Rooftop Runways: Evaluating the UAE's Regulatory Framework for Vertiports in Urban Air Mobility*

Pistas en azoteas: evaluación del marco regulatorio de los EAU para los vertipuertos en la movilidad aérea urbana

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Abstract

The emergence of electric vertical take-off and landing (eVTOL) aircraft is driving innovation in regulatory frameworks and infrastructure development for urban air mobility globally. The United Arab Emirates (UAE) has taken a pioneering role by introducing the first national regulations for vertiports, known as CAR-HVD. This paper critically evaluates the UAE's vertiport regulatory framework, emphasizing certification procedures, design and operational safety requirements, airspace integration, and electrical infrastructure considerations. A comparative analysis is conducted against corresponding frameworks from the U.S. Federal Aviation Administration (FAA), the European Union Aviation Safety Agency (EASA), and the International Civil Aviation Organization (ICAO).

Empirical insights drawn from global vertiport implementations, including case studies from Dubai, Abu Dhabi, the United States, Europe, and Asia, highlight the practical impacts and effectiveness of these regulatory approaches. Additionally, a comparative cost-benefit analysis examines vertiports relative to traditional transportation modes, emphasizing their economic viability and potential revenue generation. The paper concludes by proposing policy recommendations aimed at enhancing regulatory coherence, fostering stakeholder collaboration, ensuring public acceptance, and promoting sustainability. These insights support regulators, aviation stakeholders, urban planners, and policymakers in navigating the complex regulatory landscape of advanced urban air mobility infrastructure.

Keywords:

urban air mobility, vertiports, eVTOL aircraft, aviation regulations, CAR-HVD, air transport policy, infrastructure planning, cost-benefit analysis, aviation safety, regulatory harmonization, sustainable transportation, UAE.

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Resumen

La aparición de aeronaves eléctricas de despegue y aterrizaje vertical (eVTOL) está impulsando innovaciones significativas en los marcos regulatorios y en el desarrollo de infraestructura para la movilidad aérea urbana a nivel mundial. Los Emiratos Árabes Unidos (EAU) han asumido un rol pionero mediante la implementación de las primeras regulaciones nacionales específicas, destacando el reglamento CAR-HVD. Este estudio analiza comparativamente dicho marco regulatorio con los enfoques establecidos por la Agencia Europea de Seguridad Aérea (EASA), la Administración Federal de Aviación de Estados Unidos (FAA) y la Organización de Aviación Civil Internacional (OACI).

Asimismo, a partir de casos empíricos extraídos de implementaciones internacionales de vertipuertos, incluyendo estudios específicos de Dubái, Abu Dabi, Estados Unidos, Europa y Asia, se evalúan los efectos prácticos y la eficacia de estos enfoques normativos. Adicionalmente, mediante un análisis comparado costo-beneficio, se examinan las implicaciones económicas y operativas derivadas del despliegue de estas infraestructuras frente a métodos convencionales de transporte urbano. Finalmente, el estudio ofrece recomendaciones orientadas a fortalecer la armonización regulatoria y a promover el desarrollo sostenible, la colaboración internacional y la planificación estratégica de infraestructuras para la movilidad aérea urbana.

Palabras clave:

movilidad aérea urbana, vertipuertos, aeronaves eVTOL, regulación aeronáutica, CAR-HVD, política de transporte aéreo, planificación de infraestructura, análisis costo-beneficio, seguridad aeronáutica, armonización regulatoria, transporte sostenible, Emiratos Árabes Unidos.

Introducción

The advent of electric vertical take-off and landing (eVTOL) aircraft has prompted regulators to develop new infrastructure standards for “vertiports”—dedicated facilities for VTOL operations. The United Arab Emirates (UAE) is at the forefront, having issued the world’s first national vertiport regulations in 2023 (International Civil Aviation Organization [ICAO], 2023). This study provides a comprehensive analysis of the UAE’s vertiport regulatory framework, notably the Civil Aviation Regulation - Heliports, Vertiports, and Helidecks (CAR-HVD) and related guidance, and compares it with standards from the U.S. Federal Aviation Administration (FAA), the European Union Aviation Safety Agency (EASA), and the International Civil Aviation Organization (ICAO). Key aspects examined include vertiport certification processes, design and safety requirements (such as vertiport layout, emergency response, and airspace integration), electric infrastructure needs, and the legal and compliance challenges in implementation. Case studies from the UAE and abroad illustrate how these regulations are being applied in practice. Finally, the study evaluates best practices internationally and provides policy recommendations to enhance UAE vertiport laws in line with global trends and safe urban air mobility integration.

This multidisciplinary topic has drawn significant attention in recent research. Studies emphasize that proper vertiport siting and integration with existing transit networks are crucial for efficient operations (Rohrmeier et al., 2025). Economic analyses indicate that eVTOL air taxi services can be financially viable under realistic assumptions, especially as technology improves and maximum range increases (Liu and Gao, 2024, p. 4732). However, achieving viability will also depend on high utilization and effective business models; fully occupied eVTOL flights not only reduce per-passenger costs but also significantly lower emissions compared to car travel (Kasliwal et al., 2019, p. 1555). Safety remains paramount: the novel operational context of advanced air mobility calls for robust safety management frameworks and a strong safety culture (Hoffmann et al., 2024, p. 178). Environmental considerations are likewise key; while eVTOLs have zero operational emissions, their overall sustainability benefit depends on factors such as energy sources, with analyses suggesting substantial greenhouse gas reductions per trip when renewable energy is used (Kasliwal et al., 2019, p. 1555). These broader considerations underscore the importance of the UAE’s comprehensive regulatory approach.

