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## Essential approaches to the use of combat drones. Specific elements of the armed conflict in Ukraine

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### Abstract

Although used many years ago, by multinational allied forces acting in coalition in Iraq and Afghanistan, combat drones known as "unmanned aircraft systems" (UAS), "unmanned aerial vehicles" (UAV), "unmanned combat aerial vehicles" (UCAV) or "remotely piloted vehicles" (RPV) represent a formidable weapon both for NATO states and for the forces fighting in Ukraine. Considering their essential characteristics, dimensions, load capacity, speed, range, flexibility, ease of operation and low costs, these means of combat come with huge advantages in achieving the operational objectives of combatant structures - regardless of the category they belong to. Thus, the present study includes a theoretical approach that can actually be implemented in the military operational realm, because it includes details and essential references to combat drones designed, produced and used by belligerent and non-belligerent states in connection with the armed conflict taking place on Ukrainian territory. Starting from the objective of the study, a series of important directions resulted for strengthening the actual potential of the joint and tactical forces to be used in national and multinational context within the North Atlantic Alliance, against the aggressive force of an adversary state.

### Keywords:

armed conflict; multinational joint and tactical operations; combat drones; swarm drones; jamming and neutralizing drones; drone instructors; drone schools.

### Article info

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The armed conflict in Ukraine highlights the profound technological impact on the effectiveness of tactics and equipment compared to several decades ago. According to the American publication *Wall Street Journal*, the nature of the war has changed profoundly, especially because thousands of drones belonging to the opposing Ukrainian and Russian forces are presently hovering along the front line. The major change involves the use of drones (UASs, UAVs, UCAVs, or RPVs), their role and importance in striking troops, equipment, military and civil infrastructures, etc., as well as in reconnaissance missions and battlefield monitoring. This means that from platoon to division level, operational leaders (commanders) have permanent, real time information and data regarding the situation in the field ([Dumitrache 2023](#)).

According to the definition given by Encyclopedia Britannica, “An unmanned aerial vehicle (UAV; UAS; UCAV; RPV) is an autonomously guided military aircraft, by remote control or both, carrying sensors, target designators, offensive munitions or electronic transmitters designed to interfere with and/or destroy enemy targets. Unencumbered by crew weight, life support systems, the design and safety requirements of manned aircraft, UAVs can be remarkably efficient, offering substantially greater range and endurance than equivalent manned systems” ([Guimartin 2023](#)).

Unmanned aerial vehicles, known as drones, are stand-alone systems that include the equipment necessary for their operation and control, each consisting of three essential elements: the vehicle (aircraft) operating without a pilot; the ground control/monitoring system of the UAS (UAV; UCAV; RPV) by the operator; the two-way connection between each UAS and the ground system, for control, status monitoring and obtaining all relevant information. Depending on their capacity, weight and the actions in which they are used, there are models of drones: fixed-wing; rotary-wing; hybrid (rotary and fixed-wing). In accordance with the requirements of manufacturing standards, the energy needed to activate the drones is provided by electric and conventional sources - suitable for aviation (e.g., jet engines). In the European Union, through “Drone Strategy 2.0”, methods and commercial operations for the engagement of UAS have been established, taking into account the management of risks involved. The “Sustainable and Smart Mobility Strategy – Putting European Transport on Track for the Future”, elaborated and published in 2020, reveals the need for innovation and use of commercial drones (commercial UASs), for transport of goods within multimodal logistics, both inside and outside European urban areas ([European Parliament 2023](#)).

