# The Drone Arms Race

Drones (Unmanned Aerial Vehicles) have ushered in a new era of modern warfare with seismic implications that are reshaping the future of defense. Advancements across AI, sensors, materials, payload delivery systems, and engines are rapidly expanding UAV capabilities. Next-generation UAVs are arguably having the largest disruptive impact on combat since the introduction of the machine gun. As a result, militaries globally are "doubling down" on UAV R&D to avoid becoming vulnerable from the accelerating UAV revolution. Compared to traditional air-based military assets like fighter jets, drones are cheaper and easier to develop which allows virtually any government or non-state entity the ability to create a scalable "air force".

In This Report



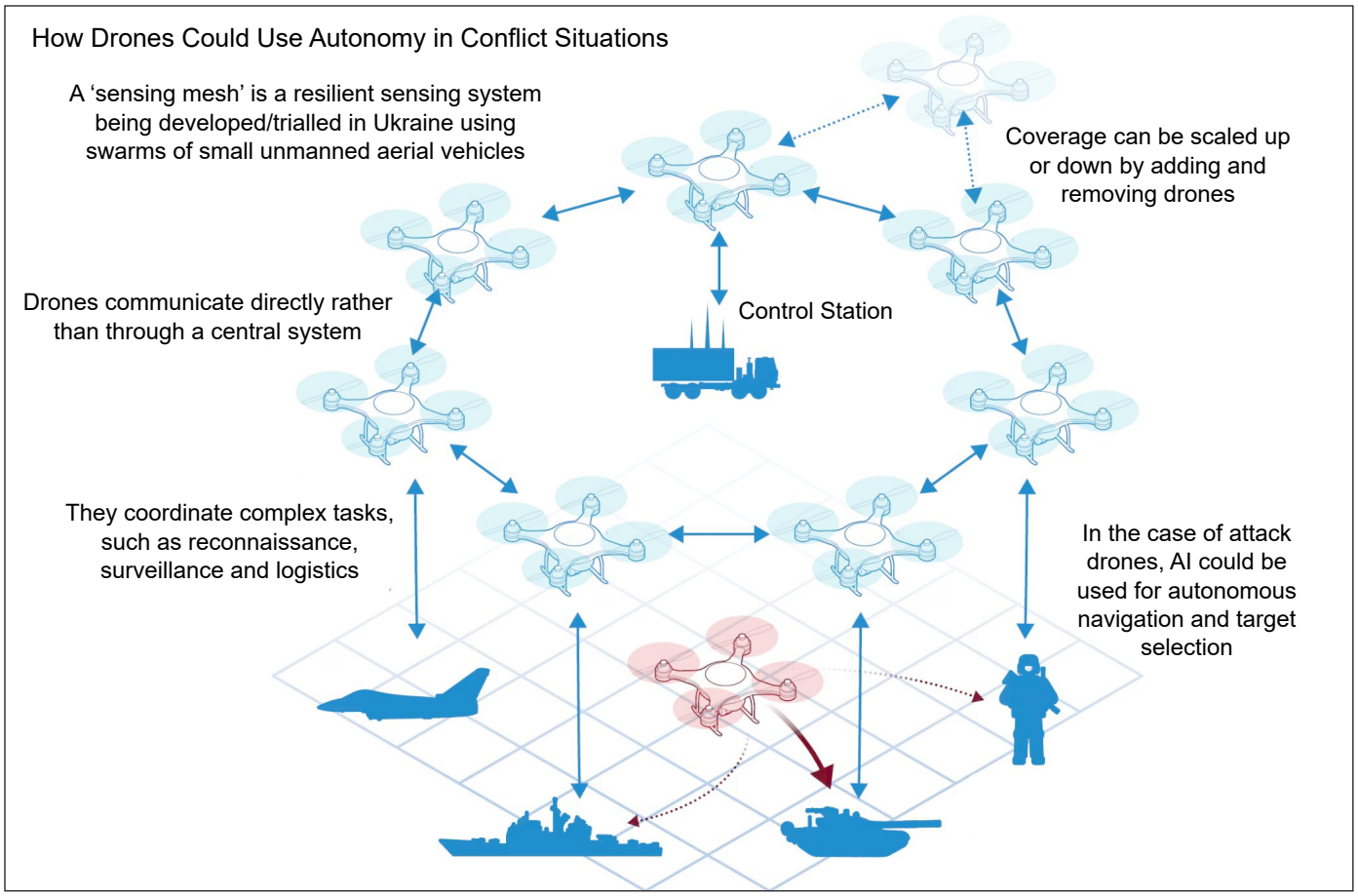
The Russia-Ukraine war marks the first true "drone war" and serves as a harbinger for the proliferation of UAVs across various defense applications. UAVs offer large "offensive" benefits while on the flip side create a multitude of "defensive" risks. For example, the Russia-Ukraine war has showcased the offensive effectiveness of UAVs by exposing the growing obsolescence of legacy military equipment including tanks and helicopters. Ukraine has utilized commercially available $400 UAVs to destroy Russian tanks worth $2 million.

