THE ORIGIN AND EVOLUTION OF MILITARY DRONE TECHNOLOGY IN WARFARE EQUIPMENT IN AFRICA

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Abstract

The development of unmanned aerial vehicles (UAVs) could potentially revolutionise how military force is used in the future. While early operational experiences with UAVs show that this operation is promising, its full range of capabilities is largely unknown. Over the years, the application of drones has shifted from traditional methods of application to a much more modern one. Despite this evolution, the process of normalising drones throughout Africa has received little scholarly attention. The purpose of this paper is to analyse the historical origin and the evolution of military drones in the theatre of conflicts in Africa. The results arrived at in this paper have been thanks to a consortium of multinational academic literature embodied with the historical methods of analyses. Besides the conceptual framework of the study, this paper examines the historical origin of military drones, their mapping and evolution in Africa, and their humanitarian impacts as well as their limitations. From our findings, state and non-state actors have been actively involved in the usage of modern military drones in Africa during armed conflicts for the last two decades, and this is in an attempt to have a complete mastery over the conflict map.

Key words: UAVs, military drones, Africa, armed conflict, security.

Introduction

Manpower has always been the core element of warfare that contributed to the military success and defeat of the enemy. The classical military textbook manpower ratio of 3:1 against the adversary is believed to guarantee success in an attack against a similarly equipped antagonist. 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, besides 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 it. The way of fighting, the use of protective armour, horses, and chariots, just to name a few, are employed to gain an edge over the enemy and simultaneously limit its own loss on the battlefield, yet it is the removal of the man from the battleground that is the most efficient.

Military jargon refers to drones as “unmanned aerial vehicles” (UAVs) or “unmanned combat air vehicles” (UCAVs), depending on whether the device carries weapons. In the official vocabulary of the U.S. Army, a drone is defined as “a land, sea, or air vehicle that is remotely or automatically controlled”. The drone family is not composed solely of flying objects. There may be as many different kinds as there are families of weapons: terrestrial drones, marine drones, submarine drones, even subterranean drones imagined in the form of fat mechanical moles. Provided there is no longer any human crew aboard, any kind of vehicle or piloted engine can be “droned.” A drone can be controlled either from a distance by human operators (remote control) or autonomously by

robotic means (automatic piloting). In practice, present-day drones combine those two modes of control. Armies do not yet have at their disposal operational autonomous lethal robots, although, as we shall see in drone expeditions, there are already advanced plans for those.

We are living, increasingly, in a drone-saturated world in general and Africa in particular. In recent years, drones have proliferated rapidly around Africa in both military and civilian spheres. Today in Africa, at least 25 nations and non-state groups are known to operate drones, including more than 15 countries with armed drones. An additional more than 10 countries have armed drone programs in development. As this technology continues to proliferate, simple weaponised drones will be increasingly placed within the reach of virtually every state and many non-state actors. The drone campaigns of the past decade and a half in Africa have involved hundreds of strikes against militant organisations, most in the Federally Administered Tribal Areas of the Congo Basin, with additional strikes in Eritrea, Somalia, Sudan, Angola, Mali, the Lake Chad areas, and many other parts of Africa. It should also be mentioned that already non-state actors such as Hamas, Hezbollah, Alshabab in West Africa, the Islamic State movement, Boko Haram, and Libyan rebel groups have used drones to conduct tactical surveillance. Individuals also have access to increasingly sophisticated commercial off-the-shelf drones and components that can either be used for surveillance. This large number of attacks over a long period of time provides the opportunity to assess in a systematic way how the sustained use of such weapons influences public support on the use of force. Besides the conceptual framework of the study, this paper will therefore examine the following: categorising air vehicles and military operations, the historical origin of military drones, mapping the evolution of military drones in Africa, and lastly, the humanitarian impact and limitations of military drones.

Results and Discussion

I- Conceptual Framework of the Study

A drone, or an unmanned aerial vehicle (UAV), according to the definition by the International Civil Aviation Organisation (ICAO), is an aircraft operated without a human pilot on-board. Unmanned Aircraft System (UAS) is defined as that which is made up of components such as a drone, the controller (ground-based), and the communication system between the two (the drone and the controller). ICAO defined the term as a Remotely Piloted Aircraft System (RPAS) with its associated remote pilot station, the required command and control links, and any other components as specified in the type design and Remotely Piloted Aircraft (RPA) (Ayamgaa Matthew et al., 2021).

All these terms are referring to a drone that is remotely controlled by an operator on the ground or preprogrammed to fly specific routes (Nelson, J. & Gorichanaz, T., 2019). Hogan and Wallace define two types of drones: a fixed-wing drone, which generates lift as it moves, enabling it to sustain velocity through the air, and the rotor, which is highly manoeuvrable and can hover and rotate with a flight controller (Hogan et al., 2017). These two types of drones have their advantages and disadvantages when it comes to flight range (endurance), battery capacity, and payload (Ayamgaa Matthew et al., 2021).

1- Agricultural Drones

According to Kim and others, the agricultural sector has seen some innovative technologies that support farm management strategies in enhancing efficiency through the precision application of farm inputs in recent years. One of such innovations is the drone technology, which has gained popularity (Kim H.G., et al., 2019) and this has been widely used in precision agriculture (Zhang C., & Kovacs J.M.,2012).

According to Hedley, several optical sensors are linked to a GPS so that the position of the readings is recorded and can be accurately mapped to inform variable rate fertiliser or growth regulation application and are available to farmers to actively monitor the development of growing

crops such as cereals, brassica, maize, and ryegrass. Depending on the crop analysis to be made on a farm, cameras such as red, green, and blue (RGB); multispectral; hyper spectral; thermal cameras; and low-cost, consumer-grade cameras are fitted on a drone to capture near-infrared (NIR) pictures (Hedley C., 2015). Drones use together with other Information Communication Technologies (ICTs) are opening a new phase in the agriculture domain where we have digital agriculture, smart agriculture, e-agriculture, and precision agriculture. From the Internet of Things (IoT), we now have the Internet of Drones (IoD), which provides generic services for various drone applications, such as package delivery, traffic surveillance, search, rescue, and more (Gharibi M. et al., 2016).

