Lesson Plans

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NFPA 2400, 2024 ed.

Standard for Small Unmanned Aircraft Systems (sUAS) Used for Public Safety Operations

Blue Ridge Mountain Drones

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Lesson 1: Plan a sUAS Operation

5.3.1.1
Plan sUAS operations given mission objectives and goals, resources, environmental conditions, and scenarios, so that a mission plan is completed that aligns with the mission objectives and goals, identifies the resources required, assesses the risks associated with the mission, and identifies the operational tasks necessary to complete the mission.

(A) Requisite Knowledge:

1) Airspace requirements
2) Weather conditions
3) Crew readiness
4) Resource capabilities
5) ICS
6) Risk assessments
7) Regulatory requirements.

(B) Requisite Skill:

1) The ability to produce and communicate a mission plan.

Terminal Objective
The sUAS Remote Pilot in Command (RPIC) shall correctly identify knowledge of airspace requirements, weather conditions, crew readiness, resource capabilities, Incident Command System (ICS), risk assessments, regulatory requirements, and produce and communicate a mission plan.

Enabling Objectives

1. The sUAS RPIC given the mission, shall have knowledge of the packing list to have a successful flight.
2. The sUAS RPIC given an appropriate mission, shall perform pre-flight Risk Management using METARs and other weather reporting tools to determine if the mission is flyable.
3. The sUAS RPIC given a mission, shall verify Visual Observer (VO), if used, are briefed and crew readiness for the mission.
4. The sUAS RPIC given a mission, shall identify pre-flight resources capabilities available to the mission such as Aeronautical Maps to comply with FAA airspace requirements.
5. The sUAS RPIC shall follow ICS.
6. The sUAS RPIC shall abide by the regulatory requirements that pertain to FAA Part 107.
7. The sUAS RPIC shall produce a mission plan and communicate it to the flight crew.
8. The sUAS RPIC given the mission, shall have knowledge of airspace to have a successful flight.

Motivation
Preflight resources, airspace, and a checklist are needed for the RPIC and crew if you're going to have a successful flight.

ENABLING OBJECTIVE 1
The sUAS RPIC given the mission, shall have knowledge of the packing list to have a successful flight.

1. Packing List for the sUAS RPIC.
    a. Extra Cables
    b. SanDisk Cards (SD Card)
    c. Batteries fully charged *
    d. Ground Control Unit fully charged
    e. Tablet / phone / device fully charged
    f. Hotspot for internet
2. Discuss the different types of devices used to control an sUAS.
    a. Propellers
    b. Required cables
    c. USB

   d. USB C
   e. Mini HDMI
   f. iPhone plugs
   g. Accessories
   h. First Person View (FPV) Goggles
   i. Headphones
3. Discuss paperwork needed for the mission
   a. UAV FAA Pilot Part 107 Certificate
   b. Authority Having Jurisdiction State Certificate or Permit
   c. Liability Insurance policy
   d. State or federal identification with a picture
4. Discuss the different sUAS sensors, payloads, applications, and Scan Disk (SD) cards needed for the mission.
   a. Three (3) Axis Stabilized Gimbal
   b. Infrared AKA IR or FLIR
      i. 13-20 modes aka Rainbow modes
      ii. White hot and black hot are most popular in search and rescue
      iii. Multi-Spectral Color Analysis
   c. Mapping sensors lens
      i. Optical
   d. Electro-Optical lens (EO) camera
      i. Consider a day camera
      ii. Lower end price point
      iii. Point and shoot
      iv. 9-13 mm lens used for search and rescue applications
   e. Lidar sensors
      i. Used for mapping
      ii. 2D and 3D Imaging
   f. SD cards
      i. Start with a clean formatted SD card (performed by your drone) issued by your department before each mission
      ii. 16 GBs sufficient for a 20-minute video flight. You'll need about 0.7GB to store a minute of video, or about 20 minutes per 16GB card
      iii. Have multiple cards in your pack in case you have a bad card or it's given to law enforcement for evidence

      ***Note**: SD cards come in many different types and forms. Be wary of buying them online due to counterfeits. Only buy from reputable dealers or stores. When purchasing SD cards, the higher the write speed, the better the card. A top card in today's market is writing 90+ mb/s. Next is the read speed. The top card on the market will read about 95+ mb/s.*
      https://phantompilots.com/threads/sd-card-recommendation.119085/
   g. Lights
      i. LED White Strobe UAV Strobe Locator style of light for dusk to dawn flights and visible for 3 nautical miles
      ii. Searchlight
   h. Optical Flow Issues
      i. Snow
      ii. Water
      iii. Asphalt
      iv. High Grass
   i. Flight Applications
      i. AirMap application
      ii. B4UFLY application
      iii. FlightRadar24
      iv. Sky Vector Flight Planning
      v. 1800wxbrief.com

5. * Discuss flight restrictions that may interfere with your mission.
    a. Temporary Flight Restrictions (TFR)*
    b. Proximity to airfields
    c. Proximity to prisons *
    d. Proximity to schools
    e. Proximity to nuclear and power plants
    f. Department of Interior lands *
        i. Blue Ridge Parkway
        ii. Yellowstone
6. Pre-Flight Resources for the RPIC and crew for a successful mission
    a. Authorization to Fly
    b. AGL for the flight
    c. Flight overview
    d. Frequencies
    e. Contingency plan for lost link https://www.androidcentral.com/best-tips-and-gps-trackers-finding-lost-drone?amp
    f. Hazards
    g. sUAS conflicts if one or more aircraft are flying
7. Preflight Checklist for the RPIC and crew
    a. Batteries, charged, warmed up, and inserted correctly.
    b. Firmware updated
    c. Inspect sUAS for obvious defects
    d. Propellers tightened/locked and check for defects
    e. Remove gimbal guard
    f. Lens filter needed? Yes or No
    g. SD card in the camera
        i. Formatted
        ii. No personal photos or videos if used to fly a mission.
    h. Monitor Brightness set to high
    i. Antenna up
    j. Mission application switched on and connected to the sUAS
    k. sUAS turned on
    l. Compass calibrated
    m. Minimum Return-to-Home (RTH) height set
    n. Check Satellite status
    o. sUAS in a safe launch area away from the general public.
    p. sUAS tracking device activated before launch.

ENABLING OBJECTIVE 2

The sUAS RPIC given appropriate mission, shall perform pre-flight Risk Management using METARs and other weather reporting tools to determine if the mission is flyable.

1. The RPIC and crew shall perform a pre-flight Risk Management using weather tools to determine if the mission is flyable.
    a. MyRadar application
    b. UAV Forecast application (uavforecast.com)
    c. Wind Compass application
    d. Aviation application
    e. METARS
    f. The Aviation National Weather Service (1800wxbrief) or www.1800wxbrief.com *
        i. KAVL 181254Z 35009KT 10SM CLR 06/02 A3006 RMK AO2 SLP176 T00610022
            1) Reporting Airport *
            2) Date
            3) Time in Zulu time

4) Wind Direction *
5) Wind Speed*
    a) Visibility *
    b) Temperature in Celsius
    c) Dew Point
    d) Altimeter Reading
    e) Automated Report
    f) Sea Level Pressure

2. The minimum flight visibility standards when referring to weather is staying 500 feet below cloud vertically and 2,000 feet horizontally and 3 miles visibility. *
3. The RPIC assumes the risk management of a flight if you have a crew of one or four. In the end, the RPIC assumes all risk *
4. The RPIC should re-evaluate risk assessments when
    a. The weather changes or ceilings have been lowered*
    b. The area of operation changes in some regard *
    c. If a scheduled crew member(s) have not arrived *

ENABLING OBJECTIVE 3

The sUAS RPIC given a mission, shall verify Visual Observer (VO), if used, are briefed and crew readiness for the mission.

1. The VO shall be appointed or recognized prior to the launch of the sUAS
    a. They are briefed on mission objectives
    b. They are using unaided eyes with the exception of glasses or contacts. An additional VO may use field glasses as an extra set of eyes
    c. Any aircraft/objects coming into the search area during the mission

2. The crew member self-assessment includes ensuring that you are mentally and physically able to perform your crewmember duties*
3. The blood alcohol content limited to operate as a crew member must be below 0.04% *

ENABLING OBJECTIVE 4

The sUAS RPIC given a mission, shall identify pre-flight resources capabilities available to the mission such as Aeronautical Charts to comply with FAA airspace requirements.

1. The use of pre-flight resources to determine airspace involving the mission *
    a. Aeronautical Chart from the AHJ – **Authority Having Jurisdiction** (FAA in the USA) *
    b. Compass, ruler for a straightedge, and a magnifying glass for reading the maps
    c. Safety plans *
    d. NOTAMS*
    e. Local ATC Tower contact number
    f. Flight vest
    g. Landing Pad
    h. Cones for LZ
    i. Crime Scene tape to cordon-off restricted areas
    j. Temporary Flight Restrictions (TFR)
2. To fly in Temporary Flight Restriction area, you must do the following
    a. Seek permission from the person or agency that filed the TFR *
    b. TFRs include details about who may get approval to fly in them. Typically, only public safety agencies, first responders and other organizations such as the media may be eligible for approval. To fly in a TFR, drone pilots must apply through the FAA's expedited approval process known as the Special Governmental Interest (SGI) process.
    c. To apply for an authorization through the SGI process you must be a Part 107 Remote Pilot with a current certificate or have a Certificate of Waiver or Authorization (COA) and Fill out the Emergency Operation Request Form (MS Word) and send it to the FAA's System Operations Support Center (SOSC) **(Updated**

"b" April 11, 2024)

3. The RPIC shall verify he or she has all the necessary resources capabilities for the flight before leaving the staging area to go to the flying site *
4. The RPIC should independently analyze the resources required to complete each different type of mission *

ENABLING OBJECTIVE 5

The sUAS RPIC shall follow ICS.

1. The sUAS RPIC shall be part of an ICS system
    a. The RPIC should fall under Air Operations in ICS
    b. ICS form 214 is the Activity Log to be filled out by the RPIC and any crew members *
    c. Only respond to an incident if you're called per ICS operating procedures *
2. The RPIC will coordinate/communicate with the Incident Command Center during the flight or a designee for the Incident Commander. This could be an *
    a. Air Operations
    b. Air Boss
3. When handling dynamic retasking, this needs to be done by the Incident Commander or their designee such as the Operations Chief or his /her designee and never by the RPIC *

ENABLING OBJECTIVE 6

The sUAS RPIC shall abide by the regulatory requirements that pertain to FAA Part 107.

