



WORKING PAPER

**SEVENTH WORLDWIDE AIR TRANSPORT CONFERENCE
(ATCONF/7)**

Montréal, HQ, 16 to 20 November 2026

**Agenda Item 4: Emerging technologies, new business models and other associated aspects
4.1: Economic regulatory frameworks on emerging technologies**

**ENSURING HUMAN-CENTRED DECISION MAKING IN THE USE OF EMERGING
TECHNOLOGIES IN AVIATION**

(Presented by Oman, the International Transport Workers' Federation (ITF), the International Federation of Air Line Pilots' Associations (IFALPA) and the International Federation of Air Traffic Controllers' Associations (IFATCA))

EXECUTIVE SUMMARY

Artificial intelligence (AI), automation and other emerging technologies can strengthen aviation safety, resilience and human performance, provided they do not undermine the human capability and professional judgement on which the system depends. Aviation already makes extensive use of automation. The emerging challenge is that some AI-enabled systems can produce outputs that are less predictable or readily explainable than conventional automation, increasing the importance of effective safety buffers.

The International Civil Aviation Organization's (ICAO) Human Performance Principles recognize that people create resilience by adapting to complex and dynamic environments. Meaningful human oversight therefore requires more than a nominal "human in the loop": workers need the skills, situational awareness, information and practical authority to understand, challenge and, where necessary, override technology-supported decisions. Where AI or automation materially influences safety-critical functions on which human life depends, effective human authority should be an explicit and assured feature of system design.

Technological change should therefore be human-centred, supported by human-factors and workforce-impact assessment, competency development, fatigue and workload safeguards, transparency, safety assurance and worker participation. Clear human authority can provide a framework within which workers, regulators and technology developers can collaborate confidently on useful innovation.

Action: The Conference is invited to:

- a) reaffirm that emerging technologies should enhance aviation safety and human capability, while preserving meaningful human-centred decision-making and professional judgement;
- b) encourage Member States and industry to ensure that emerging technologies support meaningful human oversight, informed decision-making and professional judgement, and, particularly in safety-critical functions on which human life depends, to ensure that human authority to understand,

¹ English, Arabic, Chinese, French, Russian and Spanish versions provided by ITF.

question and, where necessary for safety, override technology-supported outputs is explicit and assured; c) encourage human-factors and workforce-impact assessments addressing training and competency, staffing, fatigue, workload, psychosocial risks and the allocation of responsibility, together with transparency and ongoing safety assurance when emerging technologies materially alter aviation work or operational responsibilities; d) urge ICAO, in developing policy and guidance relating to emerging technologies, to promote human-centred decision-making and meaningful engagement with aviation workers and their representative organizations in the design, testing, implementation and review of new technologies drawing, where appropriate, on the International Labour Organisation (ILO) expertise on the world-of-work dimensions of technological change through the ICAO-ILO Cooperation Agreement: and e) request ICAO to consider developing guidance on meaningful human oversight in AI-enabled and highly automated aviation systems, covering human authority, competency and skill retention, workforce participation, transparency, safe fallback arrangements and clear accountability throughout the technology lifecycle, in consultation with aviation workers' representative organisations and, where appropriate, drawing on ILO expertise.	
<i>Strategic Goal:</i>	This working paper relates to the Strategic Goal: <i>Every Flight is Safe and Secure</i> ; and <i>The Economic Development of Air Transport Assures the Delivery of Economic Prosperity and Societal Well-Being for All</i> .
<i>Financial implications:</i>	The activities proposed should, where possible, be advanced through existing ICAO human-performance, safety, training, innovation and regulatory programmes and resources.
<i>References:</i>	ICAO Human Performance; ICAO Human Performance Principles; ICAO HP Considerations in Automated Systems; ICAO Fatigue Management; ICAO Human Performance and Cabin Crew; EASA Ethics for Artificial Intelligence in Aviation – Aviation Professionals Survey Results 2024/2025; ILO/OECD Compendium on Human-Centred AI (2026); Airports Council International (ACI) World, The Evolution of the Airport Workforce: Turning Challenges into Opportunities, 2022; Commission Implementing Regulation (EU) 2017/373 (functional system definition); EASA Artificial Intelligence Roadmap 2.0 (2023); IFATCA Review of Automation Policies (WP98, 2024); IFATCA ATCO Skills with the Use of Artificial Intelligence and Legal Liability (WP157, 2025); International Transport Workers' Federation (ITF), Seizing Control: Transport Workers' Principles for Artificial Intelligence (2026); Artificial Intelligence in Civil Aviation.

