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Regulating Air Taxis in the UAE "A Legal and Comparative Analysis"

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Abstract:

Air taxi, including UAM, represents a revolutionary shift in urban transportation, integrating electric vertical take-off and landing (eVTOL) technologies for passenger, cargo, and mail transit. This study focuses on the regulatory framework for air taxis operational requirements in the UAE, emphasizing the General Civil Aviation Authority's (GCAA) advancements in implementing policies such as CAR-UAM, CAR-AutoUAS, and CAR-HVD. These frameworks address key operational areas, including Certification of the Operators, Registration and Airworthiness, Pilot licensing Safety regulation, Air Navigation services regulations, and Vertiport Regulations In spite of these efforts, challenges remain, particularly in the pilots licensing and the safety of such operations.

The study highlights essential deficiencies in UAE regulations compared to global standards set by the Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA). The study also evaluates the sufficiency of existing frameworks to meet operational and safety challenges posed by air taxis, especially within low-altitude urban airspace.

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Using a qualitative methodology, the study reviews academic literature and regulatory frameworks to offer a comprehensive understanding of UAM's legal landscape. Recommendations are provided for refining the UAE's air taxi regulations to enhance safety, and efficiency, aligning with international best practices and ensuring the successful incorporation of air taxis into urban environments.

Keywords: Urban Air Mobility (UAM), Air Taxi, Electric Vertical Take-Off and Landing aircraft, Vertiports

INTRODUCTION

For decades, visualizing the future of smart cities was associated with seeing cars flying all over the skies, it was representation of the urban and technological development, since the early stages of 1900 the concept was introduced by inventors(1) Once considered science fiction, air taxis are now becoming a reality. Dubai is expected to launch air taxi services by 2026.(2)

In 2017, Dubai's Roads and Transport Authority (RTA) announced the preparation launch of an innovative air transport initiative featuring air taxis, however, it has not been officially operated until all safety and security requirements related to the operation of this type of vehicle are fulfilled.(3) Moreover, recently the UAE, precisely Dubai witnessed an agreement between Dubai's Road and Transport Authority (RTA) and Joby, with the intention of launching air taxi services by 2026, in addition, construct and manage four initial vertiport locations throughout Dubai (4) which aligns seamlessly with the UAE's vision to promote innovation

(1) Adam P Cohen, Susan A Shaheen, and Emily M Farrar, 'Urban Air Mobility: History, Ecosystem, Market Potential, and Challenges' (2021) 22 *IEEE Transactions on Intelligent Transportation Systems* 6074 Cohen A, Shaheen SA and Farrar E, 'Urban Air Mobility: History, Ecosystem, Market Potential, and Challenges' (2021) https://www.researchgate.net/publication/352144346_Urban_Air_Mobility_History_Ecosystem_Market_Potential_and_Challenges accessed 24 October 2024.

(2) Joby Aviation, 'Joby to Launch Air Taxi Service in UAE' (Joby Aviation, 11 February 2024) https://www.jobyaviation.com/news/joby-to-launch-air-taxi-service-uae/ accessed 24 October 2024.

(3) Shooq Houssien Shwaiky and Mahmoud Ibrahim Fayyad, 'The Civil Liability for Flying Taxi Accidents in Dubai: A Prospective Study' (2020) 17(2) University of Sharjah Journal of Legal Sciences 297-338

(4) Chuck Martin, 'Flying Taxi Deal Signed for Dubai as Mideast Takes the Lead' (IoT World Today, 12 February 2024) https://www.iotworldtoday.com/flying-vehicles/flying-taxi-deal-signed-for-dubai-as-mideast-takes-the-lead- accessed 18 November 2024.

in technology and air transportation through the developing and utilizing autonomous mobility solutions in smart cities.(1) Achieving this vision demands implementing a an integrated regulatory of Air taxi in which the UAE has accomplished remarkable progress in this sector by its General Civil Aviation Authority GCAA formulating regulations and guidelines for Urban Air Mobility (UAM) and air taxi operations.

Air taxi services are expected to operate with eVTOL Electric Vertical Take-Off and Landing aircraft, which will provide less travel time, faster transportation, minimal noise notice, operate with zero emissions, sustainable alternative, electrical clean-energy mobility option.(2)

The air taxi by Joby is engineered to accommodate a pilot and four passengers, reaching speeds of up to 200 mph (320 kph). For instance, this capability allows it to travel from DXB to Palm Jumeirah in only 10 minutes, as opposed to the 45 minutes required by road.(3) The agreement covers all the fundamental components needed to launch air taxi services successfully, including designated operational route, vertiport infrastructure supported by specialized partners.(4)

(1) UAE Ministry of Cabinet Affairs, 'UAE National Innovation Strategy' (Prime Minister's Office, 2015) https://uaecabinet.ae/en/the-national-strategy-for-innovation accessed 18 November 2024.

(2) Yang Liu, Cheng Lyu, Fan Bai, Omkar Parishwad, and Ying Li, 'The Role of Intelligent Technology in the Development of Urban Air Mobility Systems: A Technical Perspective' (2024) 4 *Fundamental Research* 1017, 1023 https://doi.org/10.1016/j.fmre.2023.08.006 accessed 20 October 2024

(3) Joby Signs Contracts for First UAE Vertiports' (Times Aerospace, 2024) https://www.timesaerospace.aero/features/air-transport/joby-signs-contracts-for-first-uae-vertiports accessed 24 October 2024.

(4) 'Al Bayan, "Joby Aviation Signs Agreement to Launch Air Taxi Service in the UAE" (Al Bayan, 11 February 2024) https://www.albayan.ae/economy/uae/2024-02-11-1.4817248 accessed 24 October 2024.

THE PROBLEM OF THE STUDY

The study's problem lies in the uncertainty surrounding the effectiveness of the UAE's regulatory framework for air taxi operations. It is unclear whether key aspects such as operator certification, licensing for onboard and remote pilots, airworthiness standards for autonomous air taxis, vertiport regulations, and safety requirements have been adequately regulated. Given the limited literature and the minimal attention academically which is dissimilar to previous studies which broadly study Urban Air Mobility (UAM) or advanced air mobility (AAM) and most of these studies have focused on air taxis primarily from a technical perspective, ambiguity persists regarding whether the existing regulations are sufficient or require further refinement.

THE OBJECTIVES OF THE STUDY

The article aims to provide a comprehensive understanding of air taxi, evaluate and assess the UAE's current regulatory framework for air taxis, including operator certification, pilot licensing, airworthiness standards, vertiport regulations safety regulation, and air navigation services, focusing on its alignment with global best practices and its ability to address unique challenges, such as low-altitude urban airspace management.

Moreover, the article focuses on comparing the UAE's regulations with those of EASA and FAA to assess their adequacy and alignment with global standards.

Finally, by critically analyzing the existing regulatory framework and identifying its gaps, the author will propose recommendations for refining the regulatory framework to support the safe and efficient integration of air

taxis into the UAE's aviation framework.

RESEARCH QUESTIONS

- Are the current UAE regulations for air taxis sufficient to address the operational and safety challenges of air taxi?
- Is the UAE's framework aligning with global best practices and addressing the unique regulatory challenges posed by air taxis or at least conforming to the safety standards established within the existing civil aviation safety framework?
- How do the UAE's key regulatory measures compare to those established by EASA and FAA?
- What regulations within the UAE's framework for air taxis require amendments or additions to address current gaps and ensure comprehensive oversight?

THE IMPORTANCE OF THE STUDY

This study is indispensable, as it provides actionable recommendations for improving regulatory frameworks in case of deficiency in the frameworks of operator certification, pilot licensing, airworthiness standards, and vertiport regulations.

In addition, the study provides a conceptual framework for understanding air taxis within the broader context of Urban Air Mobility (UAM). It includes clear definitions of air taxis and UAM, offering a foundational understanding of this emerging sector.

Moreover, the originality of the study lies in addressing the critical gap by examining the regulatory framework for air taxis in the UAE by

comparing it to other jurisdictions.

Furthermore, the research will provide a more robust resource for policymakers, aviation regulators, and legal scholars in addressing the complexities of air taxi regulations, since introducing a new mode of transportation such air taxi, creates a considerable challenge for regulatory authorities, due to the complex and unique characteristics of air taxis particularly they're intended to operation within low-altitude airspaces.

METHODOLOGY

This research employs a qualitative methodology, primarily utilizing literature review and comparative analysis, which is particularly to examine the regulatory challenges and frameworks surrounding air taxi operations in the UAE. This approach is ideal for gaining in-depth insights into the unique characteristics of air taxis and their regulatory implications, particularly in the context of Urban Air Mobility (UAM). The study begins with an extensive review of literature, including academic articles, industry reports, and international regulatory frameworks regarding air taxi, to identify key issues, gaps, and trends in the regulation of air taxis.

Emphasize a literature review and comparative legal analysis, instead of adopting a mixed-method approach that includes such as legal professional's perspectives or industry expert opinions, is intentional for several reasons:

- The primary objective of the research is to evaluate and assess the UAE's current regulatory framework governing air taxis, legal studies traditionally rely on doctrinal research methods, which prioritize the analysis of legal documents and policies, which guarantees that the research remains grounded in authoritative

sources, and adheres to established legal research methodologies.

- Comparative legal analysis facilitates an objective evaluation of different regulatory frameworks (UAE, EASA, FAA) using standardized legal criteria, such as operator certification, pilots licensing, airworthiness standards, and vertiport regulations while legal professional's perspectives or industry expert opinions may offer subjective insights, they could introduce variability and potential biases that might reduce from the consistency of the legal analysis.

