The FAA's Center of Excellence for UAS Research

ASSURE

Alliance for System Safety of UAS through Research Excellence

Disaster Preparedness and Emergency Response Phase II
Presentation to Tactical Fire Remote Sensing Advisory Committee Meeting

Jerry Hendrix – Lead PI

(256)-679-5608

Jerry.Hendrix@uah.edu

www.uah.edu

University of Alabama – Huntsville (UAH)

- Member Alabama University System – Home of the Chargers!
- Tier 1 National Research University
- 1st in Alabama Universities for Math and Science
- 6th Nationally for federally financed Aeronautical and Aerospace Research
- 10th Nationally for Computer Science Research
- 11th Nationally for NASA Research and 28th Nationally for DOD Research
- James P. Cogswell Superior Rating for Security Excellence with clearances at all levels

Team Members

- University Team Members:
  - University of Alabama Huntsville – Jerry Hendrix (PI)
  - University of Alaska Fairbanks – Cathy Cahill (Deputy)
  - New Mexico State University – Henry Cathey (Deputy)
  - University of Vermont – Jarlath O'Neil-Dunne
  - Oregon State University – Michael Olsen
  - North Carolina State – Evan Arnold
  - Mississippi State University – Junfeng Ma
  - Kansas State University – Kurt Carraway

Disaster Preparedness and Emergency Response Using UAS - Program

- The FAA Reform Act of 2018 designated this program as a major research area for the FAA; transportation disaster preparedness and response using UAS
- OMB Memo addresses the RE&D priority practice to maximize interagency coordination by ensuring that the COE works with FEMA, DOI and DHS to work ongoing initiatives with each agency during disaster responses.
- On Going Research in effective and efficient use of Un-crewed Aircraft Systems in the Disasters

Top Level Research Questions/Goals

1. What are the use cases for the different disaster preparedness and emergency response efforts that UAS can help facilitate?
2. How is coordination done today at the local, state, and federal (e.g., DOI and DHS) levels to ensure safe operations after a disaster or emergency?
3. What are the common risks for the use cases? What are the mitigations to those risks to ensure safe operations for UAS?
4. What are the Concepts of Operations and Operational Risk Assessments for the specific use cases identified? What category of assets will work with each mission type? What are the characteristics of the optimum UAS(s) for disaster preparedness and emergency response?
5. What lessons were learned from the use case demonstrations?
6. What should future coordination at the local, state, and federal (e.g., DOI and DHS) levels look like with UAS integrated into the NAS?
7. What are the Command and Control (C2) and cybersecurity considerations (identified in FAA report)?

A52_ A11L.UAS.68: – Disaster Preparedness and Response Phase II

Need/Approach

Need – This research will provide insight into safe integration of uncrewed Aircraft Systems (UAS) into the disaster preparedness and emergency response areas. The safe, effective and efficient use of UAS in a disaster and emergency are the primary goals of this project. This project will provide actionable information that will assist first responders to save lives faster and accelerate personnel and infrastructure recovery.

Approach – This research will allow the research team to exercise via mock events and demonstrations the findings found in Phase I. The effort will focus on refinement of procedures, policies and guidelines and document lessons learned and training objectives.

Lead Principal Investigator	Research Partners
Jerry Hendrix Lead PI UAH	Numerous Industry Partners

ASSURE Research Performers

Cathy Cahill: Deputy UAF
Henry Cathy NMSU: Deputy UVM
Jarlath O'Neill Dunne UVM : Michael Olsen OrSU
Evan Arnold: NCSU, Junfeng Ma MSU: Kurt Carraway KSU
FAA Tech Project Lead – Erin Sunshine

FAA PM	FAA UAS COE Program Manager
Bhanu Kota, ANG – C21	Karen Davis, ANG-C2

Major Activities

Activity (09/2021 – 12/2023)	Status
Task 0: Program Management	27 Months
Task 1: Review of Phase 1	9 Months
Task 2: Mock Event Demonstrations	15 Months
Task 3: Lessons Learned	15 Months
Task 4: Procedures and Guidelines	24 Months

Projected Benefit of Research

- Safe integration of uncrewed Aircraft Systems (UAS) into the disaster preparedness and emergency response areas
- The disaster and emergency response policies, procedures, ground rules, guidelines, Concepts of Operations (CONOPs), and Operational Risk Assessment (ORA) developed in Phase I are exercised and refined via extensive demonstration exercises of human-made and natural disasters during Phase II