2- Medical Drones

Aerial delivery of medical supplies by drones to health facilities in remote communities with bad road infrastructure and undulating topography has been successfully carried out in some African countries like Rwanda and Ghana. Ling and Draghic point out that drones provide faster response times, reduce transportation costs, and improve medical services to remote and /or underserved environments (Ling G. & Draghic N., 2019). In the wake of the Covid-19 pandemic, the United States (US) has approved Zipline and other companies to deliver medical and food supplies in some states, through which the drone delivery market is expected to make substantial gains (NASDAQ OMX's News Release Distribution Channel, 2020). According to Laksham, the success of drones in the fields of ecology and the environment alludes to the belief that they can also be used in the field of public health as medical couriers (Laksham K.B., 2019).

The motivation for medical drones has to do with the fact that they can provide precision delivery with a more efficient cost perspective than conventional delivery systems. In emergency medicine, evidence showed that the use of drones proves to be safe and feasible for delivering an automated external defibrillator (AED) for out-of-hospital cardiac arrests (OHCA) in areas identified using GIS (Geographic Information System) models (Claesson A. et al., 2016).

3- Military Drones

According to Kindervater, the military drone technology history can be traced as far back as the 1930s and was immensely used during World War I and II. However, as time evolved, the development of drones has changed over these past periods to modern Western war machines (Kindervater K.H., 2016). In the military, drones have the potential to reduce costs and risks to personnel as they are or can be used in lethal surveillance and targeted killings compared to using manned aircraft. Drones used in lethal surveillance are directly linked to targeted killings with merging mechanisms for making decisions on life and death (Bousquet A., 2018).

Artificial intelligence (AI) plays a key role in military drones, which has made such drones able to differentiate between civilians and the targets (De Swarte T. et al., 2019). The discourse is on the ability of the AI machines to be able to execute tasks with ethical considerations. Cummings states that "The debate, which has many dimensions and stakeholders, concerns whether artificially intelligent machines should be allowed to execute such military missions, especially if there is a possibility that any human life could be at stake" (Cummings, M., 2017).

Nevertheless, there is a growing interest in drone technology across critical scholarships and security studies that seeks to place the drone within a wider set of practices. In this paper, we shall exclusively be working on the military/armed drone since our area of study (Africa) is constantly backed by a series of armed conflicts.

II- Categorising Air Vehicles and Military Operations

In some cases, autonomous vehicles follow preprogrammed courses and lack the capacity of retargeting, while in other cases, autonomous UAVs will follow preprogrammed courses and can be rerouted or retargeted. In military terminology, vehicles are reusable, while weapons are expendable. In addition, UAVs have shorter life spans than manned aircraft and can suffer attrition in military operations, which means that they will survive for a relatively small number of sorties

until failures, accidents, or hostile action. The loss rate for aircraft and UAVs is important as it influences the cost-effectiveness of UAVs and manned vehicles (David Glade, 2000).

1. Categorising Air Vehicles

One way to understand the nature of unmanned vehicles as a military instrument is to develop a framework that traces the development of manned and unmanned air vehicles, assesses the technological state of the art in aircraft and computer technologies, and extrapolates how these developments may influence their use in military operations.

The simplest approach is to divide aircraft into manned and unmanned vehicles and then to further subdivide unmanned vehicles into those that are remotely operated and autonomous. This framework rests explicitly on the human role in perceiving and influencing events during the operation of air vehicles. If manned aircraft use direct human presence to directly perceive events and conditions around the vehicle, remotely operated vehicles keep the human presence at a distance. The critical factor that distinguishes between aircraft and UAVs is the amount of information that is available to the human flying a UAV. The technological and operational communities have invested considerable resources in using visual and data displays to provide information to the human about conditions in and around the vehicle. The problem is that these technologies have been inadequate because the human operator is deprived of significant information about the vehicle's performance, which includes attitude, vibration, and sound, among others things. In the case of vehicles that are operated only periodically by a human, such as the Global Hawk UAV, the operator must make decisions with significantly less information about the vehicle than an on-board pilot (David Glade, 2000). The concept of the information that is provided to a remote operator has significant implications for UAVs, principally because it directly increases the combat effectiveness, cost, and complexity of these vehicles.

If we turn to the case of autonomous vehicles, the human presence exists at a distance, is confined to receiving information about the vehicle, and does not exercise direct control over the vehicle. By their nature, humans lose control of autonomous vehicles once they are launched, which implies that human operators do not control the operation of autonomous vehicles and that available information about the status of the vehicles is quite limited. Once these limitations are understood, autonomous vehicles may be well suited to attacking targets whose location is precisely and accurately known. The value of this assumption diminishes, however, in the case of searching for mobile targets, of which SCUD missiles and command and control centres are prominent examples. One fundamental reason for the development of these vehicles is the desire of the U.S. military to destroy what is known as time-critical targets, especially when these vehicles are missiles that may be armed with weapons of mass destruction (David Glade, 2000).

Perhaps the best way to differentiate between aerial vehicles is to consider the role of human presence, which can be immediate or distant and can involve large or small amounts of information about the vehicle's operation. However, the information provided to the human operator is not the same for all types of piloted aircraft. For example, while the MiG-23 and F-15 are both manned fighter aircraft, F-15 pilots have greater visual perception than MiG-23 pilots as a result of the larger and less restrictive canopy. In principle, all unmanned vehicles possess some degree of automation. An interesting problem, however, is that completely autonomous operations create unexpected situations, which was reaffirmed during tests of the Global Hawk UAV. Not surprisingly, the price of automation is to significantly increase the cost of engines, hydraulics, electrical systems, and avionics systems to the point where these are more expensive than the less automated counterparts that are controlled by humans (Bill Sweetman, June 1997, pp. 57-61).

