

# High altitude loss of control in automated aircraft and pilot competence

- Ashok Poduval



**2009 – RAeS FSG meeting  
International Committee for Aviation Training  
in Extended Envelopes (ICATEE)**

**2011 – FAA ARC**

**2012 – ICAO, EASA & FAA**

**– Loss of Control Avoidance and Recovery Training  
LOCART (ICAO, EASA, FAA, others)**

**2014 – ICAO, SARPS & guidance material**

**Annex 1: Personnel Licensing**

**Annex 6: Operation of Aircraft, Part I**

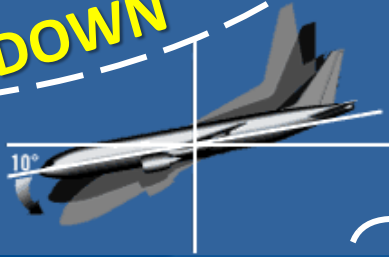
**PANS-TRG: Doc 9868**

**Manual on UPRT: Doc 10011**

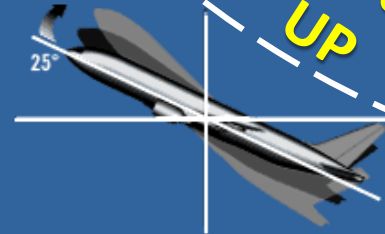
# ICAO MANUAL ON AEROPLANE UPSET PREVENTION AND RECOVERY TRAINING - Doc 10011 AN/506