1. The RPIC shall abide by the regulatory requirements.
    a. Must pass an aeronautical knowledge exam at an FAA-approved Knowledge Testing Center
2. The RPIC shall abide by regulatory requirements (airspace) set forth by the AHJ FAA when flying in the USA Airspace
    a. Be well rested, free of illness, and not under the influence of drugs or alcohol
    b. Possess general awareness of the geographical features, obstructions and hazards of the area surrounding the flight airspace
    c. Be briefed and understand the airspace restrictions
    d. Maintain an understanding of the laws governing the flight and use of sUAS and abide by them
    e. Operate within the scope of the RPIC's capabilities, training, education, and qualification
    f. sUAS must weigh less than 55 lbs. and be registered
    g. Fly during daylight, within Visual Line of Sight (VLOS)
    h. Fly at or below 400 feet AGL
    i. No operations over people
    j. Flights around airports (in control require Air Traffic authorization) using LAANCE
    k. Must be 16 years old or older
    l. Must read, write, and speak English
    m. Must undergo Transportation Security Administration (TSA) background security screening
    n. Fly in Class G airspace unless you have a FAA waiver*
    o. When doing risk assessments, the regulation does <u>not</u> allow the RPIC to operate the sUAS from a moving vehicle in heavy populated areas or urban environments *
    p. In regards to risk assessment, regulations allow the sUAS to have objects attached to the aircraft as long as they are securely attached and do not adversely affect the flight characteristics or controllability of the aircraft. This should be approved by the RPIC. Also, do not exceed the manufacturer's recommendation on weight in regards to load factors *
3. A preflight inspection must be performed by the RPIC before each flight. *
    a. https://www.faasafety.gov/files/gslac/courses/content/451/1458/PreflightInspectionChecklist.pdf for a complete checklist
    b. Visually inspect the condition of the unmanned aircraft system components
    c. Inspect the airframe structure, including the undercarriage, all flight control surfaces, and linkages
    d. Inspect registration markings for proper display and legibility
    e. Inspect moveable control surface(s), including airframe attachment point(s)
    f. Inspect servo motor(s), including attachment point(s)
    g. Inspect the propulsion system, including power plant(s), propeller(s), rotor(s), ducted fan(s), etc.

h. Verify all systems (e.g. aircraft, control unit) have an adequate energy supply for the intended operation and are functioning properly
i. Inspect the avionics, including control link transceiver, communication/navigation equipment, and antenna(s)
j. Calibrate UAS compass prior to any flight
k. Inspect the control link transceiver, communication/navigation data link transceiver, and antenna(s)
l. Check that the display panel, if used, is functioning properly
m. Check ground support equipment, including takeoff and landing systems, for proper operation
n. Check that control link correct functionality is established between the aircraft and the control station
o. Check for correct movement of control surfaces using the control station
p. Check onboard navigation and communication data links
q. Check flight termination system, if installed
r. Check fuel for correct type and quantity
s. Check battery levels for the aircraft and control station
t. Check that any equipment, such as a camera, is securely attached
u. Verify communication with UAS and that the UAS has acquired GPS location from at least 4 satellites
v. Start the UAS propellers to inspect for any imbalance or irregular operation
w. Verify all controller operation for heading and altitude
x. If required by flight path walkthrough, verify any noted obstructions that may interfere with the UAS
y. At a controlled low altitude, fly within range of any interference and recheck all controls and stability
z. FAA Part 107 sUAS Preflgih Inspections located here: https://www.faasafety.gov/files/gslac/courses/content/451/1458/PreflightInspectionChecklist.pdf

***Note**: Instead of the knowledge exam, Part 61 certificate holders can take the online training at https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot/.*

ENABLING OBJECTIVE 7

The sUAS RPIC shall produce a mission plan and communicate it to the flight crew.

1. The RPIC shall produce a mission plan
    a. Studying Area Aeronautical and topo maps
    b. Lens Sensors for DJI products. See Table 1 for a sample of sensors
    c. Mission Altitudes
    d. Date & Time of the Mission
    e. Overview
    f. Radio frequencies to be used
    g. Planned flight time
    h. Battery reserve time based on the environment.
    i. Report. **See Table 2** sample from the North Carolina Department of Transportation - Aviation Division
    j. Contingency plan for a flyaway
2. The RPIC should command the sUAS to Return to Home (RTH). If this fails, the RPIC should
    a. Call local ATC direct
    b. Last know direction
    c. Number minutes left on the battery
    d. Estimated forward speed
    e. Estimated travel distance before running out of battery
    f. Pilot Name (s)
    g. VO (s)

    ***Note**: If a camera has a sensor with 4000 pixels by 4000 pixels, it is called a 16 Megapixels camera. That is because it has 16,000,000 pixels.*
3. The RPIC shall communicate it to the flight crew
    a. Crew Resource Management should be in place
    b. The RPIC and VO shall communicate directly on any incoming aircraft, obstructions that may interfere with the mission

c. The RPIC and VO should communicate any possible sightings of the target

ENABLING OBJECTIVE 8

The sUAS RPIC given the mission, shall have knowledge of airspace to have a successful flight.

1. The RPIC can fly in Class G airspace without needing FAA permission. *
2. In other controlled airspaces, the RPIC will need to get permission from the FAA to fly in Class B, C, D, E airspace
3. For Part 107 pilots as we know today, will never fly in Class A airspace. This controlled airspace is reserved for manned flights and it is not likely drones under 55 lbs will ever fly in this airspace.*
4. If you fly within 5 miles of a Class B, C, D or surface E airport, you're most likely going to have to file a flight plan with ATC using a third-party app such as Aloft or AirMap

Table 1

Mavic Air 2	**Mavic Mini**	**Mavic 2 Pro**
Sensor Size: 6.4 x 4.8mm Max Photo Resolution: 8000 × 6000 Max Video Resolution: 3840 × 2160 @ 60fps Lens Focal Length (35mm Equivalent): 24mm Photo Formats: JPEG or DNG (RAW) Video Formats: h.264, H.265	Sensor Size: 6.3 x 4.7mm Max Photo Resolution: 4000 × 3000 Max Video Resolution: 2720 × 1530 @ 30fps Lens Focal Length (35mm Equivalent): 24mm Photo Formats: JPEG Video Formats: h.264	Sensor Size: 13.2 x 8.8mm Max Photo Resolution: 5472 × 3648 Max Video Resolution: 3840 × 2160 @ 30fps Lens Focal Length (35mm Equivalent): 28mm Photo Formats: JPEG or DNG (RAW) Video Formats: h.264, h.265
Mavic 2 Zoom	**Mavic Air**	**Mavic Pro / Mavic Pro Platinum**
Sensor Size: 6.3 x 4.7mm Max Photo Resolution: 4000 × 3000 Max Video Resolution: 3840 × 2160 @ 30fps Lens Focal Length (35mm Equivalent): 24-48mm Zoom Photo Formats: JPEG or DNG (RAW) Video Formats: h.264	Sensor Size: 6.3 x 4.7mm Max Photo Resolution: 4056 × 3040 Max Video Resolution: 3840 × 2160 @ 30fps Lens Focal Length (35mm Equivalent): 24mm Photo Formats: JPEG or DNG (RAW) Video Formats: h.264	Sensor Size: 6.3 x 4.7mm Max Photo Resolution: 4000 × 3000 Max Video Resolution: 4096 × 2160 @ 24fps Lens Focal Length (35mm Equivalent): 26mm Photo Formats: JPEG or DNG (RAW) Video Formats: h.264
Phantom 4 Pro, Phantom 4 Pro v2.0, & Phantom 4 Advanced	**Zenmuse X7 (Inspire 2)**	**Zenmuse X5S (Inspire 2)**
Sensor Size: 13.2 x 8.8mm Max Photo Resolution: 5472 × 3648 Max Video Resolution: 4096 × 2160 @ 60fps Lens Focal Length (35mm Equivalent): 24mm Photo Formats: JPEG, DNG (RAW), JPEG + DNG Video Formats: h.264, h.265	Sensor Size: 23.5 × 15.7 mm Max Photo Resolution: 6016 × 4008 Max Video Resolution: 6016×3200 @ 30fps Lens Focal Length (35mm Equivalent): 24mm, 36mm, 52mm, or 75mm via the 16mm / 24mm / 35mm / 50mm DJI Lenses (There is a crop factor of 1.5) Photo Formats: JPEG, DNG (RAW), JPEG + DNG Video Formats: CinemaDNG, ProRes RAW, ProRes RAW HQ, ProRes, h.264, h.265	Sensor Size: 17.3 x 13 mm Max Photo Resolution: 5280 × 3956 Max Video Resolution: 4096×2160 @ 59.94fps Lens Focal Length (35mm Equivalent): Can take a variety of MFT lenses. Default lens is a DJI 15mm, and with a crop factor of 2, makes it 30mm Photo Formats: JPEG, DNG (RAW), JPEG + DNG Video Formats: CinemaDNG, ProRes, h.264, h.265

