD systems (Baker Institute for Public Policy, 2025).

4.6 Drone Requirements Analysis

The analysis of drone requirements across different conflict scenarios reveals significant variations in both the quantity and types of systems needed to counter China's A2/AD capabilities and operational systems. These estimates are based on the comprehensive methodology described earlier, incorporating lessons from Ukraine, historical precedents, and China's reported military capabilities. The tables below present both optimistic and pessimistic estimates for minor and major conflict scenarios, broken down by operational target category. These operational target categories are derived from the five operational systems as identified in the TRADOC G-2 analysis of how China fights in large-scale combat operations (United States Army Training and Doctrine Command, 2025). These estimates reflect the daily drone requirements and expected attrition rates, providing a foundation for understanding the scale of unmanned systems needed to operate effectively in the contested environments of the Indo-Pacific.

The optimistic estimates assume favorable conditions for U.S. forces, including effective counter-A2/AD operations, limited Chinese counter-drone capabilities, and successful implementation of distributed operations concepts. In contrast, the pessimistic estimates account for more challenging conditions, including robust Chinese counter-drone systems, degraded U.S. communications networks, and limited access to forward operating locations. The significant difference between these estimates highlights the importance of developing flexible force structures and production capabilities that can scale rapidly in response to evolving operational requirements.

The attrition rates presented reflect the expected percentage of deployed drones that would be denied or destroyed each day, either through direct enemy action or operational losses. These rates vary by operational target, with higher attrition expected for drones targeting high-value assets like Command and Firepower Strike systems, which would likely be protected by more robust defenses. The duration ranges for each conflict scenario provide context for understanding the total drone requirements over the course of a potential conflict, highlighting the need for sustainable production capabilities and robust logistics systems to support extended operations in the Indo-Pacific.

Operational Target Category	U.S. Drones Required Per Day	U.S. Drones Denied or Destroyed Per Day
Limited Conflict Scenarios - Optimistic Estimates		
Command	50-75 / day	10-15 / day (20%)
Firepower Strike	30-50 / day	10-15 / day (30%)
Information Confrontation	100-150 / day	15-25 / day (15%)
Reconnaissance Intelligence	200-300 / day	30-45 / day (15%)
Support	20-40 / day	0-5 / day (10%)
Total	**400-615 / day**	**65-100 / day (16.5%)**
Limited Conflict Scenarios - Pessimistic Estimates		
Command	100-150 / day	30-45 / day (30%)
Firepower Strike	75-125 / day	30-50 / day (40%)
Information Confrontation	200-300 / day	60-90 / day (30%)
Reconnaissance Intelligence	400-600 / day	120-180 / day (30%)
Support	50-100 / day	10-20 / day (20%)
Total	**825-1,275 / day**	**250-385 / day (30.2%)**
Estimated Total Duration of Limited Conflict Scenarios: 14-30 days		

Limited Conflict Scenarios would likely involve limited direct engagement between U.S. and Chinese forces, primarily focused on maritime and air operations within the First Island Chain. These scenarios include freedom of navigation confrontations, limited blockades, proxy conflicts involving regional allies, cyber-physical confrontations, and contested humanitarian operations. Warfighter-portable drones would play crucial roles in maintaining situational awareness, countering information operations, and enabling effective operations despite attempts to deny access to international waters and airspace (O'Rourke, 2025; Hammes, 2024; Graham & Singer, 2025; United States Army Training and Doctrine Command, 2025). These conflicts are estimated to last between 14 and 30 days.

Operational Target Category	U.S. Drones Required Per Day	U.S. Drones Denied or Destroyed Per Day
Major Conflict Scenarios - Optimistic Estimates		
Command	200-300 / day	60-90 / day (30%)
Firepower Strike	300-500 / day	120-200 / day (40%)
Information Confrontation	500-750 / day	125-190 / day (25%)
Reconnaissance Intelligence	1,000-1,500 / day	250-380 / day (25%)
Support	100-200 / day	20-40 / day (20%)
Total	**2,100-3,250 / day**	**575-890 / day (27.5%)**
Major Conflict Scenarios - Pessimistic Estimates		
Command	400-600 / day	160-240 / day (40%)
Firepower Strike	600-1,000 / day	300-500 / day (50%)
Information Confrontation	1,000-1,500 / day	400-600 / day (40%)
Reconnaissance Intelligence	2,000-3,000 / day	800-1,200 / day (40%)
Support	200-400 / day	60-120 / day (30%)
Total	**4,200-6,500 / day**	**1,720-2,660 / day (41%)**
Estimated Total Duration of Major Conflict Scenarios: 45-180 days		

Major Conflict Scenarios would likely involve high-intensity conventional warfare between U.S. and Chinese forces across air, maritime, space, and cyber domains throughout the Western Pacific region. These scenarios include full-scale Taiwan invasion response, multi-domain operations against mainland bases, regional conflicts involving multiple U.S. allies, full-spectrum conflicts with space and cyber dimensions, and extended maritime blockade operations. Warfighter-portable drones would be employed for penetrating sophisticated A2/AD systems, maintaining command and control in degraded information environments, and enabling effective joint operations across multiple domains and theaters (Oudenaren, 2025; Rinaldi & Vartanian, 2025; United States Army Training and Doctrine Command, 2025). These conflicts are estimated to last between 45 and 180 days.

4.7 Integration of Counter-Drone Technologies

The rapid proliferation of drone technologies across the battlefield necessitates a comprehensive approach that integrates counter-drone capabilities with offensive drone operations. The U.S. Department of Defense has recognized this need through initiatives like the existing Joint Counter-Small Unmanned Aircraft Systems Office (JCO), which coordinates layered defenses against the growing threat of small, agile drones (McNabb, 2025). This integration is particularly critical in the Indo-Indo-Pacific, where China's expanding counter-drone capabilities – including laser systems, “bullet curtain” defenses, and sophisticated electronic warfare – present significant challenges to U.S. drone operations. The Pentagon's Replicator Initiative, which aims to field thousands of air, sea, and land drones by August 2025, must be complemented by equally robust counter-drone technologies to ensure operational effectiveness in contested environments (McNabb, 2025).

