Ucavs as force multipliers history essay

21. The desire to put machinery rather than humans in harm’s way has always been a feature of military history. As the balloon age gave way to fixed wing aviation, the possibility of using unmanned platforms for reconnaissance was investigated by a number of nations. As ever, warfare was the ‘ mother of invention’ and great strides were made in Unmanned Aerial Vehicle (UAV) and Unmanned Combat Aerial Vehicle (UCAV) design and conceptualisation in both the First and Second World Wars. Over the ages many countries have employed the UAVs and UCAVs as a force multiplier in conventional ops, but the main exponents of the unmanned vehicles have been the USA and Israel.

Use of UAVs & UCAVs by USA in Conventional Operations

22. Vietnam War. On 10 August 1964 President Lyndon B. Johnson issued the Tonkin Gulf Resolution, and the United States became involved in the Vietnam War. This was the first war that saw an extensive use of UAVs. A total of 3, 435 operational reconnaissance UAV sorties were flown in Southeast Asia between 1964 and 1975[1]. These sorties involved 1, 016 Ryan 147s of varying configurations and models. The 147s made great contributions to the war effort and served as the workhorse of the Vietnam-era UAVs[2].

23. During the war, Russian-built surface-to-air missiles made photo reconnaissance missions in piloted U-2s or SR-71s an exceedingly dangerous occupation over North Vietnam. The solution to the mounting losses in terms of aircrafts and trained pilots came in the form of UAVs. Aircraft were lost but no pilots were killed or taken prisoner. Teledyne Ryan Aeronautics modified its basic Firebee target drone to carry out pre-programmed, autonomous,

long-range reconnaissance missions. By the end of the war, some 28 variants for specific missions had been developed to include gathering photographic, infrared and electronic intelligence information, acting as decoys in probing enemy defences and carrying out electronic countermeasures.

24. In the face of multiple hazards like SAMs, AAA Sites and MIG 21s, the Firebee drones were modified in order to meet a variety of reconnaissance roles. One variant was fitted with a Low Altitude Barometric Control System, which allowed it to fly at ultra-low levels to avoid North Vietnamese radar. Another variant was modified to fly at very high altitude, and another, known as the 147E, was designed to meet the requirement for an ELINT platform. This particular model proved invaluable for assessing the nature of the SAM's guidance system and its fusing mechanism, and this intelligence was used subsequently by SAM suppression aircraft (Wild Weasels). The Firebee were also employed as target drones in a ' strike package' concept, whereby they flew below manned strike aircraft and high altitude reconnaissance drones, drawing enemy fire. Later in the war, Firebee target drones were used to draw fire away from B-52s operating over North Vietnam. Following successes with chaff dispensing drones in 1967-68, additional experimentation also proved the worth of the Firebee as an Electronic Counter-Measures platform[3]. In 1969, the loss of a manned ECM aircraft, an EC-121 Super Constellation, with 31 personnel on board, spurred the development of a drone capable of data collection and transmission. This model, known as the 147TE, could collect electronic intelligence from a range of 600 miles from its parent aircraft. This marked a true revolution in

ECM technology, because a drone fitted with ten receivers could collect the same amount of data as a manned ECM platform, such as the EC-121, and relay the data instantaneously[4]. By the end of the Vietnam War, great strides had also been made in photographic reconnaissance. The Firebee photographic reconnaissance models available in 1967-68 had operational ceilings of up to 66, 000 feet and a range of over 400 miles, and could photograph a 22 mile wide strip along a pre-determined track of 800 miles. By 1972, the 147SC model was fitted with an all-round horizon perspective, and the on-board cameras were capable of continuous photographic coverage along a 155 mile path, with resolutions of less than one-third of a metre. Course corrections in this model were also achieved by Doppler radar. The 147SC model performed 1, 651 operational missions in the last two years of the Vietnam War, and a late war modification also saw the 147SC Firebee used in night reconnaissance, and some drones were equipped with infra-red sensors[5].

25. During the course of the war the Lightning Bug provided some invaluable results. Some accomplishments were:

(a) It obtained the first photographic evidence of SA-2 missiles in North Vietnam.

(b) It took the first photographs of Soviet MiG-21D/E aircraft in North Vietnam.