## LOCI Aeroplane Upset

Pitch > 10 degrees  
DOWN



Pitch > 25 degrees  
UP



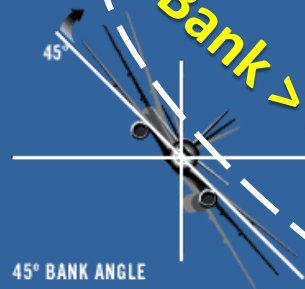
Within these  
parameters



Inappropriate  
airspeed

Stall

Bank > 45 degrees

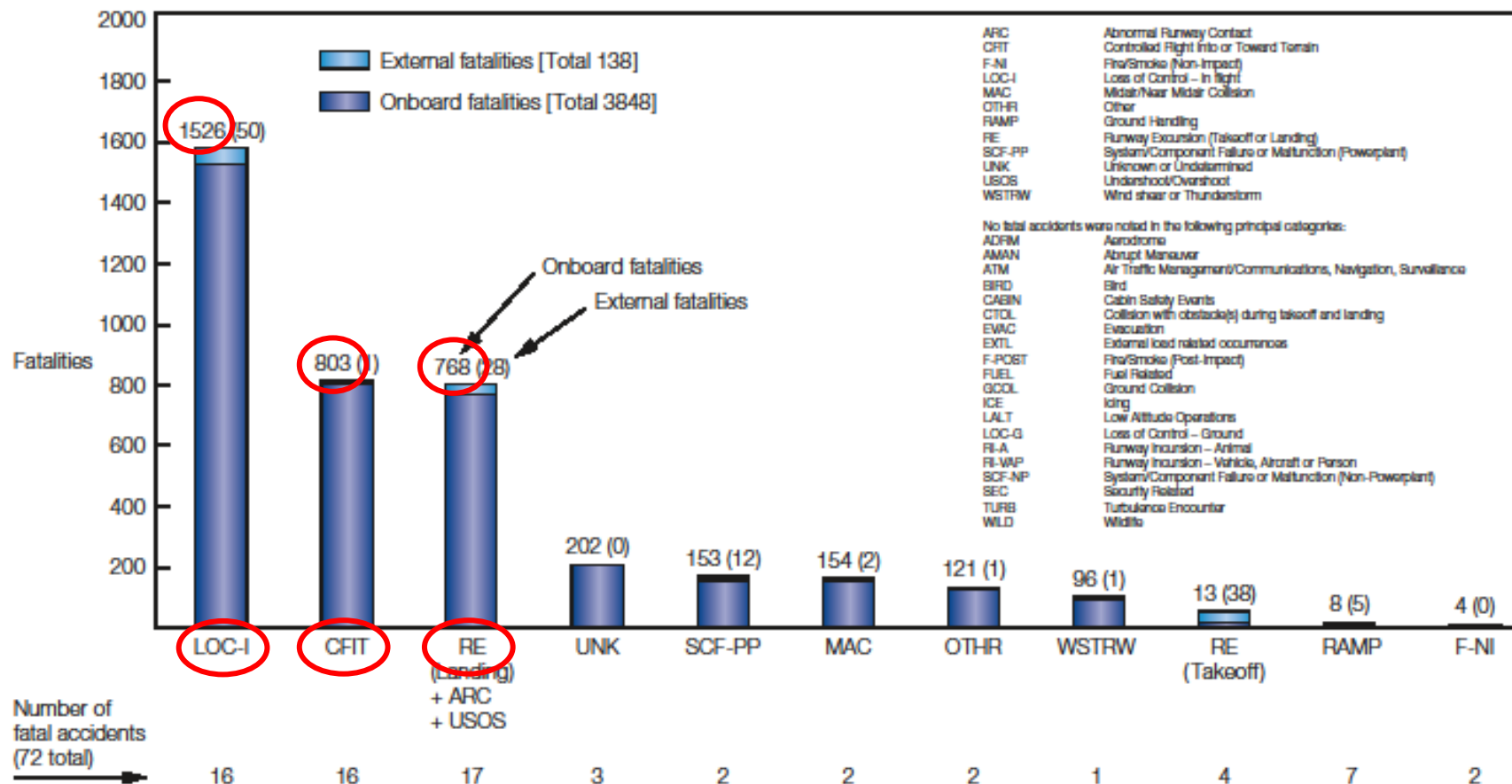


Unintentional



# Fatalities by CICTT Aviation Occurrence Categories

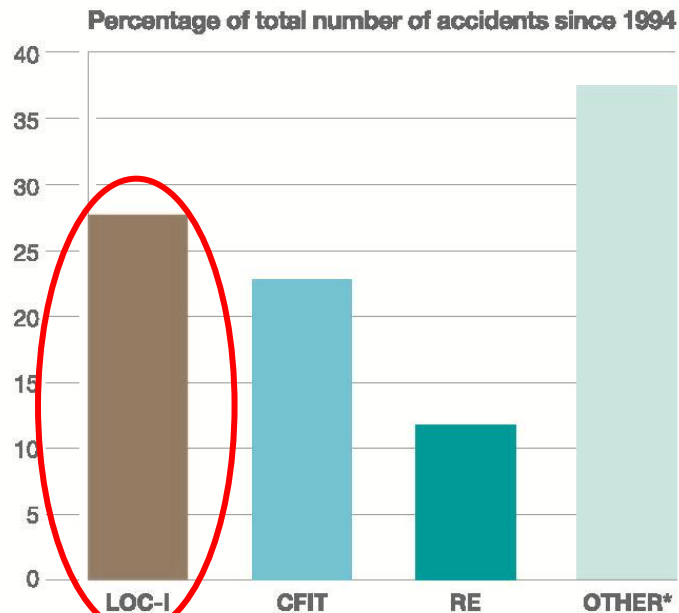
