FAA UAS SYMPOSIUM

Unraveling Risk

Federal Aviation Administration

AUVSI

Unraveling Risk

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#UAS2019

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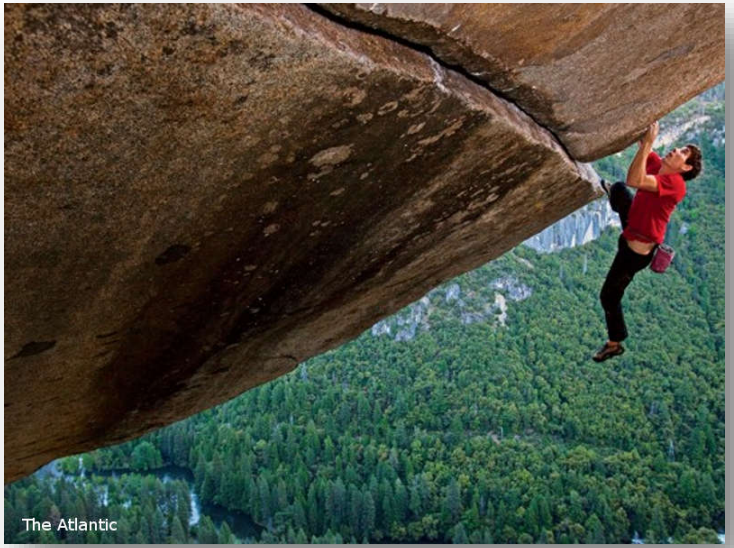
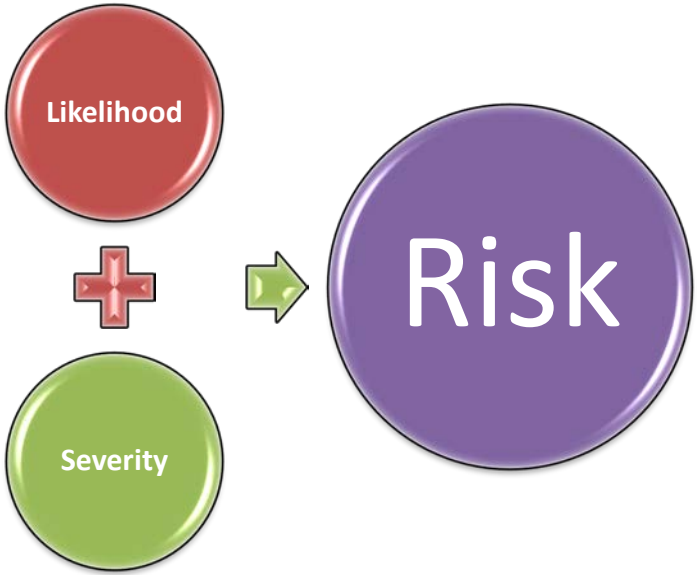
Understanding Hazards vs. Risk



The Risk Matrix (Small Aircraft)



Likelihood \ Severity	Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Frequent A	[Green]	[Yellow]	[Red]	[Red]	[Red]
Probable B	[Green]	[Yellow]	[Yellow]	[Red]	[Red]
Remote C	[Green]	[Green]	[Yellow]	[Yellow]	[Red]
Extremely Remote D	[Green]	[Green]	[Green]	[Yellow]	[Red] * / [Yellow]
Extremely Improbable E	[Green]	[Green]	[Green]	[Green]	[Yellow]

High Risk [Red]
Medium Risk [Yellow]
Low Risk [Green]