On the defensive side, neutralizing UAV threats is forcing militaries to re-evaluate the economics of traditional defensive approaches due to emerging cost strains. Commonly used anti-drone munitions, including various 155-millimeter shell configurations, cost the U.S. military approximately $3000 each. Sophisticated "smart munitions" that "lock" onto a target including drones can cost between $2.5 to $4 million each. The Pentagon has noted that counter-UAV defense has created a cost-based defense conundrum.

This report argues that a global race to develop both leading UAVs and counter-drone capabilities is underway. This golden era of drone innovation is shifting the focus of global UAV development from large, long-range drones for large payload delivery and reconnaissance to a new generation of smaller UAVs with novel capabilities. Leading next-generation UAV classifications include AI-powered drones, stealthy "mini" drones, drone swarms, and fully autonomous "killer drones". In the counter-UAV weapon arena, R&D is focused on both kinetic and non-kinetic weaponry, autonomous defense systems, and "defensive" UAVs (**Chart 1**).

**Chart 1** UAV Combat Utilization




Source: U.K. Ministry of Defense, Financial Times

***"I think some of the areas that the chief [Gen. Randy George, Chief of staff of the Army] and I feel very strongly that we need to invest more in, both from the perspective of the Army... but also the needs of the joint force, is in the areas of unmanned aerial systems, counter-unmanned aerial systems"***

- Christine E. Wormuth,
United States Secretary of the Army

## China's Drone Supremacy

The UAV race has evolved into an escalatory flashpoint between the U.S. and China. China's stranglehold on the global drone market, of which Chinese drones account for 80% of global sales, has emerged as a key vulnerability to the U.S. and the West. Specifically, the West is acutely aware that the PLA leverages their drone leadership in defense-focused UAV technical expertise, development and direct access to equipment suppliers.

China is an innovation powerhouse and is now the global leader across multiple critical technologies that are essential in developing next-generation UAVs, underscores the Australian Strategic Policy Institute (ASPI). Out of 64 critical technologies and fields including defense, China is now the global leader in 57 of them. Importantly, the ASPI notes

that China currently has a technological monopoly in radar, advanced aircraft engines, drones, swarming and collaborative systems, and satellite positioning and navigation.

Beijing's lead in defense-focused critical technologies is revolutionizing the nation's defense capabilities. China is investing approximately $700 billion annually in defense, over 2x the previous estimates, according to recent U.S. intelligence reports. Next-generation UAVs are central to President Xi Jinping's goal of modernizing Chinese defense capabilities to become a "world-class" military power by 2035. Examples of advanced Chinese UAV capabilities include:

