

# *Automation, Manual Flight Operations and Monitoring*

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Federal Aviation  
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# International Civil Aviation Organization (ICAO) Personnel Training and Licensing Panel\*



➤ [Working Paper on Automation](#)

\*Panel Structure while Study Report was developed

# Automation Working Group – Objective



- Address concerns with automation, manual flight and pilot monitoring
- Recommend changes to appropriate ICAO documentation

# Automation Working Group – Study Report



## Conduct a study

- Determine the scope of automation dependency issues.
- Identify operational procedures and associated policies and practices from a sampling of operators worldwide
- Identify assumptions from aircraft manufacturers
- Identify available guidance for how manual flying is conducted within
  - Operator policy
  - Regulatory guidance
- Identify how or if automated systems and manual flying are being incorporated into basic licensing, initial and recurrent training and testing
- Identify related research and findings

# Data Sources for Automation Study Report



- World-wide accidents: 77
- Major incidents: 309
- Excerpts from operator policies across ICAO regions: 40
- Three manufacturers
- Eight State regulatory authorities
- State survey results
- >200 references

# Findings

- Finding: conclusion based on the results of analyses of one or more data sources
- Seventeen findings in the Automation Study Report



| ICAO

Circular 361

PERSONNEL TRAINING AND  
LICENSING PANEL  
AUTOMATION STUDY REPORT



Finding 1: Based on the data and accidents/major incidents analyses, automation dependency continues to be a safety issue worldwide. Contributors to automation dependency can include operator policies, regulatory policies, and lack of confidence in pilot manual flight skills.

Date Range (based on occurrence of event)	Include Dependence on Automated Systems	Number of Accident Reports Reviewed
1990 – 2009	8 (22%)	36
2010 – 2021	20 (49%)	41
Total	28 (36%)	77

One of 17 findings, published in ICAO Circular 361



Finding 2: Additional automation-related vulnerabilities were identified. These include mode awareness/confusion, data entry errors and other FMS-related issues, and unexpected automation behaviour (automation surprises). In addition, lessons were learned that may be useful for other domains.



## Finding 2: Additional automation-related vulnerabilities and lessons learned



Lessons learned about the benefits and vulnerabilities about automated systems include topics such as:

- Different types of automated systems (e.g., control versus information automation), and much of the discussion of automation is focused on control automation systems
- Mode confusion
- Replacement myth (replacement of pilot task/function with automated system)

## Finding 2: Additional automation-related vulnerabilities and lessons learned



- **Lessons learned (continued)**
  - **Training is not necessarily decreased when an automated system is introduced**
    - How the system works (a mental model of the system and its operation)
    - How to operate the system
    - How to monitor the system
    - How to recover or manage an unintended state or malfunction. This may involve reverting to operation without the automated system.
  - **Pilot Monitoring**
  - **Operational policies**
  - **Degradation of basic skills**



- Automation dependency is under-reported in accidents and incidents
- Manual flight
- Automation and manual flight are not binary distinctions
- Monitoring as both a role and a task
- Operator policies
- Manufacturers assumptions
- Terms and definitions

## Next Steps



Develop recommendations for changes to ICAO documents to address findings

# Manual Flight Operations (MFO)



- Manual Flight Operations knowledge, skills and attitudes are foundational – cognitive and motor
- Lack of practice can lead to skill degradation
- MFO research study in B737 and A320 simulators
  1. Pilots current in the airplane type
  2. Pilots who have not flown for 6-12 months
  3. Pilots who have not flown for 12-24 monthsTotal of 39 pilots

# Manual Flight Operations (MFO) Scenarios



1. Manually flown visual approach
2. TCAS climb RA at close to max performance altitude including manual flight during cruise
3. ATC-directed go-around with autopilot failure during go-around
4. High gusting crosswinds landing with runway selection decision
5. Departure with unavailable autopilot and autothrust with flight director failure during takeoff
6. Upset due to wind shift at close to max performance altitude including executing Path Stretch and RTA clearances
7. Manually flown RNAV approach

## Example MFO Findings



- Identified maneuvers, tasks, knowledge and skills for MFO
- Experience and proficiency lead to confidence
- It is important to consider access to the knowledge needed for the skills
- Some skills are complex and must be practiced under multiple conditions. Example: Energy management
- Many more

# Thank you!



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