(c) It obtained photographic evidence of Soviet helicopters in North Vietnam.

(d) It photographed an SA-2 missile detonation at close range (20 to 30 feet).

(e) It was also used to provide daily low altitude bomb damage assessment (BDA) of B-52 raids during “ Linebacker II.”[6]

26. Gulf War I and II (1991 and 2003) – The US used UAVs extensively in both the Gulf Wars. During Gulf War I, the Pioneer UAV flew more than 530 missions into Iraqi airspace. The BAI-Exdrone and the French Alpilles-MART were among other UAVs which were used effectively by the US. Besides the orthodox employment like surveillance, reconnaissance, Arty fire control and target acquisition, the UAVs were used productively for individual chemical agent detection (ICAD), pre-ingress route recce of Apache AH-64 helicopters, and C3I functions. They were also used for damage assessment, electronic warfare, signal intelligence and communication intelligence. The US Navy made use of UAVs for detection of enemy ships, locating Silkworm anti-shipping missile launch sites, direction of naval gunfire and mine detection. Pioneers were also used in an over-the-horizon-targeting (OTHT) role to direct shore bombardment by the USS Iowa’s 16-inch guns. With the Pioneers acting as eyes on the target, the ship’s gunners recorded notable hits. In one instance, gunners in combination with the Pioneer were able to destroy their targets using one-third as many shells as gunners without a UAV. The Navy had also used the Pioneer in a ship-surveillance role, in the Persian Gulf with impressive results. The coalition forces had employed UAVs effectively as Force Multipliers for persistent surveillance, wide area reconnaissance and prompt battle damage assessment using UAVs like the Pointer, Pioneer, Mart, Midge and the Exdrone. The US Marine Corps made extensive use of its UAVs to offset the overall shortfall in aircraft-based reconnaissance.

27. Lessons Learnt. Some of the important lessons learnt from employment of UAVs in Gulf War were as follows:-

(a) Rather than having one all-purpose model like the Pioneer, with US, it is better to have a diverse family of mission specific UAVs.

(b) It was easier to operate smaller tactical UAVs near the front lines.

(c) There was a need for long-endurance UAVs, which could take off from depth and yet patrol strategic areas of the enemy.

(d) Small numbers of less visible mini UAVs could carry out recce missions with high survivability.

Use of UAVs & UCAVs by Israel in Conventional Operations

28. Israel has actively employed unmanned aircraft in all the wars since 1973. They have used US-built drones like the Teledyne Ryan 124 and Northrop Chukar and indigenously built RPVs like the Tadiran Mastiff, the Israeli Aircraft Industries Scout and the Mazlat Pioneer.

29. Yom Kippur War 1973. In October 73, the Israelis successfully used the Teledyne Ryan 124 drones on the Syrian and Egyptian fronts as reconnaissance and surveillance platforms, decoys and also UCAVs. The reconnaissance missions brought back valuable intelligence information and often the drones drew the fire of Arab surface to air missiles (SAMs) thus causing the irrelevant expenditure of valuable missiles and the weakening of Arab defences. The Israeli Air Force, on the second day of the war, used Firebees to lead attacks on Egyptian air defences along the Suez Canal. The

Egyptians fired most of their SAMs at this first wave of UCAVs, and the Firebees successfully evaded 32 of the SAMs, and destroyed 11 others with Shrike anti-radar missiles[7].

30. Operation “ Peace for Galilee”. The Israelis made extensive use of UAVs in the Bekaa Valley operations. The Israeli Air Force had used these drones in the months preceding the invasion to “ fingerprint” surface-to-air radar, providing information vital to Israeli countermeasures[8]. When the battle actually began, UAVs were used as “ decoys” to electronically simulate the radar signature of full-size strike aircraft and trick the Syrians into activating their SAM target acquisition and tracking radars[9]. This ruse provided ample targets for the AGM-78 Standard anti-radiation missile (ARM) and AGM-45 Shrike air-launched ARMs that followed[10]. Other UAVs served as cheap and survivable intelligence platforms because they were constructed out of aluminium and composite materials for a minimal radar and infrared signature. They were employed most often as photographic platforms or “ real-time” video intelligence systems whose fields of view, zoom ratios, and flight plans could be pre-programmed or changed at the discretion of the commander[11]. Once the tactical reconnaissance and deception functions were completed and strike aircraft were directed to the SAM sites, air-launched laser-guided ordnance was guided to the target by laser designators mounted on the UAVs[12]. The UAVs also provided constant, real-time surveillance of Syrian air force bases, alerting IAF air battle controllers to the take-offs of Syrian aircraft, helping them to vector IAF aircraft to optimal intercept coordinates, contributing to the lopsided score in a series of air battles, in which Israeli pilots shot down 80-100 Syrian aircraft

