INTERNATIONAL SOCIETY OF AIR SAFETY INVESTIGATORS

Unmanned Aerial System Use for Enhancing Aircraft Accident Investigations

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I - Introduction

- **Growing at an exponential pace**
- **Great capabilities at low cost**
- **Enhance the available tools and safety**
- **Appropriate integration**
- **Responsible use**

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II – Enhancing Capabilities

- **Aerial Forensic Imaging**
- **Convergence of Technologies**
  - UAS platforms
    - Lower cost
    - Availability
    - Ease of Use
  - Payloads
    - Capabilities
    - Miniaturization
    - Lower cost

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II – Enhancing Capabilities

- **Immediate Safety Assessment**
- **Mishap Wreckage Survey and Documentation**
- **Flight Path Reconstruction**
- **Visual Representation of Flight Path**

Each area explored in greater detail later in presentation

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III – Advantages of UAS

- Dull/Dangerous/Dirty (3D work)
- Unique perspectives
- Broad range of platforms
- Low cost (sometimes) / expendable
- Timely / rapidly deployable
- Accessibility
- Not a panacea

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Range of Platforms

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D/D/D – Hazardous for Manned Aircraft

D/D/D & Accessibility / Hazardous for Manned Aircraft

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Rapidly Deployed, Unique Perspective

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Unique Perspective

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IV – Detailed Capability – Immediate Assessment

- **Safeguard life, property, environment, and evidence**
- **Real-time data for first responders**
  - Assess and plan immediate actions for hazards and environmental issues
  - Debris, victims, evacuate, access and entry control
- **Timesaving common operating picture for Investigators**

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Common Operating Picture with Responders

Photographs from NTSB Report NTSB/AAB-12/01

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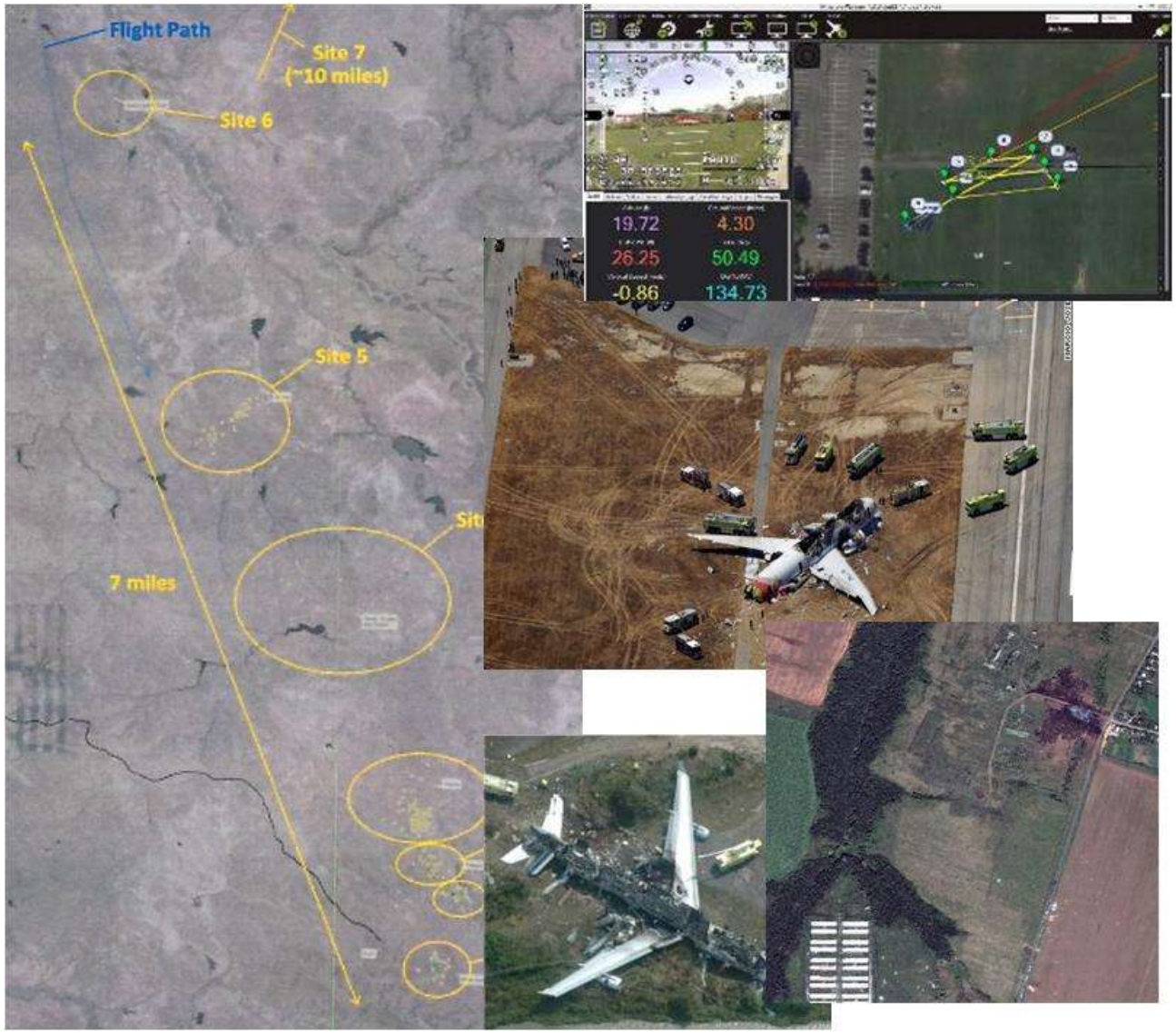
IV – Detailed Capability – Wreckage Documentation