2. Categorising Military Operations

The roles of UAVs can vary widely based on the difficulty of the military operation that is to be conducted. The simplest military operations involve attacks against fixed ground targets, while

the more challenging operations involve attacks against mobile ground targets and other air vehicles. As one would expect, an attack against fixed targets is the simplest because it is relatively easy to find targets whose location does not vary and which can be assessed with great accuracy. However, an attack against air targets is more difficult because the target's mobility makes it more difficult to find and destroy the target, and further because, the target's ability to manoeuvre makes it more difficult to prosecute an attack. Even when an air target has been located, the simplest form of attack is the unobserved attack in which the target is not aware that it is under attack (William Wagner, 1982, p.11). By contrast, an observed attack against a highly manoeuvrable target with an experienced pilot is most difficult. Consider, for instance, the case of an unobserved attack from behind a large bomber, which would be simpler to conduct than an attack against an opposing fighter whose experienced and well-trained pilot is aware that an attack is underway and will take active measures to defeat the attack (William Wagner, 1982, p.12).

Another type of attack is those against enemy targets that are out of contact with friendly forces, which are simpler than attacks in which enemy targets are relatively near friendly forces. The principal reason for the difficulty of conducting this type of attack is the high-level of coordination that is necessary if vehicles are to avoid destroying one another, which is known as fratricide. A basic rule of military operations is that the difficulty of combat situations increases as the number of enemy threats increases, and that this rule has important implications in air-to-air and air-to-ground operations when friendly and enemy targets are interspersed throughout the battle space. Ideally, all of the aircraft in one area belong to the enemy, while the aircraft in other areas belong to friendly forces, but the reality is that in modern military operations enemy and friendly aircraft will be mixed in the same area. The problem becomes even more complex in operations other than war when friendly, enemy, and neutral combatants are scattered throughout the battle space (David Glade).

These concepts have several important implications for UAVs. First, human pilots have a vastly greater ability to understand and respond to the conditions in combat around the vehicle than the human who operates the vehicle from a distance. Second, the number and type of threats, the degree of mobility of targets and threats, and the degree of sorting that is necessary to separate and classify threats directly influence the success with which UAVs can be used in military operations. Third, despite these limitations, technology has matured to the point where it will be possible to gradually shift combat functions from piloted to remotely piloted vehicles and eventually to autonomous vehicles in a migration that may transform the nature of war.

The military value of UAVs will depend on the ability to automate many of the functions that have historically been performed by humans, which range from guiding a vehicle to delivering ordnance against military targets. The simplest form of automation is the radio-controlled model aeroplane, while a more complicated autonomous aerial vehicle is the World War II V-1 Buzz Bomb, which performed tasks in a fixed sequence as does a modern cruise missile that is guided by GPS. The most complex example of automation is a UAV that relies on a rule-based or expert system to detect, identify, and attack mobile targets (Stan Gibilisco, 1994).

Fundamentally, the essence of automation is to use rules to guide decision-making, but this is a highly complex problem in war. This complexity is illustrated by the air campaign during the Persian Gulf War, which involved roughly 2,600 allied aircraft of at least 41 different types and 950 opposing enemy aircraft of 17 types, of which at least 6 types of aircraft shared common features with allied aircraft. All of these aircraft could be attacked by various air-to-air weapons, 16,000 surface-to-air missiles in 10 types, and 7,000 anti-aircraft guns. For automation to succeed in military operations, a computer must be able to sort through large numbers of choices and make good decisions about the use of lethal force in a reliable and timely fashion. At present, the problem is that rule-based decision-making has not reached a sufficient level of reliability to permit autonomous vehicles to make the kinds of decisions in war in which humans could have high

confidence, especially when failure can result in the deaths of hundreds or thousands of innocent civilians (James P. Coyne, 1992).

III- The Historical Timeline of Military Drones

Today, when we think of military drones, we tend to think of sleek, advanced planes and quadcopters. However, the world's inventors and militaries first developed drone technology as balloons, torpedoes, and aerial targets, feats of invention and innovation at the time. Since the mid-1800s, militaries around the world have been utilising drone technology for training, target practice, air strikes, bomb detection, surveillance, and hostage negotiation.

The earliest UAV in the history of drones was seen in 1839, when Austrian soldiers attacked the city of Venice with unmanned balloons filled with explosives. In 1849, the Austrian Navy used two hundred incendiary balloons in an effort to capture Venice. By the early 1900s, the United States military began exploring drone technology to build practice targets for training. However, in 1907, the world's first quadcopter was created by inventor brothers Jacques and Louis Bréguet (Palik Matyas & Nagy Máté, 2021).

1. World War I

In 1915, Nikola Tesla wrote about unmanned aerial combat vehicles. The first attempt at a self-propelled drone as an aerial target was completed in 1916 by A.M. Low. It wasn't until World War I that the first pilotless torpedo was invented by the Dayton-Wright Aeroplane Company. But in 1917, the Ruston Proctor Aerial Target became the first pilotless winged aircraft in history. It was a radio-controlled, pilotless aeroplane, based on RC technology from the inventor Nikola Tesla (Paul Fahlstrom & Thomas Gleason, 2012).

In the First World War, drones were just in the experimental phase; their mass use was impossible. As the aeroplane's main task was terror bombing, UAVs were used for this purpose. They had poor automation, so they were inaccurate. The lack of technical-technological development didn't permit making more complicated, more reliable, and more accurate drones.

But after World War I, companies worked to push drone technology forward with inventions like the Hewitt-Sperry Automatic Aeroplane and the Kettering Bug, an unmanned aerial torpedo. Most efforts during this time were completed by the military up until 1935, when actor and model-aeroplane enthusiast Reginald Denny became the first civilian to develop a remotely piloted vehicle (Paul Fahlstrom & Thomas Gleason, 2012).