without incurring a single loss. UAVs also assisted the IDF’s ground campaign. Drones furnished real-time intelligence on the location and movement of Syrian and Palestine Liberation Organization (PLO) units. Such data clearly assisted IDF commanders in planning and executing impressive tactical engagements, such as the large-scale defeat inflicted on Syrian armor by Israeli tanks and infantry around Lake Karoun. The employment of drones as part of the IDF’s ground campaign, in short, opened up a whole new avenue in air-land battlefield cooperation and was a major factor contributing to the success of the Israeli Armed Forces.

31. Lessons Learnt. During the operation certain important lessons were learnt, namely:-

(a) The UAVs substantiated their claim as a major force multiplier & re-emphasized the world’s faith in their utility in the modern battlefield.

(b) UAVs with specific task related capability, instead of an all-purpose UAV, would be more suitable in modern warfare.

(c) The low signatures (radar, IR, acoustic and optical) reduced the UAVs susceptibility to ground fire and electronic counter measures.

(d) The Bekaa Valley operation proved that UAVs are a cost effective means of conducting electronic warfare and intelligence gathering.

(e) The UAVs proved to be the ideal platform for employment in the dense AD environment of a modern TBA.

CHAPTER 3

IMPACT OF UAVs AND UCAVs AS FORCE MULTIPLIER

IN NON-CONVENTIONAL OPERATIONS.

“ Knowledge of an enemy’s dispositions and movements has always been a

key to success in war.”

John Taylor, “ Spies in the Sky”

32. As the spectre of large scale conventional war diminishes in the modern day world order, it is the threat of prolonged non- conventional operations which is rearing its head. 9/11 forced the world to realise the growing power of Terrorist organisations. The US led Global War on Terror (GWOT) has been supported by many nations, but there is no end in sight to the menace of Fourth Generation Warfare (4GW). Non-conventional operations are different from conventional operations in that the armed forces are forced to fight an enemy that is often impossible to distinguish from civilians or is so embedded in their midst that there is no way to separate them in terms of air strikes or land attacks. This is particularly true of the fighting in populated areas and street by street combat. It is in such a scenario that UAVs can help in providing persistent surveillance over difficult terrain. Over the years many countries across the world have successfully employed UAVs and UCAVs as Force Multiplier in non-conventional operations. A few such examples of their usage against non-regular forces are given in succeeding paragraphs.

33. Cuban Crisis – The Cuban Missile Crisis in 1962 demonstrated the need for timely intelligence gathering, while at the same time highlighting the political sensitivities attached to manned over flight. On 14 October, 1962, a US reconnaissance aircraft detected the installation of Soviet missiles in Cuba, and daily U-2 reconnaissance of Cuba continued until two weeks later, when one of these aircraft was shot down by a SAM missile. As a consequence, the employment of UAVs was quickly given top priority. Over the next two months, modified Firebees performed both photographic reconnaissance and ELINT missions to gather radar frequencies of Soviet built Cuban radars over Cuba, and such was the success of these operations, the Firebee was then employed officially by the USAF's 4080th Strategic Reconnaissance Wing[13].