1. INTRODUCTION

1.1 Aviation is not new to automation; highly automated systems have long supported safe and efficient operations in areas including flight operations and air traffic management. Artificial intelligence (AI), automation and other emerging technologies are already affecting aviation workplaces. The development of AI-enabled systems raises additional questions about their implications for aviation workers. European Union Aviation Safety Agency's (EASA) survey of aviation professionals with a connection to AI explored perceptions of eight hypothetical aviation applications, identifying concerns about human oversight, potential deskilling and accountability.²

² EASA, Ethics for Artificial Intelligence in Aviation – Aviation Professionals Survey Results 2024/2025.

1.2 Technological capability alone does not establish a safer or more resilient system. Some AI/Machine Learning (ML) applications introduce additional challenges because their outputs or behaviour may be less predictable or readily explainable than conventional automation. Economic and regulatory frameworks should therefore consider human capability, workforce resilience and operational safety, supported by evidence, human-factors analysis and safety assurance where safety-critical functions are affected.

2. DISCUSSION

2.1 **Human Performance and Technological Change** - The International Civil Aviation Organization (ICAO) defines human performance as the human contribution to system performance and recognizes people as integral to identifying and managing risk. Its Human Performance Principles state: *“People are key to the aviation system, creating resilience by constantly adjusting and adapting”*.³ ICAO also identifies potential risks associated with automation. Its guidance cautions that *“over-reliance on the automated system ... can contribute to skill degradation”* and notes that recovery when automation encounters conditions outside its design may depend on rapid human response.⁴ The objective should therefore be to use technology to support human performance rather than progressively erode the capabilities required to manage abnormal, dynamic, degraded or unforeseen situations.

2.2 **Meaningful human oversight** requires workers in safety-critical roles to understand system limitations, maintain situational awareness and have the training, information and authority to exercise professional judgement. This requires sufficient transparency about system capabilities, limitations and outputs for workers to exercise informed professional judgement. ICAO guidance emphasizes appropriate understanding and trust in automation. Where a function directly affects human life, human authority to understand, question and, where necessary for safety, override automated or AI-supported outputs should be explicit and assured rather than assumed. The relevant test is therefore not simply whether a human remains present, but whether effective human authority is preserved where safety-critical decisions are made. The European Union (EU) aviation regulation’s “functional system” concept - combining procedures, human resources and equipment, including hardware and software - provides a useful systems perspective: AI and automation sit within a wider human-organised system rather than outside it.⁵

2.3 **Maintaining human capability** - A well-trained, appropriately staffed and sufficiently rested workforce is fundamental to aviation safety and resilience. ICAO recognizes that performance deteriorates when people are fatigued or cognitively overloaded and that workload can compound fatigue-related risk.⁶ Training, fatigue, workload, staffing, skill retention and psychosocial risks associated with technological change should therefore be considered when technology materially changes operational roles. Formal human responsibility provides limited protection if the worker lacks the competence, alertness, situational awareness or practical authority needed to intervene effectively.

