Dealing with Unexpected Events

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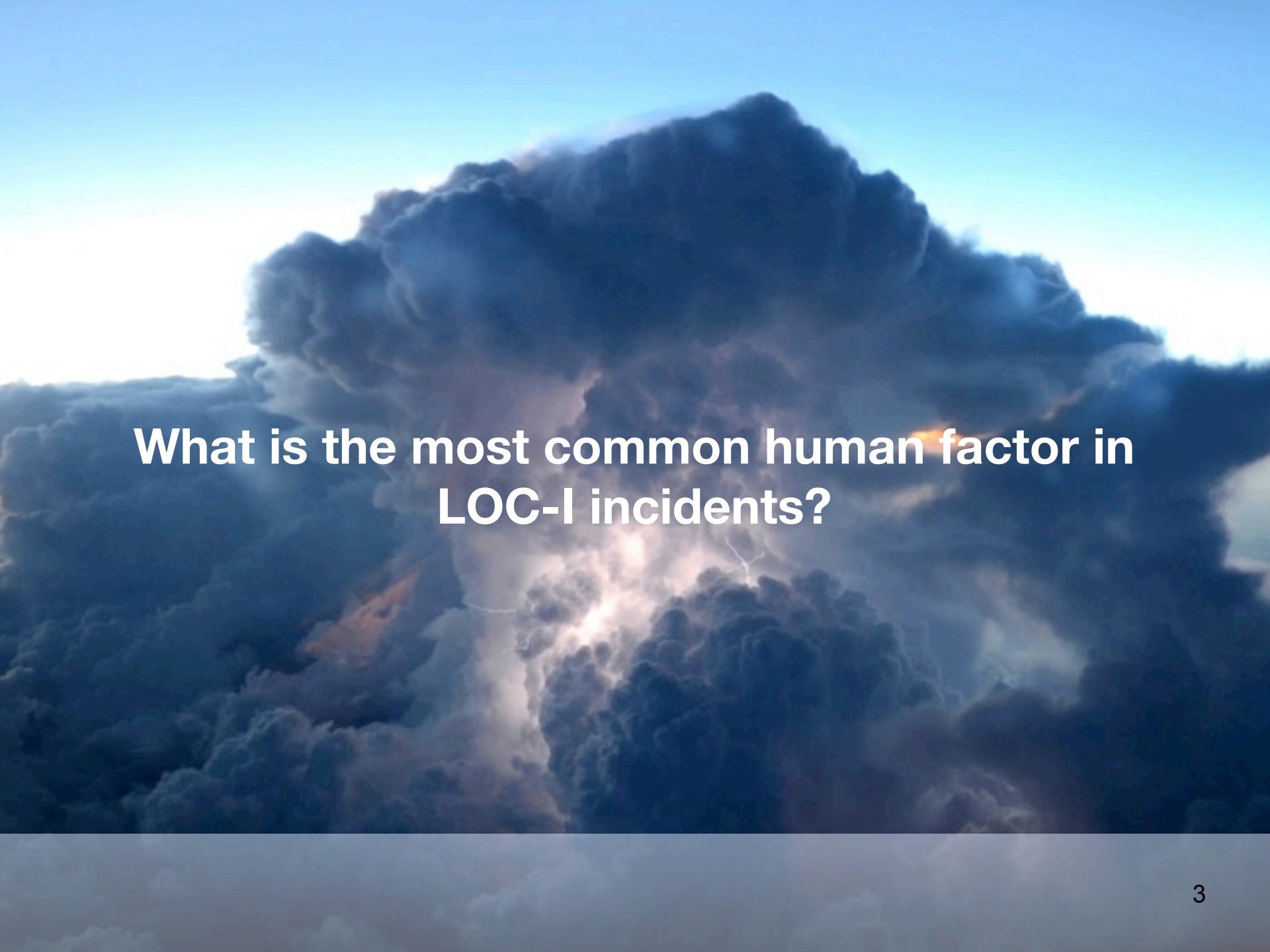
What is the most common human factor in LOC-I incidents?


