South Asian Studies
A Research Journal of South Asian Studies
Vol. 31, No. 2, July – December 2016, pp. 625 – 638

Unmanned Aerial Vehicles: A Revolution in the Making

Muhammad Nadeem Mirza
Quaid-i-Azam University Islamabad, Pakistan.
Irfan Hasnain Qaisrani
Bahria University, Islamabad, Pakistan.
Lubna Abid Ali
Quaid-i-Azam University Islamabad, Pakistan.
Ahmad Ali Naqvi
University of the Punjab, Lahore, Pakistan

ABSTRACT

Since the flight of a kite by some Chinese, thousands of years ago, the UAVs have developed to the level of unleashing immeasurable destruction even without endangering the life of the 'man in the loop'. This paper traces the history of the drones in the modern times while focusing on the American utilization of the UAVs in the wars of the twenty-first century. Drones basically address the 'friction' element of the war. While analyzing the technical aspects of the UAVs, the article assesses the revolution these have brought in the conduct of the warfare. There are issues of collateral damage being labeled against the use of UAVs, but there is no denying the fact that these are the best weapons available in the arsenal to minimize the number of civilian casualties – as compared with the manned aircrafts and the casualties caused by the missiles fired from the aircraft carriers at times stationed hundreds of miles away. Pilotless target aircraft (PTA), Reconnaissance UAVs, and Strike UAVs or UCAVs are the three main types of Drones according to their function. The advantages of the UAVs over the manned aircrafts are the performance of dull, dirty, and dangerous work, their development and use being economical, their tactical advantage of not endangering the life of the controller, and most recently their use in the civilian arena like the flood relief activities, monitoring of the borders, reconnaissance of the areas after accidents or natural disasters, etc. Biggest challenges in the development of the drones are enhancing the endurance and autonomy of the UAVs, in-flight refueling, increasing the payload capacity, having less numbers of satellites, and most importantly the issues related with the international law and the attached ethical issues. With the successful tests of Burraq, Pakistan has also joined the club of the states developing the UAVs and the race is still 'on'.

Key Words: Drone Technology, Predator, War Friction, Global Hawk, United States, UAVs.

Introduction

The first experiment to fly an unmanned aerial vehicle (UAV) was conducted just after about a decade of Wright Brother's successful experiment of Flying Machine. Since then the technology of unmanned aerial vehicles has improved to the levels that now the ideas are floating at the different policy formulation levels to make

the wars totally unmanned. One of the most important aspects of this de-manning of the war is increasing the payload capacity of the unmanned vehicles to the levels that they may carry any sort of weapons (though never discussed openly, the idea of increasing the payload capacity automatically imply that when time demands, that payload will be nuclear or other devices capable of lashing un-matched lethality on the belligerents).

Drones have revolutionised the conduct of warfare. The most important purpose of the UAVs – as is considered in the United States – is to decrease the "friction" element of war that makes the conduct of the operations difficult. United States Air Force's Basic Doctrine states that; "War is a complex and chaotic human endeavour. Uncertainty and unpredictability – what many call the 'fog' of war – combine with danger, physical stress, and human fallibility to produce 'friction', a phenomenon that makes apparently simple operations unexpectedly, and sometimes even insurmountably, difficult" (US Air Force, 1997, p. 6). Drones are networked autonomous tactical UAVs networked, because they collect the surveillance from ground and transfer the information to the man sitting in the loop. They are autonomous, because they are unmanned or to put more succinctly uninhabited. They address the element of 'friction' i.e. "danger, physical stress, and human fallibility"(Kish, Pachter, & Jacques, 2009, p. 103).

This notion has been challenged by the popular view that war is such a complex phenomenon that machines and robots cannot perform in the same way as do the humans. Robots do only what they are programmed to do, while a human brain is capable of unpredictable functionality. Merriam-Webster Dictionary defines a robot as "an efficient *insensitive* (italics added) person who functions automatically"(Merriam-Webster Dictionary, 2016). It explains everything because war involves lives of millions of human beings, and where lives of humans are involved, there insensitive and emotionless robots cannot be relied on. Regardless of this opposition, robots and drones are overtaking not only human duties but also responsibilities in almost every walk of life.[1] F. Kaplan in a 2009 piece published in *Newsweek* called it "Attack of the drones" (Kaplan, 2009). He discussed that how the advent of the drones has killed the F-22 fighter program in the United States. A similar article published in *Economist*, mentioned that the dynamics of airpower has undergone huge transformation and "the notion of air superiority, have been transformed in the past few years by the rise of remote-controlled drone aircraft, known in military jargon as unmanned aerial vehicles (UAVs)" ('Attack of the Drones', 2009). Their use since the end of the cold war by the United States and other countries has increased exponentially. They have proved their steel in the major wars of the post-cold war era: First Gulf war, Bosnia, Kosovo, Afghanistan, Iraq, Libya, and now in Syria.

