Uncrewed Weapons Journal

Edition 1

Introduction to Uncrewed Weapon Systems and Unmanned Aerial Vehicles

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"Writers of war stories, peering into the future, predict an approaching era when fighting will be done by machinery under remote control. Guns automatically operated will fire from deserted fortifications and from tanks which contain no living operators. Airplanes without human pilots will observe positions through televisors, and drop projectiles guided from a post at headquarters, many miles away. The casualties will be solely among robots of steel and copper, whose orders are conveyed to them by radio, or other subtle signalling methods. Such is the picture which is painted upon the drop curtain which conceals the next war" – Radio Craft Magazine (1931)

Uncrewed Systems

The term "drone" has been synonymous with unmanned aerial vehicles (UAV) since the fielding of breakthrough technologies during the opening strikes of the Global War on Terror (GWOT). The General Atomics MQ-1 Predator is likely the most widely known drone

used by the US, next to its replacement, MQ-9 Reaper. Military and civilian audiences across the world were shocked at its ability to surveil or carry payloads over 700kms and loiter for 14 hours while carrying Hellfire missiles. Today, *drone* is now a blanket term for the many varying systems we see in the world today; Unmanned ground vehicles (UGV), unmanned aerial system (UAS), unmanned combat aerial vehicles (UCAV), remotely piloted air system (RPAS), uncrewed surface (USV) and subsurface vehicles (USSV), uncrewed underwater vehicles (UUV), No Maning Required Ship (NOMARS), one-way attack drones (OWA), quadcopters, first-person view (FPV) drones and more names flood the battlefields and social media feeds across the globe. This paper is going to breakdown a short history, general types, pitfalls, pros and cons, and current weapons fielded in contested zones and conflict areas around the world. There are many acronyms, we will attempt to clarify

OWA UAV Quadcopter failed to detonate of impact into Russian vehicle's windshield.

repeatedly to ensure accurate understanding, please see the index if needed. The term Uncrewed is used here as it covers all bases encompassing autonomous, remotely piloted, or unmanned systems that operate in the aerial, ground, and maritime domains which would conventionally require pilots and or crew members.

Unmanned Aerial Systems

It will be surprising to most how far back unmanned aerial systems (UAS) have been used. The first recorded employment of a UAV was aerial drones used at the siege of Venice in 1845 by the Austrians. During the assault, the Austrian Navy used ~200 unmanned hot air balloons as incendiary weapons that would descend upon the defenders. A bit comical to imagine, but it shows the innovation of the human mind in warfare. Utilizing all technologies possible to gain that edge on the battlefield, it's the same for us today. Several other fascinating inventions over the decades prevailed, the fascinating steam powered No. 5 Aerodrome, the remote-controlled *Aerial Torpedoes* (remote control planes filled with explosives) of the Great War, the completely uncrewed B-17 Bombers under Project Aphrodite, and many fascinating innovations I encourage you to look up.

Today, drones have helped bridge the gap between opposing forces. Across the world, the UAV has become a staple in countless conflicts. Intelligence Surveillance and Reconnaissance (ISR) drones were once tens of millions of dollars and now a platoon could have several rapidly available ISR or strike platforms up and operating within minutes. These factors have made modern conflicts face a unique adversarial force flexibility not previously seen in history. Fascinatingly enough, to this day, the US Department of Defense seemingly only invests in the narrow section of strategic UWS, meaning high value and

small numbers controlled by the higher levels of military decision-making. One of the few efforts for integrating small drones into the ranks is driven by the US Special Operations community, the Commanding General of Special Operations Command (SOCOM), GEN Fenton, has stated that "[SOCOM] is gobbling up any lessons we can learn from the wars in Gaza and Ukraine." Speaking of which, the Ukrainian conflict is one of the most heavily contested regions in the electronic warfare space and the mass use of small drones. There are ample takeaways for every war-faring nation across the world to learn.

Though the US started as the premier drone designer, many countries have altered battle fields far away from their own borders via the export of drones. Turkey's TB-2 Bayraktar, Iran's Shahed 136, Israels Harop OWA, and Chinese DJIs have shaped tactical settings for conflicts on almost every continent. China has likely affected the most conflicts via its company DJI (Da-Jiang Innovations), which supplies around 70% of commercially available drones worldwide, and 80% of the US consumer base. This is a market that is skyrocketing, the commercial drone industry was worth around $5 billion USD in 2022, this is now projected to be ~$54 billion USD by 2030. As with most things that China produces, the data is most likely being stored or scraped in some fashion which allows them to learn from technical data from drones being used across the globe, how and where they are being used to other flight metrics. You can find DJI drones being used to photograph weddings, for

Russian drone Modified with rocket warhead.

agriculture pesticide dispersal, and being driven into tanks with shaped charges taped to them. The speed and ease in which commercial drones can be modified has led to the widespread proliferation of the drop drone or OWA FPV (first person view) being used in conflicts from Myanmar to Ukraine. 3D printer blueprints are posted to open sources allowing any group the ability to quickly modify the DJI models to accept mines, RPG-7 warheads, or M67 Fragmentation grenades.