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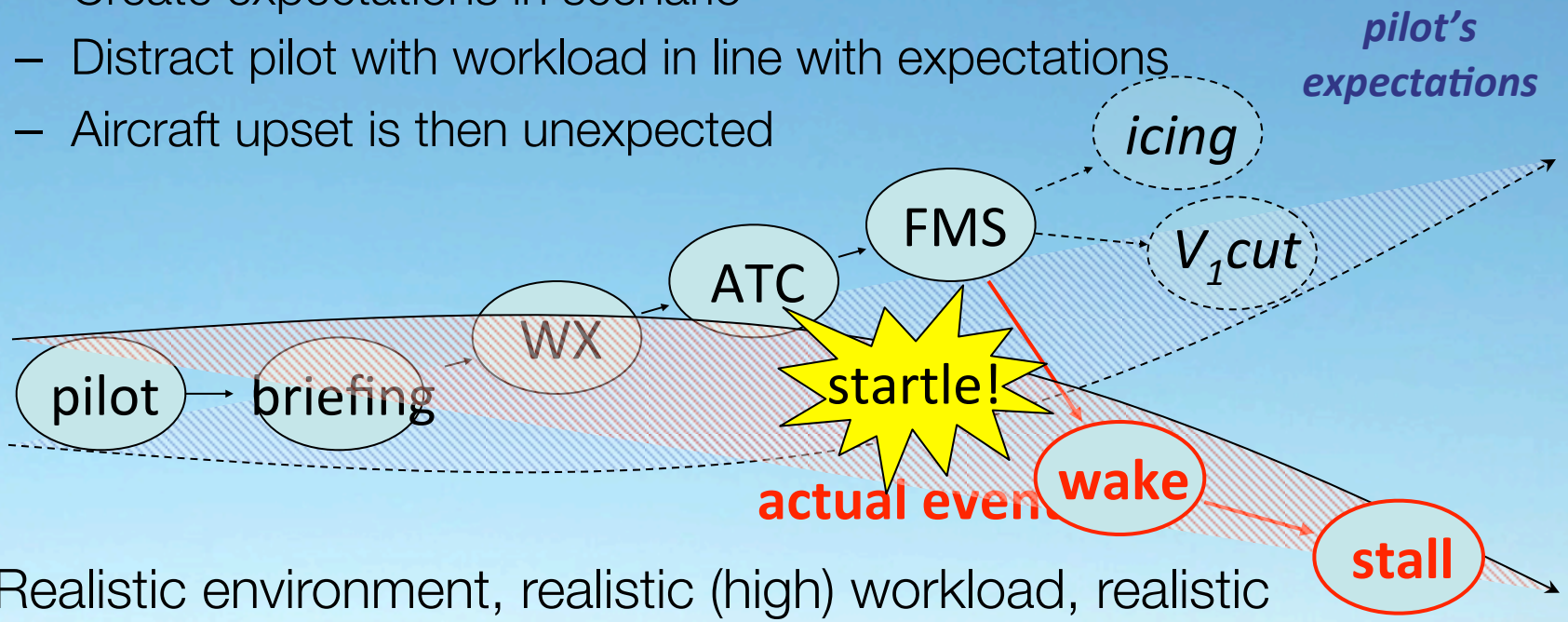
Startle

What is Surprise in Aviation?

- Created by Sudden abnormal aircraft behavior
  - wake vortex encounters
  - control surface hard-overs
  - asymmetric thrust
- Or a gradual deviation of the pilot's mental model
  - (e.g., misinform the pilot via erroneous display information)

Surprise During Training

- Surprise – Startle – Unexpected Stall
- Distract pilots by keeping them busy
  - Create expectations in scenario
  - Distract pilot with workload in line with expectations
  - Aircraft upset is then unexpected



- Realistic environment, realistic (high) workload, realistic distraction, realistic upset scenario
- ➔ **Immersion**

