

Investigation of UAS Accidents and Incidents

Presented to:

***The National Academies: Committee on
Assessing the Risks of UAS Integration***

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UAS are Here to Stay

- 60,000 small UAS commercial operators have already been approved in the U.S.
- Nearly 800,000 UAS hobbyists have registered their small UAS with FAA (*double the 320,000 manned aircraft registered*)
- \$93 billion will be invested over the next 10 years in commercial UAS technology worldwide
- Expected Sales in the U.S.: 3 million units by 2020.



Despite all the hype



***No confirmed collisions between a civil UAS
and a manned aircraft ... until last week...***



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First confirmed UAS collision

- **When**: Thursday evening, Sept. 21, at dusk
- **What**: Army UH-60 Blackhawk helicopter collided with a small civilian UAS (DJI)
- **Where**: About 300 feet above the beach in Staten Island, New York.
- **Why**: Unknown at this time.
- **Circumstances**: Flight of two helicopters. Rear helicopter pilot saw object enter the rotor system of forward helicopter. Helicopter continued to destination (Linden, NJ) and landed safely



Collision Location



Army UH-60 Helicopter - Damaged

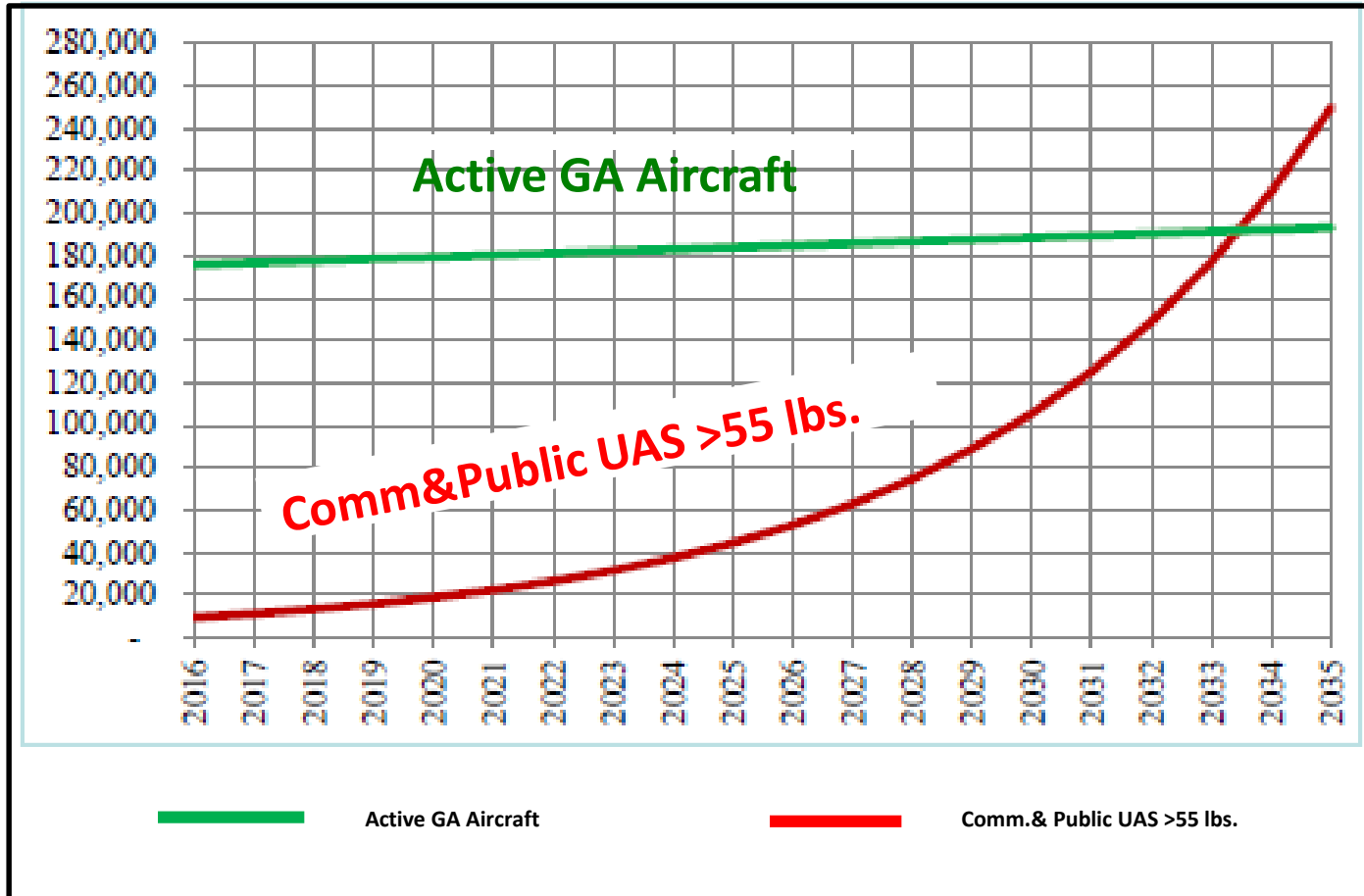


UAS Pieces found on helicopter

- “Phantom 4”
- Made by DJI



Numbers of GA Aircraft versus Large UAS



Reducing UAS Hazards

- **Data sharing and collaboration on safety analysis are still in early stages of maturity**
- **The investigation of certain “near miss” UAS sightings would be useful in validating the effectiveness of the safety controls.**
- **Such analyses would help guide the UAS industry’s ongoing safety research & design**



FAA Part 107 Rule Requirements

- Obtain a remote pilot certificate (pass knowledge exam)
- Be at least 16 years old (or supervised by the same)
- Be responsible for ensuring drone is safe before flying – via preflight visual and operational check of the UAS
- Fly under 400 feet in uncontrolled airspace
- Fly within Visual Line of Sight (VLOS)
- Fly during the day (or twilight with anti-collision lights)