Employment Methods

For both UAV and USV (Uncrewed Surface Vessels) a common tactic, and I'll assume an emerging tactic for UGVs (Unmanned Ground Vehicles), is the "Swarm" or "Flock." This technique for aerial drones is used by small and fast FPV drones fly forward towards the target location or known area of enemy activity and then land to conserve power. A "Queen" or lead drone acts as an arbiter and enables target identification, selection, and coordination for the attack drones from there. The Queen can also act as a repeater for the FPV suicide drones. As it dives on the target, many times connection is almost entirely lost as obstacles impede the line-of-sight connectivity. In order to bolster the drone's resistance to jamming or extend the range from the controller, the arbiter drone stays at a higher altitude there by assisting the relay of a communication signal. Similarly with USVs, an aerial platform can be used to assist in coordination or a different style USV can be used to allow for increased situational awareness or control to coordinate USV attacks into harbors or patrol ships.

Homing in on One Way Attack (OWA) drones, these have increased in popularity since the Nagorno-Karabakh conflict in 2022. Two of the most prevalent are the Iranian

Shahed 136 and the Israeli Harop, both of which are sold internationally and have affected conflicts across the globe. Recently the Shahed 136 has gained the most notoriety, though Iran denies it, the Shahed is blatantly being produced and used by Russia in its assault on Ukraine. The OWA is a unique class that must balance performance with price. A company must not use high-quality parts as it will be destroyed, yet the drone must make it to the target so it must be "quality enough" to survive electronic attack and be maneuverable enough to pass detection or surface to air systems. The OWA is most commonly recognized for its swarm tactics, such as in the recent failed attack by Iran which launched hundreds of OWA UAVs in an attempt to defeat Israels air defense network.

For larger UAVs in the family of Medium Altitude Long Endurance (MALE), the classic role of flying solo or in pairs is still employed. These drones were once the most commonly thought of if one used the word drone. This group includes the MQ-1 and MQ-9 family, along with the TB-2 Bayraktar which made its fame in the Nagorno-Karabakh. This conflict, though short, was a preview of conventional Large Scale Combat Operations (LSCO) warfare being mixed with modern UAV technology. The OWA Harop and TB-2 wreaked havoc against armored columns and mobile artillery positions. MALE UAVs can be employed by themselves to reconnoiter or strike deep behind denied territories or to support ground force operations providing real time intelligence and close air support. These are highly versatile platforms carrying a variety of technologies and capabilities that are interchangeable for the mission set at hand. MALEs are some of the most widely adopted UAVs across modern militaries.

Going a size up from there comes in the fighter sized UCAVs (Unmanned Combat Aerial Vehicles). These are generally fixed wing aircraft that can be designed to utilize artificial intelligence (AI) partially or wholly. For an example of fully autonomous designs, the MQ-28 'Loyal Wingman' is a drone being tailored for this role, crafted to integrate with the modern fifth and sixth generation air forces. This UCAV is capable of being equipped with modular sensor suites and sensor systems to enable it as a true multi-role aircraft. The idea of the Loyal Wingman is to create standoff between Western Forces and adversarial nations aircraft. Modern air superiority combat is a game of BVR (beyond visual range) engagements, or a predator and prey style, using stealth technologies and multi-domain

Boeing's MQ-28 Loyal Wingman.

communications to find targets and guide missiles fired from 20 miles and beyond to strike aircraft or targets without ever being detected. Having one or two MQ-28s per F-35 enables