- Given that air taxi operations are still in developmental stages globally and it's not operated yet in the UAE, there is limited practical experience and regulatory precedent to utilize which makes the availability of relevant, knowledgeable experts relatively limited, and the data they could provide may be speculative rather than based on established regulatory practice.

- The core of the study involves comparing statutory and regulatory provisions, which are publicly accessible and standardized across jurisdictions. These documents provide a sufficient basis for assessing legal adequacy without the need for additional empirical data.

- Conducting surveys, and interviews with experts and legal professionals demands significant time, and logistical coordination, and often necessitates ethical approval and approval from the aviation authority like the GCAA. Furthermore gaining access to key stakeholders like aviation lawmakers, legal professionals, or industry insiders can be challenging especially within a limited

timeframe, given that this research is being conducted as part of a graduate-level academic program, the time available for extensive fieldwork is restricted, balancing academic deadlines with the complexities of primary data collection is impractical, additionally, resource limitations, including access to specialized databases, funding for travel, or networking opportunities, further constrain the feasibility of a mixed-method approach. Additionally, the author was constrained by a maximum word limit of 9,000 words for the article, necessitating a focused and concise approach to the research.

The research also incorporates some comparative analysis of the UAE's regulatory framework with those established by international aviation authorities, such as EASA and FAA. This comparative element contextualizes the UAE's regulations within the broader global landscape, offering a nuanced understanding of its alignment with international best practices.

Selecting the FAA and EASA as comparative jurisdictions based on the following key factors:

- According to Air Taxi Readiness Index 2024, which is evaluating the readiness of the 60 countries to adopt and operate air taxi, and the ranking based on five critical factors; Consumer Acceptance, Infrastructure, Policy & Legislation, Technology & Innovation, Business Opportunity the United States, through the FAA, is ranked first globally in Air Taxi Readiness as presented in Figure 1.(1)
- The availability of easily accessible legal resources through the

(1) KPMG, *Air Taxi Readiness Index 2024* (KPMG 2024) https://assets.kpmg.com/content/dam/kpmg/ae/pdf-2024/10/air-taxi-readiness-index-2024.pdf accessed 11 February 2025

official online websites of the FAA and EASA simplifies the process of obtaining accurate, updated information. It is worth noting that China ranked second in Air Taxi Readiness Index 2024; however, it was not selected for comparison due to language barriers and limited accessibility to regulatory information on official websites.

- The UAE aims to position itself as a leader in advanced air mobility, moreover, UAE conducted a feasibility evaluation, by reviewing and conducting and gap analysis on international standards such as ICAO Annex 14, FAA Engineering Brief No. 105 on vertiport design(1) and EASA Prototype technical design specifications for vertiports(2) this effort led to the first national regulation on vertiports, its set to certify and oversee vertiports, comparing its regulations with those of the FAA and EASA, This alignment is a key reason for selecting the FAA and EASA as comparative jurisdictions in this research and since the UAE's regulatory framework has been shaped by both FAA and EASA standards, comparing its regulations with those of the FAA and EASA is essential for ensuring that the UAE's framework remains competitive and aligned with international standards.

- FAA and EASA represent two different regulatory environments the FAA operates under a federal system, while EASA manages across multiple EU member states with varying legal systems, which offers

(1) FAA, Engineering Brief No. 105: Vertiport Design (FAA, 2022) https://www.faa.gov/airports/engineering/engineering_briefs/engineering_brief_105_vertiport_design accessed 23 December 2024

(2) EASA , Prototype Technical Design Specifications for Vertiports (EASA, 2022) https://www.easa.europa.eu/en/document-library/general-publications/prototype-technical-design-specifications-vertiports accessed 23 December 2024.

diverse regulatory approaches to compare with.

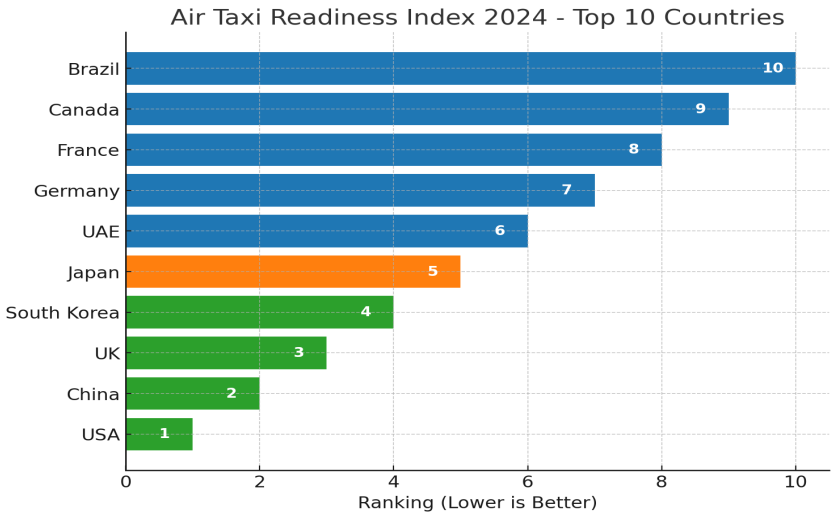

Figure 1: Air Taxi Readiness Index 2024 - UAE's Global Ranking in Air Taxi Preparedness (Source: KPMG, 2024).

RESEARCH COMPONENTS

CONCEPT OF AIR TAXI WITHIN URBAN AIR MOBILITY (UAM)

1.1. Urban Air Mobility definition

1.2. Air taxi definition

THE REGULATIONS OF AIR TAXI OPERATIONAL REQUIREMENTS

2.1 Certification and Airworthiness Requirements.

2.2 Pilot Licensing

2.3 Safety and Navigation Regulations

THE CONCEPT OF AIR TAXI WITHIN URBAN AIR MOBILITY

Urban Air Mobility (UAM) stands as a revolutionary concept, signifies the assimilation of unconventional aviation technologies into urban environments, to introduce a new transportation alternative, and endeavors to elevate and revolutionize the transportation experience. Nonetheless, it's not just another mode of transportation, notwithstanding that it transports passengers, cargo, and mail it also has its own unique characteristics, the use of electric vertical take-off and landing eVTOL, flying in the urban airspace, may contribute to environmental sustainability.(1)

Emerged aviation technologies introduce several of concepts related to Urban Air Mobility (UAM)(2) including air taxi, recognizing, and

(1) UIC2 – UAM Initiative Cities Community, *Urban Air Mobility and Sustainable Urban Mobility Planning – Practitioner Briefing* (EU's Smart Cities Marketplace, December 2021) https://urban-mobility-observatory.transport.ec.europa.eu/system/files/2023-11/urban_air_mobility_and_sump.pdf accessed 7 October 2024

(2) Anna Straubinger and others, *'Will Urban Air Mobility Fly? The Efficiency and Distributional Impacts of UAM in Different Urban Spatial Structures'* (2021) 127 *Transportation Research Part C* 103124 https://doi.org/10.1016/j.trc.2021.103124 accessed 21 September

understanding the Urban Air Mobility (UAM) concept is critical to have a comprehensive perspective on air taxis. Accordingly, understanding the conceptual framework of Urban Air Mobility (UAM) and Air taxi is extremely beneficial to understand the scope, legal framework, and key components of air taxi.

It bears mentioning that the main regulations in UAE concerning air taxi is the CAR-UAM Urban Air Mobility Operations(1) and CAR-AutoUAS Passenger-Carrying Autonomous Unmanned Aircraft System (UAS) Experimental Operations(2) and Civil Aviation Regulations (CAR-HVD) - Onshore (Heliports-Vertiports) (3) issued by General Civil Aviation Authority, Notably it did not explicitly refer to 'air taxi' and instead focused on Urban Air Mobility (UAM), this approach may reflect the prioritization of constructing a flexible regulatory framework can encompass and to adapt multiple variations of autonomous and manned aerial services aligned with advancements in aviation technology within urban environments. With a focus on UAM, GCAA drafting regulatory policies to adjust, not only passenger transportation in urban environments, but also to mail, and cargo transport which future models and operational use cases may evolve beyond the "air taxi" concept.

Defining Urban Air Mobility (UAM) is fundamental even if research about air taxi, because as mentioned earlier that air taxi is categorized within the broader framework of Urban Air Mobility (UAM) and to get a clear

(1) General Civil Aviation Authority, *CAR-UAM: Urban Air Mobility Operations* (Issue 1, 2021)

(2) General Civil Aviation Authority, *CAR-AutoUAS: Passenger-Carrying Autonomous Unmanned Aerial System (UAS) Experimental Operations – Issue 01* (1 October 2018)

(3) Civil Aviation Regulations (CAR-HVD) - Onshore (Heliports-Vertiports) and Offshore (Helidecks) - Issue 01, March 2023 (UAE General Civil Aviation Authority).

understanding we need to define it in detail. It is noteworthy that the term UAM was invented by Airbus in 2016 In the early stages then the concept was developed National Aeronautics and Space Administration (NASA) and outlined the UAM for transporting within the urban environments the passengers and cargo.(1)

1.1. Urban Air Mobility definition

General Civil Aviation Authority (GCAA) in UAE defines Urban Air Mobility (UAM) Operation: "An Urban Air Mobility Operation includes: A) Flights operating primarily in close proximity of populated urban areas, for the carriage by air of passengers, freight or mail, or any combination thereof for remuneration; and B) Where the aircraft used is an UAMV, which may be operated with pilot on-board, remotely piloted or with various degrees of autonomy".(2)

Furthermore, other bodies defined UAM, including , the European Union Aviation Safety Agency (EASA) defines urban air mobility (UAM) " as an air transportation system for passengers and cargo in and around urban environments" (3) also "urban air mobility (UAM) is a new air transportation system for passengers and cargo in and around densely populated and built-up environments, made possible by vertical take-off and landing electric aircraft (eVTOL) equipped with new technologies,

(1) Yuran Shi, 'Aviation Safety for Urban Air Mobility: Pilot Licensing and Fatigue Management' (2024) 110 *Journal of Intelligent & Robotic Systems* 35 https://doi.org/10.1007/s10846-024-02070-x accessed 14 October 2024.