Fatal Accidents | Worldwide Commercial Jet Fleet | 2004 through 2013



Note: Principal categories as assigned by CAST.

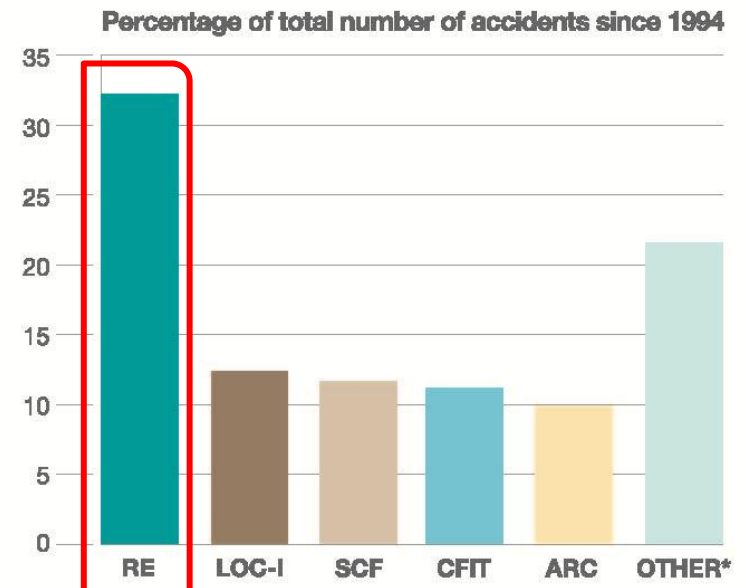
For a complete description of CAST/ICAO Common Taxonomy Team (CICTT) Aviation Occurrence Categories go to <http://www.intlaviationstandards.org/>