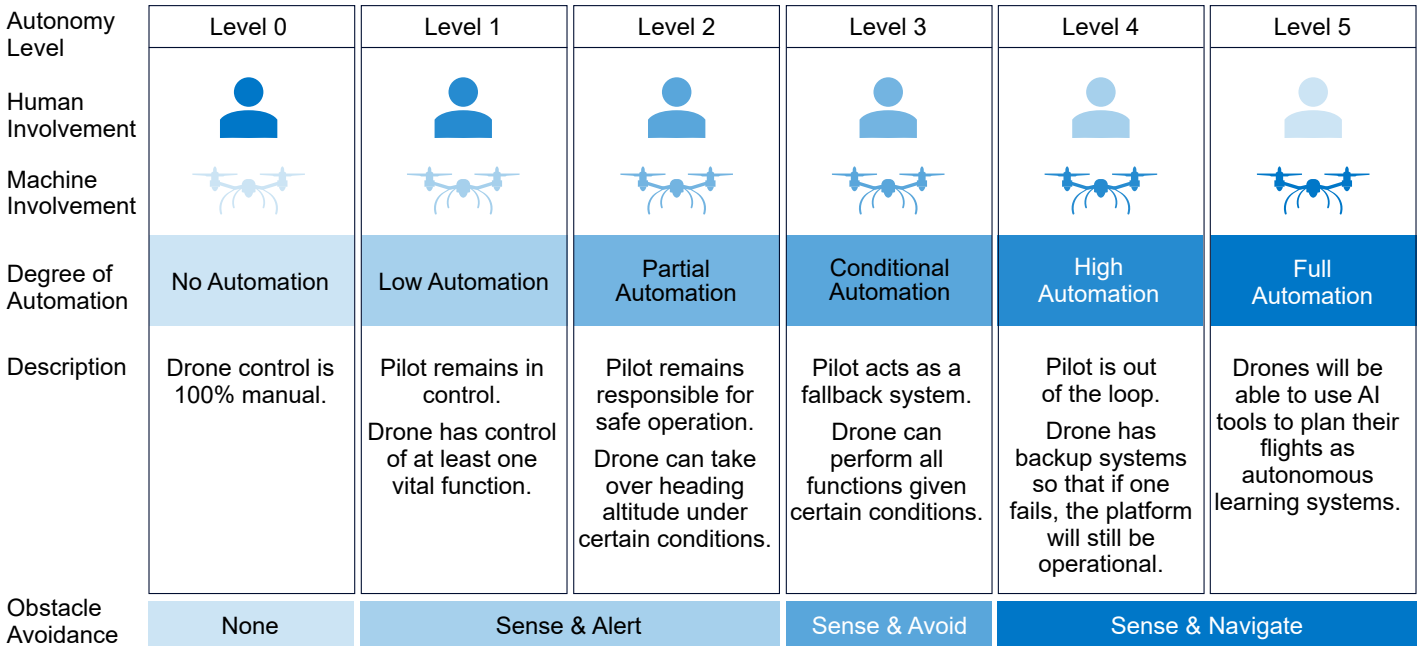
- A low-cost drone jet engine that retails for less than 20% of the comparable international price due to construction that requires 70% fewer mechanical components. This breakthrough is allowing the PLA to develop the world's cheapest, long-endurance and high-speed military drones.
- The unveiling of a war drone capable of rapidly "multiplying" midair. The multirotor UAV can split into two, three or even six smaller drones depending on operational requirements mid-flight. This is a "world's first", and reportedly has nearly double the flight efficiency of conventional drones.
- Novel drone-swarm communication methods centered on autonomous entity control, proactive environmental awareness, and a "human-like" approach to dialogue. This allows the drones in the swarm to independently divide tasks without human oversight, allowing each drone to think uniquely to make decisions for the betterment of the swarm in real time.

## The U.S. Is Playing UAV "Catch Up"

Mounting evidence indicates the U.S. military is prioritizing drone development over legacy military equipment. For example, in March of 2024, the U.S. Army, the world's largest-helicopter force, slashed a multi-billion-dollar legacy rotorcraft budget. Virtually all branches of the U.S. military are focused on UAV development and supporting systems. For example:

- Project Replicator, unveiled by the Pentagon in the fall of 2023, marks the largest initiative to boost U.S. drone capabilities to date. By August of 2025, the Pentagon plans to spend over $1 billion to deploy thousands of next-generation UAVs, some of which have fully autonomous capabilities. Deliveries already began in May of 2024, and the initiative is laying the groundwork for future rounds of "rapid" drone procurement.
- The U.S. Army is modernizing their technology package within Apache Helicopters to allow the crew to control a UAV that can operate over 30 miles ahead of the helicopter to defuse threats.
- The Air Force is focused on the development of the Collaborative Combat Aircraft (CCA) fleet. The CCA leverages a "drone wingman" that flies alongside crewed fighter aircrafts, including the F-35. The Air Force views the wingman as a key "force multiplier" for the future of combat and plans to have at least 1,000 CCAs by the late 2030s.
- The U.S. Navy has upgraded the George H.W. Bush aircraft carrier to field the world's first air drone warfare center. The control room will host operators of various unmanned systems, including the future wingman drones.