(2) General Civil Aviation Authority (GCAA), *CAR-UAM: Urban Air Mobility Operations* (Issue 1, 2021)

(3) European Union Aviation Safety Agency, Study on the Societal Acceptance of Urban Air Mobility in Europe (EASA, 2021). https://www.easa.europa.eu/en/full-report-study-societal-acceptance-urban-air-mobility-europe 7 October 2024.

such as enhanced battery technologies and electric propulsion. These aircraft will have a pilot on board or be remotely piloted".(1)

Another definition by the Federal Aviation Administration (FAA); "Urban air mobility (UAM) enables highly automated, cooperative, passenger or cargo-carrying air transportation services in and around urban areas"(2)correspondingly this definition is "UAM is safe and efficient air traffic operations in a metropolitan area for manned aircraft and unmanned aircraft systems" is by National Aeronautics and Space Administration (NASA).(3) All the above definitions are roughly equivalent to the GCAA's definition, however, FAA and NASA's definitions are not specify about the UAM vehicle type, unlike EASA(4) and GCAA.

The General Civil Aviation Authority's (GCAA), definition of the UAM, delivers a comprehensive well-defined framework for the operations of UAM, and also outlines operational environment, according to the definition UAM operations will take place near the urban areas, in other words heavily populated city areas which reflects the core concept of UAM, aiming to relieve traffic congestion through the utilizing of low-altitude airspace above urban areas.

(1) European Union Aviation Safety Agency, 'Urban Air Mobility: FAQs' (EASA, 2021) https://www.easa.europa.eu/sites/default/files/dfu/uam_-_faqs.pdf accessed 7 October 2024.

(2) Federal Aviation Administration, Urban Air Mobility (UAM) Version 2.0: Concept of Operations (FAA Office of NextGen, 26 April 2023).

(3) David P Thipphavong and others, 'Urban Air Mobility Airspace Integration Concepts and Considerations' (2021) presented at the AIAA Aviation 2021 Forum, National Aeronautics and Space Administration (NASA). https://ntrs.nasa.gov/citations/20180005218 accessed 14 October 2024.

(4) D.S. Nithya, Giuseppe Quaranta, Vincenzo Muscarello, and Man Liang, 'Review of Wind Flow Modelling in Urban Environments to Support the Development of Urban Air Mobility' (2024) 8 *Drones* 147 https://doi.org/10.3390/drones8040147 accessed 14 October

The definition does not specify that Urban Air Mobility (UAM) operations are strictly limited to within state borders. This raises the question of whether air taxis could potentially cross UAE borders to transport passengers to neighboring states. Moreover, the definition determines the subjects of the Urban air mobility, "passengers, freight or mail, or any combination" in other words, what the UAM will move throw the urban areas.

Also determines the UAM Operation type, the UAM operations can take place with the pilot on board or remotely piloted, -similar to Dron's operations -or various degrees of autonomy, which means it could be with pilotless features but still requires human oversight or control or could have human involvement with the ability to Carry out some tasks autonomously.

1.2. Air taxi Definition

Respecting the UAM definitions presented earlier, even though the Air taxi falls within the scope of UAM, there remains a need to formulate a definition for air taxi, in the absence of a universally accepted definition. "A passenger aircraft, vehicle or drone which is intended to operate without a pilot on board, or a passenger transport aircraft system, including the associated elements for an operation without a pilot on board, or a remotely piloted passenger transport aircraft system, including all the elements as may be required for all phases of flight operation, where the pilot is not on board the aircraft, such as an urban air mobility aircraft. In case the flight operation of this drone type of highly automated passenger aircraft is fully autonomous, no pilot intervention in the management of the flight is to be considered. In other words, the ancient description of (autonomous) pilotless aircraft suffices"(1)

(1) Ronald Schnittker, Dick Van Het, Drone law and policy: integration into the legal order of

The previous definition was suggested as a potential definition for drones in case if they will transport passengers in the future, the authors called this type of transportation "(semi-) autonomous human passenger aerial transport systems" which is basically describing air taxi, despite the fact that the authors restricted the operation of the air taxi to a pilotless system only, while air taxi can be operated with the pilot on board as well or at least at the initial stages of launching air taxi operation. (1) Moreover, the definition does not specify the type of aircraft (Electric vertical take off and landing aircraft, which is one of the key components of air taxi operations.

The electric vertical takeoff and landing (eVTOL) significant element in air taxi operations most of UAM vehicles use an electric vertical takeoff and landing system, for example, helicopters, are not considered an eVTOL, although they still retain the ability for vertical takeoff and landing without the electric feature.(2)

Additionally, another definition of air taxi, "Manned Vertical Take-Off and Landing Aircraft carrying humans along short routes, which are not serviced by conventional civil aviation operators". (3) This definition specifies the type of aircraft as Vertical Take-Off and Landing Aircraft, also this definition missed the eVTOL feature, and didn't include the

civil aviation,2022

(1) **Y Shi**, *Pilots in the Evolving Urban Air Mobility: From Manned to Unmanned Aviation* (2023 International Conference on Unmanned Aircraft Systems, IEEE, 2023) https://hdl.handle.net/1887/3714097 accessed 25 October 2024.

(2) Osama A. Marzouk, 'Urban Air Mobility and Flying Cars: Overview, Examples, Prospects, Drawbacks, and Solutions' (2022) https://www.degruyter.com/document/doi/10.1515/eng-2022-0379/html accessed 24 October 2024.

(3) SAFIR-Med, *Urban Air Mobility Explained* (SAFIR-Med, 2021) https://www.safir-med.eu/uam-explained accessed 25 October 2024.

geographical scope the "urban areas "or "low- altitude", which is what makes the air taxi unique mode of transportation beside the use of Electric vertical take off and landing aircraft eVTOL.

Joby Aviation has successfully conducted more than 1,500 test flights with its pre-production model and is now moving forward with testing its production model. The company is focused on achieving FAA certification and advancing toward the launch of commercial air taxi operations, also has covered more than 33,000 miles, including over 100 piloted test flights. The second prototype also marked a milestone by performing the first electric air taxi demonstration flights in New York City, flying from the Manhattan Downtown Heliport over the Hudson River in November 2023.(1)

In addition, Archer Aviation conducted 400 trial flights earlier than planned, concentrating on airflow dynamics, sound intensity, and flight steadiness. These evaluations encompassed journeys through diverse climatic conditions to confirm aircraft security.(2)

Moreover, Joby Aviation has effectively finished the FAA-monitored stationary stress evaluation on the rear framework of its eVTOL vehicle, representing a crucial milestone toward approval. The firm intends to function in New York and Los Angeles and has obtained significant funding from Delta, Toyota, and Uber.(3)

(1) Joby Aviation, 'Joby Progresses to Next Phase of Aircraft Flight Test Program' (2 May 2024) https://www.jobyaviation.com/news/joby-progresses-next-phase-aircraft-flight-test-program/ accessed 17 February 2025.

(2) Chuck Martin, 'Air Taxi Company Completes 400 Test Flights 4 Months Early' (IoT World Today, 4 September 2024) https://www.iotworldtoday.com/flying-vehicles/air-taxi-company-completes-400-test-flights-4-months-early accessed 17 February 2025.

(3) Chuck Martin, 'Air Taxi Structure Passes First FAA Tests' (IoT World Today, 19 Decem-

THE REGULATIONS OF AIR TAXI OPERATIONAL REQUIREMENTS

As Timothy M. Ravich emphasized, "UAM represents one of the rare disruptive technological innovations for which the law can lead".(1)

We know as fact that the international civil aviation industry has long been recognized as a well-regulated and exceptionally safe sector, this success can be credited to the rigorous regulatory frameworks established to address the fundamental risks involved in aviation. In particular, the Federal Act No. 20 of 1991 on Civil Aviation Law in the UAE, along with other related regulations and publications by the GCAA as a competent authority, is responsible for establishing regulations necessary to implement the provisions of Civil Aviation Law No. 20 of 1991 which serves as the legal basis for all GCAA regulations, the UAE civil aviation law plays a critical role in ensuring the safety, efficiency, and reliability of international aviation operations within the UAE. that is why its mandatory that regulatory measures for air taxi meet the same high standards as those governing international civil aviation.

Most states adopting air taxi operations often use drone regulations as a foundation(2), given that air taxis are essentially larger drones equipped

ber 2024) https://www.iotworldtoday.com/flying-vehicles/air-taxi-structure-passes-first-faa-tests accessed 17 February 2025.

(1) Timothy M Ravich, 'On-Demand Aviation: Governance Challenges of Urban Air Mobility ("UAM")' (2020) 124 Penn State Law Review 657 https://www.pennstatelawreview.org/wp-content/uploads/2020/07/On-Demand-Aviation-Governance-Challenges-of-Urban-Air-Mobility-%E2%80%9CUAM%E2%80%9D.pdf accessed 23 December 2024

(2) Mirjam Wiedemann and others, 'Advanced Air Mobility: A Comparative Review of Policies from Around the World—Lesson s for Australia' (2024) 24 Transportation Research InterdisciplinaryPerspectives https://doi.org/10.1016/j.trip.2023.100988 accessed 14 January 2025

with the capability and seating capacity to transport passengers, however with passengers' involvement, especial air taxi rules are highly required.

