International Civil Aviation Organization

WORKING PAPER

A42-WP/678
EX/294
12/9/25
(Information paper)
English only

ASSEMBLY — 42ND SESSION

EXECUTIVE COMMITTEE

Agenda Item 20: Innovation in Aviation

THE ICAO–IFAR PARTNERSHIP: ENABLING FUTURE INNOVATION AND REGULATION IN AVIATION

(Presented by International Forum for Aviation Research)

EXECUTIVE SUMMARY

The ICAO–IFAR partnership is a strategic response to the challenges and opportunities presented by rapid innovation in aviation. By fostering independent scientific assessment, bridging research and regulation, and strengthening global cooperation, the partnership enables the safe, sustainable, and timely integration of new technologies. Its work not only enhances coordination among research institutions but also ensures that regulatory processes remain robust, agile, and fit for purpose in an era of continuous transformation.

Strategic Objectives:	This working paper relates to *Every Flight is Safe and Secure.*
Financial implications:	
References:	Scientific Assessment for Urban Air Mobility (UAM), IFAR, March 2023, Montréal IFAR Press release DLR Press release: Leading research institutions hand over scientific assessment on urban air mobility

1. INTRODUCTION

1.1 The aviation sector is undergoing unprecedented transformation, driven by rapid technological advancements and the global commitment to achieve aviation net-zero carbon emission under the 2050 Long-Term Aspirational Goal (LTAG). In this context, the partnership between the International Civil Aviation Organization (ICAO) and the International Forum for Aviation Research (IFAR) serves as a cornerstone for guiding innovation and ensuring that regulatory frameworks evolve in step with new technologies. This paper describes the ICAO - IFAR partnership, identifies the needs it addresses, and outlines its contribution to integration of emerging technologies in support of a more coherent and adaptive regulatory process.

2. BACKGROUND AND IDENTIFIED NEEDS

2.1 ICAO is a United Nations agency that supports cooperation among 193 Member States to enable the safe and efficient use of global airspace. It is responsible for setting international standards and regulations in the areas of civil aviation safety, security, efficiency, and environmental protection.

2.2 IFAR, is the world's only network of publicly-funded aviation research establishments. Founded in 2010, IFAR operates on a voluntary, non-binding basis to facilitate collaboration and consensus-building on key scientific and technical issues in aviation.

2.3 The ICAO - IFAR partnership was formalized through a Memorandum of Understanding (MoU) signed in April 2022. The MoU commits both organizations to enhanced cooperation and information sharing, with a focus on fostering innovation and promoting sustainable development in international civil aviation, while maintaining strong emphasis on safety, security, and environmental sustainability.

2.4 The ICAO - IFAR partnership is driven by several key factors that aim to address the evolving challenges and opportunities in the global aviation sector:

a) The aviation industry is experiencing an unprecedented influx of new participants and technologies, such as urban air mobility, autonomous aircraft, Artificial Intelligence (AI), renewable propulsion, and digitalization. This rapid evolution underscores the crucial need for an impartial, science-based evaluation of these innovations to ensure alignment with public interest and global safety and sustainability objectives. In this context, IFAR emerges as an independent body capable of providing such evaluations and offering independent recommendations guided by scientific evidence, free from industry influence.

b) Regulatory bodies frequently encounter difficulties in keeping up with the swift and intricate pace of technological advancements. The collaboration between ICAO and IFAR helps bridge this gap by connecting cutting-edge research outcomes with the regulatory process, thereby enabling assessment, validation, and integration of new technologies.

c) One key value proposition IFAR offers to ICAO is the so-called 'Technology watch'. With approximately 40k researchers in 27 countries worldwide, IFAR offers a

technology foresight for global regulators on what is to come in the future. It is briefly indicated in 3.1 & 3.2 and demonstrated in the case study in section 4.1.

d) Given the global reach of aviation innovations, harmonized approaches to standards and regulatory practices are essential. The ICAO - IFAR partnership strengthens international dialogue, fosters consensus-building, and promotes the exchange of best practices among research institutions, further emphasizing the significance of IFAR's independent, science-driven recommendations.

3. PARTNERSHIP KEY BENEFITS

3.1 As the aviation sector advances not only technologically but also in addressing social and environmental challenges, the ICAO–IFAR partnership is structured around three key pillars to maximize its global impact:

a) Fostering Independent Scientific Assessment: Emerging technologies, from Advanced Air Mobility (AAM) to Sustainable Aviation Fuels (SAF), demand rigorous and impartial scientific evaluation. Such assessments transcend national interests, ensuring that innovations are vetted based on merit and safety rather than market dominance. By promoting international cooperation among researchers, and regulators, aviation can cultivate a global ecosystem of trust, accountability, and excellence.

b) Aligning innovation and regulation: The development of international Standards and Recommended Practices (SARPs), led by ICAO, harmonizes operations across borders. These frameworks enable seamless coordination between countries, improve safety outcomes, and support equitable access to air transport services. In an era of rapidly evolving technologies, closer coordination between research and regulators is essential to maintain dynamic and adaptive SARPs, ensuring enhancing global agility and resilience.