2. World War II

Between the two wars it turned out that one possible direction of developments is the PTA. Although we have seen some usable prototypes, they were not ready to be widespread. However, in the Second World War, using drones as target aircraft became general because of the necessity of training pilots and air defence units. Another big area where UAVs were used was the aerial torpedo. These assets tried to replace the lost aircraft during the air attacks and reduce their high cost. In addition, the leaders didn't have to count on losing a pilot's life or with captivity.

During World War II, both Allied and German forces used drones to train aircraft gunners and aid in missions. After the end of World War II, drone developers began using jet engines in technologies like the Australian GAF Jindivik and the Model 10001, built for the U.S. Navy by Beechcraft. However, after World War II, technology innovations stalled until the Vietnam War. In 1943, created for use by the German military during World War II, "Fritz X" was the nickname given to the FX1400, the first remote-controlled weapon that was actually put into operational use (Barry R. Posen, 1986).

After the Second World War, in the arms race of the Cold War, UAVs were still useful. Most often they were used as supersonic PTAs to train the air defense units' personnel. Air defense missile units went through rapid development due to the latest jet fighters and nuclear threats. This is why strategic air reconnaissance was extremely important at the time of the Cold War, but after shooting

down the U-2 over the Soviet Union, US leaders found out that it is not desired for a pilot-flown aeroplane to spend as much as 12 hours over enemy territory (Barry R. Posen, 1986). That's how the first reconnaissance UAV was born, after a long series of experiments, and it was given the name Lightning Bug.

3. The Vietnam War

In the early years of the war, the U.S. Air Force began using unmanned aircraft to cut down on pilot deaths over hostile territory. Investment in drone technology continued after the Soviet Union shot down an American spy plane in 1960 (Adam Grissom, 2006).

In the Vietnam War, the next big step was when drones were provided by a live data network, so the pictures taken by them could be analysed instantly. It was possible because of the development of electronics are systems that had been present only on conventional aircraft were mounted on UAVs, but their main purpose was to take aerial pictures. and some of the UAVs carried out electronic warfare tasks. More and more systems that had been present only on conventional aircraft were mounted on UAVs, but their main purpose was to take aerial pictures.

In 1960, a boom in RC plane popularity in the U.S. Mostly coming in kit form, these RC planes offered everything from indoor-flyable models to much larger outdoor models. By the late 1960s, the U.S. government had invested in and used drone technology throughout Vietnam and to aid in naval missions, though most of these missions was classified (Singer, P. W., 2009).

4. The 70s, 80s, and 90s

In the early 70s, Israel began using drones as decoys in the Yom Kippur War. It was during this same time that the United States officially confirmed that they had been using drones in Vietnam. According to the Armed Forces Journal International in 1982, the U.S. stated that they had flown more than 3,435 drone missions during the war for both decoy and surveillance applications (James Igoe Walsh & Marcus Schulzke, 2018).

In the late 1970s and early 1980s, digital technology made it possible to create cheaper and lighter-than-ever UAVs. Modern drone warfare began in 1982, when Israel coordinated the use of battlefield UAVs alongside manned aircraft to wipe out the Syrian fleet with very minimal losses. The leading developing country was Israel, and its drones had multiple roles. They formed the basis of the UAVs that we use today. It wasn't until the 1980s and 90s that the U.S. military began heavily investing in the technology. The U.S. Department of Defense awarded the AAI Corp and Israel-based Malat contracts in the 90s to develop more advanced drone technology, which resulted in more cost-efficient technologies (Igoe J. Walsh & Schulzke, M.).

In the conflicts of the 1990s, the US forces could execute more accurate strikes than ever. It was largely because of the information that was gathered in large quantities and was processed at a rapid pace. It led to the information warfare, where drones have a key role. In this decade it was proven that all branches can use UAVs, and they are very effective in every theatre. In the mid-90s, the U.S. government began the Predator program, which resulted in the MQ-1 Predator, equipped with a Hellfire anti-tank missile on its wings. It paved the way to the MQ-9 Reaper in 2007 (Igoe J. Walsh & Schulzke, M.)**.** The Predator and Reaper drones are what most people today picture when they think of military drones.

5. The 2000-2016 era

In the aftermath of 9/11, the CIA began flying armed drones over Afghanistan as part of the war against the Taliban. The first CIA drone-based kill operation took place in February 2002. The 2006 recognises the potential of nonmilitary, non-consumer drone applications; the FAA issued the first commercial drone permits. In 2010, the French company Parrot released their Parrot AR Drone, the first ready-to-fly drone that can be controlled entirely via Wi-Fi using a smartphone (John D. Sutter, September 7, 2011)

In December 2013, Amazon released a concept video showcasing founder Jeff Bezos' dream for a drone-based delivery system. However, the general use of drones as toys started to be introduced in 2014. While in 2016, DJI's Phantom 4 introduced smart computer vision and machine learning technology in drones. The first passenger drone was introduced at the Consumer Electronics Show (CES) in mid-2016 by Chinese entrepreneurs and was named the Ehang 184 (Scott Shane & Jo Becker, May 29, 2012).

Nowadays each military possesses some kind of UAV, including the Hungarian Defense Forces. Today, over three dozen countries and multiple terrorist groups and non-state actors have weaponised drones in their arsenal. We can see that with the extension of their role, their number will increase in the future. It should be well understood that the military conflicts all over the world were the main motivating factors to develop drones. One of the main reasons for their development is the limitations of human beings. The lack of a person on board has several advantages, like extended manoeuvrability, improved stealth capability, and almost unlimited duration in time. In addition, in most of the cases, they are cheaper than conventional airplanes (Palik Matyas, 2007). So we can say that it has always been some new need, the lack of capability, or change of application in the conventional aviation that motivated people to create UAVs.