Developing methods for drone intersystem integration at joint and tactical levels, in the case of each opposing army, has facilitated rapid success in conducting several counteroffensive operations in the armed conflict in Ukraine. So, according to different posts on web pages or to recent interviews, the increased lethal effect of drone use in joint and tactical operations is considerable. For instance, the journalist Julian Roepcke from the German daily “BILD”, a well-known observer and analyst

of the Russian-Ukrainian war, revealed (by posting on his Twitter page) that the significant number of drones at the disposal of Russian forces is slowing down Ukraine's counteroffensive. This claim was reinforced by two Ukrainian military officials. The first, major general Vadim Sibitski, deputy head of Military Intelligence Service, highlighted the fact that due to the significant number of drones used on the battlefield and due to real-time video surveillance, identified tactical combat forces - supported by tanks in the open field - can only operate for a few minutes before they are targeted (interview given to "The Wall Street Journal") (Figure 1). The second, Deputy of General Kirilo Budanov, considering the role of combat drones, stated that, "currently, an advancing tank or troop column can be detected within 3 to 5 minutes and hit in another 3 minutes...The survival rate of forces in motion is no more than 10 minutes" (Jucan 2023).



**Figure 1** Image of hitting a column of enemy tanks in motion (Vornik 2023)

Drones play a particularly important role in successful planning and conduct of multinational joint and tactical operations and their integrated logistics. The effects of drone use in military actions, as well as other threats, have led the governments and military bodies of NATO member states (and not only) to provide for the equipping of combatant structures with such low-cost means of indisputable effectiveness and efficiency. Let us remember that the use of drones was decisive for the success of Azerbaijan in the armed conflict with Armenia, between October 27 and November 10, 2020, when in just 43 days, it regained its territory from the separatist Nagorno-Karabakh region. At that time, the Azerbaijani combat forces used Turkish and Israeli unmanned aerial systems to neutralize armored and artillery units (Vornik 2023).

In the near future, the operational structures of Romanian armed forces will be equipped with the "pocket drone" (small size, for research, observation, reconnaissance missions), and furthermore they will probably receive combat drones for all categories of forces, to be used in multinational tactical and joint operations within and/or outside national territory. Currently, there are ongoing contracts with:

“Elbit Systems Ltd” for 7 systems of the “UAS Watchkeeper X” model (21 drones) - 6 systems for Air Force and 1 system for the Navy (particularly, for carrying out reconnaissance and intelligence gathering missions). Another contract was signed with “Bayraktar” company for 3 systems of the “UAS Bayraktar” model (18 drones), for land force surveillance missions, directing artillery fire or the execution of ground bombardments against enemy combatant structures. Additionally, Romanian operational forces need suitable systems for jamming enemy drones. In this regard, we already have a Romanian system that will be developed by “Blue Space Technology” company ([Minculete 2023](#), 156-165).

As the Russian-Ukrainian armed conflict consumes important resources on a daily basis, Ukrainian military experts highlight the need to replace technologically superior combat systems with much cheaper ones, that are more flexible, maneuverable and can be provided in much larger quantities as compared to the first category. For instance, the F-35 multirole aircraft is technologically more advanced and efficient than any type of drone, but in financial terms, one such aircraft costs as much as around 55,000 DJI Mavic 3 drones (made in China, which can be purchased for 2000 dollars each). This fleet would have immense action power, even if some of the drones were not to reach their targets ([Ionescu 2023](#)).

In order to obtain, analyze, evaluate and interpret the information and data needed for our novel study, we used the necessary scientific research methods and tools, such as observation, comparative analysis, evaluation, interpretation, induction and deduction. Therefore, we have carried out a study based on the latest data available, which allows those interested to understand the role and importance of combat drones and even generate ideas for further scientific research.

### **Highlights of US military experience in using combat drones**

The US armed forces have extensive experience in using combat drones in theaters of operations such as Iraq and Afghanistan. Following the lessons learned in these theaters of operations, military drones have been refined over the years. For aerial intelligence gathering, surveillance and reconnaissance, there are several types of drones (UAVs) operated by the US Air Force, which are particularly useful. Among these UCAVs (unmanned combat aerial vehicles) the following models are the most important: MQ-9 Reaper, RQ-4 Global Hawk and XQ-58A Valkyrie (experimental) ([Borcean 2019](#)).