2.4 **Sustaining aviation career pathways** - Technological change also has implications for aviation's ability to attract, develop and retain the skilled workforce it requires. Investment in education, training and professional development is more likely to remain attractive where workers can see viable long-term career pathways and opportunities to develop their skills as technology evolves. A human-centred approach that uses technological change to enhance workforce capability, supported by lifelong learning,

³ICAO, Human Performance; ICAO, Human Performance Principles.<https://www.icao.int/operational-safety/HP>; <https://www.icao.int/operational-safety/HP/HPP>

⁴ ICAO, HP Considerations in Automated Systems.<https://www.icao.int/operational-safety/HP/considerations>

⁵ Commission Implementing Regulation (EU) 2017/373, Annex I — Definitions.

⁶ICAO, Human Performance Principles; ICAO, Fatigue Management Approaches.<https://www.icao.int/operational-safety/HP/HPP>; <https://www.icao.int/operational-safety/fatigue-management/fatigue-management-approaches>

reskilling and career development, can help reconcile innovation with ICAO's parallel objectives of attracting new talent and developing the human capacity required for aviation's future growth.

2.5 Application across aviation - These principles apply across the aviation ecosystem. On the flight deck, AI and automation should augment professional judgement while preserving the human authority required for safety-critical decisions. Flight-deck automation and reduced-crew concepts raise questions concerning workload, fatigue, incapacitation, skill retention and operational resilience. Cabin technologies should support, rather than weaken, trained crew capability and readiness to perform safety and emergency functions. In air traffic management, the International Federation of Air Traffic Controllers' Associations (IFATCA) policy similarly states that AI/ML should be implemented as decision support and should not replace the decision of the air traffic controllers (ATCO).⁷ Similarly, technologies introduced into ground operations should maintain effective human-centred safety backstops. ICAO itself applies human-performance considerations across flight operations, air traffic control, maintenance and remote operations. The appropriate balance between people and technology should therefore be determined through research, testing, evidence, human-factors assessment and safety assurance, including under abnormal and unexpected conditions.

2.6 Managing change through worker participation - Human-factors and workforce considerations should be addressed from the earliest stages of design and planning through implementation and monitoring. Where technology materially changes work, this should include training and reskilling, competency and skill retention, workload and fatigue, staffing implications, human-machine interaction, transparency and accountability, and mechanisms for identifying unintended consequences. Workers who operate, maintain and interact with aviation systems possess both extensive practical and conceptual knowledge of how technology performs in real operational environments. What is needed is not just to make these items part of implementation and review but to start with a principle of co-design. This approach is also consistent with ACI World's 2022 Evolution of the Airport Workforce White Paper, which calls for technology to serve humans and for people to remain at the centre of its development, operation and maintenance.⁸ The International Labour Organisation (ILO) and the Organisation for Economic Co-operation and Development (OECD) emphasize safe, secure and trustworthy AI, resilient future workforces and preparation of workers for AI-related transitions.⁹

3. CONCLUSION

3.1 Technology should enhance human performance and capability, not diminish the conditions required for people to keep aviation safe. Emerging technologies can strengthen aviation where they enhance safety, resilience and people's ability to perform effectively. The objective is to support the success of automation enhancements in aviation and establish clear safety boundaries especially where emerging technologies introduce new forms of uncertainty or reduced explainability.

3.2 Meaningful oversight, maintained skills, appropriate staffing, fatigue safeguards, human-factors assessment, safety assurance and worker participation can help ensure technological change does not compromise but strengthens aviation safety. Where human life depends on a safety-critical function, responsibility should be matched by explicit and assured human authority to understand, question and intervene.

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⁷ IFATCA, ATCO Skills with the Use of Artificial Intelligence and Legal Liability, WP157, 64th Annual Conference, Abu Dhabi, United Arab Emirates, 28 April–2 May 2025.

⁸ ACI World, The Evolution of the Airport Workforce: Turning Challenges into Opportunities (2022).

⁹ ILO/OECD, Compendium of best practices for a human-centered development and use of Artificial Intelligence in the world of work, 2026. <https://doi.org/10.54394/INMX2843>