

# Loss of Control In Flight and UPRT

22-24 June 2015, Nairobi

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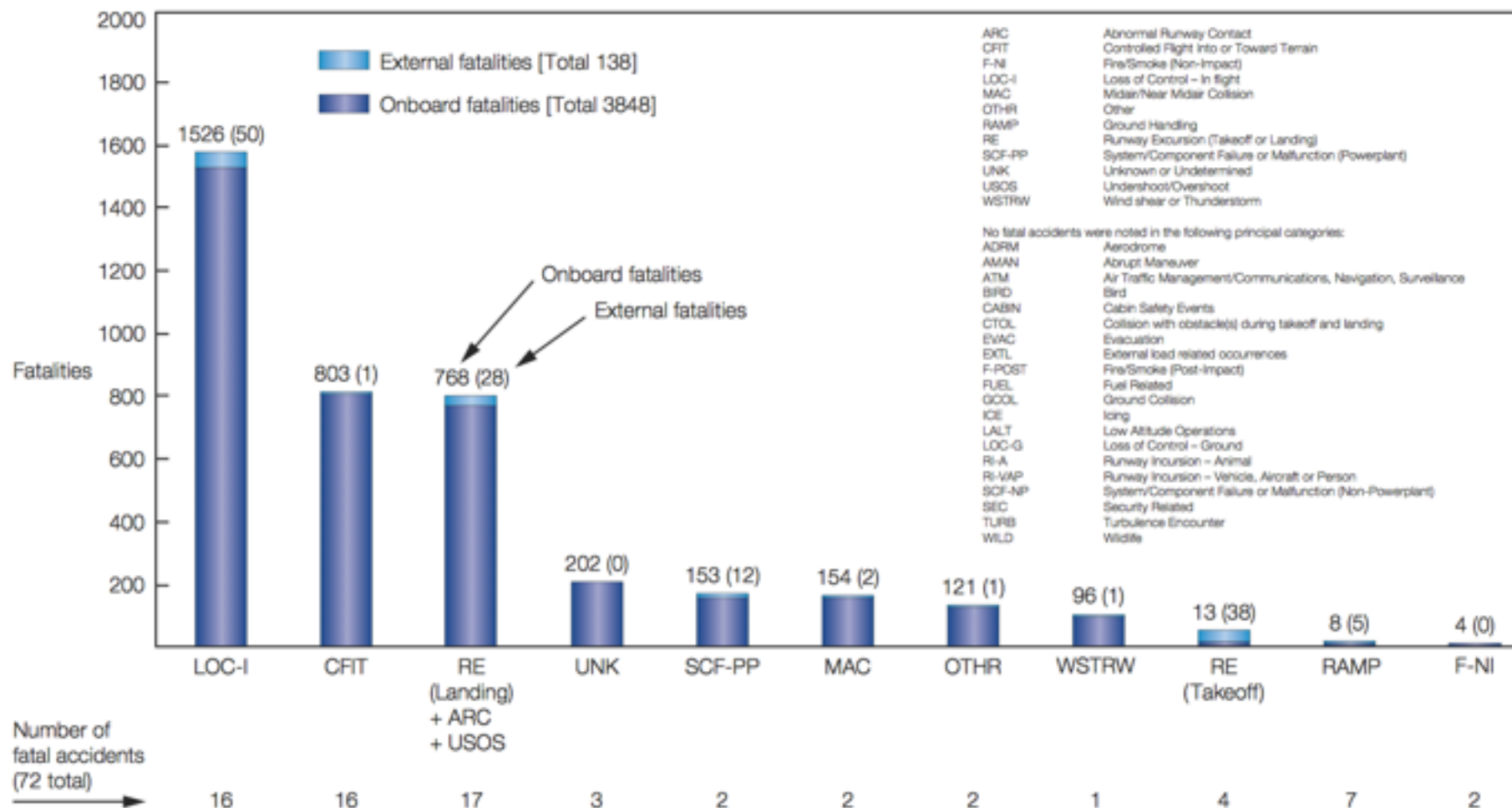


# Main Points

- UPRT deals with the number-one cause of commercial airline fatalities: LOC-I
- ICAO Manual 10011 is the defining document
- Mitigating LOC-I requires UPRT skills
  - awareness
  - recognition
  - avoidance
  - recovery
- Can be accomplished through training that integrates
  - knowledge
  - simulator
  - on-aircraft