Table 1 provided by www.djzphoto.com

Mavic Mini 2	Mavic 2 Dual Enterprise
Sensor 1/2.3” CMOS Effective Pixels: 12 MP Lens FOV: 83° 35 mm Format Equivalent: 24 mm Aperture: f/2.8 Shooting Range: 1 m to ∞ Video: 100-3200 (Auto) 100-3200 (Manual) Photo: 100-1600 (Auto) 100-3200 (Manual) Shutter Speed Electronic Shutter: 4-1/8000s Still Image Size 4:3: 4000×3000 16:9: 4000×2250 Still Photography Modes Single shot Interval: 2/3/5/7/10/15/20/30/60 s Video Resolution 2.7 K: 2720×1530 25/30 p FHD: 1920×1080 25/30/50/60 p Max Video Bitrate 40 Mbps Supported File System FAT32（≤32 GB） exFAT（>32 GB） Photo Format JPEG Video Format MP4 (H.264/MPEG-4 AVC）	Sensor – Uncooled VOx Microbolometer Lens – HFOV: 57° Aperture – f/1.1 Resolution – 160 × 120 Pixel Pitch – 12 μm Spectral Band – 8-14 μm Image Size – 640 × 480 (4:3); 640 × 360 (16:9) Still Photography Modes – Single shot Burst shooting – 3/5/7 frames Video Recording Modes – 640 × 360 @8.7 fps Accuracy – High Gain: Max ±5% (typical) Low Gain – Max ±10% (typical) Scene Range – High Gain: -10° to +140°C Scene Range – Low Gain: -10°to +400°C Photo – JPEG Video – MP4, MOV (MPEG-4 AVC / H.264) Flight Time With the accessories such as the M2E spotlight, loudspeaker or beacon mounted, the hovering time changes to the following; 27 min (with beacon on) 28 min (with beacon off) 22 min (with spotlight on) 26 min (with spotlight off) 25 min (with speaker on) 26 min (with speaker off) Mavic 2 Enterprise Spotlight This new DJI M2E has a strong dual spotlight with a brightness of 2,400 lumens to assist operators in carrying out missions in dark or low light areas. The spotlight is ideal for search and rescue as well as inspection applications. This M2E dual spotlight assists greatly in the search for missing persons in low light or night time searches. It will also allow for proper visual inspections, where structures have low light or in bad lighting conditions. Mavic 2 Enterprise Speaker The M2E has a loudspeaker with a maximum projection of 100 decibels 3.2 feet (1 meter) distance and lets pilots play up to 10 custom voice recordings on-demand, providing a communications channel to nearby individuals, which can be critical during lifesaving emergency operations. Mavic 2 Enterprise Beacon Designed with U.S. Federal Aviation Administration (FAA) night waiver standards in mind, the M2E Beacon features a bright flashing strobe, which is visible 3 miles (4 km) away. This helps pilots carry out missions in low light conditions or in the night much more safely. It provides additional airspace awareness for operators of other drones nearby and traditional aircraft. www.dronezon.com

Example of a Mission Plan (Table 2)

(Updated August 1, 2021)

Agency this data is for – Skyland Fire Rescue
Agency flying this data – Skyland Fire Rescue
Call Sign - Fire Drone One
Aircraft Registration Tail Number - FWER6TH
Flight Location – 103 Paper Birch Ave Pisgah Forest, NC
Closest FAA ATC and telephone number - AVL 828 275 3333
Law Enforcement Emergency Contact Information? 911

1. **Mission**
    a. **Type of Mission** Search and Rescue
    b. **Overview to the flight crew** – Search and Rescue for a missing 83 year old female with dementia. PLS 103 Paper Birch Ave.
    c. **Was the Mission reviewed, understood, shared and communicated with the flight crew?** Yes or No?
    d. **Can the RPIC Support the Mission Plan?** Yes or No?
    e. **Hazards unique to this flight?** Power Lines and Trees
2. **Desired Outcome** – Find the lost subject and return them back alive to their family
3. **Operational Environment**
    a. **Perimeter** – 100-acre area.
    b. **Alerts** - Trees, Power lines, and 1 building within the fight operational area
    c. **Proximity to an airport** – Just touching the 5 NM ring of the Asheville airport.
    d. **Altitude to be flown** – 200’ AGL **RTH Set?** Yes or No? **AGL** 200’
    e. **Control Location** – close to take-off location in SE corner of the field.
4. **Capabilities and Resources**
    a. **RPIC** – John R. Smith
    b. **Visual Observe**r - Sam Smith
    c. **Data Analyst** - Mark Smith
    d. **Aircraft** – Trimble UX5
5. **Landowner Permission Approvals** – Land usage permission from Forest Service LEO.
6. **Mission Plan**
    a. **Flight Plan**
        i. **Area of interest drawn on the flight computer or note pad?** - Yes or No?
        ii. **Winds -** from 250 degrees.
        iii. **Take-off and landing?** In the wind? Yes or No?
        iv. **Planned Flight Time** – 30 mins with 45 legs
        v. **Emergency landing planned?** Yes or No? **Low Battery Warnings set?** Yes or No **Contingency procedure for flyaways?** Yes or No? **Lost Link Procedure discussed?** Yes or No?
    b. **Security Plan**
        i. **PIC area secure?** Yes or No?
        ii. **Site manager present to secure flight operations area?** Yes or No?
        iii. **Any additional attendees expected?** Yes or No?
    c. **Data Plan**
        i. **SD card required?** Yes or No? If yes, how many? 1
        ii. **SD card reader and Laptop required?** Yes or No?
        iii. **Data processing using** Laptop
    d. **Schedule** – NOTAM and permission obtained 2 days to 2 weeks prior if possible
        i. **Crew arrival** Time – 9:45 am
        ii. **Setup Time** – 30 mins
        iii. **Flight Launch Time** – 10:15 am
        iv. **Recover** – 10:47 am
        v. **Estimated Departure time** – 12:00 pm
    e. **Radio Frequency**
        i. **Crew** - Channel 1
        ii. **Local Airport CTAF -** 121.100

Mission Reported Completed by: Herman Swortz **Date:** July 28, 2021

Lesson Two: Prepare the sUAS Operation

5.3.1.2
Prepare the sUAS operation given a mission plan and resources, so that the sUAS is operated by confirming a state of readiness, configuration, and operational functions are checked and verified as operational.

(A) Requisite Knowledge:

1) Knowledge of procedures and information needed to identify, configure, and check systems.

(B) Requisite Skill:

1) The ability to identify, assemble, configure, and verify the operational functionality of sUAS.

Terminal Objective
The sUAS RPIC shall prepare a mission plan, use available resources, and confirm a state of readiness by verifying the sUAS is assembled, configured, and verified as operational.

Enabling Objectives

1. The sUAS Pilot shall confirm the UAS is assembled and configured correctly.
2. The sUAS Pilot shall confirm the UAV is checked to be operational.
3. The RPIC shall be familiar with how the UAV flight software and systems work.
4. The RPIC shall know how to load a UAV with an external load.
5. The RPIC shall know the current weather conditions and other environmental conditions that may hamper the flight.
6. The RPIC shall only fly in approved FAA airspace.
7. The RPIC shall meet FAA Part 107 requirements.

Motivation
In this lesson plan, it's important to start out the mission using all available resources needed and confirm the sUAS's ground station and software are running to ensure a successful mission. Using a checklist instead of memory is used by pilots flying small to jumbo-jet planes and the pilot for an sUAS is no different.

ENABLING OBJECTIVE 1
The sUAS Pilot shall confirm the sUAS is assembled and configured correctly.

1. The sUAS pilot does a systems check to ensure the sUAS is ready to fly
    a. Props have been securely attached
    b. Payloads have been securely attached
    c. SD card has been formatted and installed
2. Verify the components are attached or have been taken off prior to flight
    a. Camera guard has been removed
    b. Strobes are attached and operational
    c. Verify the servo motors (if applicable) is working properly
    d. Extra batteries are operational
3. Verifying proper firmware and maps loaded for flight at mission location is necessary using your phone, GPS, or other methods available to you.* For most maps to come up in the UAS controller, you need the internet or hotspot to download them to use in the background.*
    a. Firmware updates can pop up without notice. It's important that this is checked regularly if this drone is being used in life or death situations.*
4. Compass or Magnetometer (IMU) calibration on-site is necessary to confirm before every flight.*

ENABLING OBJECTIVE 2

The sUAS Pilot shall confirm the UAV is checked to be operational.

1. Confirm the sUAS is operational
    a. Turn on the ground control box, screen, and sUAS
    b. Verify the antenna(s) are attached. Make sure the side of the antenna is facing the sUAS and not pointing at the sUAS
    c. Verify you have at least five (5) satellites on the screen
    d. Verify the Firmware is updated and flight software is updated
    e. Inspect the condition and airframe of the sUAS
    f. Verify the ground control and sUAV battery are at least a minimum of 75% charge *
2. **The Remote Pilot in Charge needs to ensure flight plans (if being utilized) are loaded correctly prior to the flight.**
    a. When you arrive, check to make sure your flight data has been loaded correctly
    b. Preparation is always a good trait
    c. Verify your HotSpot (internet) has a good signal for any unexpectant firmware updates.
3. A Minimum number of GPS satellites required for a position lock is five.* This is an industry-standard. If you only had four and lost one, you could lose the ability to triangulate and a flyaway is possible.* DJI systems commonly require 6 before it will confirm a lock for the takeoff position.
    a. Review the different sUAS used in public Safety
    b. Express how important it is to be familiar with the sUAS before performing a mission
4. The RPIC shall be knowledgeable about a Vertical take-off and landing (VTOL), Fixed Wing, and Rotary sUAS.
    a. VTOL aircraft that can hover, take off, and land vertically
    b. A Fixed Wing sUAS needs an extended take-off and landing area, much like a land strip
    c. A Rotary aircraft has the ability to take off straight up and land straight down

    ***Note**: All of the above can be flown manually or via autonomous modes. **
5. The RPIC should pre-configure in the sUAS before each flight and location for the following
    a. The GPS
    b. The communication devices
    c. Return-Home minimum altitude

ENABLING OBJECTIVE 3

The RPIC shall be familiar with how the UAV flight software and systems work.

1. The sUAS Pilot should have prior knowledge of UAS software and flight systems
    a. The pilot should have knowledge of
        i. Location of the sUAS at all times
        ii. Altitude
        iii. Speed
        iv. Video and camera functions
        v. Know how to obtain Latitude & Longitude coordinates
        vi. Mapping https://www.pix4d.com/rapid-tactical-mapping-webinar-recording for PIX4D React
        vii. How many satellites are being received
        viii. Battery life on the drone and ground control
2. The system signal between the controller and the UAS is important. In an urban area, your signal may be blocked by buildings and wireless signals interference in heavily populated subdivisions or apartment complexes. In rural areas, your signal may be stronger if you have rolling hills and no obstacles blocking the signal.
3. It's essential to ensure the aircraft and ground flight controller systems are properly linked before takeoff using your flight control input. This can be done by
    a. Rolling the UAS left and right
    b. Fly forward and reverse
    c. Flying a left and right yaw

ENABLING OBJECTIVE 4

The RPIC shall know how to load a UAV with an external load.

