A DEFINING MOMENT OF THE DEBATE: MANNED VERSUS UNMANNED PLATFORMS OF AIRPOWER

MANOJ KUMAR

Why the debate?

The eulogies to airpower are easily available within the milieu dealing with national security as well as those using civil aviation for their personal use. Airpower has come to be symbolised by *'glamorous'* flying machines and an equally fascinating set of people, who sit inside, managing the *'stick and the throttle'*. While the machines are always in the forefront, the men have always been right behind, in the hierarchy of popularity. From the time combat flying (as we know it today) became a reality in the World War II, men and machine have been considered two sides of the flying business. However, unmanned flying machines (excluding the balloons) have also come into the limelight around the same time for use as the armed element of airpower. While unmanned machines that could be utilised as missiles (equivalent of present day cruise missiles) over long distances had caught the fancy of the military during the World War II, these were never really imagined to be the replacement of manned flights.

Group Captain **Manoj Kumar** VSM is Senior Fellow at the Centre for Air Power Studies, New Delhi.

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The cost of human lives and the *'lethality'* of the war post World War II ensured that serious consideration was given to unmanned flights. However, at that stage it was not thought that unmanned flights could ever be able to enter the realm of replacing manned flights. With advances in technology, new sensors, GPS navigation and radio control of the unmanned platforms, thereby extending their reach over long distances. This proved to be a parallel, burgeoning new generation of war-fighting methodology. So, as the manned flight platforms were evolving from one generation to another, the unmanned platforms were also finding new usages on the battlefield, increasing its employability and decreasing the risk of human attrition. The idea of exchangeability of platforms – from manned to unmanned, was a major driver for the debate on moving to the era of Unmanned Aerial Vehicle (UAVs).

The original purpose of drones (as the UAVs have come to be known) had been to provide quick intelligence, surveillance and reconnaissance of hostile terrain (ISR). Even at that time, it was considered that to a limited extent and owing to the stealthy nature of missions, drones could be utilised to undertake such missions over an adversary's airspace. Mixed with inputs from satellites, the ISR drones could provide services that manned flights would not have been able to afford. The genesis of the debate on substitution of manned flights by unmanned, thus, started while considering such missions.

UAVs also filled a void that existed considering the high cost of operations that are needed for sustaining manned operations. While developing a UAV requires high investment, managing it requires far lesser funding. Traditionally, the debate did not consider this aspect keenly, although it was always in the background. It was more driven by the fact that the limitations of manned flight primarily due to the presence of man in the machine could be overcome by a UAV. The proponent of manned flights never took these arguments seriously; it was felt that mostly the dirty

end of the business – one that required endurance flying, flying in dubious environment or highly dangerous missions, which did not require human intuition, could be flown by the UAVs. Historically the development never took one as substitution for another. The debate on the substitution started not very far back, in 2001 (since the entry of the US and the The North Atlantic Treaty Organisation (NATO) led International Security Assistance Force (ISAF) in Afghanistan) when the notable efficacy of the UAPs in undertaking pre-decided strikes over long distance, in extremely hostile environment, was proven. The killing of Anwar al-Awlaki and other al-Qaeda activists on September 30, 2011 in Yemen by the US combat drones, has again rekindled the debate. Another addition to the debate has been the ability of the UAVs to be stealthy as well as limit the scale of hostilities. In comparison, if a manned flight incursion of airspace takes place, the country at the receiving end takes huge umbrage. In fact, manned incursion of airspace in hot pursuit of anti national forces is normally not considered an option during offensive action. This again brings to the fore the requirement to now go for unmanned, technology intensive platforms that can surpass the practical usage of manned platforms. More and more advances in the UAVs have now been started with a view to initially complement, and eventually replace manned flights. The rationale is to use them for missions that are/were not yet considered to be in the domain of unmanned flights, like real time combat strikes and air-to-air combat in the Beyond Visual Range (BVR) scenario.

This paper would strive to study how far this debate can go considering mostly the limitations of technology, our imagination and straight-jacketing of the mindset with old cultural baggage. The historical timelines of development of the UAVs may throw some light on the direction-time responses of the contemporary technology development trajectory in this field. The US has already come up with a roadmap for integration of unmanned systems with the manned operations from 2011 till 2036[1]. In such a scenario, the path that the military, in a country like India, may follow

1. at http://www.defenseinnovationmarketplace.mil/resources/UnmannedSystems Integrated RoadmapFY2011.pdf , accessed on July 04, 2012

would definitely be an essential ingredient of the paper. The future course of this debate would throw many other questions, each more complex than the other. To analyse these issues would require some multifaceted scenarios to be unravelled.