34. Bosnian Conflict. With the success of UAVs in the Gulf War, they have become a popular platform for aerial surveillance over Bosnia and elsewhere in the Balkans. In an effort to decrypt the complex situation in the region, the United Nations and NATO deployed a plethora of surveillance assets, including UAVs. The first UAV deployed over Bosnia was the Gnat-750 long-endurance UAV. The Central Intelligence Agency operated it from the Croatian island of Hvar in 1993. Shortly after the Gnat-750 became operational in the region, the US Marine Corps deployed Pioneer UAVs with Task Force Eagle, the US contingent to the intervention force (IFOR). In July 1995 the Predator UAV deployed to Albania for a six-month joint service operation during which Predators flew 128 missions in support of NATO operations Deny Flight and Deliberate Force. USAF Predators operated from Tazsar, Hungary, for another six-month deployment in support of IFOR. The

NATO forces in Kosovo-Bosnia used the Tier-2 Predator to monitor the enforcement of cease-fire. Specific tasks included detection of movement of ammunition at night and detection of tampering of mass graves by Bosnian Serbs at night.[14]

35. Israel – Hezbollah Conflict. The Israeli Air Force's UAVs played an active part in its two large-scale anti-Hezbollah actions, Operation Accountability in 1993 and Operation Grapes of Wrath in 1996. Before the start of the operations, the IAF had employed UAVs to locate Hezbollah command centres, training sites, arms depots and rocket launchers. During the fighting, UAVs provided real-time data on several objectives, including vehicles transporting insurgents from one location to another and mobile rocket launch sites. Air and artillery units then destroyed these objectives with accurate fire. UAVs, most importantly, relayed real-time intelligence on terrorist positions and movements to air and ground units in Judea, Samaria, and Gaza around the clock and played an integral part in many " targeted attacks" by helicopter gunships on terrorist operatives and Qassam rocket launch sites. UCAVs also executed some of these targeted attacks.[15]

36. Perhaps the most extensive deployment of UAVs, however, occurred during the Second Lebanon War and Operation Cast Lead. During the first night of the Second Lebanon War, IAF aircraft essentially destroyed Hezbollah's long-range rocket force in 30 minutes of intensive air strikes. UAVs, quite likely, not only helped to pinpoint the launch vehicles prior to this air assault, but also took part in target acquisition during the strikes and in battle-damage assessments after them. Real-time surveillance of medium- and short-range rocket launch sites by UAVs throughout the fighting also

drastically shortened the “ sensor-to-shooter” loop by the end of the war; IAF aircraft and helicopter gunships were able to destroy launchers within a mere two minutes of launch detections by UAVs. UCAVs carried out some attacks on Hezbollah targets, while other UAVs “ painted” these objectives with laser designators for air-delivered PGMs[16].

37. Operation Enduring Freedom. After 9/11 attacks on America by terrorists associated with Afghanistan based Al Qaida terrorist network, the US military began Operation Enduring Freedom on 7 October 2001, planned to root out Osama Bin Laden and the Al Qaida. The use of UAVs expanded quickly in Afghanistan as part of a counterinsurgency strategy that sought to reduce civilian casualties by enabling the United States Air Force(USAF) to reduce speculative targeting. The Predator UAV was a very important element in the campaign, with its video cameras gathering intelligence for as long as 20 hours, and then striking without warning. The UAVs were also used to detect time sensitive and high priority targets for air strikes. The UAVs had identified Taliban fighters, monitored their weapons storehouses and their routes in and out of the area, and mapped where they were planting roadside bombs. Although UAVs were mostly used for surveillance, they were also used to carry out missile strikes on Taliban targets across Afghanistan.

38. As part of its Global War On Terror (GWOT) the U S has also used its UAVs and UCAVs to engage terrorists in Pakistan and Yemen. The most widely reported drone strike in 2011 was the killing of Anwar al-Awlaki in Yemen on September 30, 2011[17]. On 3 November 2002, an MQ-1B operating over Yemen spotted a car that was identified as carrying a high ranking Al Qaida official and five of his people. The Predator blasted the car

with a Hellfire, killing all the occupants. The UAV was operated by the CIA & was being flown by a USAF pilot from a French military base in Djibouti, in the horn of Africa. The United States has also been using the UCAVs along the Eastern borders of Afghanistan, including the tribal areas of Pakistan, to gather intelligence as well as striking at time sensitive targets. In 2010 alone, the United States launched 118 drone strikes in Pakistan, indicating an exponential increase in reliance on UAVs over past years.

Force Multiplier Effects

39. As is seen from the examples mentioned above, the UAVs and UCAVs have been effectively used as Force Multipliers in non-conventional operations. The major advantages accrued by employment of UAVs have been listed as under:-

(a) Reconnaissance. When facing insurgents who blend into a local population, good intelligence is worth more than even the smartest bomb. The advantage of having an ‘ Eye in The Sky’ to provide early warning and enhance the situational awareness of the tactical commander is worth much more than fire support provided after the contact is established. The UAVs have been used extensively to provide real time Full Motion Video(FMV) of the area of operations before own forces go in for any operation thus reducing own casualties.

