



ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24: Aviation Safety and Air Navigation Priority Initiatives

**ACCELERATING ADVANCED AIR MOBILITY (AAM) INTEGRATION THROUGH A
HOLISTIC ROADMAP AND INNOVATION PLATFORMS IN SAUDI ARABIA**

(Presented by Saudi Arabia)

EXECUTIVE SUMMARY

This paper highlights Saudi Arabia's strategic efforts to advance Advanced Air Mobility (AAM) through a comprehensive roadmap and regulatory sandboxes, particularly the King Abdullah University of Science and Technology (KAUST) Smart Mobility Sandbox. The roadmap, structured around seven enablers and 24 initiatives, sets clear targets for starting AAM commercial operations by 2026 and local certification and manufacturing by 2032. KAUST supports these efforts by providing a testbed for validating technologies and supporting the progress of the development of the regulatory framework. Notably, its research lab (AANS Lab) is developing solutions for urban noise modeling and real-time microscale weather forecasting, both critical to safe AAM operations in complex environments.

The Assembly is invited to take note of this paper and encourage Member States to share experiences and adopt similar innovative platforms and frameworks to support global AAM development and harmonization.

<i>Strategic Goals:</i>	This working paper relates to the Strategic Goals: <i>Every Flight is Safe and Secure</i> ; and <i>Aviation Delivers Seamless, Accessible, and Reliable Mobility for All</i> .
<i>Financial implications:</i>	There are no financial implications
<i>References:</i>	Doc 10180, <i>Assembly Resolutions in Force (as of 7 October 2022)</i> Doc 10209, <i>Report of the Fourteenth Air Navigation Conference (AN-Conf/14)</i> Doc 9750, <i>Global Air Navigation Plan (GANP)</i> .

1. INTRODUCTION

1.1 The aviation sector is undergoing a paradigm shift driven by rapid advancements in automation, sustainable propulsion systems, and digital connectivity. Advanced Air Mobility (AAM) is at the forefront of this transformation, offering innovative solutions for urban, suburban, and regional transportation. It holds significant potential to enhance connectivity to remote areas, improve emergency response capabilities, and contribute to more sustainable and efficient logistics and passenger mobility.

1.2 In recognition of the increasing momentum of these technologies and their potential impact on global aviation, several States emphasized during the 41st session of the ICAO Assembly the urgent need for a harmonized international framework to guide the safe integration of AAM into the aviation ecosystem. In response, the ICAO Air Navigation Commission (ANC) established the Advanced Air Mobility Study Group (AAM SG), comprising experts from States and relevant international organizations. The group plays a critical role in assessing the evolving AAM ecosystem, identifying gaps in existing ICAO provisions, and recommending the regulatory, operational, and infrastructure advancements necessary to support scalable, safe, and globally interoperable AAM deployment.

1.3 Aligned with Vision 2030 and the ICAO's strategic plan 2026-2050, Saudi Arabia is actively enabling the AAM operations through a roadmap that includes key initiatives for regulatory development and collaborative innovation platforms. These efforts are grounded in practical experience, translated into multiple pilot projects to validate AAM technologies, including Electrical Vertical take-off and Landing (eVTOL) tests at NEOM, Unmanned Aircraft Systems (UAS) delivery trials during the Hajj season, and academic R&D on UAS control systems, helping to identify key challenges related to infrastructure, regulatory, and public acceptance. These insights have informed the development of both the roadmap and the setting of sandbox environments.

1.4 During the ICAO Assembly 41st Session, Saudi Arabia presented an information paper (A41-WP/513) outlining the implementation of the NEOM UTM system as a key enabler for AAM integration within a regional ecosystem. The paper highlighted the General Authority of Civil Aviation (GACA)'s phased and risk-based approach to regulatory development, emphasizing scalable operations, airspace safety, and data-driven performance standards. Drawing on the ICAO UTM framework and international best practices, it sets out initial certification, interoperability, and operational requirements to support the safe and efficient deployment of UAS and AAM systems.