1. When loading an sUAS, make sure the weight is distributed evenly.
    a. It's important to know how to change out cameras if applicable
    b. Know the law of gravity when hooking external loads such as;
        i. Life jackets attached via webbing
        ii. Loudspeakers
        iii. External lights
2. Automatic and Manual camera settings can be determined and changed during the flight
3. Ensuring proper camera settings for data capture is necessary when collecting the correct data
    a. ISO
    b. Shutter Speed
    c. Angle

ENABLING OBJECTIVE 5

The RPIC shall know the current weather conditions and other environmental conditions that may hamper the flight.

1. Prior to flight, it's important to check the weather from an official source such as the National Weather Service using METARS.
    a. Know your limits on when not to fly such as:
        i. Fog or low hanging clouds and adhering to the 500' below clouds minimum
        ii. Snow
        iii. Rain
2. Monitoring lighting conditions for flights near dusk and dawn is extremely important.
3. Maintaining situational awareness in a dynamic environment
    a. can often be better achieved with a VO
    b. is critical to the safety of all aircraft in the operation area
    c. is one of the more important jobs as the RPIC
4. The RPIC should monitor the weather as it changes when flying at a site for a while to
    a. help the pilot in command recognize weather fronts that may be coming into the location
    b. ensure there are no bad surprises on the horizon
    c. ensure the safety of the flight

ENABLING OBJECTIVE 6

The RPIC shall only fly in approved FAA airspace.

1. The sUAS pilot can only fly in Class G Airspace unless pre-approved by the FAA
    a. Operations in Class G airspace are allowed without air traffic control permission
    b. Operations in Class B, C, D, and E airspace need ATC approval

ENABLING OBJECTIVE 7

The RPIC shall meet FAA Part 107 requirements.

1. The requirements for meeting FAA Part 107 can be found here:
    a. Operating Requirements. The sUAS operator manipulating the controls of a drone should always avoid manned aircraft and never operate in a careless or reckless manner. You must keep your drone within sight. Alternatively, if you use First Person View or similar technology, you must have a VO to always keep your aircraft within unaided sight (for example, no binoculars). However, even if you use a VO, you must still keep your unmanned aircraft close enough to be able to see it if something unexpected happens. Neither you nor a VO can be responsible for more than one unmanned aircraft operation at a time
    b. You can fly during daylight or in twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting *
    c. c. Minimum weather visibility is three statue miles from your control station per Part 107.51

d. The maximum allowable altitude is 400 feet above the ground, and higher if your drone remains within 400 feet of a structure *
e. The maximum speed is 100 mph (87 knots)*
f. You can't fly an sUAS over anyone who is not directly participating in the operation, not under a covered structure, or not inside a covered stationary vehicle. No operations from a moving vehicle are allowed unless you are flying over a sparsely populated area
g. You can carry an external load if it is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. You also may transport property for compensation or hire within state boundaries provided the drone – including its attached systems, payload, and cargo – weighs less than 55 pounds total and you obey the other flight rules. (Some exceptions apply to Hawaii and the District of Columbia. These are spelled out in Part 107.)
h. You can request a waiver of most operational restrictions if you can show that your proposed operation can be conducted safely under a waiver. The FAA will make an online portal available to apply for such waivers. Details are found here https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20516
i. Maintain VLOS given an sUAS in flight along a designated flight path under the regulatory requirements as determined by the AHJ, so that the sUAS is maneuvered in a manner that avoids obstacles and reaches targeted locations and altitudes without losing line of sight of the sUAS in accordance with the approved operational flight plan

Lesson Three: Take Off

5.3.2.1
Perform take-off under the regulatory requirements as determined by the AHJ given a specific sUAS and confirmed state of readiness, so that the sUAS takes off after having completed systems checks and flight is initiated and maintained in a manner compliant with regulatory requirements.

(A) Requisite Knowledge:

1) Knowledge of the aircraft, systems, payload, and changes in the environmental conditions, weather, and regulatory requirements relating to the use and operating of sUAS.

(B) Requisite Skill:

1) The ability to operate the specific sUAS and maintain control in a safe manner during this phase of flight.

Terminal Objective
The UAS Remote Pilot in Command shall perform take-off under the regulatory requirements as determined by the AHJ given a specific sUAS, confirmed state of readiness, complete a systems check and flight is initiated and maintained in a manner compliant with regulatory requirements.

Enabling Objectives

1. The Remote Pilot in Command shall have knowledge about the UAV performing the mission.
2. The Remote Pilot in Command shall be familiar with how the UAV flight software and system works.
3. The Remote Pilot in Command shall know how to load a UAV with an external load.
4. The Remote Pilot in Command shall know the current weather conditions and other environmental conditions that may hamper the flight.
5. The Remote Pilot in Command shall only fly in approved FAA airspace.
6. The Remote Pilot in Command shall meet FAA Part 107 requirements.

Motivation
The pilot should know how to operate and fly the UAV prior to it being flown. You wouldn't expect a pilot that's only flown a Cessna 152 to fly a Boeing 737 without time at the controls and hours in the cockpit.

ENABLING OBJECTIVE 1
The Remote Pilot in Command shall have knowledge about the UAV performing the mission.

1. The sUAS Pilot should have prior knowledge and experience with the sUAV they are flying prior to a mission.
    a. Review the different sUAS used in public Safety.
    b. Express how important it is to be familiar with the sUAS before performing a mission.
2. There are numerous types of sUAS
    a. VTOL aircraft with manual and autonomous flight
    b. Quadcopter aircraft with manual and autonomous flight
3. The RPIC should know how to pre-configure the GPS, the communication device and return-home minimum altitude in the sUAS before flight at each location.*

ENABLING OBJECTIVE 2
The Remote Pilot in Command shall be familiar with how the UAV flight software and system works.

1. The sUAS Pilot should have prior knowledge in UAS software and flight systems.
    a. The pilot should have knowledge of:
        i. Location of the sUAS at all times
2. The controller signal in urban areas is <u>not</u> always good due to the number of wi-fis you may find in a high housing development.
    a. Altitude
    b. Speed

   c. Video and camera functions
   d. Know how to obtain Latitude Long coordinates
   e. Mapping
   f. How many satellites are being used? See Manufacturer Recommendations
   g. Battery life on the drone and ground control
3. Make sure the aircraft and ground flight controller systems are properly linked before taking off. This is important, so you will have control of the aircraft using your flight controls. You may have issues when flying in urban areas due to the extensive use of WI-Fi in the neighborhood.*

ENABLING OBJECTIVE 3

The Remote Pilot in Command shall know how to load a UAV with an external load.

1. When loading a sUAS, make sure the weight is distributed evenly.
   a. It's important to know how to change out cameras if applicable.
   b. Know the law of gravity when hooking external loads such as;
2. Life jackets attached via webbing
3. Loud speakers
4. External lights
5. Familiarity with how to switch between autonomous and manual flight modes is necessary because the UAS will not do this on its own. You may do this during flight, however, it's important you ensure the proper settings are set for data capture to make sure you collect the correct data.*
6. A reminder, Automatic and Manual camera settings can be determined and changed during the flight*

ENABLING OBJECTIVE 4

The Remote Pilot in Command shall know the current weather conditions and other environmental conditions that may hamper the flight.

1. **Prior to flight, it's important to check the weather from an official source such as the National Weather Service using METARS.**
   a. Know your limits on when not to fly such as;
   b. Fog or low hanging clouds and adhering to the 500' below clouds, 2,000' horizontal and 3 mile visibility as a minimum per FAA rules *
   c. Snow
   d. Rain
2. Monitoring sky conditions for flights near dusk and dawn is extremely important. The Remote Pilot In Charge should be doing all of the following
   a. Be sensitive to the change in light
   b. Adapt eyes for the change in light
   c. Strobes should be operating for other aircraft to see
3. **Maintaining situational awareness in a dynamic environment, the Remote Pilot In Charge should do all the following. ***
   a. Use Visual Observer(s)*
   b. Look 5-10 degrees off center for other aircraft*
   c. Keeping the conversation focused on the mission with others.*
4. The weather should be monitored by the RPIC as it could change when flying on a job site. The RPIC should
   a. Visually monitor weather fronts that may be coming into the area*
   b. To ensure there are no bad surprises on the horizon *
   c. To ensure the safety of the flight, including the crew *
   d. Review Metars for immediate weather forecast*
   e. ATIS*
   f. Review TAFs for 24-30 hour weather forecast*
   g. Monitor National Weather Service and or 1800wxbrief.com*

ENABLING OBJECTIVE 5

The Remote Pilot in Command shall only fly in approved FAA airspace.

1. The sUAS Pilot can only fly in Class G Airspace unless pre-approved by FAA
    a. Operations in Class G airspace are allowed without air traffic control permission.
    b. Operations in Class B, C, D and E airspace need ATC approval.

ENABLING OBJECTIVE 6

The Remote Pilot in Command shall meet FAA Part 107 requirements.

1. The requirements for meeting FAA Part 107 can be found here;
    a. Operating Requirements. The small UAS operator manipulating the controls of a drone should always avoid manned aircraft and never operate in a careless or reckless manner. You must keep your drone within sight. Alternatively, if you use First Person View or similar technology, you must have a visual observer always keep your aircraft within unaided sight (for example, no binoculars). However, even if you use a visual observer, you must still keep your unmanned aircraft close enough to be able to see it if something unexpected happens. Neither you nor a visual observer can be responsible for more than one unmanned aircraft operation at a time.
    b. You can fly in twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting. Minimum weather visibility is three miles from your control station. The maximum allowable altitude is 400 feet above the ground, and higher if your drone remains within 400 feet of a structure. The maximum speed is 100 mph (87 knots). *
    c. Flying a small sUAS only over those participating in the operation*
    d. From a moving vehicle in a sparsely populated area.*
    e. Flying over people in a covered structure.
    f. You can carry an external load if it is securely attached and does not adversely affect the flight characteristics or controllability of the aircraft. You also may transport property for compensation or hire within state boundaries provided the drone – including its attached systems, and payloads – weighs less than 55 pounds total and you obey the other flight rules. (Some exceptions apply to Hawaii and the District of Columbia. These are spelled out in Part 107)*
    g. Under Part 107, the maximum speed allowed by the FAA to fly a sUAS outdoors in the National Air Space is 100 MPH. There are times you may see speeds in excess of the limit, however, they may be flying indoors or have a waiver from the FAA.*
    h. You can request a waiver of most operational restrictions if you can show that your proposed operation can be conducted safely under a waiver. The FAA will make an online portal available to apply for such waivers. Details are found here https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=20516
    i. To stay in compliant with regulatory requirements, minimum weather visibility in the Class G Airspace is three (3) miles *

Lesson 4: Maintain visual line of sight of the sUAS

5.3.2.2
Maintain visual line of sight of the sUAS given an sUAS in flight along a designated flight along a designed flight path under the regulatory requirements as determined by the AHJ, so that the sUAS is maneuvered in a manner that avoids obstacles and reaches targeted locations and altitudes without losing line of sight of the sUAS in accordance with the approved operation flight plan.

