

DRONES – WEAPON SYSTEMS WITH A GROWING ROLE IN MILITARY CONFLICT –

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To strengthen national security, promote national interests, achieve or maintain technological superiority, and keep up with competitors, most states are increasingly focusing on developing effective and efficient military technologies. Drones are reshaping the way warfare is conducted in all domains. Recent conflicts, including the wars in Ukraine and in the Middle East, have been characterized by the use of drones on an unprecedented scale, making a relevant contribution to achieving success on the battlefield, which has triggered the race to develop cost-effective interceptors/drones against drones. The evolution of drones has gone, in a relatively short time, through several phases, moving from the target drone to the space-operating drone.

The lessons of war have generated questions regarding the possibility of replacing traditional weapons by drones, their classification as a type of weapon, as well as challenges regarding their reliability, potential advantages and disadvantages. Drones have proven effective in operations and environments where other types of technology are difficult to use. The primary motivation for drone using – getting soldiers out of harm's way – has been recognized during this period. Amid rising geopolitical tensions, technological advances in drones and artificial intelligence continue to reshape warfare and transform the battlefield.

Keywords: drones; unmanned aerial vehicles; reconnaissance; surveillance; swarming drones; UAV;

INTRODUCTION

The great powers have recently given increased importance to the development of emerging military technologies that have demonstrated, in recent conflicts, that they have a relevant contribution to consolidating and guaranteeing national security, in obtaining or maintaining supremacy in potential conflicts, as well as to keep up with other competitors. We are living in a world defined by conflicts that are seemingly difficult to resolve, heightened competition between great powers, and growing challenges generated by climate change, nuclear proliferation, and economic uncertainty (Miller, 2025, pp. 1-2).

Ever since the bow and arrow were invented thousands of years ago, killing from a distance, in one form or another, has been a defining feature of warfare. Drones have become essential to national security doctrines and strategies. They all essentially perform the same functions: providing intelligence, surveillance, and reconnaissance to wartime decision-makers and neutralizing adversary personnel and equipment. The US military's drone fleet ranges in size, shape, and sophistication, from the ground forces' hand-launched *Raven* drones to the Air Force's *Global Hawk*, which can reach altitudes of 20,000 m (Shaw, 2014, p. 1).

Emerging technologies and strategic competition between great powers mean that evolving technological advances, such as artificial intelligence, machine learning and anti-access/area denial capabilities, lethal autonomous weapon systems and, most recently, *drones* create difficult situations for military decision-makers in conducting combat actions but also in executing logistical support operations. Armed forces must be provided with equipment to execute precision strikes, at a distance, penetrate anti-access/area denial capabilities, and ensure efficient logistical support. To meet these challenges, there is now increased pressure to stimulate innovation, test new technologies, and implement them in the shortest possible time.

The emergence and development of *unmanned aerial vehicles (UAVs)*, commonly known as *drones (technology that has adapted to the new operational requirements and operates in all domains)*, have revolutionized the way warfare is conducted, representing an evolution that influences the future of the national security of the great powers. Although, initially, the main purpose of drones was surveillance, reconnaissance and intelligence collection, they were later equipped

with weapons for use, in a new type of action or strategy carefully planned, to achieve a specific purpose, in counterinsurgency campaigns or in the so-called “*War on Terror*” as well as in military combat actions (Haqpan, 2013, pp. 1-5). Unmanned systems – drones – are fundamentally changing how forces of all sizes, as well as non-state actors achieve their objectives and how military equipment and capabilities are employed (DoD, 2024, pp. 1-2).

The war in Ukraine has been characterized by the deployment of drones on an unprecedented scale, thousands of drones have been used to track enemy forces, direct artillery fire, and strike targets. Analysing the effects of the use of drones, it can be concluded that they represent a technology that transforms warfare (Zafra, 2024, p. 1).

Drones represent *recent topics of interest* for: analysis, debate, lessons learned, security strategies and doctrines, future force structure; identifying and countering threats posed by: adversaries with similar military capabilities, “*rogue states*” and emerging technologies; and, the impact of major global risks. The world has entered an era of drone warfare. In five major interstate wars in recent years – those in Libya, Nagorno-Karabakh, Syria, Ukraine, and the Middle East – armed drones have played a dominant, perhaps decisive, role. There are debates about their use against non-state actors, or speculation about their potential role in war between the United States of America and close competitors such as China (Lyll, 2020, p. 1, 14).

