The Second MID Region Safety Summit

27- 29 April 2014
Muscat, Oman

Loss of Control Inflight (LOC-I)

Session #6
Presentation #1

Mitigation of LOC-I risk in MID Region

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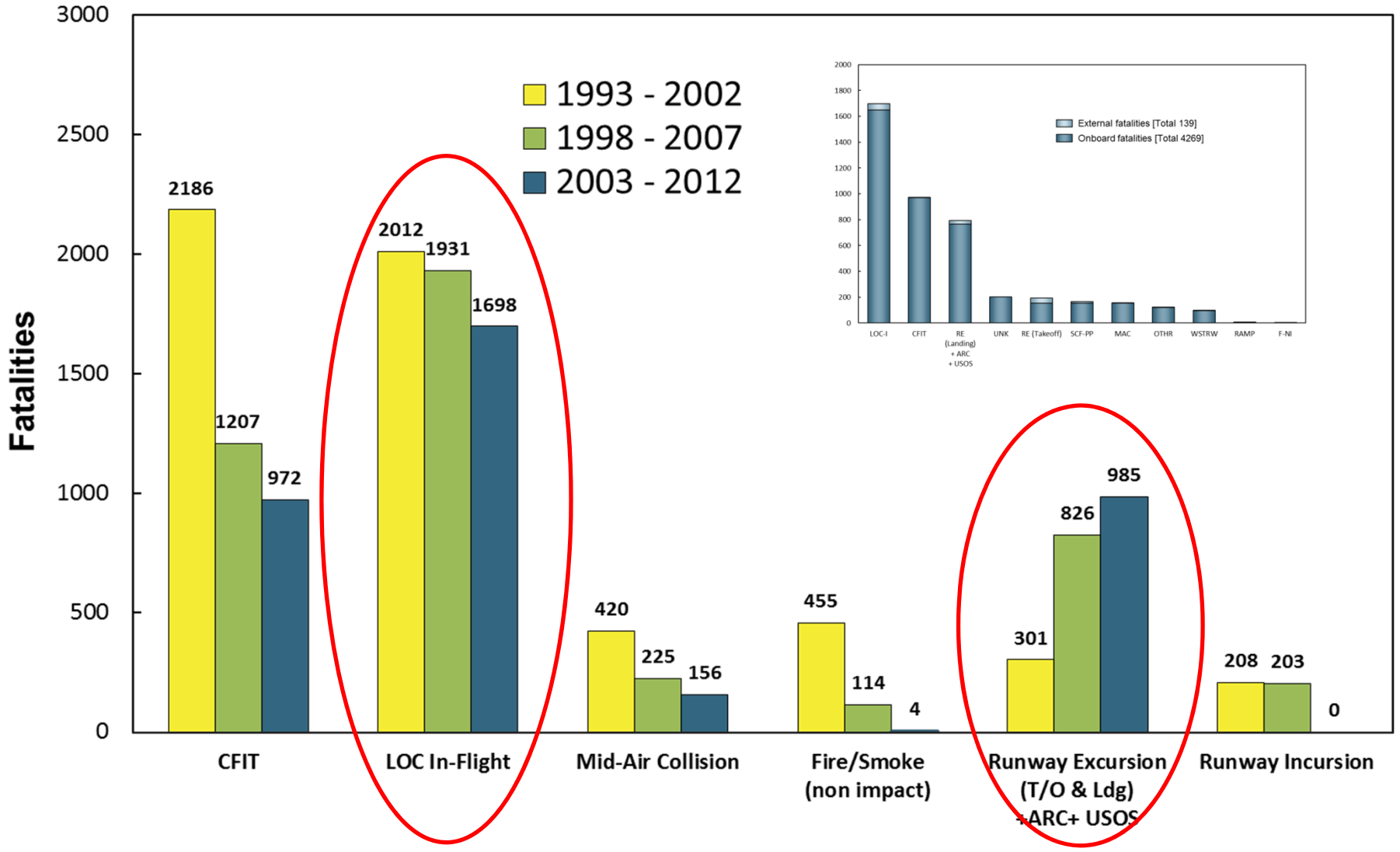
Comparison of Fatalities 1993-2002, 1998-2007 and 2003-2012
Fatalities by CAST/ICAO (CICTT) Aviation Occurrence Categories
Fatal Accidents – Worldwide Commercial Jet Fleet