1.5 Building on this momentum, Saudi Arabia is accelerating AAM integration through innovation platforms such as regulatory sandboxes. While NEOM supports early-stage validation, the KAUST Smart Mobility Sandbox offers a research-oriented, collaborative environment to test, certify, and shape future AAM operations. It serves as a living lab where regulators, academia, and industry work together to mitigate the emerging risks related to the new technologies and align regulatory development with operational realities and use cases.

1.6 These efforts exemplify how national-level planning, backed by real-world experimentation, can accelerate the safe integration of new entrants, emerging technologies while contributing to international regulatory frameworks, including the development of ICAO Standards and Recommended Practices (SARPs). The Saudi Arabia's approach also supports the broader goals of ICAO's High Priority Enablers on innovation, particularly in operationalizing innovation through structured, agile methodologies. As ICAO considers updates to Assembly Resolution A40-27 under Agenda Item 20 of this Assembly, Saudi Arabia's experience offers a practical model for facilitating innovation using coordinated roadmaps and sandbox frameworks that address all critical enablers.

2. DISCUSSION

2.1 The AAM Roadmap developed by GACA, provides a holistic framework to enable the AAM, and integrate its ecosystem into both the conventional aviation system and other modes of transportation. It is divided in seven key enablers: governance, technology and manufacturing, infrastructure, human capability, public acceptance, investment, and regulations. From this framework, 24 initiatives have been defined, each mapped to specific timelines and interdependencies to ensure coordinated implementation. The roadmap identifies five major cities or regions as early adopters, targeting

2026 for the launch of low- to medium-complexity operations. Strategic milestones include the establishment of a national training hub by 2028, the issuance of type certificates by 2030, and localized manufacturing under a Saudi Production Organization Approval (POA) by 2032.

2.2 While the roadmap provides strategic direction, the KAUST Smart Mobility Sandbox serves as an operational testbed to validate technologies and inform regulatory development. Located within segregate airspace and supported by world-class academic infrastructure, KAUST facilitates practical, use cases' experimentation in a low-risk environment. More than a traditional test site, it functions as a multi-modal innovation platform that supports the full lifecycle of AAM development, from proof-of-concept to operational validation. It is designed to accommodate both industry-led trials (e.g., vertiport development, weather simulation) and regulatory advancement activities, including UTM development and integration with eVTOL operations. To further accelerate progress, five dedicated projects have been proposed to advance technology readiness and enable the development of tailored regulatory frameworks for AAM implementation.

2.3 In 2024, KAUST's Communication Theory Lab received the ICAO Global AAM Academic Paper Competition award during the first ICAO AAM Symposium for their pioneering study, *"Urban Air Mobility Communications: Coverage Analysis and Corridor Design."* The research advances AAM communications by modelling line-of-sight connectivity in dense urban environments, accounting for factors such as building obstruction, network coverage gaps, and the use of non-terrestrial platforms, including high-altitude and tethered relay systems. It further proposes optimized corridor architectures to ensure reliable, low-latency connectivity, critical for the safe operation, navigation, and integration of eVTOL aircraft into urban airspace. The KAUST Sandbox offers an ideal environment to validate these findings, supporting the testing of deployment strategies such as integrating airborne and ground-based network nodes, measuring real-time Signal-in-Space performance across varied environments, and refining corridor designs under live operational conditions. By translating theoretical models into practical trials, KAUST strengthens the link between academic research and regulatory and infrastructure planning for AAM communications. The sandbox directly supports ICAO's call, under Assembly Resolution A40-27, to engage with industry, research institutions, and governmental actors in a manner that allows innovation to be assessed and adopted in a timely and globally harmonized manner.