Drone warfare is one of the most relevant developments in international security of the 21st century. Drone attacks have been used in various conflicts and by different actors, including the USA, Russia, Turkey, Azerbaijan, Ukraine, Iran, Israel, Nigeria, Iraq, Saudi Arabia, the United Arab Emirates and militant groups, reaching a record number of 805 Russian drones in a single night in September 2025 (Chiu, 2025, p. 7). The USA has carried out thousands of drone attacks, from attacks on non-state actors such as al-Qaeda to the January 2020 operation that killed Iranian General Qasem Soleimani. Turkey used armed drones domestically against the Kurdistan Workers’ Party and in Syria in 2020, marking the first time a country has usedUCAVs (unmanned combat aerial vehicles) in a large-scale conventional attack on the battlefield (Horowitz, 2020, pp. 1-2).

In the war in Ukraine, which began on 24 February 2022 with the large-scale invasion of Ukraine by the Russian armed forces, *drones have become a fundamental technology* in the conduct of military actions. These cheap, unmanned flight systems, generally no heavier than a few kilograms and assembled from relatively simple, commercially available components, have sometimes caused significant destructive effects on the armed forces of both conflicting countries, especially Russia, but also

on civilians in Ukrainian localities. The importance of these technologies quickly became apparent to both Kiev and Moscow. Both have developed ambitious strategies to stimulate their domestic production of versatile aerial platforms and to support innovation in order to continuously overcome new countermeasures used by the enemy (Höller, 2025, pp. 1-3, 15-20).

Drones are used to provide useful imagery and information to make more effective and timely data-driven decisions. Artificial intelligence has the potential to produce a force multiplier effect by optimizing human capabilities and adding superior capabilities to less expensive military systems. For example, a single low-cost drone is harmless against a high-tech system like the *F-35 stealth fighter*, but a “swarm” of such drones could overwhelm high-tech systems, thus generating operational advantages and simplifications in the achievement of logistical support and, at the same time, transforming some current platforms into relatively outdated equipment. Technological advances are significantly influencing modern warfare – where robots, *swarming drones* and weapons using artificial intelligence could one day rule the land, the sky and the seas (Sayler, 2020, pp. 13, 29).

Drones are changing the way combat operations are conducted. This technology is gaining more and more attention and promises to bring a higher level of efficiency in tasks such as *data and image acquisition* of areas of interest, *location and tracking of specific targets* (target detection, classification and identification), *map compilation*, *communication relay operation*, *border patrol*, ***military operations***, *persistent surveillance of large areas and search and rescue*. Therefore, the use of such systems offers a credible alternative to manned aircraft. They operate in more dangerous conditions, with greater autonomy and can be very cost-effective compared to manned aircraft (STANAG 4586, 2014, p. 3-1). Recent conflicts also show how drone exports have increasingly become a *diplomatic tool* and with the increase in drone use, states have leveraged drone exports to increase their *global influence* (Greenberg, 2022, pp. 1-5).

In recent months, there has been a remarkable increase in the number of wars involving *nuclear powers*. Between 7 and 10 May 2025, India and Pakistan exchanged artillery fire, bombs, cruise missiles, and *drones* in the most intense round of fighting since 1999. Then, on 1 June 2025, Ukraine carried out a sophisticated covert operation – an unprecedented direct attack on a country’s nuclear deterrent, neutralizing bombers that Russia would use if it ever launched a nuclear attack. And on 13 June, 200 Israeli aircraft carried out a surprise attack on Iranian nuclear facilities and strategic targets (Malkasian, 2025, p. 1).

BRIEF HISTORY OF THE EVOLUTION OF DRONES. CLASSIFICATION

The records of drone use date back to the 19th century, when approximately 200 unmanned balloons containing bombs were used by the Austrians against the city of *Venice* in 1849. Later, similar balloons were used in the American Civil War in 1862 and the *Spanish–American War* in 1898 for reconnaissance and bombing purposes, producing some of the first aerial reconnaissance photographs. Aerial surveillance was used extensively in the First World War (Vyas, 2025, pp. 1–7; IWM, 2025, pp. 1–12).

Drones, like other land, air, sea and space platforms, are a form of *power projection*. They provide the ability to launch attacks without necessarily putting personnel in direct danger. It is rare to find a technology that can *change the nature of war*. In the first half of the last century, *tanks and aircrafts* dominated the way war was fought. The fifty years that followed were dominated by *nuclear warheads and intercontinental ballistic missiles*, weapons that shaped doctrines to prevent states from ever using them. The advent of *armed drones* overturned this calculation: *war was possible precisely because it seemed so risk-free*. The “bar” for the level of warfare had been lowered, the era of remote control had begun, and killer drones became last generation equipment (Shaw, 2014, p. 24).