(A) Requisite Knowledge:
1) Knowledge of regulatory requirements, capabilities and operational controls of the specific sUAS.

(B) Requisite Skill:
1) The ability to operate the specific sUASand maintain control in a safe manner during this phase of flight.

Terminal Objective
The RPIC shall maintain a line of sight of the sUAS per the regulatory agency, verbally communicate any obstacles in the designated flight path to the Remote Pilot in Command, so time is allowed for correction action.

Enabling Objectives
1. The RPIC shall maintain a line of sight of the sUAS at all times
2. The RPIC shall identify obstacles along the flight path and verbally notify the RPIC so the obstacle may be avoided
3. The RPIC shall reach the target locations and altitudes without losing line of sight of the sUAS

Motivation
In any flight, it's always best to have several eyes in the air and assist with the flight. While the FAA does not require a VO to be in place, it's highly recommended you have at least one observer assisting in the flight.

ENABLING OBJECTIVE 1
The RPIC shall maintain a line of sight of the sUAS at all times.

1. The RPIC shall have the aircraft in the line of sight
    a. and May serve as a the RPIC and Visual Observer (VO)*
    b. Eyeglasses or contacts may be used in tracking the aircraft *
    c. VO may be used *
        i. The VO must have verbal contact with the Pilot in Command

    ***Note**: Binoculars can be used in case the aircraft is lost, however, they cannot be used to maintain control during the mission.*
2. Part 107 regulations dictate that a certified RPIC handing off of controls during flight to a non certified pilot:
    a. Has to stay with the non certified pilot in case they have to take over the controls.*

ENABLING OBJECTIVE 2
The RPIC shall identify obstacles along the flight path and verbally notify the RPIC so the obstacle may be avoided.

1. Avoiding obstacles
    a. The RPIC shall avoid all obstacles
    b. Be watchful over the sUAS to ensure it avoids trees and powerlines *
    c. If the RPIC is not adhering to the FAA rules, the VO shall alert them they are operating outside of the requirements *
    d. The RPIC may direct VOs to view television screens in assisting in searching and achieving the objectives in the mission is highly recommended *
    e. The RPIC shall be watchful flying close to cell phone towers and radio towers due to high wattage emitting and guidewires attached holding up the structure and bird nesting in these structures could be a hazard to the sUAS *

2. The sUAS capabilities, functions and feature familiarization in training is needed prior to a mission flight. A way to do this is;
    a. Fly the sUAS and see how responsive or unresponsive the aircraft will act*
    b. Understand the reaction time when a command of “Stop” is given by a VO if used
    c. Understand how the weather may be a factor for different sUAS
3. Aircraft flight limitations and capability published by the Original Equipment Manufacturer (OEM) Operating procedures are for the safe operation of the aircraft

    The RPIC should show the speed capabilities of the drone they are monitoring such as ascent and descent.
    An example here is the DJI Mavic Pro sUAS. Its max Ascent Speed is 4 m/s (P-mode) and 5 m/s (S-mode). The Max Descent Speed 3 m/s (S-mode) and 3 m/s (P-mode)*
    a. If the RPIC needs to climb or descend to avoid another aircraft, It may be better to ascend in Sports Mode at 5 meters per second to avoid the hazard.

    Metric to Imperial Conversion:
    - 3 meters per second is 6.71081 mph
    - 4 meters per second is 8.94775 mph
    - 5 meters per second is 11.1847 mph

    ***Note**: Each student should know the capabilities of the sUAS in the AHJ. Recommendation. Take time in class for each student to look up their own sUAS as a class application.*

4. The RPIC shall reach the target locations and altitudes without losing line of sight of the sUAS.
    a. The RPIC shall reach the intended target location noted in the Mission Plan
    b. The RPIC shall maintain the altitude noted in the Mission Plan
    c. The RPIC shall maintain a Visual Line of Site at all times while performing the flight

ENABLING OBJECTIVE 3
The RPIC shall reach the target locations and altitudes without losing line of sight of the sUAS

1. Flight controls
    a. To reach the target location, you must know how the flight controls affect the aircraft. When the aircraft camera is facing the operator, Left is right and right is left as the aircraft face the pilot in charge
    b. Familiarity of how to switch between autonomous and manual flight modes is necessary because the UAS will not do this on its own. *
    c. The RPIC / VO must maintain VLOS the entire time. If the sUIAS is lost, the RPIC must start the return home until the aircraft is located.

Lesson 5: Perform Aerial Maneuvers

5.3.2.3*
Perform aerial maneuvers given an sUAS in flight within designated airspace under the regulatory requirements as determined by the AHJ, so that operator demonstrates positive aircraft control in accordance with the approved operational flight plan.

(A) Requisite Knowledge:
1) Knowledge of regulatory requirements, 2) capabilities, and 3) operational controls of the specific sUAS.

(B) Requisite Skill:
1) The ability to operate the specific sUAS, activate different sUAS functions and maintain control in a safe manner during this phase of flight.

Terminal Objective
The RPIC shall perform aerial maneuvers within designated airspace approved by the FAA to determine positive aircraft control in accordance with the approved operation flight plan.

Enabling objectives
1. The RPIC shall demonstrate positive aircraft control by performing aerial maneuvers within designated airspace.
2. The RPIC shall have knowledge of regulatory requirements that may restrict the flight plan when demonstrating aerial maneuvers.
3. The RPIC shall have knowledge, capabilities, functions, and operational control of the specific sUAS while performing aerial maneuvers.

Motivation
The pilot shall have control of the sUAS at all times when performing aerial maneuvers and flying in airspace controlled by the FAA. By not having control of the UAS, could lead to damage to the UAS, personnel, bodily injury, and fatal circumstances to manned aircraft in the area.

ENABLING OBJECTIVE 1
The RPIC shall demonstrate positive aircraft control by performing aerial maneuvers within designated airspace.

1. The pilot shall perform the following maneuvers in designated airspace
    a. Fly to 400’ and hover
    b. Fly at least 500’ from the landing zone and return back
    c. Fly a 100’ circle 300’ above the landing zone

ENABLING OBJECTIVE 2
The RPIC shall have knowledge of regulatory requirements that may restrict the flight plan when demonstrating aerial maneuvers.

1. The pilot shall know the airspace restrictions
    a. Ceiling of 400’ AGL and flying a visual line of sight.*
    b. Operations in Class B, C, D, and Class E surface area flights are allowed with ATC approval. Operations in Class G airspace are allowed without ATC permission *
    c. Small unmanned aircraft may not operate over any persons not directly participating in the operation, not under a covered structure, and not inside a covered stationary vehicle
    d. Daylight-only operations or civil twilight (30 minutes before official sunrise to 30 minutes after official sunset, local time) with appropriate anti-collision lighting
    e. Must yield the right-of-way to other aircraft *
    f. May use Visual Observer (VO) but not required

g. Maximum groundspeed of 100 mph (87 knots) *
h. Maximum altitude of 400 feet above ground level (AGL) or, within 400 feet of a structure, 400 feet above that structure
i. Minimum weather visibility of 3 miles from control station and must remain 500 feet from clouds (no ceiling requirement)
j. sUAS cannot be operated from a moving manned aircraft while flying *
k. sUAS cannot be operated from a moving vehicle unless the operation is over a sparsely populated area
l. No careless or reckless operations
m. No carriage of hazardous materials

ENABLING OBJECTIVE 3

The RPIC shall have knowledge, capabilities, functions, and operational control of the specific sUAS while performing aerial maneuvers.

1. The pilot shall have the knowledge of the sUAS they are flying while performing maneuvers
    a. The pilot shall have the knowledge of the sUAS owned and or operated by the AHJ
    b. The pilot shall know the capabilities of the sUAS owned and or operated by the AHJ based on the manufacturer guidelines *
    c. The pilot shall know the software functions of the sUAS owned and or operated by the AHJ
    d. The pilot shall know how to operate the sUAS owned and or operated by the AHJ

Lesson 6: Payload Procedures

5.3.2.4
Perform payload functionality given an sUAS in flight within designated airspace under the regulatory requirements as determined by the AHJ, so that the sUAS is maneuvered in a manner that avoids obstacles and demonstrates payload drop, payload application, or data acquisition at targeted locations in accordance with the mission plan.

(A) Requisite Knowledge:
1) Knowledge of mission plan, objectives, regulatory requirements, capabilities, operation of payload functions, and operational controls of the specific sUAS.

(B) Requisite Skill:
1) The ability to operate the specific sUAS, activate different payload functions and maintain control in a safe manner during this phase of flight.

Terminal Objective
The RPIC shall use the mission plan to fly and drop a payload while avoiding obstacles within designated airspace and demonstrates the ability to collect data at the target location.

Enabling Objectives
1. The RPIC shall fly a payload given an sUAS using a mission plan.
2. The RPIC shall drop a payload in a controlled manner.
3. The RPIC shall avoid obstacles in designated airspace while flying and dropping a payload.
4. The RPIC shall demonstrate the capabilities of the sUAS in the collection of data at target locations such as video and or photos while performing payload functions.

Motivation
When flying with different payloads, you need to know how this will affect your aircraft. Knowing the aircraft's center of gravity and weight limits will be very important when you load your aircraft. If you overload it, you may not be able to take-off or your battery life will be greatly reduced. If you load it from one side and you make a turn, gravity may pull your aircraft down.

ENABLING OBJECTIVE 1
The RPIC shall fly a payload given a UAS using a mission plan.

