
Loss of Control – Inflight Research Program (core research funding)

**Tom Teller
MIT Lincoln Laboratory**

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Overview

- **Need for LOC-I Human Factors Research**
- **LOC-I Research Needs and Sponsors**
- **LOC-I Research Overview**
- **Current Research Activities/Findings**
- **Planned FY14 Research**



Loss of Control – Inflight (LOC-I)

- Recent high profile commercial aviation accidents highlighted risks posed by LOC-I and needs for flight crew training

- Air France 447 (1 JUN 2009)

- Investigation revealed loss of control subsequent to high altitude stall
- Extensive flight envelope protection nullified by pitot-static icing and flight control system reversion to degraded mode
- Training of crew for stall recognition/recovery in degraded modes a factor



- Colgan 3407 (12 FEB 2009)

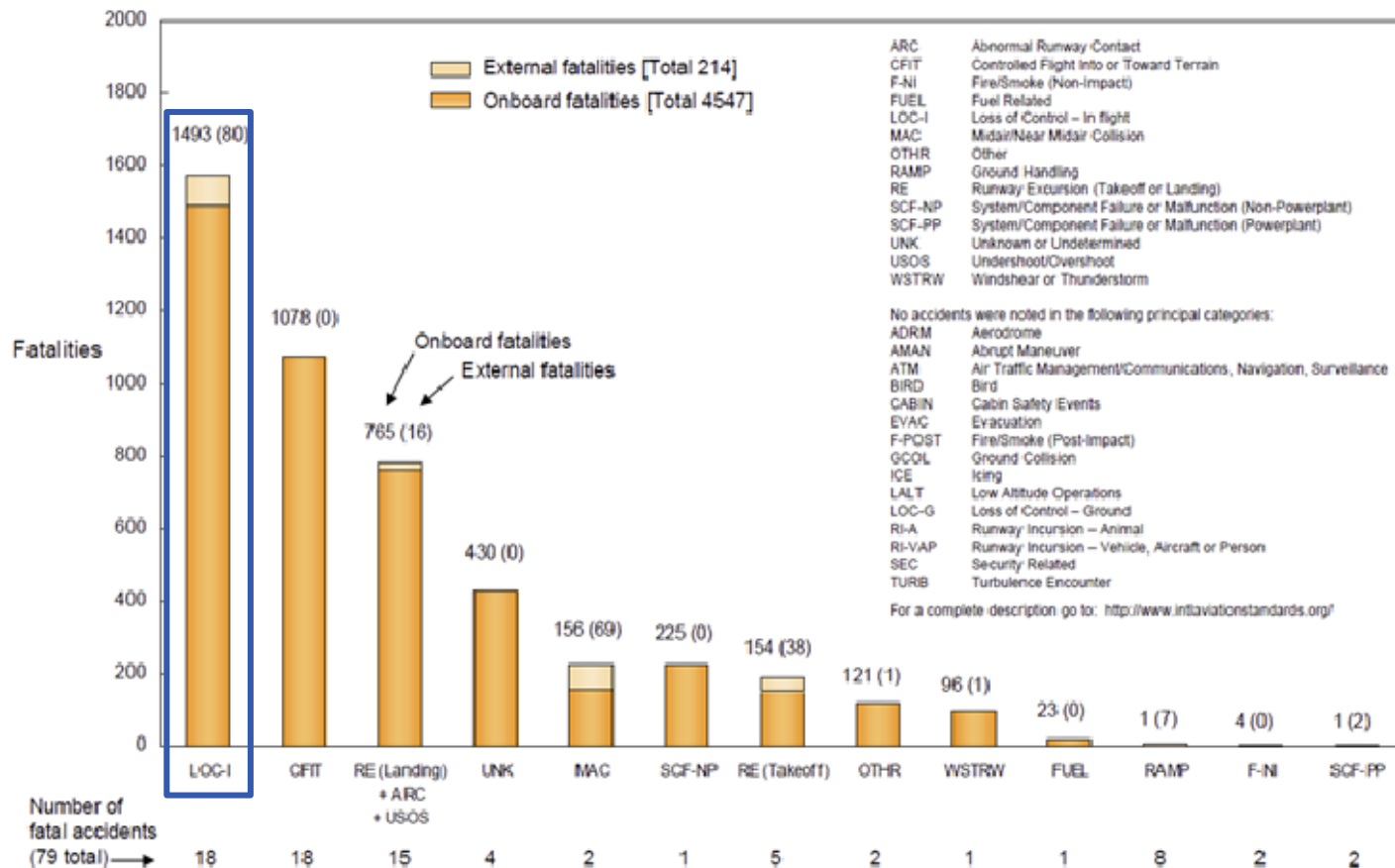
- Investigation revealed loss of control subsequent to approach to landing stall
- Pilot pulled through “stick shaker” and “stick pusher” warning systems
- Pilot training confirmed to industry standards
- Startle/Surprise deemed a factor