Genesis and evolution: unmanned platforms

Before the history of unmanned platforms is discussed, it is essential to clarify that, this term is used in a very restrictive manner in this paper. In essence, the utilisation of unplanned platforms as long range missiles may be termed as a UAV. However, the same is definitely not true for manned flights (leaving aside the kamikaze missions flown by Japanese in World War II or the 9/11 event in the US) and since the paper is about doing a comparative analysis of the two platforms from all angles, the use of the term UAV is restricted to flying machines similar to a manned aircraft. Additionally, the comparison of these platforms is confined to military environment even though the UAVs, like manned aerial machines, have been used for various non-military purposes like spraying pesticides and disaster relief monitoring etc.

In the real sense the UAVs had been used for surveillance in combat support roles around or even before the first manned airplane in 1903. But these were primitive structures like balloons and are thus, not being discussed here. The first UAV that was to be used as a flying bomb or an 'aerial torpedo'[2] was actually developed during the World War I. However, the war ended before it could be deployed. But, the curiosity of military leaders had been aroused. Most of these developments were designed to achieve an advantage over a tough adversary and as a long range missile system. The Research and Development (R&D) efforts in using this relatively safer mode of combat airpower projection were seriously launched in the UK and the US after the World War I. The first generation of the UAVs were actually radio controlled drones, developed to be used as targets for training anti-aircraft gunners. These

2. For more information on evolution of UAPs readers may wish to access the site at http://www.pbs.org/wgbh/nova/spiesfly/uavs.html accessed on July 02, 2012.

continued to evolve till the World War II, with larger planes being developed as anti-aircraft targets or target drones.

The next generation (second generation) of drones could be categorised as assault drones, those that used radar and television sensors for terminal guidance; a project known as Project Fox of the US Naval Aircraft Factory in June, 1942.[3] During the tests it was seen that such a drone was capable of providing useable picture up to 30 miles distance and hitting a target with depth charges or torpedoes. Actually from 1941 onwards, combat drones carrying 2000 lb bombs were used actively in the World War II against Japanese artillery, emplacements, bridges, tunnels and munitions dump. A shift in the tactics saw use of an unmanned TDR-1 bomber carrying 500 and 1000 lb bombs against gun emplacements and then heading back home. This was the beginning of the new operational paradigm of using drones as Unmanned Combat Air Vehicles (UCAVs)[4].

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One of the results of the Cold War was the increased need for reconnaissance by the two blocks. The drones thus developed were used for the purpose even in the Korean War and the US' War in Vietnam. In 1960, the shooting down of U-2 by the Soviets and the subsequent public trial of its pilot was a major embarrassment for the US. Recognising this, the US Air Force launched a number of surveillance drone programmes. Due to the need of the hour, the technological development then moved towards enhancing the surveillance (as against combat) role of the UAVs. From the 1970s to the 80s, the development trajectory underwent a sea change. The focus shifted to inoculating Unmanned Aerial Vehicles (UAVs) in the active battlefields, albeit primarily for ISR missions only. Israel too emerged as a major player in the development race with its Scout and Pioneer range of UAVs.

3. Lawrence R. Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicle*, (Virginia, USA: American Institute of Aeronautics and Astronautics, Inc. 2004) pp. 66-68.
4. Ibid. p. 69.

It was only in the 1990s that the third generation of UAVs came into active service. These UAVs had high endurance; they could be controlled over long distances and they could relay almost real time feedbacks using satellite data-links. The USA's Pathfinder and Predator UAVs were top of the line surveillance platforms. The Predator saw action in the Balkans and became an integral part of the Central Intelligence Agency (CIA) and the USAF operations in Iraq and Afghanistan[5]. The clock turned a full circle and the Predator series was converted into an attack platform by strengthening its wings and few other modifications that made it possible to have hard points and carry munitions like Hellfire missiles etc. Since the start of Afghanistan operations, the majority of strikes on Taliban targets on the Af-Pak border were carried out by UCAVs – the Predator or Reaper. It afforded the luxury of stand-off, to avoid retaliation against their pilots, few of the unmanned platforms were actually lost in operations either shot down or due to technical/handling issues. In fact, the first reported 'dogfight' between a manned and an unmanned (Mig 25 of Iraq versus Predator carrying air-to-air Stingers) took place on December 23, 2002 wherein the UCAV was shot down, **predictably,** and Mig 25 escaped even after being picked up and an air-to-air missile being launched at it by the UCAV[6].