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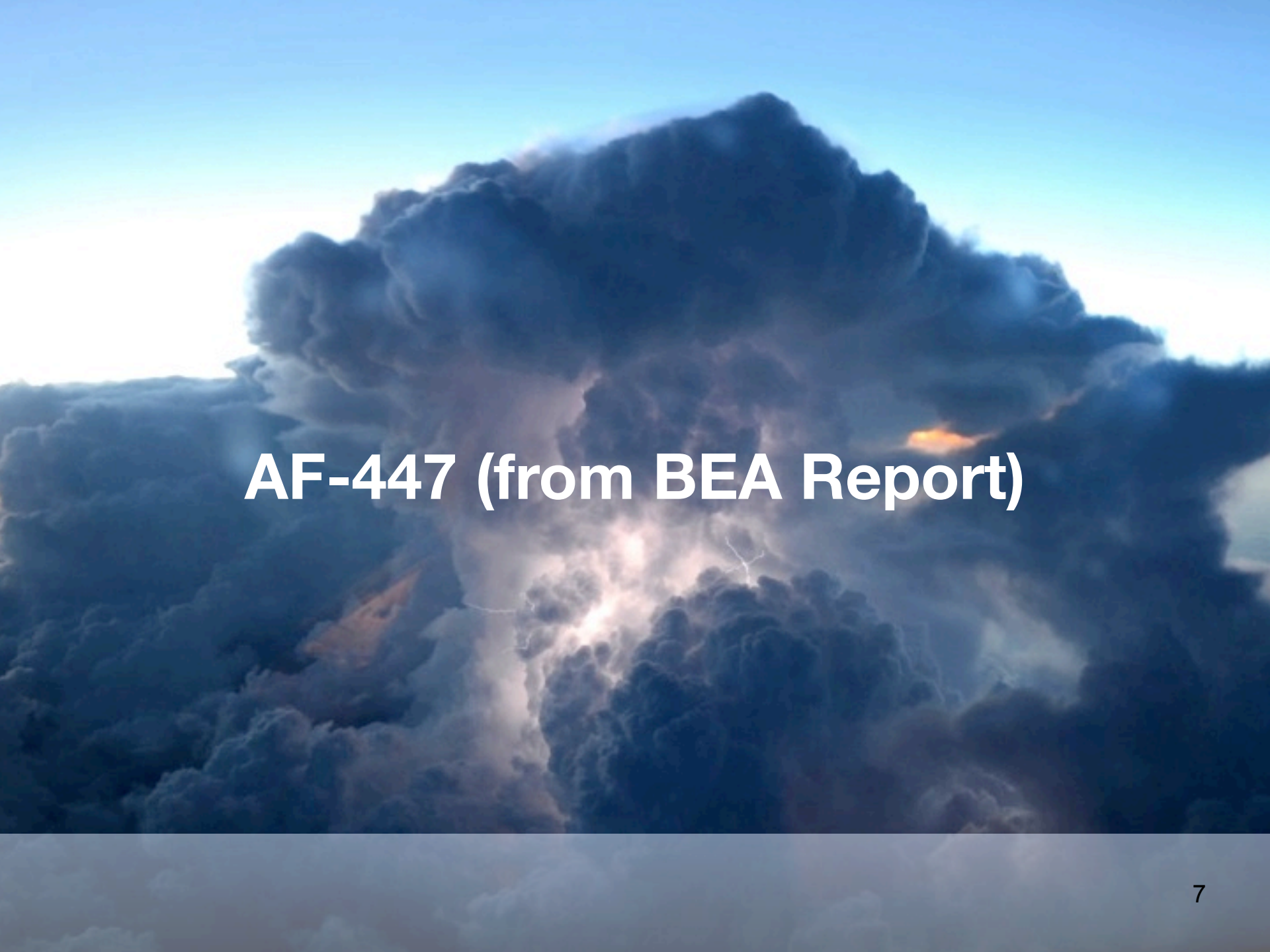

AF-447 (from BEA Report)

Note - video can be found on YouTube as “AF 447 animation”

ANIMATION

Accident on **June 1st 2009**
to the **Airbus A330-203**
registered **F-GZCP**
operated by **Air France**
flight **AF 447 - Rio de Janeiro - Paris**

