International Civil Aviation Organization

WORKING PAPER

ATConf/7-WP/193
15/10/26
(Information Paper)
English only

SEVENTH WORLDWIDE AIR TRANSPORT CONFERENCE (ATCONF/7)

Montréal, HQ, 16 to 20 November 2026

Agenda Item 4: Emerging technologies, new business models and other associated aspects
4.3 Leveraging air transport data and the digital ecosystem for seamless, secure and resilient operations

AI TRANSFORMATION ROADMAP

(Presented by United Arab Emirates)

EXECUTIVE SUMMARY

This paper presents the Agentic Artificial Intelligence (Agentic AI) Transformation Roadmap 2026–2035 of the United Arab Emirates Air Accident Investigation Sector (AAIS). The roadmap defines a supervised operating model in which AI agents execute approved, routine and non-judgemental investigation workflow activities, while investigators retain exclusive authority over findings, causes and contributing factors, safety recommendations, and final reports. It identifies eleven (11) specialized investigation agents across the investigation lifecycle, supported by a four-layer architecture and a governance, assurance and data protection framework. The roadmap sets out a strategic direction and governance framework; it does not describe systems in operational use.

1. INTRODUCTION

1.1 Air accident investigations increasingly rely on diverse sources of digital evidence. A single investigation may involve flight recorder data, air traffic services recordings, maintenance and operational records, manufacturer data, photographs, witness information, and technical reports. The volume complexity, and diversity of such evidence continues to increase, requiring investigators to systematically locate, review, correlate, and validate information within the time constraints of the investigation process. Much of this work remains repetitive and resource-intensive, while maintaining clear and consistent traceability between the underlying evidence, analytical processes, investigation findings, conclusions, and safety recommendations is essential to the integrity and credibility of the investigation.

1.2 This paper summarizes the Air Accident Investigation Sector (AAIS) Agentic Artificial Intelligence (Agentic AI) Transformation Roadmap. The roadmap describes a strategic direction and a governance framework. It does not describe operational systems; the status of each element is identified in the paper.

2. DISCUSSION

Rationale and context

2.1 The requirement for Artificial Intelligence (AI)-supported investigation capabilities arises primarily from the increasing volume, diversity, and complexity of digital evidence. Modern investigations may involve substantial quantities of flight data recorder (FDR) and cockpit voice recorder (CVR) data, Air Traffic Service (ATS) information, maintenance records, operator documentation, manufacturer information, laboratory results, technical reports, and other digital sources. Investigators must correlate events across these sources, establish common timelines, identify missing or inconsistent information, and ensure that findings, conclusions and safety recommendations remain traceable to the supporting evidence and analysis. AI techniques can assist with information retrieval, extraction, correlation, anomaly identification, evidence gap detection and the preparation of draft analytical material, while remaining under investigator supervision and approval.

2.2 These investigation requirements are well established. However, increasing volume and complexity of digital evidence, together with the growing maturity of AI technologies, present an opportunity to perform selected investigation activities more efficiently, consistently, and systematically. Accordingly, the roadmap adopts a phased approach, under which AI capabilities are introduced incrementally, validated against defined operational and investigation requirements, and subject to continuous evaluation before wider deployment.

2.3 The roadmap is aligned with the direction of the United Arab Emirates direction towards the adoption of Agentic AI across government operations, including phased implementation, continuous performance assessment, process redesign, and workforce capability development. The AAIS applies these principles within the specific context of aircraft accident and incident investigation, incorporating additional safeguards to address the security, confidentiality, evidential integrity, and independence requirements inherent in the investigation process.

2.4 In developing the roadmap, the AAIS has also considered international approaches to application of AI in aviation, particularly with respect to human oversight, assurance, validation, and cybersecurity. AI-generated investigation outputs are intended to remain aligned with the requirements of Annex 13 and, where applicable, the International Civil Aviation Organization (ICAO) Accident/Incident Data Reporting (ADREP) taxonomy, thereby supporting consistency, interoperability, and international harmonization. The United Arab Emirates currently chairs the working group of the ICAO Accident Investigation Panel (AIGP) that addresses the application of AI in aircraft accident investigation. This provides an additional opportunity to contribute operational experience, practical lessons learned, and governance considerations arising from the development of controlled AI capabilities within an accident investigation environment.

AI-enabled investigation architecture

2.5 The AAIS conducts aircraft accident and incident investigations in accordance with established procedures, supported by specialized technical expertise and professional investigator judgement. The United Arab Emirates Accident Investigation Management System (UAE-AIMS) remains the authoritative software of record for investigation information, records, and approved investigation decisions. The roadmap is not intended to replace or supersede this environment; rather it introduces controlled AI environment to support investigators throughout the investigation process.

2.6 The proposed AI environment is structured around a four-layer architecture comprising: a data foundation, knowledge layer, agent layer, and human layer.

2.7 The target architecture also provides for sovereign or private hosting environments; segregation between public, internal and restricted investigation information; role-based and least-privilege access for AI agents; immutable audit records; and mechanisms to stop, control or roll back agent activity where necessary. Architecture and governance requirements are to be approved before individual investigation agents are introduced into operational use.