Issues & Risks

- COVID 19 causing lack of working meetings, training and exercises
- National Collaboration
- Schedule

Definition of a Disaster / Emergency

- FEMA Definition of Disaster
  - A disaster is an occurrence of a natural catastrophe, technological accident, or human caused event that has resulted in severe property damage, deaths, and/or multiple injuries
  - A large-scale disaster is one that exceeds the response capability of the local jurisdiction and requires State, and potentially Federal, involvement.
- Stafford Act
  - A disaster is any natural catastrophe, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under the Act to supplement the efforts and available resources or States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.
- Emergencies are as per Section 359 of the FAA Reform Act of 2018 and the FAA Research Report

Program Stakeholders

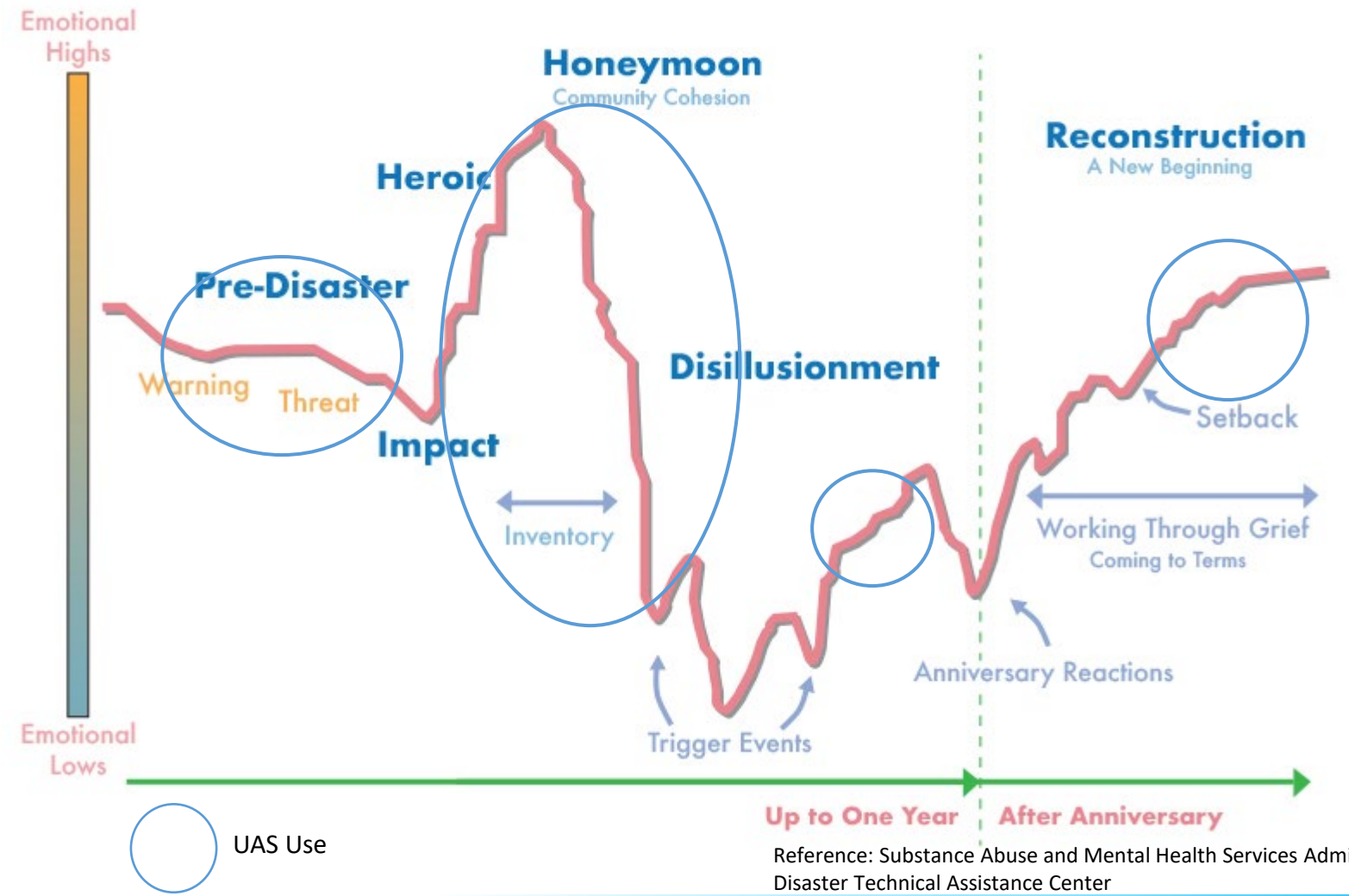
- Federal Aviation Administration (FAA)
- Supporting industry, federal and state governments organizations working in first response to disasters
  - Local responders and EMA
  - State responders and EMA
  - Federal Level organizations (DHS, DOI, DOD, DOJ, NASA, others)
  - Industry
- First Responders / Law Enforcement with their challenge to using UAS in First Response