**Fatal**



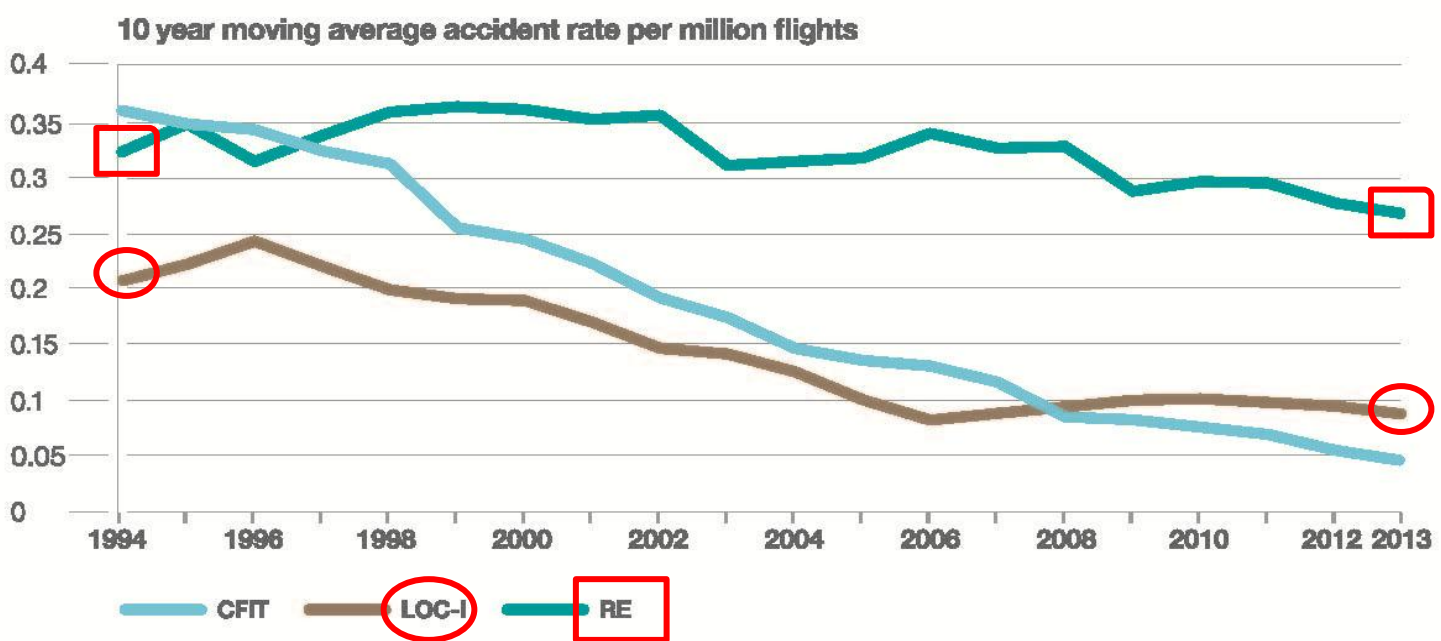
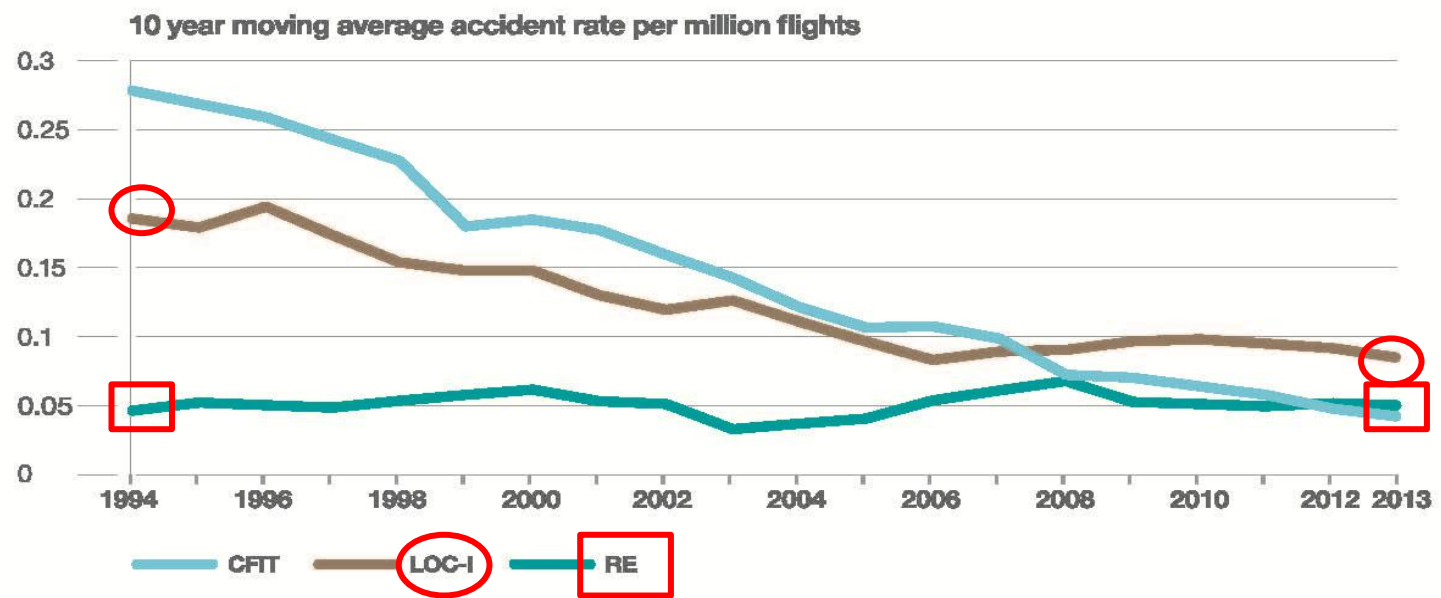
\*All the accident categories representing less than 10% of the accidents are clustered in the "OTHER" category.