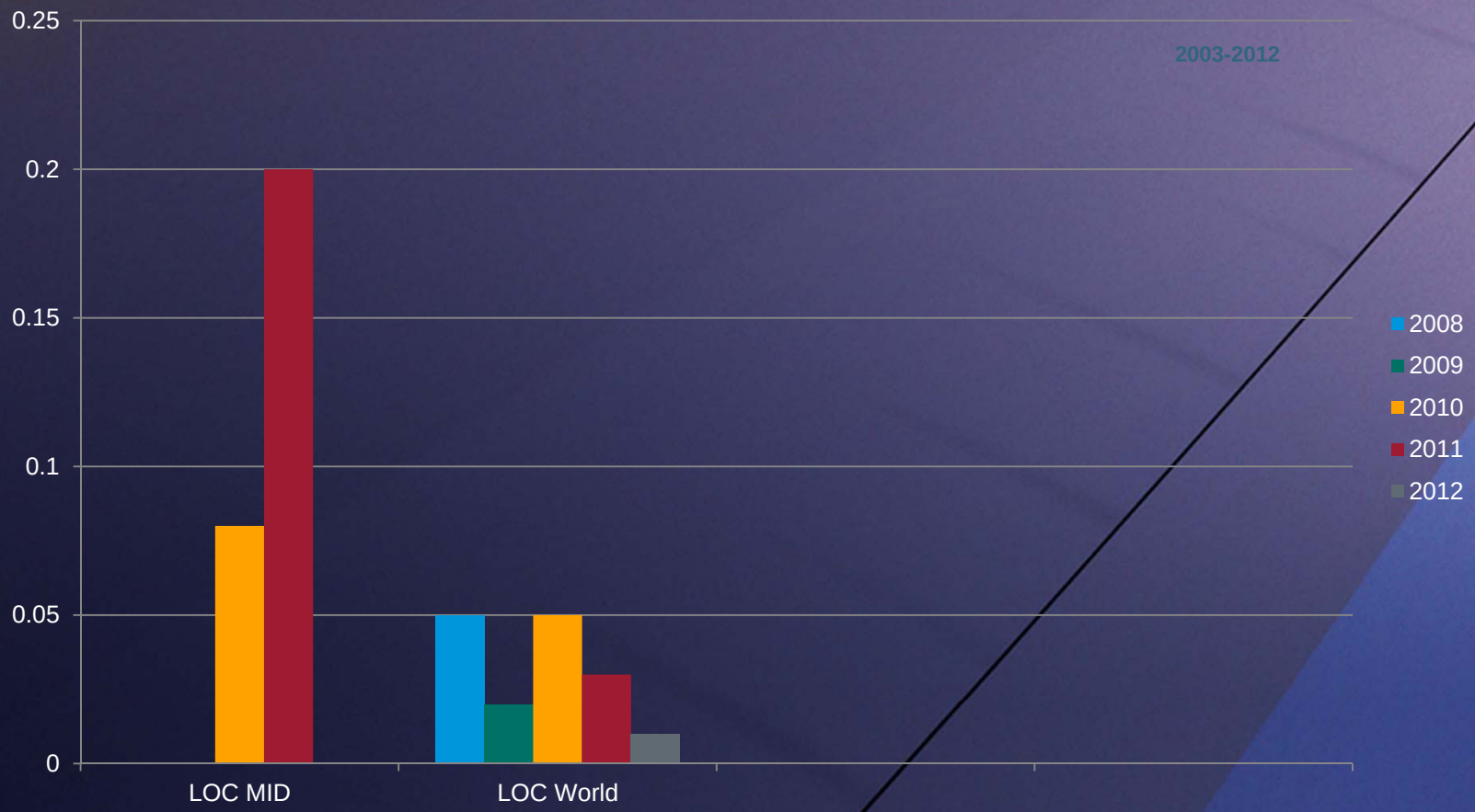


Comparison of LOC-I Accidents proportion in 2008-2012 MID region vs World

World	2008	2009	2010	2011	2012	Average
Accident per Million departure	0.24	0.07	0.2	0.01	0.03	**0.11**
Number of LOC-I Accident	7	2	6	4	1	**4**
% of total Accident	5%	2%	5%	3%	1%	**3%**

MID	2008	2009	2010	2011	2012	Average
Accident per Million departure	0	0	1.01	0.97	0	**0.4**
Number of RS Accident	0	0	1	1	0	**0.4**
% of RS Accident vs Total Accident	0%	0%	8%	20%	0%	**6%**