Current U.S. counter-drone systems include a range of technologies from radar detection systems to kinetic and non-kinetic countermeasures. The Army's Counter-UAS Mission Command Systems, for example, are being enhanced to incorporate human-on-the-loop automation that enables rapid response to emerging drone threats (Vowell & Padalino, 2024). These systems must be integrated with offensive drone capabilities to create a unified operational picture that allows commanders to make informed decisions about when to deploy offensive drones and when to activate defensive measures. This integration is particularly important considering the lessons learned from Ukraine, where both sides have deployed extensive drone and counter-drone capabilities, creating a complex operational environment where the ability to rapidly transition between offensive and defensive operations is crucial (Bendett & Kirichenko, 2025).

The integration of counter-drone technologies with offensive drone capabilities also requires a robust command and control architecture that can process information from multiple sensors and coordinate responses across domains. China's approach to counter-drone operations emphasizes the importance of such integration, with military commentators advocating for a layered defense that combines robust detection networks with a mix of kinetic and non-kinetic countermeasures (Graham & Singer, 2025). The U.S. must adopt a similar approach, developing command and control systems that can seamlessly transition between offensive and defensive operations based on real-time threat assessments. This integration is particularly important in the context of the “hellscape” concept, which envisions creating an overwhelming and unpredictable operating environment for adversary forces through the mass deployment of autonomous systems (Rinaldi & Vartanian, 2025).

The FY2025 budget request reflects this need for integrated capabilities, with significant investments in both offensive drone programs and counter-drone technologies. The budget includes funding for the Army's Counter-UAS Mission Command Systems, which are designed to provide a comprehensive operational picture that integrates information from multiple sensors and enables rapid response to drone threats (United States Department of Defense PDI, 2024). Additionally, the Pacific Deterrence Initiative includes funding for exercises, training, and experimentation related to both drone and counter-drone operations, recognizing the need to develop integrated concepts of operation that can be effectively employed in contested environments (United States Department of Defense PDI, 2024). These investments are critical for developing the capabilities needed to operate effectively in the Indo-Indo-Pacific, where China's sophisticated A2/AD systems present significant challenges to U.S. power projection.

The integration of counter-drone technologies with offensive drone capabilities also requires a workforce that is trained and equipped to operate in this complex environment. The Army's approach, which emphasizes the need for all formations at multiple echelons to operate and defend against drone threats rather than creating a dedicated drone corps, recognizes the pervasive nature of drone warfare in modern conflicts (Albon, 2025). This approach aligns with Secretary of Defense Pete Hegseth's directive to equip each combat division with approximately 1,000 drones by 2026, which will require a corresponding investment in counter-drone training and equipment to ensure that these forces can operate effectively in contested environments (Jankowicz, 2025; Office of the Secretary of Defense, 2025). By integrating counter-drone technologies with offensive drone capabilities at the unit level, the U.S. military can create a more resilient and adaptable force that is prepared to operate in the complex electromagnetic environment of the Indo-Indo-Pacific.

4.8 Key Findings from Analysis, Requirements, and Gaps

A Limited Conflict in the Indo-Pacific region would likely involve limited direct engagement between U.S. and Chinese forces, primarily focused on maritime and air operations within the First Island Chain. These scenarios include freedom of navigation confrontations, limited blockades, proxy conflicts involving regional allies, cyber-physical confrontations, and contested humanitarian operations. In these scenarios, warfighter-portable drones would play crucial roles in maintaining situational awareness, countering Chinese information operations, and enabling effective operations despite China's attempts to deny access to international waters and airspace. These conflicts would typically last between two weeks and one month, with daily drone requirements ranging from 400-1,275 systems across all domains, and attrition rates between 16.5% and 30.2% depending on the intensity of Chinese counter-drone efforts (Bendett & Kirichenko, 2025; Graham & Singer, 2025).

A Major Conflict would involve high-intensity conventional warfare between U.S. and Chinese forces across air, maritime, space, and cyber domains throughout the Western Pacific region. These scenarios include full-scale Taiwan invasion response, multi-domain operations against mainland Chinese bases, regional conflicts involving multiple U.S. allies, full-spectrum conflicts with space and cyber dimensions, and extended maritime blockade operations. In these scenarios, warfighter-portable drones would be essential for penetrating China's sophisticated A2/AD systems, maintaining command and control in degraded information environments, and enabling effective joint operations across multiple domains and theaters. These conflicts would typically last between 45 days and six months, with daily drone requirements ranging from 2,100-6,500 systems across all domains, and attrition rates between 27.5% and 41% due to China's purportedly sophisticated counter-drone capabilities including “bullet curtain” defenses, laser weapons, and electronic warfare systems (Palve, 2025; United States Army Training and Doctrine Command, 2025).

The analysis reveals several critical gaps in current U.S. drone capabilities and production capacity. First, the sheer volume of drones required for even limited conflicts far exceeds current production rates and stockpiles. The Baker Institute's analysis of munitions procurement highlights the significant gap between current production capabilities and what might be needed in a major conflict, with current procurement levels for various weapons systems remaining significantly below Cold War peak years (Baker Institute for Public Policy, 2025). This production capacity gap is particularly concerning given the high attrition rates expected in conflicts with China, where sophisticated counter-drone systems could neutralize up to 41% of deployed drones daily in major conflict scenarios.

Second, there is a significant mismatch between the types of drones currently being procured and those needed for effective operations in the Indo-Pacific. While the analysis estimates that warfighter-portable drones should comprise 30-40% of aerial drones, 10-15% of naval surface drones, and 5-10% of underwater drones, current DoD investment patterns allocate only 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding to truly warfighter-portable systems (McNabb, 2025). This imbalance creates a critical capability gap in the ability to conduct distributed operations from austere locations throughout the Pacific islands and maritime environments.

Third, the analysis identifies a need for greater emphasis on maritime drone capabilities, particularly surface and underwater systems that can operate effectively in the vast maritime spaces of the Indo-Pacific region. The minimal investment in truly warfighter-portable maritime systems – just 0.8% of surface drone funding and 0.2% of underwater drone funding – represents a significant vulnerability given the strategic importance of maritime operations in potential conflicts with China.