IV- Mapping the Presence of Military/Armed Drones in Africa

Africa has seen the proliferation and increasing use of military drones in the last 16 years. A sharp rise in the use of armed and unarmed drones by African and non-African states can be seen, in particular, in North Africa, the Sahel, and the Horn of Africa. A worrisome aspect is that states are not being transparent about the deployment of drones in military operations. This hinders open debates on the military use of drones in Africa, in spite of various African parliamentarians, civil organisations, and other civilians sharing their concerns about the proliferation of drones. African and non-African states increasingly use armed and unarmed drones in North Africa, the Sahel, and the Horn of Africa. In this section, we shall limit ourselves to analysing the use of military drones in Africa by the United States, the United Nations, and non-state actors.

1. The United States of America (USA)

Somalia, Seychelles, Ethiopia, and Djibouti

US drone deployment really took off with the Obama Administration. From 2009 onwards, US drones would steadily buzz over Somalia from a base in the Seychelles to gather intelligence for counter-terrorism missions. Two years later, the drones were armed, and drone strikes were launched in Somalia. Members of Congress wrote in a letter to President Obama that the armed drone campaign had no transparency, accountability, or oversight and that they were "concerned about the legal grounds for such strikes" (Richtsje Kurpershoek, et al., 2021). Nevertheless, the Obama Administration continued to keep details about the drone strikes secret.

In 2011, the US also invested millions of dollars in an airfield in Arba Minch in Ethiopia to build a drone base for MQ-9 Reaper drones (class III) to collect surveillance data on al-Shabaab. As the base steadily turned into a key hub for counter-terrorism operations in Somalia, the US Air Force announced that the drone flights would "continue as long as the government of Ethiopia welcomes our cooperation on these varied security programs" (Whitlock, C., 13 June 2012). In 2015, the base was closed down, but the US was vague about why it had stopped the drone deployments from Arba Minch. The closure of the base in Ethiopia did not stop the drone campaign in Somalia. The Central Intelligence Agency (CIA) used a drone base in Mogadishu, the capital of Somalia. US military intelligence agents were also sometimes involved in the counter-terrorism programme in Mogadishu, but the CIA led the operations. There are a few reports about how the CIA selects targets in Somalia, but its drone campaigns have been less transparent than the drone campaigns of the US Department of Defence. For example, a New York Times article reported that in 2012, Obama was having weekly meetings called 'Terror Tuesday', in which it was decided who in Somalia

(and in other regions) should be added to the Joint Prioritised Target List, better known as the military's 'kill list' (Kurpershoek, R. et al.).

In 2012, the Obama Administration published a new 'Strategy toward Sub-Saharan Africa', which reversed its strategy in 1995, stating that "Africa is more important than ever to the security and prosperity of the international community and to the United States in particular". The security strategy included countering terrorist groups like al-Qaeda and advancing security cooperation with African countries and regional organisations through low-cost, small-footprint operations. Various programmes were set up in which the US supported African countries in developing approaches for "tracking, apprehending, arresting, prosecuting, and incarcerating terrorists" (Benjamin D., 25 April 2012).The US also started working with non-African countries on the continent through the Global Counterterrorism Forum (GCTF), which was launched in 2011 to address 21st-century terrorism (Benjamin D.). The forum brings together counter-terrorism coordinators, prosecutors, judges, police, border control, and prison officials.

The US Air Force enlarged its drone operations in Djibouti further still in 2013 by building a drone base at Chabelly Airfield. Drones based at the airfield could cover Yemen, south-west Saudi Arabia, Somalia, Ethiopia, and southern Egypt. At the time, the Pentagon stated that the airfield would only be used temporarily, for not more than two years. In 2014, however, the US and Djibouti signed a long-term contract for the base. Within a year, the Department of Defense proposed expanding the base further still (Savage, C. & Schmitt, E., 30 March 2017). In 2017, the US decided to ease the rules aimed at preventing civilian casualties for counterterrorism strikes in Somalia. The new guidelines were similar to war-zone targeting rules, which allowed the US to engage targets easier. Since then, AFRICOM has increased the number of airstrikes. An investigative report by Amnesty International shows that in 2017 and 2018, US drone strikes in Somalia killed and injured several civilians, including children, and might have violated IHL. AFRICOM denied the allegations but did not conduct thorough, transparent investigations into the allegations (Amnesty International, 2019).

Libya and Tunisia

In 2011, the US also sent armed MQ-1 Predator drones to Libya to support the NATO led intervention to implement the UN Security Council Resolution 1973, which consisted of establishing a no-fly zone over Libya to end the violence and attacks on Libyan civilians. The US supported Libyan rebel forces in the intervention with an aggressive air campaign. The US did not engage diplomatically or politically with the rebels, which led to misunderstandings of the internal dynamics among the rebels. This laid the foundation for the post-war power struggle in Libya (Entous, A. & Ryan, M., 26 October 2016). The US continued to deploy drones in Libya after the intervention ended.

In 2016, the Tunisian government allowed the US to base its own unarmed Reaper drones in the country to gather intelligence on the Islamic State in Libya after the US pressed the Tunisian government in secret. In return, the US would share intelligence gathered by the drones with Tunisia to support their counter-terrorism operations within the country and their border security. The negotiations took place behind closed doors as the US was worried that Tunisia would otherwise pull out of the deal if the government was publicly associated with an outside military power (Entous, A. & Ryan, M., 26 October 2016). This was likely as frustration had grown among the Tunisian population with the post-revolutionary governments. Tunisian officials were worried that military cooperation with the US could prompt a public backlash, encourage militants to cross the border into Tunisia, and make it seem as if Tunisia was a party to the US military operations in Libya. The establishment of a base in Tunisia was critical to the US, as drones operated from Niger and Djibouti are further away from populous areas in Libya, and drone flights taking off from Sigonella in Italy are often cancelled due to weather-related issues (Markey, P. & Amara, T., 30 October 2016). Therefore, drones flying from Tunisia have more time to gather intelligence in the region.