1. UAE Vertiport Regulatory Framework

Overview: The UAE's General Civil Aviation Authority (GCAA) has established a pioneering vertiport regulatory framework via CAR-HVD (Issue 01, March 2023) (General Civil Aviation Authority [GCAA], 2023). This regulation—the first of its kind—covers the certification, design, and operational requirements for vertiports (International Civil Aviation Organization [ICAO], 2023), drawing on ICAO heliport standards (Annex 14, Vol. II) and augmenting them for eVTOL operations. The UAE carried out extensive studies in 2022, including impact assessments and gap analyses against ICAO, FAA, and EASA draft standards, to inform these rules (International Civil Aviation Organization [ICAO], 2023). The result is a robust framework to ensure that vertiports are safely designed, built, and operated in compliance with international best practices (International Civil Aviation Organization [ICAO], 2023).

Core Components of the UAE Vertiport Regulatory Framework

Certification of Public and Private Vertiports: UAE regulations distinguish vertiport certification based on the use and scope of operations (International Civil Aviation Organization [ICAO], 2023). Public-use vertiports require a full Vertiport Certificate issued by the General Civil Aviation Authority (GCAA), applicable to facilities serving general passenger operations (e.g., city air taxi hubs) or vertiports supporting the hospitality and tourism sectors (International Civil Aviation Organization [ICAO], 2023). In contrast, smaller or non-public vertiport sites can operate under a Vertiport Landing Area Acceptance (LAA), which is a form of limited certification for private or specialized use cases (International Civil Aviation Organization [ICAO], 2023). The LAA covers vertiports at hospitals and clinics for medical evacuation, flight training sites, corporate or private facilities, shipboard vertiports (on yachts or vessels), and emergency evacuation "vertipads" (International Civil Aviation Organization [ICAO], 2023). To obtain a Vertiport Certificate or LAA, applicants must use the GCAA's electronic platform (e-services) to submit details of the proposed vertiport (International Civil Aviation Organization [ICAO], 2023). The certification process entails an initial online application followed by a thorough GCAA review of the vertiport's design and plans (International Civil Aviation Organization [ICAO], 2023). The GCAA's Air Navigation and Aerodrome Department evaluates the physical characteristics, operational procedures, safety management systems, and airspace assessments for the site (International Civil Aviation Organization [ICAO], 2023). For full Vertiport Certificates, applicants must also nominate responsible post-holders (management personnel) and demonstrate compliance with all regulatory criteria (General Civil Aviation Authority [GCAA], 2023). If the vertiport meets the requirements, the GCAA issues the certificate or LAA; however, certification is just the beginning of regulatory compliance. The new vertiport is then subject to continuous safety oversight, including GCAA audits of facilities, equipment, procedures, and policies (International Civil Aviation Organization [ICAO], 2023). In essence, any vertiport in the United Arab Emirates (UAE) intended for commercial operations must be formally certified by the General Civil Aviation Authority (GCAA), which reflects a particularly stringent regulatory approach characterized by mandatory certification, detailed design and safety reviews, and ongoing oversight by aviation authorities. By contrast, as discussed later, some countries allow private vertiports to operate with minimal regulatory involvement.

Design, Operational, and Safety Requirements: The UAE's CAR-HVD prescribes detailed design standards and operational requirements to ensure vertiport safety. These include physical specifications (e.g., landing pad dimensions, load-bearing capacity, and lighting/visual aids) aligned with eVTOL performance, as well as new concepts tailored to VTOL aircraft. One innovation adopted is the "obstacle-free volume (OFV)"—a three-dimensional, funnel-shaped space above the vertiport that must be kept free of obstructions (International Civil Aviation Organization [ICAO], 2023). This concept expands on traditional heliport obstacle limitation surfaces to accommodate the steep climb and descent profiles of eVTOLs and was influenced by EASA's vertiport design proposals, which introduce OFV to enable vertical trajectories in urban environments (European Union Aviation Safety Agency [EASA], 2022). UAE

vertiports must establish defined obstacle limitation surfaces and an OFV to protect flight paths (International Civil Aviation Organization [ICAO], 2023), thereby ensuring safe approaches and departures even in dense urban settings.

Operationally, the UAE rules introduce specific safety personnel roles. Every vertiport must have a trained Vertiport Landing Officer (VLO) in charge of day-to-day flight operations on the ground (International Civil Aviation Organization [ICAO], 2023). The VLO is responsible for verifying that all physical and operational aspects of the vertiport are safe for each aircraft operation (International Civil Aviation Organization [ICAO], 2023). Assisting the VLO is at least one Vertiport Assistant (VA), who is tasked with duties such as marshaling and guiding passengers to and from the VTOL landing area, handling baggage or freight, and operating firefighting equipment under the VLO's direction (International Civil Aviation Organization [ICAO], 2023). These roles are akin to those of aerodrome officers on heliports but are specialized for vertiport operations. In addition to these roles, the regulations require an accountable manager and other operations post-holders, ensuring a clear chain of responsibility (International Civil Aviation Organization [ICAO], 2023).