The fourth generation of the UAV is around the corner. The development work for autonomous flights of UAVs is on with full vigour. The rationale is to remove the weakness in technology like delayed reaction time and chances of hacking the data link etc (these would be discussed later in the paper) that has prevented the unmanned platforms to really match the capabilities of its manned compliment. Following is an excerpt of a news article in the *Times of India*, New Delhi edition of July 04, 2012[7]. The future development trajectory is clearly reflected in this piece.

5. 'Predator Drones and other Unmanned Aerial Vehicles (UAVs) History, Uses, Costs, Advantages and Disadvantages' at http://middleeast.about.com/od/usmideastpolicy/a/predator-uavs-weaponry.htm, accessed on July 18, 2012.
6. At http://www.youtube.com/watch?v=wWUR3sgKUV8, accessed on July 5, 2012.
7. At http://timesofindia.indiatimes.com/world/uk/Pilotless-fighters-set-to-fly-over-Britain-from-2013/articleshow/14663399.cms, accessed on July 04, 2012.

Box 1: Flight of Next Generation of Unmanned Platform

LONDON: Pilotless fighter planes have come a step closer to reality as British Aerospace revealed that it would test such a new fighter jet next year. It is not a drone, but rather a robotic plane with a far wider range of equipment and capabilities, the company said.

The company is set to unveil a new super-fighter which can fly on its own for 24 hours with no cockpit and no human on board, *The Daily Mail* reported. If all goes as planned the artificial intelligence could mean the end of fighter pilots in the UK and bring down the curtain on conventional aircraft like the F-35. And the robotic fighter plane christened 'the Mantis' will be making its first flight in 2013 over Britain, as it is tested to see if it works.

The quantum jump in combat technology

The entry of unmanned flights into the domain of precision strike manned aircraft has actually marked a turning point in the way the world looks at them. Till the time these platforms were used primarily for ISR missions, they were never considered a challenge to the manned flights. Since the fighting end was still in control of humans, the dull and drab end of war-fighting was easy to hand over to such machines. With the advent of present day UCAV technology, these platforms are now being seen as complementing the manned operations[8]. The technology has evolved to an extent that the Ground Control Station (GCS) can be far away from the place where the unmanned flights are taking-off/landing. Only a small van now needs to be positioned near the runway from where the UAVs operate, to control the take-off and landing. Rest of the control, including munitions firing is with the GCS. With advances in electronics, the time delay in sense-to-shoot has been all but removed. It is the analysis of the target or the sense part that still vests with humans, which is presently the cause of whatever delay that remains to be tapped. The precision of the munitions is the same as in manned flights. Even then whatever delay that remains and lack of manoeuvrability is sufficient to weaken the combat potential of the

8. n. 1.

The weakness in the whole unmanned system is that of the chance of data-link between the GCS and the UAV snapping or being hacked.

machines when compared with manned platforms. This lack of manoeuvrability stems from the fact that the UAVs needed a specific airframe design and their propulsion system were not powerful enough due to technological barriers. This means that at present there is hardly any scope for using the UAVs for air-to-air combat and multiple-target strike operations, which require human intuition and extremely fast decision making. This effectively rules them out in scenarios where a minimum favourable air situation does not exist for the UAVs to operate as they cannot yet evade every air defence elements of the adversaries. However, all these limitations are for machines that are in operation today, but the R&D trajectory points towards removing them almost completely.

The second weakness in the whole unmanned system is that of the chance of data-link between the GCS and the UAV snapping or being hacked, with the result that either the UAV goes out of control or the control of the machine is lost to hackers with devastating results. In the latter case, these could be used as missiles for crashing into targets. It can be argued that these shortcomings are similar to technical defects that may manifest in any complex machine like a manned fighter jet leading to so many accidents that we see and hear of in the business of military aviation. If the pilot is able to recover the aircraft due to his/her abilities, the countervailing argument would be that the UAV has a higher redundancy of systems that allows it to be recovered in many dangerous situations.