Fourth, there is a critical need for drones capable of operating effectively in contested electromagnetic environments, with advanced capabilities for autonomous operation, resilience against electronic warfare, and the ability to function without continuous communications links. The Chinese military has reportedly invested heavily in counter-drone technologies, including electronic warfare systems, directed energy weapons, and kinetic interceptors, creating a challenging operational environment for U.S. drone systems (Graham & Singer, 2025).

Finally, the analysis highlights the importance of mass deployment as a counter to sophisticated defense systems. The “hellscape” concept being developed by U.S. military planners offers a promising framework for employing large numbers of low-cost, autonomous drones to create an overwhelming and unpredictable operating environment for adversary forces (Rinaldi & Vartanian, 2025). However, implementing this concept would require a dramatic increase in production capacity, particularly for warfighter-portable systems that can be mass-deployed from distributed locations to overwhelm even advanced defense networks.

Addressing these gaps will require significant changes in how the Department develops, procures, and employs small drone systems. The Army's plan to equip each combat division with approximately 1,000 drones by 2026 represents a step in the right direction (Albon, 2025) and must be accompanied by a fundamental shift in how these systems are designed, acquired, and employed to ensure they meet the unique requirements of the Indo-Pacific. By focusing on truly warfighter-portable systems that can be mass-deployed from distributed locations throughout the Indo-Pacific region, the Department can develop a more resilient and effective approach to countering China's A2/AD capabilities and maintaining military superiority in the Indo-Pacific region.

5. Strategic Implications and Transformational Drone Capabilities

The preceding chapters illuminated critical gaps in the Department of Defense's approach to small drone capabilities, particularly in the context of the evolving Indo-Pacific security environment. Chapter 2 demonstrated how China's comprehensive A2/AD strategy, coupled with its rapid advancement in drone and counter-drone technologies, presents a formidable challenge to U.S. military operations in the region. The drone revolution in modern warfare, exemplified by conflicts in Ukraine, the Middle East, and Nagorno-Karabakh, has fundamentally transformed battlefield dynamics, with small, low-cost systems proving highly effective against traditional military assets when deployed at scale. As the Secretary of Defense Pete Hegseth recently directed in his Army Transformation and Acquisition Reform memo, the SECDEF wants the Department of Defense to achieve "Field Unmanned Systems (UMS) and Ground/Air launched effects in every Division by the end of 2026" (Office of the Secretary of Defense, 2025). Current DoD budgets and classification systems, however, fail to adequately address the need for truly warfighter-portable systems that can operate effectively in contested environments (McNabb, 2025).

Chapter 3 revealed significant misalignment between current DoD acquisition approaches and the tactical realities faced by warfighters in contested environments. By examining the complete operational cycle – from pre-mission preparation through deployment, operation, recovery, and maintenance – the analysis identified critical constraints that traditional platform-centric approaches often overlook. Historical DoD spending patterns show minimal investment in truly warfighter-portable systems, with only a small fraction of funding allocated to systems meeting this criterion. This imbalance creates vulnerabilities in distributed operations across the Pacific islands and maritime environments, where the ability for small units to deploy drones independently is crucial for mission success.

Chapter 4 provided a comprehensive analysis of drone requirements across different conflict scenarios in the Indo-Pacific region. In limited conflict scenarios lasting 14-30 days, daily drone requirements range from 400-1,275 systems with attrition rates between 16.5% and 30.2%. Major conflicts lasting 45-180 days would require 2,100-6,500 drones daily with attrition rates between 27.5% and 41% due to China's purportedly sophisticated counter-drone capabilities (United States Army Training and Doctrine Command, 2025). These estimates highlight the need for a dramatic increase in production capacity, particularly for warfighter-portable systems that can be mass-deployed from distributed locations to overwhelm even advanced defense networks.

Historically, the challenge with recommendations to the Department of Defense has been translating analysis into concrete action. Institutional inertia, budget constraints, acquisition complexities, and competing priorities often impede the implementation of even the most compelling recommendations. The gap between identifying capability shortfalls and fielding effective solutions has frequently resulted in forces entering conflicts with suboptimal equipment and concepts of operation, as evidenced by the initial phases of operations in Iraq and Afghanistan where force protection and counter-IED capabilities had to be developed and fielded rapidly in response to emerging threats (Baker Institute for Public Policy, 2025).

Encouragingly, the new DoD leadership has already demonstrated a commitment to addressing these issues through initiatives like the Replicator program, which aims to field thousands of autonomous systems across multiple domains by August 2025 (McNabb, 2025). The Army's plan to equip each combat division with approximately 1,000 drones by 2026 further reflects growing recognition of the strategic importance of distributed drone capabilities (Albon, 2025). The recommendations in this report provide a roadmap for the new leadership to accelerate and expand these efforts, ensuring that DoD small drone requirements are properly mapped to warfighter needs and Indo-Pacific requirements to achieve strategic sufficiency in this critical capability area.

Strategic Imperative	Key Findings	Implications
1. Critical Capability Gap	Only 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding is allocated to truly warfighter-portable systems.	The U.S. lacks enough small, attritable drones that can be deployed by individual warfighters or small teams without specialized equipment or dedicated operators.
2. Contested Environment Reality	China has reportedly developed sophisticated counter-drone capabilities including “bullet curtain” defenses, laser weapons, and advanced electronic warfare systems.	Future conflicts will require overwhelming numbers of low-cost, attritable drones to saturate defenses, with mass deployment as the primary counter to advanced defensive systems.
3. Urgent Timeline to Act Now	The scale and pace of China's military modernization, coupled with lessons from Ukraine and other recent conflicts, demand immediate action.	Incremental approaches or minor adjustments to existing programs will not address the fundamental misalignment between current capabilities and operational requirements.
4. Accelerated Innovation Imperative	China's rapid advancement in drone and counter-drone technologies threatens to erode U.S. technological advantages.	The traditional acquisition cycle is too slow to keep pace with technological change, requiring novel approaches to rapidly develop, test, and field innovative drone capabilities.