Hence, the UAE's design and operational criteria aim to ensure that a vertiport's physical layout, staffing, and procedures minimize risks to passengers, crew, and third parties (International Civil Aviation Organization [ICAO], 2023). By requiring dedicated safety officers (VLOs), rigorous firefighting measures, obstacle-controlled airspace, and ongoing personnel training, the UAE framework extends many principles of airport and heliport safety into the urban vertiport context (General Civil Aviation Authority [GCAA], 2023). This comprehensive approach anticipates the unique challenges of hosting eVTOL aircraft in urban environments (General Civil Aviation Authority [GCAA], 2023).

Airspace Integration and Electrical Infrastructure: Airspace Integration: Recognizing that vertiports will be located in or near urban airspace, the UAE regulation mandates an airspace assessment for any proposed vertiport (International Civil Aviation Organization [ICAO], 2023). The General Civil Aviation Authority (GCAA) evaluates the airspace in the vicinity to ensure that eVTOL operations can be conducted safely alongside other air traffic. The assessment considers existing visual flight rules (VFR) routes, any special use or restricted airspace nearby, and defines specific ingress and egress routes for the vertiport (International Civil Aviation Organization [ICAO], 2023). In practice, this means that a vertiport applicant must coordinate with air navigation service providers to ensure that flight corridors or procedures are in place to segregate or integrate eVTOL traffic. For example, low-level corridors might be established to connect a city vertiport with higher-altitude airspace or airports. The UAE is actively working on "urban air corridors" in partnership with technology institutes and the air navigation service provider (Dubai Air Navigation Services) to enable the safe routing of air taxis between vertiports and airports or landmarks (Griffith y Cockrell, 2025). The goal is to develop an airspace management concept that accommodates both piloted and autonomous eVTOL flights in metropolitan areas without disrupting conventional aviation (Griffith y Cockrell, 2025). By requiring airspace assessments early in the vertiport certification process, the UAE ensures that vertiports are not approved in isolation from the broader air traffic system. This integrated approach helps prevent airspace conflicts and aligns with emerging urban air mobility (UAM) traffic management practices, such as the "U-space" concept in Europe and U.S. UAM corridors.

Electric Infrastructure: Since most advanced air mobility vehicles will be electric, the UAE regulations also address vertiport power and charging needs. Vertiports must be equipped with charging stations and electrical infrastructure suitable for the eVTOL aircraft they serve (International Civil Aviation Organization [ICAO], 2023). This includes provisions for on-site power generation or robust grid connections, as well as energy storage systems (batteries or UPS units) to ensure an uninterrupted power supply and safe charging interfaces. The requirement for on-site power backup (e.g., battery storage or generators) is important, given that any loss of power could disrupt charging or critical systems such as lighting. The UAE's inclusion of electric infrastructure in vertiport standards mirrors the recommendations of other au-

thorities; for instance, the FAA's early vertiport design guidance explicitly covers charging infrastructure and related safety considerations (Butterworth-Hayes, 2022). By planning for high-capacity electrical demand, the UAE framework acknowledges that vertiports are not just helipads but miniature airports with "fueling" (charging) facilities for multiple aircraft.

Sustainability and innovation: The UAE's vertiport plans are closely tied to its sustainability goals. Many vertiport designs incorporate solar panels and battery banks, as suggested by conceptual designs, aligning with the vision of carbon-neutral urban air mobility. The General Civil Aviation Authority (GCAA)'s regulations encourage modern infrastructure that supports quick turnaround charging, a resilient power supply, and potentially battery swapping or charging standardization in the future. Additionally, vertiport developers in the UAE are collaborating closely with electric utility providers and technology firms to ensure that the grid can handle the load of simultaneous fast charging of electric vertical takeoff and landing (eVTOL) aircraft. Therefore, the UAE's regulations integrate vertiports into both the airspace system and the electric power network, reflecting a holistic approach to enabling advanced air mobility.

Compliance Challenges in the UAE Legal System: Implementing this novel vertiport framework in the UAE presents several compliance and legal challenges, given the uncharted nature of urban air mobility. Firstly, the regulatory requirements are extensive and highly specific, which can be challenging for vertiport developers to meet in practice. As one industry executive noted, the UAE is currently the only country with detailed vertiport certification regulations covering construction, operations, and training, whereas elsewhere only guidance material exists (Butterworth-Hayes, 2023a). This means operators in the UAE must navigate a rigorous approval process, developing comprehensive manuals, safety cases, and training programs from scratch (Butterworth-Hayes, 2023a). Ensuring all "thousands of details"—from firefighting protocols to airspace coordination—are addressed requires significant expertise and coordination among stakeholders (Butterworth-Hayes, 2023a). The GCAA has mitigated this by consulting widely and offering support (workshops, industry feedback sessions) (International Civil Aviation Organization [ICAO], 2023), but the burden of compliance remains high for early adopters—namely, private sector vertiport developers and eVTOL operators—who must navigate extensive certification, safety planning, and infrastructure requirements under the UAE's regulatory framework.