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



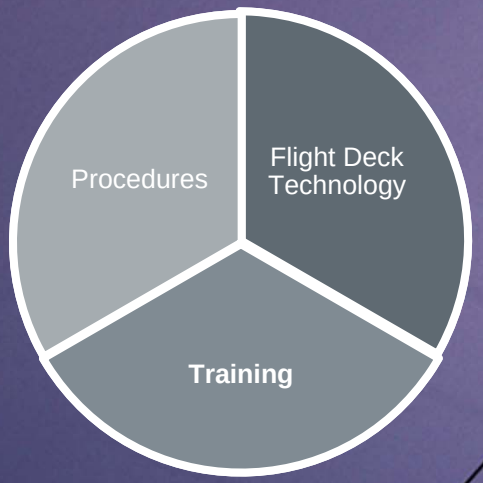
LOC-I Safety Indicator and Target

Theme	Safety Indicator	Safety Target
Loss of Control In-Flight (LOC-I)	**Number of LOC-I related accidents per million departures**	**Reduce the LOC-I related accidents to be below the global rate**

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 Airspeed 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 or 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
- SE207: Airplane State Awareness - Attitude and Energy State Awareness Technologies (R-D)
- SE208: Airplane State Awareness - Airplane Systems Awareness (R-D)
- SE209: Airplane State Awareness - Simulator Fidelity (R-D)
- SE210: Airplane State Awareness - Flight Crew Performance Data (R-D)
- SE211: Airplane State Awareness - Training for Attention Management (R-D)

No	Safety Enhancement Action	GASP Safety Initiative (ICAO Doc 10004)	Best Practices Supporting GASP Safety Initiative (ICAO Doc 10004, Appendix 2)	Safety Impact	Changeability	Indicator	Priority	Time Frame
RAST-MID/LOC-I/1	The construction, approval and implementation of RNAV(GNSS) / RNP-AR procedures to all runways not currently served by precision approach procedures	Safety Management Standarzation: Implementation of risk-based standarization Safety Oversight Standarization: Promotion of Compliance with National Regulations and Adoption of Industry Best Practices	BP-GEN-1 BP-GEN-2 BP-GEN-4 BP-STD-S-12 BP-STD-S-13	High	Moderate	P2	1	Long Term

Detailed Implementation Plan Template

No	Safety Enhancement Action	GASP Safety Initiative (ICAO Doc 10004)	Best Practices Supporting GASP Safety Initiative (ICAO Doc 10004, Appendix 2)	Safety Impact	Changeability	Indicator	Priority	Time Frame

Safety Enhancement Action (expanded)	To improve the overall performance of flight crews to recognize and prevent loss of control accidents, through effective use of automationbased 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.
Statement of Work	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.
Champion Organization	
Human Resources	IATA, Pilot Associations; Safety, Flight Operations and Training managers; ICAO, CAA's, aircraft manufacturers, training centers

Detailed Implementation Plan Template

No	Safety Enhancement Action	GASP Safety Initiative (ICAO Doc 10004)	Best Practices Supporting GASP Safety Initiative (ICAO Doc 10004, Appendix 2)	Safety Impact	Changeability	Indicator	Priority	Time Frame

Financial Resources	
Relation with Current Aviation Community Initiative	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 Automaton 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
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

No	Safety Enhancement Action	GASP Safety Initiative (ICAO Doc 10004)	Best Practices Supporting GASP Safety Initiative (ICAO Doc 10004, Appendix 2)	Safety Impact	Changeability	Indicator	Priority	Time Frame

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.

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27- 29 April 2014
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Loss of Control Inflight (LOC-I)