LOC-I Leading Cause of Accidents

- World-wide scheduled commercial jet accidents 2002-2011



Note: Principal categories as assigned by CAST.

Source: Boeing

- Technological mitigations not readily available



LOC-I Research Needs and Sponsors

- **LOC-I: “Loss of aircraft control while, or deviation from intended flightpath, inflight” (ICAO Common Taxonomy for Occurrences)**
- **Current research to support FAA review of the report of the Air Carrier Safety and Pilot Training ARC, and the development of a new Advisory Circular providing training and regulatory guidance to airlines/operators to mitigate LOC**
 - **Project Manager: Michelle Yeh (ANG-C1)**
- **Sponsors**
 - **Kathy Abbott**
 - **Robert Burke**
 - **Robyn Laporte**
 - **Doug Farrow**
- **Key stakeholders**
 - **Jeffery Schroeder**
 - **Tom Chidester**
- **Regulatory and Guidance Material**
 - **FAA AC 120-109 Stall and Stick Pusher Training (AUG 2012)**
 - **Public Law 111-216 Mandate for Full Stall Recovery Training**
 - **New AC on Upset Prevention and Recovery Training**



Highlights of Prior Work

- **International efforts to study/respond to LOC-I**
 - **Commercial Aviation Safety Team – Joint Safety Analysis Team (2003)**
 - Mandate initial and recurrent upset recovery training including stall recognition and recovery training
 - **Airplane Upset Recovery Training Aid (URTA) (Rev.2 2008)**
 - Extensive background on upset causes, dynamics, and recoveries with recommendations for comprehensive training program guidance
 - **Royal Aeronautical Society (RAeS) – Flight Operations Group (2010)**
 - Report on history, core concepts and mitigation`
 - **NASA LOC Study Team (2010)**
 - Examination of LOC accidents and recommendations for mitigation
 - **UK Loss of Control Task Force (2011)**
 - LOC causal factors and recommendations for mitigation
 - **International Committee for Aviation Training in Extended Envelopes (ICATEE)**
- **FAA/ICAO Loss of Control Aviation Rulemaking Committee (2010-2013)**



