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BRIDGING INNOVATION AND REGULATION: THE ROLE OF SANDBOX IN AAM DEVELOPMENT

(Presented by Indonesia)

EXECUTIVE SUMMARY

The rapid advancement of aviation technologies and the rising demand for sustainable transportation have accelerated the development of Unmanned Aircraft and Advanced Air Mobility (AAM) solutions. These innovations promise to ease congestion, reduce emissions, and expand mobility and logistics opportunities. However, their integration into existing airspace and urban ecosystems introduces challenges related to regulation, safety, infrastructure, airspace management, public acceptance, and environmental impacts.

To address these challenges, Indonesia initiated sandbox approaches as controlled environments for proof-of-concept and trial operations. Sandbox initiatives serve as practical platforms to:

a) generate operational data to inform evidence-based policymaking;
b) validate safety and regulatory frameworks;
c) enhance inter-agency and industry coordination;
d) foster public trust through transparency and community engagement; and
e) evaluate infrastructure and environmental impacts before large-scale deployment.

Strategic Goals:	This working paper relates to all Strategic Goals.
Financial implications:	N/A
References:	Annex 6 – *Aircraft Operations*, Part IV – *International Operations – Remotely Piloted Aircraft Systems* Annex 19 – *Safety Management* Doc 9859, *Safety Management Manual (SMM)* Doc 10019, *Manual on Remotely Piloted Aircraft Systems (RPAS)* Doc 10209, *Report of the Fourteenth Air Navigation Conference*

1. INTRODUCTION

1.1 The growing demand for sustainable and efficient transportation, coupled with rapid advances in aviation technologies, has driven the emergence of Unmanned Aircraft and Advanced Air Mobility (AAM) solutions. These innovations are expected to reshape the way people and goods are transported, offering promising benefits such as alleviating traffic congestion, reducing emissions, and creating new frontiers for both passenger mobility and logistics services.

1.2 Despite their potential, the integration of AAM, drones, and other new entrants into existing airspace and urban ecosystems raises a series of challenges. Among them are regulatory preparedness, operational safety, infrastructure readiness, public trust, airspace management, and environmental concerns. Overcoming these requires not only robust regulations and strong institutional commitment, but also innovative approaches such as sandbox frameworks, where stakeholders including regulators, government agencies, industry, academia, and communities, can collaborate to test, refine, and implement new solutions in a safe and controlled environment.

2. DISCUSSION

2.1 The applications of AAM and drone technologies are expanding rapidly, covering areas such as e-commerce deliveries, emergency response, disaster relief, medical supply distribution, environmental monitoring, and urban passenger mobility. While these applications unlock significant opportunities, they also demand new governance structures and operational safeguards to ensure safe, reliable, and sustainable integration into national and regional airspace

2.2 Based on our identification, the key considerations for managing these innovations include:

a) Regulatory frameworks

1) Clear and harmonized rules are necessary to set safety standards, define operator qualifications, aircraft certification, liability arrangements, and operational limits. Sandbox initiatives can support regulators by generating real-world data that inform evidence-based policymaking, reducing uncertainty, and avoiding fragmented approaches among States.

b) Safety and airspace management

1) The safe coexistence of unmanned and manned aviation requires robust mechanisms for collision avoidance, airspace deconfliction, and interoperability of traffic management systems. Sandbox trials can help simulate real operational conditions, providing insights to refine air traffic management concepts before large-scale deployment.

c) Infrastructure development

1) Future operations will require purpose-built infrastructure, including vertiports, charging stations, landing zones, and operations centers. Sandbox environments

provide opportunities to test and evaluate infrastructure designs under controlled conditions, ensuring scalability and resilience.

d) Public acceptance and privacy

1) Building public trust is critical to widespread adoption. Sandbox operations allow communities to observe, understand, and provide feedback on AAM and drone operations, helping address concerns over noise, safety, and privacy. This participatory approach contributes to stronger public acceptance.

e) Environmental considerations

1) AAM and drones may reduce emissions through electric propulsion, but lifecycle and operational impacts must be continuously evaluated. Sandbox activities can serve as test beds for measuring and mitigating environmental footprints, including noise levels and energy efficiency

2.3 Recent international forums, have emphasized the importance of involving innovators and regulators in joint processes, particularly encourages closer engagement between States and industry to identify hazards, manage risks, and safely integrate emerging aviation technologies such as AAM. Sandbox mechanisms align well with this recommendation, as they provide structured spaces for innovation, risk assessment, and regulatory adaptation

2.4 Indonesia, building on its trial activities conducted between 2019 and 2025, is now developing a dedicated sandbox area for AAM and drone operations. The sandbox will function as a living laboratory where proof-of-concept and pilot projects can be executed under controlled conditions. It is expected to generate critical data for refining operational concepts, validating safety frameworks, and informing the drafting of national regulations.

2.5 In addition to technical testing, the Indonesian sandbox is designed to enhance multi-stakeholder coordination, providing a platform where regulators, industry players, academia, and local communities can jointly address operational, regulatory, and societal challenges. This inclusive approach aims to bridge gaps that have previously caused inconsistencies, miscommunication, and delays in trial activities.

2.6 The establishment of a sandbox underscores the urgent need for a comprehensive and regionally harmonized regulatory framework. By combining lessons learned from sandbox activities with international best practices, States in the region can create a regulatory environment that encourages innovation while safeguarding safety and sustainability.

2.7 The meeting is invited to note the information presented in this paper, particularly the establishment of sandbox initiatives to facilitate safe innovation.

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