# 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/>

# Runway Excursion



## Runway Excursion

17 Accidents


IATA Members	41%
Hull Losses	29%
Fatal	0%
Accident Rate*	0.44

 94%  
Passenger

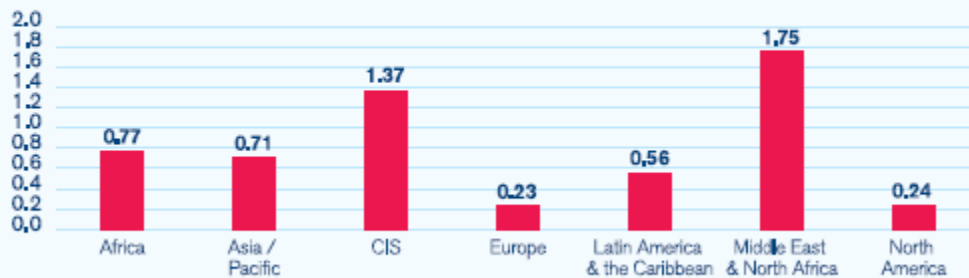
 6%  
Cargo

 0%  
Ferry

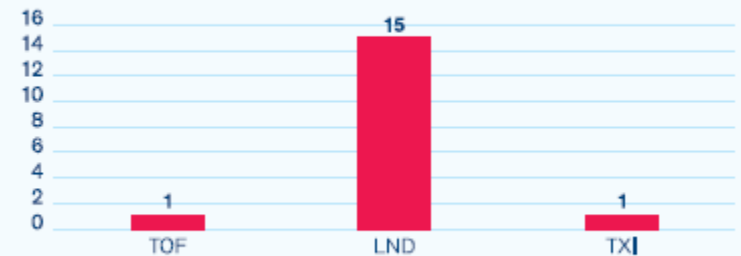
 71%  
Jet

 29%  
Turboprop

### Accident Rates per Operator Region\*



### Accidents per Phase of Flight\*\*






# Runway Excursions




# Controlled Flight into Terrain




## Controlled Flight into Terrain

10 Accidents


IATA Members	0%
Hull Losses	100%
Fatal	90%
Accident Rate*	0.26




**80%**  
Passenger




**20%**  
Cargo



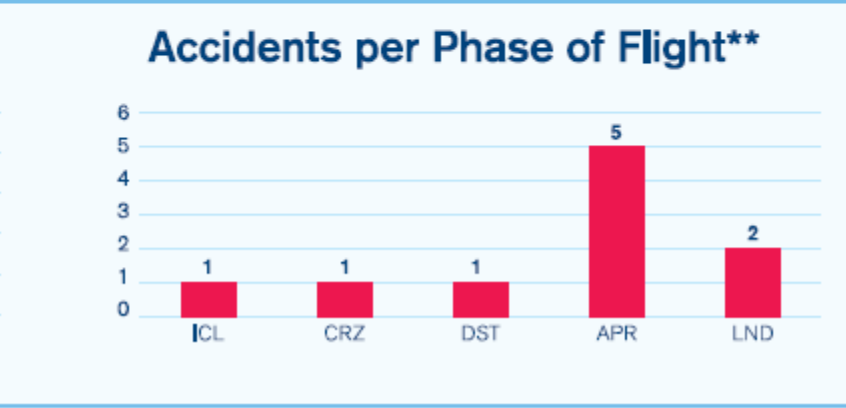
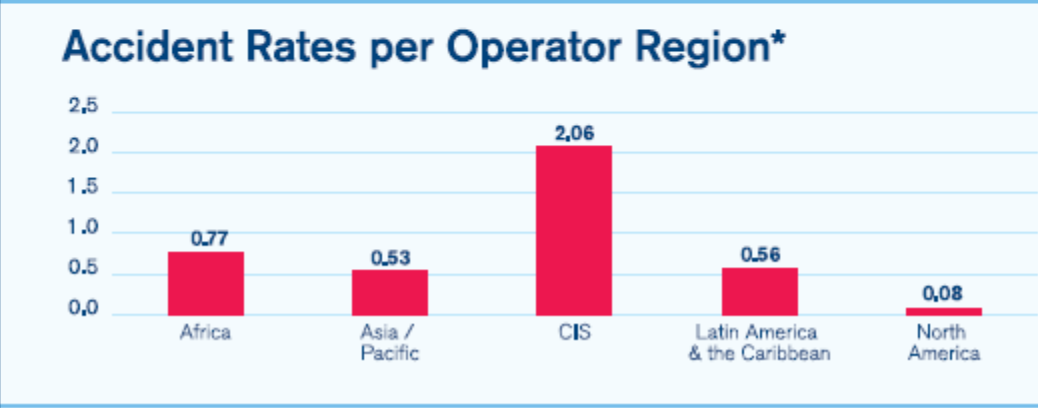
**0%**  
Ferry