- Reduce search time, improve detection and recovery time
- Search for victims and debris in an in-flight break-up scenario
- Map / geo-locate:
  - Wreckage distribution
  - Debris fields
  - Component and evidence locations
  - Ground scars, foliage damage
  - Build airborne depictions



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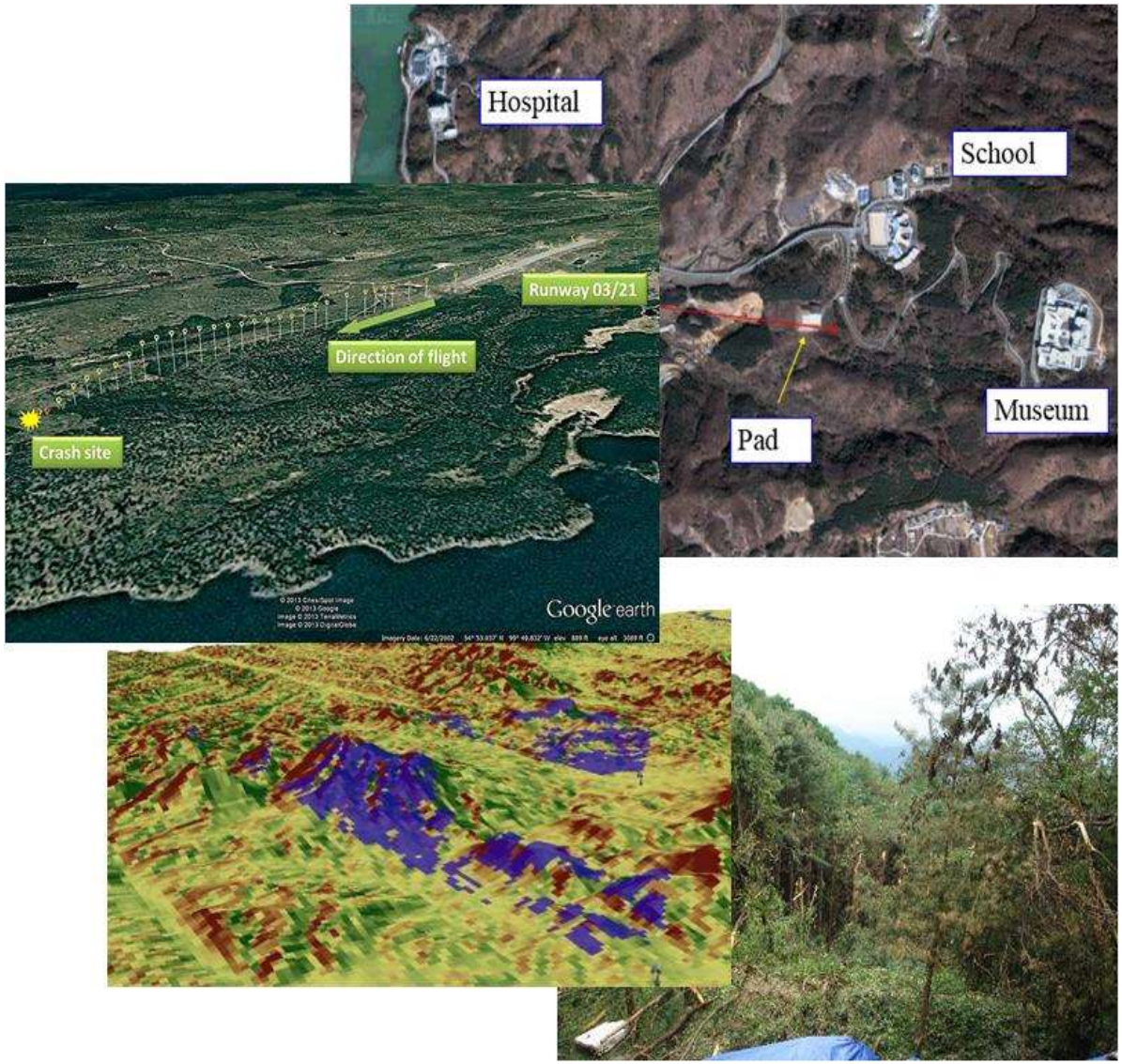
IV – Detailed Capability – Flight Path Reconstruction

