



**WORKING PAPER**

**ASSEMBLY — 42ND SESSION**

**EXECUTIVE COMMITTEE**

**Agenda Item 20: Innovation in Aviation**

**INTEGRATING ARTIFICIAL INTELLIGENCE INTO ICAO'S WORK PROGRAMS**

(Presented by Saudi Arabia)

**EXECUTIVE SUMMARY**

The continuous and rapid evolution of the global civil aviation system presents both significant challenges and opportunities. To enhance aviation safety, capacity, efficiency, and environmental protection, as outlined in ICAO's Strategic Objectives, the Organization should leverage transformative technologies. artificial intelligence (AI) and machine learning (ML) represent a paradigm shift in capability, offering powerful tools to support ICAO's entire work programs.

This paper proposes a structured approach for leveraging AI across all ICAO's activities. It outlines how AI can enhance the Organization's ability to develop, validate, and implement Standards and Recommended Practices (SARPs) and guidance material in a more agile, data-driven, and efficient manner. Rather than focusing solely on new entrants and innovations, this paper advocates for a holistic integration of AI to support all activities from safety risk modelling and compliance monitoring to the optimization of internal regulatory processes.

To formalize this strategic direction, this paper proposes an amendment to Assembly Resolution A40-27: *Innovation in aviation*. The amendment instructs the Council to adopt fundamental principles for the trustworthy and effective use of AI and directs the Secretariat to apply these principles to enhance the delivery of ICAO's work programs, thereby ensuring ICAO remains at the forefront of technological advancement in aviation

**Action:** The Assembly is invited to:

- a) note the information and the proposed approach presented in this paper;
- b) recognize the potential role of Artificial Intelligence in advancing all of ICAO's Strategic Objectives and work programs; and
- c) discuss and adopt the proposal for amendment of the Assembly Resolution A40-27: *Innovation in aviation*, provided in the attachment to this working paper.

<i>Strategic Goals:</i>	This working paper relates to <i>Every Flight is Safe and Secure</i> .
<i>Financial implications:</i>	Initial activities to be undertaken within the regular budget. The development and implementation of AI applications may require the allocation of additional resources.
<i>References:</i>	Doc 10209, Report on the Fourteenth Air Navigation Conference (AN-Conf/14) Doc 10184, <i>Assembly Resolutions in Force</i> Doc 9750, <i>Global Air Navigation Plan</i>

## 1. INTRODUCTION

1.1 The safe and orderly development of international civil aviation is a core mission of ICAO. The increasing complexity of the aviation ecosystem and the scale of operations, particularly in dense airspace and low-level environments, the rapid pace of technological change, and the emergence of new entrants such as unmanned aircraft systems (UAS), advanced air mobility (AAM), and higher airspace operations concepts challenge traditional methods for developing and implementing Standards and Recommended Practices (SARPs), guidance, and oversight mechanisms.

1.2 The rapid advancement of artificial intelligence (AI) technologies presents unprecedented opportunities to address these challenges and support ICAO's mission across all its Strategic Objectives. As recognized in Assembly Resolution A40-27: *Innovation in aviation*, the nature and pace of innovations require new methodologies to facilitate timely evaluation and assessment. AI offers a suite of powerful tools for data analysis, simulation, risk assessment, and decision-making support that can significantly accelerate the entire lifecycle of ICAO's work programs.

1.3 The current challenges in advancing ICAO's objectives include managing vast amounts of data, assessing complex safety risks in socio-technical systems, and allocating limited resources effectively. AI applications can help address these challenges through systematic approaches to simulation, data and scenario analysis, risk assessment, and verification of regulatory compliance, thereby enhancing the efficiency and effectiveness of the Organization. AI applications in civil aviation regulatory processes offer transformative potential in three key areas: automated safety risk assessment using machine learning algorithms trained on comprehensive operational datasets; simulations and predictive analytics for identifying potential safety issues before they manifest in operations; and intelligent data processing systems that can rapidly analyse large amounts of specifications and technical documentation, operational reports, and safety data to support evidence-based regulatory decisions.

## 2. DISCUSSION

2.1 To effectively harness AI, ICAO should adopt a structured, risk-based approach founded on a set of fundamental principles that build trust and ensure safe, ethical, and effective integration. Drawing from global best practices, this approach should be guided by principles such as being human-centric and in control; technically robust and safe; transparent and explainable; secure and resilient; and accountable and fair. The integration of AI into ICAO's work program can be managed through the following iterative process:

- a) *Identification and scoping*: ICAO, in coordination with States and industry, should identify specific, high-impact challenges across its work programs. The initial focus should be on AI as a tool to support analysis and decision-making rather than as a direct component in the development of safety-related material.
- b) *Information, data domain, and management*: For any proposed AI application, clear information, data domain, and applicability should be established. This requires a rigorous process of information and data management to ensure that the datasets used for training and validating the AI model are complete, representative, and of high quality, as the performance of any AI system is fundamentally dependent on the quality of its information and data.

- c) *Verification and validation in controlled environments*: Promising AI solutions should be evaluated within controlled environments, such as regulatory sandboxes and pilot projects.
- d) *Development of a learning assurance case*: The results from the controlled environment should be used to build a "Learning Assurance" case for its acceptance and usage.
- e) *Support for ICAO's work programs*: Proven AI applications, having successfully passed the assurance process, can then be used by ICAO panels and expert groups, and the Secretariat to support the development of SARPs, Procedures for Air Navigation Services (PANS) and guidance material.