In 2017, the government created ambiguity and confusion among American civilians about the military operation in Libya and concealed the magnitude of the operation. At the beginning of the year, President Donald Trump said he did not see a US role in Libya but did see a "role in getting rid of ISIS". A few months later, the President stated that the US had a "continued commitment" in Libya to defeat jihadists. Furthermore, the US launched at least eight airstrikes in Libya in 2017 and 2018, but the government initially reported just four of these strikes (Kurpershoek, R. et al.).

Cameroon

The US built drone bases near Darak and in the western Sahel as well, as this region was beyond the reach of drones based in East Africa and southern Europe. In Salak in Cameroon, near the northern border region between Nigeria and Chad, the US extended a military base in 2013. By 2015, the US had supplied the Cameroon military with six Scan Eagle surveillance drones (Class I) at Salak and built an additional air base in Garoua in Cameroon as a base for unarmed Predator drones in the effort to counter Boko Haram (Gettinger, D., 21 February 2016). Captain Jennifer Dyrcz, spokesperson for AFRICOM, stated that the Salak airfield was an important hub for their security assistance efforts and that they regularly had small numbers of US personnel (military and/or contractors) in the area supporting Cameroonian forces (Trafford, R. & Turse, N.). The base in Salak was used for US security operations and as an illegal prison. Prisoners, mostly men and often Muslim and members of the Kanuri ethnic minority, were tortured and imprisoned by the Cameroonian military. Women and children have also been detained at Salak. The detainees were not Boko Haram fighters but ordinary people arrested on suspicion of supporting Boko Haram (Trafford, R. & Turse, N.).

The US has denied being aware of the illegal torture. Yet various reports have been issued describing the torture practices. In 2007, the US State Department's Bureau of Democracy, Human Rights, and Labour reported the torture at Salak. Again, in 2016, a widely distributed Human Rights Report by the Department of State declared that people were tortured at the Salak base, citing an Amnesty International report. In 2017, Amnesty International published a new report about the torture at the base, showing that detainees could see Americans from their cells. Amnesty called for thorough, independent, and impartial investigations. Given the wide availability of the reports, AFRICOM still claims that it did not receive reports of human rights violations by Cameroonian forces in Salak, making it difficult to comprehend (Amnesty International, 2017).

Later, after The Intercept and Forensic Architecture carried out additional investigations into the torture practices, AFRICOM said it would "conduct a more informal, fact-gathering inquiry in order to determine whether further investigation is warranted". AFRICOM failed to declare whether the findings of the investigation would be published (Amnesty International, 2017).

2. United Nations (UN)

Besides the USA, the UN has been using drones in its monitoring operations in Africa since 2006. In 2006, drones were used in the EUFOR RD Congo military operation by Belgian troops in the Democratic Republic of Congo to support the UN peacekeeping mission MONUC and in Sudan after the UN Security Resolution 1706 gave a mandate "to monitor trans-border activities of armed groups along the Sudanese borders with Chad and the Central African Republic". In 2009, the UN replaced the European Union military operation in Chad and the Central African Republic. Some of the contributors that used surveillance drones in the military operation were also involved in the UN mission. Therefore, the UN took over these drones as well. In 2013, the UN considered deploying drones in the United Nations Operation in Côte d'Ivoire (UNOCI) after Côte d'Ivoire asked them to. In the end, the drones were not authorised due to an improvement in the security situation (United Nations Security Council).

In 2013, the Stabilisation Mission in the Democratic Republic of the Congo (MONUSCO) did get formal approval to use drones to track movements of armed militias and document atrocities, despite general scepticism on the use of drones among UN member states. Member states criticised

the intelligence that drones would generate, as states feared that any intelligence collection powers on the part of the UN could lead to the loss of sovereignty of member states. Nevertheless, the UN did start expanding its use of drones after deploying them during MONUSCO, as they proved to be a useful tool in UN missions (Ramjoué, M., 2011). The Expert Panel on Technology and Innovation in UN Peacekeeping stated, for example, in 2014 that the use of drones constituted "an indispensable source of information" and that "their use should […] be immediately expanded" and "maximum use" should be made of smaller drones, as the "UN peacekeeping simply cannot afford to cede the information advantage to those actors in a mission area determined to undermine prospects for peace and who use the advantages of modern technology to aid their violent cause" (Ramjoué, M., 2011).

Since then, the UN has deployed drones in other missions as well where it has received the approval of the relevant state. In the Multidimensional Integrated Stabilisation Mission in Mali (MINUSMA), the Netherlands deployed Scan Eagle and Raven drones (class I), from 2014 to 2016 from Camp Castor in Mali to gather intelligence. The Scan Eagles flew more than 1,000 hours. In 2015, Sweden complemented the Dutch drones with Shadow (class II), Wasp (class I) and Puma (class I) drones from a base in Timbuktu, Mali. A year later, Germany flew Heron 1 (class III) and LUNA drones (class I) for MINUSMA as well. A drawback in the UN mission was because the UN lacked analysts who could interpret the data gathered by the drones (Kurpershoek, R. et al.).

In 2015, the UN repeatedly asked the South Sudanese government to allow the United Nations Mission in South Sudan (UNMISS) to use drones. The government, however, dismissed all requests because they did not allow their military installations to be photographed. Additionally, they questioned why the UN wanted to use drones in the first place, because there were no 'terrorists' in South Sudan (Justin, T., 18 June 2015). In 2017, the government of the Central African Republic did approve the use of drones during the United Nations Multidimensional Integrated Stabilisation Mission in the Central African Republic (MINUSCA). French tactical drones were also used to locate armed groups and monitor their routes (United Nations).