**Chart 2** Evolution Of Autonomous UAVs




Source: Drone Industry Insights

## The Autonomous "Killer Drone" Race

Military experts classify autonomous weaponry as a third revolution in warfare, proceeding the world changing inventions of gunpowder and the atom bomb. Achieving leadership in autonomous weaponry, including autonomous UAVs, could result in a profound shift in the global balance of power.

In early 2023, the DoD issued a directive to intensify the military's commitment to autonomous weapon development – the first of such directives in a decade. Autonomous UAVs are arguably the most dangerous technology of the global arms race. As stated by James Rogers, professor of war studies at the Danish Institute for Advanced Study, ***"We got to the point where these drones are deciding the fate of nations."***

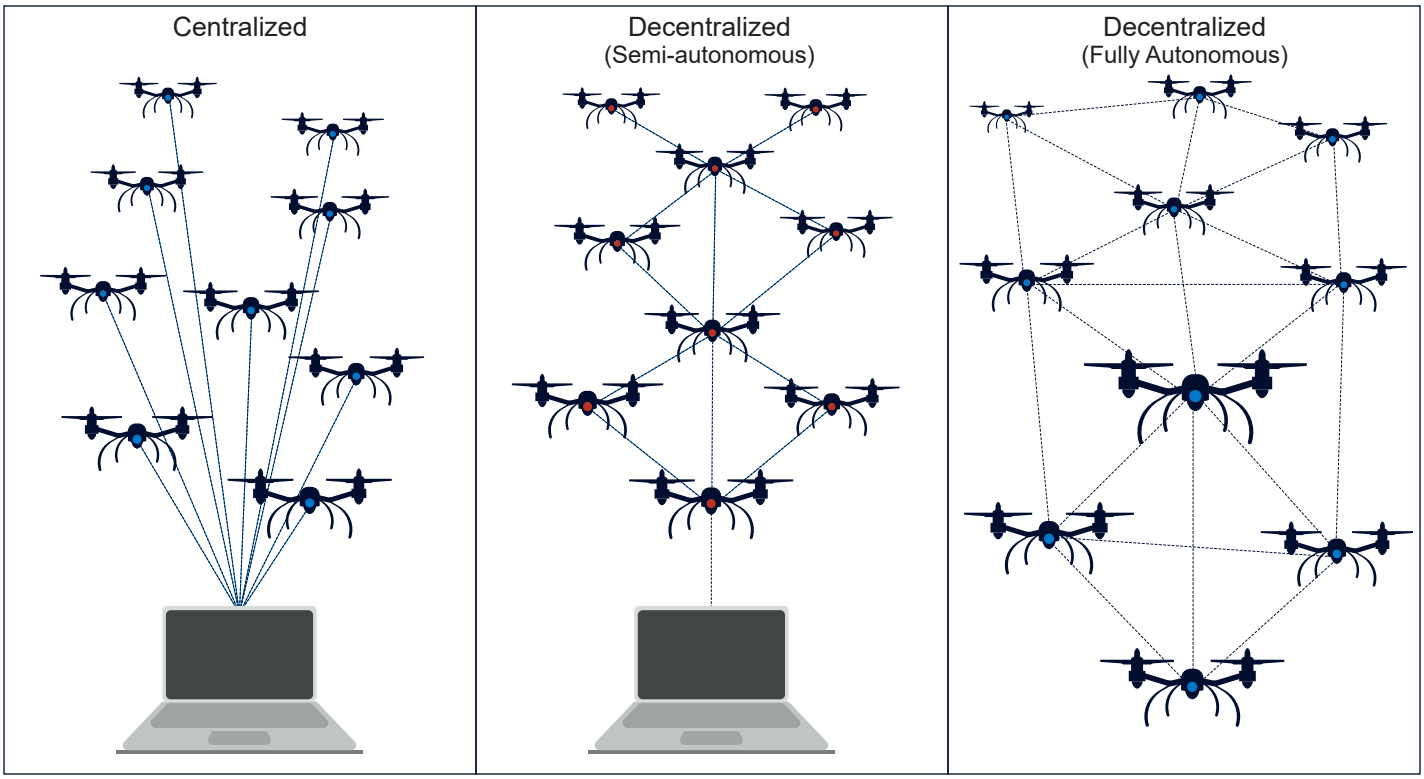
Autonomous UAVs mark the final frontier of UAV development (**Chart 2**). Already, global powers including the U.S., Ukraine, Russia, China, Israel, Iran, South Korea, the EU, and Turkey are integrating AI into drones to create "fully autonomous" killer drones.