Drones, either crudely constructed or improvised, have been used since the First World War, but reached a high level of sophistication in the Yugoslav wars of 1991–2001 and in the wars in the Middle East. The USA first used an armed drone in late 2001 in Afghanistan. 3 November 2025 marked 23 years since a remotely controlled drone was first used to commit extrajudicial killing “*beyond the battlefield*” to hunt down and kill individuals in a country with which the USA was not at war. Another example is the attack on a vehicle in Marib province, Yemen, target: Qa’id Salim Sinan al-Harithi (Dronewars, 2022, p. 1).

The main phases in the evolution of drones are described below. For each *phase*, the following *criteria* will be referenced: 1. *Time period*; 2. *Institutions*; 3. *Military logic/reasoning*; 4. *Key geographic areas*; 5. *Spatial logic/reasoning*; 6. *Iconic drones*.

Phase 1 – target drone: in the early 21st century, drones were used as training dummies. *Criteria description*: 1. Early 21st century; 2. Army, (USA); 3. Drones were used as practice dummies; 4. Developed at military shooting ranges in the UK and USA; 6. Hewitt-Sperry automatic airplane, Kettering torpedo.

Phase 2 – drone - flying bomb: in the interwar period and during the Second World War, the drone was imagined as a kind of flying bomb that could be launched behind enemy lines. *Criteria description*: 1. Interwar period; 2. Air Force,

USA; 3. Drones were used to deliver bombs and deliver messages to the enemy's disposition; guided to the target by radio; 4. Tested across the English Channel; 5. Cross the battlefield, bomb the enemy in depth; 6. Glide bomb, modified B17 bomber (Aphrodite, GB-Glider Bomb, 1943).

Phase 3 – surveillance platform drone: during the Cold War, it was used for gathering intelligence in restricted areas. *Criteria description:* 1. Cold War, Vietnam War (1964–1975), especially after the Cuban Missile Crisis; 2. Air Force and Strategic Command, USA; 3. Drones were used to photograph denied or dangerous areas; 4. Drones were used in North Vietnam, Cuba, China; 5. Battlefield surveillance, capture photos; 6. Various drones “Firebee”, “Bat”, “Ryan 147”, “AQM-34”, also known as Lighting bugs.

Phase 4 – the hunter-killer drone: since the outbreak of the war on terror (11 September 2001) the drone has been transformed into a *weapon*, combining *surveillance with killing*, thus becoming a combined hunter-killer or predator. *Criteria description:* 1. Post 11 September 2001; 2. US Air Force, CIA and JSOC; 3. Drones were used in a military “manhunt” during the war on terror; 4. Afghanistan (AF), Pakistan, Yemen and Somalia (CIA, JSOC); 5. Hunting dangerous individuals in the battle space; 6. Predator, and later the Reaper drone, as well as the Reaven portable drone.

Phase 5 – the drone as a police technology in domestic law enforcement. *Criteria description:* 1. Post 11 September 2001; 2. Police Forces, Customs and Border Patrol; 3. Drones are used by police forces in the USA and Europe; 4. Cities in the global north, used by hobbyists and criminals; 5. Monitor the street, protect VIP buildings; 6. Various drones (unmanned helicopter with four rotors).

Phase 6 – drones for intelligence collection, surveillance and reconnaissance combined with the ability to destroy personnel and equipment (Shaw, 2014, pp. 6-8) and *intercept drones* have been used in attacks in Pakistan, Ukraine, the Middle East (Ruitenbergh, 2025, pp. 1-6). Drones represent an increasingly greater challenge, confirmed by the War in Ukraine. These systems can track and hit moving tanks, artillery pieces and command posts or radio electronic means (Gosselin-Malo, 2025, pp. 1-6). Both sides involved in the Russo-Ukrainian war use drones, making it one of the first modern examples of drone use in an ongoing war (Gillis, 2024, pp. 1-10).

In response to the growing challenges posed by electronic warfare systems, both Ukraine and Russia are racing to develop next-generation drones guided by artificial intelligence. These drones identify and lock onto their targets without the need for communication with their operator, making them impervious

to signal jamming (Zafra, 2025, pp. 3-15). With Ukraine and Russia deploying millions of drones on the battlefield, the race to develop “*Octopus*” interceptors/drones – a “*new and advanced air defence interceptor drone*” – latest generation, *cost-effective* and *highly combat-effective* military equipment – began. *Criteria description*: 1. War on Terror, 2001, 2004-2015, War in Ukraine 2022-2025, War in the Middle East; 2. Land Forces, Special Forces (USA, Russia, Ukraine, UK); 3. Drones are used to neutralize personnel, equipment and infrastructure; 4. Pakistan, Ukraine, Middle East; 5. Detects and destroys personnel, armoured vehicles, and drones; 6. The MQ-1 Predator, Bayraktar TB2, Shahed 136, Ukrjet UJ-22, Orlan-10, Octopus.