1. When flying your payload, make sure
    a. The payload is secure *
    b. The payload is not too one-sided that may cause the aircraft to crash *
    c. Don’t make quick sharp turns
    d. Don’t raise or lower the drone in a quick manner
    e. Keep a watch on your battery supply *
    f. Follow your mission plan, so;*
        i. The sUAS completes its mission *
        ii. No regulatory airspace is encroached *
        iii. Radio communication is maintained *
        iv. Always keep the sUAS in a visual line of sight (VLOS)*
    g. Avoid flying over prisons *
    h. Avoid flying over schools *
    i. Avoid flying over hospitals *
2. Using payload functions while in flight while doing searches, rescues, the camera could capture;
    a. Video *
    b. Photographs *

   c. Infrared (IR) (FLIR) videos and photos. This payload measures heat on the ground and on surfaces *
3. Other payloads could be used to;
   a. Fly Crops using color spectral analysis payloads
   b. 2D and 3D mapping using LIDAR
   c. Using RGB payloads, you can use software like Aloft, BitBot and Pix4D to map 2D and 3D as well

ENABLING OBJECTIVE 2
The RPIC shall drop a payload in a controlled manner adhering to regulatory requirements.

1. When you drop a payload from an sUAS
   a. Make sure if your target is a human, loads are not dropped directly onto the patient due to injuries that may occur
   b. Have knowledge of the mission plan, so you will have knowledge of the best route and drop point
   c. Best method is not to drop it. Haul it directly to the site where someone is on the ground to receive it
   d. Using a sling load method is the best method
   e. Always keep your sUAS and payload in a VLOS *
   f. Never fly over prisons and drop off payloads such as cell phones or drugs. In 2023, The Federal Aviation Administration (FAA) issued no-fly areas over many Federal Bureau of Prisons (BOP) facilities. By doing this, You will be fined and or could serve prison time in some states *

Application: Demonstrate in the classroom the webbing and magnet method and off-center load effect.

ENABLING OBJECTIVE 3
The RPIC shall avoid obstacles in designated airspace while flying and dropping a payload.

1. When looking for a suitable place to drop your payload, you should consider
   a. Make sure your drop point is clear of any electrical wires, trees, or other obstacles that may cause the payload not to hit its target
   b. Make sure humans are clear of the drop area except for someone that may be directly involved in the drop
   c. Proper PPE should be worn by ground personnel

ENABLING OBJECTIVE 4
The RPIC shall demonstrate the capabilities of the sUAS in the collection of data at target locations such as video and or photos while performing payload functions.

1. When you do a payload drop during a mission, you should
   a. Note a latitude-longitude coordinate of the drop
   b. Note a landmark close by if directions are needed
   c. Follow your policy on how to transmit and store this data8
2. When an sUAS performs a flight with different payload capabilities, they may <u>not</u>;
   a. drop leaflets over people during political rallies
   b. map prisons without permission since they do not own the airspace above the facility
   c. be able to drop money over crowded ball game stadiums for marketing purposes
3. When an sUAS performs a flight with different payload capabilities, they may;
   a. Map agriculture *
   b. Map mudslides *
   c. Map floods *
   d. Map in Class G airspace *
   e. Cell phone towers
   f. Transmission towers
   g. Distribution poles

4. When performing payload functionality while in flight, the operational controls usually allow the sUAS to;
    a. Perform orbit turns *
    b. Fly a certain track without rolling left or right *
    c. Follow and track a moving subject *
    d. Hover

Lesson 7: Pre-Landing Procedures

5.3.2.5
Perform pre-landing procedures given an sUAS in flight within designated airspace under the regulatory requirements as determined by the AHJ, so that the sUAS is maneuvered in a manner that avoids obstacles while reaching a clear landing area, establishes a configuration for landing, and confirms a decent path free of obstructions.

(A) Requisite Knowledge:
1) Knowledge of aircraft, systems, payload, and the effects of changes in environmental conditions, weather, and airspace requirements for the specific sUAS.

(B) Requisite Skill:
2) The ability to operate the specific sUAS and maintain control in a safe manner during this phase of flight.

Terminal Objective
The RPIC shall perform pre-landing procedures, takeoffs, and landings using sUAS in designated airspace under the local airspace requirements while avoiding obstacles when landing.

Enabling Objectives
1. The RPIC shall have knowledge of different sUAS aircraft and RTH systems.
2. The RPIC shall have knowledge of weather and payloads that may affect the launching of sUAS.
3. The RPIC shall have knowledge of weather and payloads that may affect the pre-landing of sUAS
4. The RPIC shall have knowledge of the aircraft systems when pre-landing of the sUAS.

Motivation
As a pilot, you should only fly an sUAS that you are familiar with. The take-offs and landing will vary with each different sUAS. This knowledge shall be obtained when in a training mode and not on a real mission.

ENABLING OBJECTIVE 1
The RPIC shall have knowledge of different sUAS aircraft.

1. The pilot will be exposed to the current sUAS on the market. Some of those may be however not limited to:
    a. DJI Spark Drone
    b. Autel Robotics X-Star Premium Drone
    c. Yuneec Q500 4K Typhoon Drone
    d. DJI Phantom 3 Drone
    e. PowerVision Robot 4K Drone
    f. DJI Phantom 4 Drone
    g. DJI Mavic Pro Drone
    h. DJI Inspire 1 PRO ZENMUSE X5 Drone
    i. DJI Inspire 2 Drone
    j. For detailed information about each of the above UAS, go to http://www.top10drone.com
2. A system available on most sUAS to a RPIC when doing a pre-landing is:
    a. Return to home that's built into the system. You may use this method to return the sUAS back to the controller or to the takeoff area. If you take off from a boat and request the sUAS to return back to the takeoff area, the aircraft may get wet if the boat moved from the original location
    b. Be sure to set the return home to an altitude of at least 50 feet higher than any obstacles between the RPIC and airborne sUAS*
    c. Most sUAS automatically set the return home location back to the LZ

***Note**: This list is from 2018. As technology advances, this list will become obsolete. It will be necessary to update this list at least annually.*

ENABLING OBJECTIVE 2

The RPIC shall have knowledge of weather and payloads that may affect the launching and landing of sUAS.

1. The pilot shall know the different payloads for sUAS.
    a. Thermal Imaging
    b. Zoom Cameras
    c. Life jackets
    d. First Aid Kits
    e. Life-lines
    f. Loudspeaker
    g. Water
    h. Blankets
    i. Two-way radio
    j. Spotlights
    k. sUAS device locator
2. While performing launching pre-landing procedures with different payloads in different environmental conditions, the RPIC will need to visually check the wind and directions prior to landing *
3. While performing launching and pre-landing procedures with different payloads in different environmental conditions, the RPIC should *
    a. Avoid moving cars *
    b. Avoid power lines *
    c. Avoid crowded areas *
4. When launching and landing your sUAS, the winds may vary at different levels in the atmosphere causing your sUAS to drift.*
5. On a high humidity day, the RPIC should consider Density Altitude when landing the sUAS and this may cause the sUAS to perform sluggish.*

ENABLING OBJECTIVE 3

The RPIC shall have knowledge of weather and payloads that may affect the pre-landing of sUAS.

1. The pilot shall have knowledge of the weather at different levels in the atmosphere.
    a. Wind speeds in the atmosphere above the landing zone.

ENABLING OBJECTIVE 4

The RPIC shall have knowledge of the aircraft systems when pre-landing the sUAS.

1. The pilot shall knowledge a pre-landing of a specific sUAS
    a. When landing, the pilot shall stop 1-3 feet above the ground and allow downdraft from the sUAS to settle down *
    b. Rolling left or right just before landing can provide clean air
    c. Can land autonomously*
        i. While performing pre-landing procedures, the RPIC needs knowledge of the aircraft system allowing the pilot to hit “Return to Home" and fly back and land at the original take-off area
    d. Recognizes obstructions using obstacle avoidance systems *
    e. Can be landed manually *
2. When performing a pre-landing checklist, the RPIC should check the airspace to ensure the following;
    a. You are not flying over prisons when returning “Home” *
    b. Not flying over schools *
    c. Not flying over HELO (helicopter) LZs (landing zones) *
3. While performing pre-landing procedures, the RPIC shall stay away from clouds using the following; 500 feet vertical and 2,000 feet horizontal
    a. In class G airspace, you shall keep 3-mile visibility
    b. In other regulated airspaces, you must keep 3-mile visibility

Lesson 8: Landing Procedures

5.3.2.6
Perform a landing given an sUAS in flight within designated airspace under the regulatory requirements as determined by the AHJ and having completed pre-landing procedures, so that the sUAS is maneuvered in a manner that avoids obstacles and is able to touch down at a clear landing area and ceases operational functions without any damage to the sUAS.

(A) Requisite Knowledge:

1) Knowledge of small unmanned aircraft, systems, payload, and the effects of changes in environmental conditions, weather, and regulatory requirements for the specific sUAS.

(B) Requisite Skill:

2) The ability to operate the specific sUAS and maintain control in a safe manner during this phase of flight.

Terminal Objective
The RPIC shall perform a landing in designated airspace under the local regulatory requirements, avoiding damage while landing and terminate the operation of the sUAS.

ENABLING OBJECTIVES

1. The RPIC shall have knowledge of sUAS performance while landing.
2. The RPIC shall have knowledge of obstacles that may limit the safe landing of an sUAS.
3. The RPIC shall have knowledge of weather conditions when landing an sUAS.
4. The RPIC shall have knowledge of regulatory requirements for landing sUAS.
5. The RPIC shall demonstrate the landing of an sUAS.

Motivation
A successful career in aviation is very simply determined by counting the number of takeoffs and landings. If they match, you were successful.

ENABLING OBJECTIVE 1
The RPIC shall have knowledge of sUAS performance while landing.

1. The pilot shall have the knowledge of landing speed capability while landing.
    a. The pilot shall have knowledge of the landing speed without a payload
    b. The pilot shall consider the weight of the payload while landing
2. While performing landing procedures, the RPIC shall know the sUAS
    a. Could land autonomously from 0 - 400 feet AGL*
    b. Has sensors to land without crashing*
    c. Has room to land without interruption to the public*
3. When landing the sUAS, it's important that the RPIC *
    a. Knows the home location *
    b. Set the correct altitude to clear any obstructions when returning home autonomously *
    c. Not be distracted *
4. When the RPIC is landing the sUAS, they should use the following and knowledge to safely land *
    a. Use the altitude number in the controller to know how far the sUAS is off the ground *
    b. Use the Picture in a Picture (Map) to locate the sUAS to land safely *
    c. Use the "distance away" to know how far the sUAS is from the LZ *
    d. Visual Observer (VO) *
    e. Payload Operator being used as a second Visual Observer *
5. When the RPIC is landing the sUAS, the payload;
    a. Should be turned up Horizontally to protect the camera lens when landing *
    b. Should be protected from obstructions on the ground *
    c. Could be used to help land the sUAS *

ENABLING OBJECTIVE 2

The RPIC shall have knowledge of obstacles that may limit the safe landing of an sUAS.