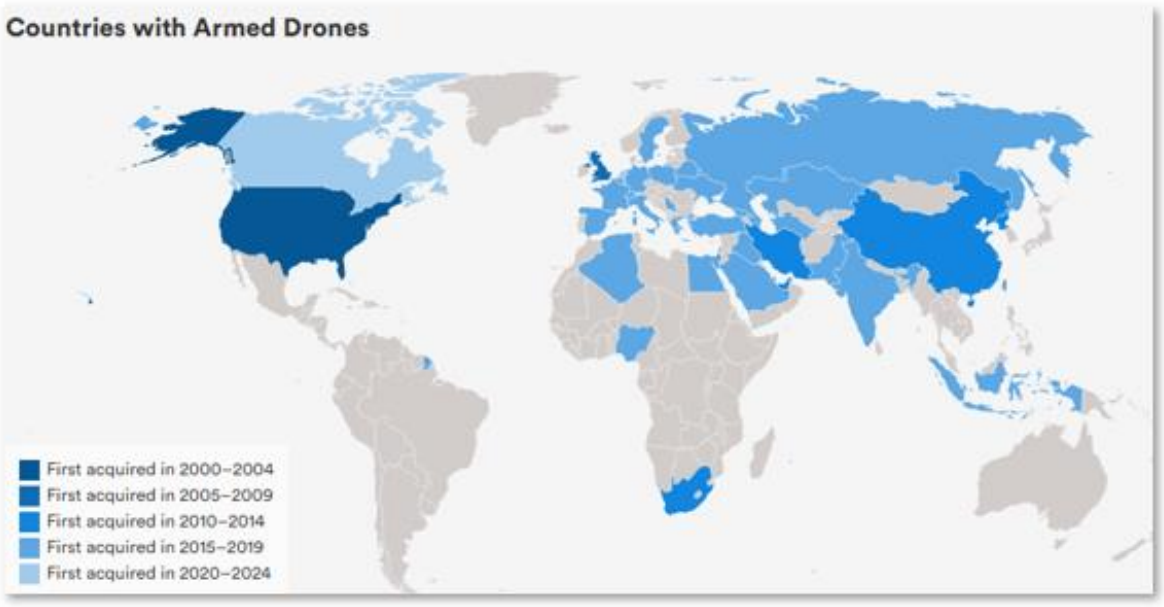
a pilot to use the drones to attack, screen, recon, or continue on the mission while enemy forces are being dealt with, this capability is an extreme force multiplier for any US fighter.

Advantages and Disadvantages

The TB-2 has fallen off as a useful platform for the Ukrainians despite its performance in the opening salvos of the Russo-Ukraine war. This was noted after an interesting incident over Kiev when Ukraine shot its own drone out of the sky after it "lost control" of the aircraft. Sure enough, the Russians successfully created a technique to hack into the Bayraktar, an interesting way to defeat the system and I would consider it almost more impactful psychologically and militarily in the long run than physically damaging to Ukraine's drone fleet. This ability to hack the drone could sell on the market or be used to barter in future geopolitical engagements. It was always assessed as a weakness for many types of drones, but it has never happened in conflict until May of 2023. Besides the possibility of hacking, uplinks are the next weak point, every drone, unless fully autonomous, needs an uplink to satellites. Once considered a very secure communication technique, is now vulnerable to electronic and physical attack. ASAT (anti-satellite attack) capabilities have greatly increased with China, Russia, and the US all having weapon systems that can physically destroy or disable communications satellites in orbit.

Advantages of UAVs are force flexibility and reduced risk to forces when employing these weapon systems. The ability for a platoon or company to have drones that can detect enemy movements even just an hour or two ahead of time could guarantee victory for an otherwise possible defeat. Intelligence always needs updating, and these varying drones could greatly change how conventional militaries train and fight in the future. The cost

variables in destroying expensive weapons systems with cheaper platforms is not only a real economic challenge but a psychological defeat as well. In the case of the Red Sea, the US Navy is spending millions of taxpayer dollars to destroy a several hundred to a few thousand-dollar drone. This cost imposition is not tenable in the long run. Accuracy and precision in not only reconnaissance but in real time artillery updates. Artillery is the king of battle and in modern conventional conflicts, the first to get accurate rounds on target is usually the victor of the battle, especially in counter battery fire. In later articles we will discuss more of the UGV (Unmanned Ground Vehicles) and USVs (Uncrewed Surface Vessels), both of which also have their set place on the battlefield along with disadvantages and advantages. There are dozens of other UAVs out there which would take up pages and pages to describe unique facets of each, with this and all the other editions, there is much missing, but I implore you to continue studying on your own.



Map from NewAmerica.org showing historical acquisition of armed drones.

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AI: Artificial Intelligence

ASAT: Anti-Satellite Attack

BVR: Beyond Visual Range

FPV: First Person View

GWOT: Global War on Terror

ISR: Intelligence, Surveillance, and Reconnaissance

LSCO: Large Scale Combat Operations

MALE: Medium Altitude Long Endurance

NOMARS: No Maning Required Ship

OWA: One-Way Attack

RPAS: Remotely Piloted Air System

UAS: Unmanned Aerial System

UCAV: Unmanned Combat Aerial Vehicle

UAV: Unmanned Aerial Vehicle

UGV: Unmanned Ground Vehicle

UUV: Uncrewed Underwater Vehicle

USV: Uncrewed Surface Vessel

USSV: Uncrewed Subsurface Vehicle