One highly important drone (“a modular reconnaissance and attack UAV”), considered to be the most efficient in the world, used by the American combat forces in various operational situations is the “MQ-9 Reaper” model, a “remotely piloted vehicle/RPV by the USAF” ([Svitlyk 2023](#)). This unmanned aerial system, produced by “General Atomics” (a military contractor), is remotely operated by specific crew of two, *i.e.* the pilot and another member who has the mission to monitor the sensors

and guide the weapons ([Euronews 2023a](#)) (Figure 2).



**Figure 2** Images of the US MQ-9 Reaper drone ([Ziua News 2023](#))

The MQ-9 Reaper drone has the following technical characteristics: “a turboprop engine (Honeywell TPE331-10GD); horsepower, 900; maximum speed, 445 km/h (240 KTAS); length, 11 meters; height, 3.6 meters; wingspan, 20 meters; maximum flight altitude, 15,240 m (50,000 ft.); duration of a target surveillance mission, maximum 24 hours; maximum take-off weight, 4,763 kg.; freight capacity, 1361 kg-external load; transport capabilities, maximum 4 air-to-ground missiles or maximum 8 in the MQ-9a version or 4 Hellfire missiles and two Mark 82 laser-guided bombs” or “16 Hellfire missiles, equivalent to the payload capacity of an Apache helicopter”; range, 1,850 km (1,150 miles); cost, 32 million dollars each ([Svitlyk 2023](#); [Bătăcă 2019](#)). With this particularly modern UAV, the following objectives can be achieved in the area/theatre of multinational joint operations: reconnaissance in enemy territory (Intelligence, Surveillance, and Reconnaissance - ISR); close air support; launching missile strikes on enemy positions; destruction of tanks, armored vehicles, shelters, fuel depots; causing significant damage to enemy warships; combat search and rescue (CSAR), such as for pilots from downed aircraft; monitoring convoys and offensive operations; release of routes; target identification; control of high precision weapon systems “ ([Pricop 2023](#)).

MQ-9 Reaper drones can be equipped with: “AGM-114 Hellfire air-to-ground guided missiles designed to precisely hit armored, lightly armored or other targets; GBU-12 Paveway II systems - high-precision aerial bombs based on the classic Mk 82, weighing 227 kg., equipped with laser guidance system; GBU-9 attack munitions, *i.e.* JDAM bombs guided to the target by GPS and an inertial system; GBU-49 Enhanced Paveway II, with laser control and GPS/INS; GBU-54 – laser munitions systems that combine JDAM precision with laser pointers” ([Svitlyk 2023](#)).

In order to carry out daily missions in Afghanistan, the new MQ-9 Reaper drone model was used by US combat forces from the end of September 2008 until their withdrawal from this country-completed on August 31, 2021 ([RFI Romania 2022](#)). Thus, the “658th Aeronautical Systems Squadron, from the 303rd Aeronautical Systems Wing, included the program managers, logisticians and their subordinate staff (to carry out the appropriate support maintenance, resupply and transport services), as part of the team effort required to ensure the functioning of armed



and airborne MQ-9 drones ([Global Security.org 2023](#)), successfully integrated into multinational joint missions conducted in Afghanistan.

Over time, drones have been used outside armed conflict zones, too. For example, "During Barack Obama's terms, there were a total of 563 strikes, mostly with MQ-9 Reaper drones, in Pakistan, Somalia and Yemen. By comparison, there were only 57 strikes under president George W. Bush." In 2019, MQ-9 Reaper drones, together with the related personnel and equipment, were relocated from the Polish Miroslawiec Air Base to Câmpia Turzii - where they are to be found even today ([Euronews 2023a](#)).

Due to their role in force multiplication, combat drones can now also (escort) fighter jets, such as the F-35A Raptor, F-22, Ra-B-21. In this situation, drones are highly important for: spotting and exposing the configuration of the enemy air defense network; jamming enemy radars and communication systems; search and detection of enemy warplanes; serving as decoys in aerial ambushes (thus being exposed to destruction); attacking enemy troops with rockets and/or other types of munitions; identifying and destroying enemy radars and surface-to-air missile installations, thus facilitating the protection of the escorted bomber plane ([Borcean 2019](#)) etc.