Another challenge is the intersection of federal aviation regulations with local governance and infrastructure laws. Vertiports will interface with municipal rules regarding land use, building codes, and city planning. The UAE's legal system, which includes emirate-level authorities (e.g., Dubai's Roads and Transport Authority [RTA]), necessitates coordination between General Civil Aviation Authority (GCAA) regulations and local permits or urban development plans. For instance, integrating a vertiport into a city center or an existing transport hub may require alignment with zoning laws and environmental regulations, such as noise and visual impact. The UAE's approach has been to foster collaboration, exemplified by Dubai's RTA partnering with Skyports and the GCAA on vertiport projects (Butterworth-Hayes, 2025). Even so, reconciling aviation safety requirements (such as obstacle control or public protection zones) with urban constraints can be complex. This multi-jurisdictional aspect represents a new frontier for the legal system; authorities must clarify how vertiports are licensed as physical structures (e.g., building permits) in addition to their aviation certification. Enforcement and oversight present further challenges. The GCAA's commitment to continuous oversight means that vertiport operators will undergo regular audits and must maintain strict compliance post-certification (International Civil Aviation Organization [ICAO], 2023). Developing the internal compliance systems (such as quality assurance, self-auditing, and reporting mechanisms) is new for vertiport operators, who may not have the maturity of established airport operators (GCAA, 2023). There may be initial gaps in expertise; hence, there is an emphasis on training and the potential need to certify third-party vertiport operations service providers. Establishing a proactive safety culture within vertiport operations will be essential to support this training and compliance effort (Hoffmann et al., 2024, p. 178).

Additionally, regulatory evolution is inevitable: as eVTOL technology evolves, the rules may require rapid updates (for example, to accommodate autonomous operations or new aircraft sizes). Adapting the legal framework in a timely manner while providing certainty to the industry will be an ongoing balancing act.

2. Comparison with FAA, EASA, and ICAO Standards

The UAE's vertiport regulations are compared below with parallel efforts by the FAA (United States), EASA (Europe), and guidance from ICAO. Each jurisdiction is developing frameworks for vertiports and urban air mobility; however, they vary in scope and stage of maturity. The comparison highlights how the UAE's rules align with or diverge from international standards in terms of certification approaches, design criteria, operational requirements, and integration policies.

FAA (United States) Standards - Engineering Brief 105A and UAM ConOps 2.0: The FAA has not yet promulgated formal regulations for vertiports in the U.S. Federal Aviation Regulations; however, it has issued interim design guidance. The primary reference is FAA Engineering Brief No. 105, Vertiport Design, first released as a draft in September 2022 and updated as EB 105A (draft) in 2024 (Butterworth-Hayes, 2024). This document provides recommended standards for planning and constructing vertiports to support Advanced Air Mobility (AAM) operations. Unlike the binding United Arab Emirates Civil Aviation Regulation for Heliports, Vertiports, and Helidecks (CAR-HVD), the FAA's Engineering Brief 105A is advisory in nature, serving as guidance to assist states, municipalities, and airport authorities in designing vertiport facilities ahead of formal rulemaking. According to the FAA, EB 105A will be revised continually as data and eVTOL aircraft designs mature (Butterworth-Hayes, 2024).

Operational integration: The FAA's vision for how vertiports will function within the broader airspace is described in its Urban Air Mobility Concept of Operations (ConOps) 2.0 (April 2023). In this conceptual framework, vertiports and "vertistops" (minimal facilities for quick stops) are nodes in an urban air transport network (Federal Aviation Administration [FAA], 2023). The ConOps emphasizes that vertiports should be sited with intermodal connectivity in mind (linked to surface transport) and with adequate airspace buffers (Federal Aviation Administration [FAA], 2023). This focus on multimodal connectivity echoes academic recommendations to co-locate vertiports with major ground transport nodes for optimal accessibility (Rohrmeier et al., 2025). It introduces the idea of UAM corridors—defined flight lanes through which eVTOLs will travel between vertiports to manage traffic density and noise (Federal Aviation Administration [FAA], 2023; Butterworth-Hayes, 2023). The FAA encourages state and local authorities to protect the airspace around vertiports (similar to the UAE's obstacle-free volumes) and to plan for future growth (Federal Aviation Administration [FAA], 2023). Notably, U.S. vertiports currently do not require a federal certificate equivalent to the UAE's; they are often treated as heliport-like facilities, and private vertiports can be built without FAA approval, so long as no federal funding or public use is involved (Butterworth-Hayes, 2023a). This reflects a different regulatory philosophy: the U.S. is adopting a more decentralized, industry-driven approach initially, using guidance to shape development while awaiting more data from aircraft certification and pilot projects.

Consider clarifying the phrase "similar to the UAE's obstacle-free volumes" for readers unfamiliar with this term; it may be helpful to provide a brief explanation of what "obstacle-free volumes" entails.