Session #6
Presentation #2

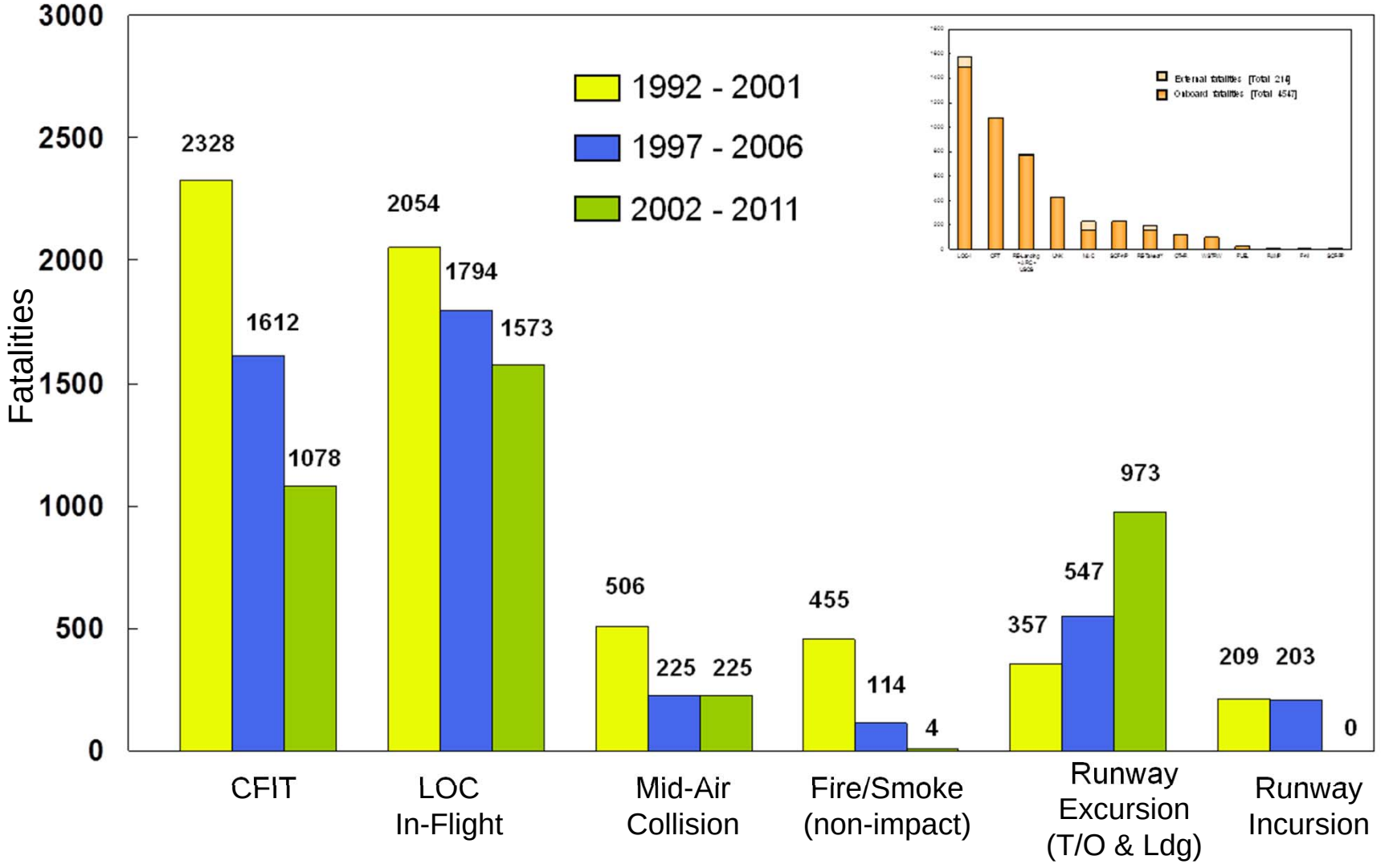
CAST Aircraft State Awareness Results

Capt. Brit Etzold
Boeing Aviation System Safety

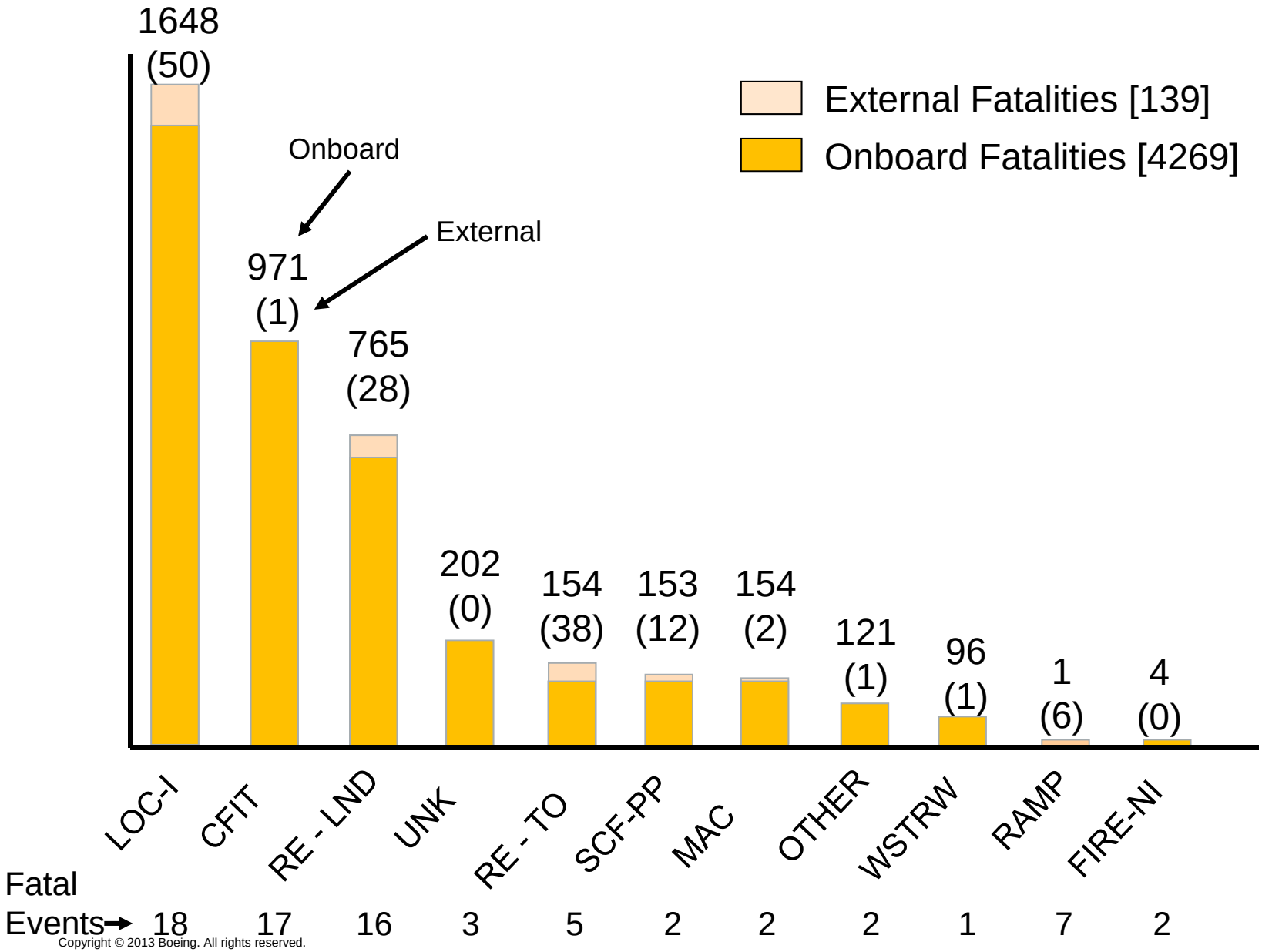
MID Safety Summit
Muscat, Oman
28 April 2014

Comparison of Fatalities 1992–2001, 1997–2006 and 2002–2011

Fatal Accidents – Worldwide Commercial Jet Fleet



Worldwide Fatal Jet Accidents 2003-2012
Airplane State Awareness Contribution



ASA Significant Themes

Summary of Significant Themes Across All Events

	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	Total
Saab 340	x	x			x		x	x	x		x		7
747-200F	x			x		x	x		x		x		6
737-300	x		x		x		x		x	x	x	x	8
737-400	x		x	x			x	x	x	x	x	x	9
737-800	x		x				x		x	x	x	x	7
737-500	x	x	x	x	x		x	x	x	x	x	x	11
A320	x		x				x		x		x	x	6
757-200	x						x		x	x	x	x	6
A320	x	x			x		x		x	x	x	x	8
757-200	x				x	x	x	x	x	x	x	x	9
717	x				x	x	x		x		x	x	7
DHC-8-Q400	x	x	x		x		x	x	x	x	x	x	10
DHC-8	x		x				x			x	x	x	6
737-800	x		x	x	x		x			x	x		7
MD-82	x	x			x		x	x	x	x	x	x	9
A320		x	x	x	x	x	x	x	x	x	x		10
737-800	x			x	x	x	x		x	x	x		8
ATR-42	x	x			x		x		x	x	x		7
Overall	17	7	9	6	12	5	18	7	16	14	18	12	