The complexity, precision and operational facilities of future wars are continuously dependent on technological developments, the endowment with modern equipment and the skills of personnel in tactical and/or joint operational structures. In this sense, the United States of America (which have been investing in similar autonomous systems for several years) will develop, through the Department of Defense (DoD), a modern fleet of high-performance drones - based on artificial intelligence - called "Replicator". This programme was inspired by the use of (low-cost) drones and smart weaponry by Ukrainian operational defence structures against superior Russian military forces, which enabled them to do so: interception necessary for proper neutralization of missiles launched by the enemy to hit cities, combat devices, military and territorial logistical infrastructure; disruption of supply-distribution chains of enemy forces in extended areas of operations; obtaining in real time the necessary information about the enemy and anticipation of his intentions; protection of operational structures, their movement, their transport columns, etc. a. Thus, "DoD aims to deploy thousands of autonomous systems in various domains over the next 18-24 months" ([Stoica 2023](#)).

### **Peculiarities of combat drone use in the Ukrainian theater of operations**

The continuous scientific and technological development has led to the appropriate modernization of drones used in Ukraine, generating mutual attacks of the two opposing states, deep in their territories. The focus of both states on extensive

destruction of the enemy's equipment, combat positions, military depots, critical and territorial infrastructure, etc. resulted in drones of various types becoming increasingly sophisticated, flexible, maneuverable and low-cost systems (surveillance, reconnaissance and attack) operating at hundreds and thousands of kilometers to aim precise objectives.

One of the low-cost drones that is particularly maneuverable is the FPV model, which becomes active through the "first-person view" function. This allows real-time video images to be provided via the (profile) camera integrated into the front of the drone. During operation, the FPV drone (a quadricopter that can quickly reach high speeds, even over 100 km/h) is operated and controlled by the operator (who has the necessary skills) using non-military equipment (used in the socio-economic sphere for making videos or photo shoots), i.e. remote control, VR goggles and a special helmet.) Thus, the operator has the possibility to maneuver the device flexibly, to change its direction immediately and to see in real time all the camera shots, like the pilot of an airplane (creating the feeling that the operator is inside the drone) ([Defense Romania 2023c](#)).

If Ukrainian specialists are researching the effects of incorporating artificial intelligence as quickly as possible into the operation of combat drones ([Free Europe 2023](#)), the Russians at the Centre for Integrated Unmanned Solutions (CCBR) have gone so far as to create invisible drones, the Joker FPV (First Person View) model; based on a variant used in sport), resistant to electronic warfare (EW) jamming during "hibernation" ("wake mode"), which occurs some time after launch, and can then be operated quickly according to the missions to be carried out. In good time beforehand, the devices "will be placed on imposing heights and on the roofs of buildings or other tall structures as prepositions for attacks. In this way, only a few seconds pass between drone reactivation and attack, leaving the adversary no chance to launch anti-drone systems" (Figure 3). With its multi-functional platform, suitable for attaching payloads, the versatile Joker FPV drone is capable of: carrying out reconnaissance missions; hitting opposing battle positions with munitions of various types; action suitable for a kamikaze. The technical characteristics of the aircraft are not published ([Răducanu 2023](#)).

The two belligerent states, Russia and Ukraine have each established their own drone factories, they are conducting research and they are continuously training operators. Desiring to achieve success in the counter-offensive launched a few months ago, for liberating national territory from Russian occupation, Ukraine has already trained 10,000 (drone) operators in the special program "Army of Drones" and another 10,000 are currently being trained. On the other hand, Russia has implemented a strategy of training operators in high schools ([Tudor 2023](#)).

