6th EUROPEAN FLIGHT TEST SAFETY WORKSHOP

Loss-of-Control - How do we tackle aviation´s number one killer?

Loss of Control In-flight

Accident Statistics and Some Personal Thoughts

Dr. Dieter Reisinger

SETP Vice President for Austria

Chairman IATA Accident Classification Task Force

Loss of Control-Inflight (LOC-I)

- LOC-I is found in all segments of aviation:
  - General Aviation
  - Air Transport (multi pilot crew, usually considered very experienced!)
  - Military aviators
  - Display Flying (see Des Barker, European FTSW 2011 workshop)
  - FLIGHT TESTING
- LOC-I is not restricted to „novice pilots / beginners“
- LOC-I is a complex subject – involves many different disciplines

Loss of Control Workshop 2012

- Participation from many different countries:
  - Argentina
  - Brasil
  - Canada
  - China
  - Japan
  - Kasachstan
  - US
  - South Africa
  - Turkey
  - Many European Countries

Loss of Control Workshop 2012

- Flight Testers have their own set of challenges
  - Prototypes, highly modified aircraft
  - Some flights high risk
  - „Can do“-Attitude (try hard to make a test point)
  - Time Pressure
  - Fatigue
- First time that flight test safety workshop is opened up to airline pilots, researchers and other subject matter experts

Loss of Control Workshop 2012

- Flight testers need to also learn from operational pilots, how their product is being used (or rather mis-used!). Operational pilots have their own set of challenges (fatigue, boredome, shift work)
- LOC is a complicated subject – requires inputs from a diversity of fields
- So far no silver bullet
- We need to learn from each other!

Loss of Control-Inflight (LOC-I)

Definition:

„A loss of control accident is an accident in which an aircraft is unintentionally flown into a position from which the crew is unable to recover due to aircrew, aircraft, environmental, or a combination of these factors.“

(Jim Burin, FSF)

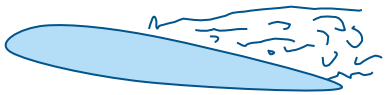
Loss of Control-Inflight (LOC-I)

Can be

- An *„Aircraft End State“* (this is how IATA uses the term) – LOC-accident
- A temporary condition (when crew looses control temporarily) – LOC-incident

(Jim Burin, FSF)