3. Non-State Actors

In Africa, various armed groups make use of COTS drones. Armed groups can obtain these drones relatively easily, as they are cheap and often purchased by 'hobbyists'. Most of these drones are produced by China, which has refused to restrict drone sales to halt their proliferation. African countries such as Sierra Leone are worried that these drones will fall into the hands of armed groups. They are struggling to regulate the sale of these drones and are enacting legislation. Furthermore, these COTS drones will be harder to combat in the future, as the technology used in these drones is advancing rapidly (Searcey, D., 13 September 2019).

In West Africa, the Islamic State West Africa Province (ISWAP), commonly known as Boko Haram, is active in Nigeria, Chad, Niger, and northern Cameroon and has 1,500 to 3,500 fighters. ISWAP has developed its own drones for reconnaissance and surveillance operations. States fear that ISWAP has ambitions to weaponised the drones for attacks. Since 2015, the Islamic State in the Greater Sahel (ISGS) has operated in the West African countries of Mali, Niger, and Burkina Faso. ISGS is also known to use COTS drones in Mali for surveillance purposes (United States Department). In North Africa, armed groups are operating drones too. The Egyptian General Command of the Armed Forces announced in 2018 that it captured a drone used by so-called "terrorists" in the Sinai region during a military operation. The drone was said to be used to monitor movements by army troops in central and north Sinai. The Algerian Ministry of Defence published in the ministry's journal that it had captured 11 drones belonging to "terrorists" in Algeria in 2019. It is possible that more non-state actors in Africa will make use of COTS drones (Bilan des opérations 2018).

The next section handles the humanitarian impact of drones' activities in the various areas of operations.

V- The Humanitarian Impact and Limitations of Military Drones in Africa

Humanitarian and human rights norms have long sought to restrict the exercise of remote violence. In the last two hundred years, the rapid development of weapons technology has enabled people to kill and maim others at increasing distances, both physical and psychological. Rifles, artillery, landmines, aerial bombing, and missiles function to reduce the potential for human encounter between an assailant and a target or victim. This section discusses some of the humanitarian impacts caused by military drones.

On 29 June 2011, US President Obama's chief counterterrorism advisor, John Brennan, stood in front of a packed room in an academic division of Johns Hopkins University in Washington, D.C., and made a bold assertion. No civilians had been killed in US counterterrorism operations in nearly a year, he said. Brennan was answering a question about "targeted killings", a euphemism for Central Intelligence Agency (CIA) drone strikes. The strikes were raining down on Pakistan at the time, though officially the administration refused to acknowledge the drone campaign even existed, sticking resolutely to the vague "counterterrorism operations" term (Ray Acheson).

1. Environmental Harm

In armed conflict and its aftermath, legal protection for the environment is weak, and systems for accountability and environmental remediation are largely absent. Those protections that do exist have been most clearly articulated in relation to massive levels of environmental harm. They primarily focus on the "natural environment" without articulating the linkages between environmental quality and the enjoyment of fundamental human rights. However, the risks of the generation of toxic remnants of war-conflict pollution that threatens human and ecosystem health should be an important consideration in taking steps and measures to progressively limit harm in the use of force.

During the last decade, there has been a renewed effort to clarify and codify the relationship between environmental obligations stemming from international humanitarian law (IHL), international environmental law, and international human rights law, before, during, and after armed conflicts. The topic is currently under consideration by the International Law Commission, and states have expressed their growing concern over the environmental and derived humanitarian consequences of armed conflict at the UN Environment Assembly (International Law Commission, 2017). Obligations to address the environmental legacy of pollution from armed conflicts and military activities have been proposed by the International Law Commission and have recently been articulated in the treaty on the prohibition of nuclear weapons, adopted in July 2017. These and other initiatives could support the advancement of both law and practice with respect to addressing toxic remnants of war.

The expansion of the use of armed drones by states to conduct airstrikes both within and outside of armed conflict has coincided with this increased interest in enhancing the protection of the environment in relation to armed conflicts. While not arguing that the environmental impact of armed drones is a central component of the harms that they cause, this short perspective proposes that air strikes conducted from drones could have environmental implications for communities and that these should be considered in any discussions about the further regulation of drones (UN General Assembly, 7 July 2017). However, the lasting environmental impacts and long-term risks to human health from the use of force must, in turn, be curbed through more robust international rules.

Recently, Nigeria became the eighth country to have used armed drones in combat, having announced a successful drone strike in its ongoing war against the militant group Boko Haram. On 25 January 2015, a photo appeared online at Beegeagle's Blog 1 showing a CH-3 UCAV that crashed upside down near Dumge village in the Mafa District of Borno Province. Despite damage to the tricycle landing gear and upper forward fuselage, the CH-3 appeared to have crash-landed due to mechanical or control difficulties, as reported on the news. In the video released of the attack, there

was a large blast, and the Nigerian Air Force claims it hit a logistics base belonging to Boko Haram, possibly an ammunition storehouse (Kelsey D. Atherton, 3 February 2016).

The Nigerian military has asserted a pressing need for counter-insurgency (COIN) equipment and has argued that drones are "necessary" in fighting the insurgency. But a key issue is how appropriate it is to launch such attacks within an area where there are not just insurgents but also civilians. There is also the danger that the targeted population might not be "terrorists" or "insurgents", but might instead be an individual or a group that fits into a specific "terrorist" profile. The geographical zones of Nigeria (northeast and northwest) where most counterinsurgency operations are taking place are known for their rich supply of farm crops such as grains and vegetables and for animal rearing such as of cattle, sheep, and goats. Drone activities, such as mapping the areas of conflict, in particular their munitions and the munitions used against them, may pose a threat to public health within these regions and their sources of livelihood: the cultivation of crops and rearing of animals (Kelsey D. Atherton, 3 February 2016). In addition, the potential effect of such use on civilians and communities poses dangers that have not yet been addressed.

