Military Use of Unmanned Aerial Vehicles – A Historical Study

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Abstract

The following study is devoted to the phenomenon of unmanned aerial vehicles used throughout known history on the battlefield or for military purposes. The purpose of the following text is to familiarise the reader with an overview with the contemporary and historical employment of the unmanned vehicles on the battlefield. The study also aims to show that the concept of unmanned combat vehicles, also unmanned aerial combat vehicles, is far more ancient than is it is widely known. The article is based on theoretical research methods, mostly multinational academic literature.

The author starts with an introduction on the role of limiting soldiers' fatalities and the concept of removing military men from the battleground. Then, the author presents known examples of using unmanned ships in battles from Thucydides' times to the invention of the Hell-burner of Antwerp. Further, the case of first unmanned combat aerial vehicle is presented, the bombing balloons from the nineteenth century, followed by a more contemporary study of the military use of unmanned aircrafts.

The article is concluded with an analysis of the present employment of drones when they tend to substitute manned aircrafts on various occasions, especially when a mission is deemed "dull, dirty or dangerous".

Keywords: Unmanned Combat Aerial Vehicles, UCAV, Unmanned Aerial Vehicles, UAV, Drones

1. Introduction

The manpower has always been the core elements of warfare that contributed to the military success – the defeat of the enemy. The classical military textbook manpower ratio of 3:1 against the adversary is believed to guarantee the success in an attack against similarly equipped foe. Elementarily, an asymmetry in the equipment (i.e. the technological advantage of one party to the conflict) or the tactic can influence the outcomes, yet it is the manpower that is the most basic element of warfare. Hence, beside winning the battle, the need to maintain the numbers of ranks has always been the utmost aim of military commanders – without soldiers even the most sophisticated weaponry remains useless, as there is no one to carry and properly employ them. The way of fighting, protective armour, horses, chariots... All were employed to gain an edge over the enemy and simultaneously limit its own loses on the battlefield. Yet it is the removal of the man from the battleground that is the most efficient.

However abstract the phenomenon might have seemed to the classical commanders, it has been gradually developed throughout the history. Philip II's and Alexander the Great's Macedonian phalanx of elite soldiers with up to six-metres long spears, sarissa, is one of the most known example of the ancient tactic of creating and exploiting the distance against underequipped adversary. Then in the late Medieval times, the man mounted a heavy horse and was armoured from tip of his toes up to his head in a gothic armour and equipped with a long tilting-lance, that provided both the distance and the security for the knight. Then, the soldier was isolated in an armoured chariot equipped with submachine guns and a cannon, a tank. When he reached the skies, he started to exploit its militarily, further increasing the distance between himself and his foe to the scale of total invisibility – when the attacked was no longer seen by the attacker. Despite this gradual distancing himself from the adversary, still though, the military man was vulnerable. Thus, finally he was removed from the battleground and allowed his weapons to continue on their own – the unmanned vehicles appeared.[1]

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[1] As an unmanned vehicle, we shall consider any vehicle from which per-

2. Premodern Unmanned Combat Vehicles

However, the appearance of the first unmanned military (combat) vehicles was more the result of tactic than a technological breakthrough. The very first such platforms were burning ships or boats that were set to drift against the opponent's fleet to disrupt his formations or set his ships on fire. Thucydides, recall such case during the Peloponnesian war when the Syracusan captured Athenians' vessels and "[they] tried to burn by means of an old merchantman which they filled with faggots and pine-woods, set on fire, and let drift down the wind which blew full on the Athenians. The Athenians, however, alarmed for their ships, contrived means for stopping it and putting it out, and checking the flames and the nearer approach of the merchantman, thus escaped the danger". [1, p. 400] This case shows use of captured vessels, as using one's own was certainly not a cost-effective tactic, since constructing ships was costly (so setting them on fire was a huge waste)[2]. As the discussed case exemplifies, while drifting ships posed a little threat, such tactic might have been employed when a warship was already set on fire by the enemy and abandoned by its crew.