- Fly at or below 100 miles per hour
- Yield right of way to manned aircraft
- Not fly over people
- Not fly from a moving vehicle unless in a rural area



FAA Definition for Part 107: Commercial UAS Accident

No later than 10 days after an operation that meets the criteria of either paragraph (a) or (b) of this section, a remote pilot in command must report to the nearest FAA Flight Standards District Office ... any operation of the small unmanned aircraft involving at least:

- (a) Serious injury to any person or any loss of consciousness; or*
- (b) Damage to any property, other than the small unmanned aircraft, unless one of the following conditions is satisfied:*
 - (1) The cost of repair (including materials and labor) does not exceed \$500; or*
 - (2) The fair market value of the property does not exceed \$500 in the event of total loss.*



FAA On-line Accident Reporting Form

The following questionnaire is a collection of information under the Paperwork Reduction Act of 1995. The Federal Aviation Administration will use the information you provide in response to the following questions to regulate and promote safety in air commerce, in accordance with its statutory authority 49 U.S.C § 44701. The following questions will take approximately 10 minutes to complete. You are not required to respond to this collection of information unless it displays a currently valid OMB control number.

OMB Control Number: 2120-0767

Expiration Date: 08/31/2019

* indicates a required field.

Remote Pilot in Command

* First name:

* Last name:

* Phone:

Email address:

* FAA Airman Certificate

Airman Certificate no.:

- None
 Unknown

* sUA8 Registration

Aircraft Registration no.:

- None
 Unknown

The Accident

* Local date:

* Local time:

Location

City:

The city field must not contain digits.

* State: ▼

Zip code:

* The accident involved...

- Serious injury
 Death
 Property damage greater than \$500
(other than the unmanned aircraft)

* Description:

Include: (1) circumstances leading to the accident; (2) property damaged and extent of damage, if any or known; (3) number of person(s) injured and extent of injuries, if any or known.