- Identify structure, terrain, or foliage struck by the aircraft (initiator or as a result of the mishap)
- Reconstructions of mishap events against the backdrop of the actual terrain and wreckage pattern
- Impact angles, imparted loads
- Post-crash fire propagation
- Photogrammetry



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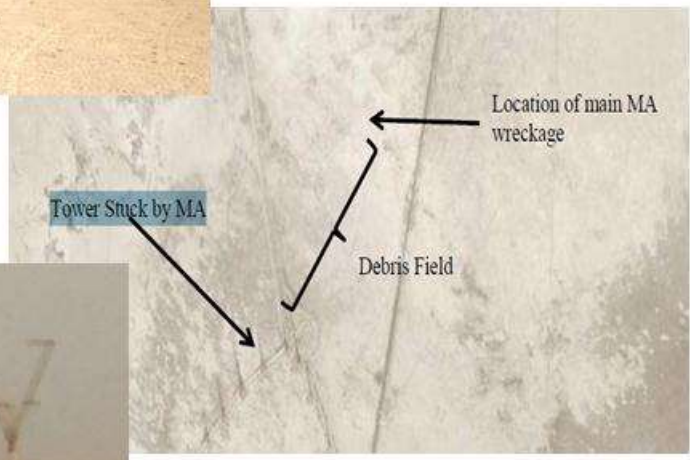
IV – Detailed Capability – Pilot Visual Representation/Perception

- Photographs and video to better approximate actual flight path vector
- View horizontally, vertically, and behind to further capture flight path and associated information
- Pilot's egocentric view
  - Visual illusions
  - Attempts to modify the flight path during the final portion of the mishap sequence or as a prelude to the mishap
  - Terrain, lighting, glare, or runway illusions