In later times, when the gunpowder was widely used for militarily purposes, they are known examples of using warships as enormous improvised explosive devices – abandoned and filled with explosives (fused kegs of gunpowder) ships were directed against the foe's flotilla. Again, though, it was a low cost-effective tactic as warships were extremely costly, and it might have proved useful only in cases when there were more ships than crew to man them, or in special case as the Antwerp naval blockade in 1584-1585. When the Dutchmen revolted against Spaniard in the Dutch city of Antwerp, the glorious Spanish armada was sent to put the rebellion down. The city port was surrounded and the population was to be subjected by starvation. Then, an Italian engineer residing within Antwerp, named Federigo Gambelli, proposed to breach the pontoon bridge not only with use of previously-known fire-ships yet to make this weapon even more lethal and efficient. Gambelli ordered two ship to be filled with metal scraps, bricks, stones and enormous amount of gunpowder (seven thousand pounds each) in a specifically prepared marble mason-work chamber under the deck. Then, on 5th April 1585, the vessels named "Fortune" and "Hope" were set drifting on the tide against the Spanish flotilla blocking the entrance to the port of Antwerp. "Fortune"

failed to reach the bridge, the well-timed clockwork mechanism on "Hope", exploded when the ship reached Spaniards' positions, wreaking havoc in a diameter of a mile and killing at least a thousand people. This unmanned naval vehicle was possible also the very first known water-borne improvised explosive device and – as Robert L. O'Connell claims due to enormous number of casualties caused by a single use – the pioneering weapon of mass destruction. Not surprisingly then that the weapon was remembered as the Hell-burner of Antwerp by its contemporary. [3, p. 137, 199], [4, p. 191-196] Despite huge tactical efficiency in this particular case, the hell-burners were rather a last-resort ad hoc tactic developed out of necessity than of a breakthrough in technical thought.

3. Pioneer Unmanned Combat Aerial Vehicles

Such a conceptual breakthrough in deliberately constructing unmanned vehicles occurred in 19th century. What is more, they were to be the first known unmanned aerial vehicles (UAVs) used for the military purposes. It happened in the years of 1848-1849, when the Austrians, controlling North-eastern part of the Italian peninsula, faced the revolt of the Venetians. Specific location of Venice on multiple lagoons and numerous islands, as well as strong spirit of the inhabitants, hampered the plans to force surrender by bombarding the city with the conventional artillery, in spite of more than 60,000 shells being fired since the siege commenced in May 1849. In such circumstances, artillery lieutenant Franz von Uchatius proposed to bomb the city from the air. The aerostation, the art of constructing and navigating aerostats (i.e. balloons and other gas-powered airships) had been known only for a few decades since the first man had elevated in the Montgolfiers' brothers balloon in 1783. Even though, von Uchatius created two specialised "aerial torpedo" units whose aim was to attack the city with aerostats. Each unit was equipped with around a hundred hot-air balloons, eighteen feet in diameter each, and made of paper and cloth. A gunpowder and shrapnel-filled pear-shaped bomb with half-hour timed burning-fuse mechanism specially designed for the mission was attached to each of the aerostats, the very first-to-be Unmanned Aerial Combat Vehicles (UCAVs). The operation itself was barely secret and even highly advertised – most probably to frighten the defenders – as even before it took place, it had been described in the Scientific American journal (see the excerpt in Fig. 1). [5, p. 401], [6]

Before the attack, tests were conducted with smaller balloons to determine the wind currents, which showed that the operation from the land was hardly feasible, as the wind mainly blew from the other direction. It was confirmed by the first, totally unsuccessful attack of 12th July 1849. The operation needed to be conducted from the other side of the city, and thus a paddle steamer, named Vulkan, was employed as the first aircraft carrier in the history. On 22nd August, von Uchatius' aerostats were lifted from the seaside equipped with burning fuse timed to blow just when the balloons drifting

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sonnel (such as drivers, pilots, sailors, soldiers, etc.) has been removed, consequently an unmanned aerial vehicle is an aircraft intentionally deprived of its pilot and pre-programmed or guided through other means. An unmanned combat vehicle is designed for military purposes, especially on the battlefield. We shall underline, though, that the term 'military' may be considered broader than 'combat', as it encompasses also the non-combat military use (e.g. distant reconnaissance).

