Aeronautical Science

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Unmanned Aircraft Systems (UAS): A Paradigm Shift in Aviation

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"The trouble with the future is that it usually arrives before we're ready for it."

Arnold H. Glasow

Two UAS Perceptions

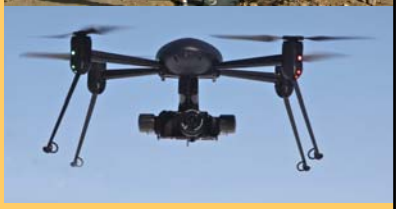
Regarded as a Disruptive Technology

-or-

Viewed as a Positive Step Forward in the Evolution of Aviation

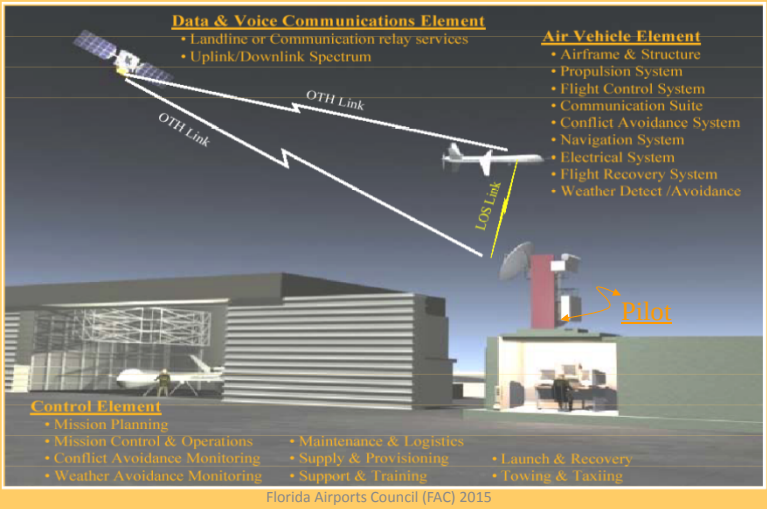
UAS Technology

- **What is it?**
  - UAS, UAVs, RPAs
  - Drones
  - RC aircraft models
  - System of systems
- **Where did it come from?**
  - Military Applications
    - Intelligence, surveillance and reconnaissance (ISR)
- **How has it changed?**
  - Not just for tactical
  - Technology development -> innovation
  - Widespread availability (affordable)
  - Increasing education



Unmanned Aircraft System

A System – Not limited to an Aircraft

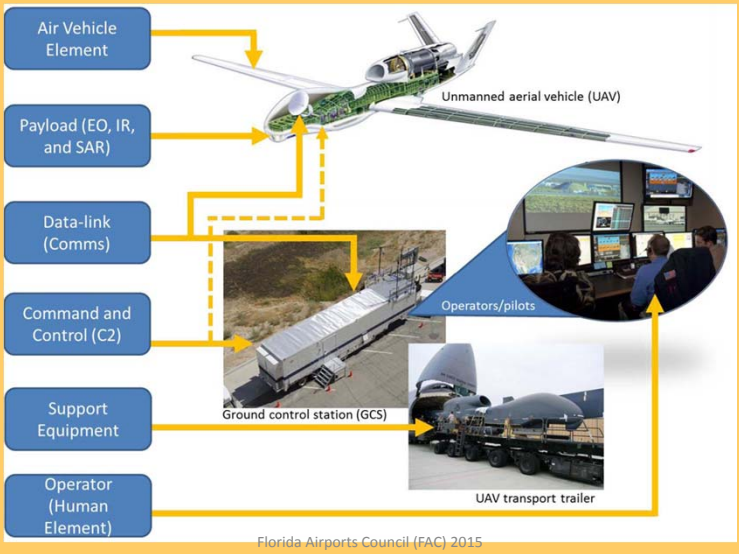


Classification

- Unmanned aviation systems (UASs) defined by several characteristics.
  - **Size:** Micro, small, medium, or large
  - **Mission:** Information or logistics
  - **Control:** Visual Line-of-sight (VLOS), Line of sight (LOS), terrestrial repeating (TR), or Satellite (SATCOM)
- UAS pilots are often referred to as "Operators"

Airframe Categories

System Architecture



A Glimpse into the Future of UAS

Public Use
- Law Enforcement
- Customs and Border Protection
- Search and Rescue
- Fire and Forest Services

Science
- Advanced Remote Sensing
  - Weather & Storm Tracking
- Coastline Monitoring and Ecosystem Conservation
  - Crop Monitoring

Commercial Use
- Structural Inspections
  - Power line and Pipeline Inspection
  - Oil Rig Inspection
  - Bridge
- Precision Agriculture
- Cargo Transport

Dull, Dirty, Dangerous Missions

Necessity Drives Market Development

- Market developments will indicate where UAS applications likely to be most necessary;
  - Large systems for high-altitude data missions
    - Public Use Agencies
  - Small systems for data missions and specialized logistics
    - Largest market for commercial use