Images from USAF AIB F-15 Mishap Report

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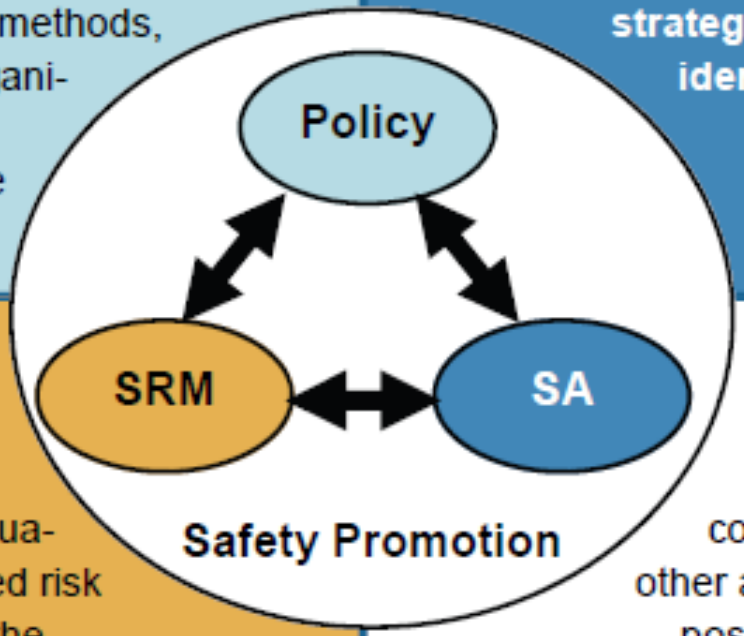
SMS and UAS

The Four SMS Components

Safety Policy
Establishes senior management's commitment to continually improve safety; defines the methods, processes, and organizational structure needed to meet the safety goals

Safety Assurance
Evaluates the continued effectiveness of implemented risk control strategies, supports the identification of new hazards



Safety Risk Management
Determines the need for, and adequacy of, new or revised risk controls based on the assessment of acceptable risk

Safety Promotion
Includes training, communication, and other actions to create a positive safety culture within all levels of the workforce

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How the Capabilities Map to SMS

- **Immediate Site Safety Assessment**
  - Maps directly to Safety Risk Management
    - Identify potential hazards entering the mishap site and analyzing the risk to responders and investigators.
  - Also Maps to Safety Promotion
    - Immediate site assessment will educate and communicate to the investigative team on the hazards they will face

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How the Capabilities Map to SMS

- **Mishap Wreckage Survey and Documentation**
  - Supports Safety Promotion
    - Allows for the relay of information about the entire site while keeping investigators from potential hazardous conditions
  - Supports Risk Management
    - Minimize the amount of foot traffic needed to document the site

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How the Capabilities Map to SMS

- **Mishap Flight Path Reconstruction and Pilot Visual Representation of Flight Path and Induced Perceptual Issues**
  - Investigating team is being shielded from unnecessary risk while identifying and mitigating hazards which supports Safety Risk Management.
    - Example: a pilot who may be put at risk by flying the same route as the mishap aircraft.
  - The team is able to view the mishap pilot's perspective without risk to personnel and expensive assets
  - The team is also receiving real time communication about the potential hazards of the path

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SMS Summary

- **All four capabilities allow the investigative team to:**
  - Minimize the risk to personnel responding and investigating a mishap
  - Communicate real time status to the investigative team

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UAS uses for a Proactive / Predictive State

- **Additional potential proactive and possibly predictive measures of UAS include:**
  - Route and obstruction verification
  - Lighting and instrument approach validation.

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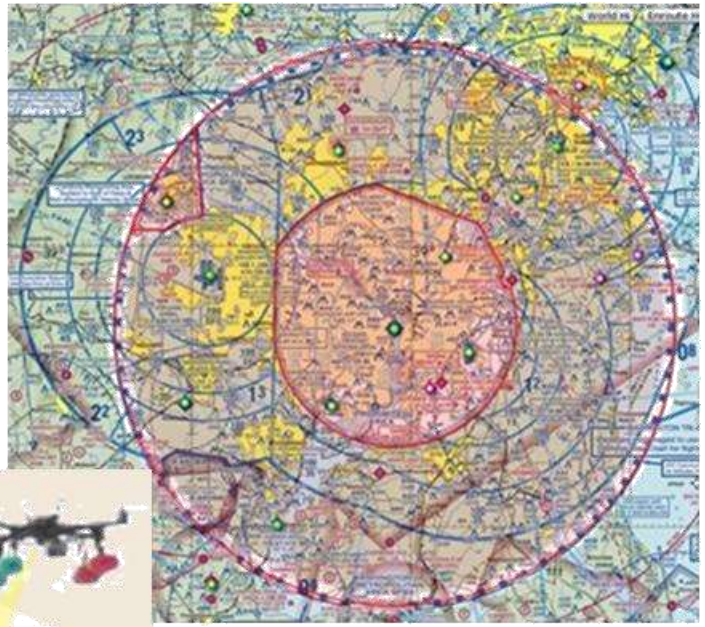
V – Barriers, Issues, Regs

