Organización de Aviación Civil Internacional
Oficina Regional Sudamericana
Decimoctava Reunión de Autoridades de Aviación Civil de la Región Sudamericana (RAAC/18)
(Sao Paulo, Brasil, 24 al 26 de febrero de 2025)

RAAC/18-WP/44
06/02/25

Item 7A
Of the Agenda: Innovation

THE IMPACT OF ARTIFICIAL INTELLIGENCE IN THE AERONAUTICAL SECTOR

Working Paper presented by Colombia, *"The Country of Beauty"*

SUMMARY

Artificial intelligence (AI) is revolutionizing the aviation industry by optimizing processes and improving efficiency in key areas such as air traffic management (ATM), predictive maintenance, and operational safety. Its ability to process large volumes of data, including meteorological information, flight plans, and transfers, and to determine patterns allows for route optimization, congestion prediction, and risk anticipation, enhancing safety and efficiency in airspace utilization.

AI also influences the development of new forms of air mobility, such as Advanced Air Mobility (AAM) and Urban Air Mobility (UAM), presenting new challenges for the integration of these operations and human-machine interaction in airspace.

It is crucial to understand AI's potential to address the challenges posed by increasing automation. Through training processes, excessive reliance on systems must be avoided, along with potential effects on operators' situational awareness, ethical dilemmas in assisted decision-making, and training challenges as elements to ensure reaction capability in critical environments.

Proposed measures for the meeting:

- Analyze training curricula to integrate education in areas such as artificial intelligence, big data, critical thinking, and decision-making in complex environments, enabling a better understanding of the opportunities that technology offers in aviation.
- Promote analysis among regulatory authorities and system manufacturers to establish clear frameworks addressing ethical and legal dilemmas, ensuring that AI is implemented safely and transparently in the sector.

References:

- **ICAO Annex 17: Aviation Security (AVSEC).**
- ICAO Strategic Objectives
- IATA Document (July 31, 2024)
- Artificial Intelligence: Disruption and Challenges in Aviation – MAPFRE Global Risks
- **Artificial Intelligence and Aviation.** EASA Article

ICAO Srategic Objectives:	- *Every flight is safe (Safety and Security)* - *Aviation offers seamless, accessible and reliable mobility for all.*

1. Introduction

1.1 The aviation industry is undergoing an unprecedented transformation driven by the rapid evolution of artificial intelligence (AI). This technology, with its ability to process large volumes of data and extract complex patterns, is optimizing key processes such as air traffic management (ATM), predictive maintenance, and operational safety. From flight route optimization to congestion prediction and risk anticipation, AI is improving efficiency and safety in airspace usage.

1.2 AI is also driving the development of new forms of air mobility, such as Advanced Air Mobility (AAM) and Urban Air Mobility (UAM), which present new challenges for integrating these operations and human-machine interaction in airspace. AI's capacity to automate tasks and analyze data in real time is transforming how aviation professionals interact with systems, creating opportunities to enhance efficiency and safety.

1.3 However, integrating AI into aviation also presents significant challenges. It is crucial to understand the implications of advanced automation on human-machine interaction, operators' situational awareness, and decision-making. Additionally, ethical dilemmas arising from AI implementation must be addressed to ensure its responsible and transparent use. In this context, training and education for technical and operational personnel, as well as the entire sector, must integrate these key elements to prepare aviation professionals for the challenges and opportunities that AI presents.

2. Discussion

2.1 Aviation, as one of the most dynamic and technologically advanced sectors, is experiencing continuous growth, as evidenced by the 9.1% increase in revenue passenger kilometers reported by IATA in July 2024. This growth demands optimizing airspace use while ensuring operational safety. Factors such as increased traffic density, the development of more precise aircraft detection and tracking systems, new predictive traffic flow management systems, and greater availability of meteorological information have transformed how personnel interact with CNS-ATM-Met systems (Communications, Navigation, Surveillance, Air Traffic Management, and Meteorology). In this context, artificial intelligence (AI) emerges as a key technology to enhance operational efficiency and safety in aviation.