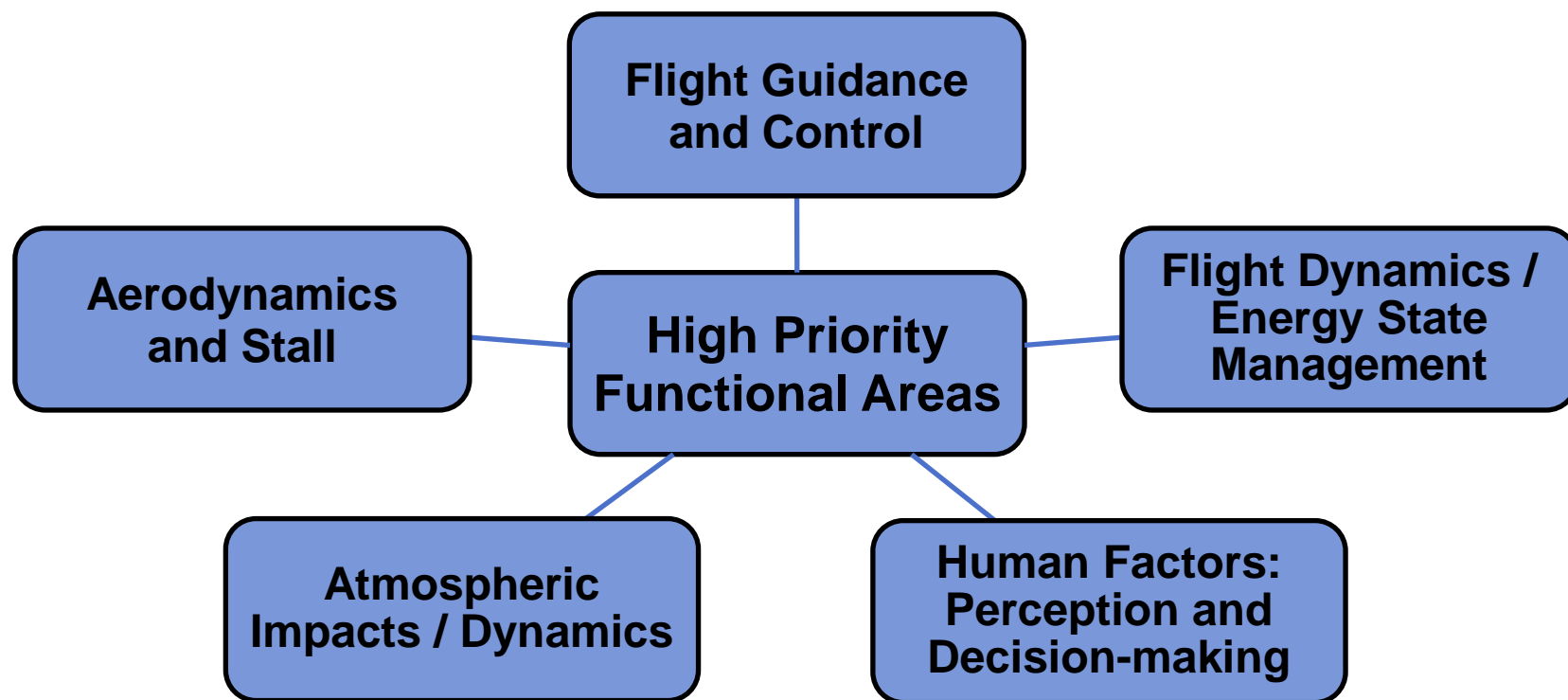
LOC-I Research Overview

- **Phase I: Completed comprehensive literature review of existing LOC-I studies including causal and contributing factors (MIT LL, PI: W. Olson in conjunction with FAA CAMI) (JAN 2013)**
 - Reviewed and summarized existing LOC-I assessment, findings, and guidance including Airplane Upset Recovery Training Aid (URTA) and ICATEE Upset Prevention and Recovery Training Matrix (Draft)
 - Proposed guidelines and specific training recommendations to mitigate LOC-I in all phases of potential LOC event:
 - Awareness/Avoidance
 - Detection/Recognition
 - Recovery
 - Identified particular issues impacting mitigation through training
- **Phase II: Develop priority objectives and measurable outcomes for training to mitigate LOC-I with initial emphasis on air carrier operations (MIT LL, PI: T. Teller) (MAR – OCT 2013)**



Framework for LOC-I Priority Training Objectives/Outcomes

- LOC-I Training Objectives/Outcomes organized in framework of five functional areas judged to be of high priority by likelihood of involvement and severity of impact

