

WHO IS FLYING THE AIRCRAFT?



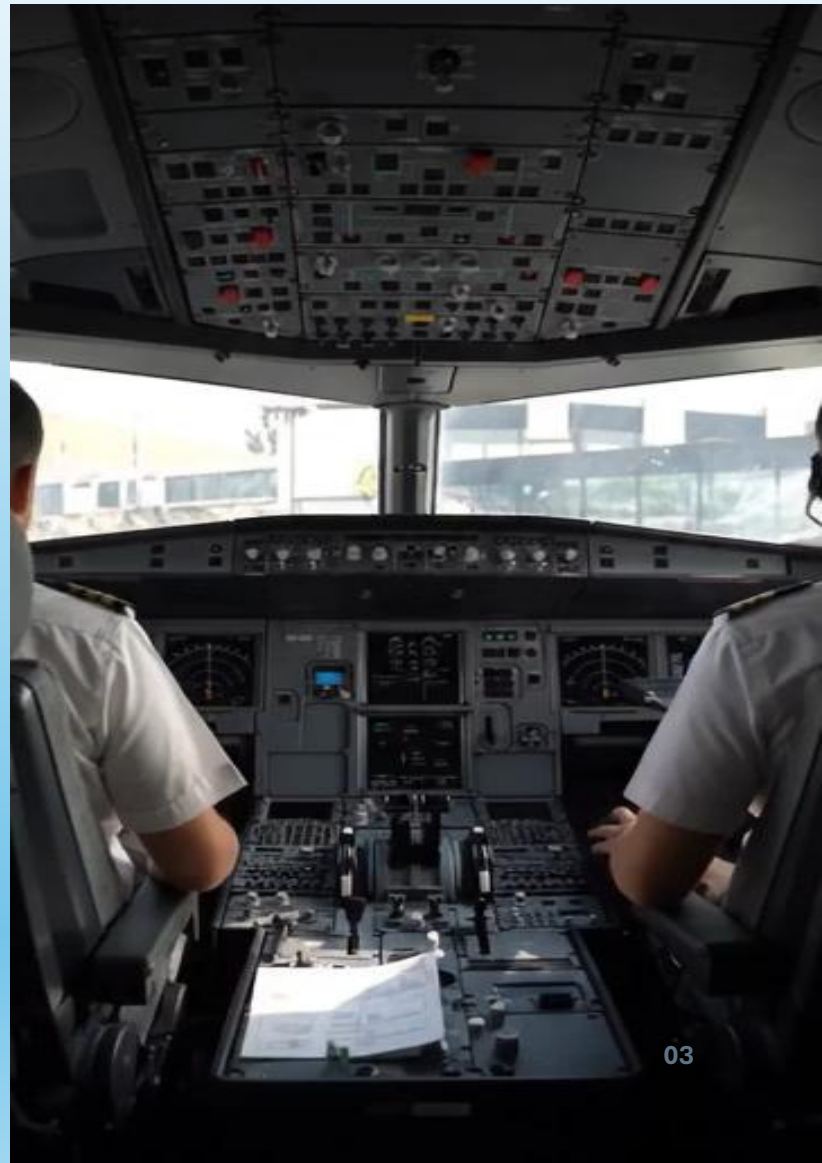
Lion Air Flight 610 Crash



Air France Flight 447 Crash

Human–Automation Teaming in Next-Generation Flight Decks

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SCOPE

I shall be focusing on pilot training and flight deck operations, with particular emphasis on pilot–automation interaction and the effective integration of human capabilities with automated systems

SEQUENCE

- The evolution of flight deck automation
- Accident case studies
- Pilot survey: technology development and pilot perceptions
- human–automation teaming
- Artificial intelligence and future challenges for pilots
- Proposed strategy for future-ready human–automation teaming
- Conclusion

EVOLUTION OF FLIGHT DECK AUTOMATION

01 **Manual Flight**

02 **Flight Director**

03 **Autopilot**

04 **Flight Management System**

05 **Advanced Automation**

06 **AI**





THE EVOLUTION OF FLIGHT DECK AUTOMATION

- Reducing pilot workload
- Enhances operational efficiency
- Integrated cockpit displays provide improved situational awareness through integrated displays



- Increased reliance on automation introduces the automation paradox

Case Studies





AF447: An Unexpected Transition to Manual Flight

1 JUNE 2009

1. Unreliable airspeed
2. Autopilot and auto thrust disconnect
3. Inappropriate control inputs
4. Unrecognized stall

SOURCE: BEA FINAL REPORT, AF447

- **Date:** 1 June 2009
- **Location:** Atlantic Ocean
- **Aircraft:** Air France Airbus A330-200
- **Cause:** Unreliable airspeed due to frozen pitot tubes
- **Key Error:** Incorrect control inputs after autopilot disconnection
- **Lesson:** Understand automation limits, and maintain situational awareness.



