59th CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION ASIA AND PACIFIC REGIONS

Cebu, Philippines
14 to 18 October 2024

AGENDA ITEM 3: AVIATION SAFETY

OPPORTUNITIES AND CHALLENGES FOR THE USE OF ARTIFICIAL INTELLIGENCE IN AVIATION

(Presented by Hong Kong, China)

DISCUSSION PAPER

SUMMARY

This paper highlights the opportunities of using Artificial Intelligence (AI) across various aspects of aviation, from aircraft design and development, to aircraft maintenance and flight operations. It also discusses various challenges and considerations associated with AI, including regulatory adaptation, system robustness, cybersecurity and addressing ethical concerns, and the role of industry stakeholders in facilitating AI integration in aviation to enhance safety, efficiency and sustainability.

OPPORTUNITIES AND CHALLENGES FOR THE USE OF ARTIFICIAL INTELLIGENCE IN AVIATION

1. INTRODUCTION

1.1 Artificial Intelligence (AI) has emerged as a transformative force across various industries, with aviation being no exception. With capabilities such as machine learning, computer vision and optimisation algorithms, AI can process vast amounts of data to generate insights and effective solutions in significantly less time than conventional methods.

1.2 With AI offering immense potentials in aviation, this aligns with the Conference's theme "Shaping the future of air transport: Sustainable, Resilient and Inclusive".

1.3 This paper highlights the opportunities of using AI in aviation, discusses associated challenges and considerations, and the role of industry stakeholders in facilitating AI integration in aviation to enhance safety, efficiency and sustainability.

2. DISCUSSION

2.1 Examples in Adoption of AI in Aviation

2.1.1 **Aircraft Design and Development:** AI enhances aircraft design and development by enabling lighter airframes, more fuel-efficient engines, and improved aerodynamic profiles. Additionally, AI's machine learning and data analysis capabilities expedite design iterations and streamline material selection, thereby reducing development costs and time for new products or design improvements.

2.1.2 **Production Line Integration:** AI's integration with automation and robotics streamlines manufacturing process, improves precision, minimises human errors, reduces lead time and cost. The analytical power of AI also enhances inventory management and production planning.

2.1.3 **Maintenance Management:** AI technologies also revolutionise aircraft maintenance management. The AI technologies integrated into aircraft design enable real-time data collection and health monitoring. By embedding these technologies at the design phase, we can effectively capture, diagnose, and transfer key parameters to the health monitoring system for detailed analysis. This integration transforms the maintenance philosophy from a fixed preventive approach to a predictive and proactive strategy tailored to the aircraft's real-time conditions. With the support of automated inspection by drones or machine scanning, the optimisation of maintenance reduces aircraft downtime and resources associated with scheduled maintenance, hence increases operational efficiency and safety.

2.1.4 **Flight Operations:** AI optimises route planning and flight scheduling by using data driven models and algorithm that can generate the optimal solution, taking into consideration multiple factors such as flight path, fuel consumption, aircraft configuration, weather, crew availably and flight time limitations, etc. This capability not only improves operational efficiency, crew utilisation and productivity, but also reduces the chance of flight delays. Additionally, AI powered systems assist pilots in real-time decision-making during flights and monitor various flight parameters, such as altitude, speed, etc., reducing the cognitive workload in flight deck and enhancing overall flight safety.

2.1.5 Similarly, AI can be applied in other aspects across the aviation ecosystem. For example, in airport operations, there are already a number of AI automated processes, such as autonomous vehicles, baggage handling and passenger flow management etc., which improve operational efficiency while allowing for better resource allocation in airport facilities.

2.2 **Challenges and Considerations**

2.2.1 While AI offers substantial opportunities in aviation, there are also challenges and considerations to be addressed.

2.2.2 The existing regulatory framework, based on conventional processes, may not comprehensively address the intricacies of AI technologies leveraging machine learning and AI decision-making. A review of the existing framework could facilitate the safe and efficient integration of AI systems, taking into account their unique challenges. For example, certifying designs generated by AI-powered systems may require new requirements and criteria in certification and airworthiness. Traditional methods may not suffice, prompting the need for the introduction of new certification standards and procedures that account for the dynamic nature of AI algorithms and their learning capabilities, ensuring the processes are justiciable and accountable. It will be imperative to continuously monitor and update certification standards as AI systems progress and evolve.

2.2.3 As AI systems require highly sophisticated data processing infrastructure, ensuring system robustness and resilience is critical, as evidenced by recent example of Operating System outage impacting global airport operations. Whilst AI can enhance a broad spectrum of operational tasks, a resilient and robust design with redundancy and diversity is essential for its uninterrupted operations.

2.2.4 The reliance on big data also raises concerns about cybersecurity and privacy of personal data. AI systems and their associated data management processes should be subject to rigorous testing and protective measures to safeguard against threats in cybersecurity, data leakage or mishandling of personal data.

2.2.5 Furthermore, the ethical implications of AI decision-making in aviation are not to be underestimated. AI systems make decisions based on various sources, including historical data that reflects past inequalities or systemic issues. Therefore, governance on the selection and management of dataset inputs for AI must be established to tackle issues on data integrity, ethical concerns and accountability for AI decision-making processes.

2.2.6 While the industry acknowledges the potential advantages of AI technologies, concerns have been raised about whether the advantages outweigh key issues, such as cybersecurity threats, data privacy, and worries about job displacement. For successful integration of AI in aviation, it is important to engage with the industry through open discussions and forums for mitigating the concerns while fostering a favourable view of AI's role in aviation.

2.2.7 Successful integration of AI in aviation requires collaboration among all stakeholders, including ICAO, regulatory bodies, industry players, researchers, and public interest groups. Collaborative efforts can help identify potential challenges in early stage and facilitate effective solutions to address the concerns from different parties, and to ensure that the benefits of AI systems are fully realised.

2.2.8 ICAO plays an important role in facilitating the safe introduction of new and evolving technologies to the industry. In the ICAO 14th Air Navigation Conference, a Recommendation was formulated, requiring ICAO and States to address the safety risks related to new and evolving aviation technologies and concepts. By actively collaborating with member states and industry stakeholders, ICAO can lead the industry to collaborate in ensuring safe and efficient AI integration in global aviation.

3. ACTION BY THE CONFERENCE

The Conference is invited to

a) recognize the transformative opportunities that AI offers to aviation;

b) note the challenges and considerations for the integration of AI technologies in

aviation;

c) promote collaboration with industry stakeholders and among authorities to share experience and develop guidelines and best practices; and

d) advocate for engagement with industry to foster a favourable view in the integration of AI technologies in aviation.

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