This article is an attempt to grasp the extent to which unmanned aerial vehicles have been developed since the first flight of a kite. What are the problems

[1] Although some scholars have tried to differentiate the two, yet in this paper the terms 'drones' and 'UAVs' are used interchangeably.

that current and potential future UAVs will face? This article is based on the descriptive research.

Defining a UAV-Drone

No authentic account exists that how the unmanned aerial vehicles (UAVs) got the name drones. The UAVs-drones initially performed reconnaissance functions which in the military jargons are known as 'dull and dry' jobs. Male drone bees also have the similar dull and dry life, and they are sting-less. (Iacobucci, 1997). So that can be one reason, the UAVs might have got the name 'drones'. US Department of Defence defines a Drone as "a land, sea, or air vehicle that is remotely or automatically controlled" (Department of Defense, 2012a). While an Unmanned Aircraft is defined as "an aircraft or balloon that does not carry a human operator and is capable of flight under remote control or autonomous programming" (Department of Defense, 2012b).

Historically these vehicles have been named differently. In earliest days, they were known as "pilotless aircraft": in 1940s, and 1950s the terms drone or drone aircraft were used. By 1960s the term RPV (Remotely Piloted Vehicle) was used because they were remotely controlled from the ground and air. By 1980s the term unmanned aerial vehicle (UAVs) emerged and since then, this term is in use (Austin, 2010, p. 3). Un-crewed aerial vehicles, unmanned autonomous vehicles, Unmanned Combat Aerial Vehicles (UCAVs) are the other names being ascribed to the drones.

Some authors prefer using the term "uninhabited aerial vehicles". This is so, because "uninhabited does not necessarily mean unmanned" because most of the times there has been a "man in the loop", which implies "there is some level of human interface with the system to make decisions at various points in the mission. The 'man in the loop' may operate from a ground station, another aircraft, or a ship" (Clark, 2000, p. 5). Current research in the field of UAVs is focussing on reducing the role of the "man in the loop", and thus making UAVs more and more autonomous of human interference. Making drones *totally unmanned* may be a possibility in the near future. Today there exist certain important components of an Unmanned Aerial Vehicle System (UAS) of which humans are a vital part. According to DoD, a "UAV system" is the one "whose components include the necessary equipment, network, and personnel to control an unmanned aircraft" (Department of Defense, 2012c). Reg Austin has detailed a UAS as the one consisting of: first "a control station (CS) which houses the system operators, the interfaces between the operators and the rest of the system"; second "the aircraft carrying the payload which may be of many types"; third "the system of communication between the CS which transmits control inputs to the aircraft and returns payload and other data from the aircraft to the CS (this is usually achieved by radio transmission)"; fourth "support equipment which may include maintenance and transport items" (Austin, 2010, p. 1).

Difference between a UAV and a Cruise Missile

Although there exists certain drones which are non-reusable and which do not return after the task is done, yet most of the drones today are considered as the ones which return and which can be reused. Lt. Col. Richard M. Clark defines a UAV as "a self-propelled aircraft that sustains flight through aerodynamic lift. It is designed to be returned and reused, and it does not have a human on board. This definition excludes lighter-than-aircraft such as balloons, blimps, zeppelins, or airships" (Clark, 2000, pp. 3–4). This definition differentiates a UAV from Cruise Missile, because cruise missiles are not reused, they are not returned, and they do not follow aerodynamic lift. The definition of a cruise missile can be; "a dispensable, pilotless, self-guided aerial vehicle that flies like an airplane and carries a lethal device" (Yanushevsky, 2011, p. 2). The cruise missiles were used extensively during 1990s by the United States. But certain deficiencies were attached with the cruise missiles of which the most important was the loss of the vehicle thus the enhancing of economic cost operations.

Categories of Drones

There are three main categories of drones based on their functionality. First, Pilotless Target Aircraft (PTA): as the name suggests these drones are usually non-reusable and serve as the target for the testing of the new weapons systems and are also used for the training purposes. These are considered as one of the oldest types of drones being utilised by the militaries across the world. Second, "the Reconnaissance UAVs gather intelligence information over enemy territory, and the role of these vehicles is nonlethal" (Wagner & Sloan, 1992, p. ix). Wagner and Solan used the phrase "over enemy territory" while writing in 1992. Since then the role of UAVs has increased exponentially and these are not only used over the enemy territory but also over the home territory for both civilian and military reconnaissance purposes. Besides, it is believed that the use of drones by Amazon, an online shopping company, for the delivery of goods will revolutionise the business strategies in the near future. Third, "Strike UAVs or UCAVs are used as weapons delivery systems to take the offensive against an aggressor with lethal military strikes" (Wagner & Sloan, 1992, p. ix). This is the type of the drones which are mostly utilised by the United States in recent times in conducting operations in Pakistan's tribal areas, Afghanistan, Yemen, Iraq, and now Syria – besides using them in other parts of the world.