Strategic Imperative	Key Findings	Implications
5. Budget Realignment Necessity	Current budget allocations for small unmanned systems appear insufficient to meet the scale of requirements identified for potential conflicts based on recent conflicts using drones.	Current budget priorities do not reflect the critical importance of small, attritable drones in modern warfare, nor the quantities required for potential conflicts with China.
6. Industrial Base Challenge	Current munitions procurement levels remain significantly below Cold War peak years, with limited domestic production capacity for small drones.	The U.S. defense industrial base lacks the capacity, diversity, and resilience needed to support wartime production rates of small, attritable drone systems.
7. Production Capacity Crisis	Major conflict scenarios require 2,100-6,500 drones daily with attrition rates of 27.5-41%. Current production capacity is orders of magnitude below these requirements.	Even with the most optimistic production estimates, the U.S. would exhaust available drone stockpiles within days of a major conflict with China, creating a critical vulnerability.
8. Distributed Operations Advantage	Warfighter-portable drones incorporating next-generation hardware enable operations from numerous, unpredictable locations across the Indo-Pacific.	Small, attritable drones deployed from distributed locations can create multiple dilemmas for adversary targeting and force protection, enhancing operational resilience and effectiveness.

This chart details the key findings and implications of this from Chapters 2, 3, and 4.

5.1 Actions to Transform DoD's Field Innovation Cycles

Five critical actions to transform the Department of Defense's approach to drone innovation cycles in response to China's rapidly advancing capabilities and lessons from recent conflicts. These five critical actions address the findings associated with the strategic imperatives of: a (1) critical capability gap, a (2) contested environment reality, an (3) urgent timeline to act now, an (4) accelerated innovation imperative, and a (5) budget realignment necessity.

1. Establish Rapid Drone Experimentation Force

The Department of Defense should establish a dedicated Rapid Drone Experimentation Force (RDEF) composed of operational units from all services tasked with continuously testing and evaluating new drone concepts, technologies, and tactics in realistic field conditions. This force would operate on compressed timelines, with authority to rapidly prototype, test, and iterate drone systems and operational concepts without being constrained by traditional acquisition processes. The RDEF would maintain direct connections to both the operational forces and the research and development community, serving as a bridge to accelerate the transition of promising technologies and concepts to the field. This initiative would build upon what the Defense Innovation Unit (DIU) has already attempted and would go further by allowing contracts for concept drone technologies and solutions to proceed directly to fielding and operations without requiring re-competition, eliminating a significant barrier that has historically slowed the transition from prototype to fielded capability (Bendett & Kirichenko, 2025).

The Secretary of Defense should direct the establishment of the RDEF through a formal directive, allocating personnel, resources, and authorities necessary for its operation. The RDEF should be organized as a joint task force reporting directly to the Deputy Secretary of Defense, with representation from all services and relevant defense agencies. Initial funding of $250 million should be allocated from existing rapid acquisition authorities, with a mandate to conduct at least quarterly field experiments focused on warfighter-portable drone systems. The RDEF should be granted authority to issue small contracts (up to $10 million) directly to industry partners for rapid prototyping and testing, bypassing traditional acquisition processes. Critically, the RDEF should be empowered with Other Transaction Authority (OTA) and Middle Tier Acquisition authorities that allow successful prototypes to transition directly to production and fielding without requiring new competitive solicitations. This approach would build on DIU's successes while addressing the "valley of death" that has prevented many promising technologies from reaching operational forces. Results and lessons learned should be documented and disseminated across the Department through a dedicated knowledge management system accessible to all relevant stakeholders.

2. Implement a DoD Drone and Counter-Drone Sandbox Program

The Department should implement a "Drone and Counter-Drone Sandbox" program at all major Combat Training Centers (CTCs), creating dedicated spaces and resources for units to experiment with commercial and developmental drone systems as well as counter-drone technologies during training rotations. This program would allow operational units to test new drone concepts, technologies, and counter-drone measures in realistic training environments, providing immediate feedback on their effectiveness and identifying potential improvements. The Sandbox would include a repository of commercial off-the-shelf drones and counter-drone systems that units could experiment with, as well as technical support personnel to assist with integration and operation. This dual focus would ensure that warfighters develop capabilities to both employ drones effectively and counter adversary drone threats, reflecting the reality of modern battlefields where both capabilities are essential.

The Army, as executive agent for the program, should allocate $50 million annually to establish and maintain Drone and Counter-Drone Sandbox facilities at the National Training

Center, Joint Readiness Training Center, and Joint Multinational Readiness Center, with additional satellite facilities at major training areas in the Indo-Pacific region. Each facility should maintain an inventory of both commercial drones and counter-drone systems, with quarterly refresh cycles to ensure access to the latest technology. Technical support teams composed of both military personnel and civilian contractors should be assigned to each facility, with expertise in drone operations, counter-drone technologies, maintenance, and integration. The program should include a formal feedback mechanism to capture lessons learned and innovative concepts developed by units, with quarterly reports provided to service acquisition executives and combatant commanders. Additionally, the program should facilitate regular exchanges between operational units and industry partners to ensure that commercial innovation is informed by warfighter needs and experiences.

3. Create Drone Industry Innovation Exchanges

The Department should establish a Drone Industry Innovation Exchange program that facilitates the temporary embedding of operational warfighters with commercial drone companies and research institutions, while also enabling industry experts to spend time with military units. These exchanges would allow service members to gain firsthand experience with next-generation drone technologies and development processes, while also providing industry partners with valuable operational insights. Participants would return to their organizations with enhanced technical knowledge and cross-sector connections, serving as innovation catalysts within their respective environments. Unlike a traditional fellowship that might require full-time commitment, this exchange program would enable participants to maintain their primary roles while participating in structured collaboration activities, making it more accessible to both military personnel and industry professionals (McNabb, 2025).

The Under Secretary of Defense for Research and Engineering should establish the exchange program through a formal directive, allocating 200 exchange positions annually across all services and industry partners. Selection criteria should prioritize personnel with operational experience and demonstrated interest in unmanned systems. Host organizations should include leading commercial drone manufacturers, research universities, and defense contractors with significant drone programs. The program should include various participation models, from short-term immersive experiences (2-4 weeks) to longer-term part-time engagements (1-2 days per week over 6-12 months), providing flexibility to accommodate different operational and business requirements. Participants should receive specialized training before their assignments, including technical fundamentals, industry practices, and innovation methodologies. Upon return to their organizations, participants should be assigned to positions where they can leverage their experience, such as experimentation cells or capability development teams. The program should include a formal knowledge sharing component, with participants required to document and disseminate their insights through reports, briefings, and participation in communities of practice.