3.2 This partnership aims to bridge the gap between cutting-edge research and the regulatory development, ensuring that new technologies are effectively assessed, validated, and integrated. It provides a critical platform for empowering regulators through the strategic dissemination of research findings. By pooling expertise and exchanging valuable lessons learned, the partners build the technical capacity needed to develop new technologies and sustain a more informed and adaptive regulatory environment.

3.3 Preparing for future

3.3.1 Specialized IFAR expert groups review and assess cutting-edge innovations, like urban air mobility and artificial intelligence in aviation, playing a crucial role by providing scientific consensus and technical guidance to ICAO. These scientific assessments can directly contribute to the formulation of international standards and regulatory frameworks that govern the sector’s safe and sustainable evolution.

3.4 Accelerating the Adoption of New Technologies

3.4.1 By engaging the global research community early in the regulatory process, the partnership fosters a proactive approach to identifying technical challenges and opportunities, thereby accelerating the time-to-market for promising innovations. IFAR's scientific assessments can provide ICAO with insight into the maturity and impact of emerging technologies, such as UAVs and autonomous systems, supporting the development of forward-thinking international standards that facilitate safe and sustainable progress.

3.5 Supporting Sustainable Development

3.5.1 Through a shared commitment to sustainability, the partnership actively ensures that innovation in aviation reinforces the sector's vital role as a driver of global sustainable development. Key focus areas include reducing emissions, improving energy efficiency, and promoting the adoption of digitalization. By disseminating research findings and fostering knowledge exchange, ICAO and IFAR strengthen the technical expertise required for effective regulatory oversight, thereby supporting the safe and responsible integration of new technologies worldwide.

4. CASE STUDIES AND EARLY OUTCOMES

4.1 Urban Air Mobility (UAM)

4.1.1 The first joint action under the ICAO–IFAR partnership was focused on Urban Air Mobility (UAM). Working collaboratively, IFAR and ICAO have undertaken an in-depth scientific assessment of UAM, examining its technical, economic, and societal dimensions. The assessment began with a study of the industry landscape, including an overview of existing market studies, proposed aircraft designs and concepts, and potential pathways for industry evolution. The subsequent Scientific Assessment, developed through joint efforts from IFAR domain experts, captured 17 focus areas relevant to UAM that presented opportunities for further research. These evaluations produced key recommendations concerning infrastructure needs (including vertiports and weather sensing), safety protocols, and data requirements (including domains such as cybersecurity, emissions and safety). IFAR officially delivered the Scientific Assessment for UAM to ICAO in March 2023, during a special session of the ICAO Council held in Montréal. The findings of the IFAR Scientific Assessment contribute to ICAO's ongoing efforts in developing international guidance and standards to ensure the secure and efficient integration of UAM technologies into global airspace systems.

4.2 Artificial Intelligence in Aviation

4.2.1 The second joint action focuses on the theme of "Certification by Analysis", which follows the initial phase on digitalization of certification processes. This initiative is part of a multi-year roadmap agreed upon by both organizations:

a) Phase 1 (2 years): Application of digital tools to improve and accelerate certification processes

b) Phase 2 (3 years): Development of a comprehensive roadmap for Certification by Analysis

4.2.2 In Phase 1, IFAR's contributions will center on fostering a shared understanding of technical challenges and opportunities across its member organizations, with the following key objectives:

a) Conduct a comprehensive assessment of existing methodologies for generating safety cases, identifying inefficiencies that digitalization can address

b) Identify digital tools that facilitate automation and enhance tracking within certification workflows

c) Provide recommendations to simplify and optimize procedures, promoting process uniformity. These recommendations aim to reduce redundancies in specification, verification, and justification, ultimately enable a more systematic, repeatable, and streamlined evaluation process by regulatory authorities.

4.2.3 In Phase 2, IFAR will support ICAO by:

a) Defining the scientific and technical foundations for certification based on analytical methods rather than traditional testing

b) Exploring model-based systems engineering (MBSE), simulation, and data-driven approaches

c) Identifying regulatory gaps and proposing frameworks to integrate analysis-based certification into global aviation standards

4.2.4 Phase 1 commenced in January 2025, reflecting the ICAO - IFAR shared commitment to modernizing aviation oversight in response to emerging technologies.

— END —