**Hull loss**



\*All the accident categories representing less than 10% of the accidents are clustered in the "OTHER" category.

Fatal



Hull loss





In 2013 Detail of Aircraft Generations

**First Generation**  
Early commercial jets



10,000 flights  
50 aircraft

**Second Generation**  
More integrated Auto Flight System



1 million flights  
1,000 aircraft

**Third Generation**  
Glass cockpit and FMS



16 million flights  
12,000 aircraft

**Fourth Generation**  
Fly-By-Wire with flight envelope protection



11 million flights  
8,000 aircraft

1st year of entry into service:

**1952**

Caravelle, Comet, BAC 111, Trident, VC-10, B707, B720, Convair 880/990, DC-8

**1964**

Concorde, A300 (except A300-600), BAE 148, Mercure, B727, B737-100/200, B747-100/SP/200/300, F-28, L-1011, DC-9, DC-10, VFW 614

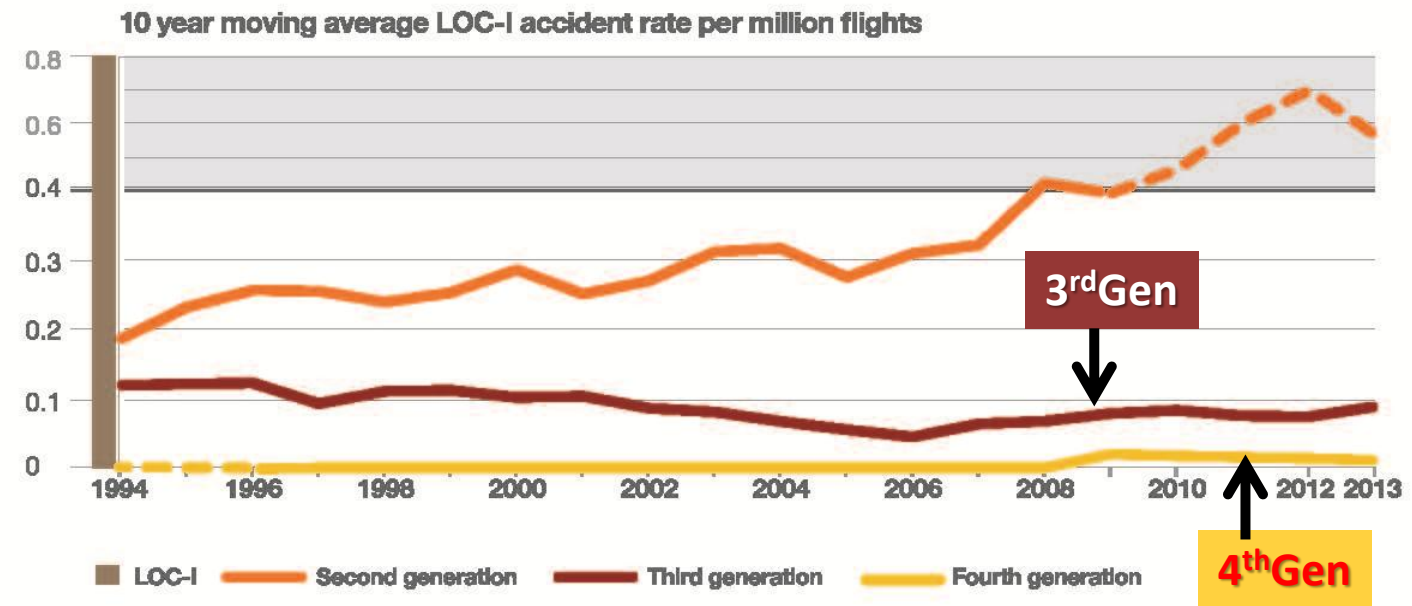
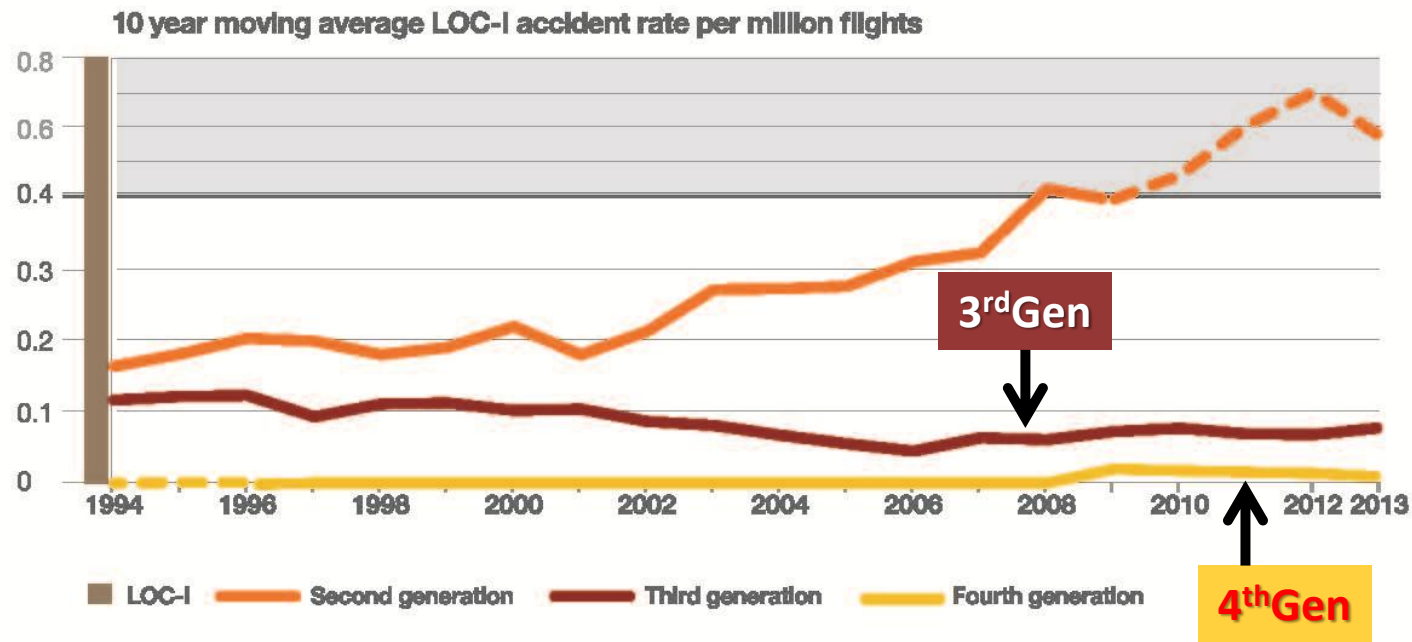
**1980**

A300-600, A310, Avro RJ series, B717, B737-300/400/500, B737 NG -600/700/800/900, B757, B767, B747-400, B747-8, Bombardier CRJ Series, Embraer ERJ Series, 328JET, F-70, F-100, MD-11, MD-80, MD-90

**1988**

A318/A319/A320/A321, A330, A340-200/300/500/600, A380, B777, B787, Embraer E Series