4. Accelerate Drone Generation Cycles

The Department should establish a dedicated Drone Generation Acceleration program focused on dramatically reducing the time between successive generations of drone technologies and capabilities. This initiative would address the critical need to increase the operational tempo of innovation, operationalization, and fielding for different drone generations, ensuring that the DoD is not buying yesterday's drone technologies today. The Secretary of Defense Pete Hegseth has emphasized this priority in his recent directive to the Department, with the SECDEF specifically charging the DoD to: “Improve Counter-UAS mobility and affordability, integrating capabilities into maneuver platoons by 2026 and maneuver companies by 2027” (Office of the Secretary of Defense, 2025). The program would implement a continuous development and fielding model, with overlapping cycles of research, prototyping, testing, and deployment that enable rapid iteration and improvement based on operational feedback and emerging technologies (Bendett & Kirichenko, 2025).

The Deputy Secretary of Defense should establish the program through a formal directive, with initial funding of $300 million over three years. The program should be structured around 18-month technology cycles, with new capability increments fielded every 12-18 months rather than the 5-7 years typical of traditional acquisition programs. Each cycle would include parallel tracks for hardware, software, and operational concept development, with continuous integration and testing to ensure that advances in any area can be rapidly incorporated into fielded systems. The program should establish dedicated rapid acquisition pathways specifically for small drone systems, with streamlined requirements, testing, and procurement processes. A key element would be the implementation of modular, open-architecture designs that allow for component-level upgrades without requiring complete system replacement. The program should also include a formal mechanism for capturing and incorporating operational feedback, with deployed units providing real-time data on system performance and emerging requirements. As Gen. Bryan P. Fenton, SOCOM Commander, observed: “What we're seeing through the lens of Ukraine needs to be an acquisition ... and procurement system that is hyper-speed, supersonic. Because over there, we're watching the changes in minutes, hours and days, and that is a very stark contrast” (United States Department of Defense, 2025). Annual technology demonstrations would showcase new capabilities and facilitate rapid transition decisions, ensuring that promising technologies move quickly from development to fielding.

5. Advance Drone Test Ranges

The Department should advance Drone Test Ranges beyond initial efforts, specifically advancing drone test ranges and facilities specifically designed for rapid evaluation of small drone capabilities in diverse operational environments. These test ranges would enable simultaneous testing of drone systems across multiple locations and conditions, accelerating the development cycle and providing more robust performance data than traditional single-site testing approaches. These test ranges would include urban, rural, maritime, and mountainous test environments, with standardized instrumentation and data collection protocols to ensure consistent evaluation metrics across all sites.

The DoD's existing Test Resource Management Center should lead the development of the Drone Test Ranges with an initial investment of $175 million over three years. The network should leverage existing military test ranges, national laboratories, university research facilities, and commercial test sites to create a comprehensive testing ecosystem accessible to both traditional defense contractors and non-traditional innovators. Each site should be equipped with advanced instrumentation for performance measurement, including radar tracking, optical sensors, electromagnetic spectrum monitoring, and environmental condition recording. A common data architecture should be implemented across all sites to enable rapid analysis and comparison of test results. The drone test ranges should include a secure communications infrastructure to allow for distributed, multi-site testing of drone swarms and collaborative behaviors. A dedicated team of test engineers and data scientists should be established to support testing operations and develop standardized evaluation protocols for different drone capabilities and mission types. Regular technology demonstration events should be conducted to showcase promising systems and capabilities identified through the network's testing activities.

5.2 Actions to Transform the U.S. Ecosystem for Warfighter-Portable Drones

There are three critical actions the to transform the U.S. ecosystem for warfighter-portable drones in response to China's rapidly advancing drone and counter-drone capabilities. These three critical actions address the findings associated with the strategic imperatives highlighted earlier in this chapter of: a (6) industrial base challenge, a (7) production capacity crisis, a (8) distributed operations advantage.

1. Accelerate Drone Manufacturing Via the Office of Strategic Capital

The Department of Defense, through its Office of Strategic Capital (OSC), should implement a comprehensive initiative to dramatically expand domestic production capacity for warfighter-portable drones. This initiative would provide financial incentives, technical assistance, and market guarantees to companies willing to establish or expand production facilities for military-grade small drones and components. The OSC would focus on creating a resilient, distributed manufacturing ecosystem capable of rapidly scaling production in response to emerging requirements and contingencies, with particular emphasis on geographic diversity to ensure production capacity exists across the country. This approach would leverage the OSC's unique authorities to deploy patient capital and other investment tools to address critical gaps in the defense industrial base (Baker Institute for Public Policy, 2025).

The Secretary of Defense should direct the Office of Strategic Capital to lead this initiative, with initial funding of $1 billion over five years. The initiative should include a combination of direct investments in manufacturing facilities, low-interest loans, tax incentives, and guaranteed purchase agreements to stimulate private sector investment across multiple regions of the country. The OSC should establish a dedicated investment fund focused specifically on expanding production capacity for warfighter-portable drones, with particular emphasis on companies developing innovative manufacturing approaches that can dramatically increase production rates and reduce costs. Priority should be given to establishing facilities in regions with existing aerospace manufacturing capabilities and workforce, as well as areas with strong academic institutions focused on robotics and unmanned systems. The initiative should include a workforce development component, with funding for specialized training programs and apprenticeships in drone manufacturing and related fields. A dedicated program office should be established within the Office of Strategic Capital to coordinate activities across government agencies and industry partners, with quarterly progress reports provided to Congress and senior DoD leadership.

2. Strengthen Supply Chains Associated with Drone Components

The Department should develop a comprehensive Drone Supply Chain Strengthening Program to identify and address vulnerabilities in the supply chains for critical drone components. This program would map existing supply chains, identify single points of failure, foreign dependencies, and potential security vulnerabilities, and invest in alternative sources and stockpiles for critical components. The program would focus particularly on components that are currently sourced primarily from China or other potential adversaries, such as specialized microelectronics, sensors, and batteries, while also addressing the risk of compromised hardware, software, and related components used in U.S. drones. This dual focus on resilience and security would ensure that U.S. drone systems remain both available in sufficient quantities and trustworthy for critical military operations (Baker Institute for Public Policy, 2025).