While humans have traditionally been involved in the UAV decision "kill loop", rapidly advancing autonomous UAV capabilities are negating this need. Indeed, Ukrainian autonomous "killer drones" are now finding and engaging targets without human oversight, notes New Scientist. Removing humans from the kill loop allows the drones to make decisions at machine speed – a truly transformational yet highly escalatory capability. It is important to note that many nations, including the U.S., Russia, Australia, and Israel argue that no international law is needed to regulate such "killer drones".

Ofc they say that

In Ukraine, over 70% of territory on the front lines is suffering from drone "jamming" – where the

**Chart 3** Rise Of Drone Swarms




Source: U.S. Government Accountability Office

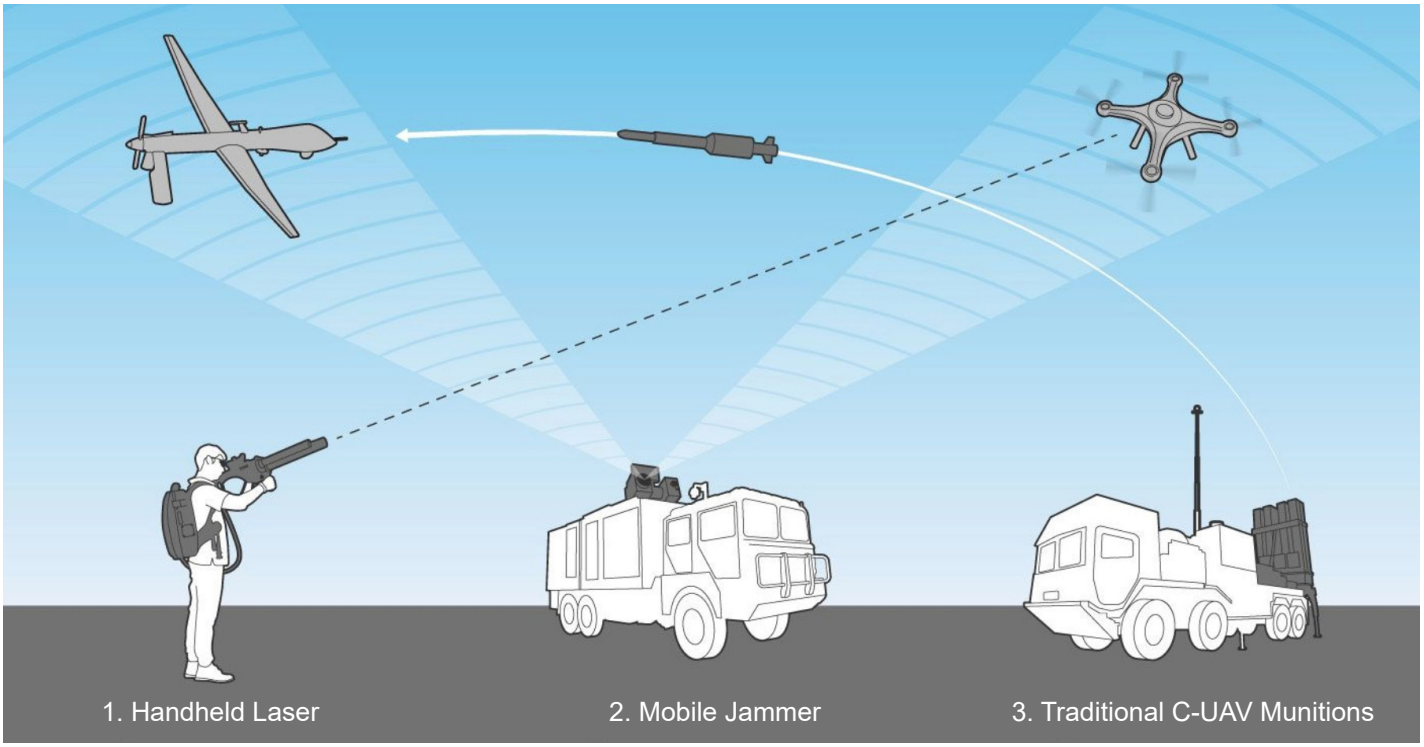
communication between a drone and its operator is disrupted. As a result, cheap commercially produced quadcopter drones last an average of just three flights before being neutralized or rendered unnavigable. Instead of using traditional GPS for navigation, autonomous drones use a layered resilience strategy that makes them less susceptible to jamming. This is a key tailwind for autonomous drones. Anti-jamming technologies leveraged by autonomous drones include inertial navigation systems, visual sensors, LiDAR, spread-spectrum signals, and frequency hopping.