Figure: Wreckages of Destruction

PILOT SURVEY: TECHNOLOGY DEVELOPMENT AND PILOT PERCEPTIONS

PILOT SURVEY: TECHNOLOGY DEVELOPMENT AND PILOT PERCEPTIONS

Methodology



PILOT SURVEY: TECHNOLOGY DEVELOPMENT AND PILOT PERCEPTIONS

Participants

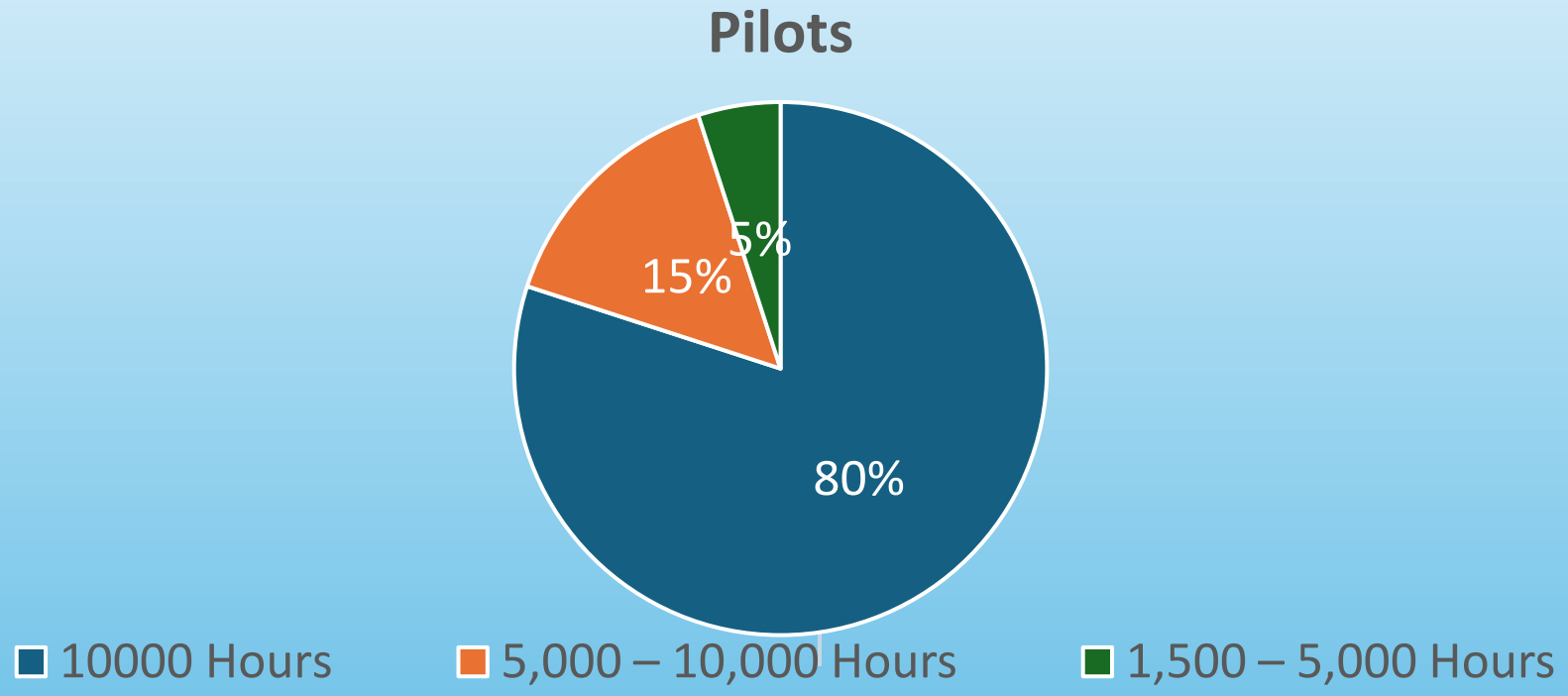


Figure 1: Survey Participant Dataset

PILOT SURVEY: TECHNOLOGY DEVELOPMENT AND PILOT PERCEPTIONS

Understanding Newly Introduced Automation

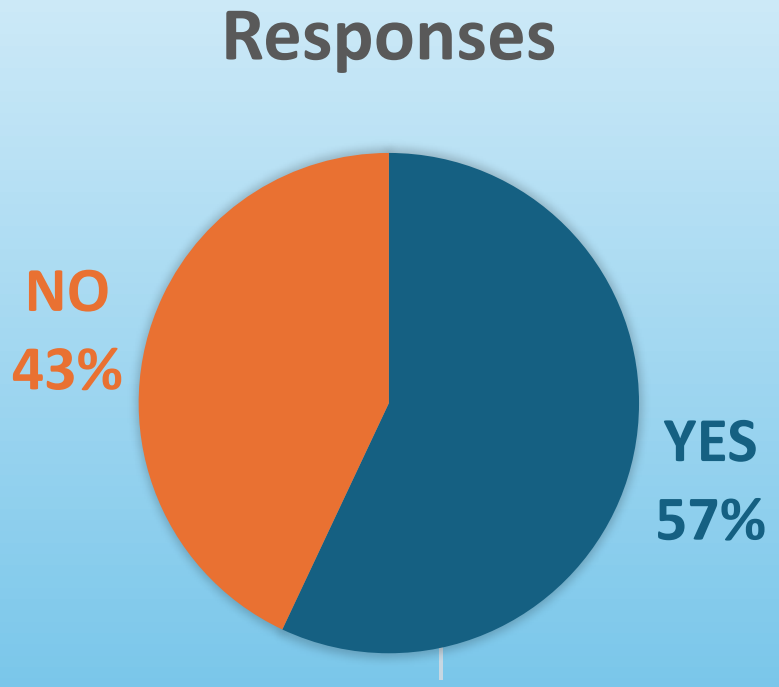


Figure 2: Pilots' Understanding of New Automation

PILOT SURVEY: TECHNOLOGY DEVELOPMENT AND PILOT PERCEPTIONS