Roadmap objective

2.8 The strategic objective of the roadmap is to increase the use of AI in routine and non-judgemental investigation workflows, while ensuring that investigative judgement and formal decision-making remain the responsibility of authorized investigators. For the purpose of the roadmap, Agentic AI refers to AI systems capable of planning, executing, monitoring, and adapting multi-step workflows within defined boundaries and under human supervision.

2.9 Such systems may support a range of investigation activities such as occurrence notification processing, transcription and translation, evidence storage and retrieval, technical research, timeline development, drafting, data analysis and task tracking. Where uncertainty, inconsistency, incomplete information, other or limitations are identified, the AI agent shall flag the matter and escalate it to a qualified investigator for appropriate for human review and decision-making.

2.10 The roadmap adopts the concept of an "AI-native investigation authority", defined as an investigator-led, evidence-secure, and assurance-governed organization in which supervised AI agents perform approved workflows. The concept does not imply the replacement of investigators or the transfer of investigative authority to AI.

AI across the investigation lifecycle

2.11 The framework is designed to support investigators throughout the full investigation lifecycle while preserving human authority at all critical decision points. AI agents may assist with information processing, analysis, correlation, drafting, and workflow management; however, their outputs remain advisory and are subject to investigator review and validation.

2.12 AI will support occurrence registration and triage by extracting occurrence information, identifying missing data, and assisting with preliminary classification, investigation scope, and resource considerations. During evidence collection, factual development, validation, and correlation, AI will assist with site assessment, evidence organization, interview processing, the Flight Data Recorder (FDR)/Cockpit Voice Recorder (CVR) analysis, timeline generation, inconsistency detection, and events reconstruction. The investigators remain responsible for validating its reliability, resolving conflicts, and approving the final factual information.

2.13 AI will also help identify information gaps, retrieve relevant references, suggest further tests or analytical methods, organize evidence, identify relationships and patterns, and compare alternative hypotheses. For conclusions and safety recommendations, AI will support traceability, consistency checks, identification of safety issues, review of previous recommendations, trend analysis, and drafting. For knowledge management and organizational learning, AI will preserve structured investigation knowledge, retrieve lessons from previous occurrences, identify recurring safety themes, and support safety intelligence. Findings, causes, contributing factors, and safety recommendations remain formal determinations of the authorized investigators and will not be made by AI. Analytical reasoning, interpretation of evidence, and decisions on whether hypotheses are supported, modified, or eliminated also remain exclusively with human investigators.

Human oversight and governance

2.14 The roadmap applies a risk-based supervision model. Activities that may influence investigation outcomes are subject to human-in-the-loop control, whereby an authorized person reviews and approves the AI output or action before it takes effect. The level of oversight applied to each agent is proportionate to the potential impact of its functions.

2.15 Executive governance provides oversight of AI strategy, investment, portfolio priorities, organizational risk, and the deployment of higher-assurance capabilities. The relevant corporate-level AI governance function coordinates assurance activities, maintains oversight of approved AI systems, and supports the application of enterprise governance requirements.

2.16 The AAIS serves as the business and operational owner for the use of AI in investigation-related activities. It identifies operational requirements, determines and approves the intended application of AI within investigation workflows, assigns appropriate human oversight and supervision, and determines whether an approved AI capability may be used for a specific investigation. Relevant technical, cybersecurity, data governance, legal, and records management functions provide the required specialist reviews and clearances, while quality, risk, and audit functions provide independent assurance, as appropriate.

2.17 No AI agent may be placed into operational use unless it has been formally registered, classified, validated, authorized, and assigned an accountable human supervisor. The AI agent register shall maintain a complete record of each agent's approved purpose and scope, assurance level, authorized data sources and tools, access permissions, model and technology dependencies, hosting environment, validation and assurance evidence, known limitations, incidents, change history, and current authorization status.

3. CONCLUSION

3.1 The AAIS Agentic AI Transformation Roadmap 2026–2035 establishes a controlled, investigator-led framework for the integration of Agentic AI into aircraft accident and incident investigation. It brings together specialized investigation agents, a controlled AI architecture, human oversight, data protection, assurance, and traceability within a unified framework. The roadmap is intended to enable supervised AI agents to support routine, information processing, and non-judgemental investigation activities, including information processing, evidence correlation, technical analysis, and knowledge management throughout the investigation lifecycle, while preserving human authority over investigative judgement and decision-making.

3.2 Investigation authority remains with the AAIS and its authorized investigators. Findings, conclusions, causes and contributing factors, safety recommendations and Final Reports remain subject to human judgement, and approval. Governance, validation, cybersecurity, evidence protection, traceability, and the ability to suspend any AI capability are therefore treated as fundamental conditions for the responsible use of AI in investigation.

3.3 Through this approach, the AAIS seeks to leverage agentic AI to strengthen investigation efficiency, analytical capability, and organizational learning of aircraft accident and incident investigations, while preserving the fundamental principles of investigation ,independence, evidence integrity, accountability, and human authority that underpin investigation process.

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