The Under Secretary of Defense for Acquisition and Sustainment should establish the program through a formal directive, with initial funding of $300 million over three years. The program should begin with a comprehensive mapping of supply chains for critical drone components, identifying key vulnerabilities, foreign dependencies, and potential security risks. Based on this analysis, investments should be made in domestic production capabilities for the most critical components, through a combination of direct funding, tax incentives, and guaranteed purchase agreements. The program should establish minimum domestic content requirements for military drone systems, to be phased in over a five-year period to allow industry time to adapt. A strategic stockpile of critical components should be established, with enough to sustain production and maintenance operations for at least six months in the event of supply chain disruptions. The program should also implement rigorous security standards and testing protocols to identify and mitigate the risk of compromised components, including hardware backdoors, software vulnerabilities, and other potential attack vectors. Regular stress testing of supply chains through simulated disruption scenarios should be conducted, with results used to refine resilience strategies. Annual reports on supply chain vulnerabilities, security risks, and mitigation efforts should be provided to Congress and senior DoD leadership.

3. Ensure the Pipeline of Future Technologies Today

The Department should establish a dedicated initiative to ensure a continuous pipeline of future drone technologies, with the Defense Advanced Research Projects Agency (DARPA) charged with researching capabilities beyond what commercial industry can already provide, and additional elements associated with the Under Secretary of Defense for Research and Engineering (USD(R&E)) responsible for bridging the gap between advanced research and fielded capabilities. This initiative would focus on identifying and developing transformative technologies that could provide significant military advantages in future conflicts, while also establishing clear pathways for transitioning these technologies from research to operational use. By creating this end-to-end pipeline, the Department would ensure that investments in advanced research yield tangible capabilities for warfighters rather than remaining trapped in the “valley of death” between research and acquisition.

The Secretary of Defense should establish this initiative through a formal directive, with initial funding of $200 million annually. DARPA should be directed to establish a dedicated drone technology research portfolio focused on capabilities that are 5-10 years beyond current commercial technology, including advanced autonomy, novel propulsion systems, breakthrough power sources, and revolutionary materials. This portfolio should be structured around specific military challenges in the Indo-Indo-Pacific, with research priorities informed by operational requirements and intelligence assessments of adversary capabilities. Simultaneously, USD(R&E) should establish a dedicated transition office specifically for drone technologies, with authority to provide staged funding for promising technologies as they mature from basic research through prototyping and initial production. This office should implement a milestone-based funding approach, with continued support contingent on demonstrated progress toward operational capabilities. The initiative should prioritize technologies that address critical capability gaps identified by combatant commanders and operational forces, particularly those relevant to the Indo-Indo-Pacific. A streamlined contracting process should be established specifically for the initiative, leveraging existing authorities such as Other Transaction Agreements to minimize administrative burden and accelerate technology transition. Quarterly coordination meetings between DARPA, elements of USD(R&E), the Services, and Operational Commands should be held to ensure alignment of research priorities with operational needs and to identify promising technologies for accelerated transition. Annual technology demonstrations should showcase emerging capabilities and facilitate transition decisions, ensuring that the Department maintains a robust pipeline of future drone technologies.

5.3 Eight Key Actions for Decision Makers

The analyses presented in this report demonstrate an urgent need for transformative action in the Department of Defense's approach to small drone capabilities. China's rapid advancement in both drone and counter-drone technologies, coupled with the lessons from recent conflicts in Ukraine, the Middle East, and elsewhere, highlight the critical importance of warfighter-portable unmanned systems in modern warfare. The current pace of U.S. innovation, acquisition, and production falls significantly short of what will be required to maintain military superiority in the Indo-Pacific region. Without immediate and substantial changes to how the Department develops, procures, and employs small drone systems, U.S. forces will face significant disadvantages in future conflicts, particularly against sophisticated adversaries like China. The following eight actions represent the highest priorities for addressing these challenges and ensuring U.S. forces have the capabilities they need to deter aggression and, if necessary, prevail in conflict (United States Army Training and Doctrine Command, 2025).

Action for Decision	Why It Matters	What Can Be Done Now
F1. Establish Rapid Drone Experimentation Force	Accelerates innovation cycles by testing new concepts and technologies in realistic conditions with operational forces, building on DIU's work while enabling direct transition to fielding	Direct establishment through SECDEF memo, allocate $250M from existing rapid acquisition authorities, establish quarterly field experiments with authority to transition directly to fielding
F2. Implement DoD Drone and	Enables operational units to experiment with both drone and	Allocate $50M annually to establish facilities at major Combat Training

Action for Decision	Why It Matters	What Can Be Done Now
Counter-Drone Sandbox Program	counter-drone technologies during training, providing immediate feedback on effectiveness	Centers, maintain inventory of commercial drones and counter-drone systems
F3. Create Drone Industry Innovation Exchanges	Builds technical expertise and cross-sector relationships through flexible exchange programs between military and industry	Establish industry exchange positions annually with flexible participation models, prioritize personnel with operational experience, partner with leading drone manufacturers
F4. Accelerate Drone Generation Cycles	Prevents DoD from buying yesterday's technologies by implementing rapid, overlapping development cycles for successive drone generations	Implement 18-month technology cycles with $300M over three years, establish modular designs and continuous feedback mechanisms
F5. Advance Drone Test Ranges	Advances rapid evaluation of drone capabilities across diverse operational environments, accelerating development cycles	Invest $175M over three years to advance drone test ranges with standardized instrumentation and data collection
E1. Accelerate Drone Manufacturing	Expands domestic production capacity to meet wartime requirements through strategic capital deployment across the country	Direct OSC to lead the initiative with $1B over five years, combining direct investments, loans, and purchase guarantees across multiple regions
E2. Strengthen Supply Chains	Reduces vulnerabilities from foreign dependencies, single points of failure, and compromised components	Allocate $300M over three years, map critical supply chains, invest in domestic production of key components, implement security standards
E3. Ensure Pipeline of Future Technologies Today	Creates end-to-end process from advanced research to fielded capabilities, with DARPA and additional elements of USD(R&E) working in concert	Direct DARPA to research capabilities beyond commercial state-of-the-art and additional elements of USD(R&E) to bridge transition gap with $200M annual funding

This chart summarizes the key actions, will details in sections 5.1 and 5.2 of this report.