2.2 AI, with its ability to analyze data from various sources and automate processes, is transforming the aviation industry due to its numerous applications. In air traffic management (ATM), AI-based systems process large volumes of real-time data, identifying patterns and anticipating critical situations such as potential collisions or traffic congestion. This translates into optimized flight routes, better congestion prediction and resolution, and greater efficiency in managing air traffic flow amid unexpected changes, such as those caused by weather factors.

2.3 Regarding the growth of new technologies like advanced air mobility (AAM) and urban air mobility (UAM), with their respective unmanned traffic management (UTM) systems, human-machine interfaces need to be rethought, integrating new forms of interaction between technology and humans. This represents new challenges for integrating these operations into the aeronautical sector, where intelligent technologies will simplify tasks under the supervision of new aviation professional profiles. Human-

machine interaction is evolving toward a supervisory role, where aviation professionals take on greater responsibility in strategic decision-making, planning, and conflict resolution.

2.4 In predictive maintenance of aeronautical infrastructure, machine learning allows for evaluating equipment conditions and identifying anomalies before they become critical failures, increasing safety and reducing operational costs. In the flight deck, AI analyzes real-time data to predict risk situations and provide decision-making recommendations, reducing pilots' workload and improving situational awareness.

2.5 In air traffic management (ATM), AI-based systems process large volumes of real-time data, identifying patterns and anticipating critical situations such as collisions or congestion. This analytical capability enables the optimization of flight routes, adapting to changing conditions and minimizing delays. Additionally, AI facilitates the integration of real-time meteorological information, predicting risk areas and adjusting routes to avoid them. It also allows for process automation, streamlining data input and interaction between different technologies. Pattern recognition in routes and corridors can also help automate actions through decision-support systems for air traffic controllers.

2.6 Consequently, AI contributes to a smoother and more efficient ATM, reducing delays, fuel consumption, and pollutant emissions. Air traffic controllers benefit from decision-support systems that, by integrating meteorological information, flight plans, and surveillance data, enable the generation of accurate forecasts of crossings and risks, providing them with a comprehensive view of air traffic. This allows them to make more informed and efficient decisions.

2.7 AI’s ability to process multiple sources of information, combined with the development of next-generation satellite and ground-based meteorological sensors and data link systems with aircraft, enhances air traffic flow efficiency, minimizing the impact of unexpected events and delays.

2.8 However, integrating AI into aviation also presents challenges. Advanced automation can affect human-machine interaction and operators' situational awareness, creating risks such as excessive reliance on systems and a lack of attention in emergency situations. To mitigate these risks, it is crucial to implement training programs that develop competencies in human-machine interaction and ensure that operators understand AI’s capabilities and limitations.

2.9 Another fundamental aspect is ethics and accountability in AI-assisted decision-making. It is necessary to establish regulatory frameworks that define responsibilities in human-machine interaction, ensuring that AI is implemented safely and transparently. Education and training are crucial to ensuring a successful transition to this new paradigm, incorporating content on AI, human-machine interaction management, and the development of critical thinking skills.

2.10 In conclusion, artificial intelligence is rapidly transforming the aviation industry, optimizing processes and improving efficiency in key areas such as air traffic management, predictive maintenance, and operational safety. However, AI integration also presents significant challenges that require careful attention.

2.11 It is crucial to address the implications of automation on human-machine interaction, operators' situational awareness, and decision-making. Additionally, it is essential to establish clear ethical and regulatory frameworks to ensure that AI is implemented responsibly and transparently.

2.12 Continuous training and education are essential for aviation professionals to fully leverage the opportunities AI offers while mitigating potential risks. Ultimately, the success of AI integration in

aviation will depend on the sector’s ability to adapt to technological changes while maintaining a human-centered approach and operational safety.

3. Suggested Actions

3.1 The meeting is invited to

a) Analyze the training curricula for aviation personnel to integrate education in artificial intelligence, big data, critical thinking, and decision-making in complex environments, enabling a deeper understanding of technology's opportunities in aviation.

b) Promote discussions between regulatory authorities and system manufacturers to establish clear frameworks addressing ethical and legal dilemmas, ensuring that AI is implemented safely and transparently in the sector.

- END -