Loss of Control Inflight (LOC-I)

Session #6
Presentation #1
Mitigation of LOC-I risk in MID Region

Chamsou Andjorin
Director, Aviation Safety
ME and Africa
The Boeing Company
Fatalities by CAST/ICAO (CICTT) Aviation Occurrence Categories
Fatal Accidents – Worldwide Commercial Jet Fleet

Fatalities by CAST/ICAO (CICTT) Aviation Occurrence Categories

- CFIT
- LOC In-Flight
- Mid-Air Collision
- Fire/Smoke (non impact)
- Runway Excursion (T/O & Ldg)
- Runway Incursion

1993 - 2002
1998 - 2007
2003 - 2012

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Comparison of LOC-I Accidents proportion in 2008-2012 MID region vs World

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<th>World</th>
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<tr>
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<td>2008</td>
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<td>Accident per Million departure</td>
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<td>Number of LOC-I Accident</td>
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<td>% of total Accident</td>
<td>5%</td>
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Comparison of LOC-I Accidents proportion in 2008-2012 MID region vs World
## LOC-I Safety Indicator and Target

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<tr>
<th>Theme</th>
<th>Safety Indicator</th>
<th>Safety Target</th>
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<tr>
<td>Loss of Control In-Flight (LOC-I)</td>
<td>Number of LOC-I related accidents per million departures</td>
<td>Reduce the LOC-I related accidents to be below the global rate</td>
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Loss of Control

Significant Themes

- Lack of External Visual Reference
- Flight Crew Impairment
- Training
- Airplane Maintenance
- Safety Culture
- Invalid Source Data
- Distraction
- System Knowledge
- Crew Resource Management
- Automation Confusion/Awareness
- Ineffective Alerting
- Inappropriate Control Actions

- SE192: Airplane State Awareness - Low Airlspeed Alerting
- SE193: Airplane State Awareness - Non-Standard/Non-Revenue Flights
- SE194: Airplane State Awareness - Standard Operating Procedures Effectiveness and Adherence
- SE195: Airplane State Awareness - Flight Crew Training Verification and Validation
- SE196: Airplane State Awareness - Effective Upset Prevention and Recovery Training
- SE197: Airplane State Awareness - Policy and Training of Non-normal Situations
- SE198: Airplane State Awareness - Scenario-Based Training for Go-Around Maneuvers
- SE199: Airplane State Awareness - Enhanced Crew Resource Management Training
- SE200: Airplane State Awareness - Virtual Day-VMC Displays
- SE201: Airplane State Awareness - Bank Angle Alerting and Recovery Guidance Systems
- SE202: Airplane State Awareness - Bank Angle Protection
- SE203: Airplane State Awareness - Features for Current Production or In-Development Fly-by-Wire Airplane Designs
- SE204: Airplane State Awareness - Features for Existing non-Fly-by-Wire Airplane Designs
- SE205: Airplane State Awareness - Features for Out-of-Production Airplane Designs
- SE206: Airplane State Awareness - Attitude and Energy State Awareness Technologies (R-D)
- SE207: Airplane State Awareness - Airplane Systems Awareness (R-D)
- SE208: Airplane State Awareness - Simulator Fidelity (R-D)
- SE209: Airplane State Awareness - Flight Crew Performance Data (R-D)
- SE210: Airplane State Awareness - Training for Attention Management (R-D)
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<tr>
<td>RAST-MID/LOC-I/1</td>
<td>The construction, approval and implementation of RNAV(GNSS) / RNP-AR procedures to all runways not currently served by precision approach procedures</td>
<td>Safety Management Standardization: Implementation of risk-based standardization</td>
<td>BP-GEN-1, BP-GEN-2, BP-GEN-4, BP-STD-S-12, BP-STD-S-13</td>
<td>High</td>
<td>Moderate</td>
<td>P2</td>
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<td>Long Term</td>
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<td><strong>Safety Enhancement Action (expanded)</strong></td>
<td>To improve the overall performance of flight crews to recognize and prevent loss of control accidents, through effective use of automation-based navigation technology is utilized, at such airfields, to provide the highest level of safety during the conduct of an approach and landing towards the runway.</td>
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<td><strong>Statement of Work</strong></td>
<td>To reduce loss of control accidents, operators will be encouraged to adopt consensus policies and procedures relating to mode awareness and energy state management aspects of flight deck automation, as appropriate to their respective operations.</td>
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<td><strong>Human Resources</strong></td>
<td>IATA, Pilot Associations; Safety, Flight Operations and Training managers; ICAO, CAA’s, aircraft manufacturers, training centers</td>
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## Detailed Implementation Plan Template

