# Aviation - The Future is Unmanned

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**Abstract**

*Unmanned aircraft technologies have now matured. The world is at a transition. Dual use (optionally manned) aircraft are flying. Unmanned Combat Air Vehicles (UCAV) are being intensively used in combat with more and more drones being armed with air-to-surface weapons. Unmanned Aerial System (UAS) are taking-off and landing by themselves including on the moving aircraft carrier. Autonomous air refuelling has been tested. Unmanned stealth bombers are under development. Uninhabited helicopter convoys can be used for delivering supplies to troops deployed on combat front lines. Coordinated UAS swarms are already a reality and could also act as a multi strike decoy or jam the enemy defences through sheer numbers. UAS strikes will be a must to lead into territories with integrated air defences. UAS are now mostly being assigned the 'Dull', 'Dirty' and 'Dangerous' missions. UAS are also being used for missions like electronic attack or other non-lethal effects. By the year 2050 every conceivable mission, including heavy lift, would be unmanned. There are ethical and legal issues and also need for regulation. With no pilot inside, there is a risk of lowering the bar to using force. Also there is the risk of terrorists and non-state actors acquiring such assets. A casual hobbyist could by mistake fly a drone into an airliner. All these issues are being considered by regulators. Counter drone technologies are also evolving. India has to accelerate the development of Artificial Intelligence (AI) based weapon systems and platforms to stem excessive technological gap.*

## Introduction

Unmanned aircraft technologies have now matured well beyond

just reconnaissance, security and targeting. Unmanned Aerial Systems (UAS) are undertaking all missions including heavy-lift cargo. World is at a transition. There are some who see the JSF F-35 Lightening II as the last dedicated manned fighter/bomber. Solar-powered UAS are already flying. Currently, the solar-powered Airbus Zephyr holds the endurance record for UAVs, with 25 days in the air.[1] Dual use (optionally manned) aircraft are also flying. United States Air Force (USAF) has already modified F-4s and F-16s to fly them remotely. For long, the Russians have been using unmanned MiG-21s as targets. In France, Dassault leads a multi nation project for delta wing UCAV 'Neuron' of the size of Mirage 2000. UK has a Strategic UAS programme 'Taranis'. UAS are taking-off and landing by themselves, including on the moving aircraft carrier (Northrop GrummanX-47B). Autonomous air refuelling has been tested. Lockheed Martin's UCLASS drone 'Sea Ghost' looks rather like a stealth bomber and is expected to carry 1,000-pound class weapons. USA's new strike bomber is likely to be optionally manned.[2] Uninhabited helicopter convoys will deliver supplies to troops deployed on combat front lines. Coordinated UAS swarms have been tested by both USA and China. The US Army's dramatic shift to nearly all-unmanned flight over the next three decades is embedded in the UAS roadmap. USAF's UAS vision document indicates that by the year 2047 every mission would be unmanned.

## UAS Military Missions and Classification

The UAS could be a fixed-wing aircraft or a rotorcraft. The military missions include 'Target' for aerial gunnery, 'Decoy' for enemy missiles, reconnaissance, battlefield intelligence gathering, unmanned aerial combat missions, operational logistics, and defence research and development. They can be further classified based on range of operations such as Hand-held (2 km), Close-range (10 km), Tactical (160 km), Medium Altitude Long

Endurance (MALE) over 200 km, and High Altitude Long Range (HALE) with unlimited range. UAS are now mostly being assigned the 'Dull', 'Dirty' and 'Dangerous' missions. Dull work could be such as; long, somewhat boring reconnaissance missions. Dirty would mean entering into a chemical or nuclear affected areas with high unsafe radioactivity. Dangerous missions involve penetrating contested air space or opening corridors or short time windows for fighters to surge into, or targets requiring long-range precision fires. More and more drones are being armed with air-to-surface weapons. UAS are also being used for missions like electronic attack or other non-lethal effects. The UAS swarm could also act as multi strike decoy or jam the enemy defences through sheer numbers. UAS will be a must to lead into territories with integrated air defences. UAS will continue to act as an eye-in-the-sky, and also to mark targets for Laser weapons and support to direct fires.

**Endurance - The Great Plus**

Unlike human pilot, UAS endurance is not constrained by physiological limits. Wankel rotary engines which are highly fuel efficient are used in many large UAS thus increasing range and payload. Aerial refuelling will add to the endurance. Hydrogen fuel cells may extend the endurance of small drones, up to several hours. Micro UAS endurance is so far best achieved by flapping-wings. Solar-electric UAS have achieved flight times of several weeks. Solar-powered atmospheric systems operating at altitudes exceeding 20 km may one-day operate for as long as five years. Electric UAS powered by microwave power transmission or laser power beaming are other potential endurance solutions. RQ-4 Global Hawk, a full-scale operational unmanned system flew for 33 hours in 2008. Qinetiq Zephyr Solar Electric flew for 336 hours in July 2010.

**Proliferation of UAS**

UAS are today used by more than 60 countries, with a few making their own. USA is the leader with nearly 10,000 operational military systems which is more than the combined strength of the rest of the world. UAS already outnumber the manned aircraft in US Armed Forces. During theatre level operations in Afghanistan, UAS flew nearly 200,000 hours a year. USA is also the lead

manufacturer with Israel a close second. General Atomics, Northrop Grumman, Israeli Aircraft Industries (IAI) and Elbit Systems are world's leading manufacturers. IAI's Harpy, Harop, Searcher and Heron are flying world over in large numbers, including in India. Elbit's Hermes 450 assault UAS carries two missiles. Miniature UAS are being used for visual and audio snooping operating in small confines like rooms or bunkers. Rotary winged UAS (RUAS), such as Northrop Grumman MQ-8B Fire Scouts, are increasing in numbers. USA manufactures around 50 per cent of all military UAS. The leading civil UAS manufacturer is China. As of February 2016, about 325,000 civilian drones were registered with the US Federal Aviation Authority (FAA)[3], though it is estimated that more than a million have been sold in the United States alone. The debate between manned vs. unmanned need not be a binary one. Offloading some manned tasks to UAS will help aircrew focus on other critical areas requiring human interface. Even Armed UAS are intensively manned, albeit at stand-off safe haven control centres.

**AI Enabled Drone Swarms**

UAV Swarming has been possible due recent advances in chip technology and software for robotics, and it has become feasible to design machines exhibiting complex behaviour, achieve mutual coordination and accomplish complex tasks. Aerial robots can ascend synchronously[4], communicate with each other in mid-air and create cross-references. Fixed formation group flights and complex group manoeuvres are possible. The swarm of drones behaves and functions somewhat like swarms occurring in nature, e.g., honeybee swarms, flying in coordination, displaying collective intelligence and each executing a small share of the collective task. Very small Drones – some weighing less than five pounds – can cause devastating effect if they are armed with weapons, and flown in a swarm of large numbers. Drone swarms can be both, remotely operated or fly autonomously, or may accompany ground vehicles and other aircraft. Even single getting through could be potentially lethal. Terrorists and other militants can also operate small, inexpensive drones loaded with weapons. Because of their size, these drones are difficult to see,