UPSET



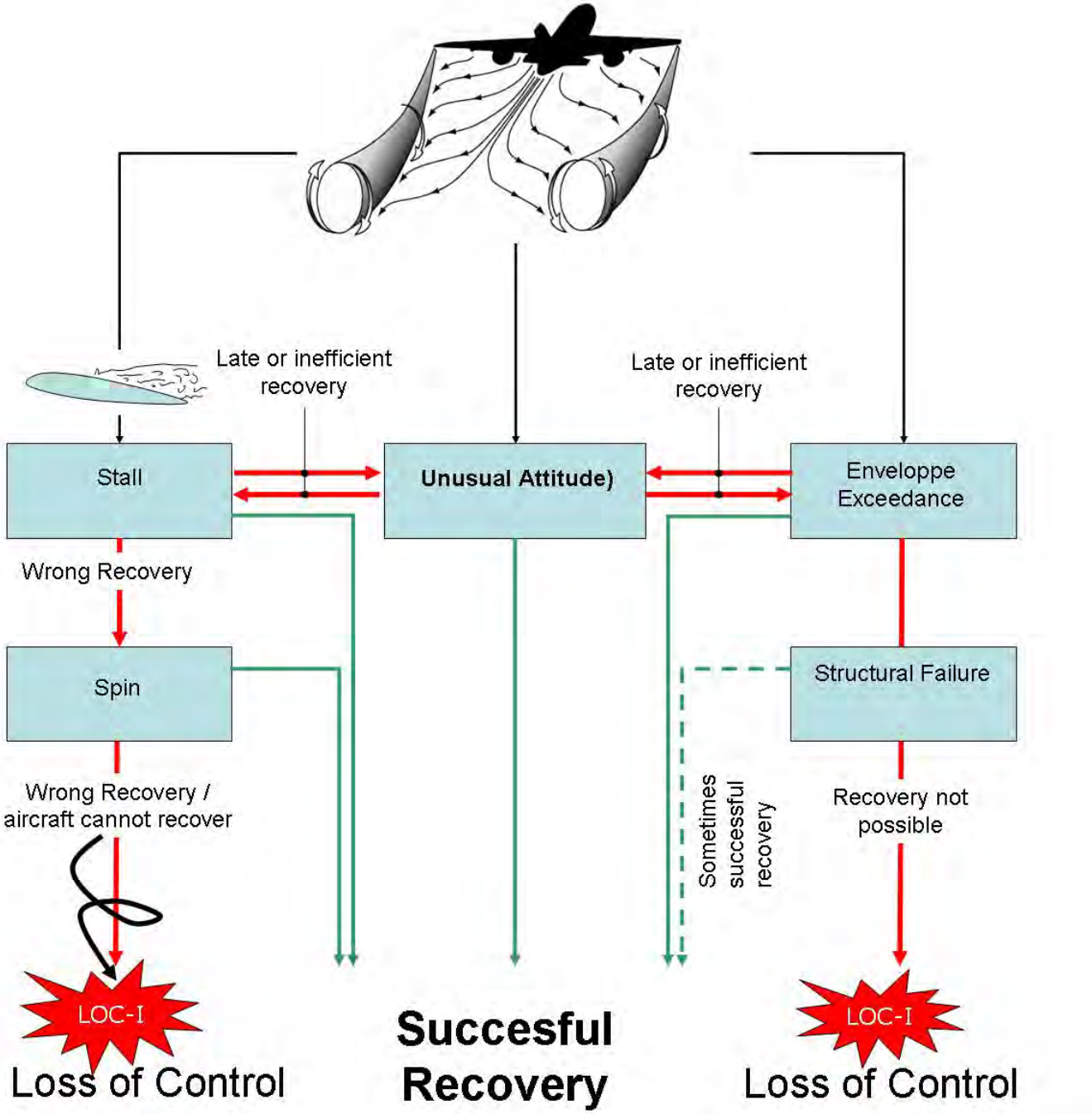
Late or inefficient recovery

Late or inefficient recovery

Stall

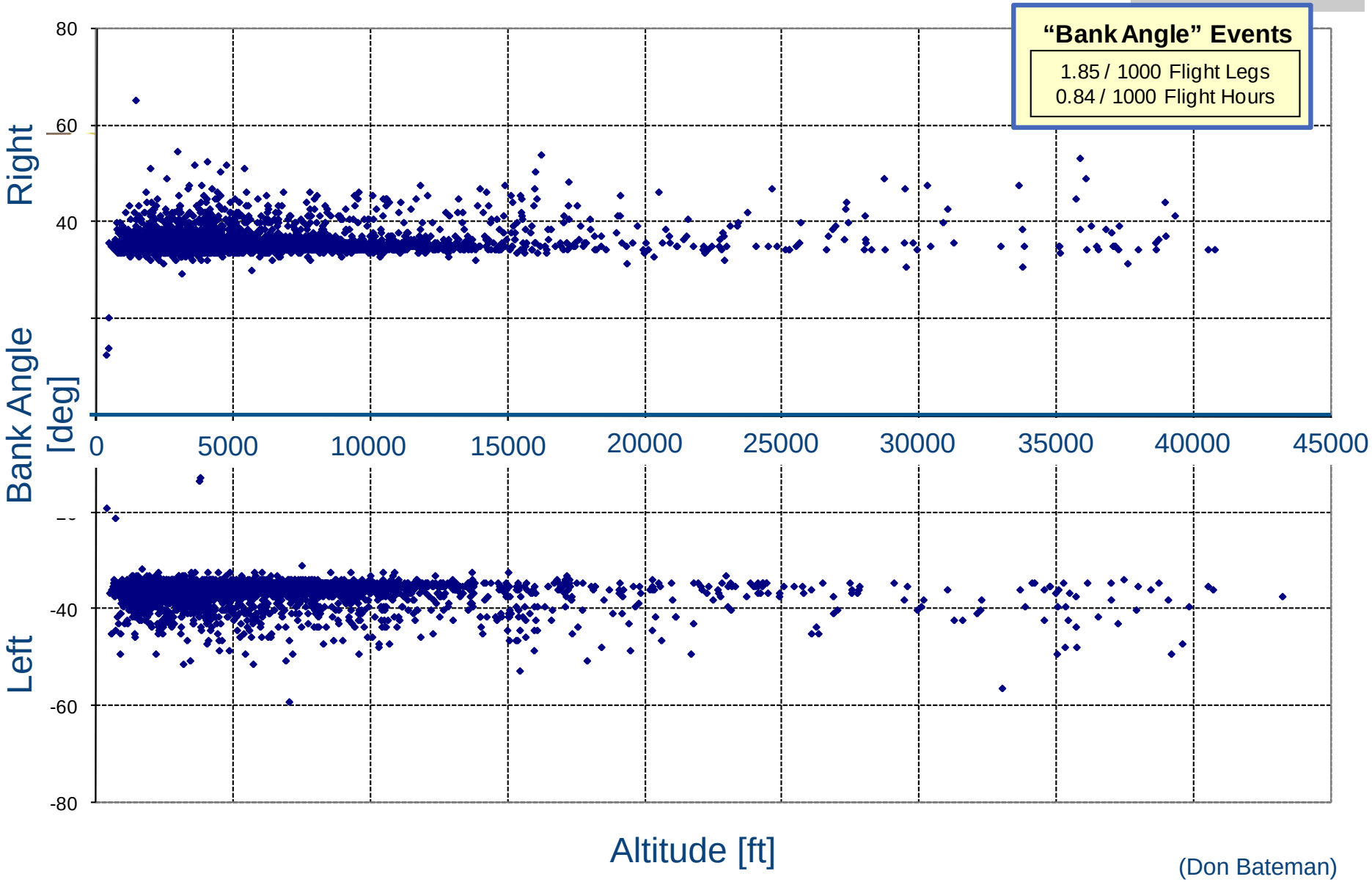
Unusual Attitude

Envelope exceedance


Late or inefficient recovery
Late or inefficient recovery
Stall
Unusual Attitude)
Enveloppe Exceedance
Wrong Recovery
Spin
Structural Failure
Wrong Recovery / aircraft cannot recover
Sometimes successful recovery
Recovery not possible
LOC-I
LOC-I
Loss of Control
Succesful Recovery
Loss of Control

Loss of Control-Inflight – Categories

- Upset in Pitch
- Upset in Roll
- Airspeed
  - Airspeed Unreliable,
  - Airspeed not appropriate for the phase of flight / configuration