The parallel described above may not be completely accurate and thus, to offset some of these weaknesses, the designers are working to make the UAVs autonomous by the use of Artificial Intelligence (AI). This would mean that in the circumstances where the control data-link is broken due to any reason, the UAV would still be able to fly to the designated site, engage the target and even recover to the launch or alternate airfield. It would even be able to go for an alternate target if there is a mismatch with some parametre of the primary target. The autonomous mode of the UAV

would also ensure that the decision making reaction time of the machine is as fast (or slow) as the onboard computer.

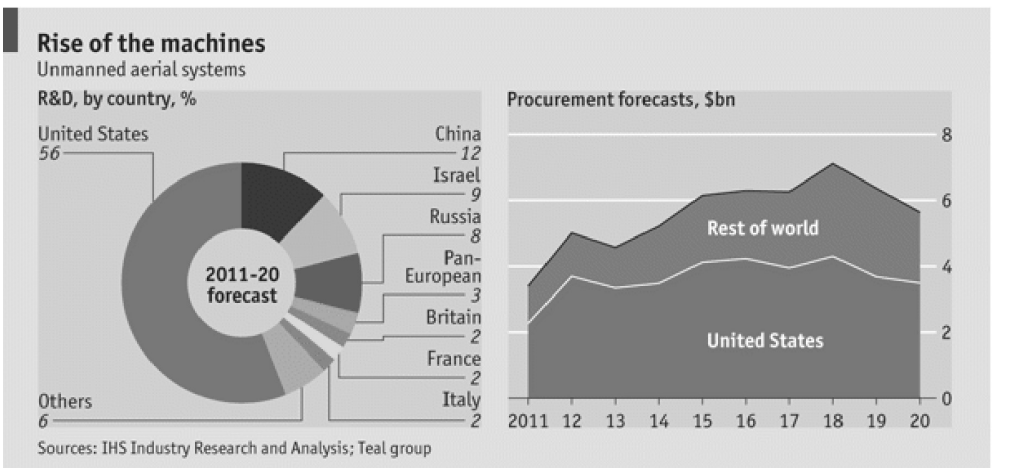
Removal of human limitations like ergonomics, atmospheric control and g-load tolerance allow the UAVs to provide for more redundancies, number of sensor systems and computational devices with superior response. Lower weight/higher payload is possible due to the fact that the person and life support systems are removed from the machine, though the extra sensors required, do not make it a one-to-one swap. With this comes the next limitation of power source that can withstand the higher demands. With next generation power devices, usage of solar panels, fuel cells and nanotechnology using batteries, a revolution of its own kind is expected in mini UAVs. However, this issue would be of an academic interest once the actual unmanned jet aircraft becomes operational as the power demand would be met by the onboard generator systems.

The next advancement in technology that is being witnessed in respect of the UAVs is the miniaturisation of systems leading to development of Mini Unmanned Aerial Vehicles (MUAVs). These systems are already in operation and being used by the US military and NATO in Afghanistan. So the unmanned flight development is taking place in both directions, towards bigger jet-engine fighters and smaller (even palm sized) flying machines, performing a variety of tasks, from reconnaissance to taking on snipers. The stealthiness of the UAV is in favour of such machines finding more and more roles. But the question that comes up is: Why the bigger machines (like the one described in box 1 above) are being developed? Since they would, presumably mimic the present day manned fifth generation fighter capabilities, why is there a need for converting them into unmanned machines of the same proportions? Some answers to these questions have already been given above, while describing the technology development process; however this is a simplistic argument unless one considers issues which go beyond mere technological developments, but to the cost of operations and attrition that a country is willing to endure.

The cost of military operations would be discussed first. The cost of developing unmanned platforms may almost be the same as manned

systems due to the requirement of high capability sensors and stealthy airframes. However, it is the cost of reduced training that can save large amount of money. In the present economic downturn around the globe, all talks of saving money are taken very seriously and specially from a non-contributing sector like the military. It is thus no coincidence that the US has already announced that the Joint Strike Fighter (JSF) is their last manned aircraft development programme. Consider the figure shown below on the amount that the developed and militarily powerful countries are spending on the R&D efforts to get an edge in obtaining the cutting edge UAVs. Indian figures are conspicuous by their absence and this would be a cause of worry in years to come.