Program Influencers

Influencer	Inputs
Local, state and federal agencies	Leaders in UAS use, response and need
Federal, state and local laws	Operational Boundaries
Technology-UAS and Sensors	Advances in response
Industry	Leading in technology and response
UAS Regulations – Emergency Ops Request	Operational Boundaries
Non-UAS Responders (Utility)	Cooperation

Influencer	Inputs
Past Research	Lessons, Risks, etc.
Past Lessons Learned from Responses	Guidance
NGO and Humanitarian / Volunteer Organizations	Agency Cooperation and Coordination
Hobbyists	Coordination
News	Coordination
Future Research	Research Refresh and Challenges

Disaster Phases and Emotional Stress – Understanding the Problem

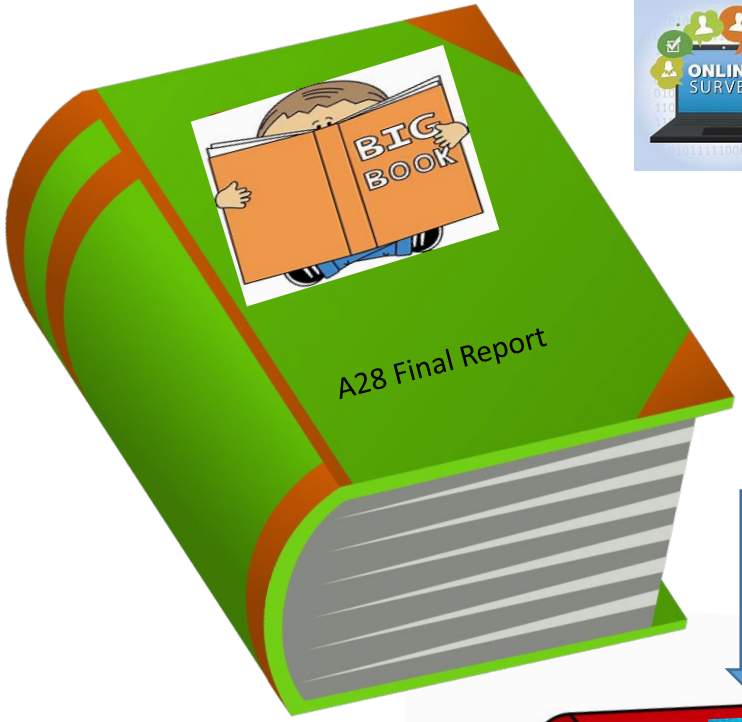


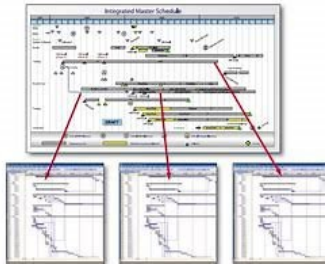
Reference: Substance Abuse and Mental Health Services Administration – Disaster Technical Assistance Center

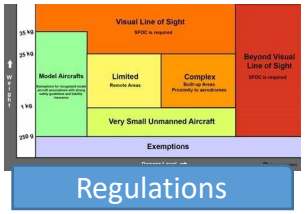
Program Research Process Diagram

- Research Task Plan (RTP)
- Integrated Master Schedule (IMS)
- Briefings (Peer Review and TIMS)
- Coordination / Disaster Orgs Report
- Questionnaires, Survey and Results
- UAS Use and Use Cases Report
- Entity Relationship Diagrams
- Risks, Waivers and Mitigation Report
- Concepts of Operations (CONOPS)
- Fire Department and Emergency Services Report
- Guidelines, Polices and Procedures by Disaster
- Final Report