According to published government information, there are more than eighty companies operating in Ukraine producing increasingly sophisticated and long-



**Figure 3** Image of Joker FPV drone (Răducanu 2023)

range combat drones with the potential to strike targets deep inside Russian territory or in Russian-controlled territory in Ukraine. The opposing state, Russia, which at the start of the war had limited resources (the somewhat more advanced Orion model, used for surveillance and reconnaissance missions), has developed new drone systems, such as the St Petersburg-made Orlan-10 (Brodsky 2023), not limited to the use of the Iranian Shahed 131 (characteristics: length, 2.2 m; wingspan, 2.5 m; weight, 135 kg; effective operational range, 900 km; explosive payload, 15 kg; cost, around \$20,000 per unit) and Shahed 136 (characteristics: length, 2.5 m; weight, 200 kg; effective operational range, 2000 km; wingspan, 3.5m; explosive payload, 30-50 kg; cost, around \$20,000 per unit) (Cârlugea 2023; Ilicea 2023).

The war in Ukraine applies the concept in a certain way, but in the future AI will be able to carry out swarm drone attacks, which means that a lot of UAVs will be able to coordinate and cooperate in the air, to achieve the synergistic objectives of attacking one or more targets. The term “swarm drones” appeared in the year 2021, when the Israeli army struck the Hamas group with a large group of functional and coordinated UAVs with integrated artificial intelligence (Goncharenko 2023) (Figure 4).

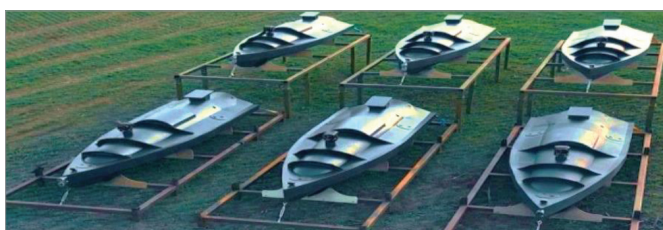
Considering the vital importance of UAVs in the war, Ukraine is currently developing the “Army of Drones” project in order to quickly supply them to tactical operational structures engaged in the counteroffensive against invading Russian forces. In this respect, the



**Figure 4** Image of a swarm drone attack (MCDC 2022)



government of Romania's neighbor removed customs barriers, so that the timely import of spare parts and the manufacture of the ammunition necessary for combat drones would be carried out. At the same time, on July 21, 2023, approval was given to produce more than forty models of drones to be used in operations (after testing and obtaining the appropriate licenses), compared to only seven for which contracts were signed a year before. In this regard, it is worth noting the interest of the Ukrainian state to develop a fleet of maritime drones by hiring the state company "SpetsTechnoExport", which succeeded in developing the maritime drone „Mägura V5" (Costea 2023), with the following essential technical characteristics: length, 5500 m; width, 1500 mm; height, 500 mm above the waterline; cruising speed, 22 knots; blast speed, 42 knots; range, 450 nautical miles (Navy Recognition 2023) (Figure 5).



**Figure 5** Image of Ukrainian maritime drones (Costea 2023)

During the course of hostilities, several types of drones have been observed to be used by Russian combat structures. In order to facilitate operations to liberate the occupied territory, Ukrainian task forces received more than 600 cardboard drones as a donation from Australia. The prototype of this drone represents an innovation challenge from Australian Army specialists to build, in 2018 through SYPAQ, a low-observable cardboard aircraft operated by the low-cost Corvo Precision Payload Delivery System for remote resupply of cargo. In preparation for missions to retake the ground from invading Russian forces, the cardboard drone allows for the following key features: capture of essential surveillance video via GoPro cameras installed in perforated holes in the cardboard material; a range of over 100 km; a payload carrying capacity of three kilograms; landing capability with an error of approx. 2 m. from the intended landing site; wing span of two metres with minimal avionics; an engine module and payload compartment with a lid that opens by lifting); safe flight even in environments less conducive to other types (with light rain, high sea humidity, etc.) (Eckstein 2023).

Some time ago, the manufacturing company (based in Melbourne) released an improved version with an increased wingspan and a carrying capacity of six kilograms. With these drones, the Ukrainian special forces (and not only) have successfully attacked, for deterrence, several critical infrastructures, both in operation areas and in Russian territory (airports; ammunition or fuel depots; bridges and viaducts; Sevastopol Harbour, etc.) (Adevărul Newspaper 2023).