2.2 Based on current research and development, several AI applications can be rapidly selected and adopted to support ICAO's work program, including but not limited to:

- a) *Advanced safety risk modelling*: Using AI to analyse global safety data, incident reports, and other complex data to identify potential and emergent risks and model the effectiveness of proposed mitigation strategies based on systems thinking.
- b) *Dynamic airspace management simulation*: Employing AI to simulate and optimize dynamic airspace configurations that can be tested for changes and new entrants such as AAM, higher airspace operations, and UTM, allowing the prediction of the optimum and safe integration of manned and unmanned traffic in complex environments, using all possible scenarios.
- c) *Automated validation and verification (V&V)*: Using AI-driven tools to conduct exhaustive testing of complex software-based systems, to identify potential edge-case failures that are difficult to find with traditional testing methods.
- d) *Intelligent document processing*: Using AI to automatically extract key information from technical submissions, State letters, and safety reports to accelerate analysis and review processes within the Secretariat activities;
- e) *Automated compliance monitoring*: Machine and deep learning systems can be used for continuous monitoring of regulatory compliance and identifying potential deviations or unsafe practices.
- f) *Data-driven regulatory development*: Analysing large-scale operational data from aviation activities, new operations such as UAS, AAM, and higher airspace operations trials to provide an evidence-based foundation for the development of new global policies, SARPs, PANS, and guidance.

2.3 To formalize this strategic direction and provide a clear mandate for action, it is proposed that Assembly Resolution A40-27 be amended. The proposed amendments will add new operative clauses instructing the Council to adopt fundamental principles for AI and directing the Secretariat to leverage AI to enhance the efficiency and effectiveness of its work, ensuring that ICAO's processes keep pace with the rapid development of aviation innovation.

### 3. CONCLUSION

3.1 Artificial intelligence offers a transformative opportunity to address the most pressing challenges across the entire global aviation system. By adopting a structured and risk-based approach, ICAO can leverage AI to accelerate the development of robust SARPs and guidance material, enhancing global safety and efficiency, and fostering the sustainable growth of civil aviation.

3.2 The proposed approach, incorporating fundamental principles and a strong emphasis on data quality and learning assurance, provides a pragmatic pathway for integrating proven AI solutions into ICAO's work programs. This will not only support the safe integration of new entrants but will also enhance the overall capacity and efficiency of the Organization in delivering on all its Strategic Objectives.

3.3 The Assembly is invited to formally recognize the strategic importance of AI in advancing aviation innovation and to endorse the approach outlined in this paper by adopting the proposal for amendments to Assembly Resolution A40-27.

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## APPENDIX

### PROPOSED AMENDMENT TO ASSEMBLY RESOLUTION A40-27

*Whereas* several ICAO Conferences have recognized the real and potential benefits and challenges that innovation and Artificial Intelligence can bring to the safety, efficiency, security, facilitation and to the economic and environmental sustainability of air transport, and that Member States should be provided the opportunity to realize these benefits in a manner that leaves no country behind;

*Recognizing* that ICAO provisions apply to all civil airspace users, and the absence of normative activity at the global level may hamper the realization of innovative technological solutions and prevent the materialization of their benefits in aviation; and to that end ICAO can benefit from continued interaction with industry, and academia to identify the latest Artificial Intelligence and technological developments their timely integration;

*Recognizing* that the nature and pace of Artificial Intelligence and innovations require regulators at the national, regional, and global level avail themselves of new methodologies that facilitate the timely evaluation and assessment of Artificial Intelligence and technological developments;

*The Assembly:*

1. *Urges* all Member States that have experience in facilitating the introduction of innovation and Artificial Intelligence in civil aviation, and that have evolved their regulatory methods to better evaluate and assess the application of such innovations, to share their experience with other States through ICAO;
2. *Directs* the Council to assess the need, as well as the resources required, to evolve the processes of the Organization, including its working methods with the industry, research organizations, and academia in order to keep pace with Artificial Intelligence applications and innovations that affect the sustainable development of civil aviation;
3. *Directs* the Council on the basis of the conclusions arising from the assessment to be undertaken pursuant to operative clause 2, to develop, high-level policies to address the findings of the aforementioned assessment and subsequently provide a framework that will help ensure the timely development of global policies and standards that support introduction of Artificial Intelligence applications and innovations in the continuing improvement of safety, efficiency, security, facilitation, economic and environmental performance;
4. *Directs* the Council to instruct the Secretary General to further liaise with States, governmental and non-governmental organizations, the private sector, academia and the relevant United Nations system entities in order to establish an inclusive dialogue at strategic level that will encourage further collaboration and sharing of experience in relation to Artificial Intelligence and innovation; and
5. *Directs* the Council to urgently consider the establishment of a high-level body with the industry to regularly provide strategic advice to the Council concerning Artificial Intelligence applications and innovation in aviation.
6. *Directs* the Council to adopt fundamental principles for the trustworthy and effective integration of Artificial Intelligence into ICAO's activities and work programs. These principles should address, inter alia,

human-centricity and control, technical robustness and safety, transparency and explainability, security and resilience, and accountability and fairness.

7. Instructs the Secretary General to ensure that Artificial Intelligence applications are used, in accordance with the fundamental principles adopted by the Council under operative clause 6, to expedite and enhance the efficiency and effectiveness of the Organization in delivering its work programs, including in the development of regulatory and guidance material.

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