Phase 7 – naval surveillance drones, which include both *surface and underwater vehicles*. In 1898 Nikola Tesla built the first radio-controlled ship, a boat (Ruitenbergh, 2025, pp. 1-6; Chiu, 2024, pp. 1-9) and Germany launched an underwater surveillance network with drones (Gosselin-Malo, 2025, pp. 1-3). The USA is pursuing an “*integrated three-dimensional surveillance system*” consisting of warships, submarines, aircraft, satellites, underwater drones, underwater microphones, and surface ships, and the Indo-Pacific region has become the main arena of military competition between the United States of America and China (Peck, 2025, pp. 1-6). In November 2016, the US Navy completed a test of a “*swarm*” of five unmanned boats equipped with artificial intelligence, which intercepted an “*intruder*” ship. The results of this experiment could lead to the adaptation of artificial intelligence technology for harbour defence and for other underwater missions, such as submarine hunting. *Criteria description*: 1. Starting with the Cold War Period, 1950, 2016, 2022-2025; 2. Naval Forces of China, USA, Russia, Germany; 3. Drones are used for underwater surveillance to detect enemy submarines and ships, destroy underwater sensors; 4. Indo-Pacific region, North Sea and Baltic, Greenland-Iceland-United Kingdom intersection; 5. Detects and classifies a variety of underwater threats; 6. SG-1 Fathom drones, Lura.

Phase 8 – space-operating drone (Sayler, 2025, p. 15). In the period 2021-2024 NASA used an autonomous drone that operated on Mars (Gillis, 2024, pp. 16-20). There are programs for the development of advanced aerospace attack capabilities based on reusable propellants (Kunertova, 2021, p. 69). Kinetic interceptors – drones – deployed in space do not have the constraints specific to other environments, but due to continuous movement, they cannot station or monitor an area for a long time, implying a *constellation* of such means to achieve permanent coverage of areas of interest (Karako, 2022, pp. 1-8; Shaw, 2018, pp. 1-8).

Criteria description: 1. 2021-2024, NASA used an autonomous drone operating on Mars. Interceptors – under study after 2022; 2. National Aeronautics and Space Administration/NASA; 3. Drones are used for endo-atmospheric interception of missiles, satellites. Aerospace attack capabilities based on reusable systems; 4. Space; 5. According to the data received from the sensors, it destroys missiles, satellites, sensors etc.; 6. Ingenuity Mars Helicopter. Equipment similar to the Falcon 9 rocket¹.

Classification of drone systems. The design, operation and regulations of aircraft vary greatly depending on their type and intended use. Aerial systems are classified in terms of the *existence of a crew* into two categories: a) *manned systems* and b) *other categories of aircraft*, which also include *unmanned aerial vehicles (UAVs)* or *drones*. Each category of aircraft has several subdivisions/classes. Aircraft are classified, certified and used in civil, general aviation, military (*developed for combat*) or other type of aviation asset (Abdullah, 2023, pp. 1-12). Drones can be classified, *according to the type of actions they support*, into two categories: those used for *reconnaissance and surveillance* purposes, in support of military actions and those armed with weapons for the purpose of *conducting military actions* (Boussios, 2015, pp. 1, 43).

Drones are *classified* according to different criteria: *wing type* (1. *with rotor* and 2. *with fixed wing*); *weight* (*very small* – 200 g, *small* – up to 1 kg, *medium* – up to 20 kg, *large* – weigh over 20 kg); *range* (*very small* – up to 5 km, *small* – up to 50 km, *short* – up to 150 km, *medium* – up to 640 km, *long* – over 640 km); *energy source* (battery, gasoline, hydrogen fuel cell and solar) and *type of activity* (toy, for photography or videography, racing, *FPV* drones (a “*first-person view*” drone – which transmits a live, real-time view from its camera to the operator, who sees it either through special glasses or on a monitor), search and rescue, *military*, construction and agricultural) (Gillis, 2024, pp. 1-10).