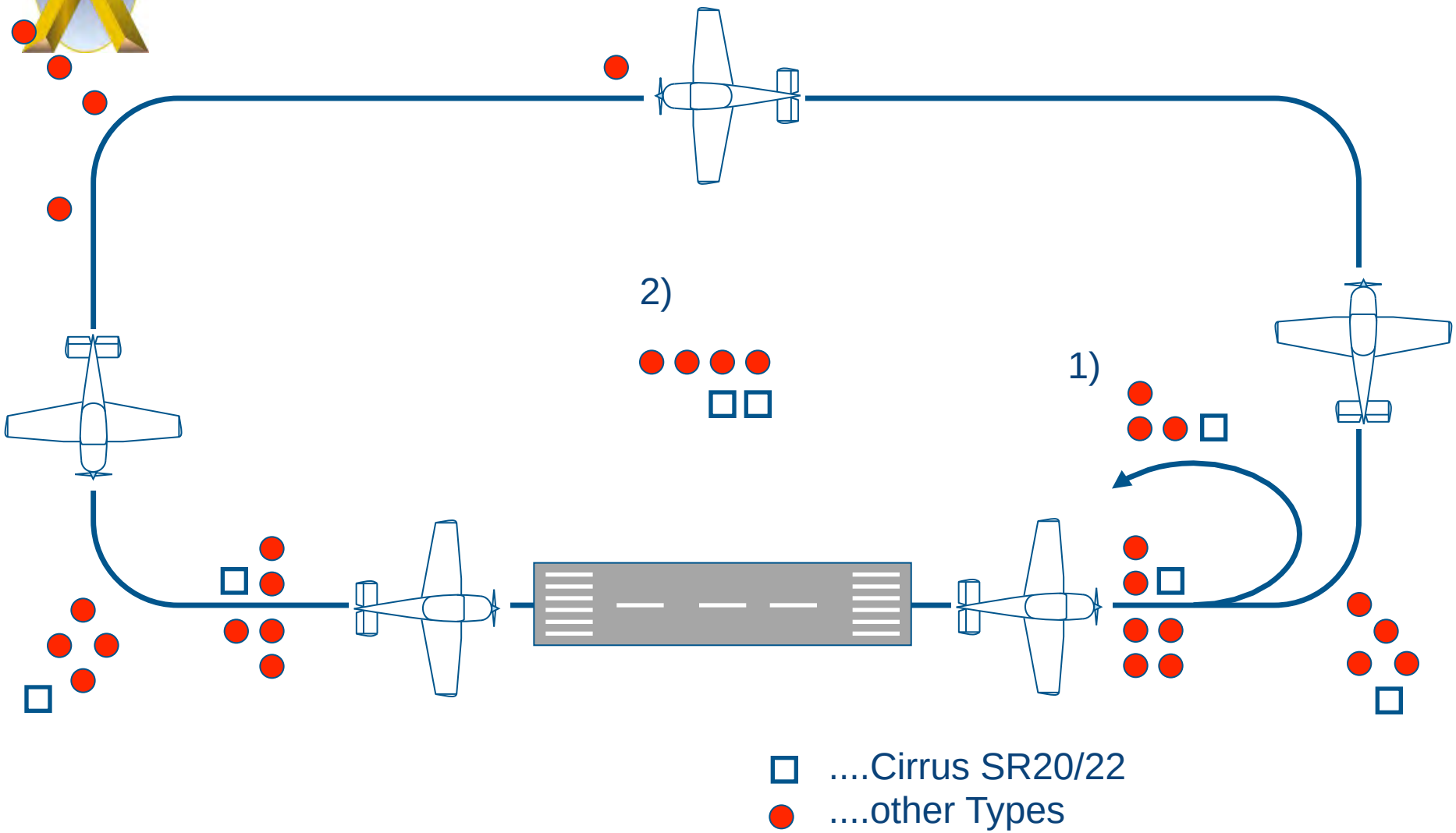

"Bank Angle" Events
1.85 / 1000 Flight Legs
0.84 / 1000 Flight Hours
Right
Left
Bank Angle [deg]
80
60
40
-40
-60
-80
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
Altitude [ft]

(Don Bateman)