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### Financial Resources

The following are some of the activities related to this project:
- Incident data has shown that flight deck automation is a core issue that needs to be addressed.
- To enhance safety, a CAST working group, including aircraft manufacturers, pilot associations, etc. developed a tactical approach and distributed policies and procedures relating to mode awareness and energy state management. The COSCAP GS could use this material to develop a generic advisory circular.
- CAST Flight Deck Automation Working Group has been formed to recommend and prioritize actions to address, for current and projected operational use, the safety and efficiency of modern flight deck systems for flight path management (including energy state management).
- The Human Factors and Pilot Training Group of the ALPA, Air Safety Structure has identified its position regarding CRM and Human Factors with respect to the use of automation.
- SAE-G10, Aerospace Behavioral Engineering Technology (ABET) Committee, deals with the philosophies, principles and criteria by which designers, engineers, pilots and behavioral scientists structure systems to achieve maximum human workload compatibility for automation efficiency. The committee has several subcommittees with on-going work into human factors and automation.

### Relation with Current Aviation Community Initiative

### Performance Goal

Goal 1: Mitigate the effects of mode confusion and energy state management as contributing factors in loss of control accidents.
Indicator: A measurable reduction of loss of control incidents and accidents related to automation.
Goal 2: Mode awareness and energy state management aspects of flight deck automation advisory circular is readily available.
Indicator: Each ICAO contracting State in the region has issued an advisory circular and distributed it to each operator's in the State. Completion of Output 3.
Goal 3: All operators incorporate mode awareness and energy state management aspects of flight deck automation guidance in their approved training programs.
Indicator: Mode awareness and energy state management aspects of flight deck automation guidance is provided to all transport airplane pilots Completion of Output 4.
## Detailed Implementation Plan Template

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### Indicators
Reduce LOC-I related accidents by 50% by the end of 2017

### Key Milestones (Deliverables)
The following milestones are based on the date of Steering Committee Approval (SCA) (months):
- Review MID advisory circular IATA SCA+6
- Issue generic advisory circular ICAO Output 1 +1
- Issuance of advisory circular by States in the Region. CAAs Output 2 +6
- Operators develop guidance based on the AC and train pilots. Operators Output 3 + 18
- Track Implementation MID-RAST’ SCA +12 and yearly

### Potential Blockers
- Operator might not embrace advisory circular material,
- Operators might not accept the potential cost of this training,
- Operators may not recognize the safety enhancement benefits,
- States may opt not to adopt and issue the advisory circular.

### Responsible
Core Team: 
1.

### DIP Notes
To reduce loss of control accidents, air carriers will be encouraged to adopt consensus policies and procedures relating to mode awareness and energy state management, as appropriate to their respective operations.
LOC-I DIP

The DIP should be further reviewed and finalized taking into consideration:

1- Outcome of the LOC-I Symposium, which will be held in Montreal, 20-22 May 2014, and

2- Guidance Material contained in the Manual on Aeroplane Upset Prevention and Recovery (ICAO Doc 10011), which will be published during the First Quarter of 2014.
ICAO’s Loss of Control In-flight Symposium is planned as a 3-day event that will bring the aviation community together to address industry concerns related to LOCI events by:

Looking at the range of contributing factors;
Considering what work is being done now and how it is being applied;
Identifying what more needs to be done; and
Coordinating efforts for maximum efficiency in use of resources to address this issue globally.
Questions
Loss of Control Inflight (LOC-I)

Session #6
Presentation #2
Fatal Accidents – Worldwide Commercial Jet Fleet

Airplane State Awareness Contribution

- **External Fatalities**: 139
- **Onboard Fatalities**: 4,269

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## ASA Significant Themes

### Summary of Significant Themes Across All Events

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ASA Themes

- Lack of External Visual References
- Flight Crew Impairment
- Training
- Airplane Maintenance
- Safety Culture
- Invalid Source Data
- Distraction
- Systems Knowledge
- Crew Resource Management
- Automation Confusion/Awareness
- Ineffective Alerting
- Inappropriate Control Actions
Event 1: DHC–8–Q400 (2009)

- FO reported to work suffering from illness and fatigue

- Night, IMC

- VREF 118 knots, near stall warning speed in icing

- CAPT (PF) reduced throttles to idle with autopilot in altitude hold mode.