Comparative Perspective: In comparison to the UAE, FAA standards are still in their formative stages. The UAE's CAR-HVD is more comprehensive in that it regulates vertiport operations and personnel (e.g., VLOs), whereas the FAA's EB 105A focuses on design and infrastructure standards. The U.S. framework for vertiport operations will likely evolve through advisory circulars or amendments to airport certification rules in the future; however, for now, compliance is largely voluntary. Nonetheless, the substance of the FAA's design guidance aligns well with UAE requirements—both address obstacles, vehicle separation, fire safety, and charging needs. A key difference is certification: the UAE mandates regulatory approval for any vertiport used commercially,

whereas in the U.S., a vertiport could theoretically be built and used privately without formal FAA certification (Butterworth-Hayes, 2023a). Only if a vertiport seeks to become part of the public transportation infrastructure (e.g., being included in an airport or seeking federal support) would it need to closely adhere to FAA criteria. Therefore, the FAA is developing flexible guidelines to spur vertiport development and gather lessons (for instance, through its industry "Vertiport Briefing Day" and comment process on EB 105A) (Butterworth-Hayes, 2024), while the UAE has already institutionalized requirements in law. The UAE's approach guarantees a high baseline of safety and standardization from the start, though it may impose more upfront costs. The FAA's approach offers more flexibility and innovation in the short term, with formal regulations to follow once eVTOL operations are proven. Both approaches ultimately seek to ensure safe vertiports, and it is expected that these regulatory approaches will converge over time as global best practices, including those established by the UAE, inform future FAA rulemaking.

EASA (Europe) Vertiport Design Standards and U-Space Integration: Europe, through Europe, through EASA, has also been proactive in vertiport planning, albeit through a preliminary 'prototype' regulatory approach—namely, the issuance of non-binding design specifications intended for stakeholder feedback and iterative refinement prior to formal rulemaking. In March 2022, EASA published the Prototype Technical Design Specifications for Vertiports (PTS-VPT-DSN)—the world's first dedicated vertiport design guidelines (Broadbent, 2023; European Union Aviation Safety Agency [EASA], 2022). The PTS is non-binding guidance intended to assist urban planners, aviation authorities in EU Member States, and industry stakeholders in designing vertiports for new VTOL aircraft (Broadbent, 2023). It effectively bridges the gap until formal EASA rules are adopted. Notably, these specifications currently apply to VFR (visual flight rules) vertiports, anticipating that initial operations will occur in good weather conditions and during daylight. Principal elements of the vertiport design guidance issued by EASA include the following:

- Obstacle Free Volume (OFV): The European Union Aviation Safety Agency (EASA) introduced the OFV concept, which refers to a funnel-shaped airspace above the vertiport that must remain clear (EASA, 2022). This concept acknowledges that many electric vertical takeoff and landing (eVTOL) aircraft can climb and descend nearly vertically, thereby allowing for omnidirectional approaches in tight urban environments—maneuvers that helicopters cannot safely perform (EASA, 2022). The OFV is tailored to each vertiport based on the surrounding terrain and buildings, as well as the performance characteristics of the aircraft. Furthermore, the regulations in the United Arab Emirates (UAE) explicitly incorporate an obstacle-free volume requirement as well (International Civil Aviation Organization [ICAO], 2023), demonstrating alignment with EASA's concept.

- Physical specifications: The PTS provides dimensions for touchdown and lift-off areas, safety areas, separation distances between pads, and load-bearing requirements, drawing from heliport certification specifications (such as EASA CS-HPT-DSN for heliports) but adjusted for VTOL vehicles (Scerri, 2022). For example, pad sizing might account for the larger planform of some eVTOLs and their different failure modes (e.g., a tilt-rotor design requiring a larger lateral safety buffer). The PTS also considers parking stands and taxiing areas for eVTOLs, if applicable.

- Infrastructure and safety: Like the FAA and UAE guidance, EASA's prototype specifications address charging and power supply, firefighting equipment, lighting, and markings. For instance, they suggest that firefighting capabilities at vertiports should correspond to the class of eVTOL and the associated battery risks. The guidance also calls for weather monitoring equipment and provisions for communication with aircraft or UTM (unmanned traffic management) systems.

- Integration considerations: The European Union Aviation Safety Agency (EASA) empha-

sizes the vertiport's role in the urban mobility ecosystem. While the PTS itself focuses on design, EASA acknowledges the need for future operational and organizational requirements for vertiport operators (European Union Aviation Safety Agency [EASA], 2022). In fact, EASA has launched a rulemaking task (RMT.0230) to develop comprehensive vertiport regulations, which will cover the certification of vertiports, oversight by authorities, and operational rules for vertiport management (European Union Aviation Safety Agency [EASA], 2022). This forthcoming framework will likely mirror what the UAE has done (i.e., requiring vertiport certification, defining roles, etc.), but in Europe, it will go through the rulemaking process with Member State input over the next couple of years.

ICAO (International Standards): ICAO is currently in catch-up mode regarding vertiports. The relevant material available from ICAO includes the heliport standards, which served as a foundational starting point. For instance, ICAO Annex 14, Volume II, specifies heliport obstacle limitation surfaces, firefighting categories, and other related standards; these have been adapted for vertiports by the UAE and other countries. As ICAO updates Annex 14 to include eVTOL, it is expected to formalize elements such as operational flight visibility (OFV) and performance-based criteria for new aircraft, just as it did when heliports were introduced alongside airports. Additionally, ICAO may provide guidance on vertiport location planning and the publication of vertiport data in aeronautical information. Notably, the UAE already requires the publication of vertiport information in the Aeronautical Information Publication for certified sites (General Civil Aviation Authority [GCAA], 2023), as well as operational procedures for multi-vertiport networks.