2.4 Since the beginning of 2024, the Advanced Algorithm and Numerical Simulation Laboratory (AANS Lab) at KAUST has been working on two main AAM/UAM challenges: Noise and microscale prevailing weather conditions. A critical aspect of the successful deployment of effective and efficient adoption of UAM and AAM vehicles is intricately linked to the challenge of managing drone and aircraft noise, even for eVTOL. In particular, establishing vertiports in populated residential areas requires thorough analyses of noise propagation to mitigate the exposure, potential disruptions to local communities, and the surrounding environment. Despite recent advancements in aviation technology, noise pollution remains a significant concern in modern urban areas. The AANS Lab at KAUST is working on establishing a robust, fast, and accurate computational aeroacoustics framework to assist in designing and collocating UAM vertiport sites in complex urban environments and variable weather conditions to minimize and control the noise. Using cutting-edge technological computational techniques coupled with efficient and accessible computing hardware, the aeroacoustics framework will provide an accurate solution to the acoustic problem for the "near-field" regions (i.e., meters to hundreds of meters around the flying devices and sites) to the far field problem (i.e., kilometres scale). Vertiport manufacturers, ATS Providers, and city administrators can also use this dedicated design framework to cooperate in designing safe and non-invasive air routings for UAM vehicles in highly populated urban areas and inform UAM regulations.

2.5 The ability to assess weather conditions in localized urban environments (i.e., micro weather) on short time horizons (often referred to as "nowcasting") is critical because of its technical

complexity and its significant impact on the safety, reliability, and weather tolerance of UAM operations. UAM operations will take place at low altitudes where microscale turbulent wind conditions are common, and for which fast and accurate prediction tools are lacking. Therefore, the UAM design characteristics and the microscale winds in urban environments are a source of high operational safety risks, including trajectory deviations, control difficulties, rapid battery charge depletion, operational delays, and decreased passenger comfort. One of the main projects in the AANS Lab are designing and testing an efficient computational pipeline to provide real-time predictions of wind velocity and temperature in arbitrary spatial positions of the city by leveraging Artificial Intelligence (AI) and Scientific Machine Learning (Sci. ML), big data, real-time sensor sampling, and Computational Fluid Dynamics (CFD) tools. This project will provide a tool that flying vehicles can use to improve their self-driving systems, self-stabilization, and analogous apparatus. Urban comfort can also take advantage of fast wind velocity and temperature predictions, helping architects and engineers optimally design urban environments. Analogously, air quality forecasting can benefit engineers when they can access fast and accurate predictions of these two quantities. Within the next few months, the AANS Lab team will test the computational tools in a real scenario at KAUST using KAUST's real layout from a LiDAR measurement campaign and the data obtained from sensors installed at KAUST.

3. CONCLUSION

3.1 The Saudi Arabia's comprehensive approach to enabling Advanced Air Mobility, through the development of a roadmap and the establishment of regulatory sandboxes, demonstrates how strategic planning and innovation platforms can work in tandem to accelerate the safe and efficient integration of emerging aviation technologies and innovation. These efforts reflect a forward-leaning regulatory mindset that embraces data-driven experimentation, proactive stakeholder engagement, and capability-building to shape a resilient and globally harmonized AAM ecosystem.

3.2 By combining long-term vision with use cases validation, Saudi Arabia has established a scalable model that aligns with ICAO's strategic objectives and goals, including safety, air navigation efficiency, environmental protection, and economic development. The KAUST Smart Mobility Sandbox not only supports the testing of AAM systems but also enables the operationalization of advanced research, such as award-winning studies on communication coverage and corridor design, thereby bridging academic development and research with regulatory and infrastructure planning.

3.3 As ICAO continues to refine its innovation policy in aviation and updates to Assembly Resolution A40-27, the Saudi experience provides practical insights on how States can operationalize innovation through structured, inclusive, and adaptive frameworks. It underscores the value of regulatory foresight, international collaboration, and agile innovation platforms that facilitate the safe, timely, and equitable adoption of transformative aviation technologies across diverse operational contexts and environments.

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