



UAVs /Drones –Review of Applications and National Policies

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Agenda



- Introduction / Background
- Drone Basics
- Classification of UAVs
- Application Areas / Benefits
- Regulation / Policies
- Summary/Concluding Remarks

Introduction / Background



- Around 1959 the USAF concerned about losing pilots over hostile territory, began planning UAVs
- Planning was intensified in 1960 after a U2 was shot down over Russia
- Highly classified UAV program 'Red Wagon' was launched
- Today armed forces round the world have switched to unmanned aerial vehicles (UAVs) /'drones'/UAS for cross-border surveillance/intelligence acquisition in a big way.
- The term UAS was first officially used by the US , FAA in early 2005 and subsequently adopted by DoD (USA)
- UAS is also used by the International Civil Aviation Organisation (ICAO)

Background ..contd



- Apart from the US , Israel has been a pioneer in UAV development .
- During the 1973 Yum Kippur War Soviet-supplied surface-to-air missile batteries in Egypt and Syria caused heavy damage to Israeli fighter.
- As a result, Israel developed the first UAV with real-time surveillance. The images and radar decoying provided by these UAVs helped Israel to completely neutralize the Syrian air defences at the start of the 1982 Lebanon war , resulting in no pilots downed.
- Today Israel remains the prime supplier of UAVs for Indian Defence forces

Background..contd



- The initial generation of UAVs were primarily used for surveillance.
- With increased operational requirements they were armed and they became known as Unmanned Combat Aerial Vehicles. (UCAVs).
- Broadly military UAVs are used for surveillance, directing artillery fire, gathering Electronic Intelligence (ELINT) , lasing targets for fighter aircraft and Post strike Damage Assessment (PSDA).
- In fact, the CIA have been using UCAVs (unmanned combat aerial vehicles) over conflict zones to target insurgents , munitions dumps and hostile facilities in Afghanistan, Libya, Syria and elsewhere

Indian Armed Forces



- The Indian Armed Forces have been operating UAVs for over a decade. The Indian Army was the first to acquire UAVs, in late 1990s from Israel, and the Indian Air Force and Navy followed
- The Indian Army initially obtained the Searcher Mark I, followed by the Searcher Mark II which could operate at an altitude ceiling of 15,000 ft and finally the Heron, which could operate at an altitude ceiling of 30,000 ft. The Indian Air Force immediately followed the Army and acquired the Searcher Mark I followed by Searcher Mark II
- **Successive IAF Chiefs of Staff from 2006 onwards have emphasized this capability of UAVs and that IAF has plans to have fully operational both UAV andUCAV squadrons by 2017.**

UAVs in Civilian Space



- In the Civilian space , UAVs/UAS/Drones have been is use in wide ranging areas /applications : aerial surveillance (of pipe lines , electric transmission lines , highway patrols),
- Commercial motion pictures (‘Bollywood’ movie ‘Baby’ , based on a counter terrorism theme ,made use of drone mounted cameras for spectacular desert scenes)
- Law enforcement, search and rescue , wild life conservation (anti poaching) , disaster relief , to surveying and mapping : oil and gas prospecting , open cast mines and so forth
- The applications are growing.....

Drone Basics



- For defence/cross border surveillance /offensive operations are usually of the fixed wing variety ,whereas for civilian applications (specially surveillance, anti -poaching etc) multi-rotor preferred for its hovering capabilities /minimum take-off and landing constraints .
- The basic components of a system are: the unmanned aircraft system(UAS) with onboard camera/sensors , navigation and communication downlink .
- Ground component / the GCS (ground control system) which is usually operated by a licensed operator or a trained pilot who is in full control of the system in flight.
- In combat applications, a combat aviator is usually responsible for flying each mission/sortie
- The ground component also provides for storage and off-line analysis of the streaming video/imageries received from the UAS.