**30%**  
Jet



**70%**  
Turboprop





# Loss of Control In-flight



## Loss of Control In-flight

8 Accidents


IATA Members	25%
Hull Losses	100%
Fatal	100%
Accident Rate*	0.21

 75% Passenger

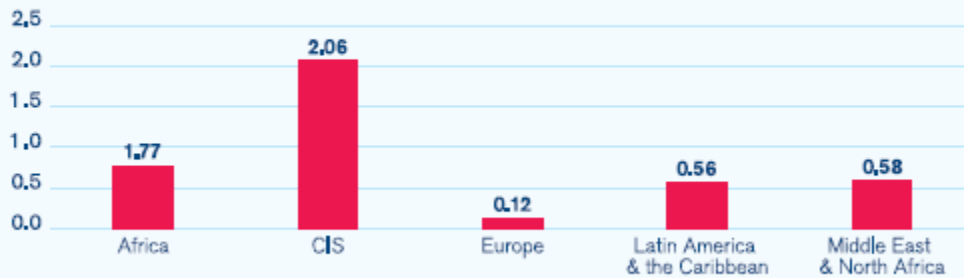
 25% Cargo

 0% Ferry

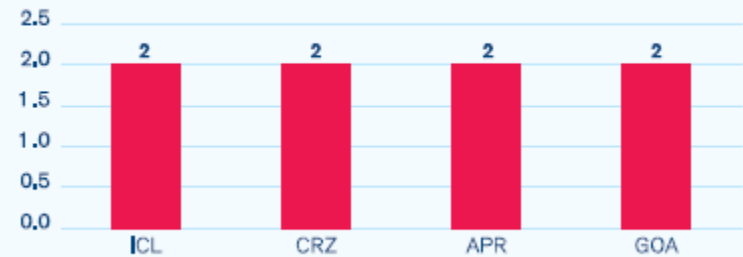
 37% Jet

 63% Turboprop

Accident Rates per Operator Region\*

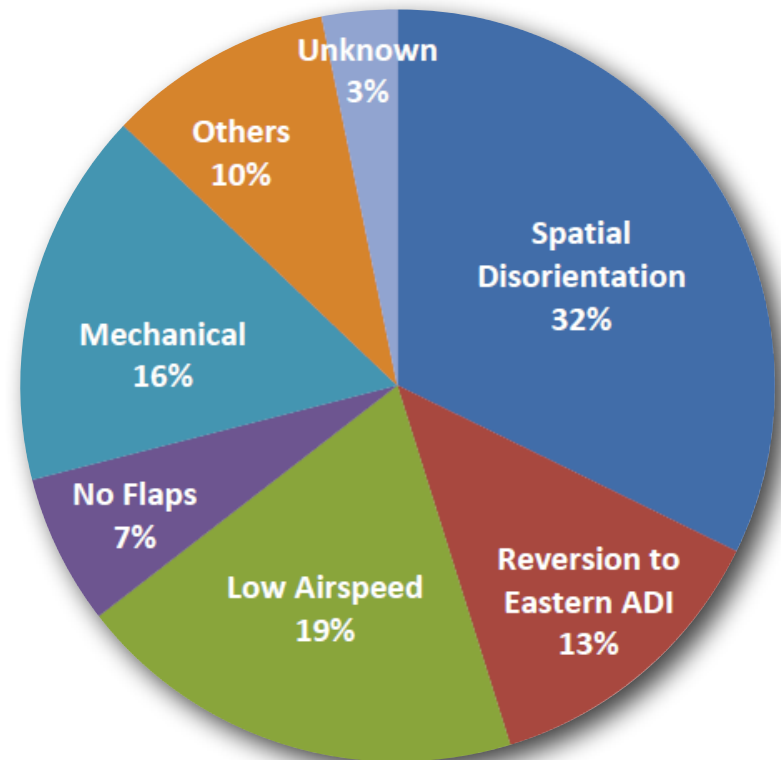


Accidents per Phase of Flight\*\*



# LOC-I Contributing factors

- Loss of situational awareness (Distraction, Complacency, spatial disorientation, etc...)
- Lack of awareness or competency in procedures for recovery from unusual aircraft attitudes
- Adverse weather
- Inadequate SOPs for effective flight management
- Insufficient height above terrain for recovery
- Inappropriate flight control inputs in response to a sudden awareness of an abnormal bank angle
- Mechanical or structural failure
- Aircraft loading





## Africa

8 Accidents

IATA Members **13%**

Hull Losses **75%**


Fatal **38%**

 **38%**  
Passenger

 **38%**  
Cargo

 **25%**  
Ferry

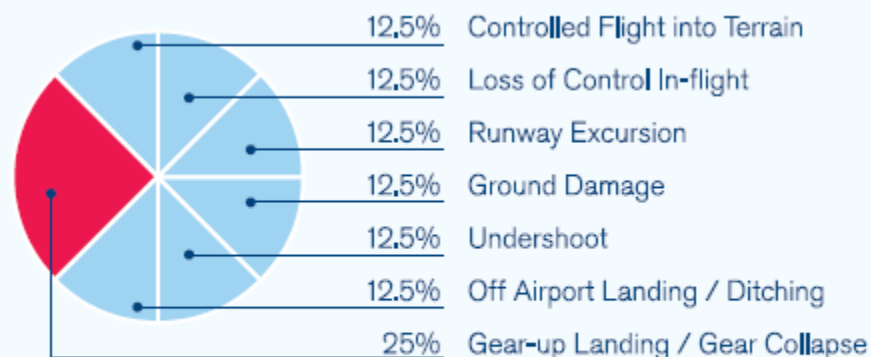
 **37%**  
Jet

 **63%**  
Turboprop

### Accidents per Phase of Flight\*



### Breakdown per Accident Category







# Our Challenge

# Our Industry Challenge

- My PILOTS may have rarely been exposed to the threat environment (full stalls, high bank angles)
  - aircraft are reliable
  - SOP's limit their manual handling skills
- My INSTRUCTORS may not have seen this either
- My REGULATOR has also not encountered this requirement, yet there are requirements out there

# Training Objective

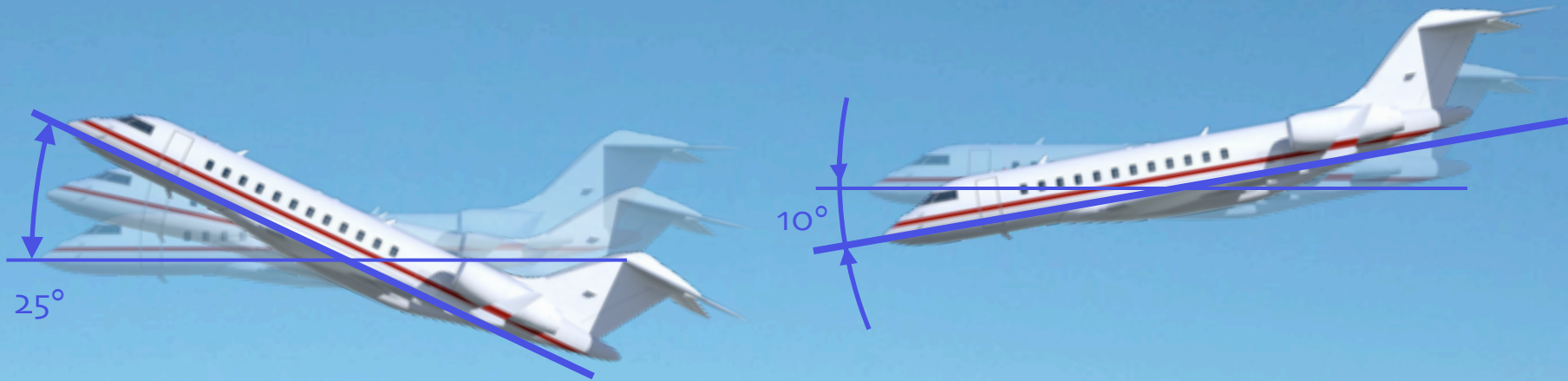
- Flight crews should be able to prevent and recover from airplane upsets
- Individual pilot knowledge and skills need to be at a level:
  - to understand the threat environment
  - to demonstrate proficiency
  - have the capability to deal with it operationally (type-specific)
- Instruction capability should concentrate on providing the feedback to the air crews