I'm not a robot

reCAPTCHA
Privacy - Terms



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Part 107 vs NTSB Rules

Regarding UAS Accidents

	<u>FAA Part 107</u>	<u>NTSB</u>
Serious Injury	Level 3, 4, 5 on the AIS Scale – reversible injury but requires hospitalization.	Part 831 – broken bones; 48-hr hospitalization.
Damage Threshold	Repair or fair market value exceeds \$500	Part 831 definition of “substantial damage”
Time to Report	No later than 10 days	Immediately
Incidents	Not Applicable	As per Part 831 listing
Reporting Means	FAA web site form	Not defined - Can be verbal
Intended Use	Safety <u>and</u> Enforcement	Safety only
Hobbyist	Only if operated illegally	Not Applicable (as accident)
Final Report	FAA 8020-23 Form (same for any manned aircraft)	NTSB Format - Same as for manned aircraft accident
Investigation Protocols	Same for Manned Aircraft	Same for Manned Aircraft

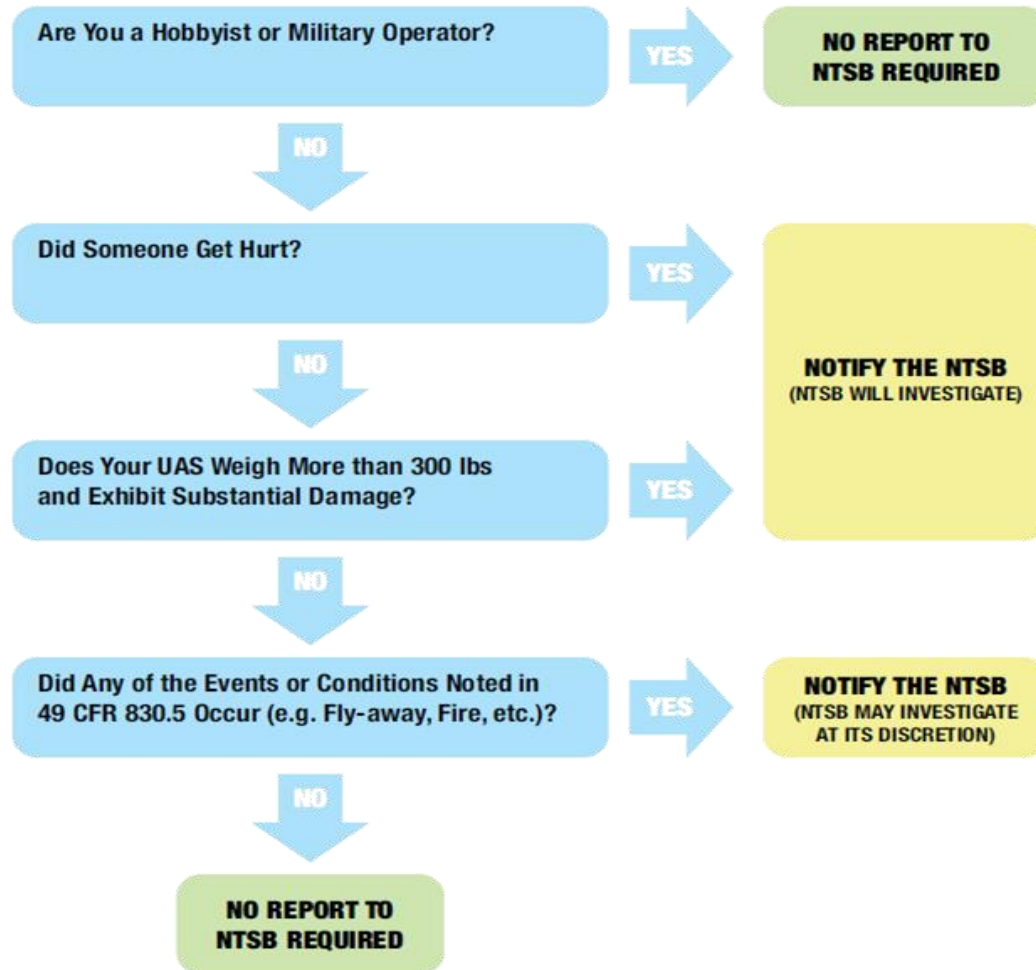


NTSB UAS Accident Cases

- DCA15CA117 – May 1, 2015 - Titan Solara 50 experimental UAS crashed after takeoff in New Mexico. *Structural failure of left wing due to overspeed condition.*
- DCA14CA043 – Jan. 27, 2014 - MQ-9 Predator - intentional ditching near Pt. Loma, Ca. *Intentional ditching due to failure of the starter/generator (power loss)*
- ANC13TA072 - July 26, 2013 - SIERRA UAS operated by NASA for research impacted ocean ice 90 miles north of Prudhoe Bay, Alaska. *Continued operation into engine intake system icing conditions resulting in power loss; schedule pressure; insufficient risk mgmt.*
- DCA13CA088 -- May 10, 2013 - MQ-9 Predator, Customs & Border Protection UAS. Bounced landing and runway excursion at the Patrick AFB, Florida. *An improper flare leading to a nose-wheel first touchdown, resulted in PIO and subsequent substantial damage.*
- DCA12CA023 - Dec. 20, 2011 - Experimental Meridian UAS, operated by the Univ. of Kansas, crashed on final approach at McMurdo Station. *An stall induced by an inadvertent autopilot Home command.*



NTSB UAS Investigation Protocol



Key Question for Investigators

(Tom Farrier, ISASI 2013)

To what extent is it desirable or practical to investigate accidents and incidents of UAS of different sizes ?

- ***What types of UAS accidents and incidents warrant in-depth investigation ?***
- ***Does it make sense to expend investigative resources on small UAS accidents? If so, under what circumstances ?***