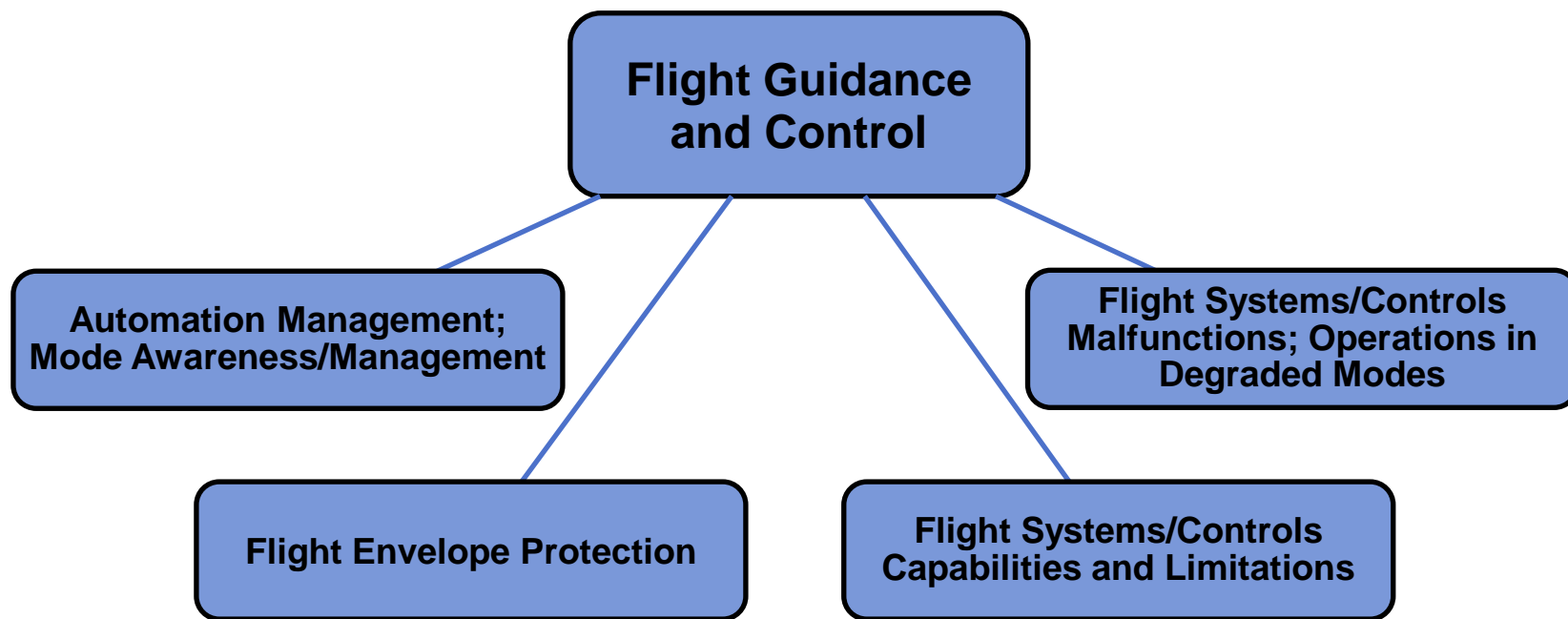


- Framework applicable to all levels of pilot training/certification



Each Functional Area Further Decomposed to Key High-Level Sub-areas

- For example, for *Flight Guidance and Control*

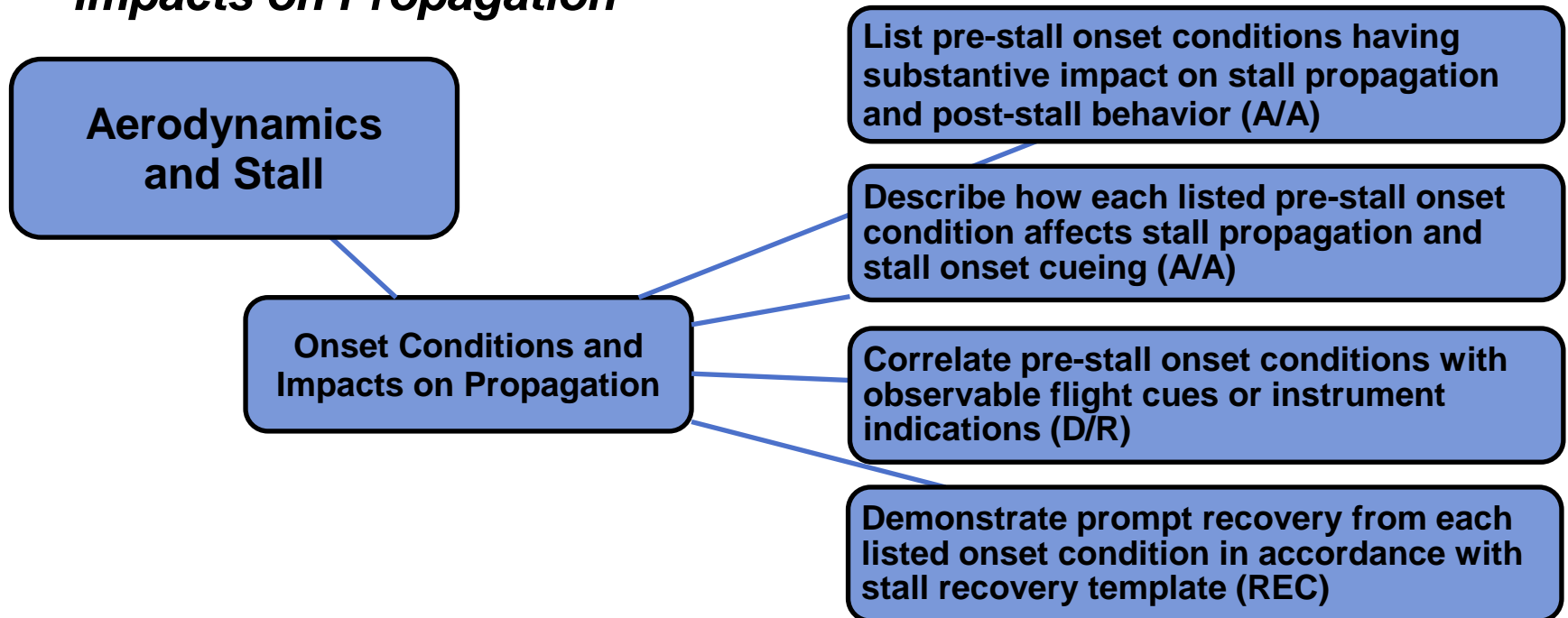


- Not all functional sub-areas applicable to all levels of pilot training/certification, e.g., Flight Envelope Protection is generally applicable only to pilot training/certification for advanced “fly-by-wire” air transport aircraft



High-Level Objectives Specified for each Functional Area/Sub-area

- For example, for *Aerodynamics and Stall: Onset Conditions and Impacts on Propagation*



- Objectives/Outcomes specified for Awareness/Avoidance (A/A), Detection/Recognition (D/R), and Recovery (REC)
 - Measurable outcomes devolve from objectives and vary with level of training/certification (initial emphasis air carrier training/operations)



Cross Correlation of Objectives/Outcomes

- **Objectives/Outcomes may cross correlate with multiple functional areas/sub-areas, for example:**
 - **Objectives/Outcomes associated with contamination of wings and/or control surfaces may cross correlate with**
 - **Atmospheric Impacts/Dynamics: Airframe Icing**
 - **Aerodynamics and Stall: Onset Conditions and Impacts on Propagation and Post-Stall Variables and Impacts**
 - **Flight Dynamics and Energy State Management: Thrust and Drag**
 - **Flight Guidance and Control: Flight Systems/Controls Capabilities and Limitations**
 - **Once priority objectives/outcomes fully specified, resulting set will be re-indexed in accordance with instructional/training design hierarchy rather than by functional area/sub-area, eliminating duplications due to cross correlation**



Concurrent Activities in Support of Development of Objectives/Outcomes

- **Informal consultation with air carriers and other operators regarding current LOC-I training implementation and priorities**