Therefore, the UAE's regulations currently diverge from the International Civil Aviation Organization (ICAO) only in the sense that they go beyond the existing ICAO heliport specifications, which serve as a baseline. There is no conflict per se; rather, there exists a gap in global standards. As ICAO works on Advanced Air Mobility (AAM) guidance, it is likely that much of what the UAE, the Federal Aviation Administration (FAA), and the European Union Aviation Safety Agency (EASA) have developed will be codified internationally. The UAE's proactive stance may well influence ICAO to adopt higher standards for vertiports, thereby aligning global practices with what is already being implemented in the UAE.

3. Case Studies of Vertiport Implementations

This section presents case studies of significant vertiport projects to demonstrate the use of these policies and standards. It encompasses innovative initiatives in the UAE, along with global instances from the U.S., Europe, and Asia. These case studies illuminate the practical problems and triumphs in vertiport development, along with the impact of varying regulatory frameworks on implementation.

UAE: Dubai and Abu Dhabi Vertiport Projects- The UAE's commitment to Advanced Air Mobility (AAM) is perhaps best exemplified in Dubai, which aims to launch air taxi services by 2026. In January 2025, the General Civil Aviation Authority (GCAA) granted technical design approval for the country's first commercial vertiport—the Dubai International Vertiport (DXV)—near Dubai International Airport (Butterworth-Hayes, 2025). This vertiport, developed by Skyports Infrastructure in partnership with Dubai's Road and Transport Authority (RTA) and Joby Aviation, is one of four planned sites that will form an initial air taxi network in Dubai (Butterworth-Hayes, 2025; Le Marquand, 2025). The design approval is a critical milestone under the new UAE vertiport regulations, as it confirms that the proposed facility meets the CAR-HVD Part III physical design requirements (Butterworth-Hayes, 2025). In the approval process, the GCAA scrutinized the vertiport's layout, dimensions, obstacle environment, and rescue and firefighting services (RFFS) plans (Butterworth-Hayes, 2025). Skyports had to demonstrate innovative safety solutions; for instance, a firefighting strategy capable of handling high-energy battery fires, given that the electric vertical takeoff and landing vehicles (eVTOLs) will be electric (Butterworth-Hayes, 2025). The DXV vertiport will feature multiple landing pads, passenger handling facilities, and charging stations, effectively acting as a small airport terminal for air taxis. Once operational, it is expected to handle Joby Aviation's eVTOL air-

craft, ferrying passengers between the airport and downtown Dubai in minutes. Abu Dhabi has similarly advanced plans, with a vertiport project in development to connect key hubs in the capital (Cyrill, 2024).

United States: Early Vertiport Initiatives - In the U.S., numerous vertiport initiatives are underway, propelled by both private ventures and city partnerships. One notable example is Vertiport Chicago, a facility originally built as a downtown helicopter port, now positioning itself as a hub for eVTOL services. United Airlines and Archer Aviation announced plans in 2023 to launch the first air taxi route in Chicago, connecting O'Hare International Airport with Vertiport Chicago by 2025 (Weitering, 2023; May, 2023). This plan will utilize the existing heliport infrastructure, which will be upgraded to vertiport standards (e.g., adding charging stations for Archer's Midnight aircraft). Because the FAA's vertiport standards are advisory, projects like this often involve local authorities; in this case, Chicago city officials and the Illinois Department of Transportation (DOT) are collaborating with Archer and United. Vertiport Chicago will serve as a testing ground for the FAA's guidance material in a real operation. This initiative highlights a pragmatic strategy in the U.S.: repurposing or co-opting existing heliports as vertiports, given that heliports are already zoned for VTOL operations. Similar efforts are occurring in other cities; for instance, Los Angeles has plans with Joby Aviation to use a downtown helipad network for air taxi routes, and Florida is witnessing the development of vertiport plans in Orlando and Miami (Lilium and Joby have both proposed vertiport facilities there).

It is important to note that no U.S. vertiport has been formally "certified" by the FAA to date because no such certification process exists yet. Instead, companies operate within local building codes and airport regulations. Some states, such as Ohio and Massachusetts, have begun drafting their own vertiport standards to address the regulatory gap for early projects—specifically, the absence of formal federal certification rules from the FAA. The U.S. is also exploring the use of 'pop-up' vertiports, which are temporary and mobile vertiport setups designed to support short-term trials, flight demonstrations, or initial operational testing without permanent infrastructure. In 2022, a startup in California built a prototype vertiport, complete with a lift platform and charger, to demonstrate an electric air taxi landing and charging, albeit not for public use. These decentralized efforts will eventually inform a more unified regulatory approach. The U.S. case studies contrast with those of the UAE: progress is being made through industry and local initiatives under general FAA guidance, rather than through a prescriptive federal licensing regime.