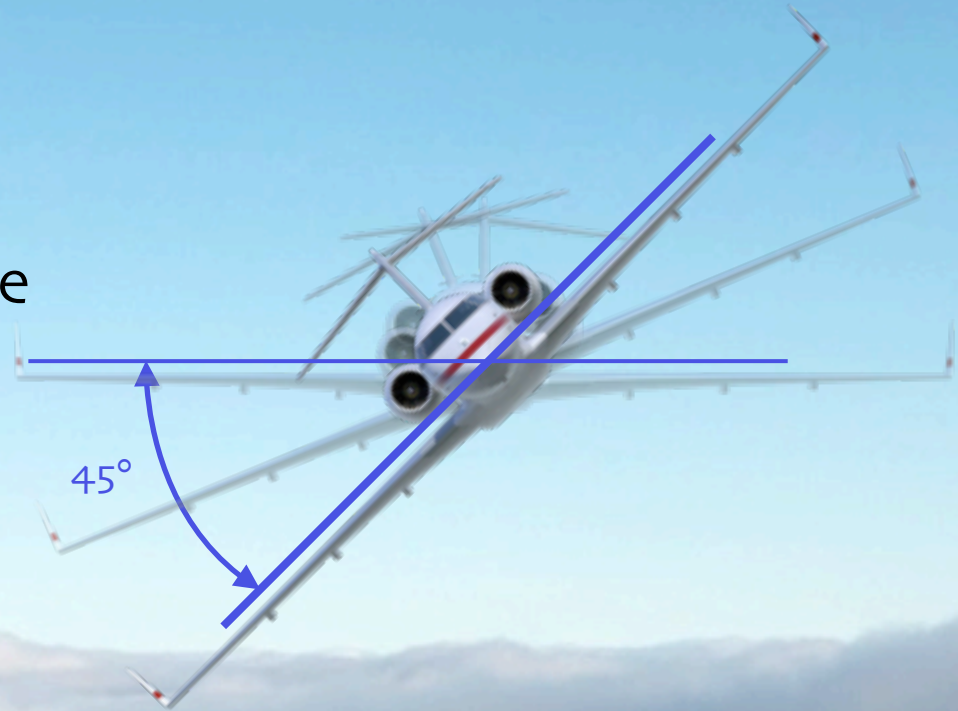


# What is UPRT?

# Airplane upset definition



Unintentionally exceeding any of these, or flight at inappropriate airspeed for the given configuration



# Propagation of an Upset

- Normal flight
- Unintended deviation
- Escalation
- Stall
- Upset
- Loss of Control