Same as the existed rules which are applicable on traditional civil aviation related to the international carriage such as certifications, flight crew licensing, and infrastructure regulations, can't be imposed all on air taxi services, because it's not aligned with its needs, the unique characteristic of the air taxi, requires rules related and suitable to the operations in the low altitude urban airspace.(1)

The UAE has implemented several regulatory frameworks to manage UAS operations effectively:

- Federal Decree-Law No. (26) of 2022 on the regulation of the Civil use of Unmanned aircraft and related activities.
- CAR-UAC: UAS Commercial and Governmental Operations
- CAR-UAD: UAS Demonstration operations.
- CAR-UAEV: UAS Events operations.
- CAR-UAX: UAS Experimental operations.
- CAR-UAM: Urban Air Mobility operations
- CAR-UAR: UAS Recreational flight.

In addition, Dubai Civil Aviation Authority DCAA, as well issued regulations On the UAS Operations (DCAR-UAS) including air taxi, and serves as a regulatory framework for unmanned aircraft systems

(1) Yuran Shi, 'Aviation Safety for Urban Air Mobility: Pilot Licensing and Fatigue Management' (2024) 110 *Journal of Intelligent & Robotic Systems* 35 https://doi.org/10.1007/s10846-024-02070-x accessed 17 February 2025

(UAS) operations only within the Emirate of Dubai. It outlines policies, requirements, and operational standards for UAS activities. (applies only on the remote pilot and Autonomous Air taxi).

UAE's General Civil Aviation Authority issued the Urban Air Mobility Operations, which is applicable to air taxi operation although the regulation does not explicitly use the term 'air taxi' or state that it is applicable to air taxis, and since the definition of UAM outlines the conditions and scope of UAM operations which in correspondent with the characteristics and concept and functionality of air taxis, UAM vehicles are described as «Small-Category Vertical Take-Off and Landing VTOL" operating within the urban zones, transporting passengers in exchange for money.(1) CAR-UAM provides a regulatory framework for Urban Air Mobility (UAM) Operations or also referred to as 'air taxi' operations within the context and the purpose of this research, even though UAM operations has wider context than air taxi.

2.1 Certification and Airworthiness Requirements.

According to CAR-UAM, no person or organization is permitted to carry out UAM operations without authorization from the GCAA, as mandated by this regulation, the operator should obtain a UAM certificate issued by GCAA, moreover, obtaining the certificate requires the operator to present the compliance with the requirements under this law and the issuance of the certificate should not conflict with the interests of aviation safety.

It is notable that DCAR-UAS by Dubai Civil Aviation Authority DCAA also required the operator of the UAS to obtain Dubai UAS Operator

(1) *CAR-UAM: Urban Air Mobility Operations,* Issue 1, 2021

Authorization D UAO.(1) It is crucial to observe that EASA(2) and FAA also require an operator certificate to conduct the air taxi operations.

Initially, the GCAA regulation specifies that the Urban Air Mobility Vehicle (UAMV) must fall under the classification of Small Category (VTOL), designed for a maximum of 9 passengers and a maximum authorized take-off weight of 3175 kg or less. EASA and FAA both impose comparable requirements for the certification of Urban Air Mobility Vehicles (UAMVs) as stated by the FAA's Update to Air Carrier Definitions(3) and EASA's Special Condition for vertical take-off and landing (VTOL) capable aircraft. (4)

Air taxi should be registered with the GCAA and display UAE A6 nationally and registration mark(5) Furthermore the air taxi shall be airworthy, the design and manufacture should be verified and approved by the GCAA in accordance with the airworthiness requirement of CAR 21, before it operates and continuing airworthiness it's the responsibility by the operator by performing an inception before each flight, repairing any defect and damage affecting safe operation, and executing all routine maintenance procedures required by maintenance framework issued by

(1) DCAR.UAS. F.01, Section F

(2) European Union Aviation Safety Agency, Frequently Asked Questions on Urban Air Mobility (UAM) (2023) https://www.easa.europa.eu/sites/default/files/dfu/uam_-_faqs.pdf accessed 8 December 2024

(3) Federal Aviation Administration, 'Update to Air Carrier Definitions' (Final Rule, Federal Register, Vol 88, No 142, 26 July 2023) codified at 14 CFR Parts 1, 91, 110, 119, 121, 125, and 135 https://www.federalregister.gov/documents/2023/07/26/2023-15619/update-to-air-carrier-definitions#h-64 accessed 8 December 2024

(4) European Union Aviation Safety Agency, Special Condition for Small-Category VTOL-Capable Aircraft, Issue 2 (SC-VTOL-02) (Regulation, 10 June 2024)

(5) CAR-UAM, UAM.OPS.115

the manufacturer, in addition, DCAR-UAS also required registration and airworthiness of UAS.(1)

On the other hand EASA recently issued regulation to address the type certification and airworthiness standards for Vertical Take-Off and Landing (VTOL) capable aircraft in the small category aircraft designed for passenger and cargo transportation. While the GCAA's air taxi airworthiness requirement referred to the airworthiness requirement addressed in CAR 21 regarding the requirement of the regular aircraft. FAA likewise did not specify special airworthiness requirements for air taxi.

2.2 Pilot Licensing

It has been recommended by EASA and FAA that the launching air taxi will better be within three phases, the first phase operating the air taxi with pilot in board, the second phase is: remotely pilot air taxi and thirdly, fully autonomous air taxi.(2)

- **Pilots on board**

Dubai taxi intended to transport passengers with the pilot on board(3) that require pilot training and licensing regulations, CAR-UAM does not explicitly state that a pilot is required to hold a specific license to operate an air taxi. However, It required as operator's responsibility is to have qualified personnel for the planned tasks and activities to be performed in

(1) DCAR.UAS. F.09 and 10

(2) Yuran Shi, 'Aviation Safety for Urban Air Mobility: Pilot Licensing and Fatigue Management' (2024) 110 *Journal of Intelligent & Robotic Systems* 35 https://doi.org/10.1007/s10846-024-02070-x accessed 14 December 2024

(3) Flying Taxi Vertiport Construction Starts in Dubai, *IoT World Today* (online, 2023) https://www.iotworldtoday.com/flying-vehicles/flying-taxi-vertiport-construction-starts-in-dubai accessed 13 December 2024

accordance with the applicable requirements, and should maintain a record for appropriate experience, qualification, and training for personnel, furthermore among the documents required to be onboard of air taxi is crew licenses/authorization, that implies indirectly that its necessary to have trained and licensed pilots for air taxi operations,(1) Nevertheless the regulation did not specify pilots licensing requirements or referred to the requirements for the traditional aircrafts pilots.

On the contrary, FAA requires the pilot having a license to operate air taxi and must obtain one of these licenses, (2) Airline Transport Pilot (ATP) certificate with a type rating for the powered-lift category, Commercial Pilot certificate for the powered-lift category and private pilot certificate for the powered-lift category moreover, including among the required certifications and ratings are: Powered-lift Instrument Rating, Flight Instructor certificate, and Instrument Instructor authorization. Furthermore, the pilots who already hold a commercial pilot certificate with certain ratings in other aircraft categories may meet alternative experience requirements, accelerating their certification process for powered-lift operations(3). Likewise, EASA in the mandates that pilots obtain license to operate air taxi, at first only qualified and experienced airplane or helicopter pilots will be authorized to fly air taxis, these pilots already possess the required credentials for their respective categories and will complete further

(1) CAR-UAM.ORG.105,110, CAR-UAM.OPS205.230,105

(2) Federal Aviation Administration, *Air Taxis: Frequently Asked Questions* (FAA, 2024) https://www.faa.gov/air-taxis/FAQ accessed 14 December 2024

(3) Integration of Powered-Lift: Pilot Certification and Operations; Miscellaneous Amendments Related to Rotorcraft and Airplanes, 88 Fed Reg 38892 (14 June 2023). https://www.federalregister.gov/documents/2023/06/14/2023-11497/integration-of-powered-lift-pilot-certification-and-operations-miscellaneous-amendments-related-to#h-228 accessed 14 December 2024

specialized training and assessments customized to air taxi operations, and as the industry progresses, a new pilot qualification and licensing system will be developed, specifically designed for air taxi operations.(1)

The CAR-UAM regulations do not address the issue of pilot fatigue or provide specific guidelines for its management in UAM operations, considering that operating air taxi with the pilot on board presents critical considerations, including pilot fatigue which imposes serious challenges to safety and operational efficiency, in the civil aviation, numerous factors may lead to pilot fatigue such as extended flight hours, early work shifts, night shifts, extended duty-call periods, unpredictable work patterns. pilot fatigue management existing technical standards are insufficient, which is results in the absence of a global tracking system and the operators can avoid compliance with flight hour limits.(2)

- **Remote pilot licensing**

In respect of the second stage of air taxi operation which is operated with remote pilot, indeed it requires a regulatory framework, The CAR-UAM, which governs Urban Air Mobility operations, does not include provisions or specific requirements for licensing remote pilots operating air taxis, this omission represents a critical regulatory gap in addressing the qualifications and competencies required for remote pilots in such operations, while the CAR-UAC Unmanned Aircraft (UA) Commercial and Governmental Operations, issued by the General Civil Aviation Authority

(1) European Union Aviation Safety Agency, *Urban Air Mobility: Frequently Asked Questions* (EASA, 2024) https://www.easa.europa.eu/sites/default/files/dfu/uam_-_faqs.pdf accessed 14 December 2024.