BEA

Summary of AF 447

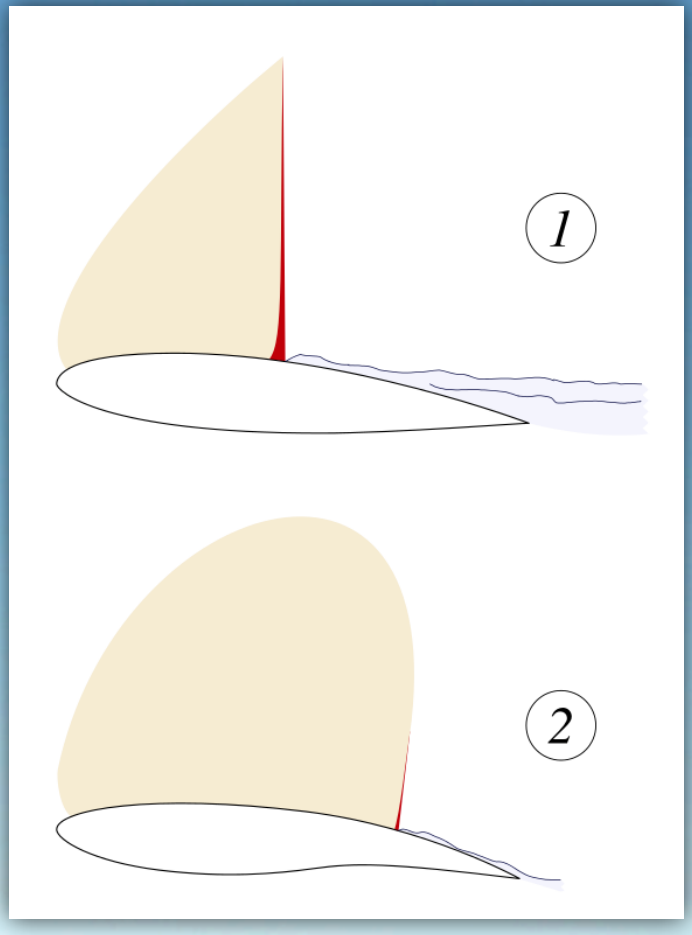
- The accident resulted from the following succession of events:
  - Temporary inconsistency between the measured airspeeds led to autopilot disconnection and a reconfiguration to alternate law,
  - Inappropriate control inputs that destabilized the flight path,
  - Crew disconnect between the loss of indicated airspeeds and the appropriate procedure,
  - The PM's late identification of the deviation in the flight path and insufficient correction by the PF,
  - The crew not identifying the approach to stall, the lack of an immediate reaction on its part and exit from the flight envelope,
  - The crew's failure to diagnose the stall situation and, consequently, the lack of any actions that would have made recovery possible.

Pilot Mis-perceptions of Overspeed

- Pilots consider in-flight overspeeds a serious risk.
- Origins:
  - Flight theory training
    - dangers of shock stall = low-speed stall
    - onset flutter or Mach tuck >>> Only on older aircraft
  - VMO/MMO corresponds to a critical limit; excursions not demonstrated during training
  - VMO/MMO excursions are severe, requiring maintenance inspection
  - Certification criteria state that overspeeds should be indicated by a red ECAM MSG, with alarm

Realities of Overspeed

- Modern supercritical airfoils have improved high-speed performance
  - position of aerodynamic centre is virtually stable
  - drag increase is so great that it's extremely unlikely (impossible) to fly faster and enter flutter
  - FBW and load-factor limitations prevent structural damage



Risk of Low Speed

- Loss of control
- **Aerodynamic stall**
- However, not all aircraft demonstrate the same characteristics, even from day-to-day

BEA Recommendations (AF 447)

- specific and regular exercises dedicated to **manual aircraft handling of approach to stall and stall recovery**, including at high altitude.
- to make sure, through practical exercises, that the **theoretical knowledge**, particularly on flight mechanics, is well understood.
- define criteria for selection and recurrent training among instructors that would allow a **high** and **standardized level of instruction** to be reached.
- training scenarios of the effects of **surprise** in order to train pilots to face these phenomena.


Subtle Unexpected
Events

Automation Dependency–
Ensuring Robust Performance in Unexpected Situations

Sunjoo Advani, IDT

Man4Gen

GOAL: to identify the causality behind incidents and accidents which required manual operations. Recommend short-term changes to procedures, training, flight-deck technology in order to reaffirm proper manual operations.