During the deployment and evolution of the counter-offensive of the Ukrainian liberation fighting forces, due to the effectiveness and efficiency of combat drones,

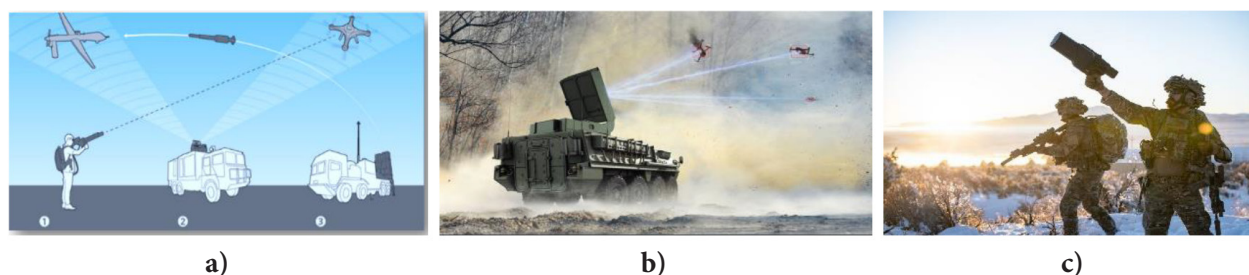
a real drone war was and is taking place operated by both forces in conflict. Thus, in the period from 25 September to 2 October 2023, the operational structures of the invaded Ukrainian state destroyed 220 units (pcs.) of equipment of the Russian combat and support units with the help of drones at their disposal, compared to the quantities of 87 units and 189 units destroyed previously in the weeks from 24 to 31 July and 28 August to 4 September (the same year). According to the assessment made by Ukrainian military specialists, the effects of the use of attack drones can be seen in the percentage of destruction caused by them in the total of 220 units of equipment (by type) as follows: 66% of all tanks; 50.7% of armoured infantry fighting vehicles; 36.2% of artillery barrel systems; 30% of MLRS (reactive projectile launchers – RPA); 25.1% of troop transport trucks; 50% of radio-technical means (radars, radio stations, electronic warfare systems, etc.); and 50% of the equipment of the Russian military.)” ([Orjanu 2023](#)).

Based on funds raised through the “Come Back Alive” Foundation in the framework of the joint project with UNITED24 and Monobank, the first batch of 5,000 kamikaze drones - PFV model (drone cost \$52,000/unit) was purchased and delivered to the Ukrainian fighting forces (Defense Romania Team, 11 October 2023). Moreover, in the immediate future, Ukrainian volunteer specialists will develop and manufacture approx. 100 “Morok” kamikaze drones (long-range and with a warhead weight of up to 30 kg), with the aim of striking targets located up to 800 km away, including on the territory of the invading state. But, for implementation funds are needed, which will be provided through the foundation of Serhi Pritula – TV presenter in the Ukrainian state ([Defense Romania 2023b](#)).

### **Protection against attack drones**

Regarding the development of protection systems against swarm drones, the USA did the following: in 2020, they launched “Project Convergence” in coordination with NATO multinational partners (which allows the creation of a prototype suitable for producing swarm drones); they established the Joint Counter-Unmanned Aircraft Systems Office (or JCO) to conduct experiments with the UAS system interceptor, operable in combination with the ground system that generates intense microwave flows, to neutralize swarm drones that attack equipment, combat positions and shelters, warehouses, moving columns, etc. with rockets, bombs, grenades ([Montalti 2023](#), 1-5) (Figure 6).

An essential means of defending the Ukrainian state against Russian invasion forces is the use of *soft-kill* capability to disable enemy-launched drones. The mechanism of this smart jamming system is focused on radio frequency, allowing operators to actively monitor drones and neutralize them using appropriate handheld devices. The same system - *soft-kill* - can operate with limited performance using 25-35 mm caliber ammunition, taking into account the problems related to resupply ([Montalti 2023](#), 1-5).