* High Risk with Single Point and/or Common Cause Failures

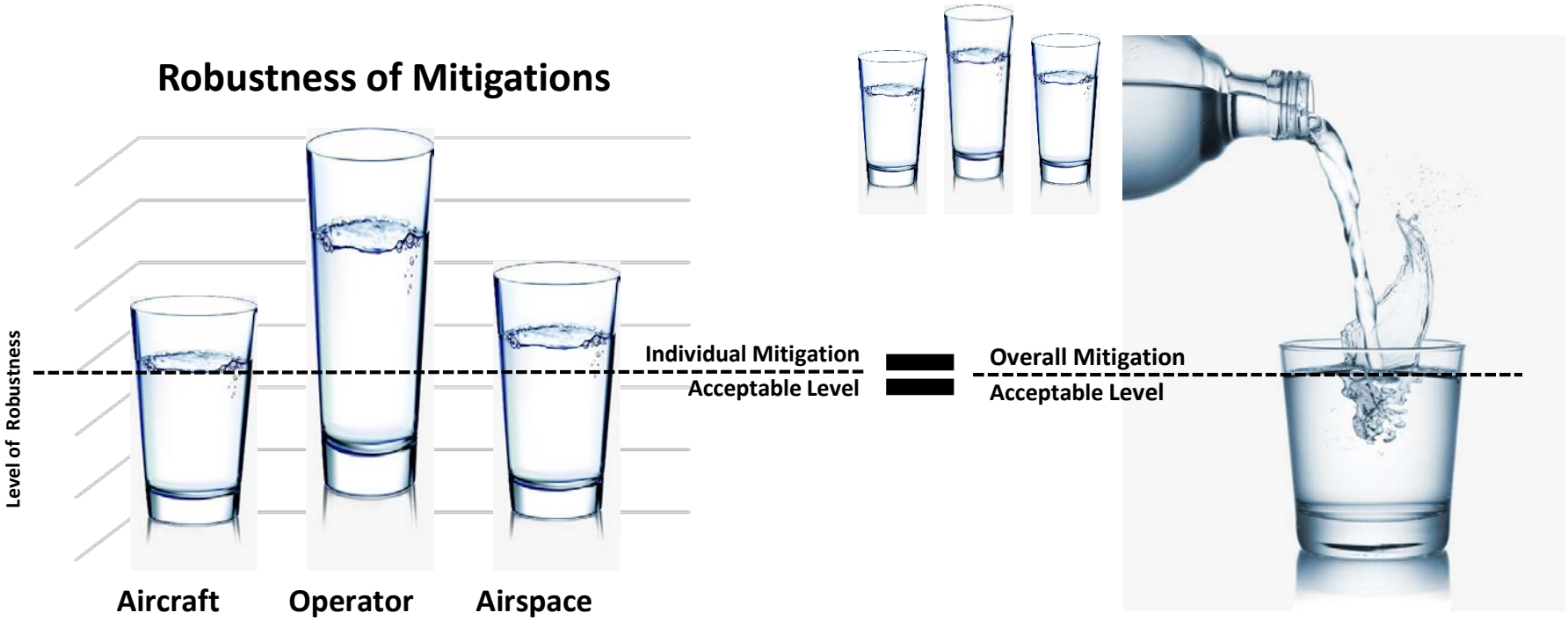
Breaking Down Severity

Minimal 5	Minor 4	Major 3	Hazardous 2	Catastrophic 1
Negligible safety effect	- Physical discomfort to persons - Slight damage to aircraft/vehicle	- Physical distress or injuries to persons - Substantial damage to aircraft/vehicle	Multiple serious injuries; fatal injury to a relatively small number of persons (one or two); or a hull loss without fatalities	Multiple fatalities (or fatality to all on board) usually with the loss of aircraft/vehicle

Breaking Down Likelihood

	Qualitative	Quantitative – Time/Calendar-based Occurrences Domain-wide/System-wide
Frequent A	Expected to occur routinely	Expected to occur more than 100 times per year (or more than approximately 10 times a month)
Probable B	Expected to occur often	Expected to occur between 10 and 100 times per year (or approximately 1-10 times a month)
Remote C	Expected to occur infrequently	Expected to occur one time every 1 month to 1 year
Extremely Remote D	Expected to occur rarely	Expected to occur one time every 1 to 10 years
Extremely Improbable E	Unlikely to occur, but not impossible	Expected to occur one time every 10 years

Taking a Holistic Approach to Risk



Must be met in each area

Must be met overall

FAA Safety Risk Management (SRM) Philosophy

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FAA's Role as a Regulator

- FAA has a responsibility to regulate with safety risk in mind
  - FAA uses regulations and standards to control safety risk in the system
  - Waivers are the removal of safety risk controls and therefore require a safety assessment
- FAA needs confidence that granting regulatory relief would:
  - Not adversely affect safety OR provide a level of safety at least equal to that provided by the rule being relieved
  - Control safety risk to an acceptable level (as determined by FAA Management)
- Operator still has ultimate responsibility for the safety of their operation and compliance with applicable regulations

Making the Case for Safety

The *operator produces the safety assessment* used as an input to the FAA safety review and approval/denial decision

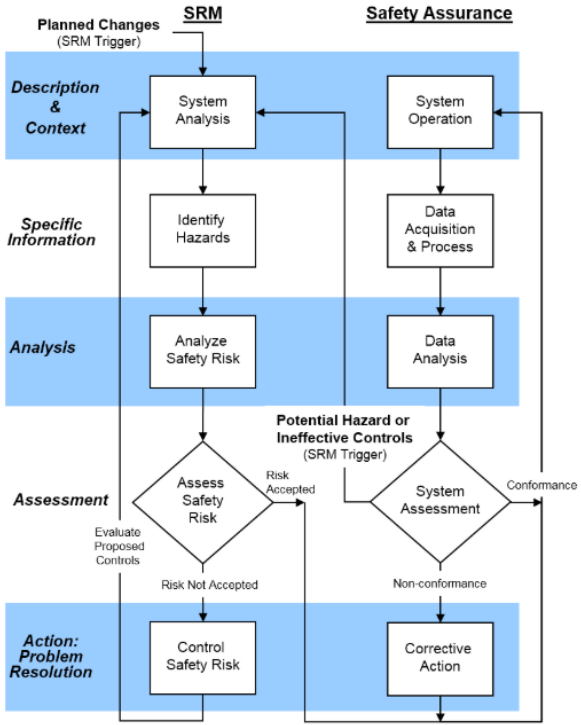
The *FAA may perform a safety assessment of its own* to provide confidence necessary for the approval/denial decision