Incident: Roll-Upset in Cruise at 41.000 ft

Kenya Airways, Spiral Dive after departure on May 4, 2007

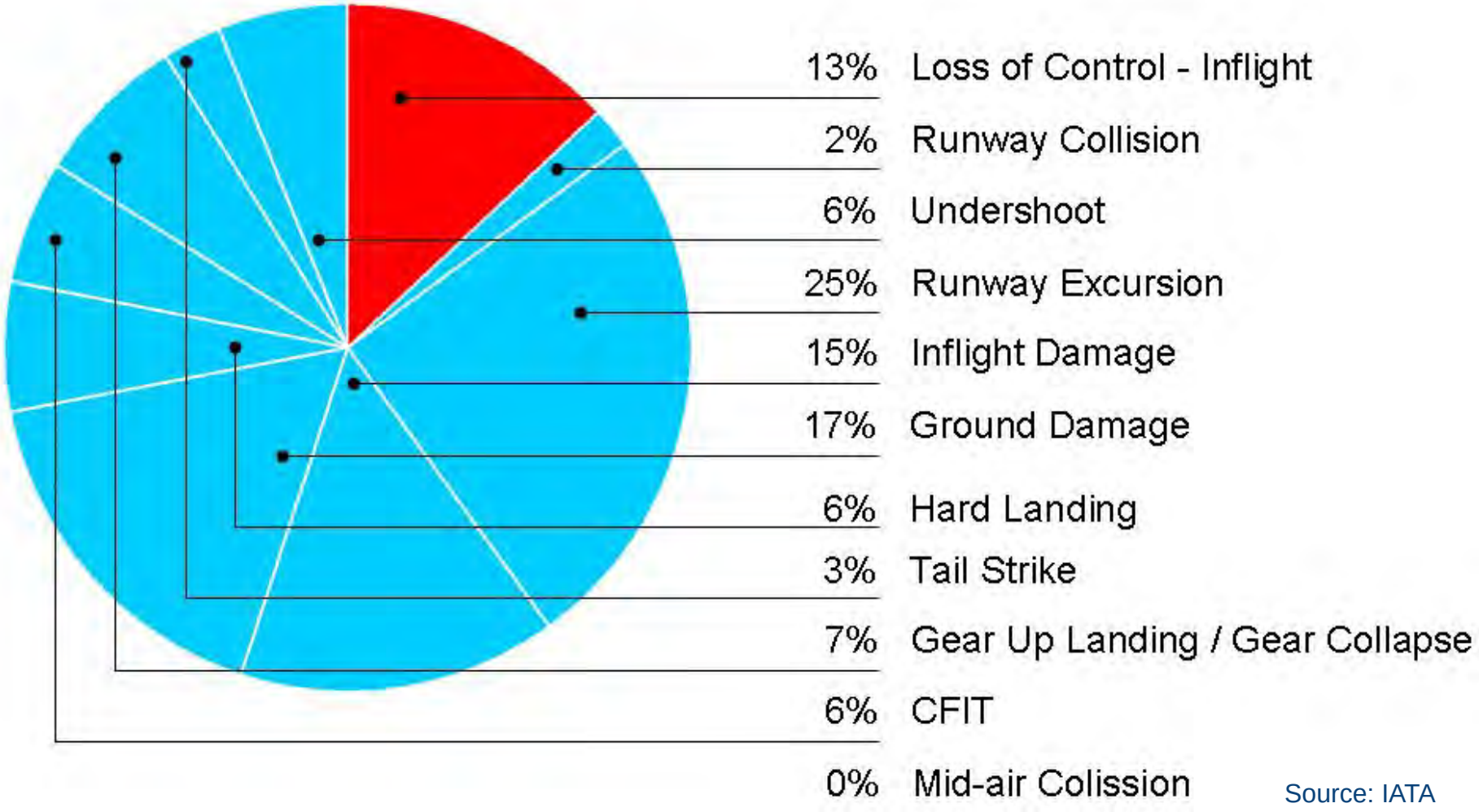
Loss of Control – General Aviation


2)
1)
....Cirrus SR20/22
....other Types

LOC – General Aviation Commonalities

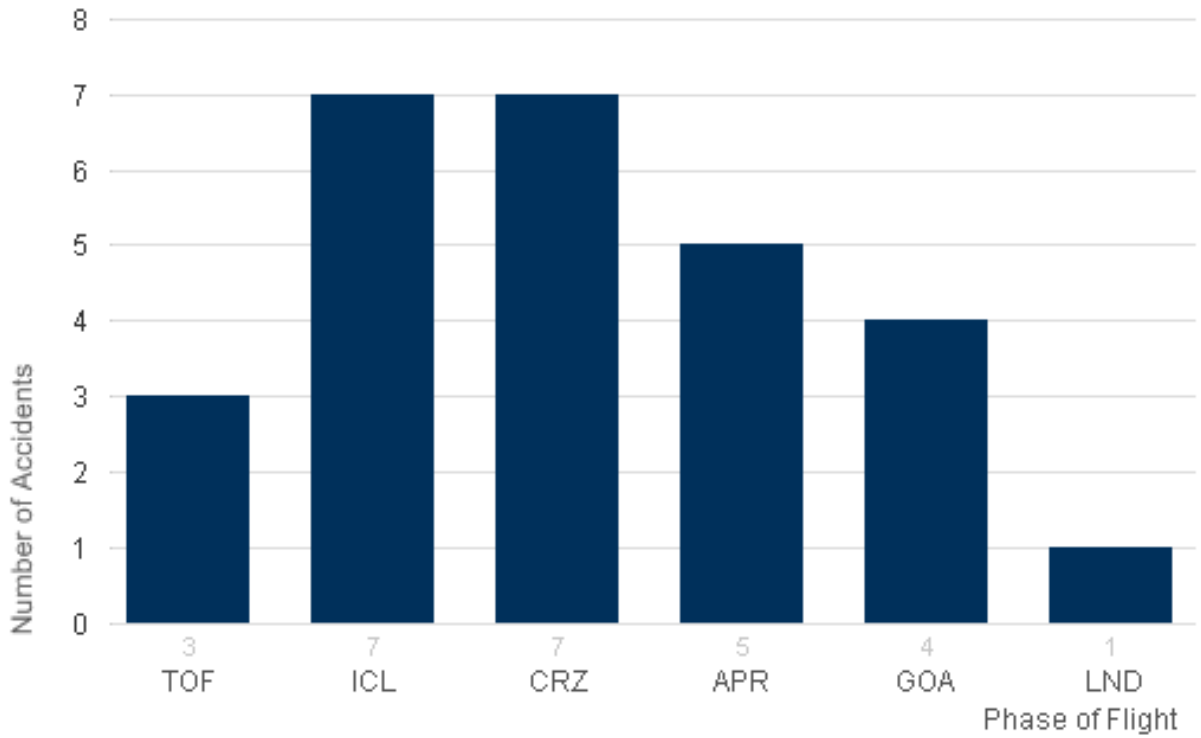
- Often less experienced pilots
- Training usually less sophisticated (in particular training for non-normal situations)
- Capability of the aircraft vs Pilot Capability
  - Low performance overestimated by pilot
  - High Performance underestimated by pilot

Loss of Control – Air Transport


13% Loss of Control - Inflight
2% Runway Collision
6% Undershoot
25% Runway Excursion
15% Inflight Damage
17% Ground Damage
6% Hard Landing
3% Tail Strike
7% Gear Up Landing / Gear Collapse
6% CFIT
0% Mid-air Colission

Source: IATA

LOC-I Accidents by Phase (2009-2011)



Loss of Control Accidents 2009-2011 – Air Transport

	2009	2010	2011
Total Accidents	90	94	92
LOC Accidents	9	10	8
% LOC	**10%**	**11%**	**9%**
Total Fatal Accidents	18	23	22
Fatal LOC Accidents	8	10	8
% LOC	**44%**	**43%**	**36%**