1. The pilot shall have Situational Awareness at all times when performing a safe landing while there are
    a. Moving vehicles near the landing zone.
    b. Bystanders *
    c. Search and rescue personnel
    d. Other sUAS flying in the area
    e. Small children *
    f. Animals *
2. While performing a landing procedure, the RPIC is encouraged to use VO and
    a. Payload Operators *

ENABLING OBJECTIVE 3

The RPIC shall have knowledge of weather conditions when landing an sUAS.

1. The pilot shall know the weather conditions at the ground level when landing*
    a. Windsock near the LZ for landings *
    b. Use of an anemometer *
    c. Weather apps *
    d. The effect the wind has on nearby trees *
    e. Land into the wind if possible, especially with fixed wing sUAS *
2. Winds affecting a landing*
    a. The most severe type of low-level wind shear, a microburst, is associated with convective precipitation into dry air at the cloud base. Microburst activity may be indicated by an intense rain shaft at the surface but virga at cloud base and a ring of blowing dust is often the only visible clue. A typical microburst has a horizontal diameter of 1–2 miles and a nominal depth of 1,000 feet. The lifespan of a microburst is about 5–15 minutes during which time it can produce downdrafts of up to 6,000 feet per minute (fpm) and headwind losses of 30–90 knots, seriously degrading performance. It can also produce strong turbulence and hazardous wind direction changes. *During an inadvertent microburst encounter, the small UA may first experience a performance-increasing headwind, followed by performance-diminishing downdrafts, followed by a rapidly increasing tailwind.* * This can result in terrain impact or flight dangerously close to the ground. An encounter during approach involves the same sequence of wind changes and could force the small UA to the ground short of the intended landing area.-FAA Remote Study Guide.*

ENABLING OBJECTIVE 4

The RPIC shall have knowledge of regulatory requirements for landing sUAS.

1. The pilot shall know what areas are restricted when landing an sUAS.
    a. You cannot land on private property unless you have permission in some states and Provinces.
    b. Example, you cannot land on Federal property in the USA owned by the Department of Interior unless you have permission.
    c. Regulatory Airspace: Regulatory airspace is subject to the rule-making process in order to define strict standards. Contolled airspace includes Class A, B, C, D, and E airspace areas, restricted and prohibited areas. -FAA Remote Study Guide

ENABLING OBJECTIVE 5

The RPIC shall demonstrate landing of an sUAS.

1. The pilot shall land an sUAS
    a. Using manual controls
    b. Using Return Home controls or autonomous

Lesson 9: Complete post-flight procedures given an sUAS

5.3.3.1
Complete post-flight procedures given an sUAS that has performed a successful landing, so that the sUAS is visually inspected for damage, configured for transport and storage, confirmed ready for service through immediate maintenance, or out of service for scheduled maintenance.

(A) Requisite Knowledge:
1) Knowledge of small unmanned aircraft systems, payload, transport mechanisms, and storage procedures for the specific sUAS.

(B) Requisite Skill:
2) The ability to complete logbooks, forms, records, and any digital programs for information from sUAS operations.

Terminal Objectives
The RPIC shall complete post-flight procedures such as a visual inspection for damage, ready for transport and storage of the payloads and confirm ready for service or out of service status for an sUAS.

Enabling Objectives
1. The RPIC shall visually inspect the sUAS for damage post-flight and systems errors.
2. The RPIC shall configure the sUAS for storage and transport of payloads post-flight.
3. The RPIC shall confirm the sUAS is ready for service or out of serve post-flight.

Motivation
During a flight, many things can damage your aircraft such as bugs, birds, tree limbs, electrical wires, and even hail. It's important to find this out immediately after a flight, so you can take it out of service or do repairs before the next flight.

ENABLING OBJECTIVE 1
The RPIC shall visually inspect the sUAS for damage post-flight and systems errors.

1. The RPIC will inspect the aircraft as follows
    a. Check the aircraft for signs of damage and excessive wear and tear *
    b. Check the gimbal and camera at their attachment points *
    c. Check to make sure there are no loose wires *
    d. Attached the gimbal protection device or disconnect payload for storage*
    e. Turn batteries off before disconnecting *
    f. Disconnect propellers and landing gear if applicable*
2. Systems check post flight *
3. Check your controller for system errors that may be corrected before your next flight such as battery status, Compass and or IMU setting. Errors should be corrected immediately and not left for someone else to find. * It may take 20-30 minutes for an IMU recalibration and the RPIC may not have this available time if an emergency call comes in for the crew to fly *
4. Document any damage or errors found by the crew and correct immediately or take the sUAS out of service *

ENABLING OBJECTIVE 2
The RPIC shall configure the sUAS for storage and transport of payloads post-flight sUAS

1. The RPIC shall have an appropriate method of storing and transporting the aircraft and payloads
    a. Do not store above or below the temperature recommended by the manufacturer *
    b. Transport the aircraft and payloads in sturdy boxes that are water and dustproof *
    c. When traveling via plane, be sure to check the batteries on the aircraft in case of fire and are easily accessible by the cabin crew *

d. When transporting a drone, be sure the gimbal cover is attached and it's transported in the case it came with. Extra padding is needed to protect the drone if you're checking the drone into the belly of an aircraft
e. When transporting a drone via a car, Use the case the drone came in, never store anything loose in the case, and lay the case flat according to the drone laying flat
f. When the drone is stored for long periods of time, it's recommended the batteries not be at 100% charged in case of fire. Drain batteries before storing them in a safe, temperate place. Store Li-po batteries at or near room temperature in a location where you would spot a potential fire. If you have a healthy battery that isn't overheating and has no punctures or puffing, it should be safe to store, but spontaneous battery fires do happen. DJI, which sells well over half of all personal drones in use today, recommends that if you don't plan to use a drone for 10 days or more, discharges its battery to 40% to 65% * of its capacity. * A partial discharge reduces stress on the battery and helps give it the longest possible life, according to Cadex testing.* Check your battery manufacturer's recommendations for discharging, which will prevent the battery from degrading. Source Wirecutter Article "How to Safely Charge and Store Lithium Drone Batteries" *

ENABLING OBJECTIVE 3

The RPIC shall confirm the sUAS is ready for service or out of service post-flight.

1. The RPIC shall ensure the aircraft is ready for the next flight by
    a. Making sure batteries are charged
    b. Firmware is updated
    c. New SD cards have been installed
2. The Remote Pilot in Command shall confirm the aircraft is out of service by;
    a. Marking the aircraft with bright color tape or markings "Out of Service"
    b. The Out of Service marking should be dated and who put it out of service and the reason why
    c. A memo or email should be sent to other pilots advising them the aircraft is out of service

Lesson 10: Mission Debrief

5.3.3.2
Conduct a mission debrief given a mission plan at the end of sUAS operation so that the operational tasks necessary to complete the mission are identified as complete, incomplete, or deviated from the designated mission plan for specific reasons.

(A) Requisite Knowledge:
1) Knowledge of mission plan elements, contents, and the potential impact of changes in environmental conditions, weather, and regulatory requirements on the specific sUAS.

(B) Requisite Skill:
1) The ability to communicate and present information obtained from sUAS operations.

Terminal Objective
The Pilot in Command shall conduct a debriefing at the end of an sUAS mission with the flight team to see if the mission was completed, incomplete or the flight plan had to be deviated due to weather, environmental and regulatory requirements.

Enabling Objectives
1. The Pilot in Command shall have knowledge of mission plan elements and content to debrief.
2. The Pilot in Command shall conduct a debriefing with the team at the end of a mission to see if the objectives were met.
3. The Pilot in Command shall conduct a debriefing with the team to see if the mission was not completed due to weather, environmental and regulatory requirement and any potential impact in the changes of the environmental conditions that pertain to flight.
4. The Pilot in Command shall conduct a debriefing with the team to see if the mission was deviated due to weather, environmental and regulatory requirements.
5. The Pilot in Command shall communicate relevant information obtained from the operation to the sUAS team.
6. The Pilot in Command shall present information obtained from the operation to Incident Command via ICS chain of command, and others as needed.

Motivation
After every important call, we should be doing a debrief on what happened, what we did wrong, and how we can improve for the next flight. No difference in new technology being used for search and rescue such as Unmanned Aircraft.

ENABLING OBJECTIVE 1
The Pilot in Command shall have knowledge of mission plan elements and content to debrief.

1. The Pilot in Command shall know the parts of a mission plan when debriefing such as
    a. Permission to take off and land *
    b. Is the aircraft registered with the FAA?
    c. Altitude to fly *
    d. Mission Overview
    e. Operating frequencies Example: 2.4 GHz or 5.8 GHz
    f. Planned flight time
    g. Contingency procedures: Lost link, divert, etc.*
    h. Hazards unique to the flight.*
        i. Winds aloft *
        ii. Powerlines *
    i. Closest Airport
        i. Airport Identifier

j. Emergency Contact
    i. ATC tower number in case of a flyaway
    ii. Number for local emergency services. Ex 9-1-1
    iii. Site manager if applicable
k. Roles discussed and observations by the
    i. RPIC*
    ii. VO(s)*
        1) Were there any safety concerns by the VO and RPIC?*
        2) Was an alternative landing site needed*
        3) Pertains to safety of the crew and the public*
        4) What data was collected and how it will be stored for future use?*
        5) Did the RPIC have to divert to an alternative landing site?*

2. Data Analyst to collect and store data for future use.
    a. Have a robust policy on storing data, so you're not saving it in three or four different locations. The more you store, the more room you are taking on servers and hard drives

ENABLING OBJECTIVE 2
The Pilot in Command shall conduct a debriefing with the team at the end of a mission to see if the objectives were met.

1. The Pilot in Command shall debrief the team to make the objectives met.
    a. Did the RPIC debrief the flight team? If so, what was covered?
        i. -Time of the flight *
        ii. -Battery issues *
        iii. -Close calls with obstructions *
        iv. -Other aircraft encountered
        v. -Safety issues
        vi. -Any rules broken to accomplish the objective
        vii. -Were the objectives met?
    b. Write the comments written down to be implemented on the next flight.