- **Appropriate platform**
  - Wrong tool -> mishap
- **Know your aircraft**
- **Know your limits**
- **Privacy issues**



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V – Barriers, Issues, Regs

- **Know your regulations**
  - National
  - Local
  - Commercial vs. Gov't
- **Need COA**
  - Government Agency Regs
- **Use of "commercial" or hobbyist**
  - Are you giving tacit approval?
  - Is product robust?

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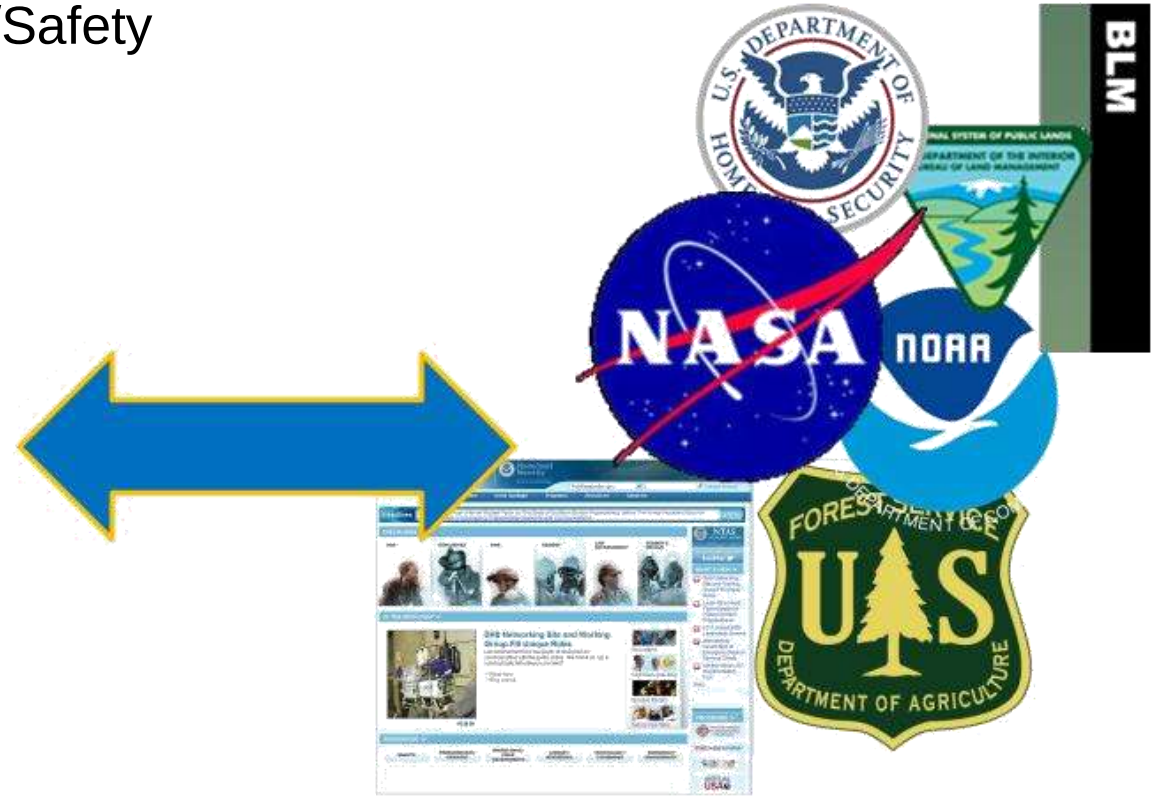
V – Barriers, Issues, Regs

- **Develop SOPs, especially for outsource**
  - Platform
  - Payload and products
  - Operational control/Safety
  - Privacy
  - Data handling