Summary: 10 % of accidents, 41% of fatal accidents

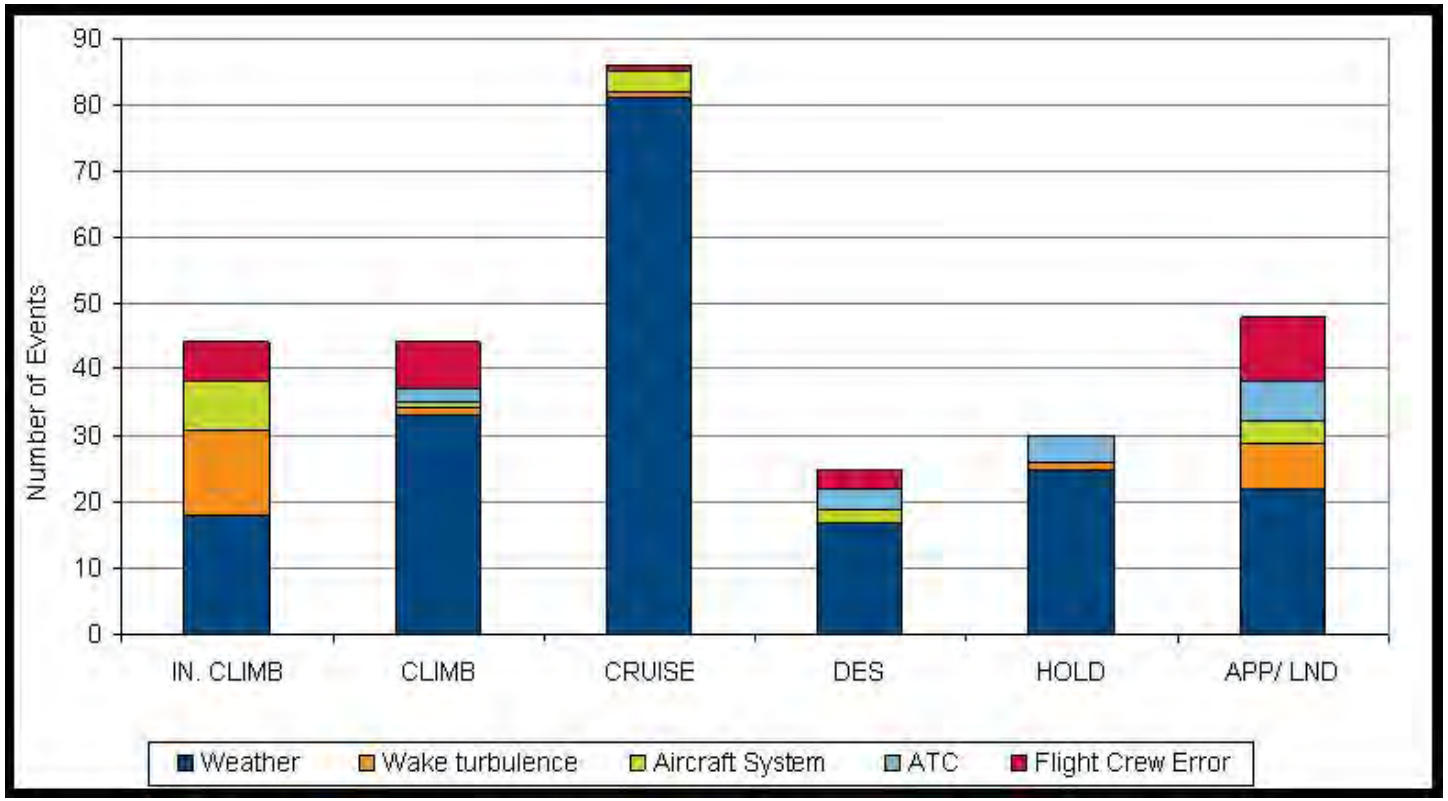
(IATA)

Loss of Control Accidents 2009-2011

	2009	2010	2011
Total Fatalities	685	786	486
LOC Accident Fatalities	639	241	213
% LOC	**93%**	**31%**	**44%**

Summary: 56% of industry fatalities

IATA Survey Approach to Stall



Colgan – Stall on Approach

2A · FRIDAY, FEBRUARY 20, 2009 · USA TODAY

Crash experts focus on sharp rise of plane's nose

By Alan Levin
USA TODAY

Investigators trying to solve the week-old crash of Continental Connection Flight 3407 near Buffalo are hoping to find clues that will explain the mystery of why the plane's nose inexplicably shot up during a seemingly normal landing.

Understanding what the crew was thinking in the final moments could help explain why the plane's nose rose 31 degrees before quickly losing control and plummeting to the ground.

The Bombardier Dash 8 Q400 had been in a normal approach to Buffalo Niagara International Airport in icy weather when the nose suddenly shot upward, according to National Transportation Safety Board (NTSB) member Steven Chealander. That maneuver, well beyond the degree of a normal climb, is being looked at as the reason the plane plummeted to the ground. All 49 people aboard died, along with a man on the ground.