(2) Yuran Shi, 'Aviation Safety for Urban Air Mobility: Pilot Licensing and Fatigue Management' (2024) 110 *Journal of Intelligent & Robotic Systems* 35 https://doi.org/10.1007/s10846-024-02070-x accessed 14 Dec. 24.

(GCAA)(1) addressed the remote pilot licensing and outlines requirements for their training and certification, nonetheless, this regulation explicitly excludes unmanned aircraft intended for the carriage of passengers. As stated in the CAR-UAC, the scope of the regulation does not apply to passenger-carrying UA, making its provisions inapplicable to air taxi operations.

In the absence of specific provisions regarding remote pilot licensing in CAR-UAM, the Dubai Civil Aviation Authority issued the Dubai Civil Aviation Regulations for UAS Operations (DCAR-UAS) which is formulated to establish guidelines and standards for managing all aspects of UAS and their operations within Dubai, it provides a comprehensive framework for the regulation, operation, and management of unmanned aircraft systems (UAS) (2), it could be applied on autonomous or remote piloted air taxi it explicitly addresses such operations under section E, DCAR.UAS.E.01 UAS operations categories.

According to this section, air taxi operations, and manned transportation, fall within the certified category, the inclusion of air taxis, ensures that autonomous or remotely piloted air taxi operations are regulated under the comprehensive framework provided by the DCAR-UAS, however, this regulation is applicable only in the Emirate of Dubai. The regulation provided a definition for AU pilot as "A person charged by the operator with duties essential to the operation of a remotely piloted aircraft and

(1) Civil Aviation Regulation Unmanned Aircraft Commercial and Governmental Operations (CAR-UAC), Issue 02 (2023)

(2) Dubai Civil Aviation Authority Regulation (DCAR-UAS), DCAR.UAS.A.01 https://betawebapi.dcaa.gov.ae/Uploads/Dubai%20Civil%20Aviation%20Regulations%20for%20UAS%20Operations.pdf

who manipulates the flight controls, as appropriate, during flight time".(1) Furthermore, the regulation outlined the responsibilities, competencies, and the requirements of the UA Pilot. The regulation obligated the UA Pilot be registered with the DCAA and possess a valid UA Pilot License to secure approval for conducting flight operations within Dubai Airspace.(2)

- **Fully Autonomous air taxi**

Operating air taxi with pilot on board for a long time, may not facilitate the financially sustainable revolutionizing of UAM due to high training expenses, concerns over pilot exhaustion fatigue which defeats the purpose of having air taxi operating fully autonomously (3)

The Implementation of artificial intelligence (AI) is intended to Improve human decision-making and elevate efficiency and performance, by using data to detect patterns, perform scenario analysis based on predictions, draw knowledge from past events, and recommend strategies to optimize performance(4)

Autonomous air taxi will highly depend on Artificial Intelligence driven systems integrated into autonomous flight operations and its essential to the efficiency, reliability for ensuring the functionality and safety of modern

(1) DCAR.UAS. Definitions

(2) DCAR.UAS. F.12

(3) Y Shi, Pilots in the Evolving Urban Air Mobility: From Manned to Unmanned Aviation (2023 International Conference on Unmanned Aircraft Systems, IEEE, 2023) https://hdl.handle.net/1887/3714097 accessed 13 December 13, 2024

(4) Alexander M. Geske, David M. Herold, and Sebastian Kummer, 'Artificial Intelligence as a Driver of Efficiency in Air Passenger Transport: A Systematic Literature Review and Future Research Avenues' (2024) 3 *Journal of the Air Transport Research Society* 100030 https://doi.org/10.1016/j.jatrs.2024.100030 accessed 13 February 2025

air taxis operational. Implementing AI algorithms will handle essential functions of air taxi operations such as light path management, collision prevention, flight scheduling, operational strategy, and real-time decision-making (1)

- Artificial intelligence (AI) has redefined ground transportation through advancements like autonomous vehicles. Its integration into Urban Air Mobility (UAM) systems is essential, particularly in electric Vertical Take-Off and Landing (eVTOL) aircraft control.
- AI enables dynamic flight control by modeling eVTOL behavior and refining control mechanisms.
- AI plays a key role in air traffic regulation for UAM, particularly in addressing urban airspace congestion.
- AI is critical in flight planning, enabling efficient route selection, reducing travel duration, and improving passenger experience.
- Ensuring flight safety is crucial for eVTOL aircraft, particularly as UAM operations take place in urban environments, sharing airspace with ground vehicles and pedestrians.
- AI in Aircraft Collision Avoidance Systems, AI-based methodologies are fundamental to eVTOL collision prevention(2)

(1) Newton H Campbell Jr, Michael J Acheson, and Irene M Gregory, 'A Systems Approach to AI Model Integration and Performance Evaluation for the Generic UAM Simulation Framework' (NASA Langley Research Center, 2024) https://arc.aiaa.org/doi/abs/10.2514/6.2024-0718 accessed 13 February 2025

(2) Yang Liu et al., 'The Role of Intelligent Technology in the Development of Urban Air Mobility Systems: A Technical Perspective' (2024) 4 *Fundamental Research* 1017 https://doi.org/10.1016/j.fmre.2023.08.006 accessed 13 February 2025

- Furthermore, for the safety of air taxi operations, regular maintanance will be required, and it can be done with the help of Artificial Intelligence such as:
- Maintenance forecasting by processing data from air taxi sensors to forecast when it needs maintenance.
- Technical inspections and oversight, when regular inspections needed, using AI can examine air taxi collected to detect potential probable defects
- AI can process this information to offer guidance to maintenance teams, assisting them in making better choices because maintenance planning can be intricate, requiring technicians to evaluate various aspects such as repair expenses, spare part availability, and serviceability impact.
- In the future, self-operating servicing infrastructures could execute predefined upkeep duties on urban air vehicles independently. For example, AI-driven robotic systems, integrated with smart algorithms, might carry out scheduled assessments, conduct minor restorations, replace faulty components, and verify system performance. These advancements would decrease manual labor, optimize repair operations, and boost safety by reducing worker involvement in hazardous procedures.
- AI can assist aerial transport managers in lowering running expenses by precisely forecasting upkeep demands and refining servicing timelines, AI contributes to limiting redundant evaluations and avoiding excessive hardware swaps, thereby cutting down repair

workforce expenditures. Additionally, by mitigating unforeseen service interruptions and maximizing vehicle deployment, AI can boost earnings while reducing monetary setbacks caused by flight restrictions.

- Artificial intelligence technologies can constantly track the status of eVTOLs while in service by examining live monitoring metrics to identify deviations or foreseeable hazards. By pinpointing operational breakdowns and issuing timely notifications, AI assists in avoiding mishaps and guarantees that upkeep needs are met before escalating into a threat, ultimately increasing total aviation reliability within advanced air mobility systems.(1)
- AI also contributes to enhancing industrial sustainability by promoting intelligent systems by optimizing operations. key areas where AI can provide significant benefits include demand forecasting, trajectory prediction, and safety management, air taxi primarily operate in urban environments, ensuring passenger and operational safety is important.(2)

The fully autonomous operation mandates the development of advanced operational regulations guidelines and improvements to infrastructure.(3)

(1) Cyient, 'Artificial Intelligence in Urban Air Mobility' (Cyient, 6 October 2022) https://www.cyient.com/blog/artificial-intelligence-in-urban-air-mobility accessed 13 February 2025.

(2) Liu Lingrui and Wen Xin, 'Towards Smart Aviation with Sustainable Development: Artificial Intelligence Insights into the Airline and Advanced Air Mobility Industries' in *Decision Support Systems for Sustainable Computing* (Elsevier 2024) https://doi.org/10.1016/B978-0-443-23597-9.00009-3 accessed 13 February 2025.

(3) Yuran Shi, 'Aviation Safety for Urban Air Mobility, Pilot Licensing and Fatigue Management'

However, CAR-UAM is applicable on UAMV "operated with pilot on-board, remotely piloted or with various degrees of autonomy" the regulation did not refer to the specific operational guidelines which are applicable to autonomous operations only, since operating air taxi autonomously necessitates heightened attention to safety due to the significant risks associated with such operations.(1)

In this case, the DCAR-UAS operational guidelines and regulations are more suitable to be applied on the autonomous and remote pilot-operated air taxi, because DCAR-UAS is more specific on the UAS operations. However, according to CAR-UAM, operations of air taxi, must be conducted in accordance with the operations manual approved by the GCAA and in compliance with the specified operations specifications. UAMVs must operate within the limitations outlined in the approved Commercial Air Transport UAM Flight Manual or an equivalent document issued by the manufacturer or detailed in the operations manual.(2)

2.3 Safety and Navigation Regulations

The GCAA, regulates the safety of air taxi operations by requiring operators to establish, implement, and maintain a Management System proportionate to the size, nature, and complexity of their activities. (3)

The GCAA references the requirement for organizations to maintain a Safety Management System (SMS) that complies with CAR Part X, which manages safety risks in aviation operations of traditional aviation

(1) Iván László Arnold, 'Urban Air Mobility: A New Dimension of the Urban Landscape' (2022) 8(1) *IGLUS Quarterly* 8 https://iglus.org/wp-content/uploads/2022/04/IGLUS-Quarterly-Vol-8-Issue-1.pdf accessed 19 December 2024.