## Proliferation Of Drone Swarms

Drone swarms formed by a cloud of coordinated small, stealthy drones are a key area of focus in the global UAV arms race. Current counter-UAV systems struggle to detect small drones as radar systems are trained to scan for larger aerial threats like missiles or fighter jets. For a radar to detect a small drone, the "cross section" the radar scans for must be reduced. But this then detects "noise" from "non-threats" including birds and is not efficacious.

Drone swarms fly in proximity and can change their shape and speed, adding yet another layer of detection woes (**Chart 3**). Advanced UAV swarms use AI to coordinate or even synchronize actions, optimizing their attack strategy in real time. Importantly, breakthroughs in drone swarming technology allow the swarm to continuously self-optimize if one drone is neutralized or if the target changes in real time from algorithmic feedback from sensor/combat data.

**Chart 4** Counter-UAV Weaponry




The effectiveness of drone swarms has already been proven in battle and is rapidly improving congruently with AI capabilities. Swarms have unparalleled battlefield utility, as they can be leveraged in virtually any combat application. Unleashing a swarm attack can easily overwhelm an adversary, forcing all attention on engaging the swarm threat itself and subsequently leaving the attacked susceptible to other forms of offensive attacks.

In 2021, Israel became the first nation to use AI-integrated swarming drones in combat. Numerous nations, including Russia, India, the U.K., Turkey, Israel, the U.S., and China are developing next-generation drone swarming capabilities. Autonomous drone swarms could rapidly escalate combat into becoming fully autonomous, as the only way to defend oneself is to do so autonomously. Simply put, the only effective defense if attacked by a killer drone or killer drone swarm is an autonomous drone or autonomous counter-UAV system.

## Counter UAV Systems

The defensive weaknesses exposed by UAVs, especially autonomous UAVs, has nations spiriting to create novel counter-UAV systems. Counter-UAV systems are now an essential part of effective deterrence (**Chart 4**). In Ukraine, autonomous anti-drone defense systems that require zero human intervention are already being widely used. Yet, new and improved systems will be needed as the capabilities of autonomous UAVs improve.

Globally, the counter-UAV market is roaring. By 2029, this market alone is forecast to grow to about $5 billion. Last year, the Pentagon allocated $700

million to counter UAV R&D, and nearly $80 million on procurement. Key focus areas guiding counter-UAV capabilities include:

- Developing next-generation radars with improved detection and identification capabilities.
- Improving kinetic weaponry to specialize in neutralizing drone threats. A key goal is to develop economically viable counter-UAV munitions.
- Creating robust non-kinetic weaponry, including weapons that can be carried by an individual soldier. Examples include next-generation direct energy weapons, hand-portable jammers, high-energy lasers and microwaves.
- Facilitating autonomy manipulation of an adversary's autonomous UAVs by improving the technical understanding of how the UAV's "brains" operate. As drones become more autonomous, using their "intelligence" against them becomes more possible and may prove to be more effective than jamming or shooting them down.

