Dealing with Unexpected Events

ICAO LOC-I Symposium
22-24 June 2015, Nairobi
Sunjoo Advani - President, IDT
What is the most common human factor in LOC-I incidents?
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
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**
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
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
Flying is Safe

- Air travel is the safest mode of transportation
- Accident rates have subsided to the lowest level
**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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**Experiment Validation and Concept Procedure**

Friday, April 17, 2015
Scenario

1. Initial Approach
2. ILS
3. Go Around
4. Birdstrike
5. Missed Approach & Land/Hold

Experiment Validation and Concept Procedure
Friday, April 17, 2015
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.