UAVs can also be categorised on the basis of their shape and size. While following this criteria five major groups can be delineated as "short take-off and landing (STOL), fixed-wing, rotary-wing or rotorcraft, vertical take-off and landing (VTOL), and helicopters." Huge research is being conducted on the development of the design and size of the UAVs. The continuous struggle of the researchers is, on the one hand, to reduce the size and make UAVs easy to use and

to control, while on the other hand to make them more autonomous, stealthy, and endurable.

History of Drones

Although it is usually mentioned that the first time use of the unmanned aerial vehicle was done around 1915, but authors like Wagner and Sloan trace the history of the UAVs to 2000 years ago, when "a young man in China stood on a lonely windswept hill and flew recorded history's first remotely piloted vehicle (RPV) – a 'kite' with a piece of string as a down link to the controller on the ground" (Wagner & Sloan, 1992, p. 15). Chinese use of the armed kites against the enemy soon followed. Similar view is held by Dr Christina J. M. Goulter who has traced the early history of UAVs (Goulter, 2009, pp. 11–25).

During next two thousand years many attempts at gliders were made, but the 19th century balloons were the second major development in this field. Their use in the siege of Paris in 1870s was a major step in this regard. Development of the modern unmanned aircrafts took place during First World War. In 1914 British Army developed 'aerial targets' used for training and for long range bombing (Austin, 2010, p. 304). In 1917 two Americans, Dr Peter Cooper and Elmer A. Sperry "carried out tests with their first 'aerial torpedoes' (Hewitt-Sperry Automatic Airplane) at Long Island, New York, in December 1917 … A more sophisticated unmanned aircraft was designed by Charles F. Kettering of Delco, later General Motors. Known as the 'Kettering Bug,' it could also carry a 300 lbs. bomb load over short distances" (Oliver & Ryan, 2000, p. 132). Although these 'bugs' were not used in WW-I yet by October 1918 successful flights were conducted and they were included in the US arsenal. Today's cruise missiles are considered as a variant of these aerial torpedoes.

In the "mid-war period" the United States and Britain developed unmanned aircrafts initially for antiaircraft training purpose and then as missiles. But actually it was Germany which leads the race in the research and development of these vehicles. It was Dr. Fritz Gosslau of the Argus Motor Works in Germany who "developed the FZG-43 (Flakzielgerat-43, antiaircraft target device-43) … In October 1939, Argus proposed a more revolutionary scheme using a larger radio-controlled drone dubbed Fernfeuer (Deep Fire)" (Zaloga, 2008, p. 7). It was a revolutionary idea then, because if completed these could have the capacity to be reused and returned to the base after delivering the payload – the main characteristic of today's UCAVs. It could not get the approval from German authority – had Fernfeuer been approved by the German government, this could have been a great leap in the development of the UAVs. During WW-II, Germany developed Fieseler Fi-103, also known as "terror weapon" or "flying bombs" or simply "V-1" (V stood for *Vergeltungswaffe* – vengeance weapon). They were "pulse-jet-powered aircraft carrying a 2,000 lbs. warhead designed to be launched from a ground ramp or from an aircraft. It could cruise at 400mph and be pre-

programmed to fly 100-150 miles before its engine cut out and it would fall vertically on to its random target" (Oliver & Ryan, 2000, p. 132). These were used widely against Britain during 1944-45, and resulted in huge destruction. The United States also developed its UAVs during WW-II and tried to develop the technology. Its navy successfully utilised those UAVs against Japanese shipping in late 1944. Its army also "purchased 15,000 of unmanned aircrafts during World War II, using them as targets to help train pilots and anti-aircraft gunners" (Creveld, 2011, p. 229).

In the post WW-II era, Americans and Soviets advanced their missile and drone programs on the basis of highly advanced German V-1. The most important development of the post Second World War era was the American "Firebee" also known as "lightening bug" developed by Ryan Aeronautical. The United States had flown 3,435 sorties of remotely piloted vehicles (RPVs) 'Firebee' launched from DC-130 Hercules aircraft, during Vietnam War (Clark, 2000, pp. 18–19; Oliver & Ryan, 2000, pp. 12–13). Now the drones were being used for the surveillance purpose against the belligerent positions. Earlier the United States had been using high altitude U-2 *manned* aircrafts for surveillance missions. Although the use of the manned aircrafts continued, yet gradually the progress was made in the development of the UAVs, both at the technical and the operational levels.