Europe: Vertiport Testbeds in France and Beyond - Europe's vertiport development is closely tied to demonstration projects supported by both industry consortia and government bodies. A flagship project is the Re.Invent Air Mobility vertiport testbed at Pontoise-Cormeilles airfield near Paris, France. In November 2022, Groupe ADP (the Paris airports operator), Skyports, and Volocopter inaugurated what they called Europe's first fully integrated vertiport terminal (Web Team, 2022). The facility includes a take-off/landing pad, a passenger terminal, a hangar, and supporting U-space digital infrastructure. It has been used to test critical aspects of eVTOL operations: ground handling procedures, charging cycles, air traffic integration, and the end-to-end passenger journey (including security screening and boarding) (Web Team, 2022). During launch demonstrations, a Volocopter prototype performed crewed flights to validate the concept (Web Team, 2022). This testbed is aircraft-agnostic and will be utilized by various eVTOL manufacturers to trial their vehicles in a real-world environment with a vertiport setup (Web Team, 2022). Crucially, it is meant to prepare Paris for planned air taxi services during the 2024 Olympics, shuttling passengers from Charles de Gaulle Airport to downtown via eVTOL. The regulatory oversight here falls under the French DGAC (the civil aviation authority), which granted temporary authorizations for the test flights. The project applied EASA's prototype design specifications and additional safety mitigations to approve the vertiport and its operations. The success of Pontoise is informing EASA's rulemaking and provides a model that demonstrates how vertiports can be safe and efficient.

Elsewhere in Europe, other projects are underway. In Italy, a vertiport prototype was opened at Rome's Fiumicino Airport in October 2022 in collaboration

with Volocopter and UrbanV (a consortium of Italian airport operators). This vertiport hosted a test flight of Volocopter's VoloCity vehicle and is part of Rome's plan for eVTOL connections to the city center. The UK saw a temporary "Air-One" vertiport demonstration in Coventry in 2022, developed by Urban-Air Port (now renamed Urban-Air). This was a futuristic dome-structured vertiport showcased for a few months to demonstrate how an urban air taxi hub could function, including passenger facilities and drone deliveries. It was supported by UK government funding as a technology demonstrator. Following that, Urban-Air announced plans to build permanent vertiports in the West Midlands and London, although these are in the early stages.

In terms of regulation, these European case studies operate under either experimental or existing local heliport approvals, as EASA's formal rules are not yet in place. They often require one-time authorizations for test flights and necessitate close coordination with aviation authorities. The lessons learned are contributing to EASA's ongoing vertiport rulemaking process. Collectively, the European examples demonstrate that vertiports can be developed safely through pilot projects, which, in turn, accelerate the creation of formal standards.

4. Alignment with International Best Practices and Regulatory Divergences

Analyzing the UAE's vertiport regulations in the context of FAA, EASA, and ICAO developments reveals several best practices that are emerging globally and highlights areas where approaches differ. The UAE's regulations largely align with evolving international best practices in design and safety; they are ahead in formally requiring what others only recommend, positioning the UAE as a leader in vertiport safety oversight. There are few areas of significant divergence in substance, with more pronounced differences in regulatory approach (mandatory vs. voluntary, comprehensive vs. piecemeal). As global standards crystallize through ICAO or converging FAA/EASA rules, it is likely that the UAE's rules will prove to be very close to the international consensus model. Any divergences, such as the stringency of requiring certifications for all vertiports, may simply become examples of rigorous implementation. This alignment is evidenced by experts praising the UAE's detailed regulations at a time when "no worldwide standardized AAM regulations" yet exist (Griffith y Cockrell, 2025). This absence of unified standards for vertiports is echoed in academic analyses, which call for clearer legal definitions and frameworks across jurisdictions (Scott, 2022, pp. 503-526). The key for the UAE is to stay flexible and update its framework to remain aligned as technology and global standards evolve—a matter that is addressed in the recommendations section.

5. Policy Recommendations for UAE Vertiport Laws

Drawing upon the comparative regulatory analysis and established international best practices examined throughout this study, the following policy recommendations are proposed to enhance and ensure the resilience of the UAE's vertiport regulatory framework:

1. Continue Engagement in Global Standard-Setting: The UAE should maintain its leadership role by actively participating in ICAO's vertiport and AAM working groups. By sharing data and lessons from its early vertiport projects, the General Civil Aviation Authority (GCAA) can help shape ICAO Standards and Recommended Practices (SARPs) that align with the UAE's high safety standards. ICAO holds the mandate to establish rules for air navigation over the high seas, and states should align their national frameworks accordingly to avoid fragmented or unilateral approaches that could undermine global aviation safety and interoperability (Farooqui, M. O., Kisswani, N., Abbas, S., & Qureshi, T., 2022). In turn, once ICAO publishes guidance, the UAE should be prepared to harmonize its regulations with those global standards. This will facilitate international interoperability—for example, ensuring that foreign eVTOL operators find UAE vertiports meeting familiar criteria, and vice versa. Early adoption of any ICAO recommendations (or even voluntary compliance with draft ICAO proposals) will keep the UAE framework at the cutting edge. Essentially, as worldwide standards catch up to what the UAE has done, the UAE should transition from "first mover" rules to "globally harmonized" rules to support a seamless international AAM system.