Training During Technology Upgrades

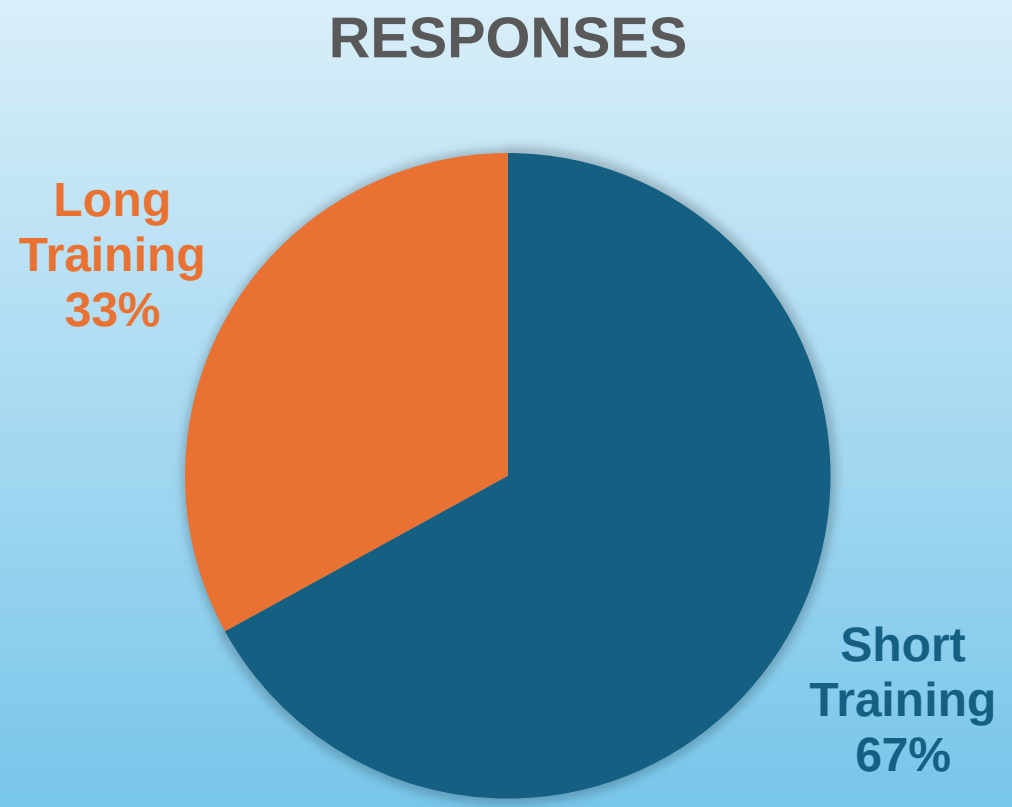


Figure 3: Automation upgradation & Old Pilots Understanding

PILOT SURVEY: TECHNOLOGY DEVELOPMENT AND PILOT PERCEPTIONS

Implications of the Survey

- Pilots may become operationally familiar with an aircraft while remaining uncertain about newly introduced automation features

- Clear communication, accessible technical material, appropriate ground and simulator training, and checks that confirm understanding—not simply receipt of information.