- Airspeed decreased at ~ 2-3 kts/sec for 20 secs, unobserved by crew despite red low speed cue on airspeed indicator

- Stick shaker activated; CAPT responded with thrust and aft column

- The aircraft entered a full stall – several violent roll oscillations in full stall, with CAPT attempting to control with wheel and rudder

Flight Crew Impairment
Lack of External Visual References
System Knowledge
Automation Awareness
Ineffective Alerting
Inappropriate Control Response
Distraction (Channelized Attn)
Event 2: B 737 (2007)

- IMC conditions at night

- G/S captured with throttles at idle. Autothrottle disconnected – flashing alert not observed

- Airspeed decayed and autopilot trimmed stabilizer airplane nose up to maintain G/S

- At 110 knots CAPT took control, disconnected the autopilot, and called for a go-around. Within a second, stick shaker activated.

- CAPT applied full forward throttle. Aircraft began to pitch up in response to thrust change. CAPT did not recognize out-of-trim condition and did not use trim in recovery.

He could not arrest nose-up pitch from thrust with stabilizer trimmed for 110 IAS with column alone. Airplane stalled.
Event 3: MD–82 (2005)

- Significant weather along the planned route; not noted on the flight plan

- Night, IMC

- Crew requested FL330 but could not reach altitude in level change mode. Crew turned off anti-ice; switched to vertical speed mode; aircraft climbed at max power, losing airspeed

- At FL330, crew restored anti-ice, re-engaged A/P in altitude hold, commenced other activities

- Aircraft could not maintain altitude at selected airspeed; Mach began to decrease until stick shaker activated

- CAPT disengaged autopilot and pulled the column aft, then began to trim nose up

- Aircraft entered full stall. FO recognized stall but did not intervene. CAPT did not respond to FO.
CAST Approved Safety Enhancements

• **SE 192 Low Airspeed Alerting**
  • Incorporate existing service bulletins to install low airspeed aural alerting in the U.S. fleet

• **SE 194 SOP Effectiveness and Adherence**
  • Review and update SOPs to align with latest CAST, manufacturer, and ATO recommendations
  • Assess and revise SOPs based on feedback from data monitoring programs

• **SE 196 Enhanced Upset Recovery Training, Including Approach-to-Stall**
  • New approach-to-stall recovery procedures and realistic scenarios, including autoflight ON
  • Upset prevention & recovery, including unreliable airspeed
CAST Approved Safety Enhancements

- **SE 197 Training for Non-Normal Situations**
  - Focus on flying the airplane first

- **SE 198 Scenario-Based Training for Go-Arounds**
  - Go-arounds for other than decision height
  - Complicating factors (trim, light weight, entry into clouds)

- **SE 199 Enhanced Crew Resource Management**
  - Focus on pilot monitoring duties
CAST Approved Safety Enhancements

- **SE 200 Virtual Day-VMC Displays:** Virtual display of terrain with energy path guidance, available full time to both crew members.

Flight Safety Foundation, 2009, HUD Symbology

**Positive and Likely Positive Safety Properties**

**Loss of Control (70 Positive + Likely Positive)**
### ASA Significant Themes

#### Themes and Events Related to Low Airspeed

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- SE 192 Low Airspeed Alerting
- SE 194 Standard Operating Procedures
- SE 196 Effective Upset Prevention and Recovery Training, Including Stalls
- SE 197 Policy and Training for Non-normal Situations
- SE 198 Scenario Based Training for Go-Arounds
- SE 199 Enhanced Crew Resource Management Training
- SE 200 Virtual Day-VMC Displays
Thank You for Your Attention
Loss of Control Inflight (LOC-I)

Session #6
Panel Discussion

Moderator: Mr. Mashhor Alblowi, ICAO MID
Panelists: Mr. Chamsou Andjorin, Boeing
Mr. William B. Etzold, Boeing
Mr. Luis Savio Dos Santos, Embraer