Deliverable Products of Research

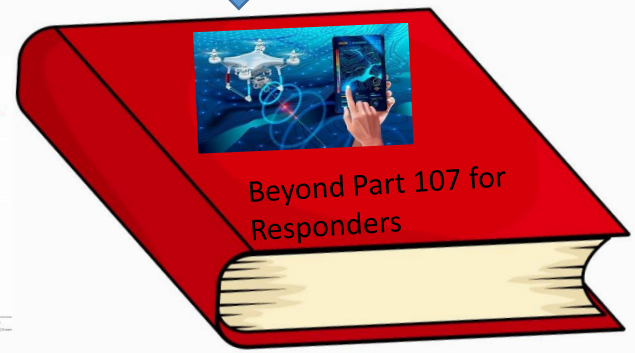






Regulations

UAS Disaster COA/Waivers



Mock Events and Demonstrations

Re: Images from Internet Sources

Step one: Develop a standard set of disasters

Four Major Groups; Seventeen Subsets

Wind and Storm
- Wind & Storm – Hurricanes
- Wind & Storm – Tornadoes
- Wind & Storm – Wind
- Wind & Storm – Flood

Geohazards
- Geohazards – Volcano
- Geohazards – Seismic
- Geohazards – Landslide
- Geohazards – Subsidence
- Geohazards – Avalanche

Technological
- Technological – Pandemic
- Technological – Oil Spill
- Technological – Terrorism
- Technological – Vehicular
- Technological – Biohazard
- Technological -- Other

Fire
- Wildland Fires
- Industrial-Urban Fires

Step two: Conduct On-line Survey of Emergency Responders

- Survey developed in Qualtrics through an iterative process with input from an expert advisory committee
- Targeted both users and non-users of UAS across six professional sectors
- Consisted of 43 total questions and 2 primary branches; respondents were directed to the appropriate branch based on their response to question 1.8, “Does your organization have a UAS program?” in the Introduction question block. The “yes” branch has a maximum of 38 potential questions. The “no” branch has a maximum of 13 potential questions.

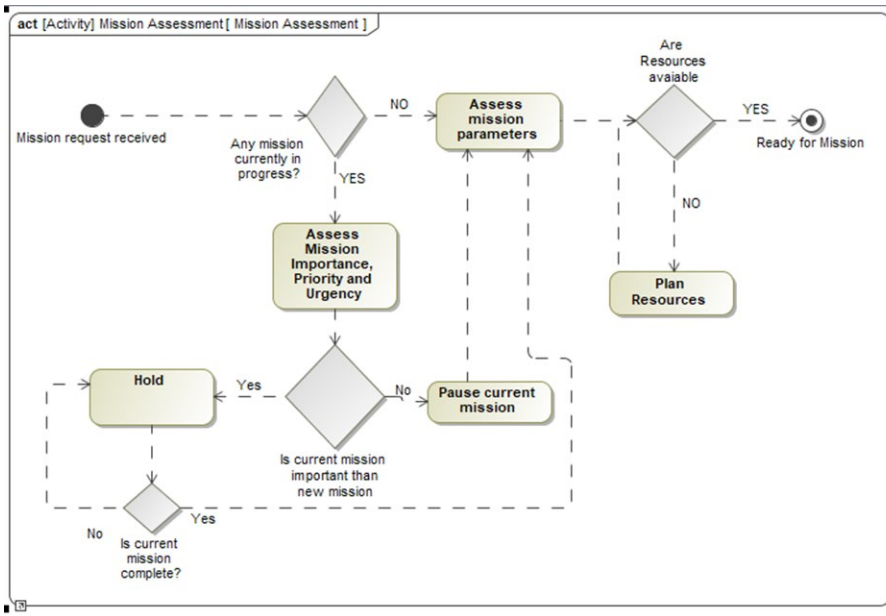
Step three: Produce a Detailed Case Study/ Characterization Report on Each Candidate Disaster