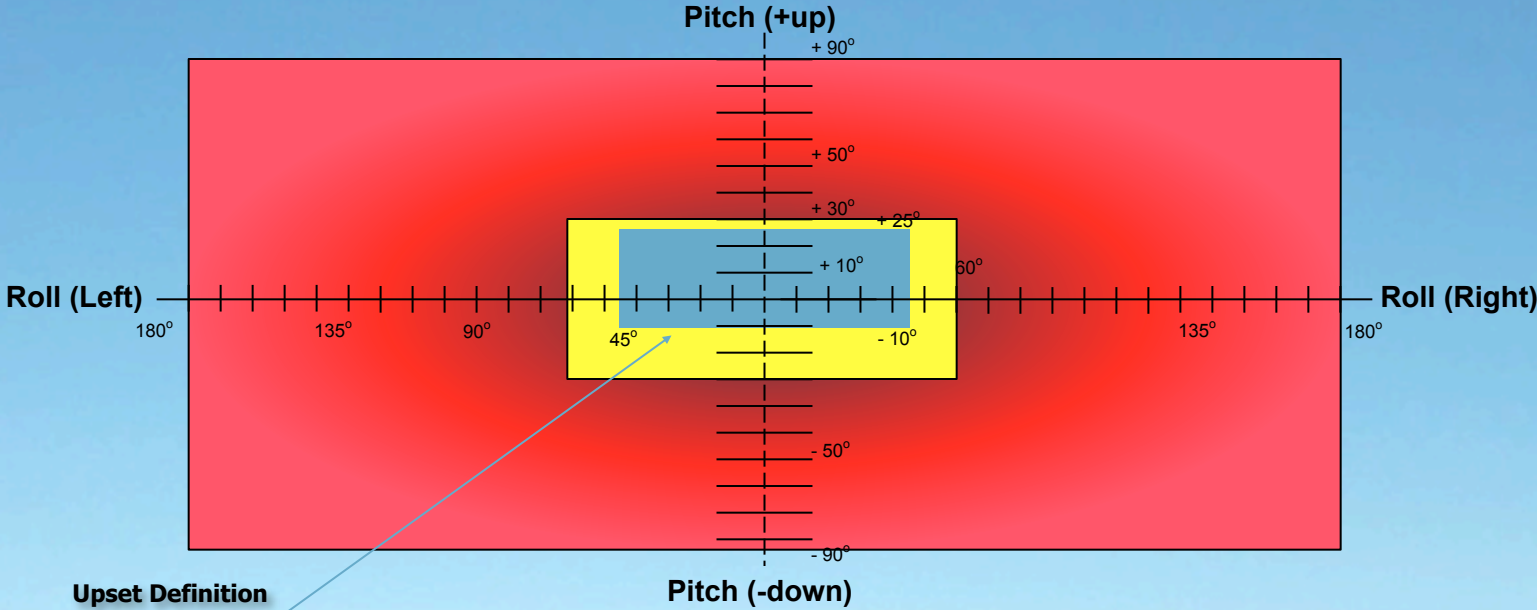


Awareness  
Recognition  
Avoidance  
Recovery

**TO PREVENT UPSETS and LOC-I, WE MUST INCLUDE  
PROPER STALL RECOVERY TRAINING**



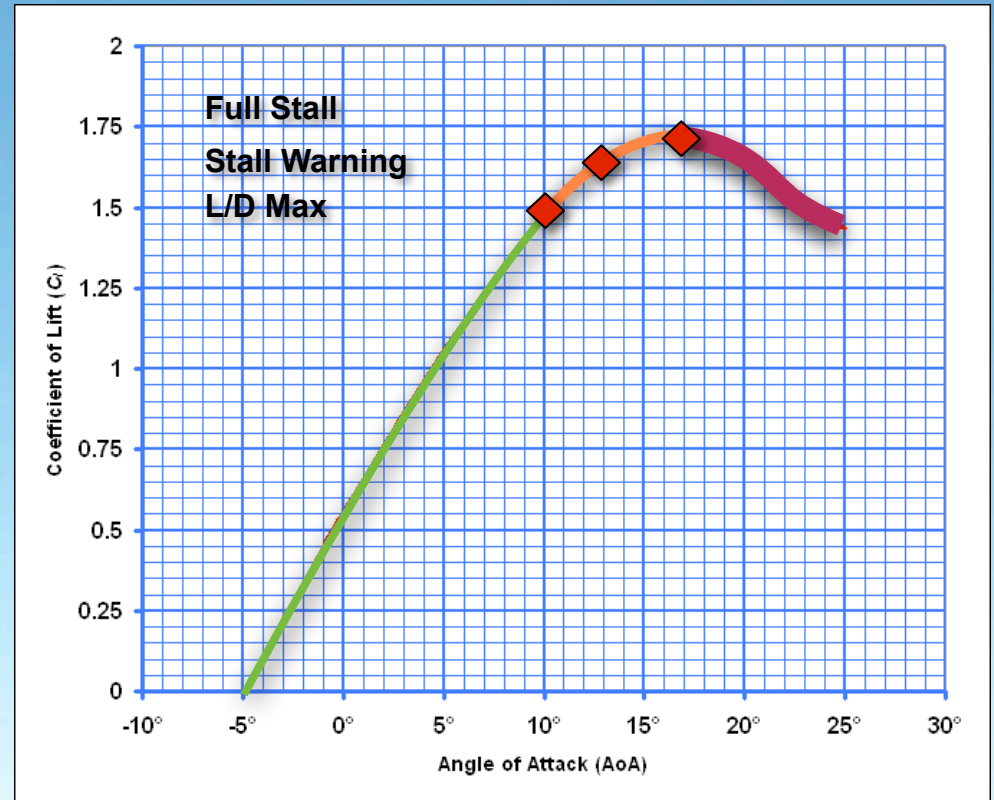
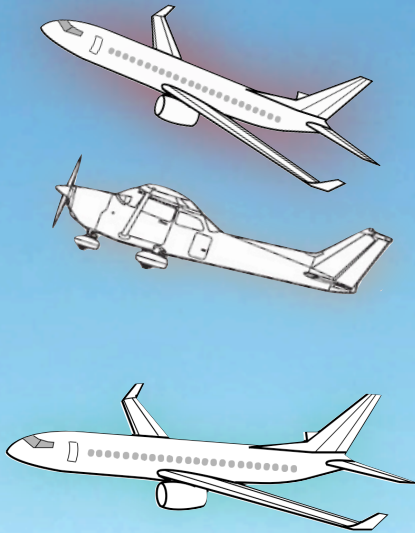
# All-Attitude Knowledge Deficiencies



**Upset Definition**  
**Airplane Upset Recovery**  
**Training Aid**

- 4.9 % Upset Definition (45 AOB, +25 & -10 Pitch)
- 11.1 % Max Licensing Limits (60 AOB, +/-30 Pitch)

# Flight Envelope Knowledge Deficiencies





**Why do airlines need this training?**





## Spring 2009 Flight Simulation Conference

### Flight Simulation: Towards the Edge of the Envelope

Wednesday 3 – Thursday 4 June 2009

No.4 Hamilton Place, London W1J 7BQ, UK

Sponsored by:



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**THALES**



INTERNATIONAL COMMITTEE FOR AVIATION TRAINING IN EXTENDED ENVELOPES

# ICATEE Participants

Category	Participants
Organization	RAeS-FSG, ICAO
Airframe Manufacturer	Boeing, Airbus, Bombardier
Regulator/Government	FAA, NTSB, IATA (ITQI/EBT), Transport Canada, EASA, Russian CAA
Training Provider	CAE, FlightSafety, Boeing Flight Training, APS, CALSPAN, Embry-Riddle
Simulation Provider	CAE, FlightSafety, Thales, Opinions, ETC, Bihrl
Industry Body	ALPA, IFALPA, ATA, BBGA
Airline	KLM, Alaska, Flybe, FedEx, Air Canada, Lufthansa, SAA, several airlines
Research	AIAA MSTC, NASA, UTIAS, NLR, TNO, IDT, DLR, U Liverpool, SOS, Volpe

45 organizations, over 80 individuals



# ICATEE Team



# ICATEE's Basic Rules

- Define complete training objective (Training Matrix)
- Work with OEM's
- Use existing training infrastructure wherever possible
- Avoid negative training transfer

HOT-2: gear's down.

HOT-1: flaps fifteen before landing checklist.

HOT-2: uhhh.



National Transportation Safety Board

22:16:27

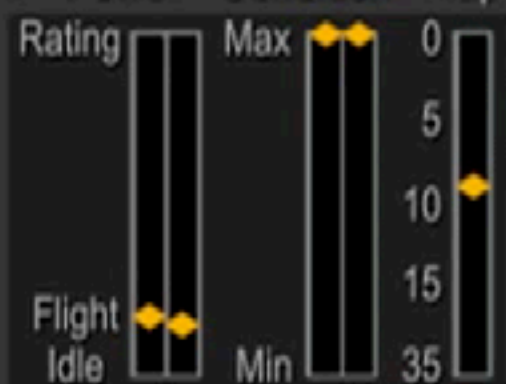
**130** knots **2280** feet **Shaker ON** Pusher **OFF** Power Condition Flap



Heading **247**°



L R  
Pedal 



Auto Pilot **OFF** Gear **DOWN**



# US Public Law (PL 111-216)



... provide flight crewmembers with ground training and flight training or **flight simulator training** —

(A) to **recognize and avoid a stall** of an aircraft or, if not avoided, to **recover from the stall**; and

(B) to **recognize and avoid an upset** of an aircraft or, if not avoided, to execute such techniques as available data indicate are appropriate to **recover from the upset in a given make, model, and series of aircraft**.





