

# ICAO Personnel Training and Licensing Panel Automation Study Report

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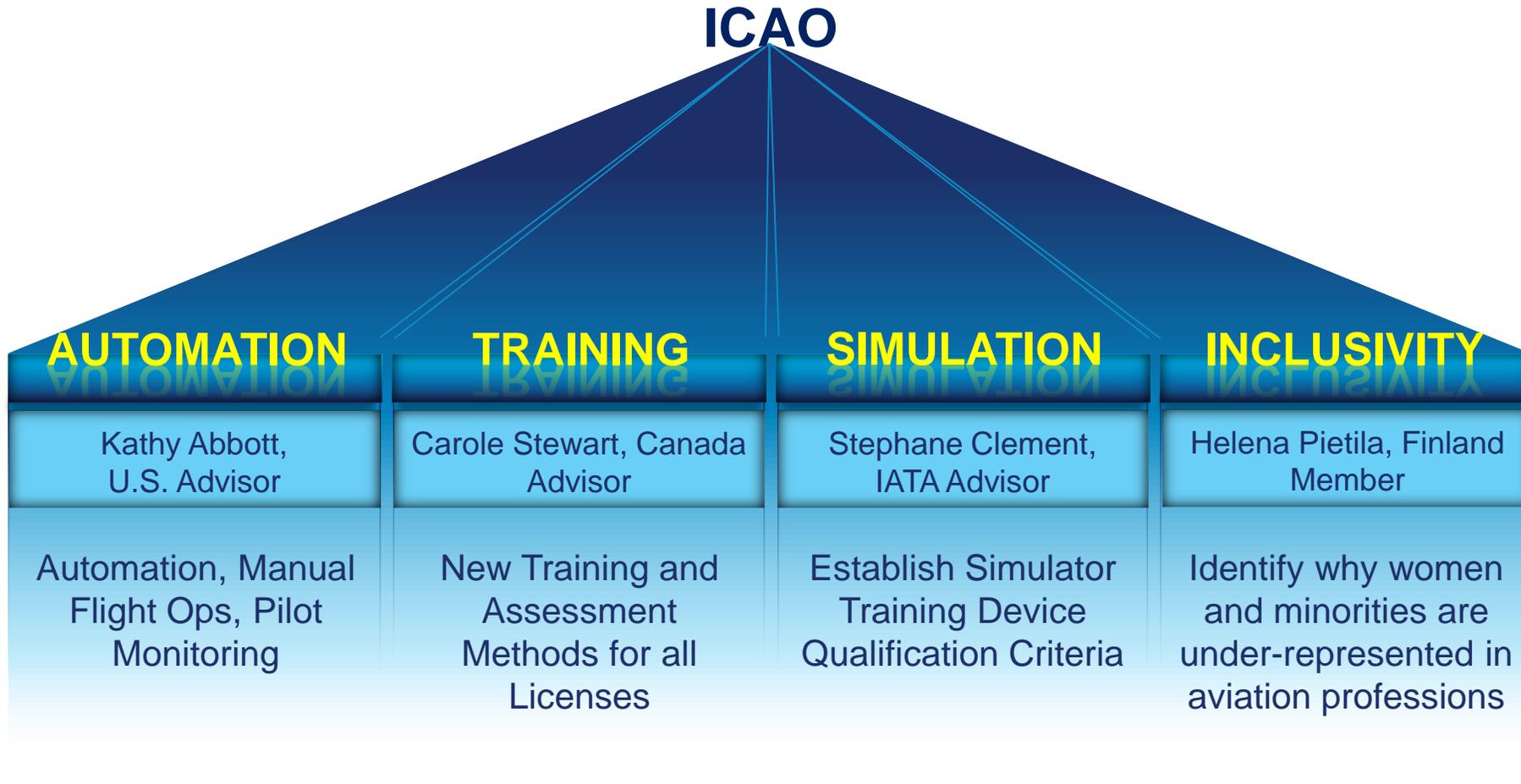
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Federal Aviation  
Administration

**STEP** SENIOR TECHNICAL  
EXPERTS PROGRAM  
ADVANCING SAFETY THROUGH SCIENCE

# 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

- 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
<b>Total</b>	<b>28 (36%)</b>	<b>77</b>

One of 17 findings, to be 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**





## **Finding 3: Automation dependency is under reported in accidents and incidents**



**Finding 4: Manual flight errors continue to be cited in accidents and incidents, and sometimes co-occurred with dependence on automated systems.**





**Finding 5: Some operators, manufacturers, and regulators approached Automation Management and Manual Flying as separate and distinct tasks or skills, while others approached them more as elements of a continuum.**

# Monitoring: Findings 6 and 7 Summary



- **Monitoring was often addressed in the context of tasks and responsibilities of the Pilot Monitoring (PM), but sometimes was described in relation to the monitoring of automation, monitoring of the flight path, or monitoring of the other pilot**
- **Information on how and when for a pilot to intervene, with automation or another pilot, was addressed in some States' regulatory material but not all**



# Finding 8, 9 and 10: Operator Policies - Summary



## **Operator policies concerns (examples):**

- **How and when to conduct automated or manual flight but did not define them or describe them in the context of overall flight path management**
- **Sometimes conflicting guidance on use of automated versus manual flight**
- **Many did not address pilot monitoring**
- **Manufacturers' recommendations for operator policies offer a strong framework but may lack specificity and operational context**
- **A small number of policies provided guidance on the entire concept of flight path management**
- **Most policies only address flight path control, omitting guidance on the overall concept of Flight Path Management**



**Finding 13: Manufacturers made many assumptions about manual flight, use of automated systems, and pilot training that were integrated into equipment design, operator training programs, procedures and documentation. Examples:**

- Prior piloting experience is assumed for all aircraft models
- The crew shall use an appropriate level of automation and that the automation is intended to assist the pilot
- Situation awareness will be maintained at all times
- Current Crew Resource Management (CRM) techniques and practices are necessary for operational safety
- The level of crew intervention will vary accordingly with the available system capability, but the final authority remains on the flight crew to perform the abnormal procedures

# Findings 14-17 Terms and Definitions - Summary



- Automation dependency, over-reliance and complacency
- Flight Path Management, Manual Flight Operations, and autoflight / automated systems
- Regulatory guidance materials used high-level terminology such as that used in ICAO guidance (e.g., “UPRT”, “flight path management – automation”, “flight path management – manual flight/control
- “Levels of automation” may be useful conceptually but can be hard to operationalize

# Next Steps



Develop recommendations for changes to ICAO documents to address findings



# Additional Related Work – Manual Flight Operations (MFO) Study



- MFO includes both motor and cognitive skills, as written in Advisory Circular 120-123 Flightpath Management
- Research Phases I and II looked at current training and proficiency and required knowledge and skills
- Phase III: Simulator study examining skill degradation
- Data under analysis – stay tuned!



# Thank you!



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