Drone Basics-Classification



- Classification of drones depend on the specifications similar to aircrafts : **Design**(fixed wing/multi rotor), **Ceiling**, **Endurance**, **Pay Load**
- The US Armed Forces follows a tier system of classification :
- **Tier I-** Low altitude long endurance (Gnat -750)
- **Tier-II-** MALE – Medium altitude long endurance: ceiling ,60 to 65,000 feet , speed 560 km/h, radius 6,000km and endurance 48 hrs(,RQ-4 Global Hawk, Israeli Searcher II and Heron)
- **Tier –III** –High altitude ,long endurance , low observable UAVs /**HAPs** (high altitude platforms)- designed to operate at a very high altitude (17– 22 km)and is able to stay there for hours, even days. *The new generation of HAPs, are expected to expand this period to several years.*

Application Areas - Combat



- **ISR** -The initial generation of UAVs were primarily used for surveillance.
- Broadly military UAVs are used for surveillance, direction of artillery fire, gathering Electronic Intelligence (ELINT) , lasing targets for fighter aircraft and Post strike Damage Assessment (PSDA).
- **UCAVs**- With increased operational requirements UAVs were armed and they became known *as Unmanned Combat Aerial Vehicles. (UCAVs)*.
- The CIA have been using UCAVs over conflict zones in Afghanistan, Libya, Syria , to target insurgents , munitions dumps and hostile facilities.
- **Rationale** for increased use of UAVs/UCAVs are: reduction in loss of trained combat pilots and costs of UAVs verses fighters : *"The only reason we need (UAVs) is that we don't want to needlessly expend the man in the cockpit."*
- **Costs** : The MQ-9 Reaper costs \$12 million while a F-22 (most widely used fighter jet) cost over \$120 million.

UAVs/Drone-Combat



- **Global Hawk** -Primary function: high-altitude, long-endurance ISR
- Contractor: Northrop Grumman (Prime), Raytheon, L3 Comm
- Wingspan: 130.9 feet (39.8 meters)
- Range: 12,300 nautical miles
- Endurance: more than 34 hours
- Ceiling: 60,000 feet (18,288 meters)



UAVs/Drone-Combat



RQ-1 / MQ-1 Predator armed with two Hell Fire missiles

Manufacturer :General Atomics Aeronautical Systems

In operation since around 1995

Cost around USD 4.03 million



Application Areas – Non-Combat

- **Border Enforcement** : anti smuggling / cross border infiltration specially in difficult terrain
- **Coastal Surveillance** –Extending reach of Coast Guard/ BSF/Police
- **Post Disaster Relief and Rescue Operations** – *UAS inputs are invaluable in creating a ‘Common Operational Picture’(COP) , which can be ‘published’ on an autonomous web which all agencies in the disaster zone can access using handheld devices/smart phones.*
- **Forestry / Wild Life Conservation** – Anti poaching activities closely connected with insurgency
- **Surveying and Mapping** – Deployment of UAVs has Today UAS based mapping is optimal for projects which are too small for conventional mapping photography / too large for ground based surveys/ Projects requiring repeat flying on a regular basis , like volume estimation in open-cast mines
- **Inspection of Power lines and pipelines**

Application Areas – Non-Combat



- A [DJI Phantom](#) UAV for commercial and recreational aerial photography



- [Parrot Mini Drone Rolling Spider \(Red\)](#)- From Amazon site
- [Rs. 13,990.00](#)Fulfilled
- Only 2 left in stock - order soon. /More Buying Choices
- [5 offers from Rs 13,980.00](#)
- FREE Delivery. Eligible for Cash on Delivery.

Workflow : From data capture to information



Capture



Process Manage

- AT
- DSM
- Ortho

- Mosaic
- Compression
- 3D objects
- Change

- Metadata
- Catalogue

Use Share



Workflow : Acquisition of Real Time data to Information Dissemination



Capture

Process Manage

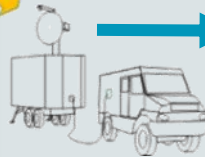
Use Share

Recording multisensor



downlink real time

Data preprocessing
- Georeferencing
- Mosaicing



Geo-data server

Remote data processing and interpretation
Web-Client
WPS



Local analysis
- Direct file access



1 sec/image from capture to webservice

Real-time Updates of the DM Portal



The screenshot shows a web browser window with the URL `http://gimli/apollo-client/ApolloPro.aspx`. The browser's address bar and search bar are visible. The application interface features a header with the **GEO SYSTEMS** logo and a navigation menu with options like **Datenquelle**, **Werkzeuge**, **Auswahl**, **Bearbeiten**, **Zeit**, **Messung durchführen**, and **Authentifizierung**. A user is logged in as **admin**. The main area displays a map of a rural region with various features like roads, fields, and buildings. A sidebar on the left shows **Karteneinhalt** with **Google Maps** selected. At the bottom, there are navigation controls and a status bar indicating that Firefox is sending data to Mozilla for user experience improvement.