[2]For example, in Thucydides times, to build trireme, an ancient warship with three banks of oars, it costed one talent, i.e. 6000 drachmas, while the daily allowance for food and servant for an Athenian hoplite soldier was 2 drachmas and a drachma a day was the average pay for a skilled craftsman, according to Lorna Hardwick. [2, p. XXVI]

More about Balloons.

The Presse, of Vienna, Austria, has the following :—" Venice is to be bombarded by balloons, as the lagunes prevent the approaching of artillery. Five balloons, each twenty-three feet in diameter, are in construction at Treviso. In a favorable wind the balloons will be launched and directed as near to Venice as possible, and on their being brought to vertical positions over the town, the fire will be given by electro magnetism. Each of the five bombs affixed to the balloon is in communication by means of a long isolated copper wire with a large galvanic battery placed on the shore. The fusee is ignited by connecting the wire. The bomb falls perpendicularly, and explodes on reaching the ground. By this means twenty-five bombs a day may be thrown, supposing the wind to be favorable. An experiment made at Trexis on the 9th, succeeded completely."

We suppose that the Austrians wish to try the experiment with the Vienese which Marshal Jourdan tried with the Austrians in 1794 as it is said that he obtained the victory of Fleuries over the Austrians by reconnoitreing their position by means of a balloon.
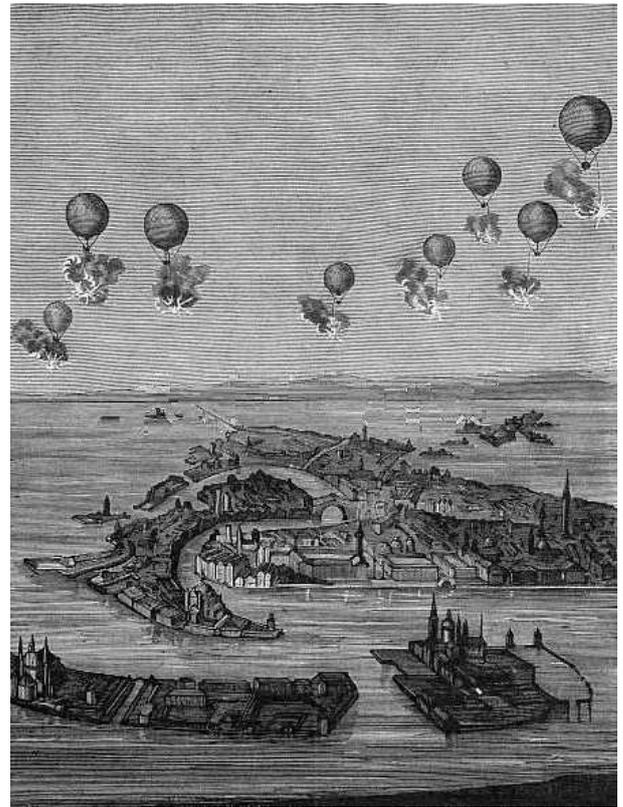
Figure 1: Excerpt from the Scientific American on plans of using balloons to bomb the Venice in 1849. The paper suggested the employment of an electromagnetic fuse – rather an exaggeration, as use of this technology was highly unlikely in those times. The paper also points to the first use of a balloon for reconnaissance during the battle of Fleurus, 1794. (source: http://www.ctie.monash.edu.au/hargrave/rpav_home.html - 19.01.2018).