(2) CAR-UAM.OPS.205, 110,215

(3) CAR-UAM UAM.ORG.105

sectors(1), however, this requirement is not strictly binding as it falls under the category of Acceptable Means of Compliance (AMC). This means the operator, has the option to demonstrate compliance through other means. (2) Furthermore, passenger safety is addressed as well in the regulations.(3) The CAR-UAM address safety by prohibiting the carriage of dangerous goods unless specifically authorized.(4)

The flight operations section of CAR-UAM, illustrates that the GCAA regulates air navigation for UAM operations by requiring compliance with all Air Traffic Services (ATS) requirements for the applicable airspace, UAM operators must comply with existent airspace regulations, harmonize with Air Traffic Control (ATC).(5)

ETHICAL AND PRIVACY CONSIDERATIONS

The integration of artificial intelligence (AI)-driven navigation, real-time surveillance, and data collection systems into air taxi operations raises significant ethical and privacy concerns. The widespread use of autonomous flight control systems, passenger identification technologies, and continuous tracking mechanisms requires a regulatory framework that ensures data security, privacy protection, and ethical compliance.

One primary concern involves passenger data privacy. Air taxis will likely employ facial recognition, biometric authentication, and passenger

(1) CAR-SMS saftey Management System**,** Issue 6, General Civil Aviation Authority (10 March 2022)

(2) CAR-UAM AMC1 UAM.ORG.105

(3) UAM.OPS.705

(4) UAM.OPS.720, 725, 730

(5) UAM.OPS.520

movement tracking for enhanced security and personalized services. However, the absence of clear guidelines on data collection, storage, and processing could pose risks of unauthorized access and potential misuse.

Additionally, cybersecurity risks associated with AI-powered air taxis must be addressed. The potential for hacking, system manipulation, and data breaches could compromise passenger safety and disrupt urban air mobility operations. Implementing secure data encryption, intrusion detection systems, and AI algorithm transparency is essential to mitigate vulnerabilities.

Ethical concerns also arise in the decision-making capabilities of AI-driven air taxis. Autonomous systems must be programmed with ethical considerations, particularly in emergency scenarios where passenger safety and risk assessment must be prioritized. Ethical dilemmas regarding collision avoidance, emergency landings, and accountability for AI-driven decisions should be explicitly addressed within regulatory frameworks. Establishing a clear liability framework for AI-driven air taxis will ensure accountability in case of system failures or accidents.

To ensure comprehensive oversight, future UAE air taxi regulations should incorporate privacy, data security, and ethical impact assessments. These assessments should evaluate the risks associated with passenger surveillance, AI decision-making, and cybersecurity threats to ensure that autonomous air taxis operate safely and ethically within urban environments.

2.4 Vertiport Regulations and Infrastructure Requirements

UAM operations need a place to take off and land, similar to mini airport. Electric vertical take off and landing aircraft, to take-off, land and

technical support. (1) It may be suggested that the air taxi will collect and drop passengers directly from their offices or residences or that passengers could board an air taxi from any spot similar to the ground taxis, however, for safety concerns there will be a designated spot called vertiports.(2) However, CAR-UAM stipulated: "Unless an emergency situation requires otherwise, a UAMV shall only take-off and land at vertiports authorized by the Authority", that limits the air taxi operation to be operating exclusively from designated areas "vertiports", and it will not be possible to pick up passengers from any other point than the vertiports. Vertiports are essential for eVTOL aircraft operations. According to the GCAA vertiports is "An area on a structure intended to be used wholly or in part for the arrival, departure, and surface movement of Urban Air Mobility Vehicles".(3)

The global pioneer company for the Advanced Air Mobility (AAM) infrastructure, building, designing and operating, "Vports" is committed by the year 2045 to construct and operate 1,500 vertiports in across regions worldwide,(4)including in the UAE, pursuant to an agreement between Vports and the UAE General Civil Aviation Authority (GCAA) the Mohammed bin Rashid Aerospace Hub (MBRAH) in Dubai. Aspirating to make the UAE a leading international hub for Advanced Air Mobility (AAM). (5)

(1) *Research Part A*, vol 188, 104202 https://doi.org/10.1016/j.tra.2024.104202 accessed [31October 2024].

(2) Aditya Inwale and Yash Parikh.

(3) General Civil Aviation Authority (GCAA), *CAR-UAM: Urban Air Mobility Operations* (Issue 1, 2021)

(4) VPorts, *VPorts Homepage* (VPorts) https://vports.com/ accessed 30 October 2024

(5) VPorts, 'VPorts AAM Integrator Centre' (Press Release, December 2022)

Additionally, as a part of the AAM integrator world center in Dubai, Vports plans to establish Vertiport Operation Control Centre (VOCC), this center will be forced in AAM air traffic management, establish communication procedures between eVTOLs, vertiports, and Air Navigation Service Providers (ANSP), the use of artificial intelligence in AAM operations. The Vertiport Operation Control Centre (VOCC) will also manage the cargo and mail operations as well as business activities, security checks, cyber protection, ground services, and aircraft charging and maintenance. In addition, to promote the innovative technology through partnered research and development projects, Vports intended to work with universities and research groups including the University of Sharjah. The network of the vertiports expected to be spared out across the major industrial zones in the UAE.(1)

Vports made a deal worth $40 million To establish the world's first AAM integrator center in Dubai, a significant commercial and tourism hub in the United Arab Emirates.(2) Furthermore, a memorandum of understanding has been signed with Ras Al Khaimah (RAK) Airport to build and operate the first vertiport in RAK. This initiative is aimed at positioning the UAE as a world-class hub for Advanced Air Mobility

https://vports.com/wp-content/uploads/2022/12/Press-release__VPorts_AAM-Integrator-Centre_FINAL-Eng.pdf accessed 30 October 2024

(1) VPorts, 'VPorts AAM Integrator Centre' (Press Release, December 20224

(2) Dubai Airshow, 'UAE Ready to Adapt to Advanced Air Mobility (AAM), General Civil Aviation Authority Published World's First' (Dubai Airshow, 2024) https://www.dubaiairshow.aero/uae-ready-adapt-advanced-air-mobility-aam-general-civil-aviation-authority-published-world%E2%80%99s-first accessed 15 October 2024

(AAM)(1), 10,000-square-metre site will be dedicated to build vertiport from Ras Khaimah International Airport, suitable for electric vertical take-off and landing (eVTOL) aircrafts. This initiative corresponds with H.H Sheikh Saud bin Saqr Al Qasimi 2040 vision Efficiency and Renewable Energy Strategy(2)

During the ICAO's Twentieth Meeting of the Middle East Air Navigation Planning and Implementation Regional Group ,Tenth Meeting of the Regional Aviation Safety Group held in Muscat, Oman May 2023, UAE presented a paper with comprehensive summary of the progression of the advancement and releasing the vertiport's regulation which considered the first actional regulation regarding vertiports in the world, the paper expresses the need of new infrastructure to suit the electrical vertical take-off and landing eVTOL, advancements. The adequate infrastructure including integrated vertiport for the eVTOL grants the sustainability, reliability, and safety of the urban air mobility operations. The new advancements in eVTOL require updated regulations, involve unconventional aviation stakeholders, and advance modeling systems facilitate to UAM. In the absence of comprehensive guidance by ICAO regarding UAM, UAE still managed to issue regulation in related to vertiport by emphasizing standards and optimal recommended practices in UAM operations.(3)

(1) VPorts, 'VPorts to Establish a First Vertiport at Ras Al Khaimah Airport' (Press Release, 15 March 2023) accessed 15 October 2024

(2) VPorts, 'VPorts to Establish a First Vertiport at Ras Al Khaimah Airport' (VPorts, 20 December 2022) https://vports.com/vports-to-establish-a-first-vertiport-at-ras-al-khaimah-airport/ accessed 30 October 2024.

(3) ICAO, *UAE Vertiport Regulation* (Report No 88, MIDANPIRG, 2023) https://www.icao.int/MID/MIDANPIRG/Documents/MID20%20and%20RASGMID10/WP88%20-%20UAE%20Vertiport%20Regulation.pdf accessed [31 October 2024].

The GCAA introduced national regulation regarding vertiports (CAR-HVD) in March 2023, which is considered the first national vertiports regulation globally,(1) establishing regulations and standards for UAM takeoff and landing operations are essential for maintaining a leadership position within the industry.(2) CAR-UAM addressed specific provisions in which required the operator to meet with the GCAA to plan and approve the landing site designs and it should be submitted to the GCAA before executing landing site and must provide take-off and landing site details, the routine checks, upkeep, fuel/energy supply management, and incident documentation fall under the operator's responsibilities.(3) Moreover, it provided requirements regarding vertiport staffing and publication of vertiport information(4) however CAR-HVD outlines the regulatory framework for vertiport operators and regulated it in more details and compliance with the international standards of ICAO Annex 14, Volume II, CAR-HVD encompasses the certification, development, and operational standards and requirements for vertiports, UAE conducted a feasibility evaluation, by reviewing and conducting and gap analysis on international standards such ICAO Annex 14, FAA Engineering Brief No. 105 on

(1) Civil Aviation Regulations (CAR-HVD) - Onshore (Heliports-Vertiports) and Offshore (Helidecks) - Issue 01, March 2023 (UAE General Civil Aviation Authority).