These simple drones played an important role in the Arab-Israel Wars of 1973 and 1982 (Hasik, 2008, p. 33). Especially in the 1982 war, Israel utilised these drone effectively to monitor the Syrian troops and then dodging their air defence system and later on destroying them (Creveld, 2011, p. 229).[2] While drones were proving their worth in other part of the world, the United States in 1979 cancelled all the UAV Programs (Ehrhard, 2000, p. 513; quoted by Hasik, 2008, p. 34). By 1982, only 33 unmanned aircrafts remained in the US inventory, and all of those were in storage (Schemmer, 1982, p. 38). It was Israel that advanced in the field of the research and development of drones during 1970s and 1980s and it developed a large cache of drones like "Pioneer" which were later bought by the United States during First Gulf War. American CIA had been running a large number of 'black' projects for the development of the drones. Similarly Lockheed Martin's 'Skunk Works' was also the place where different UAV development programs were carried out secretly.

After the establishment of the importance of modern UAVs during first Gulf War, the United States again opened the funding for UAVs research and development. 1990s advancements in computers and broadband GPS helped the impetus and thus in June 1995 there flew "General Dynamics Predator", developed

[2] Martin van Creveld notes, "It was in 1982, during the Israeli invasion of Lebanon, that drones really came into their own. Originally the Israelis had hoped to use their drones in order to locate their enemies on the ground. Yet what left much of the military world gaping was their use against the Syrian SAM batteries in the Beqa Valley. First, the drones flew over the area for months to pinpoint the missile batteries and learn as much as possible about them. Next, before the actual attack, other remotely piloted vehicles (RPVs) were sent out as decoys. They made the Syrians switch on their radar sets, thus revealing the frequencies on which they operated. Once this had been done, other drones, or perhaps they were the same ones, were sent to home in on those sets and destroy them."

from a CIA "black" program – the GNAT 750. Predator is a Medium Altitude Endurance (MAE) UAV and it was operational in "1996 over Bosnia in support of the International Force (IFOR)" (Oliver & Ryan, 2000, p. 133). All these developments were possible because the United States in 1994 started the "Advanced Concept Technology Demonstration (ACTD) program which is a pre-acquisition activity that allows war-fighters to use and assess leading-edge command, control, communications, computers, and intelligence (C4I) capabilities" (Department of Defense, 2011). With ACTD**,** "DOD has taken a quantum step in the right direction for long term program survival of UAVs. ACTDs provide a useful, short term acquisition cycle, which at the end of a 30 month process enable DOD to go into production to fill service requirements for needed weapon system" (Bierbaum, 1995). Since then, the United States is leading in the research and the development of UAVs and it has scored a lot of success stories.

Use of UAVs

Why use UAVs and not the Manned-Aircrafts?

First and foremost question that comes in the mind is why to use UAVs? The answer is that UAVs perform certain functions which are *"dull, dirty, and dangerous"* (Lam, 2009, p. v)[3]. *Dull roles* include surveillance and reconnaissance operations which demand days and even months of patience while at the same time continuous vigilance. UAVs can hover over the target for days without anyone's notice. *Dirty roles* include the operations in the nuclear or chemical and biologically dangerous zones, especially for monitoring the environment for the contamination. In such environment, the use of manned aircrafts increases the risk of casualties. *Dangerous roles* include operations in the enemy areas where sending the manned aircrafts or spies can be dangerous. *Research role* include the use of UAVs in aeronautical field and for training and testing purposes (Austin, 2010, pp. 5–7).

Economically, UAVs cost less and are more efficient than a manned aerial vehicle. Operational cost of a Predator UAV is about $100 per hour as compared to a manned tactical aircraft whose minimum cost is at least $1500 per hour (Hasik, 2008, p. 41).

Tactically manned tactical aircrafts puts the life of the pilot at risk, or more importantly the risk of becoming a Prisoner of War (POW) resulting in diplomatic humiliation. Besides, the absence of a man from the cockpit increases the

[3] Thanh Mung Lam notes, "Unmanned and micro aerial vehicles (UAV and MAV) have the potential to enable low-cost and safe operation. Due to their small and lightweight platform the aerial vehicles can be used for surveillance, search and rescue, and scientific research missions in unknown, dangerous environments and operations where the use of manned air vehicles is not suitable or too expensive."

endurance capacity of the aircrafts (Rasmussen, Shima, & Chandler, 2009, p. 1). P.W. Singer stated that "drones enable a government to avoid the political risk of putting combat boots on foreign soil" (P.W. Singer quoted in 'Attack of the Drones', 2009). Foreign states may allow the use of the drones to kill high profile targets, but they may not accept military boots on ground, as is evident from the example of Pakistan. Thus "a robotic strike … would give rise to fewer diplomatic complications" (Creveld, 2011, p. 229). Besides, the use of UAVs in the protracted conflicts like Iraq, Afghanistan, or generally in the war on terror is more feasible than the manned fighter jets, because there are no concentrated "strategic targets to destroy or no opposing air force to go after" (Kaplan, 2009).