THE POTENTIAL FOR EMPLOYING DRONES IN ARMED CONFLICTS

Reconnaissance, surveillance, intelligence collection and fire assets neutralization are essential for maintaining information advantage, superiority in personnel and equipment on the battlefield and mission accomplishment, and unmanned aircraft,

¹ Sources for Criteria Description: Shaw, 2014, pp. 1, 6-8, 24; Gosselin-Malo, 2025, pp. 1-3; Gosselin-Malo, 2024, pp. 1-6; Peck, 2025, pp. 1-6; Brock, 2023, pp. 1-10; Gosselin-Malo, 2025, pp. 1-3; Gillis, 2024, pp. 1-10, 16-20; Zafra, 2024, pp. 1, 3-15; Kunertova, 2021, p. 55, 69; Becker, 2020, pp. 3-5; Franke, 2017, pp. 1, 3-12; Saylor, 2020, pp. 1, 13 -16, 29; Ruitenbergh, 2025, pp. 1-5; Chiu, 2025, pp. 1-9.

flexible and agile, help to provide extensive battlefield coverage, while being difficult to detect and intercept. This chapter will explore the role of drones in surveillance, battlefield reconnaissance, striking targets and achieving objectives, potential advantages, disadvantages and limitations of drone use and challenges in collecting and evaluating data and acting on timely reconnaissance data.

In the past year, unconventional warfare has undergone rapid changes, from cyber and information warfare to the use of drones (unmanned aerial vehicles) in all environments, air, land and sea, with an unprecedented development of drone and counter-drone technology in all theatres of operations, simultaneously generating debates about the features of the force of the future. We are witnessing a technological revolution, and new technologies, especially drones, due to their results on the battlefield, are being implemented at a rapid pace by all armed forces. Drones contribute to maintaining the efficiency of combat, support and logistics forces, to strengthening the resilience and capacity to support the reaction posture of the armed forces. They also contribute to preparing the force of the future, modernizing weapon systems and rethinking the entire defence ecosystem, from industrial production to force training (Ruitenbergh, 2025, pp. 2-5).

Characteristics of swarming drones – they have a *degree of autonomy* (not under centralized control), are able to detect their local environment and other participants, communicate locally with drones in the swarm and cooperate to accomplish a specific task. “*Swarming*” is a part of the development of autonomous vehicles, with uses ranging from large formations of “*low-cost*” drones designed to *overwhelm* defensive systems to small squadrons of drones that coordinate to provide *electronic attack, fire support, and localized navigation and communications networks* for ground troop formations (Sayler, 2020, pp. 14-15).

Integration of Drones into the Force Structure – Features, Characteristics

As militaries struggle to learn the lessons of the war between Russia and Ukraine, one question looms above all: *Can drones replace traditional weapons, such as aviation, tanks, and artillery?* Effective use of drones also requires developing the tactics, techniques, and procedures of the force categories that operate them, while integrating the use of drones into combat or combat support structures, reshaping operational requirements for military equipment, and accelerating military innovation cycles across all militaries (DoD, 2024, pp. 1-2). The military use of drones in the air, land and sea is booming, as well as the need to ensure their energy source. The war in Ukraine confirmed that batteries, and therefore essential

minerals, are truly important for both drones and communications. *Almost 80% of weapons systems rely on essential minerals* (Williams, 2025, pp. 1-3).

Chinese arms manufacturers are selling drones, promoted as capable of full autonomy, including the ability to carry out lethal targeted attacks. Some analysts warn that the proliferation of AI systems could decouple *military power* from population size and *economic power*. This decoupling could allow smaller countries and non-state actors to have a *disproportionately large impact* on the battlefield if they are able to take advantage of the scaling effects of AI (Saylor, 2020, pp. 16, 29).

An *unmanned aerial vehicle* (UAV) or *unmanned aircraft system* (UAS), often referred to as a drone, is an aircraft without a *physical human pilot on board*. Instead, a ground operator controls the flight of the UAV remotely via a communications link. Drones can be *remotely piloted* from a ground station or can *fly autonomously* using signals from ground-based sensors. The term *Unmanned Aerial System* (UAS) is often used in reference to drones because it emphasizes the importance of elements beyond the UAV, which generally include ground-based control systems and support equipment, such as a *command centre*.

The US Federal Aviation Administration (FAA) defines a UAV as a “*motorized aerial vehicle (powered by mechanical or electrical power) that does not have a human operator on board, uses aerodynamic forces to provide lift off the ground, can fly autonomously or be remotely piloted, can be disposable or recoverable, and can carry a lethal or non-lethal payload*”. It means that a UAV generally falls into the category of *powered take-off and landing aircraft*. Small UAVs/drones mainly use lithium-ion (Li-ion) or lithium-polymer (Li-Po) batteries to power electric motors. UAVs/drones are *powered by internal combustion engines or hybrid internal combustion engines and electrical sources* (a facility where electricity is generated for distribution). In the United States of America, the FAA defines any unmanned or *unoccupied aircraft* as a *drone*, regardless of its size or weight. Therefore, a *radio-controlled aircraft* is always officially classified as a *drone* if it has a flight control system that allows it to *fly autonomously (the human operator is part of the target selection and strike decision process)* (Embry-Riddle, 2022, pp. 1-26).

