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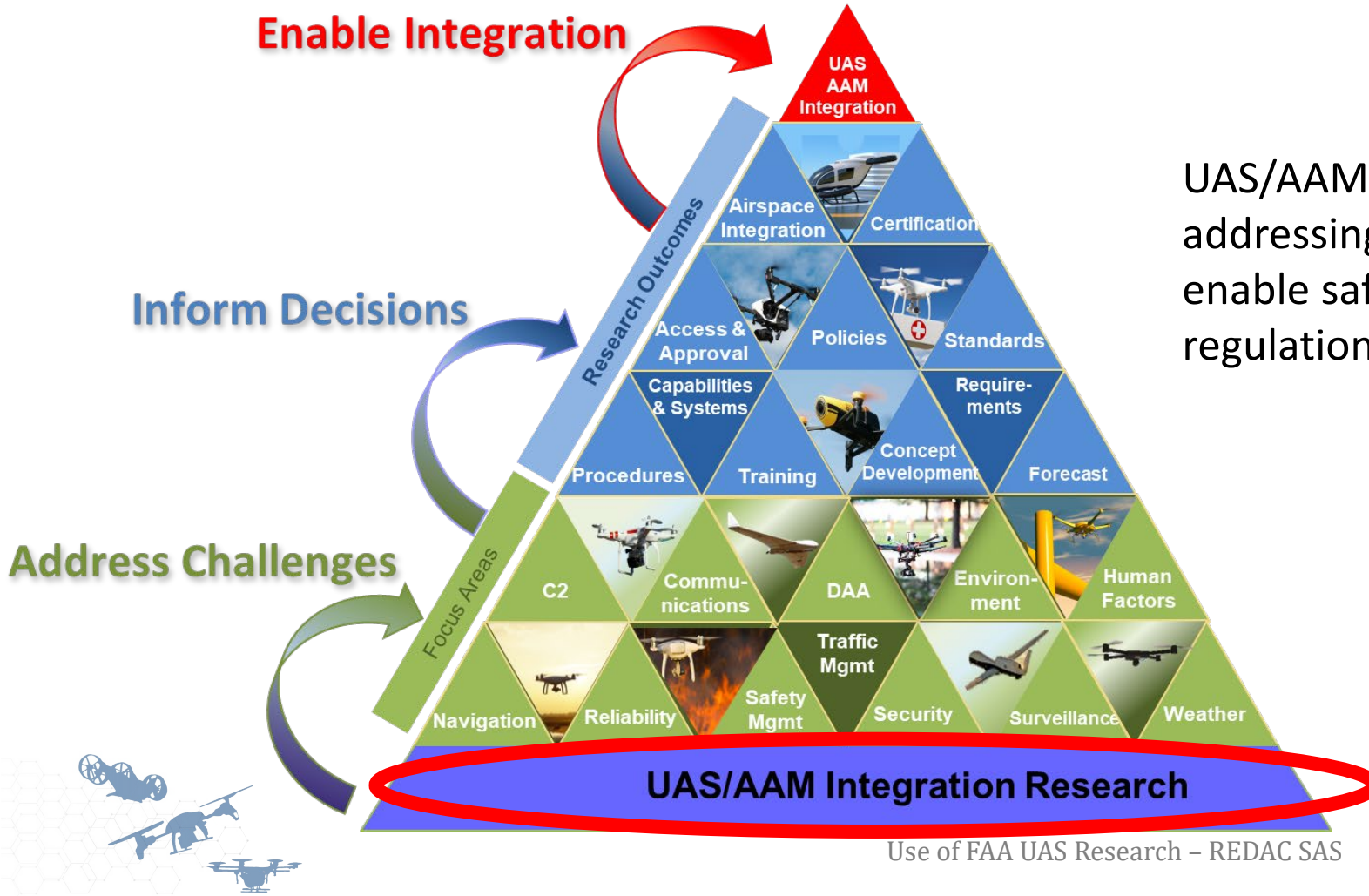


The Use of FAA Unmanned Aircraft Systems (UAS) Research Outputs – A Few Examples

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UAS/AAM Integration Research



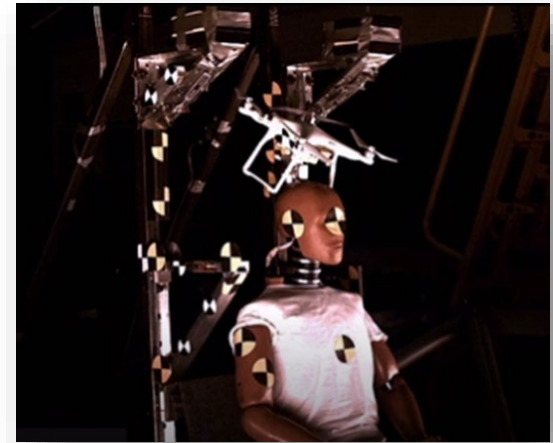
Use of FAA UAS Research – REDAC SAS



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Informing Rulemaking – Small UAS (sUAS) Ground Collision Severity for Operations Over People