Technically UAVs have some advantage over manned aircrafts and satellites. "Compared to the former, their radar signature is much smaller; some are even said to have achieved true stealth capabilities at much lower cost. Compared to the latter, they are able to fly closer to the earth's surface and can remain over the same area for a considerable time" (Creveld, 2011, p. 230).

Militarily, UAVs have transformed the landscape of warfare. Not only in the air force but also in navy and army, UAVs are performing their role efficiently. US Navy for example in the 1950s, acquired the first helicopter attack drone, the QH50 DASH (drone antisubmarine helicopter) (Zaloga, 2008, p. 16).

The most important functions of the UAVs in the combat are strike, suppression and destruction. UAVs do not only gather vital intelligence information about the targets but they also are used to soften the target before the actual launch of the attack. Reg Austin has categorised following role of UAVs in military sphere: in navy **"**shadowing enemy fleets, decoying missiles by the emission of artificial signatures, electronic intelligence, relaying radio signals, protection of ports from offshore attack, placement and monitoring of sonar buoys and possibly other forms of anti-submarine warfare." In army "reconnaissance, surveillance of enemy activity, monitoring of nuclear, biological or chemical (NBC) contamination, electronic intelligence, target designation and monitoring, location and destruction of land mines." In air force "long-range, high-altitude surveillance, radar system jamming and destruction, electronic intelligence, airfield base security, airfield damage assessment, elimination of unexploded bombs" (Austin, 2010, p. 2). As has been utilised by the Israel, these drones are also employed "as decoys to bluff enemy surface-to-air missiles (SAM)" (Zaloga, 2008, p. 12).

In the *civilian* arena, some of the potential UAV usage include; "aerial photography, crop monitoring and spraying, coastguard search and rescue, coastline and sea-lane monitoring, border surveillance, fire-fighting especially forest fires, pipeline security, news information and pictures, disaster control, meteorological services sampling and analysis of atmosphere for forecasting, mapping, search for missing persons, flood and pollution control, geographical, geological and archaeological survey" (Austin, 2010, pp. 1–2). Recently the UAVs have been utilised by different media organisation for capturing the million marches and protestors especially where the risk factor for the journalists is

heightened. Some e-commerce organisations are on the move to utilise the drone for the delivery of the goods to the customers at the doorsteps. Besides, these have also been used for the surveillance on the economic zones (Carvalhal, Santos, Ferreira, Silva, & Afonso, 2009, p. 1).

The recent natural disasters have motivated the use of UAVs in the monitoring of the weather, and search and rescue operations, and disaster assessment. UAVs can act as "first-responder support in case of natural disasters, remote sensing, scientific research, and geographical surveying" (Rabbath & Lechevin, 2010, p. 1). UAVs (especially Predators flying 18,000-20,000 feet above sea-level) were extensively used by the United States in 2008 hurricanes that struck Louisiana and Texas. Recently Australia has developed a drone that is hurricane resistant and can enter inside the hurricane thus providing real time data about its development.

Current issues/problems in the development of UAVs

There are certain areas in which current UAV research is focussed:

Cost: although the operational costs of the UAVs are very low as compared to the manned aircraft, yet the cost of development of certain UAVs is very high. For example the "unit price of a Global Hawk is said to be $35 million, a figure that is more than trebled if development costs are included" (Merle, 2004).

Endurance: Although current UAVs have endurance which is much higher than the normal manned aircrafts but that is still considered to be low for a UAV. In 1970s the idea of flying UAVs with the solar energy was forwarded, and indeed certain UAVs were developed, but they are still unable to increase the endurance as is demanded by the military. Recently USAF has launched a program named 'Vulture Program'('Vulture - The Unmanned Aircraft Able to Stay in the Air for 5 Years', 2008) whose purpose is to develop a UAV with endurance of up-to five years. Although it seems a novel idea, yet the development in this direction has happened significantly and sooner the first UAV capable of staying above the surface for five years with a payload capacity of about 1000 lb. will take off.

Autonomy: Another issue facing UAVs is autonomy. Researchers are trying to develop UAVs which can perform most of their functions by themselves, and rely less on the "man in the loop". For this purpose increased C4I and advance artificial intelligence feature with more advanced and complex systems on board are being developed. "Autonomy is replacing the human operator in many applications" (Tsourdos, White, & Shanmugavel, 2011, p. 1)[4] Lockheed Martin is developing UAVs with advance C4I, which will be autonomous to a larger extent. Although the debate is still going on in the policy circles that how much autonomy should be allowed to UAVs?

[4] Tsourdos, White, and Shanmugavel notes, "Advances in avionics, navigation based on GPS (Global Positioning System), flight control techniques and low-cost electronics have further fuelled the use of UAVs in commercial and military applications. Future UAVs will be more autonomous than the remotely piloted reconnaissance platforms in use today."