UAVs have most often been associated with the military, with drones being deployed on missions deemed too dangerous for manned aircraft. They were initially used for anti-aircraft training, intelligence collection and, more controversially, as *weapon platforms*. For military purposes, drones have two basic functions: flight and navigation. In order to fly, drones must have a power source, such as a battery or fuel. They also typically have rotors, propellers, or wings, and a frame.

Drones require a “*controller*”, which allows the operator to use remote controls to launch, navigate, and land the aircraft – all while the pilot remains on the ground. Controllers communicate with the drone using radio waves, such as Wi-Fi. Drones also typically have an onboard camera, which transmits what it sees to the operator’s control system. Some drones can automatically fly a set path using a *combination of sensors* to detect obstacles for collision avoidance and *GPS*. A common implementation of this function is the return-to-home feature on some consumer drones (Gillis, 2024, pp. 16–20). The British drone, the Zephyr, can fly non-stop for over 82 hours, is less expensive and does not involve exposure to risks for its own personnel (Boussios, 2015, p. 43). *The initial use of drones* was as weapons in the form of remotely piloted aerial missile *launchers*.

Drone features vary depending on the intended use. Examples of distinguishing attributes or aspects, features or inherent parts include the following: various types of high-performance cameras; artificial intelligence to have the ability to track targets; augmented reality features that overlay virtual objects on top of the drone’s camera feed; media storage format; maximum flight time, which determines how long the drone can stay in the air; maximum speeds, including climb and descent; hover accuracy (an aircraft that can hover in one place in the air); obstacle sensing range; altitude hold, to keep the drone at a fixed altitude; live video feed; flight logs; automatic return to home point and tracking mode (Vyas, 2025, pp. 1-25).

New drone strategies have already emerged, with US Secretary of Defense Pete Hegseth arguing in a July 2025 *Memorandum* that small drones should be *treated as munitions*, not aircraft, an aspect that could spur drone production and move forward very quickly. *The Memorandum* regulates several essential aspects. Most importantly, it treats small drones *under 25 kilograms* – so-called *Group 1 and 2 drones* – as *consumables* rather than “*durable goods*” (Tucker, 2025, pp. 1-10). In recent years, there have been debates in the USA about the rapid expansion of drone forces, the production of prototypes, experiments, and especially a doctrine regarding the use of drones in a war similar to the one in Ukraine.

One experiment in Indiana featured a pickup truck carrying a refrigerator-sized box in the middle of a field, from which six drones emerged in succession from a “*hive*”, rose into the air, and remained stationary to strike the target. Inside, screens showed the target, as well as the location of other elements, network connectivity, and more. The drones then moved to eliminate the target: an armoured vehicle some distance away. No actual large-scale coordinated fire materialized. But the most important elements of the demonstration were invisible: *a network of new*

detection, communication, and autonomy technologies working together under tight time constraints to show a new way forward for drone warfare – one with all the elements that the Ukrainians say they wish they had had in greater numbers from the start. They include *better communications, concrete doctrine, and a robust manufacturing base* (Tucker, 2025, pp. 1-10).

The USA is already working to develop ground force tactics, techniques, and procedures for operating FPV armed drones with operator vision while integrating the use of drones by infantry units. In May 2025, the USA announced that *the YFQ-44* combat aircraft, an *autonomous drone* designed to fly alongside the most advanced air force fighter jets, had officially begun ground testing. Advances in artificial intelligence and the use of drones in combat operations continue to argue that they represent an effective technique, leading the armed forces of many states to adapt their defence doctrines and strategies and to identify new companies that can provide them with the necessary drone stocks (Losey, 2025, pp. 1-15). Drone dominance is both a *process race* (a series of actions or steps taken to achieve a specific goal) and a *technology race*. Modern battlefield innovation requires a new procurement strategy that connects manufacturers with frontline troops. Fighting forces will take a technological leap, equipped with a variety of low-cost drones, manufactured by top engineers and artificial intelligence experts.

Leaders of major powers have pledged to rebuild militaries *to match threats with capabilities*. *Drones are the biggest battlefield innovation in a generation*, accounting for most of the casualties in the past year of the war in Ukraine. Global production of military drones has skyrocketed in the past three years. The realities of the modern battlefield have demonstrated that combat structures must be equipped with *small, lethal drones*. The US Department will invest in *unmanned aerial systems (UAS)*, such as single-strike capabilities and *loitering munitions*. By the end of 2026, each infantry group will have disposable, low-cost drones, with priority given to Indo-Pacific combat units and in accordance with other strategic guidance documents from the Secretary of Defense (Secretary of Defense, 2025, pp. 1-5).