2. Psychological Harm

The sky in the Yemeni countryside, or the United States (US) drones' playground, regularly inflicts violence without any warning or reason on people that are already vulnerable to both poverty and conflict. US drone attacks have thus emerged to shape the perceptions, fears, and life choices of a large proportion of the Yemeni population. In turn, this "drone generation" which is inevitably viewing the skies as a medium of death, is suffering tremendously from mental stress that also culminates into physical distress (Ray Acheson).

The repercussions of drone operations on civilians living in areas where the skies are a source of trauma, especially those who have not directly lost a relative or loved one to a drone strike, have not been given due consideration within policy or academic debates. Nevertheless, the concern over the potential psychological impact of drones has been shared by human rights and humanitarian organisations such as the Office of the UN High Commissioner for Human Rights (OHCHR) and the International Committee of the Red Cross (ICRC), which have expressed concern about the lack of measurement of the consequences of the constant presence of drones on mental health (Peter Mauer, 10 May 2013). The combination of unclear legal and policy mechanisms around drone operations and technology closely intersects with the perpetuation of post-traumatic stress disorder (PTSD) among Yemeni civilians living under drones. A complete dearth of institutional mechanisms with regard to regulation, accountability, and retribution has served to perpetuate loss of civilian lives, trauma, and disruption of everyday activities. Strongly addressing these shortcomings will be instrumental, not only for delivering justice to already vulnerable people but also for ameliorating their lives in a country experiencing instances of violence on numerous fronts (Peter Mauer, 10 May 2013).

3. Harm to Global Peace and Security

The primary focus of the debate about the impact of armed drones has been as a result of their use for extrajudicial killing outside of the battlefield: targeted killing, as it has become more widely known. Almost since they were first deployed, armed drones have been used by the United States in particular but also more recently by Israel and the United Kingdom to "find, fix, and finish" those deemed to be a threat to national security (Ray Acheson).

While the policy of using armed drones to carry out targeted killings beyond the battlefield is rightly an issue of serious concern, the wider impact of the technology itself also needs to be addressed. Drones combine various pre-existing technologies to form a new and radically different way of launching armed forces. The impact of this new weapon system, enabling so-called risk-free war, on the political-military decision-making process in times of crisis, as well as on long-term military policy, needs to be carefully examined. It is the advent of the remote-controlled armed drone that has enabled the huge

expansion of targeted killing over the past decade. There is growing evidence that the existence of this new form of war making and its impact on policymakers is lowering the threshold for the use of armed force, transferring the risk of warfare from combatants to civilians, and increasingly disconnecting the public from the human impact of armed combat (Ray Acheson).

Djibouti is a country of less than 900,000 people that would not register significantly in the global consciousness except for its strategic location in East Africa. Tim Mak of the Daily Beast writes that Djibouti is strategic because it is at the mouth of the Red Sea and the rest of the Persian Gulf. A small, hot, dry country with high levels of poverty has made its claim to fame by virtue of its location, attracting the militaries of some of the most powerful countries in the world. The US, China, France, Japan, Saudi Arabia, and Italy have or are constructing military bases in the country. Russia, Spain, Germany, and the United Kingdom also have troops operating out of Djibouti (Ben Ho Wan Beng, 18 March 2016).

The military attraction has in part to do with antipiracy efforts off the coast of Somalia. All ships passing through the Suez Canal to Europe or to the Indian Ocean need to sail through the Bab al-Mandab Strait. Twenty thousand ships and 20% of global exports travel this route every year. Beyond that, Djibouti is critical for geostrategic military operations in the post-9/11 world. Djibouti sits between East Africa and the Arabian Peninsula, allowing aircraft stationed there to reach Somalia or Yemen in minutes. Many of the foreign militaries operating in Djibouti participate in operations against al-Shabaab in Somalia or al-Qaeda in the Arabian Peninsula in Yemen, either directly through drone strikes or by training Djiboutian and other East African militaries. US Special Forces use their base in Djibouti for operations against Boko Haram, the Lord's Resistance Army, and Daesh, and as a launching pad for drone strikes (Katrina Manson, 1 April 2016).

Besides the above, the lack of transparency prevents the victims and their families from obtaining any semblance of accountability and foments anger and fear among communities in targeted regions. It also undermines democratic legitimacy and the rule of law, because still-secret legal justifications for and consequences of this lethal force mean that the public is unable to independently assess the merits and legality of this deeply controversial programme. Greater transparency is critical to ensuring that US policies and practices comport with international and domestic legal standards and that the US government is held accountable when they do not.

Conclusions

The main aim of this paper was to analyse the historical origin and the evolution of military drones in conflict moments in Africa. The proliferation of drone technology across Africa has significantly expanded humanitarian, development, business, and military operations. Drones, also known as unmanned aerial systems, have many positive uses. In the hands of non-state armed groups however, they pose a threat that governments must be prepared for. Drones already form part of the military's arsenal in many African countries and are deployed in peacekeeping missions. Although the adaptation of commercial drones by insurgents into strike platforms in Africa is yet to happen, there's evidence of their use by armed groups for surveillance and precision targeting. In exploiting the benefits of transformative technology, African states should be aware of the potential risks and develop strategies to track and trace drone proliferation. Besides the US, UN, France, Russia, armed groups have recently used drones to locate targets in many conflict areas in Africa. Highly sophisticated military-specific drones, costing millions of dollars, currently require substantial trained experts and adequate infrastructure to operate. Because of that, they are neither accessible to nor affordable for non-state actors and many state militaries. Nonetheless, the increasing number of indigenous producers and growing international market suggest that an increasing number of countries will possess armed drones in the next 5 to 10 years. Given their growing exposure to the spread of this technology African policymakers should play an active role in shaping future drone

policy. This emerging threat demonstrates how conventional militaries no longer have a monopoly on appropriating technological innovation that will shape the battlefield.

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