Getting a SAR Drone Team Started in Mountain Rescue

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DJI SAR Drone Document (temporary)

Goals and Learning Outcomes

- Why bother? What are the capabilities?
- FAA regulatory compliance
- Absolute minimum needed to get started
- Capabilities with that minimum
- Training and SOPs
- Management of a SAR drone program
- Problems to expect

Key Concept to Always Remember

Don't adapt your mission to your drone.

Adapt your drone operations to match the missions you actually have.

What will a basic setup let you do?

- Newest FAA regulations
 - Limited BVLOS
 - Night ops
 - Flights over people
- Hasty search of trails, known collection points, cell pings
- Search cliff bands, shallow crevasses
- If in patient contact, can they hear the drone?
- Basic patient assessment (responsive/unresponsive, obvious injuries, stable location)
- Situational Awareness for teams and IC
- Route assessment for teams & evacuation
- Searching rivers, canyons, hard to access locations

Video of lost snowboarder at N.F. Park for DJI.

Summary of SAR drone mission roles

- Hasty search
- Detailed search
- Ground support
- IC Overwatch



What are our most common missions?

- Search, especially at night
 - Phone pings or other PLK
 - IR search



- Providing a visual target for ground teams: "patient is directly under the drone"
- Ground team support, especially night ops and our spotlight



FAA Regulatory Compliance

- sUAS are Aviation Assets, governed by FAA
- You *are* an "agency"
 - "Volunteers with recreational drones" Nope!
- Need at least one certified "Remote Pilot"
- "Part 107" certification
 - \$175
 - Many free and paid courses
 - Not very hard & practice tests are available
 - Free "recurrent" training every 24 months
- Make sure your drone is registered (\$5)
- Verify that your AHJ will cover liability



Basics Needed for Minimum Operation

Rescue climbers need more than a rope and harness, similar issues with a drone.

- Personnel
 - RPIC = Remote Pilot In Command (licensed or nearby licensed RPIC)
 - VO = Visual Observer (no license needed)
- Drone
 - Camera with live feed
 - GPS capability

Video of first drone mission.



Training and Certification

- One or more FAA Certified Part 107 Pilot(s)
- Drone team only training
 - Train in all terrains and seasons
 - Point of Interest (POI) flying
 - Flying in tight or challenging terrain
 - Flight field training
 - The National Institute of Standards and Technology (NIST) has created the sUAS Open Test Lane
- Training incorporated with all other teams
- Learning spatial awareness of position, orientation, obstacles and hazards
- Training different phases of flight: Preflight, takeoff, departure, on station, approach, landing, and post-flight

NIST Test = <u>https://www.nist.gov/system/files/documents/2021/02/12/NIST%20sUAS%20Open%20Test%20Lane%20-%20Fabrication%20Guide%20%28v2020B%29.pdf</u> Image from NIST.



Aircraft (AC) Selection

- Gimbaled High Res camera with live feed
 - 4k recording is helpful
 - IR is amazing but expensive
- Flight duration: ≥ 30 minutes
- Flight range: Remote Controller \leftrightarrow AC
 - Note: 2.4 GHz is often longer range than 5 GHz
- Stability
 - GPS flight mode
 - Able to handle unusual winds
 - Obstacle avoidance is valuable
- Display of GPS and flight telemetry
- Payload options and capacity



Inexpensive Starter Drone Pros/Cons



DJI Mini 2 SE, \$489, <249g, Amazon.com

Bwine F7MINI Drone 4K, \$198, <250g, Amazon.com

Pros:

Low price, 30-45 minute flight times, light weight, compact, easy to fly, highly field transportable.

Cons:

Needs cell phone, transmitted video quality, poor low light levels, no accessories, no payload, limited range.

Parrot - Thermal Drone 4K, \$2k, Amazon.com

Expensive Drone Pros/Cons



DJI M300/350: \$13,000 H20T: \$9,800 DJI M30 \$14,700

Autel Dragonfish with Z2 camera \$ 90,250

Pros:

Amazing capabilities, especially at night.

Cons:

Very expensive to crash/repair. Accessories/batteries = \$\$\$

Payload and Sensor Options

- Thermal camera (more on next slide)
- Beacon (if not built in)
- Spotlight
- Independent Remote Control of Camera
- Zoom camera
 - H20T has 23X optical, 200X total!
- HDMI output/broadcast to monitors
- Laser range finding
- Remote payload drop (radio, 1st Aid, Water)
- Radio repeater/comms (Probably custom only)



Other Expensive Drone Upgrades

- IR/FLIR ("thermal camera")
 - Decent units start at \$2.5k and go up in \$\$ fast
 - Drone platforms that can carry a FLIR are expensive
- All weather rated drone and cameras
- Loudspeaker is cool in concept, but we don't really use it.
- Support Systems/Options
 - Mobile command with multiple monitors
 - Mobile WiFi hotspots
- Project Lifeseeker (more in next class) -

Image: DJI.com H20T thermal camera





Image: Sheri Trbovich

Support Personnel "Upgrades;" No Cost!

