# LOSS OF CONTROL ROOT CAUSE MODELING

Meeting 9 - Report out to EAA

June 14th 2019



### WELCOME



Andy Bryan

Charlie J

Dave

> Jim

Mike

▶ Robert P

> Tom

Robert O

### CHECK IN





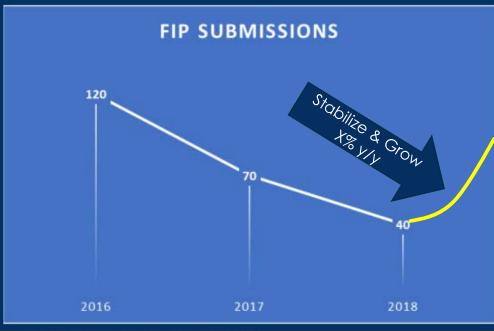
- Meeting Objectives:
  - Present our results to the EAA
  - Get EAA guidance on next steps
- Discussion Topics
  - Introductions EAA and our Team
  - Overview of the Root Cause Model development
  - High-level model architecture
  - Presentation of groupings details
  - Learnings
  - Innovation space, bow tie and swiss cheese models
  - Other uses for the model
  - Next Steps how to communicate to the FIP community, other applications

### MEETING OBJECTIVES & AGENDA

### FIP PROGRAM GOALS

(PROPOSED TO EAA IN 2018)

- Dramatically Increase the FIP Program in <u>Three Dimensions</u>:
  - ▶ 1. Number of FIP submissions
  - ▶ 2. Quality of Submissions
  - 3. "Conversion Rate" to implemented solutions in the GA fleet
- To achieve a measurable decrease in LOC fatalities