Sincere gratitude is extended to all the individuals and organizations who provided open-source information that informed this report. Their dedication to transparency and knowledge-sharing has been invaluable in developing a comprehensive understanding of the challenges and opportunities in the domain of unmanned systems. Additional gratitude is extended both to members of the Stimson Center, the Center's Loomis Council, and those experts to include Dr. Anthony Scriffignano, former Acting Deputy Assistant Secretary of

Defense for Special Operations and Combatting Terrorism Andrew Coté, and other anonymous individuals who were willing to provide additional reviews of this report who provided thoughtful feedback and insights that strengthened the analysis and recommendations.

This report acknowledges significant limitations inherent in relying on open-source information to analyze military capabilities and requirements. Information on Chinese military capabilities, particularly regarding counter-drone systems and electronic warfare, is often incomplete, outdated, or potentially influenced by deliberate misinformation. The Chinese military 's actual capabilities may be substantially different from what is publicly reported, potentially leading to underestimation or overestimation of both threat levels and required countermeasures. Production capabilities, stockpile levels, technical specifications, and operational concepts for both U.S. and Chinese unmanned systems are closely guarded information, making precise assessments challenging. Despite these limitations, open-source analysis remains valuable for identifying broad capability trends, force structure developments, and strategic priorities that can inform more detailed classified assessments. By triangulating information from multiple sources and applying conservative assumptions where uncertainty exists, this analysis provides credible estimates that can support strategic decision-making while acknowledging the inherent limitations of unclassified information.

The strategic implications of the drone revolution for U.S. military operations in the Indo-Pacific region cannot be overstated. Small, warfighter-portable unmanned systems have fundamentally transformed modern warfare, enabling distributed operations, overwhelming adversary defenses through mass, and providing persistent surveillance and precision strike capabilities at a fraction of the cost of traditional platforms. China's comprehensive A2/AD strategy and rapid advancement in both drone and counter-drone technologies present a formidable challenge to U.S. military operations in the region. Current DoD approaches to drone development, acquisition, and employment are insufficient to meet this challenge, with minimal investment in truly warfighter-portable systems and production capacities far below what would be required in a major conflict. The eight actions outlined in this report provide a roadmap for transforming the Department's approach to small drone capabilities, accelerating innovation cycles, expanding production capacity, and ensuring U.S. forces have the capabilities they need to deter aggression and prevail in conflict. Implementing these recommendations will require sustained leadership commitment, resource allocation, and institutional change, but the alternative – continuing the current status quo – would leave U.S. forces at a significant disadvantage in future conflicts. The time to act is now.

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This report draws from an extensive array of open-source information to analyze drone warfare capabilities, counter-drone technologies, and military strategic planning. The reference information employed by this report provides comprehensive insights into global drone technology trends, attrition rates in various conflicts, counter-UAS developments, and the strategic implications of small drone proliferation in contested environments, particularly in the Indo-Pacific.

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6.6 About the Stimson Center, Loomis Accelerator, and Report Author

The Stimson Center promotes international security and shared prosperity through applied research and independent analysis, global engagement, and policy innovation. For three decades, Stimson has been a leading voice on urgent global issues. Founded in the twilight years of the Cold War, the Stimson Center pioneered practical new steps toward stability and security in an uncertain world. Today, as changes in power and technology usher in a challenging new era, Stimson is at the forefront: Engaging new voices, generating innovative ideas and analysis, and building solutions to promote international security, prosperity, and justice.

The Loomis Accelerator is a novel platform for testing and developing promising ideas and technologies that have the potential to tackle global security challenges. Under the leadership of Dr. David Bray as Chair and inspired by the legacy of Alfred Lee Loomis, this initiative brings together innovative thinkers and novel technologies to address critical international issues.

The Accelerator is designed to explore diverse ideas from a variety of sources: public, private, and governmental. By fostering collaboration across sectors, it seeks to develop fresh approaches to global security, human rights, and environmental challenges. In today's fast-paced world, traditional policymaking can't always keep up with new threats. The Accelerator aims to bridge this gap by enabling real-time learning and adaptation, ensuring practical solutions that can make a real-world impact. By focusing on "learning by doing," the Accelerator prioritizes projects that can deliver innovative and effective results, advancing the Stimson Center's mission in dynamic new ways.

The Loomis Innovation Council itself serves as the premier forum for addressing these emerging global technology policy challenges. It brings together Stimson's extensive experience in international policy with the innovation and expertise of leaders from the tech sector. By merging policy insights with the ability to operationalize solutions, the Council provides a space for meaningful collaboration. Council members are part of a dynamic network of experts at the intersection of technology and policy. They apply their specialized knowledge to real-world policy issues, participating in valuable discussions that influence both the future of technology policy as well as the solutions to global challenges. Details at https://www.stimson.org/project/alfred-lee-loomis-innovation-council/

The primary author of this report is Dr. David Bray, both a Distinguished Fellow and Chair of the Accelerator with the Alfred Lee Loomis Innovation Council at the non-partisan Henry L. Stimson Center. He also is a CEO and transformation leader for different "under the radar" tech and data ventures seeking to get started in novel situations. He is Principal at LeadDoAdapt Ventures and has served in a variety of leadership roles in turbulent environments, including bioterrorism preparedness and response from 2000-2005. Dr. Bray previously was the Executive Director for a bipartisan National Commission on R&D, provided non-partisan leadership as a federal agency Senior Executive, worked with the U.S. Navy and Marines on improving organizational adaptability, and aided U.S. Special Operation Command's J5 Directorate on the challenges of countering disinformation online. He has received both the Joint Civilian Service Commendation Award and the National Intelligence Exceptional Achievement Medal.