Teams from the NTSB are also studying computer plots, running aerodynamic simulations and picking over charred wreckage in search of mechanical problems.

Determining why pilots act the way they do is among the most difficult tasks that the NTSB undertakes, safety experts and former investigators say.

The crash-proof cockpit voice recorders often leave few clues other than clipped comments and grunts. Even the most sophisticated data recorders do not say whether a pilot flicked a switch intentionally or accidentally.

AP

Marvin Renslow: Was a pilot of plane.

"It's an old, old issue in accident investigation," said John Lauber, a former NTSB board member who studied pilot performance at NASA. "The technology does not exist that allows you to capture the intent. You always have to infer the intent."

Investigators will interview the pilots' co-workers, study their training and search for clues in their personality. They will also listen carefully to the cockpit recording.

"It's extraordinarily difficult and it's emotionally draining," said Peter Goelz, who served as managing director of the NTSB. "It means you have to listen very, very carefully to the sounds and activities of the last moments of an airplane. It's terrible."

The NTSB will spend months studying the pilots' performance, spokesman Keith Holloway said.

In several major cases during the past 15 years, NTSB investigations have revolved as much on psychology as engineering:

▸ When a US Airways jet crashed near Pittsburgh in 1994, killing 132 people, investigators concluded that a flaw in the jet's rudder brought it down. Malcolm Brenner, an NTSB specialist in human performance, concluded that the pilots' grunts were likely reactions to a rudder problem.

▸ A co-pilot at the controls of an American Airlines Airbus A300 on Nov. 12, 2001, tore the jet's tail off by making several sharp movements of the rudder. The plane crashed in Queens, N.Y., killing 265 people. The NTSB found the airline's training had improperly emphasized rudder use and that the design of the jet led to overuse of the rudder.