The results of using drones in war. On 14 April 2022, Ukrainian forces stunned the world when they sank the heavily armed cruiser *Moskva*, the flagship of Russia's Black Sea Fleet, managing to hit the ship with their homegrown *Neptune* missiles, despite the ship's significant defences and the coordinated support of *Bayraktar TB2* unmanned drones, which are not detectable by radar (Cagaptay, 2022, p. 1). What seemed like a theoretical possibility became frighteningly close

to reality in June 2025, when Ukraine's *Operation "Spider's Web"* took place. Ukrainian agents spent months illegally smuggling hundreds of drones into Russia. In a coordinated attack, more than 100 small drones destroyed between 20 and 40 Russian warplanes at five air bases spread from Moscow to Siberia. The damage was a blow to Russian air power or the Kremlin's pride. Drone footage of burning bombers sent a terrifying message to nations around the world. If it could happen to Russia, it could happen to any country, including the United States of America. Operation Spider's Web represents an event, discovery, or change that marks a milestone or turning point in the use of drones. The emergence of small, easily transportable drones warns that even facilities thousands of kilometres from the contact line are not safe (Peck, 2025, p. 1). Beginning on 13 June 2025, as part of Operation Rising Lion, Israel used single-target attack drones that had been smuggled into Iran piece by piece to destroy Iranian air defences, helping Israel gain full control of Iranian airspace (Horowitz, 2025, p. 1).

The concentration of anti-aircraft systems near the front lines has created a no-fly zone for aviation and has amplified the role of drones, especially FPV drones, small and cheap drones that have become one of the most powerful weapons in the war in Ukraine. They take off from improvised platforms located from 5 km to 20 km from the front line, depending on the battery capacity and payload, are usually controlled by two ground operators and carry an explosive charge with which they accurately hit targets, tanks, artillery pieces, radio stations (Boussios, 2015, p. 44).

Potential benefits and risks. Like any military technology, drones have their own *advantages and disadvantages* regarding their use in combat.

Advantages. The latest research has shown that the weapon systems on board these drones are becoming even *smaller in size* and *more precise*. *Accuracy on target*, relative ease of use, *reduced* (human) *risk* and considerably *reduced costs* compared to other means with similar effect on target, as well as *the high cost* of protection against them make them *very effective capabilities*. Thus, a global proliferation of drones has been triggered very quickly (Boussios, 2015, p. 45). Detecting drones and protecting sensitive capabilities within military installations and base locations is a threat posed by the way drones operate. Automating some or all of the flight requirements of remotely controlled drones allows for significant cost savings and multiplies the effects on the target. In addition, autonomous systems are generally able to react substantially faster than operators (Lucas, 2016, p. 10). Drones make manoeuvring difficult and force troops and vehicles to remain

in shelter and fortifications, and FPV drones, guided by fibre optic cables, cannot be jammed.

The use of drones creates a situation in which the place of decisive human decision-making physically moves *outside the area of combat actions* and, at the same time, it is becoming increasingly characteristic that the decision, chronologically, is located quite *far from the moment of kinetic action* (Boussios, 2015, p. 44).

Among the relevant advantages can be mentioned: unmanned (low risk); capable of extended surveillance with autonomy; full-motion video (day or night); increases effectiveness and combat power; protection through real-time situational monitoring; both tactical and strategic platforms; capable of autonomous flight; capable of air-to-ground weapons launch; CAS – close air support; detection and neutralization – convoy security; signals intelligence collection (SIGINT); imagery intelligence collection (IMINT)/Ground Moving Target Indicator (GMTI); communications intelligence support (COMINT); electronic intelligence collection (ELINT); rapid response and target determination for indirect fire (IDF), ambush/troops in contact (TIC); high-value person targeting (HVI), and named/targeted area of interest (NAI/TAI) recognition (Wallestad, 2011, pp. 1-3).

Potential risks. The UN Charter, Art. 2, 44 and numerous international treaties prohibit the killing of persons on foreign territory, outside of an armed conflict, except in extraordinary circumstances. Drone attacks have a powerful effect on the adversary and create enormous short-term benefits, but the damage they cause to political alliances in the long term is worrying. The legal, authorized use of drones is conditioned by location and purpose. In the area of “*declared*” combat actions, the use of drones has clear rules of engagement. According to the UN Charter, Art. 51, countries can use force in self-defence. Article 2, paragraph (4) of the UN Charter prohibits the use of force (Boussios, 2015, p. 45).