Pilots' refusal to leave cockpit duties: Another related issue is the refusal of the pilots to leave the cockpit duty and join the *drawing room* type control room of a UAV. The culture of service is seriously been affected by the advent of the drones. Very few of these operators of drones "are volunteers, as most have expressed a preference for flying in the cockpit, rather than remotely" (Fulghum, 1998, pp. 61–62). Although the new generation of pilots or more precisely drone operators, who are especially trained for the UAVs may have fewer objections on it, yet the norms of the service have been challenged.

Scarcity of satellites: Although the United States is developing a big fleet of its UAVs but they cannot be functional at a single time because of the limited number of the satellites in the orbit. For example the United States might have a fleet of hundred Predators with it, but all of those cannot be operational at one time because of this limitation. (Sirak, 2002). In 2001 and 2002, the ability of the USAF was to keep operational only two Predators and one Global Hawk in Afghanistan at one time (Hasik, 2008, p. 42). This capability of the United States has improved significantly in the recent years, yet the challenge still remains.

In-flight refuelling: Researchers and developers are trying to develop UAV-UAV refuelling in air in an attempt to amalgamate the issues related to autonomy of the UAVs. Northrop Grumman is specifically trying to develop UAV-UAV refuelling facility (Bigelow, 2010). A parallel program is the development of the solar-powered UAVs to mitigate the effects of this limitation.

Stealth Technology: Recent target of the developers is to develop "a relatively stealthy, unmanned strike aircraft with an airframe built from nearly 90 per cent composite materials" (Sweetman & Cook, 2001, p. 59). U-2s were successful for a considerable period of time in the cold war only because of the inability of the Soviet Union to shut them down. If successful in developing the stealth technology enabled UAVs, the United States will be in a better position to monitor the activities of those states which do not allow the American drones in their airspace – most prominently China.

Greater payload capacity: Currently UAVs can carry payloads that are not considered 'enough' in the military jargons. So the demand is to either increase the payload capacity of current UAVs or to develop new UAVs with the greater payload capacity. The target is to increase the endurance of UAVs to novel lengths with the nuclear devices on it thus ensuring not only the second strike capability but also to create a deterring effect on the belligerent.

Ethical Issues: Biggest ethical issue in the use of UAVs is the collateral damage. Criticism is often raised that the operator of a UAV while sitting thousands of miles away in a control room cannot *precisely* judge the situation on ground. Firing of missiles on the wedding ceremonies in Afghanistan – where the culture of aerial firing at the occasion of happiness is rampant – is just one example of such scenarios. A Brookings study in 2009 concluded that the "number suggests that for every militant killed, 10 or so civilians also died" (Byman, 2009). Critics have raised the concerns that it is just like 'video game scenario', and "operators can now safely manipulate battlefield weapons from control rooms half a world

away, as if they are playing a video game" ('Attack of the Drones', 2009). On the other hand there is no denying the fact that these are the best weapons available in the arsenal to minimise the number of civilian casualties – as compared with the manned aircrafts and the casualties caused by the missiles fired from the aircraft carriers at times stationed hundreds of miles away. Manned fighter jets can pound the positions of the belligerents within a very limited time slot. But in the case of the UAVs, the operator can wait for months while monitoring the activities on ground and finding a suitable time to launch the attack thus ensuring the minimum number of the civilian casualties.

A related problem is the breach of international law. Recasting the terms of sovereignty being one of the major parts of the Bush Doctrine entitled the United States to enhance the UAVs operations in many parts of the world. The sovereignty has become a highly relative term in the post 9/11 era especially for the weaker states. Scholars challenge this position on the basis of being a grave threat to the international law and the norms of the international society. Targeted killing without any trials raised a new plethora of ethical and legal issues.

Types of UAVs being used by the United States

The United States has maintained a large variety of UAVs at this time. This thing is evident from the fact that it used around ten types of UAVs against Iraq. The major UAV System being used by the United States is as under;

US Air Force: Predators (Predator B, also known as 'Reaper' can carry up to 14 Hellfire Missiles), and Global Hawk (can fly from Australia to United States without refuelling). Predators are Medium Altitude Endurance (MAE) UAVs. They fly at 7.6 km, and their endurance is 24 hours. They are the mostly used UAVs in American campaigns since 1995. Predators are developed by General Atomics. Global Hawk is the High Altitude Endurance (HAE) UAV. It is one of the largest UAV US has (13.54 m long) in its arsenal. It can fly at 20 km, and can fly up-to 35 hours. It is developed by Northrop Grumman.

US Navy/Marines: US Navy mostly employed 'Pioneer' UAVs which are the Israeli inspired drones and their maximum capacity to reach at the altitude is 4.5 km. It can stay in air for five hours and is a short range UAV (Pike, 2000).