# ICATEE LOC-I Events Analysis

# Causes of Upsets

- **Environmental**
  - Wake vortex
  - Clear Air Turbulence
  - Mountain Wave
  - Thunderstorm
  - Icing
  - Microburst
- **System Anomaly**
  - Flight Instruments
  - Autopilot
  - Flight Control System
- **Pilot Induced**
  - Inappropriate use of A/P
  - Pilot technique
  - Incapacitation
  - Vertigo
  - Distraction
  - Inattention
  - Adjusting attitude & PWR
  - Instrument crosscheck





Environmentally-  
Induced

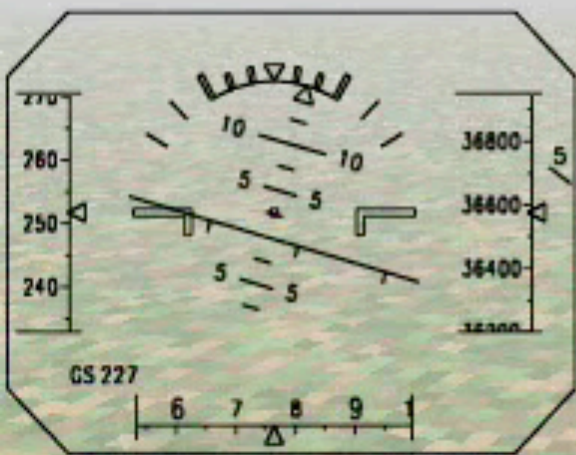
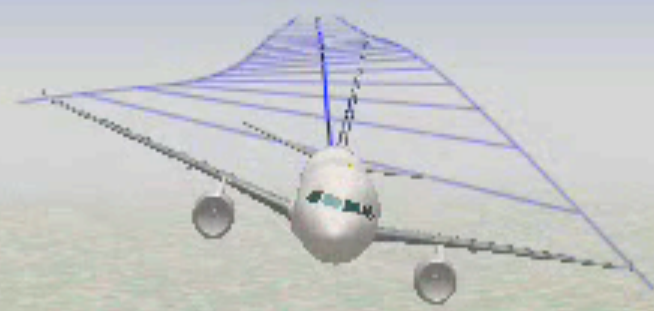
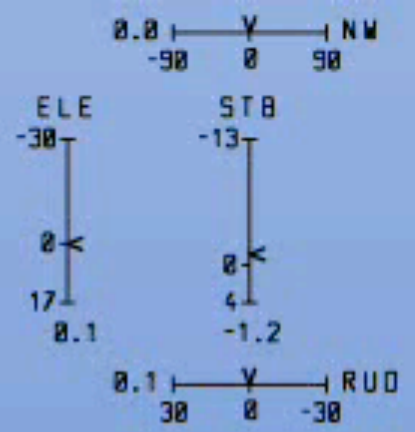
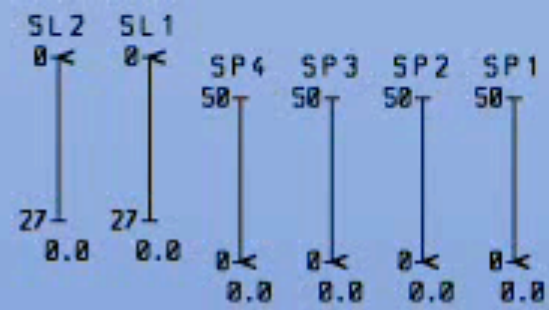
VertAcc: 1.157 g  
AirSpd: 220 Kt  
WindDir: 307.4 Deg  
WindSpd: 11 Kt  
AOA: 0.8 Deg



# High-Altitude Windshear

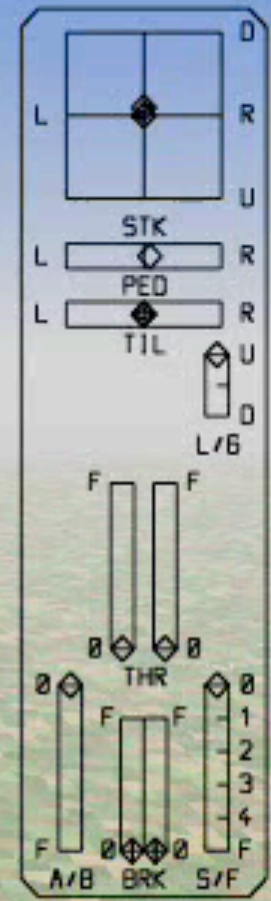
- Demonstrates:
  - sensitivity of control inputs
  - proximity to limits
  - limitations of power available
  - need to maintain alertness
  - avoidance of startle
  - danger of accelerated/secondary stall