Figure 2: Artistic depiction of the aerial bombardment of Venice in 1849. Artwork from Aerostation - Aviation (1911) by Max de Nansouty.

with the power of wind, would arrive upon Venice. Despite all these inventions and preparations, the efficiency was negligible. According to the Venetians only one bomb exploded within the city, what comparing to 60,000 artillery shells fired upon the city with conventional artillery seems utterly insignificant. Moreover, some of the 'wind-guided missiles' were to explode above the Austrians' positions to the great joy and applause of the city inhabitants. Nonetheless, the Venetians surrendered the city two days later, though it was rather due to starvation and outbreak of cholera than aerial operation. However the poor strategic outcome of the aerial bombardment of Venice, the thought of 'aerial terror', that would force the civilian population to surrender their cities, started to ripe among the military commanders, bearing the fruits in the form of "strategic bombings" of London, Dresden and Tokyo in the following century. [5, p. 401-402]

4. Contemporary use of Unmanned Combat Aerial Vehicles

The beginning of contemporary use of unmanned aerial vehicles can be traced back to attempts undertaken during the first World War, when an aircraft was built for the purpose of aiming practice. [7, p. 154]. However, only with consecutive technological development and construction of UAVs capable of effectively taking part in an armed conflict several decades later, this technology found its contemporary employment.

The Cold War and hence arising perception of an imminent threat was a major motivator for financing and developing of new technologies of strict military purpose. One of the direct causes of development of military UAVs was a Soviet capture of U2, a US spy aircraft, in 1960. The administration of president Dwight Eisenhower decided to pursue a programme of development of UAVs in order to avoid human loses, pilot apprehensions and leaks of sensitive and highly classified military know-how. In 1962, the Ryan Aeronautical Company started works on pilot-less constructions of Ryan 147 AQM-34, dubbed the Lighting Bug. Its construction was very similar to a typical military aircraft, though smaller in size and – of obvious reasons – lacked the pilot cabin, that was replaced with a computer (see picture below). The unmanned vehicle was attached to Hercules DC-130, a transport plane, and released in the air. Its route was pre-programmed or remotely-controlled from the deck of its

Figure 3: Ryan 147, AQM-34 „Lightning Bug" and the family of Teledyne Ryan Aeronautical UAVs (source: http://blog.udn.com/TUANPETERSON/5395873).

"mother-platform", the Hercules. Upon completion of its mission, the first reconnaissance UAV released a parachute and was collected by specially adapted helicopters. The Lighting Bug flew its spy missions over skies of China, Cuba and the North Korea. However, it was the war in Vietnam that provided an opportunity to test the novelty of the unmanned technology in the combat environment. In the years of 1964-1975, the pilotless aircraft realised over three thousand combat missions over Vietnam. Overall production of the Lighting Bugs reached over a thousand of machines, yet in the next decade the funding for the UAV programme was scaled down. [8, p. 700], [9, as quoted in 8, p. 700]

Unmanned Aerial Vehicle Programme was also initiated by the Israelis, who employed pilotless aircrafts in combat operations during the Yom Kippur war of 1973 and in the 1980's in the Syria-occupied Lebanon. Initially, Israeli UAVs served as flying dummies whose aim was to mislead the enemy. In 1982 in the Lebanese Beqaa Valley UAVs were used as a "bait" for the Syrian anti-aircraft (AA) defence system. The Israeli Airforce flew pilotless aircrafts over valley, and while the Syrians consumed their firepower on the "dummies", the Israeli pilots and artillery were able to target the Syrians who not only revealed their positions but also fired most of their surface-to-air missiles on the "dummies". Furthermore, other Israeli UAVs equipped with cameras and sent deep into the Syrian territory were monitoring movements on three main Syrian airfields, and yet others Israeli drones were directing laser-guided missiles on Syrian positions. Thanks to use of UAVs, the Israeli won decisively in the Beqaa Valley, in one afternoon destroying seventeen out of nineteen Syrian AA

positions and numerous aircrafts protecting them. [10], [7, p. 154] Therefore, even in 1980s unmanned aircraft vehicles were used in variety of missions and in wide spectrum of roles including dummy-baits, reconnaissance, and missile-guiding.

