

EXPLORE FLIGHT

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Safety's Two Parts – Design Safety & Operational Safety



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NASA

National Academies Recommendations



NASA

National Academies Recommendations

- An IASMS will continuously monitor the NAS to collect data on the status of aircraft, air traffic management (ATM) systems, airports, weather, and so on, and then assess that data, as follows:
 - Assess data on a second-by-second, minute-by-minute, and hour-by-hour basis to detect or predict elevated risk states based on rapid changes in system status.
 - Assess data over periods of days to detect risks based on longer-term trends.
 - Detect and predict elevated risk states that arise from a confluence of factors, none of which by itself would be noteworthy
 - Assess data in the context of a thorough understanding of (1) the nominal performance of systems and operators, (2) historical data regarding both the occurrence and consequences of off-nominal situations, and (3) the fault tolerance of the NAS and its key elements.
 - Assess system outputs over long periods of time to identify emergent risks that in some cases should be added to the list of risks that the system is designed to check for.
- An IASMS will be focused on risks that require safety assurance action in-flight or prior to flight.
- Safety Assurance actions generated by an IASMS may take the form of recommendations that operators take action. In some cases when urgent action is required, IASMS may be designed to initiate safety assurance actions on their own

IASMS High-Level Architecture (National Academies)





Scope of the Academy's Safety Management System



- Overall Safety
 Management System
 - In-Time Aviation
 Safety Management
 Systems (IASMS)
 - In-Time System-Wide Safety Assurance (ISSA)



Stakeholders vary by domain (e.g., Commercial Ops, sUAS, UAM, GA)

Operational Safety: In-Time System-Wide Safety Assurance





In-Time Aviation Safety Management System (IASMS)





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Emerging TC-x: End to End IASMS Safety Demonstrators



- Purpose: Leverage the emergency-response community assembled and energized by STEReO to develop and deliver IASMS related safety enhancements, tools and processes needed for increasingly autonomous, heterogeneous air vehicle missions. Leveraging this community lowers the cost for development and assurance of safety processes and tools while providing immediate societal benefit.
- Accelerated series of use cases and demonstrations of an increasingly complex and capable IASMS
- SD-0: Baseline Safety Measurements and Prototypes leveraging already-planned STEReO data and missions
- SD-1: IASMS for Disaster Monitoring and First Responder related deliveries
 - Dedicated airspace;
 - Move towards increasing m:N ops in conjunction with TTT and AAM/HDM;
 - Focus on development and assurance of assess and monitor functions. Alert operators for mitigation
- SD-2: Urban to Rural Medical Emergencies or Forest Fires Manned and unmanned vehicles
 - Transition between shared and dedicated airspace (in conjunction with ATM-X);
 - Move towards increasing m:N ops in conjunction with TTT and AAM/HDM;
 - Increase capabilities of assess and monitor functions. Develop and assure mitigation services for 'simple' contingencies.
- SD-3: Urban emergency response in a major disaster (Earthquake, pandemic)
 - Shared airspace in degraded urban environment (in conjunction with ATM-X);
 - Assumes full m:N ops in conjunction with TTT and AAM/HDM;
 - Assess, monitor and mitigation services for complex contingencies.

Summary of ISSA Capabilities and Services

Risks to Operation:

- Flight Over People 3rd party risk
- Flight Over Moving Vehicles 3rd party risk
- Weather
- Vehicle system failure power system, propulsion system, CNS, CC
- Traffic Collision

SWS ISSA Solutions:

- Casualty Metric Modeling
 - Pre-flight cell phone model seasonal
 - Ops-Time cell data model
- Advanced Weather Models
 - Cell phone service Climacell
 - Infrastructure fed
- Vehicle health monitors
 - Battery health monitor
 - Time remaining model
- DAA Safety Monitor
 - Vehicle response
 - Reporting of detection

- RF Interference Models
 - RT Updated models from vehicles and infrastructure
 - Historical models from database
- GPS Degradation Models
 - Ops-Time Updated models from vehicles and infrastructure
 - Pre-Flight estimated Vehicle Position + GIS
 + satellite position models
- APNT Solutions
 - LOCD-IN 4/5G augmentation
 - LOCATA
 - NextNav

- ATM-X Metric
 - Deconfliction algorithm and model monitor
 - UTM Participant validation with DAA detection combined with UTM information

- Terrain Collision (CFIT)
- Obstacle Collision (building, tower, etc)
- RF Interference
- GPS Degradation
- 4DT route conflict resolution failure



Conclusions



- Safety Demonstrators provide a tail wind to help speed the development of an IASMS for AAM implementation.
- The Safety Demonstrator series represents the scaling complexity of autonomous flight and contingency management that require increasingly numerous and integrated ISSA services and capabilities to assure safety.
- ISSA services and capabilities can be leveraged by IASMS for integrated safety assurance and risk management.