The U.S. is forging full steam ahead on advanced counter-UAV development with encouraging progress. For example, Fortem Technologies has produced a counter-UAV drone dubbed DroneHunter F700. The UAV is equipped with six rotors, an autonomous radar, and two "net heads" that can be fired to entrap an adversary's drones. Evidence also suggest that U.S. counter-UAV innovation is accelerating. This year, the DoD fielded a competition for a range of non-kinetic and kinetic weapons along with multi-mission radars, electro-optical/infrared cameras, radio frequency scanners and jammers, guided rockets, interceptor drones and small arms weapon systems. Next year, competitions are set for both UAV interceptors and mobile flat-panel array radars.

## Investment Considerations

Both next-generation UAVs and the counter-UAV systems needed to neutralize the emerging UAV threat is a significant area of competition within the global arms race. To reduce Sino UAV vulnerabilities, the House of Representatives has passed the "Countering CCP Drones Act". The bill which would ban the sale of new DJI drones in the U.S. but still needs senate approval.

Growing UAV capabilities from non-aligned nations is driving UAV adoption. For example, South Korea recently unveiled a plan to spend about $423 million over the next five years on UAVs following an explosive drone test from Pyongyang. NATO members near Russia have also jointly decided to build a "drone wall" on their eastern border with Russia.

Nations that are "AI leaders" will realize technical UAV and counter-UAV supremacy, as the autonomous drone sector is so closely correlated with advancements in the AI. In addition, we believe UAVs are poised to begin to disrupt the business models of the largest defense contractors. Unlike traditional weapon development programs that can take decades, innovation in the UAV space allows for accelerated R&D and procurement. This could help "level" the playing field in the defense industry and create a unique opportunity for smaller players to gain market share in the small and tactical drone market. Robust VC funding for military tech is also a key tailwind for the industry (**Chart 5**).

In 2024, worldwide procurement of UAVs is expected to top $14 billion and reach $23.1 billion annually by 2033. Forecasted totals equal $186.8 billion in procurement over the next 10 years, notes the Teal Group.

UAVs with leading autonomous capabilities including swarming, vertical or short takeoff and landing, advanced sensors, high-speed flight, and payload delivery capabilities are positioned to benefit. In addition, counter-UAV weapons that are continuously optimized to neutralize ever evolving UAV threats are also poised as key beneficiaries. Companies offering leading hardware and software solutions in the UAV and counter-UAV space include AeroVironment (AVAV), Kratos (KTOS), Teledyne Technologies (TDY), and Elbit Systems (ESLT).

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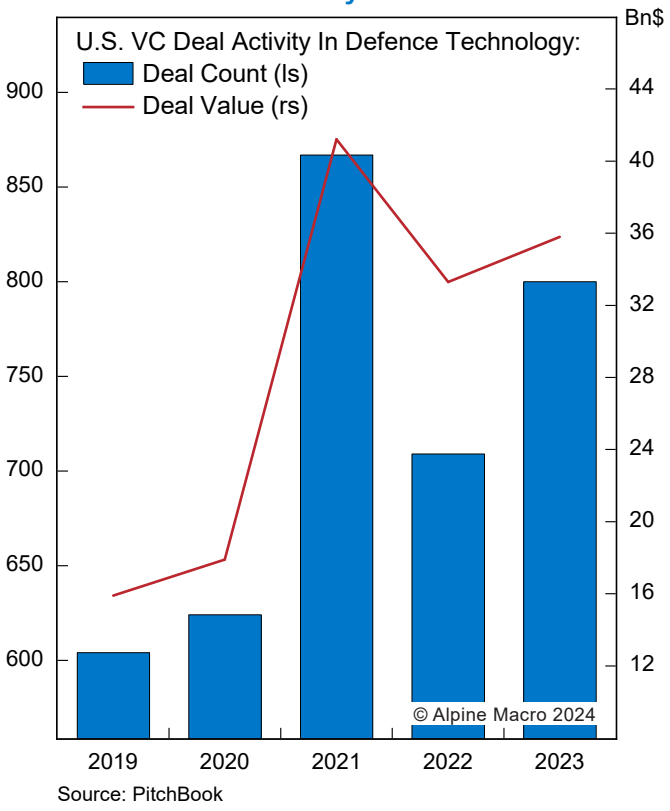
**Chart 5** **Increasing VC Funding For Military Tech**




Source: PitchBook