- RPIC and VO are minimum
 - Backup pilots & VOs
- Support team
 - Search team (at large monitors)
 - Battery management
 - LZ control
 - Tech support (WiFi, etc.)
 - Setup/tear down.
- Air Commander:
 - Coordination with IC, ground teams, radio, RPIC, other air assets (multiple drones, helicopters, fixed wing aircraft) This takes a major load off the flight crew.
- Dedicated radio/comms operator



Support System Upgrades

- WiFi hotspots, Starlink
- Large screen monitors
 - Many controllers have HDMI
 - Bad weather
 - Easier to see details
- Place for pilots to warm up
- SARTopo or other mapping integration (e.g., ATAK)
- Generator for battery charging
- RV stuff: solar panels, deep cycle batteries, inverters
- Headsets for comms



Standard Operating Procedures (SOPs)

- Preflight checklist
- Emergency protocols (especially RTH)
- Communication protocols (IC and teams)
- Define personnel roles
 - RPIC
 - VO
 - Person Manipulating Controls
 - Air Commander
 - Searchers
 - Flight Support
- Policy for moving to separate drone ICP



Integration with Existing Systems

- Drone team's role in overall SAR missions?
- Operate only from an ICP or field portable?
- What support equipment can be modified? (Our climb trailer.)
- Coordination with helicopters and air assets



Video of drone team and MRA team.

Threat and Error Management (TEM)

- Identify Potential Hazards/Challenges
 - Cold weather and pilots
 - Power lines/RF
 - Pilot skill currency
 - Night flights
- Mitigate these risks
 - Safety for personnel
 - Safety for bystanders
 - Safety for drone assets



Threat and Error Model

- Continually evaluate for evolving operational conditions
- Always be willing to move your drone base of operations.

It is not all unicorns and roses

- Crashes & Spare Props!
- Power lines and RF interference
- Battery life, especially cold and high altitude
- Curious bystanders
 - Team members
 - General public (questions & drone haters)
 - Family
- Weather & flight teams
 - A non-aerobic activity
 - Gloves and touch screens
 - Sunny days and viewing flight screens
 - Night flying = high risk & high stress



Yet more problems!

- Trees: VLOS & signal strength
- Maps on flight controllers: need topos/terrain
- Communications and coordination with IC
- VO and maintaining VLOS
- Situational awareness; VO is critical
- Spatial awareness
 - Visual position, map position, camera views, obstructions
- Maintaining currency
 - Training alone and with other teams
- Mountain weather = complex winds, thin air, cold
- Air space deconfliction

Data Management and Analysis

- Record flight tracks.
- Who is in charge of the flight video?
- What plans do you have for that video?
- Live data feeds online. (DroneSense, Motorola Cape, AirData, Responder Cast)
- Need secure storage of lots of video
- Future analysis with Loc8 or similar.



Management: DroneSense, Airdata UAV, DJI FlightHub 2

- These are subscription-based apps
- Flight tracks
- Aircraft commands and health
 - Investigate accidents for training
- Pilot data
- Aircraft maintenance
- Live stream video
 - Sheriff, AHJ
 - PIO



https://airdata.com/features#tab-panel-1

Maintenance and Inspections

- Battery maintenance
- Drone inspections and maintenance
- Firmware status
- Equipment storage and who has access
- Support equipment maintenance (IC trailer, etc.)
- Expansion and upkeep needs ongoing funding...



Money. It is what keeps you in the air.

- Initial outlay
- Ongoing expenses for
 - Upgrades/accessories
 - Software subscriptions
 - Battery replacement
 - Repairs
 - Replacement of entire drone (crash, loss, age)
- WiFi hotspots (Jetpack) or Starlink
- Expansion of program
 - More/better drones
 - Trailer/mobile command
 - Monitors
 - Solar panels, generators, 12V deep cycle battery banks, inverters, power system monitoring (all RV stuff)



Public Relations and Privacy Issues

- Communicate with the general public and about your program.
- Be sensitive to others. Don't dwell over hikers or campers. Keep a safe distance.
- Many people don't like drones at all.
- Iowa state law H.F. 572 restricts flights over farms. (Not sure if it got signed.) Probably an unenforceable law, but the point is that some people are on edge.

Summary Recap

- Drones are part of (almost) every Weber County Sheriff's SAR mission.
 - Search
 - Patient assessment
 - Situational Awareness for everyone (IC and teams)
- Must follow FAA regulations. Need Part 107 certified pilot(s).
- Can get started with minimal expense.
- Can be *very* expensive but ROI can be huge.
- Need to have a training program and SOPs.
- Needs ongoing management and maintenance.
- Problems exist and must be mitigated.
- Need to be sensitive to legal and privacy concerns.



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Next Session Covers Intermediate Topics

- Crew Resource Management (CRM)
- ICS Organization Chart with air assets
- Team Structure
- Training Details
- Asset Management
- Program Expansion Options
- Problems/Threats



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Questions?

• Summary: Just do it!



If time, show the North Fork rescue video or other video such as Kyle interviewing patient video.