Fig 1: Research and Development Efforts and Procurement by Countries for developing Unmanned Aerial Systems[9]



Reducing training reduces costs in other ways too. The airframe of the UAVs do not have to be flown often (mostly for operational missions) and thus, it could be designed with a service life of lesser flight hours, allowing for quick technical obsolescence. This would still allow as much operational action as on a manned fighter, but not having to worry about fatigue and

9. The article was published in *'The Economist'* at http://www.economist.com/node/21531433 accessed on June 22, 2012.

stresses from training flights would allow the UAV to be designed cheaper. Another dimension is that the machine would allow positioning of additional and latest systems without worrying for its human interface as finally all it has to do is to generate signal for onboard computer or the GHS. Without such a limitation, an up-gradation of the machine may be eminently possible and easier to handle for unmanned machines. Therefore, if one considers that the initial costs of developing a machine gets divided over a span of many years in which same platform provides for development of later generation of gadgets to be installed in the same machine, then costs get further reduced. And unlike the manned machines that require changing the airframe and matching engines for a new version machine, the UAVs would primarily require changes in internal electronic sensors and computational devices.

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With a reduced ground infrastructural requirement, the UAVs again tend to provide value for money. The technological changes would see MUAVs being launched from anywhere and controlled by sets carried by troops in their backpacks. The real problem would come in managing airspace with larger UAVs and manned civil and military flights taking place. Federal Aviation Administration (FAA) of the US has still not cleared the unmanned flights for the fear that if a pilot-controller was to temporarily lose control of a UAV, it might ram into an airliner in shared airspace. Additionally, it would require reliable data up and down-links for information transmissions to connect manned flight pilots, UAVs, their ground controllers, and air traffic controllers, in real time, to enable pilots and the UAV ground controllers to work together to avoid routing conflicts and plan the most direct and efficient flight routes through crowded airspace. This gains importance because in manned flights there is a human being to take last minute evasive action, if all other means fail. However, this problem is not insurmountable. Civil aviation authorities can learn from the military's experiences of integrating military and commercial aircraft in the same airspace. Many difficult issues of enabling civil and military

aircraft with vastly different flight capabilities in the same airspace could be applied to integrating manned and unmanned aircrafts. With technological advances that would equip the UAVs with Air Collision Avoidance Systems (TCAS), these challenges can be overcome. The task that would remain is to make them feel-safe and also ensure that cultural constraints – allowing unmanned and manned flights in the same airspace do not come in the way of allowing air traffic clearance for the UAV flights. Creating a separate corridor for the UAVs may also be considered within the airspace – civil or military, depending on the agency operating the unmanned machine. As more and more UAVs with matching abilities take flight, standard operating procedures would emerge within the developed technological paradigms. This would then become a safety management problem instead of retaining a pure technological fixation.

Now the only question that still remains to be resolved is the technological fix to increase the versatility of the UAV. Making the UAV similar to a modern multi-role fighter presents a three-fold challenge. One, it should be adaptable to the role that may not always be pre-decided and may be thrust upon it as the tactical battle progresses or if any changes take place. So it should have simultaneous multiple precision munitions carriage capability. For example, it should be able to carry and use simultaneous strike and limited air-defence munitions so as to switch roles at will. It should also have other roles, like Electronic Warfare (EW) pod carriage capability and it should be flexible to switch roles with ease. Second, it should have the capability to take on beyond visual range targets with high performance radar and then be able to manoeuvre in an air-to-air battle to save itself from an adversary's radar lock. Thirdly, it should have weather radars and be able to autonomously decide alternatives in case it encounters bad weather, looses control link and has to change plans. The UAVs/UCAVs now being developed by British Aerospace (BAe) Systems in the UK alone (Mantis and Taranis) or with partnership with Dassault Aviation (Telemos MALE –Medium Altitude, Long Endurance – a future combat air system) are considered "*critical to the sustainment of defence aviation skills and capabilities in Europe beyond the current generation of manned Gripen,*

Rafale and Typhoon jet fighters."[10] This would give an idea that the current progress in the UAVs/UCAVs is towards overcoming precisely the limitations that have always pushed them out of contention when being considered a replacement for sophisticated manned fighter aircraft. The work currently on in the UK shows how seriously this replacement for manned machines is being considered as a possibility, sometimes in the future.

Considering the past development trajectory, such machines may see operations anytime around or after 2030.