- ASSURE Research (Phases 1 & 2: 2015-2019)
 - Over 512 impact tests and simulations were conducted
 - 16 different fixed-wing and multi-rotor UAS, as well as various objects and payloads
 - Determined thresholds of serious but non-lethal injury utilizing Abbreviated Injury Scale (AIS)
 - Developed a test methodology for assessing the level of risk of sUAS to persons on the ground
- The ASSURE results were used to show that injury caused by a rigid object at kinetic energy levels (Cat 2/Cat 3) in the Operations Over People Notice of Proposed Rulemaking is equivalent to the injury caused by a sUAS at a higher kinetic energy
- ASSURE developed simplified test methods that are informing potential means of compliance for the Operations Over People rule



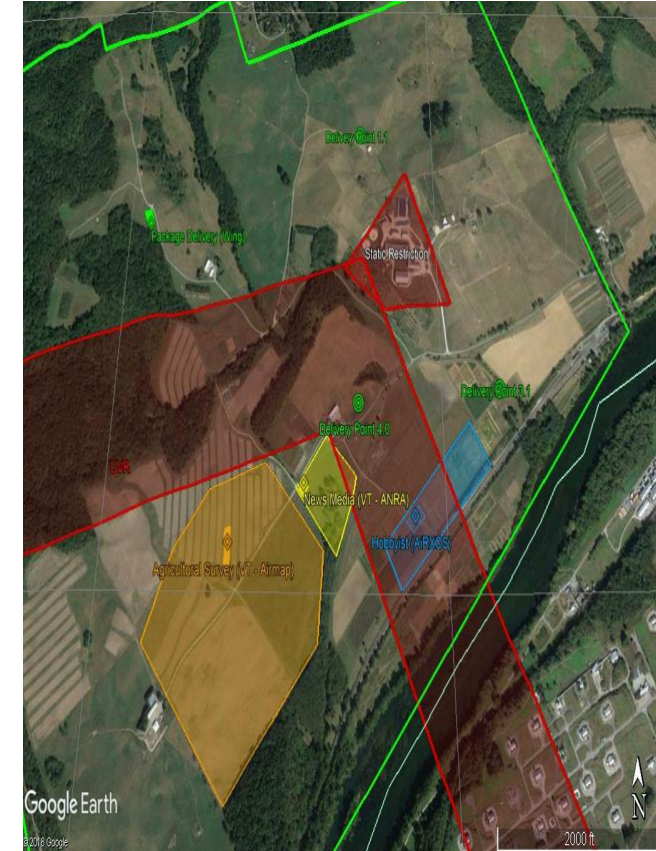
Informing Rulemaking – BVLOS Aviation Rulemaking Committee

- The FAA has initiated an Aviation Rulemaking Committee (ARC) for Beyond Visual Line of Sight (BVLOS) Operations which is underway now
- AUS-300 has provided a compilation of all relevant research that might inform the ARC Recommendations including, but not limited to:
 - Develop Test Methods and Performance Requirements for small Unmanned Aircraft Systems (sUAS) Detect and Avoid (DAA) Systems - ASSURE
 - Develop Recommendations for Well-Clear Compliance for small Unmanned Aircraft Systems (sUAS) Terminal Area Flight Operations – Science and Research Panel (SARP)
 - Validate Visual Detection and Avoidance Operations Standards for sUAS – ASSURE
 - Evaluate Multi-Sensor Data Fusion Strategies for Detect & Avoid (DAA) Technology – William J. Hughes Technical Center



UAS Traffic Management (UTM) Pilot Program (UPP) Phase 1 Demonstration

- UAS Research program developed and tested UTM architecture and technical infrastructure to enable UPP Phase 1 demo
- UPP Phase 1 was successfully completed in August 2019 and demonstrated the following:
 - FAA connectivity and data exchange with UAS Service Suppliers
 - Sharing of information between UAS Service Supplier
 - Creation & Sharing of UAS Volume Reservations
 - Tested Discovery Services
- Results from UPP Phase 1 informed the regulatory guidance to support the FAA with industry standardization of operational procedures