Basis for FAA Decision

For the FAA to reach a decision, it requires:

- A clearly defined operation (i.e., risk picture)
  - Include specific details of the operation (i.e., what, when, where, who, and how)
  - How is the operator controlling the severity and likelihood of what could happen for the proposed operation?
  - What is the predicted severity and likelihood with those controls in place?
- Solid rationale and supporting data (i.e., proof)
  - Manned aircraft within operating area
  - Population below operating area
  - Failure modes and rates
  - Reliability levels
  - Test results (i.e., occurrences rates)

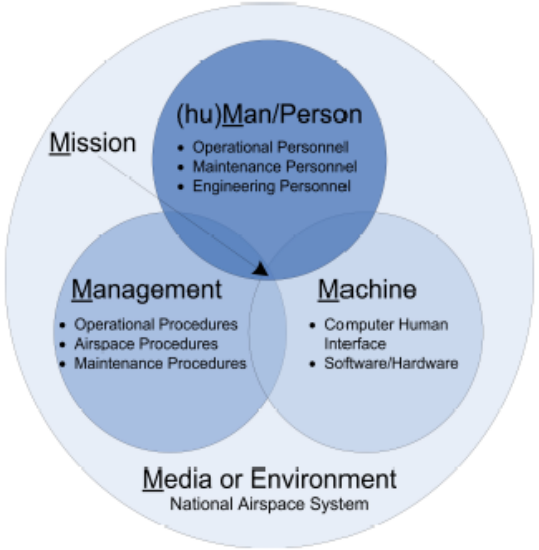
SRM Interaction with Safety Assurance



- Flight Standards has a responsibility to:
  - Assess compliance with regulatory requirements and any other safety risk controls set by the FAA as well as those developed by a operator's SRM process
  - Measure and assess the effectiveness of safety risk controls and determine the need for changes to or additional safety risk controls
- SRM and Safety Assurance (SA) processes operate in a continuous exchange

Properly Defining the System

- Understanding the different elements of the system is key to effective risk assessment and management
- New UAS operations challenge risk control framework of existing regulations
  - Operating regulations tie together the different parts of the system to enable safe operation (e.g. aircraft design, operating conditions, pilot qualification, airspace procedures, etc.)
  - Regulatory responsibilities may need to evolve to consider:
    - Increased level of automation
    - Use of UTM Service Providers
    - Novel business models



5M Model

AIR Efforts Towards Risk-Based Certification

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- Level of Rigor Tied to Aircraft, Type of Use, and Area of Operation
- "Low Risk" UAS Ops Still Require TC for Compensation/Hire Commercial Use
- Creating Regulatory Structure for Low, Medium, High Risk UAS

- Certification manages risk through "Safety Assurance"
  - Confidence a proposed product or action will meet FAA safety expectations to protect the public
  - FAA risk-based TC processes are well-proven
- SORA-based Risk Analysis Tool Sets Level of Rigor In Development
  - Using Low, Medium, and High Classification for UAS to Set Level of Rigor
- Risk Framework - Two Dimensional Risk Framework Considers UAS Performance and Use Case

AIR Tiered Risk Framework

- Combines JARUS SORA-like Airspace Encounter Classes and Energy Based Risk Classes
- Lower Risk Part 107 and TC utilizing reliability as MoC
- High Risk – Using 21.17(b) TC Process
- Medium Risk – To Be Addressed by MOSAIC Rule

	Airspace Impact on Design Rigor											
UAS Performance Based Risk Class	Low Risk : Uncontrolled, Zero to Low Population, Low Density Airspace			Medium Risk Airspace: Uncontrolled Over Populated Areas, Above 500 Ft.					High Risk Airspace: Airport, Mode C, TMZ Controlled – High Population			
	12	11	10	9	8	7	6	5	4	3	2	1
6												
5												
4												
3												
2												
1												

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Lunch Plenary starts at 12:30 PM…

Delivery by Drone – On the Route to Routine

Boxed lunch available – Level 400 Ballroom

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Back-Up

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5 Common Hazards

1. Technical issue with UAS
2. Deterioration of external systems supporting the UAS operation
3. Human error
4. Adverse operating conditions
5. Unable to see and avoid

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