**Figure 6** Images with mobile attack drone neutralization systems (surveillance, reconnaissance) by: a) laser; radio frequency; jamming (Dima 2023); b) microwave (Montalti 2023, 1); c) radio frequency (with portable soft-kil system (Eckstein 2023)

The drone jamming effect is achieved by sending intense signals (similar to “loud noise”) in the direction of hostile drones. These will disrupt enemy drones, causing operators to lose control over them and try their best to recover the drones. Moreover, there are cyber tactics suitable for taking control of small enemy drones for one’s own military purpose. However, in the case of larger drones, “kinetic” interception is effective; with Iranian-made “Shahed” drones and other models, large-scale jamming was required since they were frequently and intensively used for bombing critical and territorial infrastructures, various real estate in Ukrainian villages and towns. As a result of these attacks, many NATO members donated drone jamming systems to Ukrainian combat forces (Borcea 2023). Furthermore, Israel approved export licenses for two companies, Elbit and Rafael, in order to sell drone neutralizing systems, needed by the Ukrainian armed forces (The Times of Israel 2023).

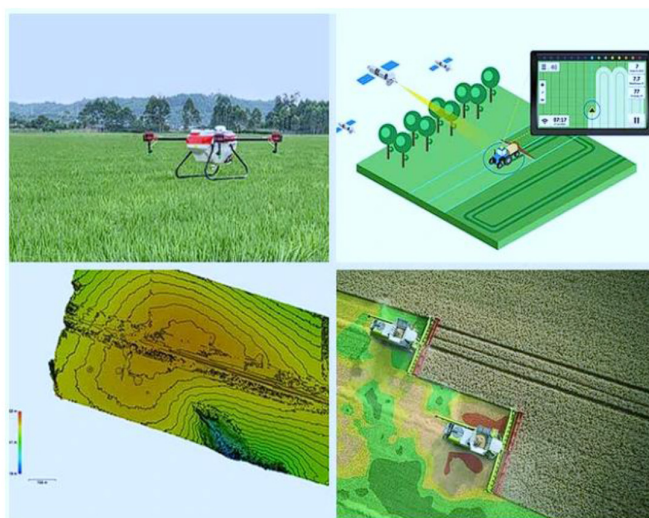
To counter the use of enemy drones for destructive purposes in Ukraine and to reduce this threat to NATO, in September 2023, over a hundred specialists from member and partner countries of the Alliance had a meeting in Netherlands. They addressed the medium and long-term objectives of NATO members regarding the integration of techniques (equipment) to neutralize drones and other weapons at tactical and joint levels. In this sense, quite shortly (until winter begins), the first “interoperability standard for anti-drone tactics” will be created, a project in which the NATO Communications and Information Organization (or NCIA) (NATO 2022), as well as the companies accredited in the Alliance’s defense field, will be involved. The set standard will be particularly important, giving the guidelines to be followed in manufacturing the mentioned equipment, which should have the necessary characteristics to connect with those of the military in crisis and/or armed conflict situations (in the operational environment) (Borcea 2023).

## Drone operator training

Thousands of combat UAV operators are currently being trained by co-opting private drone schools and non-governmental organizations in states around Ukraine. According to the instructors from Kruk and Dronarium drone schools in Kiev, in the process of training, within five days, operators are trained towards the

following objectives: avoiding enemy detection while operating drones; effective use of camouflage tarps to conceal the positions from which drones are operated; the course of action in situations when the Russian electronic warfare structures take control of drones (the operator will be able to fly the drone further, if they control its movements, even if they no longer have access to other functions); mastering tactics of movement, camouflage, and use of maps (Free Europe 2022) etc.

When operating drones on reconnaissance missions, teams trained for this purpose will work in pairs of two, like snipers. While one soldier will coordinate the drone using a keyboard, the other will monitor its movement on an electronic map, based on the video stream transmitted by the drone, then they will determine the coordinates and transfer the images from the battlefield to the servers and headquarters of the respective combatant unit, immediately destroying the target with fire (Figure 7). Based on the training done, Ukrainian forces will act to keep drones in the air by: adjusting software; diversifying supply chains; using commercial drones on the battlefield, much easier to procure, etc. By September 2023, some 4,500 pilots have graduated from the Dronarium drone school, and most of them are now integrated into Ukraine's operational forces (Ilicea 2023).



