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# DRONES – A CREDIBLE ENABLER CHALLENGING THE HEGEMONY OF ARTILLERY IN CURRENT AND FUTURE CONFLICTS

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***Abstract:*** *This article explores how unmanned aerial systems (UAVs) are reshaping the tactical and strategic dynamics of modern warfare by evaluating their potential to rival traditional artillery in medium- and high-intensity conflicts. Using a mixed-method approach and comparative analysis of recent conflicts, it introduces a framework to assess UAVs against conventional artillery based on criteria like accuracy, cost-efficiency, mobility, survivability, and integration within the kill chain. The research reveals a growing doctrinal alignment between UAVs and artillery, suggesting not a full replacement, but a redefined role for artillery within multi-domain operations. It also examines the key vulnerabilities of UAVs in electronically contested environments and analyzes the logistical and doctrinal challenges of shifting toward a force structure centered on autonomous and semi-autonomous systems. Overall, the study supports an integrated vision of future warfare, underlining the urgent need for institutional and doctrinal adaptation to keep pace with rapid technological advancements in the military sphere.*

**Keywords: drones, UAVs, artillery, missile, fires**

## 1. Introduction

The rapid evolution of today's operational environment demands a reassessment of how traditional and emerging capabilities interact within modern military power. Among recent technological advances, drones (Unmanned Aerial Vehicles – UAVs) have emerged as particularly disruptive, with the potential to transform the nature of warfare and challenge the conventional dominance of systems like artillery.

From the conflicts in Nagorno-Karabakh to the high-intensity war in Ukraine, the widespread and innovative employment of drones suggests a potential recalibration of the traditional hegemony of field artillery within the doctrinal framework of fire support for joint operations.

This study is based on the premise that drones are not merely a technological extension of long-range strike capabilities, but rather a potential strategic enabler of the transition toward an operational paradigm centered on speed, precision and flexibility. Within this context, it becomes imperative to investigate a research question that remains insufficiently explored in the academic literature: *To what extent can drones reduce—or even replace—the role of field artillery in contemporary and future armed conflicts?*

This study adopts a dual approach: it compares the technical and tactical performance of UAVs versus conventional artillery, and examines emerging doctrinal trends on their integration, coexistence, or

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potential substitution within land forces.

Using a mixed, qualitatively focused methodology, the research draws on doctrinal documents, comparative system analyses, and case studies from recent conflicts.

The research is expected to reveal a clear trend toward operational convergence between UAVs and artillery, without supporting a complete substitution of the latter. Instead, a reconfiguration of indirect fire support doctrines is anticipated, in which drones play an increasingly significant role in Intelligence Surveillance Target Acquisition, and Reconnaissance (ISTAR) functions, precision strikes, and real-time fires correction. The conclusions will help clarify the conceptual boundaries between complementarity and substitution of these two capabilities and will provide recommendations for adapting force structure and doctrine to the evolving realities of the multi-domain battlespace.

## 2. Artillery and Missiles Are Back "The King of Battle"

Artillery has long been recognized by military strategists as a decisive force on the battlefield. Revered for its destructive power, particularly during the World Wars, it earned the title "King of Battle," complementing the infantry, the "Queen," in a dynamic drawn from chess that underscores their mutually reinforcing roles.

Artillery also forms the backbone of Russian military doctrine, which emphasizes massed firepower with maneuver forces in a supporting role, contrasting sharply with Western doctrines. This emphasis has given Russia a significant advantage in terms of artillery volume, munition variety, and strike range. While NATO forces focused on counterinsurgency, leading to the atrophy of large-scale artillery competencies, states like Russia, China, Iran, and North Korea advanced their fire support capabilities. Their modernization efforts have included long-range precision fires, drone integration, electronic and cyber warfare, and resilient, automated C2 systems.

Growing concerns over Russian aggression, particularly in the wake of the 2014 Zelenopillya artillery strike in Ukraine, spurred a doctrinal reassessment in the West. That strike, enabled by drone-guided targeting and electronic warfare, served as a wake-up call for NATO, prompting renewed focus on indirect fire capabilities.