At present the race is on – unmanned platforms trying to emulate manned platforms and trying to match their capabilities. But with fast maturing technology and no restriction of a manned cockpit, the constrictions that have been faced in the development process of the UAV would be a thing of the past. The platforms that would be developed then would be out of the box and may be potential airpower game changers. The timelines for such machines is difficult to predict accurately but considering the past development trajectory, such machines may see operations anytime around or after 2030. Will this lead to complete changeover of airpower environment? The answer is almost certainly no. Till the time AI develops to such an extent that it can match human reactions to a very large extent (it is beyond the writer's imagination that a complete or superior match is technologically possible even in the distant future), manned flights would retain an edge and thus continue to be deployed, albeit in decreasing numbers. The numbers would continuously decrease also because of the second factor that had been mentioned earlier – acceptance of human attrition.

The main advantage of a UAV that can not be surpassed is the safety net that it provides to lives of its users. Considering the stand-off that is afforded to pilots flying the UAVs, a cool and calculated decision making is normally possible. The infrastructural requirement close to the field of operation is

10. More details are available at http://www.defensenews.com/article/20120620/DEFREG01/306200001/U-K-French-UAV-Contracts-May-Signed-Farnborough and at http://www.ainonline.com/aviation-news/2012-07-08/taranis-and-mantis-uavs-move-forward-towards-active-service accessed on July 11, 2012.

also minimal for operating the UAVs and thus the support personnel are not really required to move in a big group along with the machine. Thus, flying these machines in dangerous environment may be possible till it can be ensured that the risks from AD elements of the adversary are minimal. The latter is very important at this juncture because the UAVs are yet to develop effective evasive capabilities. Once the UAVs become more and more like, or superior to, the flying machines of today, the threshold for their launch for offensive missions would increasingly reduce. This brings us to the stark dilemma that is being faced by the military leaders and proponents of unmanned machines. Once the threshold of employing offensive airpower comes down due to lowering of the attrition costs, the obvious question would be whether coercive actions become a norm even without exhausting all alternatives of avoiding a conflict? This question is repeatedly being debated in the countries that are spending a big amount of money on developing the latest generation of UAVs. So even when ethics of employment are debated, the development process goes on unabated.

The state of the debate

The debate on the use of unmanned flights has assumed many more hues. It now actively considers the question of ethics of employability of the UAVs vis-à-vis manned platforms. The genesis of the debate would be the thought of machines shooting at humans as one would have seen in some hollywood motion pictures. Till the time the final button for launching munitions is under human control, some rationalisation for employment of the UAVs may be forwarded by the worst sceptics. Once the AI induced automation becomes a norm in the UCAVs of tomorrow, the dilemma of allowing machines to decide when and how to kill humans would be a tough call to make. But it is for sure that when weighing this deployment against the option of suffering human causalities in a dense AD environment, the former would win, without fail.

The ethical dilemma though real has not come in the way of developing the latest UAVs. Wars and militaries are a reality that the world has come to accept, some may say, grudgingly. So till the time innovative ways can

be found to keep the dirty end of war that leads to human causality away the UAVs would find favour with the military. The long term perspective is what merits consideration during the development process. The final control of aborting a mission or a kill has to remain in human hands, to lend some legitimacy to 'wars by machines'. The ethical debate would continue but this is the least concession that can be made to the sceptics. However, by the time ubiquitous use of the UAVs becomes a reality, most of the adversaries would also deploy UAVs of their own. The airpower and its deployment doctrine then would seem much different than how it is seen presently. This is a separate subject of discussion. Suffice to say that manned machines would be increasingly replaced or supplemented by their unmanned version as the technology matures to allow their free interference and versatile deployment.

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A Mindset Change

Once it is accepted that the future of airpower would lie in unmanned platforms, what remains to be studied is the organisational impediments to their immediate acceptance in some countries, even as their global usage increases exponentially. The ethical issue discussed above, even though important, has not yet attracted much attention primarily as the UAVs/UCAVs are not at that stage in their cycle of development where such questions become an impediment. Reluctance in rampant development and thereafter deployment of UAVs stems from cultural blocks within the military organisation. It would be surprising to note that this mindset block is pervasive even among developed countries where UAVs are being developed with vigour. This block stems from the mindset in any aviator's mind that wants to see the supremacy of the man over machine. It is difficult for that aviator to see and accept that this position may change in future.