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Conclusion

- **Summary**
  - UAS technology promises a significant enhancement to traditional methods of aircraft accident investigations
  - Efficiency, safety, capabilities, cost
  - Issues associated with operation, integration, responsible use, and safety
  - UAS capabilities directly relate to components of SMS

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Conclusion

- **Additional study**
  - Multi-modal transportation / Industrial/disaster response
  - Evaluation of UAS during accident investigation training scenarios; goal to establish baseline guidelines and criteria for:
    - Vehicle selection
    - Reliability
    - Safety
    - Performance
    - Operating altitudes and locations
    - Test objectives (photographic, survey, immediate assessment, photogrammetry, flight path reconstruction,
    - candidate pilot/operator selection
    - reporting requirements
  - Evaluate the use of UAS for first responders under applicable incident response and command systems.

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Conclusion

- **Additional study**
  - Evaluate the use of UAS for first responders under applicable incident response and command systems.
  - Develop techniques, best practices and standard operating techniques; collaborate (national investigation boards, industry partners, groups such as ISASI can participate
    - Serve as a clearinghouses for information regarding the efficacy, considerations, and concerns of operating UAS for accident investigation
  - Conduct evaluations under representative and realistic conditions to the maximum extent possible consider:
    - Operating terrain, performance
    - Use of actual wreckage or test parts to evaluate effectiveness
    - Integration into incident reporting systems for first responder and accident investigator real-time dissemination and situational awareness.

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Where Boeing is….

- **2 DJI Phantom III PROs Purchased**
- **N numbers have been assigned**
  - ~90 day turnaround from time forms submitted
  - Although you can use online form as of April 2016 (opposed to hard paper forms that were required prior)
- **333 Exemption is in work**
  - Trying the approach to allow all of Boeing ASIs at any location to use these or any new platforms
  - One thought for Military Investigations is to have the Board declare the Boeing UAVs as "Public Use" Aircraft during the duration of the mishap investigation.
    - These platforms would then be exempt regardless of the FAA 333 form status

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FAA Public Use Aircraft Operations

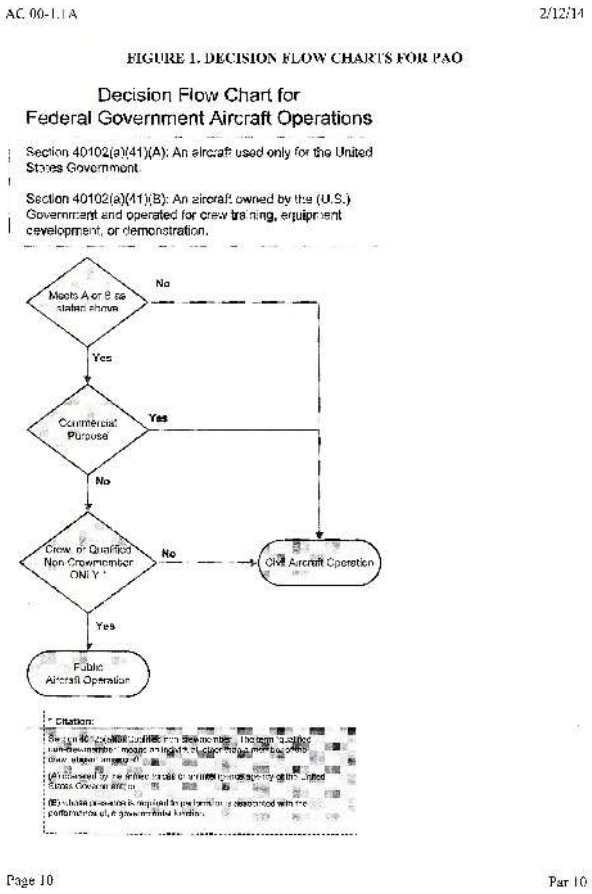

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FIGURE 1. DECISION FLOW CHARTS FOR PAO

Decision Flow Chart for
Federal Government Aircraft Operations

Section 40102(a)(41)(A): An aircraft used only for the United States Government.

Section 40102(a)(41)(B): An aircraft owned by the (U.S.) Government and operated for crew training, equipment development, or demonstration.

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Questions/Discussion

- **Questions / Discussion?**

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