International Civil Aviation Organization
Asia and Pacific Office

Fourteenth Meeting of the Regional Aviation Safety Group – Asia and Pacific Regions (RASG-APAC/14)

(Bangkok, Thailand, 28-29 November 2024)

Agenda Item 4: ICAO/ Member State / Industry Presentation

TRANSFORMING THE FUTURE OF AVIATION: EMBRACING UNMANNED AVIATION AND ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN AIRCRAFT MAINTENANCE

(Presented by Hong Kong, China)

SUMMARY

Advanced air mobility is revolutionizing the transportation of passengers, goods, and services by reshaping the aerial mobility in different contexts. Among these, the use of Unmanned Aircraft Systems (UAS) in combination with Artificial Intelligence (AI) technology in aircraft maintenance, such as inspection of aircraft surface and identifying structural damages, is envisioned to be a game changer which could improve inspection effectiveness, enhance personal safety, optimise maintenance schedule and increase aircraft utilisation. This paper shares the experience of Hong Kong, China in using UAS for aircraft inspection and the challenges to be overcome before the use of UAS and AI technology can be widely adopted in aircraft maintenance.

1. INTRODUCTION

1.1 The aviation industry is undergoing a transformative phase, driven by advancements in technology developed for the Advanced Air Mobility (AAM) concept including drones and other unmanned aircraft systems (UAS) as well as a wide range of other new aircraft designs and flight technologies. Among these, UAS and Artificial Intelligence (AI) stand out as pivotal innovations that heighten the efficiency, precision, and safety of modern technological applications in the aviation industry. With the capabilities of AI 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 The use of AI technology in combination with unmanned aircraft system (UAS) in aircraft maintenance, such as inspection of aircraft surface and identifying structural damages, is envisioned to be a game changer which could improve inspection effectiveness, enhance occupational safety, optimise maintenance schedule and increase aircraft utilisation. This paper shares the experience of Hong Kong, China in using UAS for aircraft inspection and the challenges to be overcome before the use of UAS and AI technology can be widely adopted in aircraft maintenance.

2. DISCUSSION

UAS Applications in Aircraft Maintenance

2.1 The Civil Aviation Department (CAD) of Hong Kong, China has been facilitating the innovative development and diversified application of UAS whilst safeguarding aviation and public safety. The CAD recognises the potential of UAS technology in aircraft maintenance to enhance safety and efficiency. While traditional inspection methods that often require the access of difficult-to-reach areas using elevating work platforms or scaffolding, takes time and poses safety risks, UAS offer a safer alternative by allowing the inspection at the extremities of the aircraft such as wing and tail surface more efficiently and safely. Furthermore, UAS with advanced sensors can capture high resolution images and data for health monitoring at routine inspection, and ad-hoc inspection to determine if further maintenance is required after a reported incident such as lightning strike. The combination of UAS pairing with measurement software and AI capable of vast data processing can further expand the capability of UAS application to enable predictive maintenance based on continual monitoring and analysing of the aircraft real-time condition, such that appropriate maintenance action could be taken before the condition turning into a big problem. As the time and labour cost required for inspection with UAS are significantly reduced compared with manual inspection, the inspection can be conducted more frequently to enhance safety.

2.2 CAD had been in discussion with a local operator to explore the use of UAS for aircraft inspection. UAS operations had been conducted within the hangar initially to demonstrate the use of technology, and gradually at the airport apron to simulate aircraft inspection in line maintenance environment. Considering the airport area falls within the UAS restricted flying zone, guidance and facilitations from the CAD and the Airport Authority were given along the way to coordinate and authorise the inspections within designated area and time-frame to ensure the operations would be under control and safely segregated from the busy manned aircraft traffic. Through these UAS operations, data was collected for further analysis, model building and mapping with the existing aircraft damage record, paving the way for autonomous flights in accordance with pre-determined paths for inspections on a routine basis in the airport area.

Challenges and Considerations

2.3 While the potential benefits of using UAS for aircraft inspection have already been recognised, there are still challenges to overcome before the UAS applications can be widely adopted for aircraft maintenance.

2.4 From certification perspective, the development of a maintenance program of an aircraft type involves a robust process to certify the procedure, interval, components and equipment required for each task. Furthermore, maintenance work on aircraft must also be performed by personnel with appropriate training and qualification. In order to qualify the use of UAS for aircraft maintenance in lieu of manual inspection, thorough evaluations of the methodology, capability and limitations have to be undergone in order to establish the equivalency with the existing traditional method. This requires collaborations between the UAS manufacturers, aircraft manufacturers and operators for data collection, flight trials, verification and substantiation, together with the support from the States of Design of the aircraft types and the aviation authorities overseeing the operations and maintenance of the aircraft.

2.5 On the operation side, considering that the majority of aircraft maintenance activities are taking place at the airport area, customised regulations and procedures shall be established with due considerations of the air traffic and ground activities within the airport area to govern the UAS operations for the specific aircraft maintenance tasks. With the rapid advancement in UAS and AI technology, it will be imperative to continuously monitor and update respective regulations and operation requirements to foster innovative development while safeguarding aviation and public safety.

3. ACTION BY THE MEETING

3.1 The Meeting is invited to:

a) note Hong Kong, China's efforts in fostering the development of the use innovative technologies to enhance safety and efficiency in aircraft maintenance;

b) note Hong Kong, China's efforts in facilitating the use of UAS and AI technology in aircraft maintenance; and

c) share the experiences of UAS applications in aircraft maintenance.

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