ENABLING OBJECTIVE 3
The Pilot in Command shall conduct a debriefing with the team to see if the mission was not completed due to weather, environmental and regulatory requirements.

1. If the mission was not completed, what was the cause?
    a. Weather
    b. Battery malfunction due to weather *
    c. Firmware issues
    d. Airspace conflict
    e. Cloud ceiling too low *
    f. Rain, snow, or freezing participation *

2. There is always a potential impact of changes of environmental conditions in the weather and is a major consideration when flying. It is suggested pilots set their own personal minimums, especially when it comes to weather. As pilots evaluate the weather after a particular flight, they should consider the following
    a. What was the current ceiling and visibility? *
    b. Consider the possibility that the weather may be different than forecasted. *
    c. Were there any winds, thunderstorms or adverse weather present or forecasted? *
    d. If there were clouds, was there any icing, current or forecasted? *
    e. What was the temperature/dew point spread and the current temperature at altitude?
    f. Were the METARS or weather forecasts correct or were they different?*

3. Evaluation of terrain is another important component of analyzing the flight environment. Not keeping a VLOS at all times could cause a terrain impact with the drone. In the debriefing, evaluate it as if you came close to an impact. *

ENABLING OBJECTIVE 4
The Pilot in Command shall conduct a debriefing with the team to see if the mission was deviated due to weather, environmental and regulatory requirements.

1. Was the mission deviated due to weather, environmental and regulatory requirements?
    a. Was the flight deviated and flown prior or after the mission launch time due to:
        i. Weather
        ii. Environmental issues such as weather
        iii. Airspace restrictions
2. Situational awareness (SA) in aviation is the ability to understand and perceive all factors that affect safety before, during, and after a flight.*

ENABLING OBJECTIVE 5
The Pilot in Command shall communicate information obtained from the operation to the sUAS team.

1. What information was communicated from the operation?
    a. Flight time
    b. Altitude
    c. Route flown
2. Any regulatory requirements were broken using the specific sUAS such as
    a. Fly in Class B airspace*
    b. Fly in Class C airspace*
    c. Fly in Class D airspace
    d. Fly in Class E airspace
    e. Prohibited areas
    f. Restricted areas*
    g. Warning areas
    h. Military operation areas (MOAs)
    i. Alert areas
    j. Controlled firing areas (CFAs)
3. The air traffic system maintains a high degree of safety and efficiency with strict regulatory oversight of the FAA. If a sUAS lifts off in open sky, you are flying in National Air Space or the NAS*

ENABLING OBJECTIVE 6
The Pilot in Command shall present information obtained from the operation to Incident Command via ICS chain of command, and others as needed.

1. The Pilot in Command should present the information
    a. Electronically reporting using third-party software
    b. NFIRS
    c. In house written report
    d. Oral

    Application: Class to build a mission plan for a search and rescue flight
    Application: Demo third party software on reporting your flight

Lesson 11: Evaluate Operational Roles as a Visual Observer

5.4.1.1
Evaluate operational roles given a mission plan, RPIC, and sUAS operation, so that operational tasks necessary to support the mission are identified, listed, and communicated to the RPIC.

(A) Requisite Knowledge:
1) Knowledge of airspace requirements, weather conditions, and regulatory requirements.

(B) Requisite Skill:
1) The ability to review, understand and support a mission plan.

Terminal Objective
The Operation personnel aka Visual Observer, Payload Operator, and Airspace Coordinator or Air Boss roles shall evaluate the operational task from a mission plan and communicate this to the Remote Pilot in Command.

Enabling Objectives
1. The Operations personnel shall identify operation tasks in the mission plan.
2. The Operations personnel shall have knowledge of airspace requirements.
3. The Operations personnel shall have knowledge of weather conditions.
4. The Operations personnel shall have knowledge of regulatory requirements.
5. The Operations personnel shall review, understand, and know-how to support a mission plan.

Motivation
When planning a trip to an unknown location, I always use GPS (WAZE today) to find the best route to my destination. When you review the mission during the pre-flight period, make sure you identify key points listed and it's communicated to the Pilot in Command. Know what the mission demands, so the flight is a success. Someone's life may depend on it.

ENABLING OBJECTIVE 1
The Operations personnel shall identify operation tasks in the mission plan.

1. The VO shall know the task in the operation or parts of a mission plan such as
    a. Mission Overview
    b. Permission to take off and land
    c. Altitude to fly
    d. Operating frequencies Example: 2.4 GHz or 5.8 GHz
    e. Planned flight time
    f. Contingency procedures: Lost link, divert, etc.
    g. Hazards unique to the flight *
        i. Winds
        ii. Powerlines
        iii. Closest Airport
        iv. Airport Identifier
        v. Emergency Contact
        vi. ATC tower number in case of a flyaway
        vii. The number of local emergency services. Ex 911
        viii. Site manager if applicable.
        ix. Class Airspace *
        x. Know the different classes of Airspace and how to fly in them *

ENABLING OBJECTIVE 2

The Operations personnel shall have knowledge of airspace requirements.

1. The VO shall know the regulatory requirements for proper sUAS missions.
    a. Class A
    b. Class B (Blue lines)
    c. Class C (Magenta lines)*
    d. Class D (Dash Blue lines)
    e. Class E (Faded Magenta)
    f. Class E Surface (Dash Magenta)

ENABLING OBJECTIVE 3

The Operations (Visual Observer) personnel shall have knowledge of weather conditions.

1. The VO shall know what weather conditions are favorable or not favorable to fly.
    a. The sUAS should be landed into the wind, especially fixed wing sUAS. *
    b. Rain on an Unmanned Aircraft is favorable if it's IP 43 rated. (Matrice series)
    c. Flight is 500 feet below clouds or 2,000 feet horizontal from clouds with 3 mile visibility. *

ENABLING OBJECTIVE 4

The Operations (Visual Observer) personnel shall have knowledge of regulatory requirements.

1. The VO shall have knowledge of regulatory requirements such as
    a. Flights cannot occur over 400 feet AGL*
    b. No beyond-line-of-sight flights unless a waiver has been obtained through the FAA*
    c. No flying over people unless they are part of your operation
    d. No flights over jails
    e. No flights over large gatherings of people such as a parade or ball game
    f. The Pilot in Command can only monitor one person at a time that is flying and not a 107 pilot
    g. No interference by Unmanned Aircraft with manned aircraft

ENABLING OBJECTIVE 5

The Operations (Visual Observer) personnel shall review, understand, and know how to support a mission plan.

1. The VO helps support the mission by
    a. Remind the Pilot in Command of the mission objectives
    b. Assist in preparing the aircraft for deployment
    c. Know what the target looks like
    d. Know where an alternative landing site is before the flight

    ***Note**: If there is a crash and damage to the aircraft or property, it's the responsibility of the Pilot in Command to take full responsibility for the event.*

Lesson 12: Visual Line of Sight as a Visual Observer

5.4.2.1
Maintain visual line of sight of the sUAS given an RPIC and an sUAS in flight along a designated flight path under the regulatory requirements as determined by the AHJ, so that obstacles are identified and communicated to the RPIC prior to a potential collision and in a time that allows for corrective action.

(A) Requisite Knowledge:
1) Knowledge of regulatory requirements and operational and flight capabilities of the specific sUAS.

(B) Requisite Skill:
1) The ability to communicate verbally to the RPIC.

Terminal Objective
The Operations personnel shall maintain a line of sight of the sUAS per the regulatory agency, verbally communicate any obstacles in the designated flight path to the Remote Pilot in Command, so time is allowed for correction action.

Enabling Objectives
1. The Operations personnel shall maintain a line of sight of the sUAS at all times.
2. The Operations personnel shall identify obstacles along the flight path and verbally notify the RPIC so the obstacle may be avoided.

Motivation
In any flight, it's always best to have several eyes in the air and assist with the flight. While the FAA does not require a VO to be in place, it's highly recommended you have at least one observer assisting in the flight.

ENABLING OBJECTIVE 1
The Operations personnel (Visual Observer) shall maintain a line of sight of the sUAS at all times.

1. The VO shall have the aircraft in the line of sight
    a. Cannot be aided by Binoculars
    b. Eyeglasses or contacts may be used in tracking the aircraft *
    c. More than one VO may be used *
    d. The VO must have verbal contact with the Pilot in Command

    ***Note**: Binoculars can be used in case the aircraft is lost, however, they cannot be used to maintain control during the mission.*

ENABLING OBJECTIVE 2
The Operations personnel shall identify obstacles along the flight path and verbally notify the RPIC so the obstacle may be avoided.

1. Avoiding obstacles
    a. Being the eyes and ears for the Pilot in Command *
    b. Be watchful over the Unmanned Aircraft to ensure it avoids trees and powerlines *
    c. If the Pilot in Command is not adhering to the FAA rules, the VO shall alert them they are operating outside of the requirement *
    d. Monitoring big television screens by a second, third, or fourth VO and assisting in searching and achieving the objectives in the mission is highly recommended *
    e. Be watchful flying close to cell phone towers and radio towers due to high wattage emitting and guidewires attached holding up the structure and bird nesting in these structures could be a hazard to the sUAS *

2. The VO needs to know the flight capabilities of the specific sUAS they are monitoring. A way to do this is:
    a. Fly the sUAS and see how responsive or unresponsive the aircraft will act*
    b. Understand the reaction time when a command of “Stop” is given*
    c. Understand how the weather may be a factor for different sUAS*
3. The VO should show the *variable* speed capabilities of the drone they are monitoring such as ascent and descent. An example here is the DJI Mavic Pro sUAS. Its max Ascent Speed is 4 m/s (P-mode) and 5 m/s (S-mode). The Max Descent Speed 3 m/s (S-mode) and 3 m/s (P-mode) *
    a. If you give advice to the RPIC to climb or descend to avoid another aircraft, It may be better to ascend in Sports Mode at 5 meters per second to avoid the hazard.

Converting Metric to Imperial

- 3 meters per second is 6.71081 mph
- 4 meters per second is 8.94775 mph
- 5 meters per second is 11.1847 mph

***Note**: Each student should know the capabilities of the sUAS in the AHJ. Recommendation. Take time in class for each student to look up their own sUAS as a class application.*

Special thanks to James Bono for formatting the lesson plans.