David accepted a leadership role in December 2019 to direct the successful bipartisan Commission on the Geopolitical Impacts of New Technologies and Data that included Senator Mark Warner, Senator Rob Portman, Rep. Suzan DelBene, and Rep. Michael McCaul. From 2017 to the start of 2020, David also served as Executive Director for the People-

Centered Internet coalition Chaired by Internet co-originator Vint Cerf and was named a Senior Fellow with the Institute for Human-Machine Cognition starting in 2018. Business Insider named him one of the top "24 Americans Who Are Changing the World" under 40 and he was named a Young Global Leader by the World Economic Forum.

From 2017-2021, he both worked with multiple services associated with the U.S. Department of Defense on improving organizational adaptability and countering disinformation online – including personally surviving a disinformation attack that occurred in 2018. In 2019, he was invited to give the AI World Society Distinguished Lecture to the United Nations on UN Charter Day. In 2023, he was named a distinguished Academy Fellow with the National Academy of Public Administration focused on the role of transformative technologies in public service.

This report is a product of the Stimson Center's Loomis Accelerator. The image used for the report's cover and back was generated using AI, specifically FLUX Pro.

Chart 6: Key Findings and Implications from this Report

Strategic Imperative	Key Findings	Implications
1. Critical Capability Gap	Only 12.6% of aerial drone funding, 0.8% of surface drone funding, and 0.2% of underwater drone funding is allocated to truly warfighter-portable systems.	The U.S. lacks enough small, attritable drones that can be deployed by individual warfighters or small teams without specialized equipment or dedicated operators.
2. Contested Environment Reality	China has reportedly developed sophisticated counter-drone capabilities including "bullet curtain" defenses, laser weapons, and advanced electronic warfare systems.	Future conflicts will require overwhelming numbers of low-cost, attritable drones to saturate defenses, with mass deployment as the primary counter to advanced defensive systems.
3. Urgent Timeline to Act Now	The scale and pace of China's military modernization, coupled with lessons from Ukraine and other recent conflicts, demand immediate action.	Incremental approaches or minor adjustments to existing programs will not address the fundamental misalignment between current capabilities and operational requirements.
4. Accelerated Innovation Imperative	China's rapid advancement in drone and counter-drone technologies threatens to erode U.S. technological advantages.	The traditional acquisition cycle is too slow to keep pace with technological change, requiring novel approaches to rapidly develop, test, and field innovative drone capabilities.
5. Budget Realignment Necessity	Current budget allocations for small unmanned systems appear insufficient to meet the scale of requirements identified for potential conflicts based on recent conflicts using drones.	Current budget priorities do not reflect the critical importance of small, attritable drones in modern warfare, nor the quantities required for potential conflicts with China.
6. Industrial Base Challenge	Current munitions procurement levels remain significantly below Cold War peak years, with limited domestic production capacity for small drones.	The U.S. defense industrial base lacks the capacity, diversity, and resilience needed to support wartime production rates of small, attritable drone systems.
7. Production Capacity Crisis	Major conflict scenarios require 2,100-6,500 drones daily with attrition rates of 27.5-41%. Current production capacity is orders of magnitude below these requirements.	Even with the most optimistic production estimates, the U.S. would exhaust available drone stockpiles within days of a major conflict with China, creating a critical vulnerability.
8. Distributed Operations Advantage	Warfighter-portable drones incorporating next-generation hardware enable operations from numerous, unpredictable locations across the Indo-Pacific.	Small, attritable drones deployed from distributed locations can create multiple dilemmas for adversary targeting and force protection, enhancing operational resilience and effectiveness.

Chart 6 details the key findings and implications of this from Chapters 2, 3, and 4.

Chart 7: Eight Key Actions for Decision Makers

Action for Decision	Why It Matters	What Can Be Done Now
F1. Establish Rapid Drone Experimentation Force	Accelerates innovation cycles by testing new concepts and technologies in realistic conditions with operational forces, building on DIU's work while enabling direct transition to fielding	Direct establishment through SECDEF memo, allocate $250M from existing rapid acquisition authorities, establish quarterly field experiments with authority to transition directly to fielding
F2. Implement DoD Drone and Counter-Drone Sandbox Program	Enables operational units to experiment with both drone and counter-drone technologies during training, providing immediate feedback on effectiveness	Allocate $50M annually to establish facilities at major Combat Training Centers, maintain inventory of commercial drones and counter-drone systems
F3. Create Drone Industry Innovation Exchanges	Builds technical expertise and cross-sector relationships through flexible exchange programs between military and industry	Establish industry exchange positions annually with flexible participation models, prioritize personnel with operational experience, partner with leading drone manufacturers
F4. Accelerate Drone Generation Cycles	Prevents DoD from buying yesterday's technologies by implementing rapid, overlapping development cycles for successive drone generations	Implement 18-month technology cycles with $300M over three years, establish modular designs and continuous feedback mechanisms
F5. Advance Drone Test Ranges	Advances rapid evaluation of drone capabilities across diverse operational environments, accelerating development cycles	Invest $175M over three years to advance drone test ranges with standardized instrumentation and data collection
E1. Accelerate Drone Manufacturing	Expands domestic production capacity to meet wartime requirements through strategic capital deployment across the country	Direct OSC to lead the initiative with $1B over five years, combining direct investments, loans, and purchase guarantees across multiple regions
E2. Strengthen Supply Chains	Reduces vulnerabilities from foreign dependencies, single points of failure, and compromised components	Allocate $300M over three years, map critical supply chains, invest in domestic production of key components, implement security standards
E3. Ensure Pipeline of Future Technologies Today	Creates end-to-end process from advanced research to fielded capabilities, with DARPA and additional elements of USD(R&E) working in concert	Direct DARPA to research capabilities beyond commercial state-of-the-art and additional elements of USD(R&E) to bridge transition gap with $200M annual funding

Chart 7 summarizes the key actions, will details in sections 5.1 and 5.2 of this report.

“The innovation cycle now turns in days and weeks, not months and years. Our adversaries use $10,000 one-way drones that we shoot down with $2 million missiles … that cost-benefit curve is upside down.

Our current acquisition procurement system … I would just offer, it's outdated. It's glacial. I think it works in years and decades.”

Gen. Bryan P. Fenton, SOCOM Commander – April 2025

https://www.stimson.org/about/stimson/mission-vision/