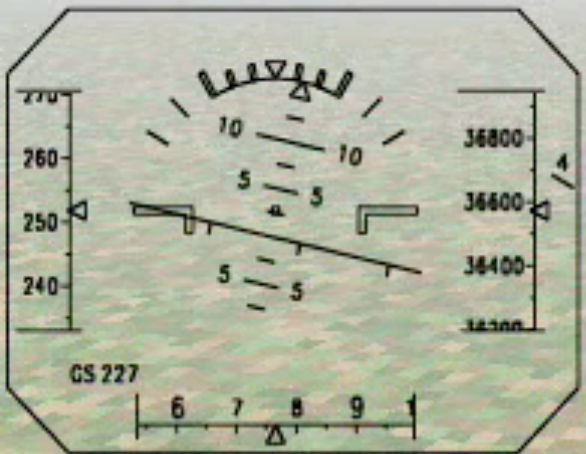
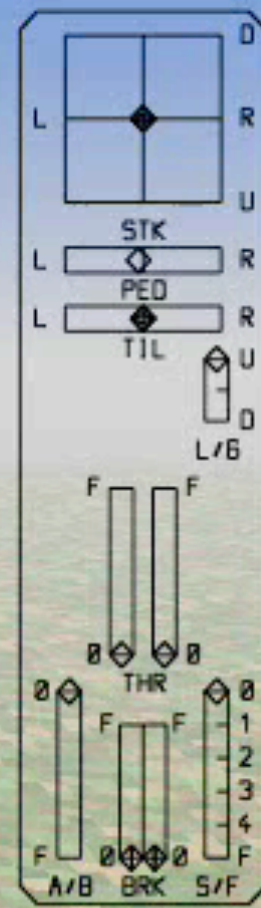
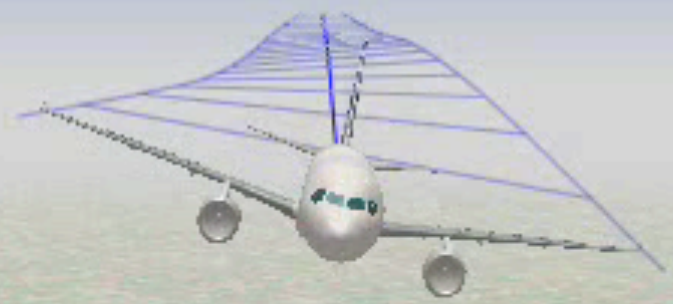
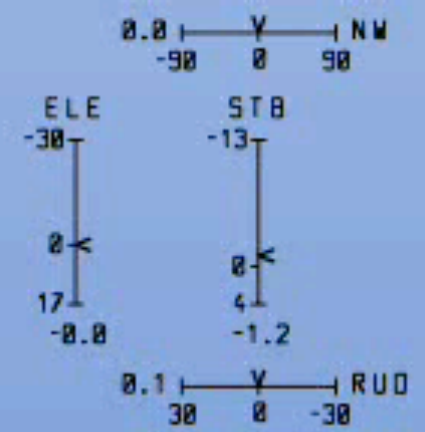
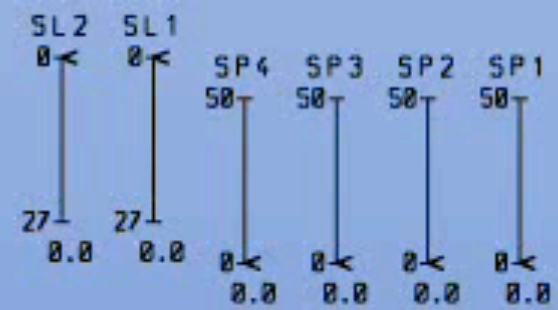


T = 0 : 0 : 44    RXC = N/A    REC = 871  
 ALT = 36575 FT    IAS = 251.6 KTS    V/S = 524 FT/MIN  
 PHI = -15.4 DEG    THE = 2.8 DEG    PSI = 76.6 DEG  
 ALF = 2.2 DEG    BET = -0.0 DEG    GAM = 0.7 DEG  
 LAT = N 0 : 1 : 14.46    LON = E 0 : 5 : 10.00

Wortex with pilot effect







T = 0 : 0 : 43      RXC = N/A      REC = 869  
 ALT = 36572 FT      IAS = 251.7 KTS      V/S = 411 FT/MIN  
 PHI = -12.6 DEG      THE = 2.9 DEG      PSI = 76.7 DEG  
 ALF = 2.4 DEG      BET = -0.0 DEG      GAM = 0.5 DEG  
 LAT = N 0 : 1 : 14.29      LON = E 0 : 5 : 9.37



