To drone or not to drone...

THINGS TO CONSIDER WHEN CONSIDERING THE USE OF UAS IN YOUR WORKFLOW
First, We are Airmen.

Airman; noun

a pilot or member of the crew of an aircraft.

- Make no mistake... an sUAS is an aircraft.
- If you are flying it, then you are an Airman.
- Anything above the ground is the air.
- The first responsibility is safety
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- President of AirView Mapping, LLC
- Registered Professional Photogrammetrist (OR-2006, VA-2008)
- Certified Photogrammetrist (ASPRS-1998)
- FAA Certified UAS Pilot
- 30+ years of Experience in Photogrammetry
- Oregon Board of Examiners for Engineering and Land Surveying
- ASPRS Board of Directors (Retired)
- ASPRS Executive Committee (Retired)
- ASPRS Region Officer (Two cycles-Retired)
- Member of the PLSO, SAME, AUVSI, NSPS, Timbers Army
Goals of this session

- Provide a high level view of considerations for UAS operations.
  - Equipment Considerations
    - Aircraft
    - Sensors
    - Crew
  - Operational Considerations
  - The Current Regulatory Landscape
    - FAA
    - Professional Registration
Introducing sUAS into your workflow

- What is an sUAS?
  - Small unmanned Aerial System (Drone)
- What do you want to do with it?
- Does it make sense for what you need at the end of the day?

Because at the end of the day, it isn’t the drone that is important. It is what the drone provided you with that is important.

The sUAS is just the tool to capture data, in some form, for use in your operation.
Potential Applications

- Inspection
  - Imagery
  - Thermal
  - Video
- Monitoring
  - Project Progress
  - Volume Computation
- Emergency Response
  - Situation Awareness
  - Supply Drop
Potential Applications

- Geospatial
- Photogrammetry
  - Digital Imagery/Orthophoto
  - Topographic Mapping
  - 3D Point Cloud
- LiDAR
- Remote Sensing
  - Thermal
  - Infrared
  - Multispectral
Advantages

- Safety
- Access
- New Technology
- Time Savings
- Ease of repeatability
Drawbacks

- Risk Management
- Flight Operation
- Specialized Equipment
- Specialized Staff
- Specialized processing
- Cost
sUAS Anatomy - Basic Components

- Airframe/Aircraft
- Controller
  - RC Controller
  - Tablet/application
- GPS
- IMU (inertial measuring unit)
- Sensor
- Pilot
- Observer
Aircraft Types

- **Fixed wing**
  Consist of a rigid wing that creates lift from the forward airspeed of the craft.

- **Rotary wing**
  Consists of 2 or more rotor blades that revolve around a fixed mast that generates lift from the rotation of the “wing.”
Fixed Wing Aircraft

Advantages:
- Much simpler structure, less moving parts
- Less maintenance and/or repair
- Faster
- Longer flight durations
- Cover larger areas
- Natural glide capability

Disadvantages:
- Require a runway or launcher for takeoff and a runway for landing, preferably something soft.
- Must keep moving to remain aloft, cannot remain stationary or “hover.”
Rotary Wing

Advantages:
- VTOL—Vertical take off and land
- Operate in smaller confined space
- Remain stationary or hover in place
- Variable speeds from very slow to very fast
- Agile maneuvering
- Varied payload capacities for different sensors
- Can follow a moving object on the ground (virtual tether)
- More varied applications
Rotary Wing

Disadvantages:
- Greater mechanical complexity
- More complicated maintenance and repair
- Reduced operational time
- Generally lower speeds
- Shorter flight range
- Increased operational costs
Categories

- Not all sUAS are created equal
  - Toys
    - Low cost, low performance.
    - Good for training an operator
  - Consumer – Hobbyist
    - Traditional RC airplanes
    - The go-pro set
  - Pro-sumer *
    - Consumer grade/cost platforms and sensors
    - Business applications
  - Professional
    - Serious aircraft and sensors for serious cost

*sweet spot for starting out, typically a good bang for the buck
Prosumer - Enthusiast
Commercial - Professional
Sensors

- **Weight**
  - Can the drone pick it up?
  - What impact will it have on your flight time?
- **Power**
  - Running off the drones power?
  - Does it have it’s own battery?
- **Control**
  - Do you have control of the sensor from the command console?
  - Is it on a gimbal or is it fixed to the axis of the aircraft?
Cameras
Imagery

Go Pro - consumer/prosumer

Point and Shoot

DSLR

Drone Specific
Imagery

- RGB/ BW

- Resolution will depend on what camera you use.
  - Application requirements/needs.
  - Depends on what the sUAS can support.

- Still frame or video depending on your application.
  - Go Pro
  - Off the shelf Point and Shoot
  - Off the shelf DSLR
  - Drone specific or hard mounted
Imagery

Infrared

Red Edge

Multispectral

Video
LiDAR

- Light Detection and Ranging
  - Mature Technology
  - Weight and power requirements
  - Far more specialized than imagery
  - Processing requirements
Miniaturization has been critical.