(b) Surveillance. The need for a constant watch over the area of operations and interest cannot be underestimated. The UAVs, with their enhanced endurance and low operating costs have been very effective in providing persistent real time surveillance over the Tactical Battle Area(TBA).

(c) Target Acquisition. The UAVs have been instrumental in helping to identify and track valuable targets in the difficult terrain. It has also been effective in providing targeting data to own Air Force and Artillery assets as well as being used themselves as strike platforms.

(d) Psychological Operations. The UAVs have also been used effectively as part of Psychological operations to gain an upper hand in actions against insurgents and have succeeded in putting the fear of having a constant aerial eye on them in the mind of the extremists.[18]

(e) Electronic Intelligence. The electronic sensors on board the UAVs can be employed gainfully in signal mapping of the various sets used by the insurgents. With their persistent coverage, the UAVs can be used to intercept and locate the sources of insurgent transmissions and guide own forces to destroy them.

CHAPTER IV

EMERGING TECHNOLOGY AND FUTURE TRENDS

“ We have just won a war with a lot of heroes flying around in planes. The next

war may be fought with airplanes with no men in them at all. It certainly will be

fought with planes so far superior to those we have now that there will be no

basis for comparison. Take everything you’ve learned about aviation in war and

throw it out of the window and let’s go to work on tomorrow’s aviation. It will be

different from anything the world has ever seen.”

General Henry H. “ Hap” Arnold

40. Operational Need For UAVs And UCAVs. The development of UAVs and UCAVs has been progressing in an uneven manner. Few periods of substantial development have been followed by relative inaction. There have been some basic operational requirements that have led to the evolution of the UAVs and UCAVs as we see them at present. These basic operational needs are as follows:-

(a) Persistent area surveillance providing continuous real time update of battlefield operations.

(b) Battlefield reconnaissance to provide real-time update and feedback.

(c) Real-time Artillery engagement of targets.

(d) Post-Strike Damage Assessment on targets engaged.

(e) Communication relay via airborne or ground assets.

(f) Monitoring of routes for checking infiltration/exfiltration in Low Intensity Conflict scenario.

(g) Requirement of entire ambit of Electronic Warfare.

41. Limitations of Present Day UAVs. Despite the many capabilities of present generation UAVs, there are certain limitations to overcome. Some current concerns with regards to UAVs are:-

(a) UAV survivability. Although the reduced noise levels and radar cross sections along with low infrared signature are strengths of UAVs, they are not invulnerable.

(i) Most UAVs are comparatively slow in comparison to manned jets. Jets diminish their disclosure to hostile fire courtesy their high speeds. UAVs, on the other hand, have to maintain a slower speed to increase their on station time, whereby they can loiter over a hostile area to pass information back to friendly forces.

(ii) As the UAVs depend on line-of-sight guidance, they cannot use terrain to shield themselves from the adversary’s detection and fire like airplanes do while performing their mission.

(iii) Also current UAVs lack redundant on-board systems like aircraft to continue their missions once damaged by enemy fire.

(b) Data-Link Technology. Another concern for UAVs is the existing data-link technology which restricts their range and flexibility. The use of relay UAVs may however resolve this limitation in the future, by passing collected information back to friendly forces. Current data links are also vulnerable to jamming, and decreasing this weakness drives up the cost of UAVs.

(c) Manpower And Training Requirements. Current manpower and training requirements for operating UAVs is an important area that needs to be reviewed. For example, operating an air-launched UAV unit in Southeast Asia in 1974 required 94 people of the USAF to sustain a sortie rate of two per day. The same sortie rate for a ground-launched version of the new US medium-range UAV, requires only 16 people[19]. Thus in addition to increasing the fleet of UAVs, it is equally important that trained manpower be catered for operating the same.