In response, NATO and the U.S. have prioritized long-range, high-precision strike development to counter potential adversaries and penetrate Anti-Acces /Area Denial (A2/AD) systems. The U.S. is leading this effort, investing in precision-guided munitions and hypersonic systems to restore firepower dominance. Figure 1 provides a comparative overview of the current capabilities of NATO and Russian artillery and missile systems.

On the battlefield, Russia has demonstrated

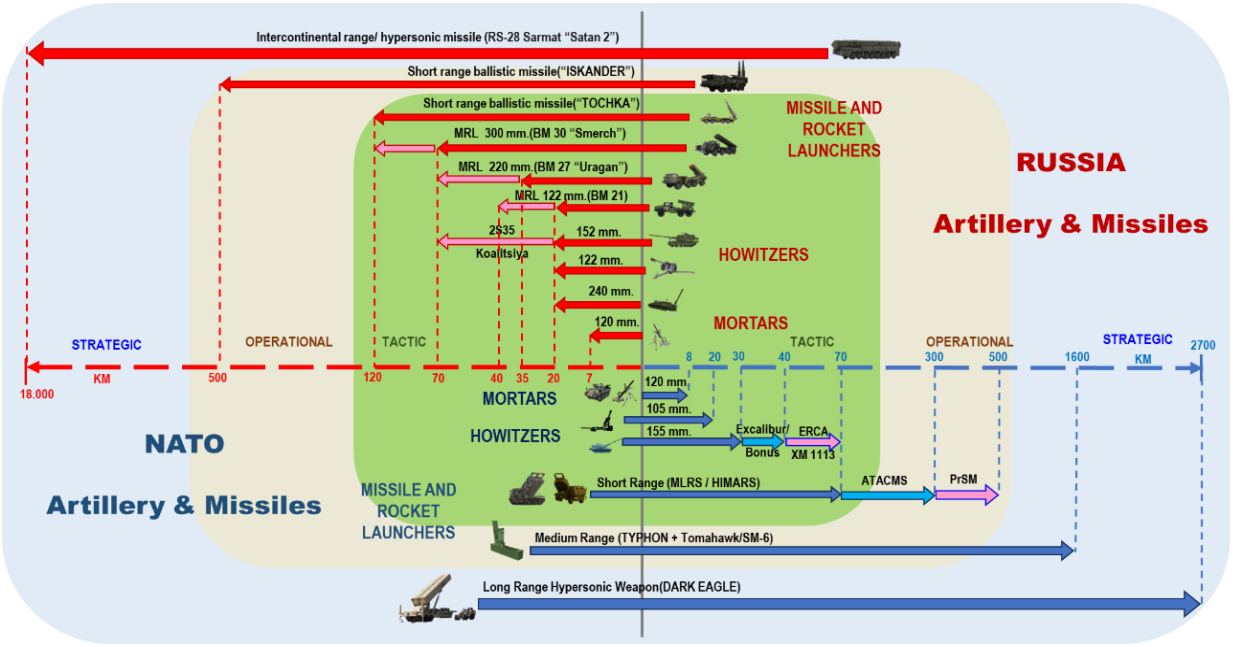


*Figure 1. Current Artillery and Missile Capabilities: NATO versus RUSSIA (Author's Concept)*

the effectiveness of its modernized artillery in Syria and Ukraine, integrating UAVs and electronic intelligence into a robust reconnaissance-strike complex [1]. Their use of "shock fire" tactics and rapid counter-battery operations has proven highly effective [2].

Ukraine, initially disadvantaged with a 5:1 to 10:1 artillery gap, has narrowed the divide with NATO support. The delivery of advanced systems such as HIMARS and MLRS extended Ukraine's reach and disrupted Russian logistics and command nodes. Still, counter-battery fire remains a persistent threat. To mitigate losses, Ukraine employs decoys, camouflage, mobility, and dispersed deployments. Resource constraints have also driven an increased reliance on drones as cost-effective, precision-strike tools—augmenting, but not replacing, conventional artillery [3].

## 3. The Rise of Drones in Contemporary Warfare

Throughout military history, long-range technologies have been strategically employed to maximize lethality while minimizing risk to operators, and drones unequivocally align with this paradigm. Drones are remotely piloted aircraft, varying in size, that are currently capable of performing a wide array of functions, including ISR, electronic warfare (EW), and precision strike operations.