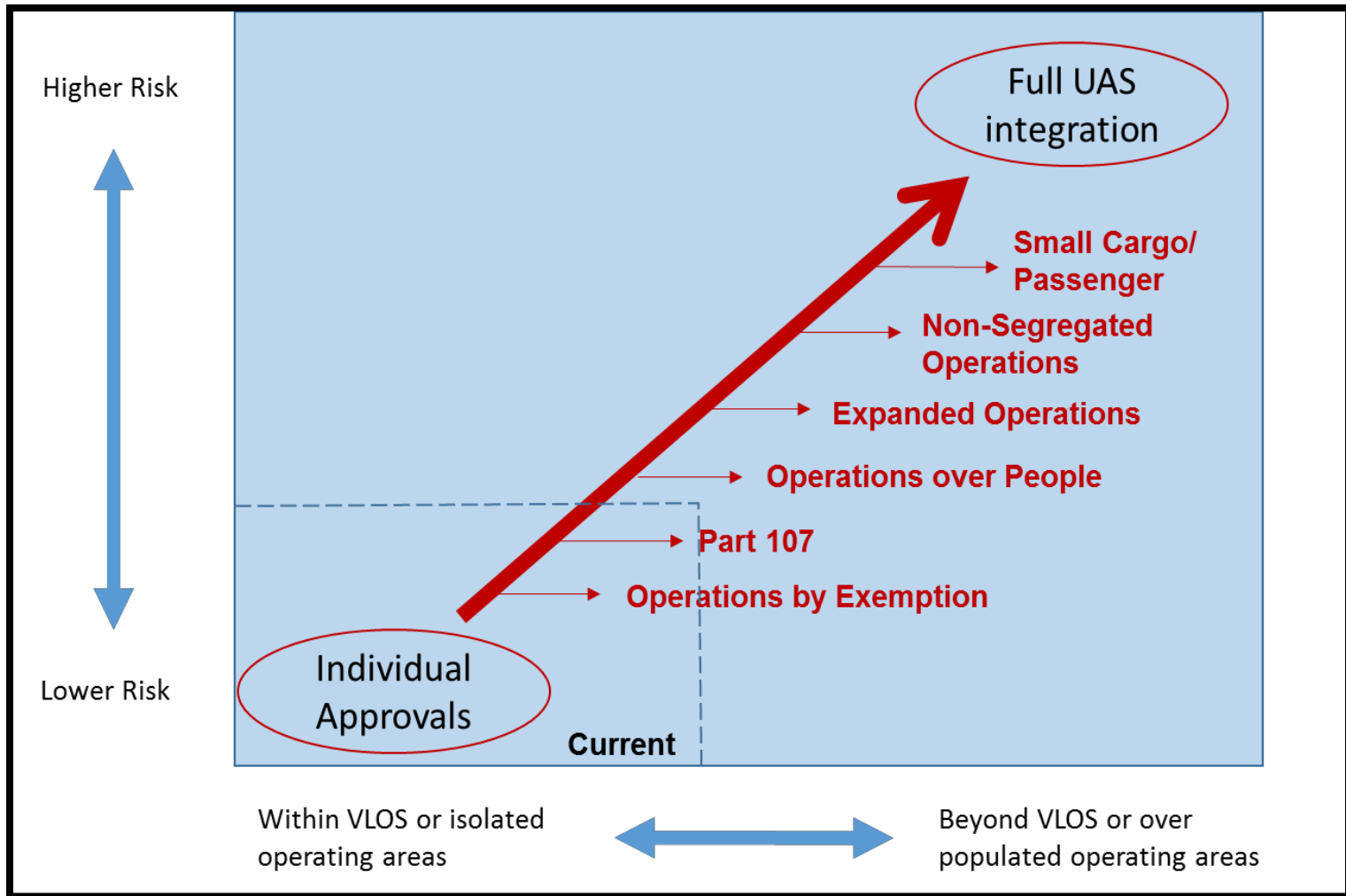


UAS Investigations

- The first few collision incidents & accidents will prompt a large investigative response
- Investigators should focus on see-and-avoid breakdowns
- Investigative protocols remain the same as for manned aircraft
- An important task:
 - Identify hazards
 - Inform evolving implementation strategy
 - Validate on-going safety research
 - Improve investigation techniques
 - Allay, or incite, public concern as needed