Achieved through:

- Analysis of relevant accidents and incidents related to manual skills
- Analysis of unexpected and challenging situations
- Understanding breakdown of situation awareness
- Developing and performing experiments related to unexpected events
- Analyzing system monitoring, decision-making and manual control
- Development of recommendations for training, procedures and system design

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Man4Gen

European FP7 2012 Aeronautics and Air Transport programme.

Man4Gen consortium partners:

- NLR (coordinator, the Netherlands)
- DLR (Germany)
- IDT (the Netherlands)
- Linköping University (Sweden)
- Boeing R&T (Spain)
- University of Vienna (Austria)
- Medical University of Vienna (Austria)
- Global Training Aviation (Spain)
- Airbus and Airbus Operations (France)

The project started in 2012 and will run until the end of 2015

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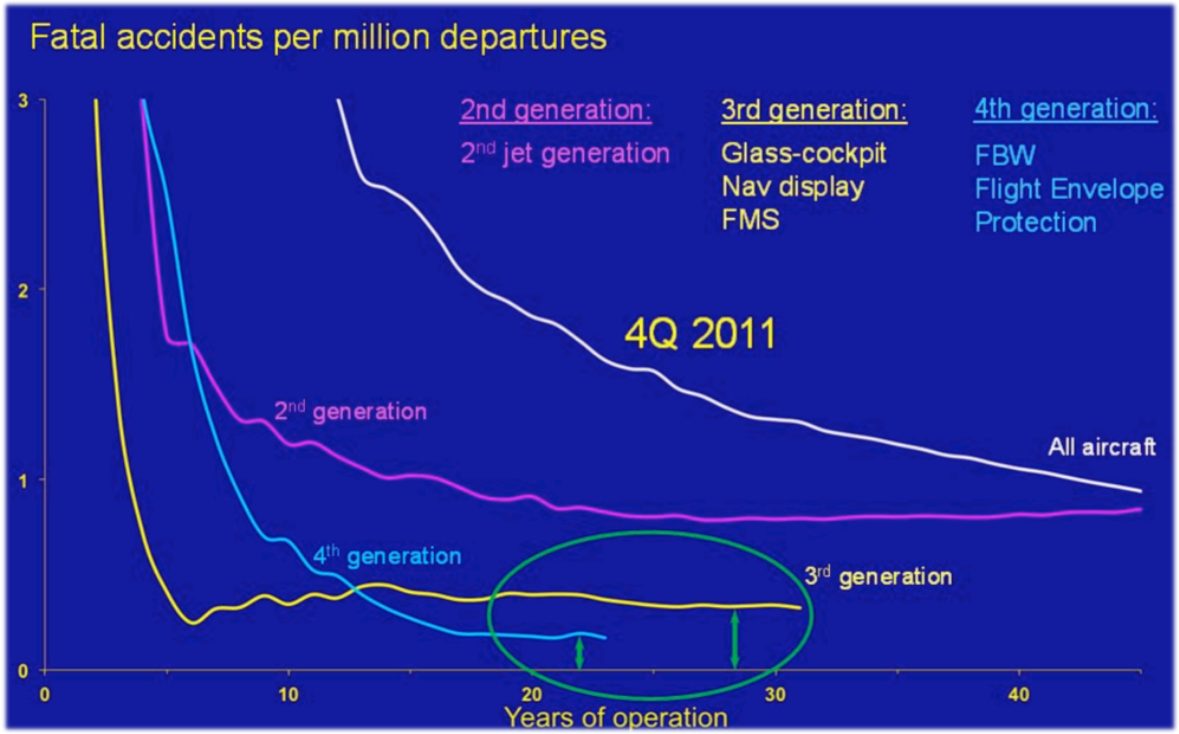
Flying is Safe

- Air travel is the safest mode of transportation
- Accident rates have subsided to the lowest level



Ascend, Airbus 2011

Experiment

Intention: to study decision making and risk assessment in response to unexpected and challenging situations

Experiment scenario elements:

- reversion to manual control,
- unexpected and challenging
- active and authoritative decision making

- Crews were observed for actions, communications and behaviour using the Desirable Flight Crew Performance (DFCP) method and the Airbus Assessment and Grading System.