Fatal

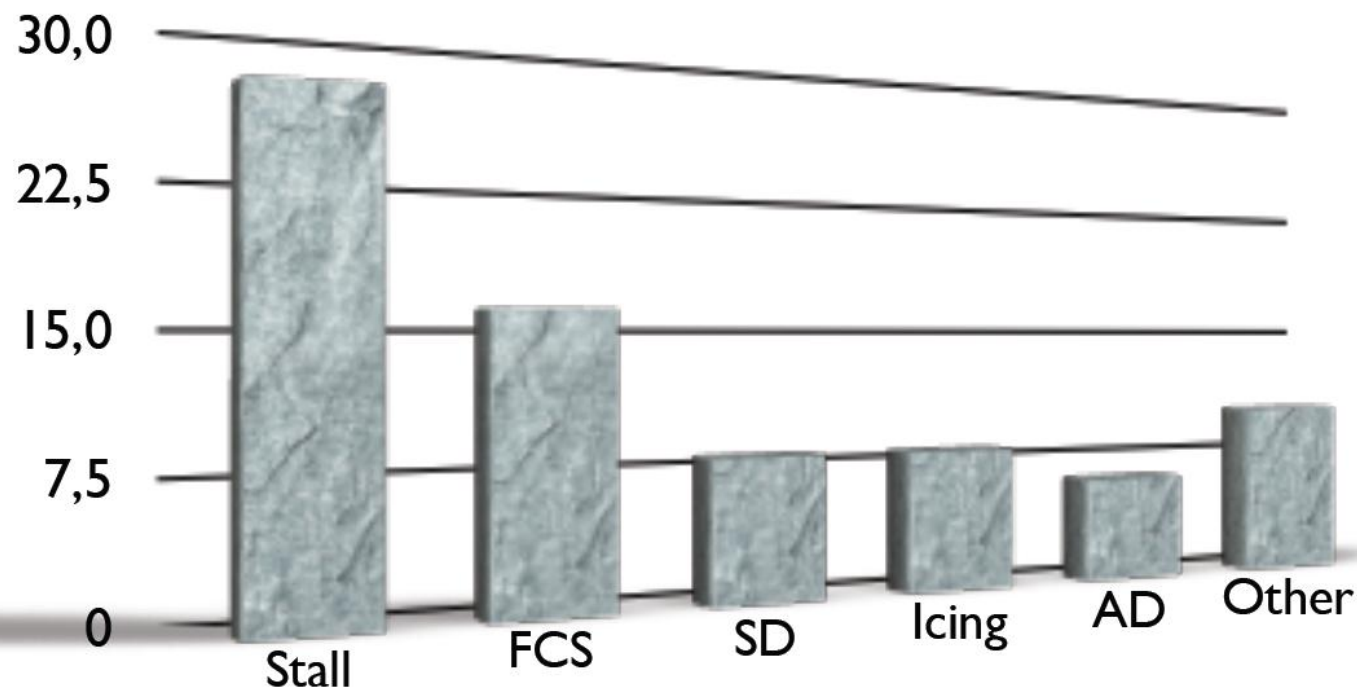


Hull loss

Source: Airbus







*Figure 1 - Numbers of Loss-of-Control In-Flight incidents, 1993-2007*

FCS = Flight Control System  
SD = Spatial Disorientation  
AD = Atmospheric Disturbance

## **August 2005 – WCW 708, West Caribbean MD80, Venezuela**

## **June 2009 – AF 447, Air France A330, Brazil**

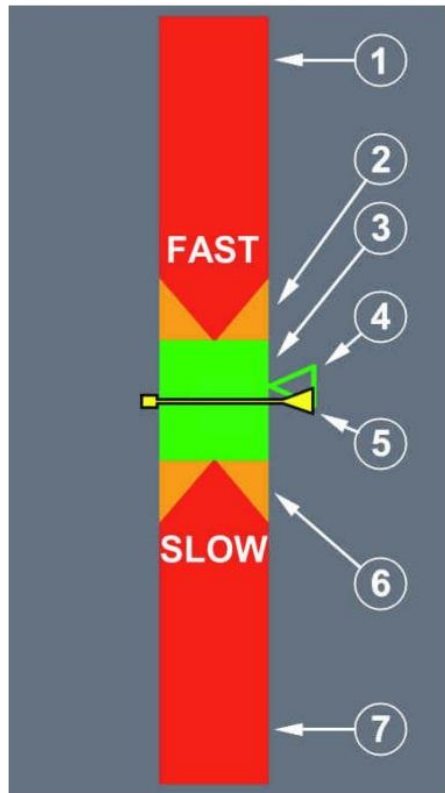
- The speed displayed on the left PFD was incorrect for 29 seconds, that of the speed on the ISIS for 54 seconds and the speed displayed on the right PFD for 61 seconds at most.
- The AP then the A/THR disconnected while the aeroplane was flying at the upper limit of a slightly turbulent cloud layer.
- In less than one minute after autopilot disconnection, the aeroplane exited its flight envelope following inappropriate pilot inputs.

