



ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives

INVESTIGATION OF ADVANCED AIR MOBILITY ACCIDENTS AND INCIDENTS

(Presented by the United Arab Emirates)

EXECUTIVE SUMMARY

The ICAO Advanced Air Mobility Symposium (AAM 2024) held in Montréal (9 to 12 September 2024), emphasized global harmonization and interoperability for electric vertical take-off and landing (eVTOL) operations. This will indeed require establishing an international framework for eVTOL operations safety, including accident investigation.

This working paper highlights the forecasted unique challenges posed by the eVTOL operations and presents initiatives to ensure investigators are equipped with the required competencies to conduct effective accident investigations and support the safe integration of eVTOL operations into urban airspaces.

The Air Accident Investigation Sector (AAIS) of the United Arab Emirates has launched an innovative solution by creating a dedicated Technology Investigation Unit and implementing a capacity-building program grounded in competency-based training. This initiative directly addresses the distinctive challenges of eVTOL accident and incident investigation, particularly in the areas of high-capacity battery systems, automated flight controls, distributed data recording architectures, and novel airframe technologies that differ fundamentally from conventional aircraft.

Action: The Assembly is invited to request ICAO to establish a dedicated working group, under the auspices of the Accident Investigation Panel (AIGP), to develop comprehensive guidance material on the investigation of occurrences involving advanced air mobility (AAM).

<i>Strategic Goals:</i>	This working paper relates to <i>Every Flight is Safe and Secure</i> and <i>Aviation Delivers Seamless, Accessible, and Reliable Mobility for All</i>
<i>Financial implications:</i>	No financial implications are anticipated.
<i>References:</i>	Annex 6 — <i>Operation of Aircraft</i> , Part IV — <i>International Operations – Remotely Piloted Aircraft Systems</i> Annex 13 — <i>Aircraft Accident and Incident Investigation</i> Doc 10206, <i>Manual on Aircraft Accident and Incident Investigation Training</i>

1. INTRODUCTION

1.1 Advanced air mobility (AAM), driven by the rapid emergence of electric vertical take-off and landing (eVTOL) technologies, is poised to transform short-haul transportation within densely populated urban environments. These next-generation vehicles promise significant benefits in terms of mobility and efficiency. However, this kind of operation may introduce novel safety challenges that differ significantly from those associated with conventional aviation. As such, there is a growing need for dedicated and forward-looking approaches to their relevant accident investigation.

1.2 Despite the robustness of traditional aircraft investigation methodologies, they are insufficient when applied to eVTOL operations. Key differentiators, such as high-energy battery systems, distributed electric propulsion, automated flight control algorithms, cloud-based data recording, and highly complex urban operating environments, necessitate specialized protocols and investigators' skillsets. These differences underscore the urgency of developing new investigation guidance tailored to the unique attributes of AAM.

1.3 In recognition of these developments, the ICAO Advanced Air Mobility Symposium (AAM 2024), held in Montréal in September 2024, focused on the global harmonization and interoperability issues surrounding AAM operations. The symposium emphasized the need for tailored regulatory frameworks and robust safety mechanisms, particularly relevant to eVTOL systems. Referencing this event underlines the alignment of this working paper with ICAO's ongoing discourse and strategic direction.

1.4 ICAO has gained good experience in addressing the investigative and operational implications of similar other emerging aviation technologies. Notably, Amendment 19 to Annex 13 — *Aircraft Accident and Incident Investigation* (2024) introduced provisions specific to unmanned aircraft system (UAS) investigations, while Annex 6 — *Operation of Aircraft, Part IV — International Operations – Remotely Piloted Aircraft Systems*, established comprehensive standards for the international operations of remotely piloted aircraft systems (RPAS). These developments serve as a regulatory precedent and highlight ICAO's proactive approach in adapting existing safety frameworks to accommodate new forms of aviation.

2. DISCUSSION

2.1 The eVTOL operations present unprecedented safety challenges that extend beyond traditional aviation frameworks. These include the need for new airworthiness standards, the adoption of advanced battery technologies, integration into existing air traffic systems, enhanced flight tracking requirements, and evolving security threats all of which demand specialized investigative approaches.

2.2 One prominent example is the shift from conventional fuel to high-capacity batteries, which introduces unique risks such as thermal runaway and prolonged fire hazards. These require investigation techniques and protocols distinct from those used in traditional fuel-related incidents. Similarly, the integration of eVTOL vehicles into conventional airspace necessitates the development of advanced traffic management systems to ensure safe coexistence with the regular operations.

2.3 Unlike conventional aircraft equipped with standardized flight data recorder (FDR) and cockpit voice recorder (CVR) systems, eVTOL platforms currently lack uniform regulatory requirements for onboard data recording. Certification authorities such as the Federal Aviation Administration (FAA) and European Union Aviation Safety Agency (EASA) have yet to mandate specific provisions in this area. As a result, industry approaches vary significantly—while some manufacturers, such as , intend to incorporate combined recorders in models like the MEDMIGHT, others, including JOBY, have no such plans. This regulatory gap and variability in implementation pose significant challenges to data accessibility, standardization, and ultimately, the effectiveness of accident investigations. Establishing globally harmonized requirements for data recording, storage, and retrieval in eVTOL operations is therefore critical to ensuring consistent and internationally aligned investigative outcomes.

2.4 While the AAM Study Group (AAM SG) is actively progressing work related to the operational integration of AAM into the existing aviation ecosystem, the aspect of accident and incident investigation remains insufficiently addressed. A specialized working group would enable the development of globally harmonized investigative frameworks and facilitate coordination with the AAM SG through regular engagement and technical presentations, ensuring alignment across related ICAO initiatives.

2.5 The absence of standardized investigation guidance for eVTOL occurrences poses potential risks to the safe advancement and societal acceptance of this kind of operations. Without harmonized protocols, investigations may yield inconsistent safety outcomes, fragment international cooperation, and delay the establishment of global safety standards. This inconsistency could undermine public confidence, resulting in missed opportunities to address recurring hazards, and erode trust in the safety of these transformative technologies. Furthermore, inadequate investigation capabilities may negatively impact industry development, insurance structures, and regulatory credibility, ultimately impeding the integration of eVTOL into the future of urban mobility.

2.6 As a response to these evolving operations and their associated challenges, the Air Accident Investigation Sector (AAIS) of the United Arab Emirates has taken strategic initiative to build dedicated eVTOL investigation capabilities. As a foundation, a dedicated Technology Investigation Unit has been established, focusing exclusively on AAM technologies.

2.7 The AAIS has also introduced targeted training programs, addressing the specific demands of eVTOL investigations. These programs cover critical areas such as battery hazard analysis, assessment of automated flight systems, and innovative crash investigation techniques tailored to electric aircraft. The training is aligned with ICAO standards and global best practices, ensuring investigators are equipped to meet future investigative challenges. The AAIS adopts the implementation of competency-based training programs in alignment with global best practices such as ICAO's *Manual on Aircraft Accident and Incident Investigation Training* (Doc 10206).

2.8 By engaging in international collaboration and sharing technical knowledge, the AAIS supports the global advancement of eVTOL safety practices through a well-defined roadmap promoted by ICAO. This integrated international effort helps standardize investigative approaches and facilitates the safe integration of eVTOL operations into urban airspaces, providing a valuable reference for other ICAO Member States.