The precision and accuracy of drone attacks are conditioned by *information from the ground* and its *timely transmission*. There have been situations when close-up video recordings of the effects of drone action have been made live. However, there are some doubts about whether: the targets were selected correctly, collateral damage was avoided and whether the on-board equipment provides images that correspond to the real description of the target. Even if the final result seems to be a success, it leaves a trace of doubt about how precise the confirmation of the target was: equipment or personnel, hostile (Ib., p. 44).

Among the essential disadvantages can be mentioned: reinforcing the feeling of “*distant enemy*” or something else, creating a false image in public opinion

about the consequences of the war; questionable legality that further distances policy from practice; drone use reflects torture – a “*torturer*” harming a helpless victim, without any risk to himself -, created by the image of a drone operator in Langley firing on a target in Afghanistan, which differs from conventional armed conflict in which two adversaries pose a *similar level of threat* to the other; may be subject to cyberattacks or enemy interception; potential to foster domestic terrorism; data overload; lasting psychological effects on pilots due to lethal use on a video monitor (as if playing a video game) (Wallestad, 2011, pp. 1-3).

There are already drone interceptors, technology developed by Ukraine, the UK and other states – a technology that has proven “*extremely effective*” against the Shahed unidirectional attack drones and costs less than 10% of the cost of the Russian systems they destroy (Ruitenbergh, 2025, pp. 1-5).

Countering drones. Mobile counter-drone systems are being experimented with, which can be deployed, including by commercial aircraft, to respond to drone incursions, thus supplementing the sometimes difficult-to-implement multi-layered defences of military installations, including jamming, microwave and laser weapons, and kinetic weapons such as machine guns (Peck, 2025, pp. 1-6). Directed energy weapons (DEWs) (lasers and microwave weapons) complement kinetic weapons and will combat various emerging threats, such as *swarming drones*. While DEWs are best suited to combat drones for now, the use of laser weapons could represent a less expensive alternative to missile-based defences, which can be overwhelmed by multiple targets, against scenarios with swarms of small, inexpensive drones flying at low altitudes. Electronic warfare methods have also been used to block drone signals by jamming radio frequencies (Demarest, 2023, p. 4).

One of the main concerns with today’s non-autonomous remote-controlled weapons systems is represented by the issue of both insecure connections to the remote operator and the possibility of enemy interference. There is the possibility that the enemy could “*hack*” the computerized control systems frequently used for network communication (Lucas, 2016, p. 10). Many analysts believe that electronic warfare is the most effective defence against small drone variants. Defending military bases against drones is both a matter of law and a matter of technology. Responding to drone attack requires specific and explicit rules of engagement. There is an informal political agreement concluded in 1987, the Missile Technology Control Regime – to limit the proliferation of missiles and missile technologies – which also applies to certain unmanned aerial vehicles (drones) and obstructs the trade in drones with other states (Dent, 2025, p. 1).

CONCLUSIONS

Evaluating the use of drones in combat actions in recent conflicts, it results that they are very effective and efficient; drones that cost a few hundred dollars can neutralize expensive combat equipment – tanks, artillery pieces, radio-electronic stations or warehouses with stocks of vital materials to support the war – worth millions of dollars, which demonstrates their transformative role in modern warfare. To deal with a large number of drone incursions, especially small ones and in groups/swarms, simultaneously on multiple critical military installations and locations, militaries need more anti-drone technology and expanded authority to act against them, as well as accelerating the production of technologies to detect and destroy enemy drones. At the strategic level, drones provide the ability to substantially reduce personnel losses, financial costs, and public disapproval of the conflict, while at the operational level, they disrupt combat assurance measures, force manoeuvre, and logistic support.

The effects of using drones in combat determine the re-examination of the following aspects: the defence of forces, bases and strategic positions, providing rapid solutions with an emphasis on the detection, tracking and identification of threats, as well as active and passive defence. The following elements: keeping pace with advances in unmanned systems; clarifying, streamlining and delegating authority as necessary; adapting force doctrines; organizing, equipping, leading and training personnel; strategies for using and countering drones and deploying sufficient means of defence against attacks in swarms and simultaneously at multiple locations will contribute to achieving a competitive advantage.

The widespread use of drones in the war in Ukraine has led to an equally high demand for anti-drone equipment. *Directed energy weapons* represent an alternative option to expensive means of countering drones, an effective tool for defending against attacks by armed drones, which have been widely used in the Russo-Ukrainian war and other regional conflicts. Interceptor drones, state-of-the-art equipment, inexpensive compared to conventional drones and air defence missiles, are an effective option in countering waves of unidirectional attack drones.

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