US Army: Hunter and Shadow UAVs are medium altitude drones i.e. 4.5 km. Hunter has endurance of ten hours. It is also developed by Northrop Grumman. While the endurance of Shadow is six hours it is developed by AAI Textron Systems.

These are a few of the long list of UAVS being employed and developed by the United States, and they are not strictly under the control of a specific force only e.g. Predators are recently being employed by the US Border Security Force for monitoring the US-Mexican border. Besides these UAVs, the United States also uses 'Eagle Eye' which operates like a helicopter, and the 'Dragon Warrior' which is also a vertical take-off and landing UAV. Novel ideas of developing the

smaller drones – the size of a fly – are floating in the strategic community, and it seems that the day is not too far when they will be operational – some scholars even opine that these are already operational in the tactical operations conducted by the United States.

Conclusion

Unmanned Aerial Vehicles have been used by the human being since two thousand years. But the pinnacle of the development that they have seen today is unmatched, and some scholars predict that the process of this development is still in the state of infancy. The development of the Micro-UAVs, bio-inspired sensors and surveillance techniques will make the future UAVs easier to carry and use. The idea is that every platoon commander in future to have a UAV in his backpack.

It is not only the United States that is in the competition of development of UAVs, almost every country of the world is in the struggle to develop UAVs to meet their needs. UK is currently using a big fleet of UAVs, and it has even launched the projects of converting the fighter jets into drones. Israel is in the field since 1970s, when even the United States was not taking it seriously. The Russian research in the development of the UAVs started in 1950s. Early 1950s saw the development of the first Soviet UAV design. At first, these were mostly target drones, but reconnaissance UAVs followed soon enough (Gordon, 2005, p. 4).
The US at the time is leading the race followed by Israel. Then comes "Britain, France, Germany and Italy. Russia and Spain are not far behind, and nor, say some experts, is China" ('Attack of the Drones', 2009). Pakistan is also working on many drone projects and it has developed some of the drones successfully. The list of drones developed by Pakistan includes the names of more than fifteen UAVs. One of the best is "Tornado" developed by Integrated Dynamics at Karachi "which emits radar signals that mimic a fighter jet to fool enemies." ('Attack of the Drones', 2009). Pakistan has also conducted the successful testing of Burraq – an armed drone. Pakistan has employed these drones successfully in the Operation Zarb-e-Azb. In the civilian arena, different media outlets have utilised some small drones during recent protests in Pakistan, and their future employment will exponentially increase.

Drones business in the world is booming. Like public, the private sector has also invested heavily in the business and is offering 'drone services' to the needy states, and non-state organisations. UAVs are the future not only of the warfare, but their use in the civilian arena will also be unmatched.

References

Attack of the Drones. (2009, September 3). *The Economist*. Retrieved from http://www.economist.com/node/14299496

Austin, R. (2010). *Unmanned Aircraft Systems: UAVS Design, Development and Deployment*. West Sussex, U.K: Wiley-Blackwell.

Bierbaum, M. W. W. (1995). UAVs. *Air & Space Journal, Chronicles Online Journal*. Retrieved from http://www.airpower.maxwell.af.mil/airchronicles/cc/uav.html

Bigelow, B. V. (2010, July 1). Northrop Grumman Planning First UAV-to-UAV Aerial Refueling. Retrieved 20 December 2016, from http://www.xconomy.com/san-diego/2010/07/01/northrop-grumman-planning-first-uav-to-uav-aerial-refueling/2/

Byman, D. L. (2009, July 14). Do Targeted Killings Work? Retrieved from https://www.brookings.edu/opinions/do-targeted-killings-work-2/

Carvalhal, P., Santos, C., Ferreira, M., Silva, L., & Afonso, J. (2009). Design and Development of a Fly-by-Wireless UAV Platform. In T. M. Lam (Ed.), *Aerial Vehicles*. Vienna: In-Tech.

Clark, R. M. (2000). *Uninhabited Combat Aerial Vehicles: Airpower by the People, for the People, but Not with the People*. Alabama: Air University Press.

Creveld, M. V. (2011). *Age of Airpower*. New York: PublicAffairs.

Department of Defense. (2011). Advanced Concept Technology Demonstration (ACTD). Retrieved from http://www.disa.mil/News/PressResources/Fact-Sheets/ACTD

Department of Defense. (2012a). Drone. *Dictionary of Military and Associated Terms*. Defense Technical Information Center, US Government. Retrieved from http://www.dtic.mil/doctrine/dod_dictionary/data/d/3874.html

Department of Defense. (2012b). Unmanned Aircraft. *Dictionary of Military and Associated Terms*. Defense Technical Information Center, US Government. Retrieved from http://www.dtic.mil/doctrine/dod_dictionary/data/u/18955.html

Department of Defense. (2012c). Unmanned Aircraft System. *Dictionary of Military and Associated Terms*. Defense Technical Information Center, US Government. Retrieved from http://www.dtic.mil/doctrine/dod_dictionary/data/u/18956.html

Ehrhard, T. P. (2000). *Unmanned Aerial Vehicles: A Comparative Study of Weapon System Innovation*. Johns Hopkins University, Maryland.