Though often seen as new, drones have a history dating back to the early 20th century, with early models like the Curtiss-Sperry Flying Bomb and Kettering Bug in the U.S., and later the Queen Bee (UK) and V-1 (Germany). Over time, major powers such as the U.S., Russia, and Israel expanded drone capabilities for ISR, electronic warfare, and decoy missions. Key milestones include U.S. use in Vietnam (1964), Israel in Lebanon (1982), and the U.S. again in Iraq (2003), reflecting the steady integration of drones into modern military operations [4].

Post-2000, drone technology rapidly advanced, driven by significant investments from emerging powers like China, Iran, Turkey, and France. This made drones more widely available, including to non-state actors such as ISIS or Hamas. The deployment of ISR-strike platforms like the U.S. MQ-1 Predator and Israel's Heron and Hermes drones marked a turning point, establishing unmanned systems as force multipliers and essential tools in contemporary warfare [5].

The Syrian conflict became a key testing ground for unmanned aerial systems with strike capabilities. Russia used the opportunity to evaluate platforms like the Orion and Forpost in support of pro-Assad operations. Simultaneously, Turkey demonstrated the effectiveness of its Bayraktar TB2 drones in halting Syrian advances near Idlib [6]. Iran also capitalized on the conflict, deploying Shahed-129 drones—similar to the U.S. MQ-1 Predator—in attacks on Western coalition forces, marking a notable expansion of UAVs in regional asymmetric warfare [7].

The 2020 Azerbaijan-Armenia conflict is often dubbed the "first drone war" due to the large-scale and effective use of unmanned aerial systems (UAS) by both sides. Azerbaijani forces, in particular, leveraged Turkish-made Bayraktar TB2 drones to decisive effect, destroying around 30% of Armenian military assets. [8] (see Figure 2).

These drones played key roles in both suppressing enemy air defenses and capturing strike footage for propaganda. However, the conflict was not defined by drones alone; rather, it highlighted their critical integration with artillery, particularly for target acquisition, fire adjustment, and coordinating loitering munitions like the Harop, Orbiter-1K, Orbiter-3, and SkyStriker [9].

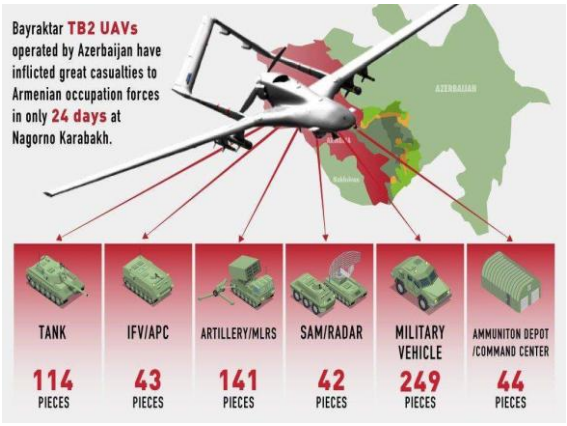


*Figure 2. Bayraktar TB2 Impact in 24 Days during the Nagorno-Karabakh Conflict* [10]

The conflicts in Ukraine and the Middle East have both emerged as defining "drone wars," marked by early and extensive drone use, rapid innovation, and fast-paced technological development.

Initially, Russia dominated drone operations in Ukraine, while Ukrainian forces began integrating UAVs in 2016, mainly for surveillance in Donbas, relying on civilian-sourced platforms. Following the February 2022 escalation, any UAV providing real-time imagery became a critical asset for tactical intelligence [11]. In the early weeks of the invasion, Ukraine successfully used Turkish Bayraktar TB2 drones to disrupt Russia's advance on Kyiv.

The "Magyar Birds" unit, established in August 2022, was Ukraine's first dedicated UAV force, born out of resource shortages. Using modified commercial drones like the DJI Mavic, it performed reconnaissance, targeting, and strike missions. In 2023, it became the first to use First-Person View (FPV) drones offensively, demonstrating their dual role as both ISR tools and precision strike assets [11].