(2) Joomin Kim, 'Case Study Building a Vertiport for UAM Commercialization: Based on the Demonstration in Pontoise-Cormeiles, France' (2024) 27(1) Journal of the Korean Society of Industry Convergence 77 https://koreascience.kr/article/JAKO202410243572445.page accessed 19 December 2024

(3) UAM.OPS.405

(4) UAM.OPS.410, 415

vertiport design(1) and EASA Prototype technical design specifications for vertiports(2) this effort led to the first national regulation on vertiports, its set to certify and oversee vertiports, aiming to ensure the safety, reliability, and efficiency of VTOL and eVTOL aircraft operations at vertiports, also the regulation mandates compliance with applicable national regulations and SARPs.(3)

The CAR-HVD outlines the standards for certifying vertiports designated for public and private purposes divided into the following categories Vertiport certification for (Public, Hospitality, tourism) and Vertiport Landing Area Acceptance LAA for (Private, Flight training, Hospitals, and Emergency Medical Services) Submitting the certification applications via e-service by GCAA, the applications will be reviewed and handled by the GCAA Air Navigation and Aerodrome Department, focusing on factors like the physical design, operational procedures, safety systems, and airspace compatibility, in addition, an audit will be performed by the GCAA to verify the facilities, equipment, policies, and safety measures, and once the Vertiport Certification or Landing Area Acceptance is granted the vertiport operator will be regularly monitored to ensure the compliance.(4)

(1) FAA, Engineering Brief No. 105: Vertiport Design (FAA, 2022) https://www.faa.gov/airports/engineering/engineering_briefs/engineering_brief_105_vertiport_design accessed 23 December 2024

(2) EASA , Prototype Technical Design Specifications for Vertiports (EASA, 2022) https://www.easa.europa.eu/en/document-library/general-publications/prototype-technical-design-specifications-vertiports accessed 23 December 2024.

(3) ICAO, *UAE Vertiport Regulation* (Report No 88, MIDANPIRG, 2023) https://www.icao.int/MID/MIDANPIRG/Documents/MID20%20and%20RASGMID10/WP88%20-%20UAE%20Vertiport%20Regulation.pdf accessed 23 December 2024

(4) ICAO, *UAE Vertiport Regulation* (Report No 88, MIDANPIRG, 2023)

It is relevant to mention that The Federal Aviation Administration (FAA) and the European Union Aviation Safety Agency (EASA) have developed policies to support the deployment of Advanced Air Mobility (AAM) aircraft through vertiport infrastructure planning, FAA Engineering Brief No. 105, Vertiport Design and EASA's, Prototype Technical Design Specifications for Vertiports (EASA, 2022)

In 2022 EASA published the first guidance for the design of vertiports in the world, which benefits the Urban developers and local authorities to facilitate the secure planning of vertiports to support these vertical take-offs and landing VTOL aircraft, it incorporates the Funnel-Shaped "Obstacle-Free Volume" innovation which fits the unique operational characteristics of VTOL (vertical take-off and landing) aircraft.(1) FAA also issued design standards for vertiport, which will function as a preliminary framework to provide crucial details for airport owners, administrators, and Infrastructure planners to initiate the construction of facilities designed to support the operations of Advanced Air Mobility (AAM) vehicles, which are powered by electricity and capable of vertical take-off and landing. However, the only purpose of EASA Prototype Technical Specifications, is to provide technical guidance, it does not address vertiport certification requirements in its current form but refers to future legislative and regulatory provisions, including validated and finalized certification specifications, which will be developed as part of the rulemaking task (RMT.0230)(2)

The FAA Engineering Brief No. 105, Vertiport Design provides interim

(1) EASA, **'EASA Issues World's First Design Specifications for Vertiports'** (Press Release, 24 March 2022) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-issues-worlds-first-design-specifications-vertiports accessed 23 December 2024

(2) EASA, 'Prototype Technical Specifications for the Design (PTS-VPT-DSN)' (EASA, March 2022

guidance for the development and operation of vertiports designed for VTOL aircraft, it outlines key design elements, including safety-critical geometry that specifies dimensions for touchdown and lift-off.(1)

It's notable that FAA updated the Engineering Brief No. 105A, recently in 2024, the updates include modifications to the dimensions of the core vertiport geometry, categorization based on powered and non-powered lift capabilities, the inclusion of a new section on parking, and the introduction of an area dedicated to downwash and outwash protection.(2) FAA's vertiport guidelines also don't cover vertiport certification criteria, it seems that the guidelines are intended to provide technical and design recommendations rather than regulatory or legal requirements.

(1) **FAA, 'FAA Issues Design Guidelines for Vertiport Construction'** (AASHTO Journal, 6 October 2022) https://aashtojournal.transportation.org/faa-issues-design-guidelines-for-vertiport-construction/ accessed 23 December 2024.

(2) Urban Air Mobility News, 'FAA Publishes Updated Design Guidance for Vertiports, Organizes Industry Briefing Day' (Urban Air Mobility News, 28 September 2024) https://www.urbanairmobilitynews.com/emerging-regulations/faa-publishes-updated-design-guidance-for-vertiports-organises-industry-briefingday/ accessed 23 December 2024.

CATEGORY	GCAA REGULATIONS	FAA REGULATIONS	EASA REGULATIONS
REGISTRATION	Requied	Requied	Requied
OPERATOR CERTIFICATE	Requied	Requied	Requied
PILOT LICENSING	CAR-UAM didn't specify pilots licensing requirements or referred to the requirements for the traditional aircraft's pilots.	The pilot required to obtain, an Airline Transport Pilot (ATP) certificate with a type rating for the powered-lift category, or Commercial Pilot certificate for the powered-lift category or private pilot certificate for the powered-lift category	only qualified airplane or helicopter pilots operate air taxis initially, requiring additional specialized training. A dedicated air taxi licensing system will be developed as the industry evolves.

UAMV CERTIFICATION STANDARDS	must fall under the classification of Small Category (VTOL), designed for a maximum of 9 passengers and a maximum authorized take-off weight of 3175 kg or less	Similar requirements for the certification of (UAMVs) as stated by the FAA's Update to Air Carrier Definitions(1)	Comparble requirements by EASA's Special Condition for vertical take-off and landing (VTOL) capable aircraft. (2)
UAMV AIRWORTHINESS	Airworthiness requirement referred to the airworthiness requirement addressed in CAR 21 regarding the requirement of the regular aircraft.	Likewise the GCAA FAA, did not specify special airworthiness requirements for air taxi.	Issued separate regulation to address the type certification and airworthiness standards for Vertical Take-Off and Landing (VTOL)

(1) Federal Aviation Administration, 'Update to Air Carrier Definitions' (Final Rule, Federal Register, Vol 88, No 142, 26 July 2023) codified at 14 CFR Parts 1, 91, 110, 119, 121, 125, and 135 https://www.federalregister.gov/documents/2023/07/26/2023-15619/update-to-air-carrier-definitions#h-64 accessed 8 December 2024

(2) European Union Aviation Safety Agency, Special Condition for Small-Category VTOL-Capable Aircraft, Issue 2 (SC-VTOL-02) (Regulation, 10 June 2024)

VERTIPORT REGULATION	Yes, Civil Aviation Regulations (CAR-HVD) - Onshore (Heliports-Vertiports) and Offshore (Helidecks) - Issue 01, March 2023	FAA, Engineering Brief No. 105: Vertiport Design (FAA, 2022)	EASA, 'Prototype Technical Specifications for the Design (PTS-VPT-DSN)' (EASA, March 2022
VERTIPORT Certification	vertiport certification is requied, two classification of **Vertiport certification for public (hospitality, tourism)** and **private use, with Landing Area Acceptance (LAA) for training, hospitals**	Vertiport certification criteria is not coverd, the only purpose is to provide technical guidance, rather than regulatory or legal requirements. .	vertiport certification criteria is not coverd , the only purpose is to provide technical guidance but refers to future legislative and regulatory provisions certification specifications, which will be developed as part of the rulemaking task (RMT.0230)

Table 1: Comparison of Air Taxi Regulatory Framework of the GCAA, FAA, and EASA.

CONCLUSION AND RECOMMENDATIONS

In summary, the paper has provided a comprehensive conceptual framework of air taxi within the context of UAM, including the definitions, it has addressed and analyzed the UAE regulations regarding air taxi, epically those related to the operational requirements, such as operator certification, pilot licensing for on board and remote pilots, UAMV certification Standards, Registration, and Airworthiness, Air Navigation services regulations, vertiport regulations, and safety regulations.

THE FINDINGS OF THE STUDY

What can be inferred from the preceding text, the UAE is one of the first states, globally to regulate UAM including air taxi, the CAR-UAM framework comprehensively addresses nearly all aspects of air taxi regulation, however, the framework requires further refinement and updates, as air taxi operations have not yet commenced, and practical challenges may arise upon their full implementation.

Moreover, the UAE regulated the vertiport comprehensively, including addressing requiring vertiport certification, while EASA and FAA's vertiport guidelines do not cover vertiport certification criteria, it seems that their guidelines are intended to provide technical and design recommendations rather than regulatory or legal requirements.

- The GCAA has made significant strides in regulating Advanced Air Mobility (AAM), including Urban Air Mobility (UAM), with the regulations being easily accessible and readily available on the GCAA's official website under the Emerged technology section.
- Airworthiness requirements referred to the airworthiness

requirement addressed in CAR 21 regarding the requirement of regular aircraft, on the contrary EASA has separate regulations on this issue.

- Regarding pilots on board, CAR-UAM does not explicitly state that a pilot is required to hold a specific license to operate an air taxi. Moreover, did not specify pilots licensing requirements or refer to the requirements related to pilots licensing in civil aviation, while FAA requires that the pilot should obtain one the certificates an Airline Transport Pilot (ATP), or Commercial Pilot certificate for the powered-lift category or private pilot certificate for the powered-lift category. Likewise, EASA in the mandates that pilots obtain licenses to operate air taxi.