Regulations/Policies



- Need for Regulation – Stems from:
 - Flight Safety(threat to aviation from, during take-off and landing is well known. UAVs pose greater threats, depending on the size and inherently small radar signature, posing challenges for ATCs.
 - Security –Insurgents / organised criminal agencies mounting unauthorised surveillance of sensitive areas / installations and possibility of drone borne attacks on the same
- Internationally :
 - USA- On Feb 15,2015 – The FAA proposed long awaited rules on : ‘on the commercial use of small drones, requiring operators to be certified , fly only during daylight and keep their aircraft in sight’. The proposed regulation would cover : drones weighing up to 55 kg), speed limit 100 mph and altitude up to 500 feet . *It is to be noted , that the ‘line of sight’ specification rules out the proposed use of drones for delivery of packages by Amazon.*

Regulations/Policies –Contd..



- International Regulations (contd.)-
 - Abu Dhabi - On March 14,2015 , the Department of Economic Development(DED), halted the trade in UAVs, after a “recreation drone caused Dubai airport operations to stop for almost an hour after the device flew near the critical flight paths” . In January the General Civil Aviation Authority(GCCA) announced that ‘it will release a set of rules to regulate the use of drones’.
 - Dubai - One needs to obtain a permit from the Dubai Civil Aviation Authority for drone operation by providing details of the proposed flight at : www.dcca.gov.ae . It takes 5 working days for a permit and costs AED 3,010 (about INR 53,000).
- India -- The ‘Instructions’ issued by the MoD in May 2006 , to the State Governments with copies to DGCA amongst others , appears to be the ruling on the subject. Information on any subsequent revisions are not available.

Regulations/Policies –Contd..



- India (Contd.)- The essential features of the Instructions are :
- Applications to be submitted to DGCA **at least 6 weeks in advance** of a proposed mission.(www.dgca.nic.in/forms/) providing all details prescribed.
- Disaster Management – NRSA/Government agencies may carry out ‘aerial surveys’ with prior intimation to MoD /MHA. The MoD may specify the need for ‘security officer on board the aircraft’ for such missions. **All data will undergo security vetting by concerned agencies , except where ‘urgency is considered in national interest’.**
- Security Classification – All aerial data will undergo ‘**a two tier screening**’. **Initial grading ‘Secret’, which may be reviewed at the stage of ‘Final Screening’.** The post-vetting of data has been dispensed with in case the aircraft is equipped with state of the art navigation/positioning devices, the output from which needs to be provided to MoD for vetting.
- As would be observed, the policy has no specific guidelines on use of drones (specification for on-board security officer rules out the same). In Disaster management scenario , the inherent delays in implementing the Instructions (in spite of best intentions) may deprive the relief and rescue agencies the vital technological edge available today ,

Summary/Concluding Remarks

- Today Defence forces around the world, including in India are investing in UAVs/UCAVs in a big way , as they provide viable intelligence acquisition and combat capabilities , at a fraction of the cost of manned combat aircrafts. .
- While an experienced combat aviator may score over a UCAV in a hostile environment, the ‘intelligent ‘ combat capabilities of the latter are undergoing rapid enhancement . Further the adverse political fallout and impact on public morale in the event a manned combat aircraft is shot down and the pilot captured is immense.
- In the civilian applications space ,versatility offered in a range of applications from :surveillance , anti poaching to cross-border anti smuggling operations are immense. It is sad that the agencies and in turn the Indian citizens are being denied the benefits of these technologies due to lack of understanding / appropriate policies essential for responsible usage of the technology.
- It is hoped, that this paper would contribute in a small way towards changing this scenario.