In the Ukrainian conflict, UAVs range from micro-drones like the 12 cm Black Hornet to larger armed systems such as the Bayraktar TB2 and Orion. Ukraine widely uses commercial quadcopters like DJI drones for tactical tasks due to their affordability and versatility, while both sides increasingly employ loitering munitions for precision strikes.

For Ukraine, drones provide a crucial asymmetric advantage, helping to counter Russia's superior artillery and extend strike capabilities. While Ukraine has developed long-range fixed-wing drones (up to 800 km), its main focus has been on building a large fleet of FPV drones for fast, close-range targeting. Russia, meanwhile, relies heavily on Iranian-made Shahed 136 drones—now domestically produced as Geran-2—for low-altitude, evasive, saturation attacks.

Similarly, in the 2023 conflict, Hamas used suicide drones to disable Israeli defenses along the Gaza border, facilitating a major offensive. The Israel Defense Forces (IDF) responded with advanced drones for reconnaissance, tunnel scanning, and hostage location, alongside AI-driven target selection, demonstrating high levels of technological integration in combat operations [12].

## 4. Comparative Analysis: Drone Capabilities vs. Artillery

The steady flow of battlefield footage from recent conflicts often shows drones destroying tanks, disrupting enemy movements, and delivering critical reconnaissance, fueling the perception that unmanned systems may soon replace conventional artillery. However, this analysis challenges that view, arguing that drones and artillery serve distinct yet complementary roles in modern warfare. To clarify these differences, the study examines their respective uses in recent battles.

The Azerbaijan–Armenia conflict demonstrated the complementary roles of drones and conventional artillery, reaffirming the importance of indirect fires in modern warfare. While drones played a key role in precision strikes, Azerbaijan's major investments focused on self-propelled artillery and long-range rocket systems, which caused the most significant

damage. This strategy reflected the high cost and vulnerability of strike-capable drones, which are susceptible to jamming and air defenses. Consequently, drones were used for targeted, high-value missions, while artillery provided sustained, large-scale firepower for attritional combat.

At first glance, Ukraine's long-range strikes deep into Russian territory—conducted using remotely piloted or semi-autonomous drones—might be interpreted as the emergence of a "new artillery" for the 21st century. However, a closer analysis reveals that these platforms function more accurately as a "poor man's air force" rather than as a direct substitute for traditional indirect fire systems [13].

Unlike conventional artillery, drones offer superior operational versatility, capable of executing a wide range of missions—from precision strikes and ISR, to logistical resupply, electronic warfare, communications support, combat engineering, and force protection.

The continued and increasingly prominent relevance of modern artillery within force architecture can be convincingly substantiated, particularly when viewed through the lens of cost-effectiveness relative to low-value targets. Precision-guided 155 mm "smart" projectiles, combined with the extended range capabilities of modern artillery guns—reaching distances of 40 to 100 km—and augmented by the Multiple Rounds Simultaneous Impact (MRSI) technique, offer a robust and sustainable alternative to the employment of costly UAVs. Even higher performance is achieved with rocket artillery systems capable of engaging targets beyond 200 km, further strengthening the case for integrating high-precision indirect fire systems as either a replacement for or complement to drones.

Artillery and missile systems often benefit from layered air and missile defense coverage, a protection UAVs generally lack, leaving them more vulnerable in contested environments.

Economically, conventional artillery holds a structural advantage in cost-efficiency. Modern self-propelled systems offer high durability, capable of firing thousands of rounds with minimal performance loss. As well, even precision-guided artillery shells are significantly cheaper than advanced strike drones or loitering munitions, reinforcing artillery's cost-effectiveness in sustained operations.

This financial asymmetry underscores the sustainability and scalability of artillery in high-intensity conflict scenarios, where efficient resource expenditure becomes a critical determinant of resilience and the ability to sustain combat operations over extended periods.