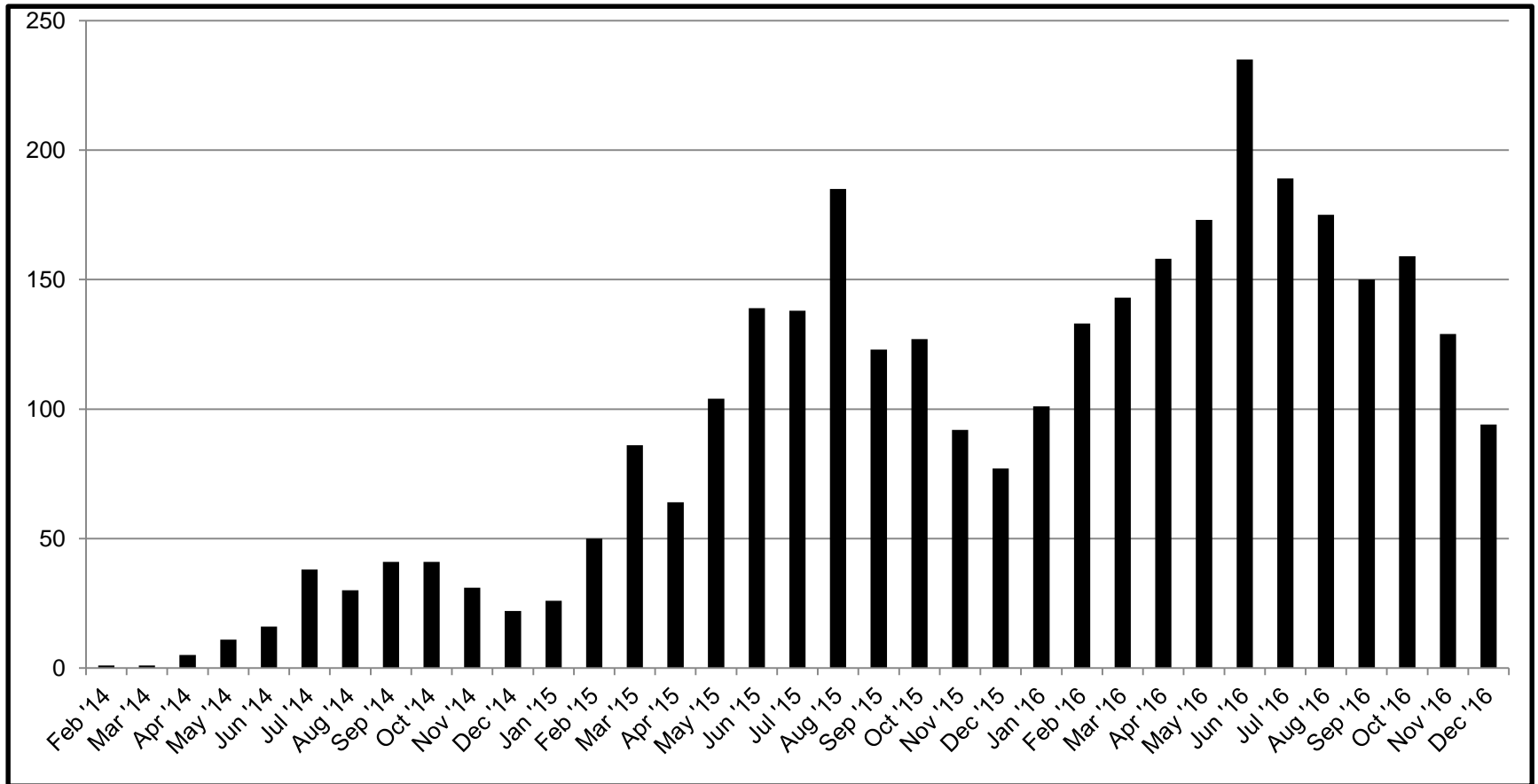


FAA Rulemaking Strategy for the Evolution of UAS Integration



UAS Incident Reports to FAA

Feb. 2014 – Dec. 2016



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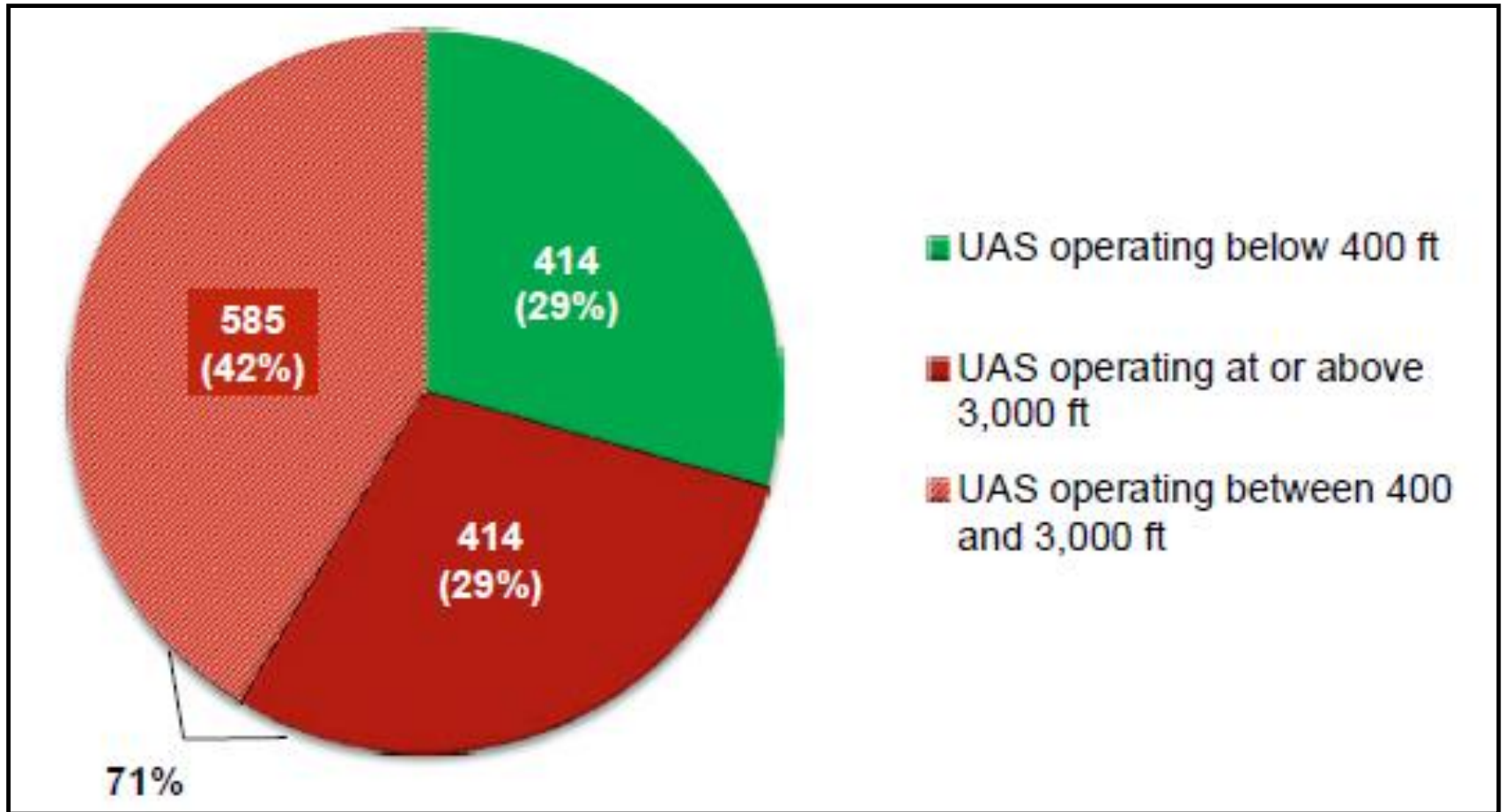
Selective Investigating:

- **Continuing Operational Safety**
- **Risk-Based Decision Making: Prioritizing your investigations**
- **Identifying the factors that contribute the most risk**