Standards Development – RTCA Large UAS C2 & DAA Standards

- Research to *Evaluate the Command and Control (C2) Link Compatibility with UAS*, including the assessment and validation of interoperability, safety, security, and performance informed development and validation of RTCA Special Committee 228 (SC-228) C2 Standards:
 - C2 Link Systems Minimum Aviation System Performance Standards
 - C2 Data Link Minimum Operational Performance Standards
- Detect and Avoid Research including *Detect and Avoid Multi-Sensor Data Fusion Strategies*, informed development and validation of RTCA SC-228 DAA Standards:
 - Minimum Operational Performance Standards for DAA Systems
 - Minimum Operational Performance Standards for Air-to-Air Radar for Traffic Surveillance



Standards Development – ASTM sUAS standards supporting BVLOS

- UAS research to inform test methods and performance metrics to support approval of Beyond Visual Line of Sight operations:
 - Airborne collision encounter modelling – MIT-Lincoln Laboratories
 - Test Methods and Performance Requirements for small Unmanned Aircraft Systems (sUAS) Detect and Avoid (DAA) Systems - ASSURE
 - Evaluation of ASTM Remote Identification (ID) standards to verify compliance with final Remote ID Rule
- As research continues, results are being shared with ASTM groups to inform the development and validation of industry consensus standards for BVLOS



Safety Analysis – Waiver Trend Analysis to Inform Operators

- UAS Researchers evaluated the sufficiency and insufficiency of data provided to the FAA for the assessment of risks in approving UAS Part 107 Waiver Requests.
 - Identify data characteristics needed for operators to establish a viable safety case and provide the FAA with a sufficient dataset for the assessment of risk in the waiver approval process.
 - Provide information on common areas of insufficiency in waiver applications
- Trend analysis results were published on the FAA's public website to help future applicants learn from past approvals and denials
 - [https://www.faa.gov/uas/commercial_operators/part 107 waivers/waiver trend analysis/](https://www.faa.gov/uas/commercial_operators/part_107_waivers/waiver_trend_analysis/)

Beyond Visual Line of Sight (107.31) Waiver Trend Analysis				
Waiver Application Elements	Command and Control (C2) Link and Emitters Performance Capabilities	Detect-and-Avoid (DAA) Methods	Weather Tracking and Operational Limitations	Training Requirements for Pilots and Other Participating Persons
Sufficient Information -- Characteristics of the Beyond Visual Line of Sight (BVLOS) applications approved after requests for additional information	-States and demonstrates max range and envelope that C2 can operate in, taking into account geographic area, environment, and terrain -Provides a complete description of each emitter, including the Federal Communications Commission (FCC) grant of authorization and FCC ID number for each transmitter/emitter on the sUA and ground control station	-Detailed descriptions and procedures for risk mitigations to avoid collisions with aircraft (ex. Visual Observers, and technology)	-Details when weather reports will be gathered, what will be gathered, and where they will be taken from. -States weather limitations, such as small unmanned aircraft system (sUAS) manufacturer's limitations or wind speed	-Details and provides means for validating effectiveness of employee training and testing program. Example: -Lists out courses/subjects covered -Tests corrected to 100% and stored for easy retrieval later
Insufficient Information -- Characteristics of the Beyond Visual Line of Sight (BVLOS) applications after requests for additional information	-C2 operational capabilities not evident -Not demonstrating C2 can operate at stated max range or stating the envelope, i.e. lacking data -Application did not include FCC grant of authorization or FCC identification number for each emitter on the small unmanned aircraft system (sUAs) and ground control station	-Detailed methods or procedures to see and avoid or detect and avoid participating or non-participating aircraft and non-participating persons/moving vehicles are not evident or adequately described Examples: -If used, a video feed alone may not be sufficient, because detection would be limited to the direction the camera is pointing (i.e. not 360 degree detection) and does not address avoidance. -If used, Automatic dependent surveillance - broadcast (ADS-B) In alone may not be sufficient because ADS-B In only provides data for cooperative traffic and does not address avoidance.	-Providing general, or no statements Examples: -'We only fly on clear days' -'Weather is to be of Visual Flight Rules in nature' -Multiple applications not addressing weather requirements	-Provision of a method of assuring all required persons participating in operation have knowledge in all aspects of BVLOS not evident -Not stating who will have the training, what the training will consist of, or a method of assuring all required persons have been successfully trained



Aviation Forecasts

- UAS research efforts studying UAS “hotspots”, growth projections, and traffic trends inform Aerospace forecasts, enable modeling, and predict future demand
 - Aerospace Forecast: https://www.faa.gov/data_research/aviation/
 - Internal FAA UAS Trends and Forecast platform provides visualization and reporting of data and various UAS metrics (including registration, operations, and applications)

Questions?



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