To illustrate this point, we can refer to comparative data (as shown in Figure 3): the effect of a single conventional 152mm/155mm explosive projectile (approximate cost: $3,000) at its maximum range could alternatively be achieved through the use of 3–4 loitering munitions, whose cost—depending on type—may be three to thirty times higher. Thus, as engagement range increases, the destructive effect of a single artillery munition (especially in the case of rockets) could only be replicated by deploying dozens of high-performance drones, making this approach highly inefficient against area targets. Conversely, when engaging high-value, point-specific targets that require increased precision, minimal collateral damage, and the avoidance of unnecessary destruction, drone systems represent the most suitable and effective solution. For wide-area effects and cost efficiency, artillery (especially unguided rounds) remains preferable for low to medium-value targets. Loitering munitions are more suitable for precision engagements on high-value point targets where conventional artillery would risk overkill or excessive collateral damage. The disruption of supply chains,

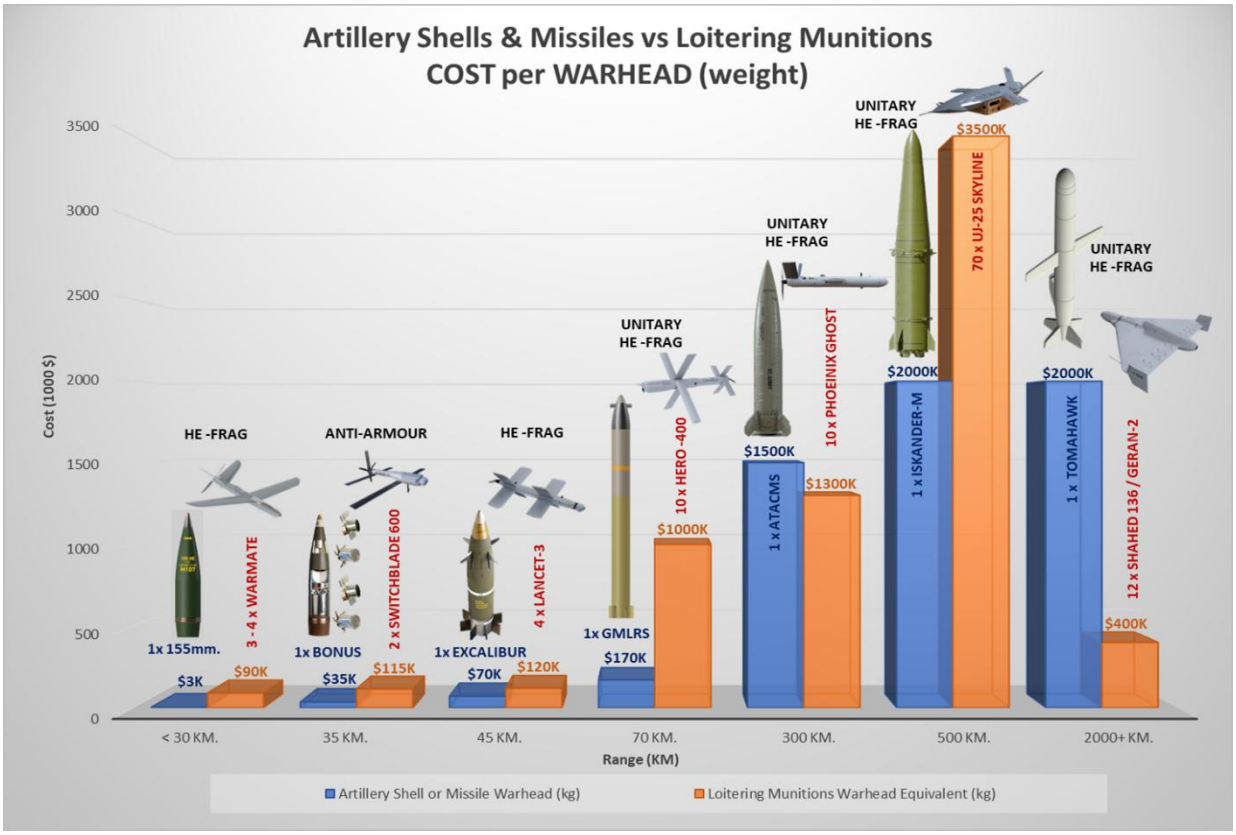


*Figure 3. Cost-equivalence between Artillery Ammunition and Loitering Munitions (Author's Concept)*

particularly for artillery forces, poses major operational dilemmas. For example, when three Russian ammunition depots—such as the 107th Arsenal in Toropets [14]—were effectively destroyed, along with billions of dollars' worth of artillery shells and rockets, by a swarm of drones costing, at worst, only tens of thousands of dollars, the Ukrainians clearly gained the upper hand in the cost-benefit equation. If Russia's overarching strategy is to exhaust Ukrainian resistance through attrition, then the degradation of artillery as the principal operational vector of this strategy may be interpreted as a potential indicator of failure [13].