- B747-400 research flight simulator at NLR in Amsterdam, and
- A320 research simulator at DLR in Braunschweig.

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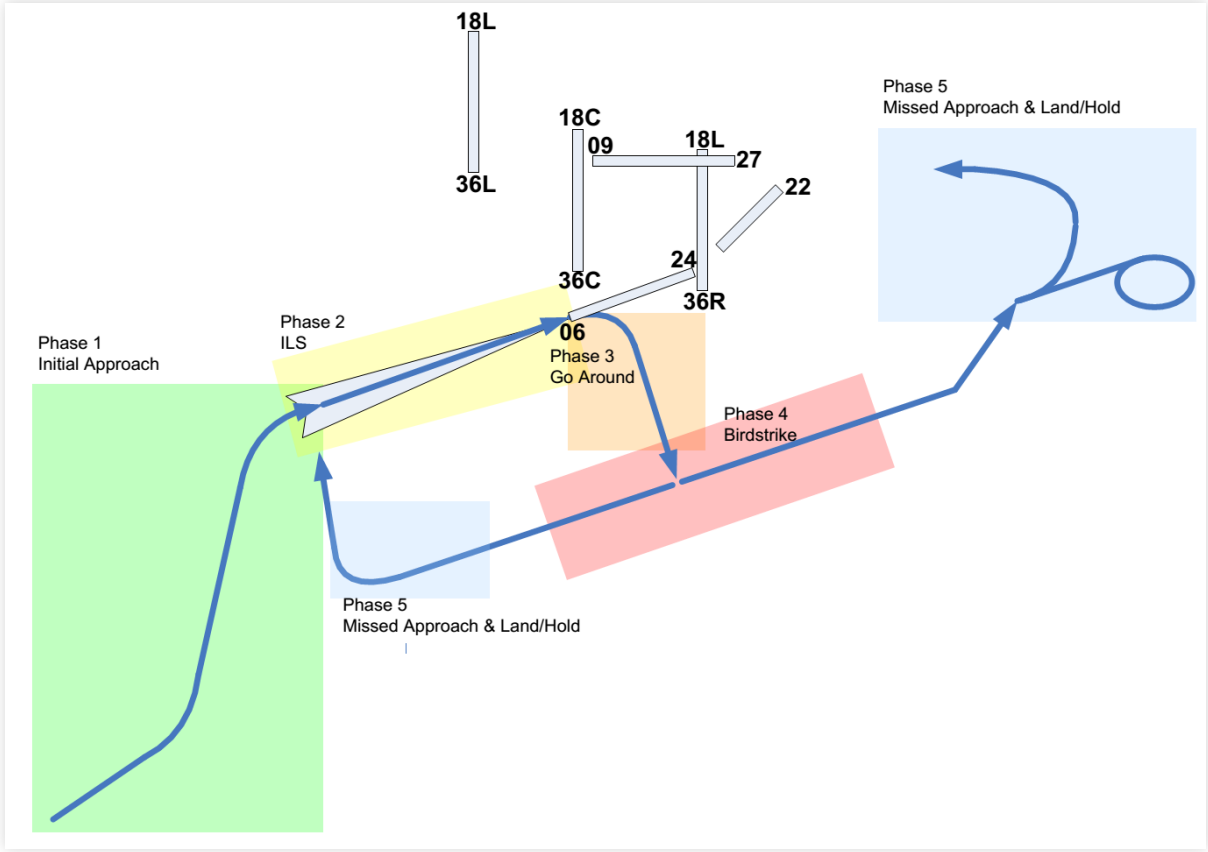
Scenario



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Observations

- Crews indeed experienced the events in the scenario as “unexpected events”.
- Crews appeared to have more difficulty than expected with the scenario.
- Some cases leading to unstable approaches and very short final line up distances.
- The decision to land as quickly as possible led to abbreviated procedures and checklists, if run at all.
- Crews failed to perform complete threat assessment and made decisions without considering the impact of these decisions.

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