**Figure 7** Sequential images from operating a combat drone (Ilicea 2023)

If at first, the Bayraktar military drone model was successfully used by Ukrainian defense forces, since then, along with the Turkish drone, UAV operators have also used the following models: Shark; RQ-35 Heidrun; Flirt Cetus, etc. Although (as mentioned above) important manufacturing capacities have been developed, for the time being, only 10% of the war needs are met (approx. 300 drones/day). In this situation, some drone operators use cheap models (2500 euros/item) with small dimensions, manufactured in China by the DJI company, such as *Mavics* and *Matrices* (Ilicea 2023). These drone models were purchased with funds from donations of NGOs, in accordance with the “Army of Drones” initiative launched by the Ukrainian Ministry of Digital Transformation at the beginning of July 2022

(Andrei 2022), thus purchasing 1400 civil (commercial) drones, in three months. Meanwhile, from the beginning of the Russian invasion until October 2023, more than 4100 UAVs produced by DJI (mostly “Mavic” model) were purchased, through the Ukrainian charity foundation “Serhiy Prytula” (Ilicea 2023). All these acquisitions facilitate and enable the continuous training of volunteer drone operators.

## Conclusion

Through the intensive drone use in the battles between the Ukrainian liberation forces and the Russian invaders, the action of the combatant forces was reconfigured in conjunction with the new destructive risks, especially regarding the integrated operational logistics. An example of the effective Ukrainian planning and action is the counteroffensive launched, on June 4, 2023, against the Russian occupation army; using cheap drones in these operations, the Ukrainian combat structures destroyed Russian equipment of tens and hundreds of millions of dollars. Therefore, the focus of action, with all means at its disposal and especially with drones and drone swarms, on the destruction of important combat equipment (tanks, complex artillery and missile ground and anti-aircraft systems, combat aircraft and ships, drones, etc.), ammunition and fuel depots of the enemy highlights the success achieved and the prospect of its development, for the complete liberation of the territory of the Ukrainian state from Russian occupation.

The lessons learned from the armed conflict in Ukraine show that drones can play a huge role in preparing and conducting combat actions, because they facilitate: the observation of invading forces in motion, thus reducing the number of military reconnaissance personnel needed to slip behind enemy lines for intelligence gathering; the launch of more accurate strikes by artillery units based on the coordinates provided; avoiding causing civilian casualties as much as possible, etc.

The effectiveness and efficiency of drone use in Iraq, Afghanistan and Ukraine reveal their increasing role of these devices in future wars, becoming an actual priority for NATO member states and for the Alliance, in general. Although there are resources and production capabilities in the field, it is necessary to develop and implement allied interoperable standards and capabilities appropriate for the production, training and use of advanced combat drones, as well as means of countering the enemy in high intensity joint and multinational tactical operations against (an) opponent(s) with equal potential.

Additionally, certain changes and doctrine adaptations are needed, to facilitate the integration of combat drones in the methods, techniques and procedures of planning, preparing and conducting offensive and/or defensive allied operations. Consequently, operational force leaders at joint and tactical levels will have to act proactively, anticipatively and collaboratively in planning and operational action,



by taking into account the situations and conditions resulting from analysis and evaluation: *situations and possibilities for effective and efficient use of combat drones in offensive and defensive operations; searching and determining the enemy's attack potential with such means (including swarm drones) on combatant forces (national and/or allied) and logistical structures within the force; counteraction and protection of own forces against all combat drones and/or enemy swarm drones by ensuring the availability and immediate use of specific jamming and neutralization equipment.* These considerations are also corroborated with the provisions of law no. 283 of December 6, 2021 (amending and supplementing Law no. 122/2011), regarding the situations and conditions of military intervention by Romanian armed forces, to neutralize drones, as well as remote control radioelectronic equipment.

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