## **July 2014 –AH5017, Swiftair MD 83, Mali**

## **Dec 2014 – QZ 8501, Air Asia A320,**

“The investigator, from Indonesia's National Transportation Safety Committee (NTSC), added that the pilots' voices were drowned out by the sound of the alarms”

# Airbus Back Up speed scale



- (1) Red FAST area:  
This red area indicates excessive speed range.
- (2) Amber area:  
This amber area indicates excessive speed range while keeping an appropriate margin to the maximum structural speeds.
- (3) GREEN area:  
The green area indicates the safe speed range.
- (4) Target speed (green):  
This symbol indicates the optimum target speed.  
During approach, it indicates the target speed for the approach.
- (5) Actual Speed Reference Line (Yellow):  
This fixed reference line, next to a yellow triangle, indicates the aircraft's current speed.
- (6) Amber area:  
The amber area indicates too low speed while keeping an appropriate margin to the stall speed.
- (7) Red SLOW area:  
The red SLOW area indicates the speeds that are lower than the stall speed.

## Contributory factors

- **Aeroplane systems induced**
- **Environmentally induced**
- **Pilot/human induced**
  - ✓ **improper procedures**
  - ✓ **spatial disorientation**
  - ✓ **poor energy management**
  - ✓ **crew member distraction**
  - ✓ **improper training**

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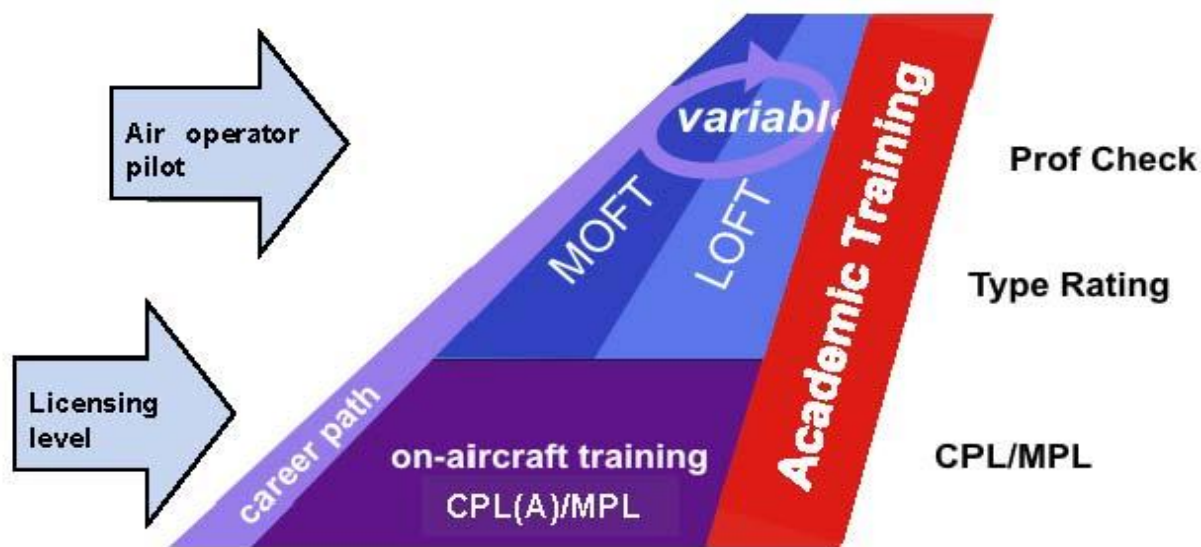
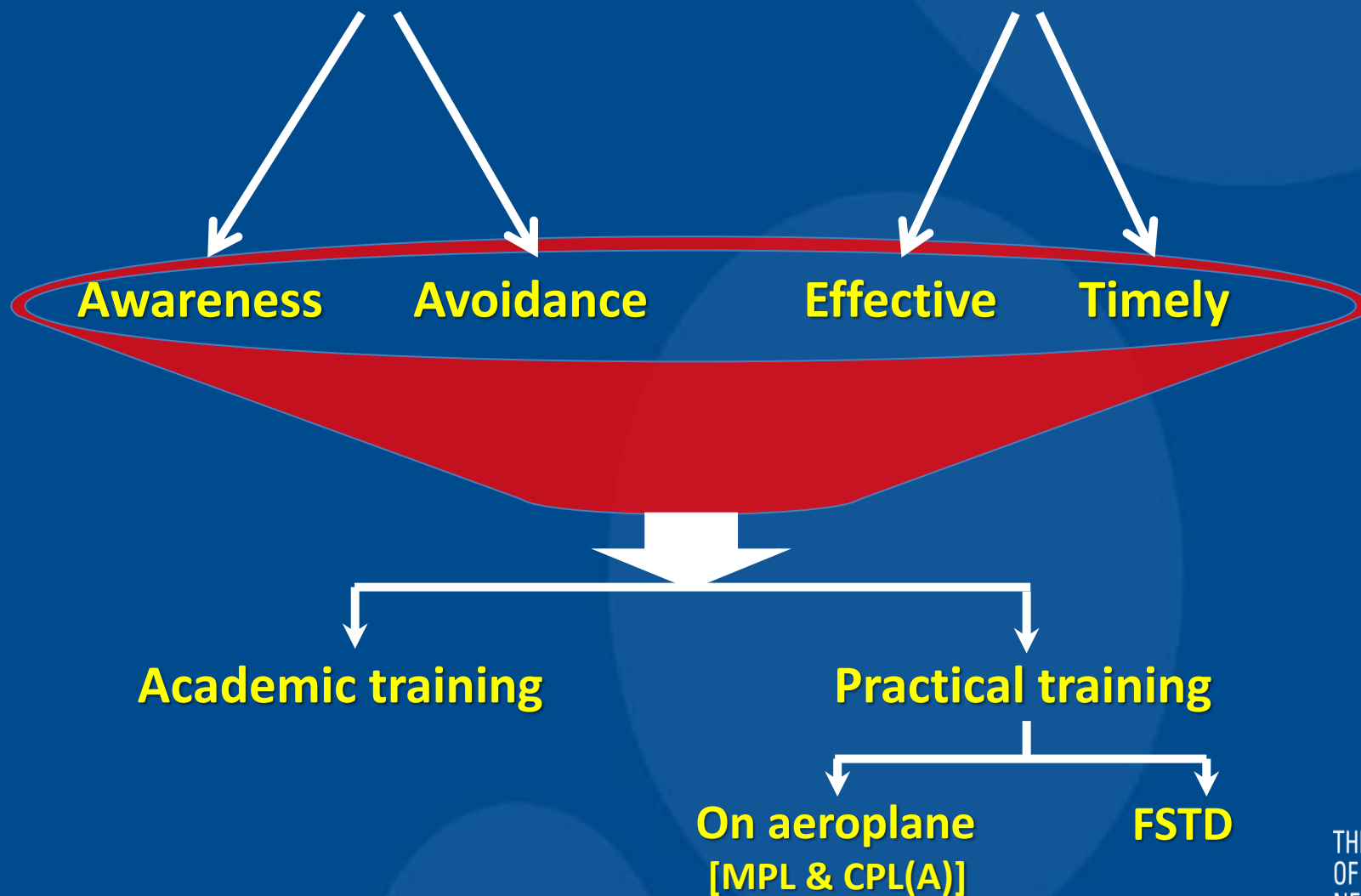