- The CAR-UAM regulations do not address the issue of pilot fatigue or provide specific guidelines for its management in UAM operations.

- Pertaining to the remote pilots, CAR-UAM does not include provisions or specific requirements for licensing remote pilots operating air taxis. However, DCAR-UAS addressed this issue by requiring the UA Pilot to be registered with the DCAA and possess a valid UA Pilot License to secure approval for conducting flight operations within Dubai Airspace, Nevertheless, this regulation is limited to operations within Dubai and does not extend to other emirates in the UAE.

- Regarding the fully autonomous air taxi, the regulation did not refer to the specific operational guidelines which are applicable to autonomous operations only, since operating an air taxi

autonomously necessitates heightened attention to safety due to the significant risks associated with such operations, which function without direct human control, given their role in urban air mobility, where they operate in complex environments with high population density, introducing unique challenges in ensuring passenger, public and operational safety.

- CAR-UAM stated that the operations of air taxi, must be conducted in accordance with the operations manual approved by the GCAA and in compliance with the specified operations specifications.
- while DCAR-UAS operational guidelines and regulations are more suitable to be applied to the autonomous and remote pilot-operated air taxi, because DCAR-UAS is more specific on the UAS operations.
- Concerning Safety regulation, CAR-UAM references the requirement for organizations to maintain a Safety Management System (SMS) that complies with CAR Part X, however, this requirement is not strictly binding as it falls under the category of Acceptable Means of Compliance (AMC).
- The Air Navigation Services, CAR-UAM required compliance with all Air Traffic Services (ATS) requirements for the applicable airspace, UAM operators must comply with existent airspace regulations.
- On the subject of the Vertiport regulation, it was regulated in a separate regulation, the GCAA introduced national regulation regarding vertiports (CAR-HVD) in March 2023, which is

considered the first national vertiports regulation globally, which marks a significant milestone toward establishing integrated air taxi operations. CAR-HVD was issued after reviewing and conducting and gap analysis on international standards such ICAO Annex 14, FAA Engineering Brief No. 105 on vertiport design(1), and EASA Prototype technical design specifications for vertiports.

DISCUSSION OF THE FINDINGS

The regulatory framework governing air taxi operations in the UAE has made considerable progress with the introduction of the CAR-UAM regulatory structure. However, significant gaps persist, particularly in areas concerning pilot licensing, airworthiness standards, and regulatory oversight for autonomous air taxis. While the UAE has initiated regulatory policies to accommodate urban air mobility, practical challenges associated with implementation remain unexplored, necessitating further refinement.

A comparative analysis of international jurisdictions with advanced air taxi regulations provides crucial insights into the existing deficiencies in the UAE's approach. The Federal Aviation Administration (FAA) has established specific licensing requirements for powered-lift aircraft pilots, mandating that they obtain one of the following: an Airline Transport Pilot (ATP) certificate, a Commercial Pilot certificate, or a Private Pilot certificate for the powered-lift category. Similarly, the European Union Aviation Safety Agency (EASA) has developed Special Conditions for Vertical Take-Off and Landing (VTOL) aircraft, which explicitly outline airworthiness certification criteria tailored for eVTOL operations.

(1) FAA, Engineering Brief No. 105: Vertiport Design (FAA, 2022) https://www.faa.gov/airports/engineering/engineering_briefs/engineering_brief_105_vertiport_design accessed 23 December 2024

By contrast, the UAE's regulatory framework relies on CAR 21, which provides general airworthiness certification applicable to conventional aircraft. The absence of dedicated airworthiness standards specific to eVTOL aircraft within the UAE's regulatory framework could result in operational and safety challenges. Given the complexity and technological advancements associated with air taxi operations, the UAE must establish specialized airworthiness criteria that cater specifically to eVTOLs and their operational requirements.

Beyond airworthiness certification, pilot training and licensing requirements remain an area of regulatory ambiguity in the UAE. Lessons drawn from FAA and EASA experiences reveal that regulators are progressively adopting a phased licensing model for air taxi operations. This model ensures an incremental transition from piloted air taxis to remotely operated and, eventually, fully autonomous systems. However, pilot fatigue management remains a major oversight in UAE regulations. Unlike FAA Advisory Circular AC 117-3, which sets forth clear guidelines for fatigue risk mitigation among high-frequency urban aviation operations, the UAE's CAR-UAM lacks a specific regulatory framework for pilot fatigue monitoring and mitigation. As air taxis are expected to operate at high frequency in low-altitude urban environments, the absence of a fatigue risk management framework poses potential safety concerns.

In addition, the UAE's regulatory stance on autonomous air taxis remains underdeveloped. Research and regulatory insights from EASA's AI-driven approach to autonomous aviation indicate the necessity of clear risk mitigation protocols and robust oversight mechanisms. Without dedicated autonomous air taxi regulations, the UAE may encounter operational risks, public trust issues, and safety vulnerabilities. As urban

air mobility expands, ensuring rigorous oversight for pilotless air taxis will be imperative to maintaining public confidence and regulatory compliance.

While this study employs a doctrinal legal analysis, future research should incorporate empirical data from real-world applications, expert opinions, and operational case studies to further validate regulatory effectiveness. The incorporation of practical insights from jurisdictions with established air taxi operations will contribute to a more comprehensive regulatory framework in the UAE.

RECOMMENDATION

- Develop a dedicated airworthiness certification framework for air taxis, rather than relying solely on CAR 21, by incorporating best practices from EASA's Special Condition for VTOL aircraft. This will ensure clear, performance-based safety standards tailored to eVTOL aircraft.
- Establish clear pilot licensing standards within CAR-UAM, aligning with FAA's powered-lift aircraft licensing framework, to ensure air taxi operators meet internationally recognized safety benchmarks. This will eliminate ambiguities in pilot certification requirements and enhance training protocols.
- Introduce a regulatory framework for pilot fatigue management, modeled after FAA Advisory Circular AC 117-3, to mitigate safety risks associated with high-frequency urban air taxi operations. Given that air taxis will require frequent take-offs and landings, fatigue monitoring is critical to ensuring safe and efficient operations.

- Implement a phased licensing model for autonomous air taxis, beginning with piloted operations, transitioning to remotely piloted aircraft, and ultimately enabling fully autonomous systems. This approach, similar to EASA's AI-driven risk assessment for autonomous aviation, ensures incremental regulatory oversight and safe operational integration.
- Encourage regulatory authorities to incorporate real-world case studies and empirical data in future policy revisions, ensuring that the legal framework evolves alongside technological advancements. Empirical insights from operational air taxi programs in the FAA and EASA should inform future revisions to CAR-UAM.
- Establish bilateral agreements between the UAE's GCAA, EASA, and FAA to harmonize air taxi certification processes and exchange safety data through regulatory workshops and shared compliance frameworks.
- Establish a regulatory sandbox to test and refine operational guidelines for fully autonomous air taxis before full implementation, ensure that operations manuals required by CAR-UAM are comprehensive, and provide clear guidance for the safe and efficient operation of air taxis.

By adopting these recommendations, the UAE can strengthen its air taxi regulatory framework, ensuring compliance with global best practices while addressing specific safety, licensing, and operational challenges inherent to urban air mobility.

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التنظيم القانوني في دولة الإمارات العربية المتحدة لتشغيل التاكسي الطائر "دراسة تحليلية ومقارِنة"

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ملخص البحث:

يمثل النقل الجوي باستخدام التاكسي الطائر، بما في ذلك التنقل الجوي الحضري، تحولاً ثورياً في وسائل النقل من خلال استخدام تقنيات الطائرات الكهربائية للإقلاع والهبوط العمودي (eVTOL) لنقل الركاب والبضائع والبريد، يركز هذا البحث على الإطار التنظيمي لمتطلبات تشغيل التاكسي الطائر في الإمارات العربية المتحدة، مع التأكيد على التقدم الذي أحرزته الهيئة العامة للطيران المدني (GCAA) في سن القوانين المتعلقة بالتاكسي الطائر والتي تغطي هذه الأطر مجالات تشغيلية رئيسية تشمل: ترخيص المشغل، التسجيل و شهادة صلاحية الطيران، ترخيص الطيارين، تنظيم السلامة، خدمات الملاحة الجوية، وتنظيم المطارات العمودية.

على الرغم من هذه الجهود، لا تزال هناك تحديات قائمة، لا سيما في ترخيص الطيارين وضمان سلامة العمليات، يسلط البحث الضوء على أوجه القصور الجوهرية في تنظيمات هيئة الطيران المدني، مقارنةً بالمعايير العالمية التي وضعتها إدارة الطيران الفيدرالية، ووكالة سلامة الطيران الأوروبية كما يقيم البحث مدى كفاية الأطر الحالية لمواجهة التحديات التشغيلية والسلامة التي يفرضها التاكسي الطائر، خاصةً في نطاق الطيران منخفض الارتفاع، باستخدام منهجية نوعية، يستعرض البحث الأدبيات الأكاديمية والأطر التنظيمية لتقديم فهم شامل للمشهد القانوني للتنقل الجوي الحضري. ويوفر البحث توصيات لتحسين لوائح التاكسي الطائر في الإمارات لتعزيز السلامة والكفاءة، بما يتماشى مع أفضل الممارسات الدولية، وضمان الدمج الناجح التاكسي الطائر في البيئات الحضرية.

الكلمات الدالة: التنقل الجوي الحضري (UAM)، التاكسي الطائر، الطائرات الكهربائية للإقلاع والهبوط العمودي، المطارات العمودية

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