The Israeli experiences in the early drone-warfare from 1980s renewed American military's interest in UAVs combat capabilities. UAVs were more and more used in the American Navy, when it had been discovered that drone-guided artillery fire reduces the amount of fired shells at the target by two-thirds. [11] as quoted by Tice in [10] Nevertheless, when an Israeli UAV constructor emigrated to the US, his proposal of developing a drone programme did not gain the Pentagon interest and his enterprise bankrupted. Later though, he was hired by the General Atomics Aeronautical Systems Inc., that worked on drones for the US Department of Defense. The outcome of the cooperation was the notorious UAV, the Predator. This UCAV was introduced in 1995 and opened a new chapter in the use of drones for military purposes. Initially, it served in recon missions (i.a. in the Balkans), yet after 9/11, when the American forces entered Afghanistan, UAVs of the Predator family were equipped with air-surface missiles capable of eliminating hostile targets on the ground. [7, p. 154] A new era in the use of pilotless aircrafts on the battlefield commenced with targeted killings operations that infamously mark the contemporary use of unmanned combat aerial vehicles.

Triple "D" standing for Dull, Dirty and Dangerous is a catchy way of summarising contemporary utility of unmanned combat aerial vehicles. Drones, unlike manned aircrafts can fly to, and hover over, the target for multiple hours (or even days), while a pilot generally should not spend more than twelve hours in the cockpit. While there are known examples, at least since the Second World War, of giving stimulants (such as amphetamines) to pilots to overcome sleeplessness and eliminate fatigue, such practices have been limited in more recent times. [12, passim] Thus, drones seem to be a better solution for prolonged, tiring and dull long-endurance missions, than a drugged pilot. According to US Airforce captain, Brian P. Tice, who coined the "Triple-D" term, dirty refers to a mission that could endanger the pilot by exposing to hazardous chemical or radiological material. Although, in the context of the more contemporary use of UCAVs, dirty much more often stands for extrajudicial killing operations, when a suspect, often unarmed, is killed upon an order of a foreign (most often US) military. Here, dirty would stand for "dirty job", military engagements whose legality and morality is doubted. Similarly, drones are significantly more useful for the purpose of such missions for various reasons, yet this is to be discussed in the forthcoming continuation of this study. The final "D", for dangerous, refers to missions where the lethal threat to a pilot would be too much elevated to risk his life, and replacement with an UAV seems a reasonable solution to save lives and limit costs (both training of a pilot and his aircraft are extremely costly by comparison to the cost of an UAV).

Presently, unmanned aerial vehicles tend to overcome

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manned aircrafts in the sky due to their primary value of being pilotless, thus totally reducing the risk of own men fatality. On the other hand, UAVs are slower, thus more exposed to enemy countermeasures (given that the opponent is a state actor). Drones make up for it with lower production cost, further limited with lower cost of training of the drone operator – the cost of the original Predator is a fifth that of an F-16, even excluding pilot's training. They are capable of flying longer missions without being subjected to human endurance limitations (operators can easily replace themselves, while fighter planes pilots cannot at all), however manned aircrafts offer better performance in bad weather and can be refuel by aerial tanker. What is more important, though, due to direct control and more situational awareness, traditional aircrafts allow greater flexibility of action, while the drone operator has somehow a "soda straw" limited perspective, without the broader context. [13] Furthermore, they are not as dependant on ground or satellite signals that may fail, as drones are, what make them more reliable. Incorporated stealth technology in higher dimensions makes them also less visible, though drones are smaller, thus more difficult to detect, and can fly into more hostile environments. Last but not least, UAVs are easier to transport and store. [14] To sum up, contemporary drones create a spectre of new possibilities in aerial reconnaissance, intelligence gathering, diversion and, more infamously, extrajudicial killings, or means short of war, that previously were outside pilots' range.

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