 - Interpretation of current LOC-I training and regulatory guidance including implementation of “best practices” identified by ARC
 - Training modalities and best practices
 - Priorities for future LOC-I training guidance and requirements
- **Support for other concurrent efforts linked to LOC-I training**
 - Technical review of startle/surprise/distraction in the cockpit (FAA ANG-C1, PI: F. Jentch, University of Central Florida Orlando)
 - Evaluation of simulator software models for conducting mandated air carrier full-stall training (FAA, PI: J. Schroeder)
- **Collaboration with key stakeholders to address challenges to implementation of LOC-I Training**
 - Development of realistic and repeatable training scenarios
 - Methods and metrics to assess LOC-I training effectiveness



Planned FY 14 Research

- **Additional work required to fully realize and implement LOC-I training objectives/outcomes**
 - **Identify set of tasks for implementing upset recovery training and develop specific performance standards for these tasks**
 - **Provide review of evaluation of computer models for training/simulation of LOC-I**



Summary

- **Current research supports:**
 - **FAA review of report and recommendations of the Air Carrier Safety and Pilot Training ARC**
 - **Development of a new Advisory Circular providing training and regulatory guidance to airlines/operators to mitigate LOC**
- **Current research focused on developing priority objectives and measurable outcomes for training to mitigate LOC-I with initial emphasis on air carrier operations**
- **Additional work required to fully realize and implement LOC-I training objectives/outcomes**
 - **Identify set of tasks for implementing upset recovery training and develop specific performance standards for these tasks**
 - **Provide review of evaluation of computer models for training/simulation of LOC-I**