In such a context, the loss of supremacy in the domain of indirect fires—whether through logistical erosion or through effective technological and tactical countermeasures employed by Ukraine—undermines the foundational assumptions of a strategy based on quantitative superiority and sustained strike tempo. Artillery remains the primary means of inflicting mass casualties on the battlefield, and recent data from the Russo-Ukrainian conflict indicates that approximately 80% of casualties and destruction are caused by conventional, unguided artillery shells. In contrast, while drones are valuable for their precision, their effects are typically limited and localized, lacking the capacity to generate paralyzing impact on the enemy. Even in strikes on critical infrastructure such as communications nodes, refineries, or power plants, UAVs rarely succeed in inflicting lasting damage or causing complete operational shutdowns.

In this regard, artillery continues to serve as the principal "breaching instrument" within offensive architecture, breaking through fortified structures and subsequently enabling drones to conduct precision strikes against essential nodes within the adversary's system.

## 5. Artillery and Drones – Convergence or Substitution?

As previously highlighted, drones have proven highly effective in modern warfare, particularly in intelligence, target acquisition, and fire correction. Originally designed for surveillance, UAVs now play a vital role in artillery operations by providing accurate targeting data, enabling rapid fire adjustments, and replacing or augmenting traditional forward observers—especially at long ranges and in high-risk environments. Unlike human observers, UAVs can operate deep within enemy territory, maintaining consistent performance over extended durations and eliminating risks associated with fatigue or human error. In this context, for detection and fire adjustment missions at ranges of 40–70 km or beyond, drones represent ideal forward observation platforms. They significantly enhance the efficiency and lethality of artillery systems while preserving trained human personnel—a resource far more valuable than hardware [15].

The 2020 Armenia–Azerbaijan conflict showcased the operational value of drones in supporting indirect fires, with Azerbaijani forces using UAVs to detect and strike Armenian positions. Similarly, Ukraine, learning from Russia's use of drones in 2014, has refined and elevated drone-artillery integration, using UAVs for precise, persistent targeting while maintaining conventional artillery's vital role. By internalizing the fundamental principles of warfare, Ukrainian commanders have maintained a firm commitment to the use of conventional artillery, recognizing that drones—while highly valuable for enhancing situational awareness and delivering precision fire support—cannot replace the intrinsic capabilities of artillery: extended range, high volume of fire, destructive power, and operational reliability in diverse weather conditions.

Artillery delivers massed fire and psychological impact across wide areas—capabilities drones cannot match. Instead, drones offer precision and situational awareness, complementing rather than replacing artillery. Together, they form a unified fire support system: drones for detection and accuracy, artillery for range, volume, and destructive power. Drone-guided artillery can strike high-value targets at distances up to 100 km, while precision missiles and advanced drones are better suited for deep, high-accuracy strikes. This integrated approach shows that drones and artillery are not rivals but complementary systems within a unified fire support framework, which is illustrated in Figure 4.

Drones still face key limitations—difficulty identifying camouflaged targets, dependence on GPS, and vulnerability to jamming—making human oversight and