- **Need to establish networks with local stakeholders in law enforcement and aviation. *Example: FAA's LEAP program***



Percentage of UAS Sightings by Reported Altitude

Nov. 2014 through January 2016



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ASSURE Research Projects for UAS

(Alliance for System Safety of UAS Through Research Excellence)

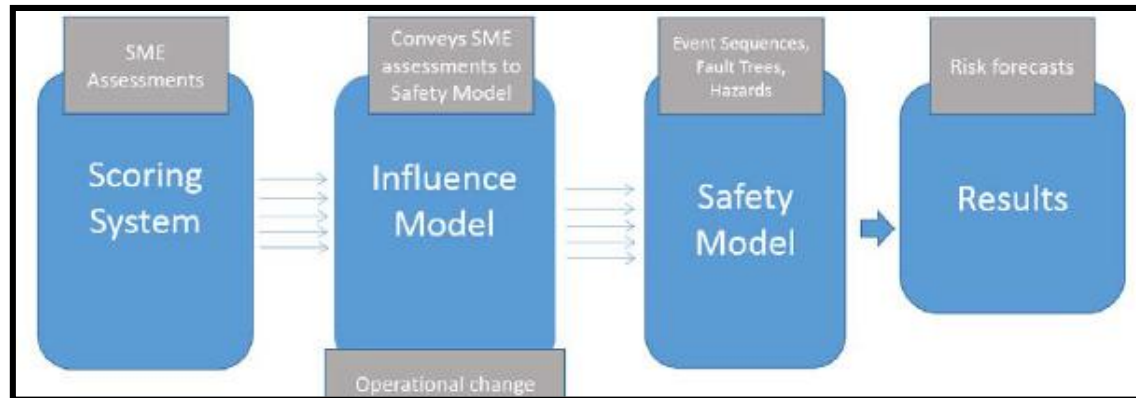
- **A1: Test Cases to Validating sUAS Industry Consensus Standards – Kansas State University**
- **A2: Small UAS Detect-and-Avoid Requirements for Beyond VLOS Ops – University of North Dakota (UND)**
- **A3: UAS Airborne Collision Severity Evaluation – Wichita State University (WSU)**
- **A4: UAS Ground Collision Severity Evaluation – University of Alabama at Huntsville (UAH)**
- **A7: Human Factors Station Design Standards - Drexel Univ.**
- **A10: Human Factors UAS Control Station Certification and Procedures – Embry-Riddle Aero. University**
- **A11: Low Altitude Safety: Part 107 Waiver Study – UAH**