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	Flight Crew Impairment
- Night, IMC	Lack of External Visual References
- VREF 118 knots, near stall warning speed in icing	System Knowledge
- CAPT (PF) reduced throttles to idle with autopilot in altitude hold mode.	Automation Awareness
- Airspeed decreased at ~ 2-3 kts/sec for 20 secs, unobserved by crew despite red low speed cue on airspeed indicator	Ineffective Alerting
- Stick shaker activated; CAPT responded with thrust and aft column	Inappropriate Control Response
- The aircraft entered a full stall – several violent roll oscillations in full stall, with CAPT attempting to control with wheel and rudder	Distraction (Channelized Attn)

Event 2: B 737 (2007)

- IMC conditions at night	Lack of External Visual References
- G/S captured with throttles at idle. Autothrottle disconnected – flashing alert not observed	Ineffective Alerting
- Airspeed decayed and autopilot trimmed stabilizer airplane nose up to maintain G/S	Automation Awareness
- At 110 knots CAPT took control, disconnected the autopilot, and called for a go-around. Within a second, stick shaker activated.	Distraction / CRM
- 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.	Training
He could not arrest nose-up pitch from thrust with stabilizer trimmed for 110 IAS with column alone. Airplane stalled.	Distraction / Channelized Attn

Event 3: MD-82 (2005)

- Significant weather along the planned route; not noted on the flight plan — **Safety Culture**

- Night, IMC — **Lack of External Visual References**

- 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 — **Systems Knowledge**

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

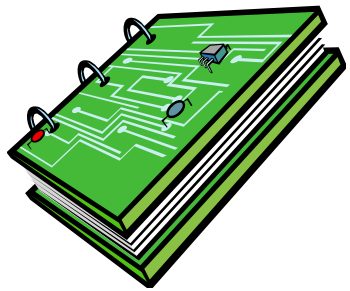
- Aircraft could not maintain altitude at selected airspeed; Mach began to decrease until stick shaker activated — **Ineffective Alerting**

- CAPT disengaged autopilot and pulled the column aft, then began to trim nose up — **Inappropriate Control Response**

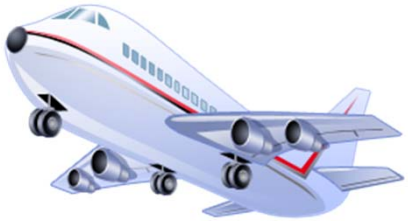
- Aircraft entered full stall. FO recognized stall but did not intervene. CAPT did not respond to FO. — **CRM**