Figure 3-1. Integrated training concept

**Implementation of UPRT within an existing MPL or evidenced-based training (EBT) recurrent programme does require that it be integrated as a competency-based training programme**



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**On-aeroplane UPRT is not intended to be delivered while operating transport category aeroplanes or aeroplanes requiring two or more crew members; for those operations, UPRT should not be permitted to be conducted outside the confines of a suitable FSTD.**



*Always trust your  
instruments, son!*

# The Challenges

## Aerobic training vs Unusual attitude training

- *It is important to make the distinction that UPRT is not synonymous with aerobic flight training – ICAO UPRT manual*
- *Nor does aerobic flight training necessarily provide the best medium or develop the full spectrum of analytical reasoning skills required to rapidly and accurately determine the course of recovery action during periods of high stress – ICAO UPRT manual*

**5 hours in a light aircraft followed by years of straight and level?**

**Light aircraft handling / high altitude – high speed handling**

## Training for ‘startle’ effect

- *From the human factors aspect, aerobatics does not specifically address the element of “startle” – ICAO UPRT manual*

## **Surprise**

**an unexpected or astonishing event**

**an unexpected event, piece of information, etc.**

**the feeling caused by something that is unexpected or unusual**

# The Challenges

## Manual handling skills

- *Manual handling training should include training on the use of full control inputs, if necessary to counter adverse external forces – ICAO UPRT manual*
- *The tendency is for pilots not to use full control authority because they rarely are required to do so in normal operations. Pilots need to overcome this habit when recovering from severe upsets – ICAO UPRT manual*
- *The training should highlight when it is appropriate to fly manually versus using automation – ICAO UPRT manual*

**Airline policies – Manual handling only below 10,000 feet under special circumstances**

**High altitude manual handling characteristics – no practice**

**All engines operating go around**

# What is an acceptable Level of Safety?