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Integrated Safety Assessment Model (ISAM)

- **Assesses baseline & comparative future safety risk of commercial manned aviation in the NAS**



- **Recently adapted to include the UAS operations**
- **Uses data to quantify how unique hazards affect risk**
- **Provides a method to evaluate specific risks and their mitigations for UAS**
- **Led by FAA's AVP-220 division**



FAA UAS Investigation Protocols

- Basically the same as for Manned Aircraft (FAA Order 8020.11C)
- Currently, AVP-100 will provide the FAA IIC for all UAS accidents that involve serious injuries, fatalities, mid-air collisions, or hi-visibility.
- For all other UAS accidents & incidents, AVP-100 will coordinate with AUS and/or Flight Standards to determine which office will assume FAA IIC responsibility.
- AVP-100, AUS, and AFS will work collaborative together, and also with NTSB



False Positive - London, England

April 17, 2016; Airbus A320

- British Airways pilot reported that he nearly colliding with UAS during approach
- Guardian newspaper headline: *“Drone Crashes into Passenger Jet as it Comes into Land”*
- **Conclusion: No evidence of a collision. Crew likely saw a plastic bag floating near them.**



False Positive – Leesburg, Virginia

June 22, 2015; Cessna 172 S

- Student pilot on solo X-country reported hitting a UAS at 3,500 ft.
- Reported substantial damage to right wing. No visual evidence of bird remains.
- FAA took photos of damaged wing and sent parts in to NTSB lab. Part examined and swabs taken at Smithsonian Feather Ident. Lab
- **Conclusion: *Airplane collided with a large black vulture***



False Positive: Joliet, Illinois

August 27, 2015; Piper PA-23 Aztec

- NTSB Case no. CEN15IA385
- 140 knots and 2,500 ft. agl
- Pilot heard a “pop”
- Noticed damage to left horizontal stabilizer
- No blood found
- Swabs of damaged area were taken and sent to the Smithsonian Feather Ident. Lab
- **Conclusion: *Airplane collided with a dove or pigeon***



“Takeaway” Findings:

UAS Incident Investigations

- ❑ *UAS are here to stay, and they are growing !***
- ❑ *Over 60,000 small UAS commercial operators have already been approved in the U.S.***
- ❑ *The number of large UAS (55+ lbs.) is expected to surpass the active GA aircraft in 15 years.***
- ❑ *Rules for safe UAS operations are evolving – beginning with simpler, more conservative goals and move towards more complex and riskier operations involving larger UAS.***
- ❑ *FAA and NTSB have separate and differing UAS accident criteria – collaboration is needed***



“Takeaway” Findings (Cont’d):

UAS Incident Investigations

- ❑ *Investigative processes for UAS events are generally the same for manned aircraft***
- ❑ *Investigators should concentrate on those UAS incidents involving potential collision risks***
- ❑ *Investigation and analysis of UAS incidents inform safety research and modeling***
- ❑ *Bird strikes on aircraft structure may not leave signs of blood or snarge***
- ❑ *“False positives” of reported UAS collisions must be investigated fully***



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