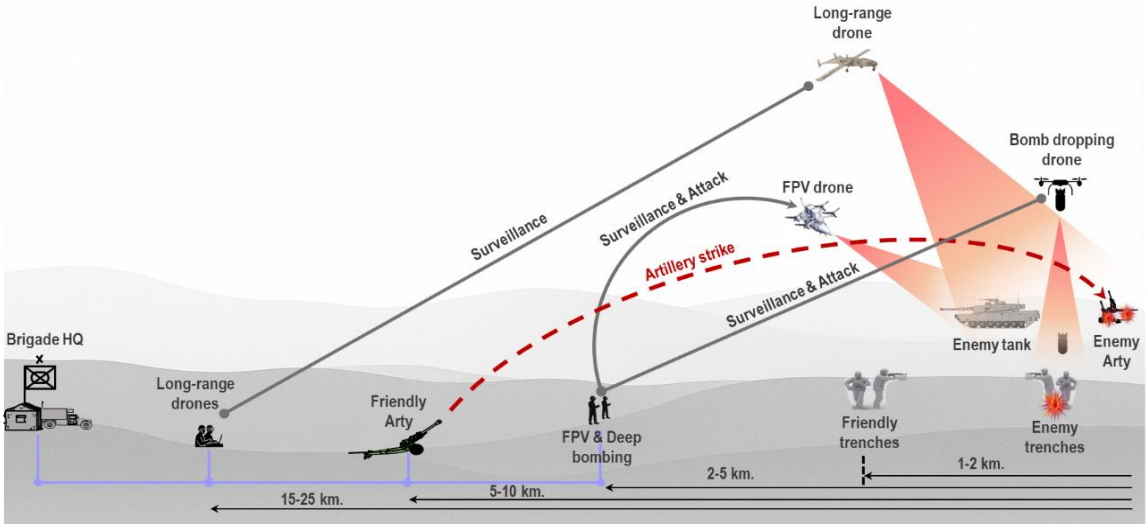


*Figure 3. Integration and Complementarity of Drones with Artillery. Adapted from* [16]

system integration essential. Moreover, while drone strikes are precise, they lack the psychological shock effect of massed artillery, and their media portrayal can even downplay the realities of war.

Relying on drones alone as a battlefield solution would be a strategic error. History shows the dangers of over-specialization. The future lies in synergizing new and traditional systems—leveraging drones to enhance, not replace, the enduring strengths of artillery.

## 6. Emerging Ballistic Vectors in Future Conflicts

The rapid integration of drones has clearly transformed combat tactics by enhancing precision, reducing risk to personnel, and accelerating decision-making. However, this shift also presents challenges for doctrine, force structure, and training, demanding ongoing adaptation.

A key driver of this transformation is artificial intelligence (AI), which allows UAVs to autonomously identify, track, and engage targets, significantly shortening the Observe–Orient–Decide–Act (OODA) loop and increasing strike efficiency. AI also helps counter electronic warfare by enabling adaptive guidance and coordination within drone swarms—collections of small, intelligent UAVs capable of acting autonomously and collaboratively to overwhelm enemy defenses [17].

Swarm warfare, first used operationally in 2021 by Israel and later by Ukraine, exemplifies this evolution. These AI-guided systems function as integrated sensor–decider–effector units, reducing human input and boosting responsiveness and resilience [18].

Advanced concepts like the U.S. Precision Strike Missile (PrSM) and China's Jiutian SS-UAV—a high-altitude drone carrier launching swarms over vast distances—highlight the shift toward "mothership" systems for long-range autonomous strike operations.

This evolution has prompted structural change: by 2024, Ukraine and Russia had established dedicated "Drone Corps" [19], and similar formations are expected in the U.S. and NATO. Looking ahead, drones will not replace artillery but will operate alongside it as equal partners in tech-enabled warfare, prompting a doctrinal shift that redefines artillery's role within an integrated and increasingly autonomous firepower architecture.

## 7. Conclusions

Drones and artillery are currently complementary, and while drones may challenge artillery's dominance in the future, this shift depends on multiple factors. Drones offer key advantages—high-precision strikes at lower cost, operational flexibility, and rapid targeting—even in contested environments. Advances in AI and electronic warfare are pushing drones toward autonomy, potentially transforming them into core combat assets.

However, drones still face limitations: they lack the volume of fire for large-scale operations, are vulnerable to air defenses and jamming, and rely on complex supply chains. In contrast, artillery can be stockpiled, operates reliably in varied conditions, and is evolving through "smart" precision-guided, AI-enabled systems.

Recent conflicts show that while drones enhance precision and reshape counter-battery warfare, they cannot fully replace artillery. Lessons from Ukraine indicate that the artillery of the future will not be defined solely by gun caliber, but rather by who sees first, strikes first, and repositions fastest.

Artillery remains essential for delivering sustained, high-intensity fire. The future lies not in choosing between the two, but in integrating them—combining artillery's firepower with drones' sensing and targeting capabilities to build a more adaptive and effective firepower architecture.

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