Systems differ in capabilities and cost in a less direct proportion.

Require more power than a camera

Heavy payload
Thermal
Corona
Specialty Sensors

If it can be manufactured, someone is trying.
Operational Considerations

- Flight Operation
  - Adhering to regulatory requirements*
  - Management of aircraft
- Mission Planning
  - Specialty software for flight plans
  - Control plan, safety plan, sensor choice
- Pilots and crew
  - Training
  - Certification
- Maintenance
- Communications
- Aviation Insurance

*we’ll get to this
What are you really trying to achieve? What other benefits could you reap from using a drone?

- **Processing**
  - Application driven- Typically one product doesn’t do it all
    - Software ranges from $ to $$$$$$$$$$$
    - You DO typically get what you pay for
  - Training
  - Photogrammetrist and/or surveyor ?
- **Data Handling**
  - Potentially BIG data sets
Processing

- Desktop, SaS, or a combination
  - Pix4D
  - SimActive
  - Agisoft
  - Drone Deploy
  - Numerous others
Regulatory
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Part 107
Current Rules

- Pertains to COMMERCIAL operation of the sUAS.
- Hobbyists operate under a different set of rules.
- Commercial means anything that is done for compensation or as part of a business or service enterprise including photography for internal use.
- Government agencies get a pass on this, but still have to follow safety and basic flight rules.
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 visual observer. • At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer. • At all times the small unmanned aircraft must remain close enough to the remote pilot in command and the person manipulating the flight controls of the small UAS. Alternatively, the unmanned aircraft must remain within VLOS of the visual observer. • Daylight-only operations, or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting. • Must yield right of way to other aircraft. • 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 groundspeed of 100 mph (87 knots). • Maximum altitude (AGL) of less than 400 feet AGL remain within 400 feet of a structure. • Minimum weather visibility of 3 miles from control station. • 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 a remote pilot in command or VO for more than one unmanned aircraft operation at one time. • No operations from a moving vehicle. • No operations from a moving vehicle unless the operation is over a sparsely populated area. • No carriage of hazardous materials. • Requires preflight inspection by the remote pilot in command. • 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. • Foreign-registered small unmanned aircraft are allowed to operate under part 107 if they satisfy the requirements of part 375. • External load operations are allowed if the object being carried by the unmanned aircraft is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. • Transportation of property for compensation or hire allowed provided that the aircraft, including its attached systems, payload, and cargo weigh less than 55 pounds total; or the flight is conducted within visual line of sight and not from a moving vehicle or aircraft; and the flight occurs wholly within the boundaries of a State and does not involve transport between (1) Hawaii and another place in the United States; (2) the District of Columbia and another place in the District of Columbia; or (3) a territory or possession of the United States and another place in the same territory or possession. • Most of the restrictions discussed above are waivable if the applicant demonstrates that his or her operation can safely be conducted under the terms of a certificate of waiver. Remote Pilot in Command Certification and Responsibilities • Establishes a remote pilot in command position. • A person operating a small UAS must either hold a remote pilot airman certificate with a small UAS rating or be under the direct supervision of a person who does hold a remote pilot certificate (remote pilot in command). • To qualify for a remote pilot certificate, a person must: • Demonstrate aeronautical knowledge by either: • Passing an initial aeronautical knowledge test at an FAA-approved knowledge testing center; or • Hold a part 61 pilot certificate other than student pilot, complete a flight review within the previous 24 months, and complete a small UAS online training course provided by the FAA. • Be vetted by the Transportation Security Administration. • Be at least 16 years old. • Part 61 pilot certificate holders may obtain a temporary remote pilot certificate immediately upon submission of their application for a permanent certificate. Other applicants will obtain a temporary remote pilot certificate upon the FAA’s written approval. The FAA anticipates that it will be able to issue a temporary remote pilot certificate within 10 business days after receiving a completed remote pilot certificate application. • Until international standards are developed, foreign-certificated UAS pilots will be required to obtain an FAA-issued remote pilot certificate with a small UAS rating. A remote pilot in command must: • Ensure that the small UAS is in the condition for safe operation. • Conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure that the small UAS is in the condition for safe operation. • Ensure that the small UAS complies with the existing registration requirements specified in § 91.203(a)(2). A remote pilot in command may deviate from the requirements of this rule in response to an in-flight emergency. Aircraft Requirements • FAA airworthiness certification is not required. However, the remote pilot in command must conduct a preflight check of the small UAS to ensure that it is in the condition for safe operation. Model Aircraft • Part 107 does not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112-95. • The rule codifies the FAA’s enforcement authority in part 101 by prohibiting model aircraft operators from endangering the safety of the NAS.
Part 107 Summary

Operational Limitations

- 55lbs or less
- Line of Sight (VLOS)
- Daylight*
- Maximum Altitude is 400 AGL*
- No operations of persons not involved
- No operations over property not involved
- Operations Class B,C,D,E airspace requires ATC permission
- No operations from moving vehicles*
- *Some of these can be overcome with a Certificate of Waiver (COW)
Airspace Classification