42. Developments in UAV technology are however, helping to correct these deficiencies. Efforts are continuing in signature reduction to make UAVs even harder to detect. Multispectral sensors are being developed to effectively control UAVs in bad weather, making them tougher to detect and destroy. Other advances include changed flight profiles so the UAVs become more unpredictable and thus harder to engage, augmented range for the sensors so the UAVs can operate from standoff ranges and the use of countermeasures against the adversary’s guided air defense weapons. Modern technologies, for example millimeter-wave data links, laser communications, and ultrawide-band data links, will diminish the probability of detecting, much less jamming, future links. Manpower requirements may be reduced by automated maintenance aids replacing maintenance

technicians in the field. “ Smart” training systems will reduce the training requirements.

43. The impact of developing technology on the future of UAVs and UCAVs is likely to be in the under mentioned fields:-

(a) Cost. One particular important field for the future of unmanned aircraft is the likely impact of emerging technology on the cost of these aircraft. At the general level, technology is likely to be engaged to drive down the total cost of unmanned aircraft in the inventory. Here a great deal can be done by improving reliability, perhaps though not necessarily, by accepting some increase in unit cost, but at the same time reducing the number of aircraft required to complete a given mission.

(b) Advances in IR Technology. Advances in IR designs seem likely to produce important operational improvements. In particular, the number of IR detectors elements that can be fitted within an IR seeker head is being dramatically increased and this gives the following advantages:-

(i) Resolution. Resolution is improved so that better surveillance and more detailed ELINT will be possible.

(ii) Field of View. Field of view is increased with obvious advantages for reconnaissance and target acquisition.

(iii) Sensitivity. The sensitivity of the seeker is enhanced increasing its range by as much as a factor of two and giving better effectiveness in poor atmospheric conditions.

(c) Advancements in Millimetric Wave Radars. In the future the advancements in millimetric wave radars are likely to be very significant. As the size of the radar is directly related to the wave length, the radar fit carried by an unmanned aircraft can be much smaller. Secondly as high frequencies have narrow beam widths they are far less easy for opposing force defences to jam. Lastly the higher frequencies give narrower beam widths which improve the discrimination of the radar and its ability to detect smaller targets.

(d) Miniaturisation. The continuing trend in micro miniaturisation of electronics and the striking increase in computational densities are likely to have a great impact on the control and operation of UAVs. In the last one decade computing power using VLSI etc. has increased by a factor of ten and the volume required has been reduced by a factor of six. This continuing process of increasing computational density clearly has very important implications for the operational function of future UAV and in particular for the physical size of the payload and ultimately for the craft itself. This is likely to mean that UAV in roles such as surveillance will have a good chance of escaping detection and engagement and that even if they are acquired by opposing weapon systems, the relatively high cost of their destruction would be justified only by the certainty that the target was indeed a reconnaissance machine and not a decoy

44. Across the world most countries have realised the necessity and importance of UAVs and UCAVs. As a result, there is a lot of research and development taking place in the field. Most of the countries are focussing on improving the surveillance capabilities, enhancing the Radius of Action (ROA)

and on station time, reducing the cross section and radar signature and enhancing the strike capabilities of the UAVs and UCAVs. A few emerging technologies in the field of UAVs and UCAVs are covered in succeeding paragraphs.

45. Gorgon Stare. This is a new video capture technology being developed by the United States military, also known as wide-area surveillance sensor system. It is an array of nine cameras attached to an aerial drone that makes it possible to monitor a four square kilometres area in real time. The system is capable of capturing video of an entire city, which can then be analysed by humans and/or artificial intelligence systems. Any ground or airborne unit within range of Gorgon Stare’s Tactical Common Data Link (TCDL) and equipped with a Remote Operations Video Enhanced Receiver, One System Remote Video Terminal or a hand-held receiver can view one of the chip-outs[20].

46. Phantom Eye UAV. To fulfil the need for continuous battlefield surveillance, Boeing has developed the Phantom Eye UAV, a drone aircraft that can scout a theatre of operations for up to four days at a time without blinking. This high altitude, long endurance (HALE) UAV relies on a mix of hydrogen power and portly aerodynamics to stay aloft for the duration. The UAV can carry up to 450 pounds of equipment-in addition to the 1, 900 pounds of liquid hydrogen-while cruising at an average speed of 150 knots (170 MPH) and as high as 65, 000 feet. To maintain combustion at those

heights, the Ph