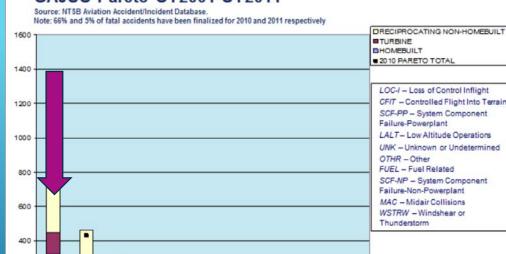




CFIT SCF-PP

LOC-I

LALT



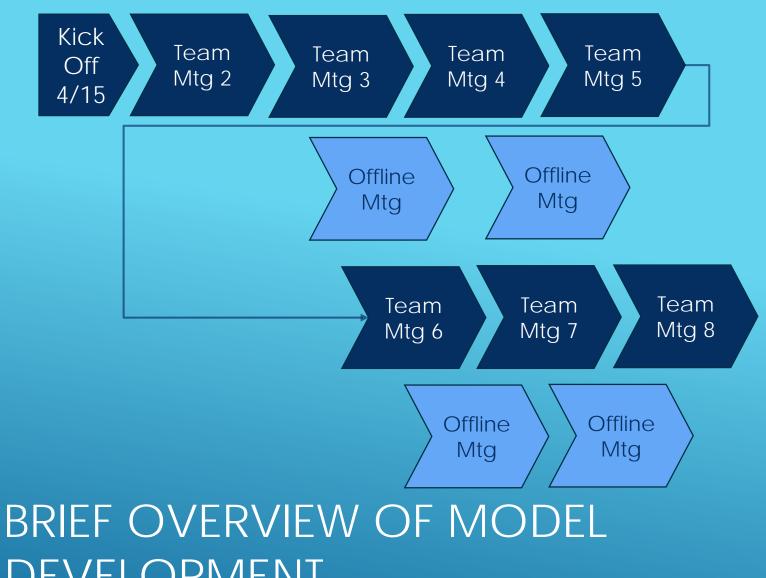
#### **Our Efforts**

- RCM →
- Narrative



END IN MIND





DEVELOPMENT

# Model Themes & Architecture

Pilot Actions and Behaviors

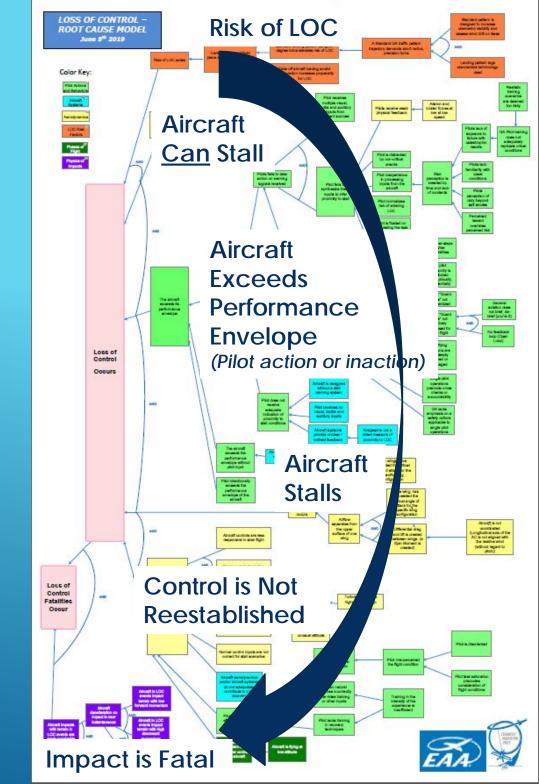
Aircraft Systems

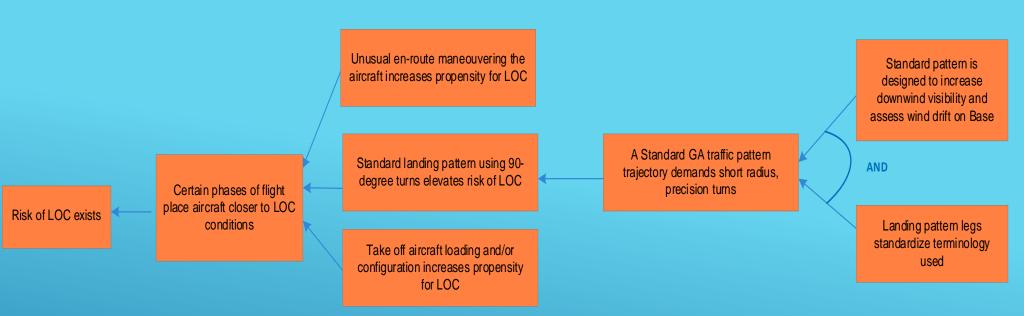
Aerodynamics

LOC Risk Factors

Phases of Flight

Physics of Impacts





### RISK OF LOC EXISTS - MIKE

It is possible to command an aircraft to exceed the performance envelope

(Performance: cost trade off that meets market preferences)

- Aircraft Design
  - Design trade-offs mean that aircraft are <u>capable</u> of exceeding their performance envelopes

#### AIRCRAFT DESIGN

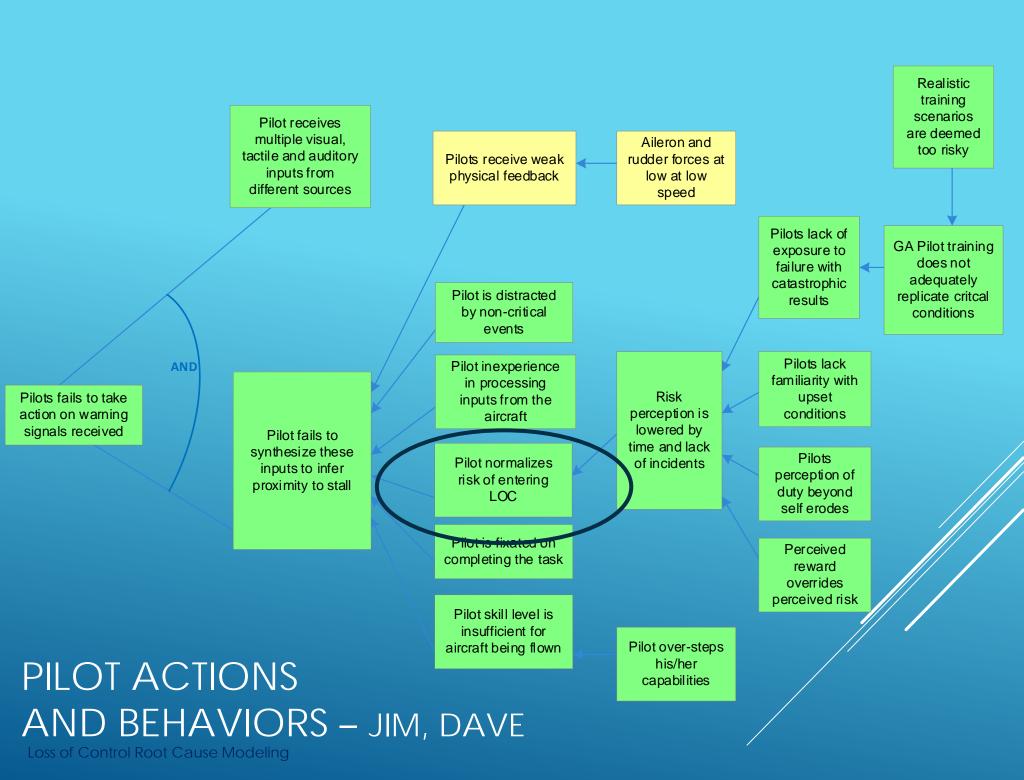
Pilots fails to take action on warning signals received

The aircraft exceeds its performance envelope The aircraft is flown into a stalled condition

## PILOT ACTIONS AND BEHAVIORS (1)

Loss of Control Root Cause Modeling

Pilot does not receive adequate indication of proximity to stall conditions



**GA** pilot community is distributed geographically, experientially Safety "Guard Rails" not standardized Safety "Guard Rails" not routinely discussed for **GA Pilot culture** each flight underemphasizes **GA flying** actual flight risk missions are not deeply defined or managed Single pilot operations preclude cross checks or accountability **GA lacks** emphasis on a safety culture