HUMAN–AUTOMATION TEAMING

- Ability of pilots to understand and effectively interact with systems may not always develop at the same pace

- A comprehensive understanding of their underlying functions, limitations, and decision-making processes expected

HUMAN–AUTOMATION TEAMING

Human-Automation Teaming means: Human + Automation — not Opposition

NOT **HUMAN VS AUTOMATION**

BUT **HUMAN + AUTOMATION**

❖ The objective is complementary performance, not replacement

HUMAN–AUTOMATION TEAMING

Automation as a Supporting Partner

- Effective human–automation teaming treats automation as a partner
- Monitor that automated actions match the intended flight path and intervene when operational conditions require it



HUMAN–AUTOMATION TEAMING

Automation as a Supporting Partner

- The crew entered an incorrect heading into the flight computer, flying deep into a remote area of the Amazon Forest.
- Attempts to reach an alternative airport were unsuccessful and the plane eventually ran out of fuel, crashing during a bally landing in the jungle



Varig Flight 254 Crashed in the Amazon Forest

HUMAN–AUTOMATION TEAMING

Pilot Authority and Manual Control

- Pilots remain the final authority responsible for aircraft control and safety
- “Aviate-Navigate-Communicate,”
- Pilots must be confident in disconnecting automation and manually controlling the aircraft



HUMAN–AUTOMATION TEAMING

Training for Complex and Unexpected Events



Procedural compliance and checklist execution



Decision-making, situational awareness, and operational resilience



Prepare pilots for unexpected situations, automation failures, and complex operational environments.

HUMAN–AUTOMATION TEAMING



HUMAN–AUTOMATION TEAMING

Upset Prevention and Recovery Training (UPRT)

- Loss of Control In-Flight (LOC-I)
- Upset Prevention and Recovery Training (UPRT)
- Manual flying skills



HUMAN–AUTOMATION TEAMING

Startle and Surprise Management





HUMAN–AUTOMATION TEAMING

MAINTAINING
MANUAL FLYING PROFICIENCY

SKILL | AWARENESS | CONFIDENCE | SAFER SKIES

FLY PREPARED FOR WHAT MATTERS

PRACTICE REGULARLY
Keep your manual flying skills sharp through regular practice and training.

STAY ENGAGED
Fly the aircraft, monitor its behaviour, and maintain situational awareness.

UNDERSTAND THE AIRCRAFT
Know its handling characteristics across the flight envelope.

BE PREPARED
Maintain proficiency to confidently handle unexpected situations.

BUILD CONFIDENCE
Consistent practice enhances skill, judgment, and safety.



PRACTICE TODAY FOR A SAFER TOMORROW

SKILLED PILOTS SAFER FLIGHTS

CONFIDENCE IN EVERY FLIGHT

HUMAN–AUTOMATION TEAMING

CRM in Automated Cockpits

- Workload distribution
- Both pilots must maintain shared understanding
- Clear communication between crew members
- Mutual monitoring is important
- Clear task allocation



HUMAN–AUTOMATION TEAMING

Pilot Monitoring Function

- Continuously cross-checking flight path parameters & automation status
- Effective monitoring and communication between pilots



HUMAN–AUTOMATION TEAMING



ARTIFICIAL INTELLIGENCE AND FUTURE CHALLENGES



ARTIFICIAL INTELLIGENCE AND FUTURE CHALLENGES

Potential Applications of AI



ARTIFICIAL INTELLIGENCE AND FUTURE CHALLENGES

Explainability and Operational Boundaries

- Major challenge of AI-based aviation systems is explainability. Traditional automation generally follows predefined rules and logic:



- AI-based systems may instead process large amounts of data through complex models:



- Pilot should understand its purpose, capabilities, limitations, and appropriate operating boundaries.

ARTIFICIAL INTELLIGENCE AND FUTURE CHALLENGES

Appropriate Trust Rather Than Blind Reliance



ARTIFICIAL INTELLIGENCE AND FUTURE CHALLENGES

Future Role of Pilot



STRATEGY FOR FUTURE-READY HUMAN–AUTOMATION TEAMING

- Align training depth
- Provide clear, accessible upgrade briefings and technical publications, and verify that pilots understand the changes.
- Use evidence-based scenarios
- Maintain manual flying proficiency
- Strengthen CRM, PF/PM coordination
- Train pilots to assess automated and AI-supported recommendations critically
- Assess competence
- Review survey data and training outcomes periodically

Conclusion

- Technology alone cannot replace human judgment, adaptability, and leadership
- The safest next-generation flight decks will be those where skilled pilots and intelligent automation work together as true partners
- Operators to ensure that training, publications and competency assessments keep pace with technological changes
- A future-ready safety mindset is not achieved by technology upgrading alone, Automation should enhance pilot professionalism—not weaken it

THANK YOU