FL 800
18,000 MSL

Class A

Class B

Class C

Class D

Non-towered
airport with
inst. approach

Class G

14,500 MSL

1,200 AGL

Class E

Non-towered
airport with no
inst. approach

AGL – above ground level
FL – flight level
MSL – mean sea level

Airspace | Class A | Class B | Class C | Class D | Class E | Class G
--- | --- | --- | --- | --- | --- | ---
Entry Requirements | ATC clearance | ATC clearance | Prior two-way communications | Prior two-way communications | Prior two-way communications* | Prior two-way communications*
Minimum Pilot Qualifications | Instrument Rating | Private or Student certification, Local restrictions apply | Student certificate | Student certificate | Student certificate | Student certificate
Two-Way Radio Communications | Yes | Yes | Yes | Yes | Yes, under IFR flight plan* | Yes*
Special VFR Allowed | No | Yes | Yes | Yes | Yes | N/A
VFR Visibility Minimum | N/A | 3 statute miles | 3 statute miles | 3 statute miles | 3 statute miles** | 1 statute mile†
VFR Minimum Distance from Clouds | N/A | 500 below, 1,200’ above, 2,000’ horizontal | 500 below, 1,000’ above, 2,000’ horizontal | 500 below,** 1,000’ above, 2,000’ horizontal | Clear of clouds†
VFR Aircraft Separation | N/A | All | IFR aircraft | Runway Operations | None | None
Traffic Advisors | Yes | Yes | Yes | Workload permitting | Workload permitting | Workload permitting

*Only if a temporary tower or control tower is present is the exception.
**Only true below 10,000 feet.
†Only true during day at or below 1,200 feet AGL (see 14 CFR part 91).

Figure 8-1. U.S. airspace classification.
Part 107 Summary

Pilot in Command

- Requires an Airman Certificate with UAS rating
- Aeronautical knowledge test
- Understand the National Air Space (NAS) and flight rules
- Responsible for the aircraft and its safe operation
- Responsible to report incidents to the FAA within 10 days

YOUR FIRST RESPONSIBILITY IS TO ALWAYS FLY THE AIRCRAFT UNTIL IT IS SAFELY ON THE GROUND AND POWERED DOWN
State and Local Aviation Regulations

- Some states, cities, municipalities have enacted their own drone regulations
  - These range from common sense and benign to downright draconian
  - Some are actually enforceable and some are not
  - The FAA trumps all of them
  - However, you may still spend the night in jail.
Professional Regulations

- Professional registration
- Mostly overlooked
- Depending on what you are doing, this may be a professional service requiring professional registration or licensure.

- Topographic Mapping
  - Digital Surface or Terrain Models
  - Contour maps
  - Planimetric Mapping
  - 3D Renderings
- Volume Computations
- Boundary Surveys
- Digital Orthorectified Images
The mission of the Oregon State Board of Examiners for Engineering and Land Surveying is to regulate the practices of engineering, land surveying, photogrammetry, and water right examination in the State as they relate to the welfare of the public in safeguarding life, health and property.
How the state of Oregon defines Photogrammetry and Land Surveying

The OSBEELS uses Oregon Revised Statutes (ORS) to determine how it defines land surveying and photogrammetric professions and services.

A land surveyor, professional land surveyor or registered professional land surveyor is defined as an individual who is registered and holds a valid certificate to practice surveying in the state of Oregon. In order to identify yourself or offer professional land surveying services in Oregon you must be registered with OSBEELS.

Photogrammetric mapping is defined as the process of evaluating and measuring land through the interpretation of aerial and remote sensing data to determine topography, area, contours and land features.

To view additional examples of photogrammetric mapping and land surveying work as defined by the state of Oregon, refer to ORS 672.002, ORS 672.005 and ORS 672.007.
The Photogrammetry and Remote Sensing Task Force

- OSBEELS recognized that new tools made it possible for layman to produce geospatial products, essentially with the push of a button.
- It was clear that enthusiasts would see the potential of using sUAS captured imagery and other data for many purposes.
- It was also clear that many of these people would not realize that some of the services and products that they could produce were part of regulated profession.
The task force was created to reach out to the public and make them aware of the state regulations that govern providing professional land surveying and professional photogrammetry services.

And we wanted to do this before people found themselves at odds with state laws by providing or offering services that require professional licensure.

Operators offering or providing these services without proper licensure, knowingly or unknowingly, are subject to discipline that can include fines and other legal actions.
Future

- BVLOS
  - Longer flights, great news for corridors
- Larger UAS
  - $$$$$
  - Greater range, duration, Payloads, etc.
  - WAY MORE COMPLICATED FLIGHT OPERATIONS
- Improved sensors
- Improved processing tools
  - I have yet to see technology go backward.
Risks...

https://youtu.be/XYJ9IDio_2U
First, We are Airmen.

QUESTIONS

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