Turkish 1951 – Stall on Short Final

Air France 447 – Stall in Cruise

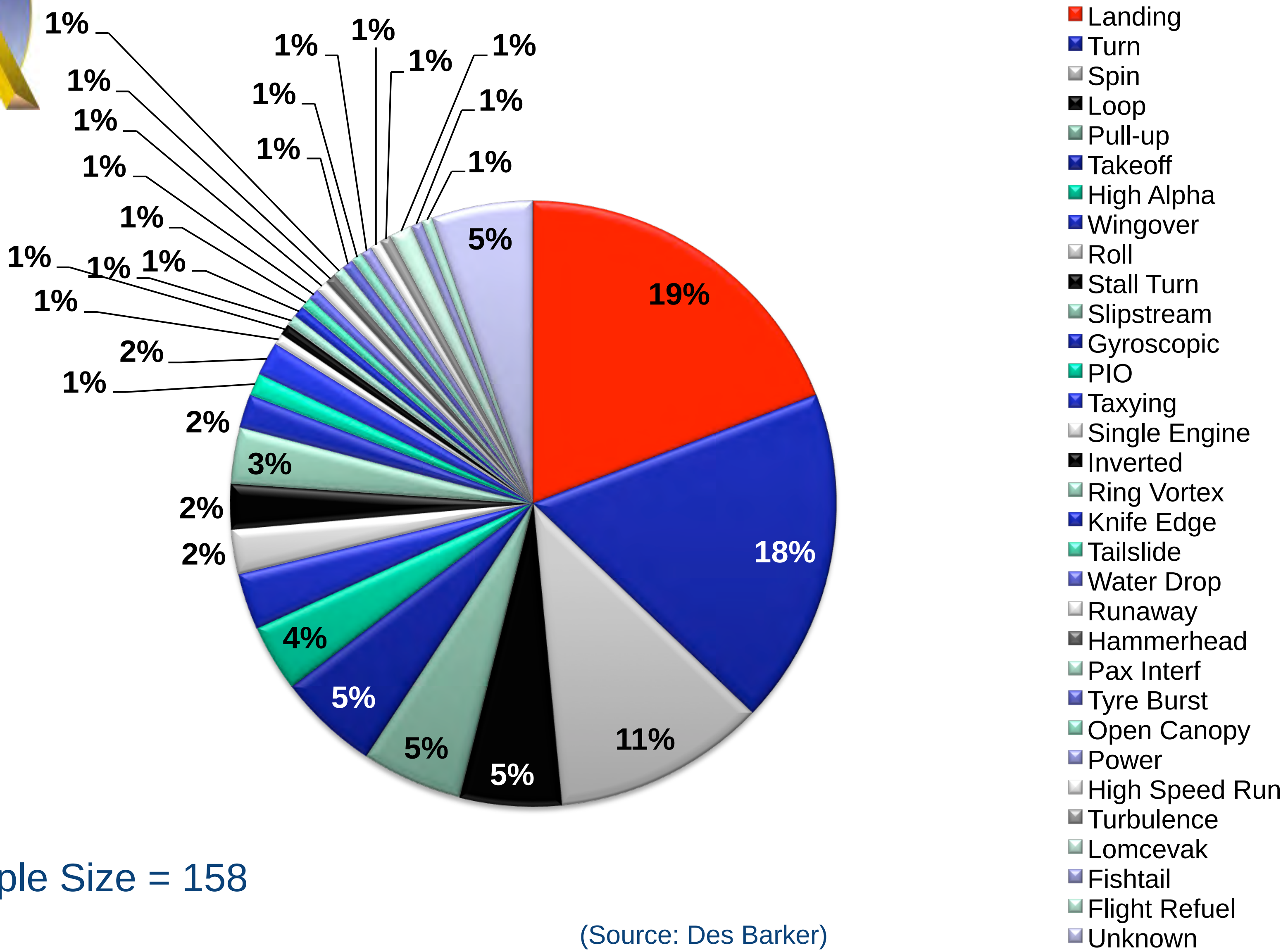
LOC – Air Transport Commonalities

- Very experienced pilots, multi-pilot crew
- One flight is like the other (with small variations)
- Boredom and Monotony
- Chronic Fatigue
- Expectation that the aircraft is fine
- Startle factor
- Potential that flying skills degrade over the years

Loss of Control-Inflight – Display Flying

AWRY: The B-52 exceeded authorized maneuvers and, after aborting a landing, lost altitude

Loss of Control Elements



Sample Size = 158

(Source: Des Barker)

LOC – Root Causes

- Pilot Aircraft Handling
  - McDonnell Douglas C-17, Alaska, 28 July 2010
  - DH Mosquito, Barton, UK, 27 July 1996
- Engine Failure
  - Spitfire, Rouen Valley, 4 June 2001
  - Yakolev 52, Romania, 24 June 1995
- Passenger Interference

LOC – Display Flying Commonalities

- Very experienced pilots
- Usually single pilot
- Close to ground
- High closure rates
- Peer Pressure
- No margin for error

Details: See Des Barker, „Zero Error Margin“

Loss of Control-Inflight – Flight Test

Selected Accidents – Flight Test

- Airbus A330-300, speed below v_{MCA}, 30 June 1994
- Challenger 600 – deep stall, April 3, 1980
- Gulfstream G650, April 2011
- Many other, including „close calls“

LOC - Flight Test Commonalities

- Very experienced pilots, multi-pilot crew + engineer(s)
- High risk testpoints (but are those always really necessary)
  - V_{MU}-Testing?
- Time Pressure
- Expectation that the aircraft is NOT fine

LOC - Flight Test Commonalities

- Lack of or limited test point build-up
  - Time pressure
  - Not seeing a need for build up
- Pilot „trying to make a test point“
  - Using special technique which no regular pilot would use
  - Note: if test point can be made using a special technique, flag should be raised!

Loss of Control-Inflight – Personal Thoughts

Maintaining Situational Awareness is Key

- Startle Factor („I do not know what it is doing“)
- When under Spatial Disorientation
- When automation (partially) fails
- When pilots are fatigued

Source: Don Bateman

Do we need to revise the FARs / CS

- Usefulness of VMU Testing?
- Certain phenomena not fully addressed in aircraft certification (e.g. Crystal icing)
- Accident data shows that environmental conditions can exist, which are outside (or exceed) the coverage of Certification Design Regulations and Requirements

Pilots Skills and Knowledge

- This is not about knowing that the aircraft has three 90 kVA generators
- One accident is not like the other!

Source: Internet

Use Existing Training Aids

- Upset Recovery Training Aid, developped in 1996 and updated in 1998 is still a valid and excellent training tool
- **Knowledge of instructor and the way he instructs is vital –**
  - No shortcuts!
  - Build-Up Approach

Training in Aircraft

- For confidence building and peace of mind aerobatic instruction in a real aircraft is a MUST
  - Talk to spin-instructors!
- This is not about handling techniques – it is about
  - Rules of thumb
  - Self confidence (I have been there, I have seen it, I have survived this)
  - g-load experience

Training in Advanced Simulators

- Safe way to expose pilots to „critical“ situations
- Many initiatives to enhance aero model
- Specialised simulators for disorientation training
- Can never substitute a real flight (pilot psychology)

Source: TNO

WE NEED THE ABILITY OF THE HUMAN BRAIN TO ADAPT QUICKLY TO SITUATIONS WHICH WERE NOT FORESEEN BY OTHERS!

Source: Internet