PILOT ACTIONS AND BEHAVIORS -CULTURE - TOM, CHARLIE

Loss of Control Root Cause Modeling

applicable to single pilot operations

General aviation does not brief, debrief (you're it)

AND

No feedback loop (Open Loop)

Pilot does not receive adequate indication of proximity to stall conditions

Aircraft is designed without a stall warning system

Pilot receives no visual, tactile and auditory inputs

Aircraft systems provide unclear / indirect feedback

Airspeed is not a direct measure of proximity to LOC

## PILOT ACTIONS AND BEHAVIORS (C) – AIRCRAFT SYSTEMS SUFFICIENCY BRYAN

Airflow separates from the upper surface of both

Stall of wing(s) occurs

wings

Airflow separates from the upper surface of one wing

Both wings have exceeded the critical angle of attack for the specific wing configuration

AND

One wing has exceeded the critical angle of attack for the specific wing configuration

Differential drag and lift is created between wings (a Spin Moment is created)

Aircra is not coordinated (Longitudinal axis of the AC is not aligned with the relative wind (without regard to pitch))

### BASIC AERODYNAMICS

Aircraft controls are less responsive in slow flight AND Flight controls (including power) have insufficient authority to re-enter the performance envelope Turbulence causes Aircraft structure Control surfaces are no Control of the higher than design becomes longer effective aircraft is not reloads damaged established Instrumentation Pilot acts on incorrect performance is information affected by unusual attitude Normal control inputs are not correct for stall scenarios

### CONTROL IS NOT RE-ESTABLISHED (1) DAVE



CONTROL IS NOT RE-ESTABLISHED (2) - MIKE

Loss of Control Fatalities Occur

# IMPACTS ARE FATAL ROBERT

Aircraft impacts with terrain in LOC events are rarely survivable Aircraft decelleration on impact is near instantaneous

D

Occupants remain in the aircraft in LOC events

Aircraft in LOC events impact terrain with low forward momentum

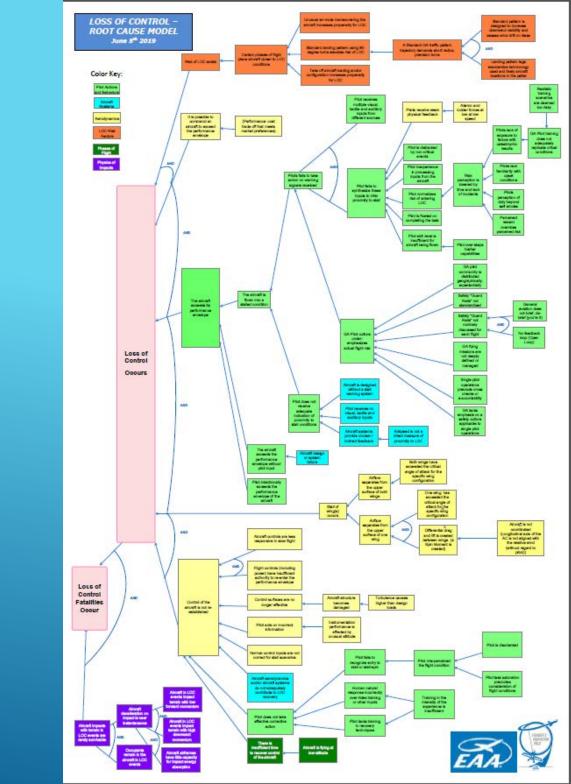
AND

Aircraft in LOC events impact terrain with high downward momentum

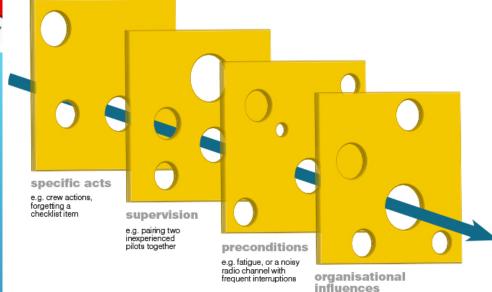
Aircraft airframes have little capacity for impact energy absorption

- LOC fatalities have a multitude of causes
  - There is <u>no one solution</u> to this problem
- The preponderance of causes are "green" Pilot Actions and Behaviors
- Single GA Pilot risk normalization and lack of a cohesive safety culture are likely major underlying causes
- There is little data on LOC accidents at the granularity of this model
- There is <u>ample</u> innovation space on specific causes in the model
- There is also innovation space in addressing the <u>chain</u> of events
  - Bow tie and Swiss Cheese models illustrate additional opportunities

#### KEY LEARNINGS







e.g. airline culture that places great value on on-time departure, thereby creating subtle pressure to get through checklists quickly

### SAFETY BOW TIE & SWISS CHEESE MODELS

- ▶ FIP Judging Criteria
- Pilot Training syllabi upgrades
- CFI Training syllabus upgrade
- Improved GA Accident Investigation Template (LOC only)
- Innovation around Better Accident Data Gathering
- ERAU Interest
  - ▶ Tom

### OTHER USES FOR THE MODEL

### DISCUSSION AND NEXT STEPS

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