It is a known fact that in the military services, progress or lack of it, in developing new doctrines and procedures can be attributed to cultural attitude. Any Air Force's cultural baggage is that, men of action in the air have always been deemed responsible for operational policies. While this may have been, or still is, a necessity, the situation would definitely change with the UAVs arriving on the scene. In such a revolutionary scenario, it is absolutely possible that this community may feel threatened when a holistic view of the future wars is not available to them. In this context, analytical work on the UAV's deployment in future airpower engagements would be able to convince all, about the need to seriously consider their development and induction in today's forces. The asymmetry that a UAV builds in a conventional war is and would be a very sought-after attribute of future deployment of airpower. Rather than jeopardising its air warriors, if any air force can continue to utilise their talent effectively during the war without suffering attrition even while causing unsustainable damage to the adversary, the morale of its personnel as well as citizens of the nation would be greatly boosted. This asymmetrical advantage may prove to be the tipping point in future conflicts. It is thus essential for any military that at this juncture suitable budgetary and policy initiatives are taken to leapfrog the race for developing the next generation of UAVs.

It should also be appreciated that even now deployment of a UAV allows for controlling the scale of a conventional war. In the common man's perspective, UAVs are yet not treated at par with manned platforms in depicting a nation's aggressive stance in a conflict and their deployment is considered a notch lower than a full-blown war. Thus, they provide an ideal platform to launch surgical strikes, the kind India may have planned to carry out against insurgents (and their training camps) across the Line of Control (LOC). Even in a Kargil like conflict, the use of UAV allows for taking out miniscule targets in bunkers and such sheltered places in the hills (slow moving and allowing for easy pick-up), without affording reasonable chance of counter-attrition. Using UAVs for controlling escalation of conflicts is actually a huge advantage for the policy-makers. This is because owing to inherent offensive nature of airpower, its deployment is normally

regarded as an escalation of the conflict and thus the policymakers have been wary of its usage. UAV usage may also lead to escalation but to a lower level and thus the policy-makers may be more amenable to its deployment, thereby providing a useful tool in the hands of military planners.

It would be worthwhile for the military leaders to start treating UAVs as the latest expansion of war fighting paradigm.

At this point it would also be worthwhile to analyse the implications of unmanned machines for civil aviation. Most of the benefits of the UAVs during combat operations like flying dangerous, hostile opposition and monotonous long-duration missions over inimical territories cannot be visualised for civil passenger missions. The rationale for converting civil passenger/cargo flights to unmanned ones is not quite strong yet, other than an aside of saving on the costs incurred on account of salaries paid to the aircrew manning the flights. When weighed against the prospect of machines flying humans, this seems a bit far-fetched even in the future as the need is not really acute vis-à-vis the gains that accrue. So even if civil aviation sees unmanned flights, it would be much later than military aviation sector. However, right now it seems highly unrealistic for civil aviation to start using these machines even if bigger combat jets are becoming unmanned. Only cost considerations do not actually portend a just case for this to happen albeit the technological leap for making it a reality has been taken; a change in the mindset would take many, many years more. The possibility cannot be ruled out!

The Future…

Considering the issues mentioned above, it would be worthwhile for the military leaders to start treating UAVs as the latest expansion of war fighting paradigm. The technology behind UAV and its envisaged usages should serve as a wake-up call for changing the mindset that exists in many militaries. The UAVs are here to stay by being used more and more in combat operations. A military that does not possess the machines and related technology would find it severely handicapped and would have to undertake asymmetric missions exposing itself to unwanted attrition. The

present requirement of ensuring minimum air superiority for undertaking unmanned missions may also be a thing of the past when the next generation of UCAVs being developed by the UK, France and the US appear on the scene.

It is clear from the above that manned flights, at least for military use, would continue for a few more decades. In the civil sector it is difficult to predict if and when unmanned machines would make their foray. It would be some time before the air traffic management of the UAVs, AI facilitated autonomy and versatility, enhanced power source/load carrying capacity and superior control links, would mature to a level that would be able to give the manned machines a run for their money. It is also true that the road is clear for the development of UAVs to a level where the manned flights are now, and finally overtake them. The monetary costs involved in training on new machines and losses in terms of human lives make it prohibitive to keep on developing manned machines that would continue to challenge the frontiers of technology and always stay one step ahead of the adversary. Even though it may be a difficult call to predict at this juncture but the indications are there to point to a future that belongs to unmanned machines in combat operations. It is also being said that UAVs may "not just be a substitute for manned aircraft, but a tool with dramatically enhanced capabilities"[11].

(The paper reflects the views and conclusions of the author and not necessarily the opinion of the Centre or any other institution.)

11. Israel special - Israel broadens UAV use with advanced designs at http://www.flightglobal.com/news/articles/israel-special-israel-broadens-uav-use-with-advanced-designs-221444/, accessed on July 20, 2012