Environmentally-  
Induced



System Anomaly-  
Induced







Environmentally-  
Induced



System Anomaly-  
Induced



Pilot-Induced



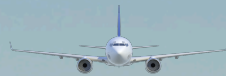
13:48:18 UTC

41002 feet





**“SOKOAGE” Program:  
From the Ground Up**





Environmentally-Induced



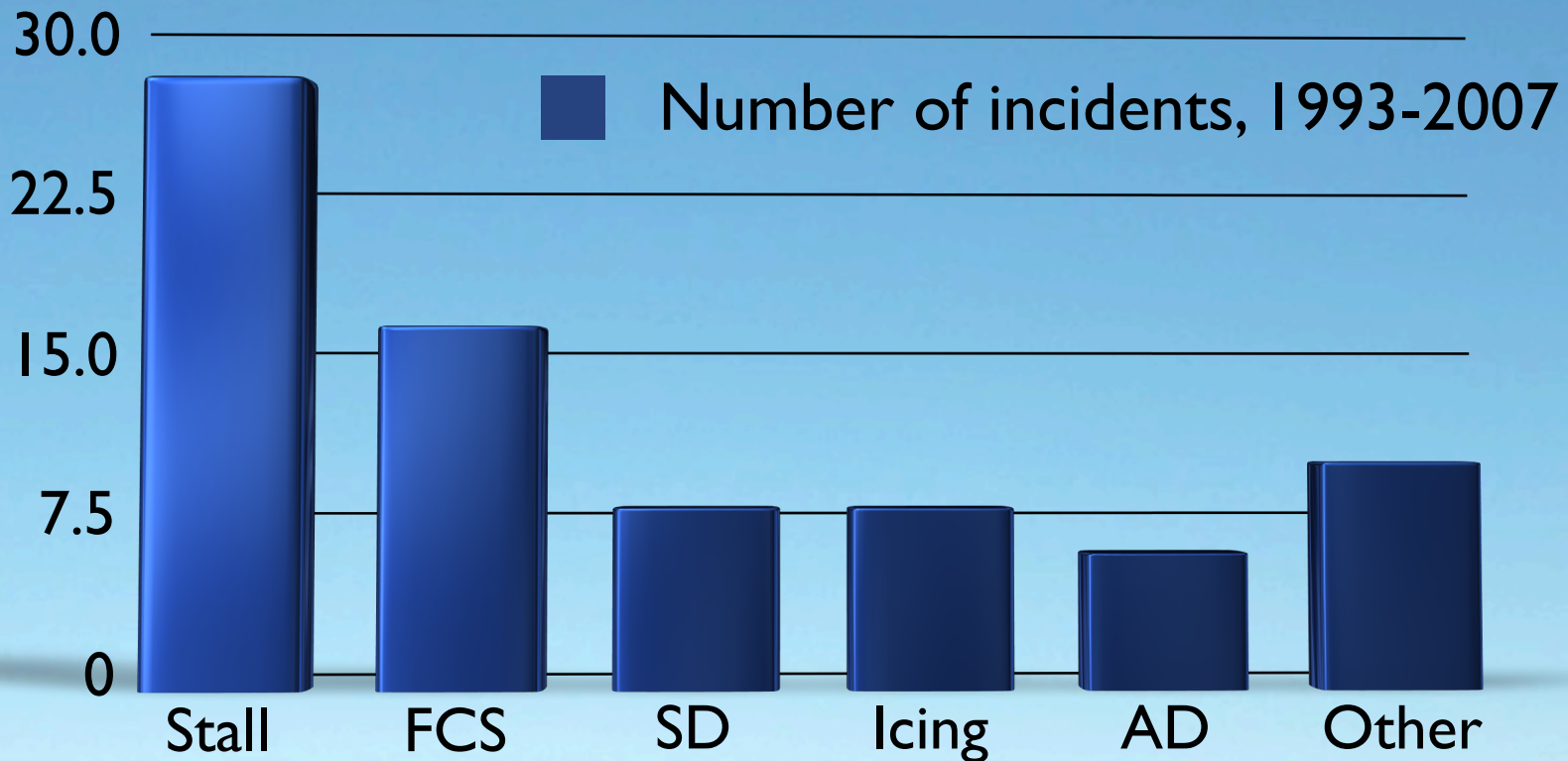
System Anomaly-Induced



Pilot-Induced

**Regardless of the cause, the number-one resulting condition is aerodynamic stall**

# Airplane upset causes



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

Lambregts, et al, "Airplane Upsets - Old Problem, New Issues". In Proc. of AIAA Modeling & Simulation Technologies Conf., Honolulu, Aug 2008, AIAA-2008-6867 CP.



# ICAO Manual 10011

- Regulatory Guidance for UPRT
- Foundational training concepts:
  - On-aircraft training at licensing level
  - Simulator training
- Does NOT specify training programs
- *It is the shopping list of ingredients, not the cookbook*

Doc 10011  
AN/506



## MANUAL ON AEROPLANE UPSET PREVENTION AND RECOVERY TRAINING

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And published under his authority

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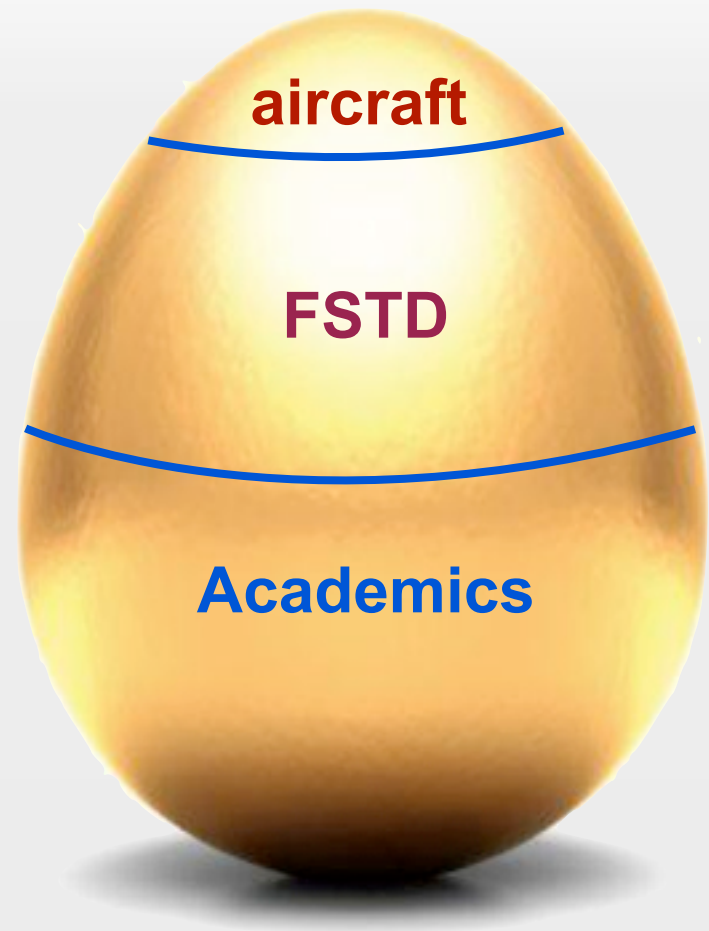
INTERNATIONAL CIVIL AVIATION ORGANIZATION

# Using the ingredients properly



# Developing Integrated UPRT Skills

## UPRT Requires Integrated Training Elements







AA-587: Inappropriate  
use of the rudder  
contributed to the loss of  
the A300-600

**WE MUST AVOID**  
**Negative Training**  
**Transfer**



# Think about....

- Training INSTRUCTORS
- Practical Solutions
- Graduated Implementation
- Global Standards



728



133



LE BOURGET, France—The latest trend in training pilots to fly commercial jets features the practicing of extreme maneuvers in small, propeller-powered aircraft.

Using a technique unheard of until recently, carriers such as [Delta Air Lines](#) Inc. and South African Airways are sending some of their most experienced flight instructors back to flight school to learn how to recognize and recover from [airborne upsets](#).

The efforts are part of a world-wide trend to step up so-called upset recovery and stall training, prompted by a series of deadly accidents that have raised concerns about an erosion of manual flying skills in the cockpit. Simulators generally are considered less effective at depicting extreme aircraft behavior.

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*‘Pilots must learn to do the right thing, even when it is counterintuitive’*

—Sunjoo Advani, consultant to South African Airways

Video on YouTube:

**“NOS Loss of Control”**



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