Cost Effectiveness

- Different characteristics = different price tags
  - **Size:** Rapid cost increase as size/weight grows
  - **Mission:** Rapid increase as sensor sensitivity and/or payload weight increase
  - **Control:** Roughly, each step from LOS to TR to SAT increases cost by order of magnitude
  - **Pilots:** Offboard pilots more expensive than onboard pilots

Cost Effectiveness

Least expensive: Micro/small systems utilizing VLOS control regimes, adjunct crews

Draganflyer

1. Ground Control Station/ Crew (GCS)
2. Data Link
3. Ground Data Terminal
4. Air Vehicle
5. Payload

Most expensive: Large systems utilizing SAT control regimes, dedicated crews

Business Opportunities

- **Customers**
  - Commercial
  - Civil government (Federal, State, Local)
  - Military/Tactical or public use (DoD, law enforcement)
- **Challenges**
  - Apparent benefits > perceived costs
  - Regulations/laws in constant state of flux
  - Public outreach and knowledge
- **Must have a convergence of**
  - Enabling technologies
  - Need
  - Viable economic climate

Career Opportunities

Market and opportunities significantly expanding

- Business Development
- Analysis, Development, and Engineering
- Assembly/Technician Positions
- Support
- Management
- Operations (including operators/pilots)

Career details available in 2015 ERAU-Worldwide Unmanned Systems Related Career Opportunities report

Regulations/Laws

Major Regulation

- FAA Modernization and Reform Act of 2012
- AC 91-57 n/a for commercial
- COAs/333/SACs
- FAA NPRM for Operation and Certification of sUAS
  - 55lbs with registered (displayed) N-number
  - Limited ops: VLOS, daylight, <100mph, <500ftAGL, class G (B-E requires ATC),
  - Operator to pass knowledge exam (17yrs and older, recurrent every 24mo, register with TSA)
- Florida specific
  - SB 92- Freedom from Unwarranted Surveillance Act (1 July 2013)
  - HB 649/SB766 – Surveillance by a Drone (1 July 2015)

NPRM: (sUAS)

Overview of Small UAS Notice of Proposed Rulemaking

Summary of Major Provisions of Proposed Part 107

The following provisions are being proposed in the FAA's Small UAS NPRM.

Operational Limitations	• Unmanned aircraft must weigh less than 55 lbs. (25 kg). • Visual line-of-sight (VLOS) only; the unmanned aircraft must remain within VLOS of the operator or visual observer. • At all times the small unmanned aircraft must remain close enough to the operator for the operator to be capable of seeing the aircraft with vision unaided by any device other than corrective lenses. • Small unmanned aircraft may not operate over any persons not directly involved in the operation. • Daylight-only operations (official sunrise to official sunset, local time). • Must yield right-of-way to other aircraft, manned or unmanned. • May use visual observer (VO) but not required. • First-person view camera cannot satisfy "see-and-avoid" requirement but can be used as long as requirement is satisfied in other ways. • Maximum airspeed of 100 mph (87 knots). • Maximum altitude of 500 feet above ground level. • Minimum weather visibility of 3 miles from control station. • No operations are allowed in Class A (18,000 feet & above) airspace. • Operations in Class B, C, D and E airspace are allowed with the required ATC permission. • Operations in Class G airspace are allowed without ATC permission • No person may act as an operator or VO for more than one unmanned aircraft operation at one time. • No careless or reckless operations. • Requires preflight inspection by the operator. • A person may not operate a small unmanned aircraft if he or she knows or has reason to know of any physical or mental condition that would interfere with the safe operation of a small UAS. • Proposes a microUAS option that would allow operations in Class G airspace, over people not involved in the operation, provided the operator certifies he or she has the requisite aeronautical knowledge to perform the operation.
Operator Certification and Responsibilities	• Pilots of a small UAS would be considered "operators". • Operators would be required to: o Pass an initial aeronautical knowledge test at an FAA-approved knowledge testing center. o Be vetted by the Transportation Security Administration. o Obtain an unmanned aircraft operator certificate with a small UAS rating (like existing pilot airman certificates, never expires). o Pass a recurrent aeronautical knowledge test every 24 months. o Be at least 17 years old. o Make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the proposed rule. o Report an accident to the FAA within 10 days of any operation that results in injury or property damage. o Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is safe for operation.
Aircraft Requirements	• FAA airworthiness certification not required. However, operator must maintain a small UAS in condition for safe operation and prior to flight must inspect the UAS to ensure that it is in a condition for safe operation. Aircraft Registration required (same requirements that apply to all other aircraft). • Aircraft markings required (same requirements that apply to all other aircraft). If aircraft is too small to display markings in standard size, then the aircraft simply needs to display markings in the largest practicable manner.
Model Aircraft	• Proposed rule would not apply to model aircraft that satisfy all of the criteria specified in Section 336 of Public Law 112-95. • The proposed rule would codify the FAA's enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.

Concerns about UAS

- Integration in the NAS
  - Detect and Avoid
  - Air Traffic Management
- Privacy
  - IV Amendment
- Human Interface Issues
  - Cognitive and Perceptual
- Operator/Crew Training and Qualification
- And many more

Questions