- Wind & Storm – Hurricanes
  - Hurricane Harvey – TX& LA, 2017
  - Location: Texas and Louisiana
  - Year: 2017
  - FEMA Declared: Yes (DR-4332-TX, EM-3382-LA, FEMA-4332-DR)
  - Estimated Cost: $125 billion

Step four: MBSE Process Modeling and Diagramming of Selected Disasters

- Produce Block Definition Diagram for disaster response relationships
- Produce Use Case Diagram for disaster response dataflow interface
- Produce Activity Diagram for disaster response mission assessment interaction

Specific Disasters in MBSE Toolset
Mississippi Flooding
Vermont Missing Person
North Carolina Hurricane
Texas Crane Collapse
Texas Tornado



Typical Block Diagram

Step five: Identify Use Cases/CONOPS for each disaster type

- For each disaster type, the CONOPS is defined by:
  - Mission Purpose/Objectives
  - Mission Procedures/Approach
  - Mission Results
  - Mission Milestones
- Level of detail is sufficient to support:
  - Safety & Operational Risk Assessment (ORA)
  - Mitigation Plans
  - Serve as a detailed “script” for events – Seminars, Drills, Tabletop Exercises, Practical Exercises
- Contents of each CONOPS includes
  - Situation
  - Systems
  - Mission
  - Execution
  - Administration & Logistics
  - Command & Signal
  - Appendices of Maps, Charts, Imagery

Beyond Part 107 Document for First Responders

Description

- The Beyond Part 107 is a document created by the University members of ASSURE to assist in the simplification of rules, understanding of the intent of each rule, and suggested responses for First responders to comply with each rule. The hopeful outcome of the Beyond Part 107 is to provide first responders with an understanding the rules that govern operations of Unmanned Aircraft, particularly while conducting more risky operations, and provide additional resources such as quick references to common acronyms.

Couple of examples:

- ATM Air Traffic Management
- BVLOS Beyond Visual Line of Sight
- LAANC Low-Altitude Authorization Notification Capability

Beyond Part 107 Document for First Responders

Part 107.43 Operation in the vicinity of airports:

- No person may operate a small unmanned aircraft in a manner that interferes with operations and traffic patterns at any airport, heliport, or seaplane base.

Interpretation of Part 107.43 for First Responders

- sUAS operations near airports must be coordinated in a way to avoid any interference with day-to-day airport functions. The RPIC must be prepared to always give way to manned aircraft. These include small and specialized airports, for instance, uncontrolled airports without a tower, heliports, grass strip airports, and seaplane bases.

Practical Suggestions for Complying with Part 107.43

- While operating a small UAS near an airport the RPIC must maintain their situational awareness to keep clear of manned aircraft operations. It is strongly advised that the RPIC use a VO during operations near airports as well as a radio tuned to the airport, or the nearest airport, and Common Traffic Advisory Frequency (CTAF).

FEMA Preparedness Cycle for Exercises (Task 2)

A52 Requirements:

- Plan - Mock Event Demonstration Plan
- Organize – Select participants and capabilities
- Exercise – the actual testing event including the test, daily hot wash, data/information capture, participant feedback, etc.
- Evaluate – After Action Reviews, test event results, planning, collection of lessons learned, technology assessments, etc.
    - Feedback for the next Mock Event Demonstration
    - Mock Event Demonstration Test Report and Review
    - Next Demo Approval

Potential Exercise Locations

Event	Location	Exercise Lead	Project Lead
Hurricane with Flood	South Alabama or Texas	NMSU & UAF, UAH	UAH, NCSU, MSU, KSU
Tornado	Mid-West or Mississippi	NMSU & UAF, UAH	MSU, UAH, KSU
Earthquake	Alaska or MUTC	NMSU & UAF, UAH	UAF, KSU
Fire Event	TBD	NMSU & UAF, UAH	OrSU, UVM, KSU
Train Derailment	Clovis NM or Vermont	NMSU & UAF, UAH	UVM, KSU
Terrorist Attack at Airport	Huntsville (HSV) Airport	UAH, NMSU & UAF	UAH, NMSU, KSU
Health Pandemic	TBD	NMSU & UAF, UAH	UVM, KSU

Moving forwards

- Seminars, Workshops, Drills and Full Scale Exercises Mapped to all Disasters
- All events planned and ready to conduct based on developed planning documentation