Fulghum, D. A. (1998). Anti-Air Defense Role Eyed for Predator. *Aviation Week & Space Technology*, *148*(25), 61–62.

Gordon, Y. (2005). *Soviet/Russian Unmanned Aerial Vehicles*. Hinkcley: Midland Publishing.

Goulter, C. J. M. (2009). The Development of UAVs and UCAVs: The Early Years. In O. Barnes (Ed.), *Air Power, UAVs: The Wider Context*. London: Royal Air Force, Directorate of Defense Studies.

Hasik, J. (2008). *Arms and Innovation: Entrepreneurship and Alliances in the Twenty-First Century Defense Industry*. Chicago: University of Chicago Press.

Iacobucci, R. (1997). The Drone. Retrieved 20 December 2016, from http://www.roctronics.com/bee-base.htm

Kaplan, F. (2009, September). Attack of the Drones. *Newsweek Magazine*, *19*.

Kish, B., Pachter, M., & Jacques, D. (2009). Effectiveness Measures for Operations in Uncertain Environments. In T. Shima & S. Rasmussen (Eds.), *UAV Cooperative Decision and Control: Challenges and Practical Approaches*. Philadelphia: Society for Industrial and Applied Mathematics.

Lam, T. M. (Ed.). (2009). *Aerial Vehicles*. Vienna: In-Tech.

Merle, R. (2004, December 7). Price of Global Hawk Surveillance Program Rises. *Washington Post*. Retrieved from http://www.washingtonpost.com/wp-dyn/articles/A41769-2004Dec6.html

Merriam-Webster Dictionary. (2016). Robot. Retrieved from https://www.merriam-webster.com/dictionary/robot

Oliver, D., & Ryan, M. (2000). *Warplanes of the Future*. Osceola, USA: MBI Publishing.

Pike, J. (2000, March 5). Pioneer Short Range (SR) UAV. Retrieved from https://fas.org/irp/program/collect/pioneer.htm

Rabbath, C. A., & Lechevin, N. (2010). *Safety And Reliability In Cooperating Unmanned Aerial Systems*. Singapore: World Scientific Publishing.

Rasmussen, S., Shima, T., & Chandler, P. (2009). Introduction. In T. Shima & S. Rasmussen (Eds.), *UAV Cooperative Decision and Control Challenges and Practical Approaches*. Philadelphia: SIAM.

Schemmer, B. F. (1982). Where Have All the RPVs Gone? *Armed Forces Journal International*.

Sirak, M. (2002, January 9). Interview: James Roche, Secretary of the U.S. Air Force. *Jane's Defence Weekly*.

Sweetman, B., & Cook, N. (2001, June 20). Hidden Agenda: What Next for Low Observables Technology? *Jane's Defence Weekly*.

Tsourdos, A., White, B. A., & Shanmugavel, M. (2011). *Cooperative Path Planning of Unmanned Aerial Vehicles*. West Sussex, U.K.: Wiley-Blackwell.

US Air Force. (1997, September). Air Force Basic Doctrine Document 1. US Government.

Vulture - The Unmanned Aircraft Able to Stay in the Air for 5 Years. (2008, March 5). Retrieved 20 December 2016, from http://www.infoniac.com/hi-tech/vulture-unmanned-aircraft-able-stay-the-air-for-years.html

Wagner, W., & Sloan, W. (1992). *Fireflies and Other UAVs (Unmanned Aerial Vehicles)*. Arlington, Tex: Midland Publishing.

Yanushevsky, R. (2011). *Guidance of Unmanned Aerial Vehicles*. London: CRC Press.

Zaloga, S. J. (2008). *Unmanned Aerial Vehicles: Robotic Air Warfare 1917-2007*. Oxford: Osprey Publishing.

Biographical Note

Dr Muhammad Nadeem Mirza is faculty member at School of Politics and International Relations, Quaid-i-Azam University Islamabad, Pakistan.

Dr. Irfan Hasnain Qaisrani is Assistant Professor at the Department of Humanities and Social Sciences, (HSS) Bahria University Islamabad, Pakistan.

Professor Dr. Lubna Abid Ali is former Director at the School of Politics and International Relations, Quaid-i-Azam University Islamabad, Pakistan.

Mr. Ahmad Ali Naqvi is Lecturer at the Department of Political Science, University of Punjab Lahore, Pakistan.