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**

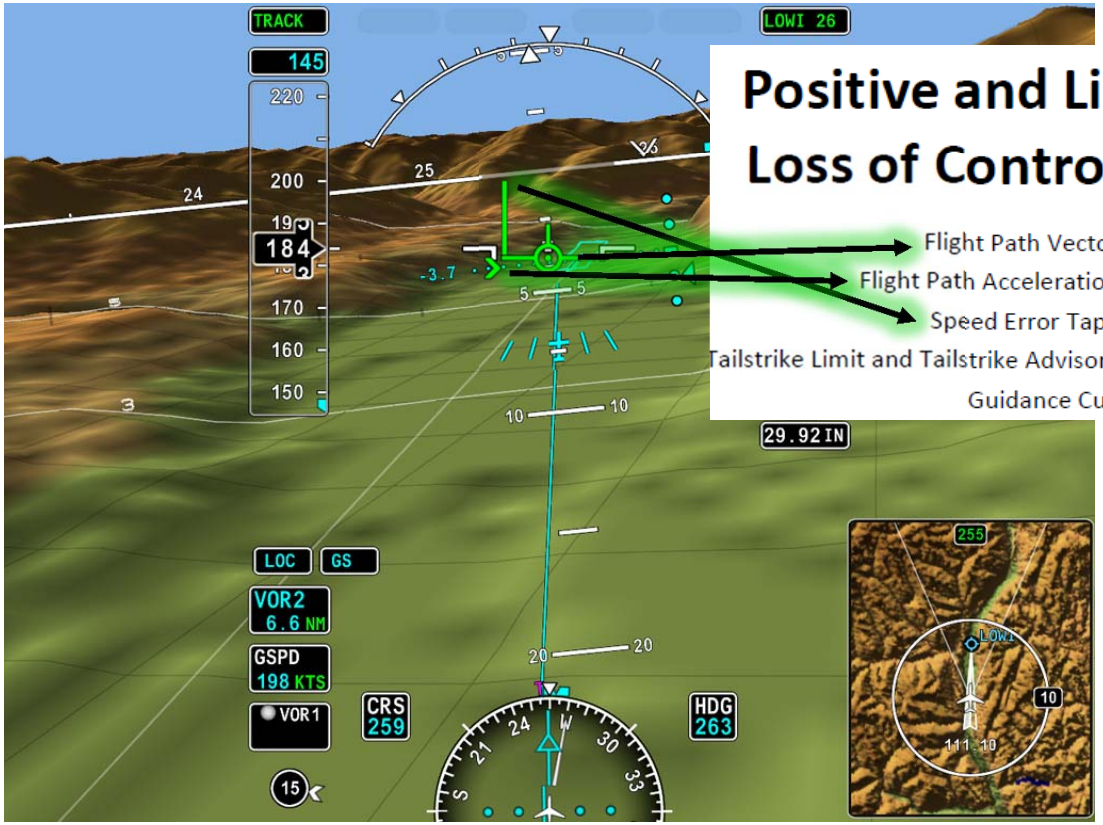
CAST Approved Safety Enhancements

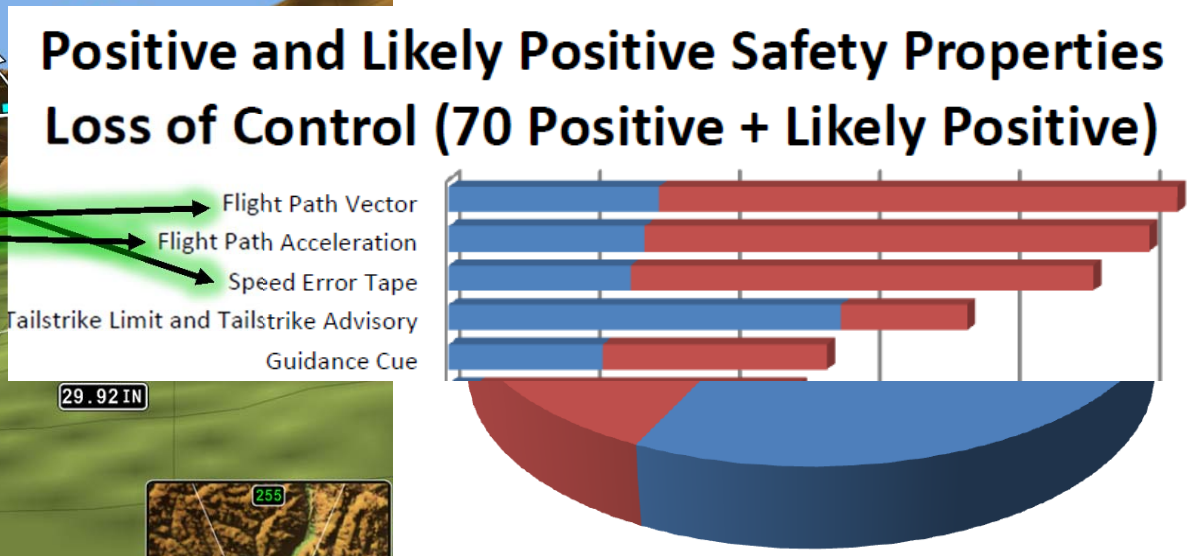
- **SE 197 Training for Non-Normal Situations**
  - **Focus on flying the airplane first**
- **SE 198 Scenario-Based Training for Go-Arounds**
  - **Go-arounds for other than decision height**
  - **Complicating factors (trim, light weight, entry into clouds)**
- **SE 199 Enhanced Crew Resource Management**
  - **Focus on pilot monitoring duties**

CAST Approved Safety Enhancements

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

Flight Safety Foundation, 2009, HUD Symbology





ASA Significant Themes

Themes and Events Related to Low Airspeed

	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
DHC-8-Q400	x	x	x		x		x	x	x	x	x	x
DHC-8	x		x				x			x	x	x
737-800	x		x	x	x		x			x	x	
MD-82	x	x			x		x	x	x	x	x	x
737-800	x			x	x	x	x		x	x	x	
ATR-42	x	x			x		x		x	x	x	
Relevant SEs	200		196		194		197 198	197	199	196 198	192 200	196

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

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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