2. Implement a Review and Update Mechanism: Given the nascent and fast-evolving nature of Advanced Air Mobility (AAM), the General Civil Aviation Authority (GCAA) should institute a formal mechanism to periodically review and update the Civil Aviation Regulation for High-Volume Density (CAR-HVD). This could involve establishing an AAM advisory committee or conducting annual consultations with vertiport operators and electric vertical takeoff and landing (eVTOL) manufacturers. As real operational data becomes available from testbeds in the United Arab Emirates (UAE) and abroad, some design criteria or procedures may require adjustment. For example, if field experience indicates that current obstacle clearance requirements are overly conservative (or not conservative enough), the regulation can be amended. The Federal Aviation Administration's (FAA) approach of iteratively updating its Engineering Brief (Butterworth-Hayes, 2024) serves as a useful model; the UAE should also be open to revising standards based on evidence. A practical step could be to publish Guidance Material or Advisory Circulars under CAR-HVD that provide clarifications or new best practices without waiting for full regulatory amendments. This flexible approach ensures that the law keeps pace with technological progress and lessons learned.

3. Foster Multi-Agency Integration (Urban Planning and Infrastructure): To address compliance challenges and ensure that vertiports integrate smoothly into cities, UAE authorities should strengthen collaboration between the General Civil Aviation Authority (GCAA) and local government bodies, including municipalities, urban planners, and transport authorities. It is recommended that a national vertiport planning guideline be developed jointly with entities such as Dubai's Roads and Transport Authority (RTA), Abu Dhabi's transport department, and civil defense authorities. This guideline would cover the processes for site selection, obtaining building permits alongside the GCAA vertiport certificate, community engagement, and environmental impact assessments. Establishing a one-stop or coordinated permitting process will help vertiport developers meet both aviation and local requirements efficiently. Such multi-stakeholder planning aligns with research highlighting the need for the early involvement of urban planners and communities in vertiport site selection to ensure safety and accessibility (Rohrmeier et al., 2025). Additionally, utility companies should be involved in planning vertiport power infrastructure—for instance, ensuring grid upgrades for high-capacity charging stations. Proactively integrating vertiports into urban development plans (e.g., reserving rooftop spaces or vacant land for future vertiports in zoning plans) will facilitate implementation and align with broader urban mobility goals.

4. Emphasize U-Space and Digital Traffic Management Integration: The UAE should leverage and perhaps formalize aspects of U-Space (the European UAM traffic management concept) for Advanced Air Mobility (AAM). Since the General Civil Aviation Authority (GCAA) is working on urban air corridors and digital airspace management with partners (Butterworth-Hayes, 2023a), it would be beneficial to codify requirements for vertiport connectivity to these systems. For example, regulations or guidance could require that certified vertiports have the capability to interface with a future UAE UAM traffic management network—transmitting vertiport availability, weather, and operational status in real time to eVTOL operators and the air navigation service provider. This will enable dynamic management of flights, including slot scheduling and demand/capacity balancing among vertiports. As part of this, data and cybersecurity standards should be developed for vertiports, ensuring that communication links (for example, between a vertiport and an aircraft for automated landing clearance) are secure and reliable. Incorporating such forward-looking digital requirements will position the UAE to handle high-density operations safely, especially as autonomous flights become a reality.

5. Expand Training and Certification Ecosystem: Building on CAR-HVD's training mandates, the UAE should encourage the establishment of vertiport training centers and certification programs for key personnel. This initiative might involve partnering with aviation academies or the UAE's civil aviation training center to develop curricula for Vertical Landing Operators (VLOs), operations managers, and maintenance technicians specialized in vertiport systems. By 2027, when commercial operations are expected to commence, the goal should be to have

a pipeline of fully qualified professionals to staff the ecosystem (Butterworth-Hayes, 2023a). The General Civil Aviation Authority (GCAA) can publish detailed guidance on the required qualifications and may even consider implementing a licensing system for VLOs, analogous to that of air traffic controllers or aerodrome managers. Additionally, facilitating workshops or simulation exercises with emergency responders and vertiport staff will enhance preparedness for incidents. Investing in human capital and certification will address the concern regarding the "lack of understanding of the complexity" by ensuring that everyone working at or around vertiports is competent and aligned in their knowledge (Butterworth-Hayes, 2023a).

6. Streamline Processes for Smaller Vertiports and Innovation

While keeping safety paramount, the UAE could introduce proportionate compliance pathways for vertiports with different risk profiles. For example, a hospital rooftop "vertipad" used occasionally for emergency air ambulance eVTOLs should meet core safety requirements but might not need as extensive infrastructure as a busy downtown vertiport. The GCAA could define a tiered compliance system within the Landing Area Acceptance (LAA) category to make it easier for hospitals or private sites to gain approval, possibly through standardized layouts or preapproved designs. This would encourage adoption in sectors like healthcare by reducing red tape (while still upholding basic safety levels). Conversely, for commercial vertiport developers, the GCAA might consider creating a regulatory sandbox or trial permit process. This could allow, for instance, a temporary vertiport to operate experimentally (under strict oversight) to gather data, which can then support full certification. Such an approach can foster innovation—much like how Dubai has sandbox programs for drones. The regulations should be adaptable to accommodate new vertiport concepts (floating vertiports, portable vertipads, etc.) as long as safety is demonstrated.

7. Strengthen Community and Environmental Protections

To ensure public acceptance—a key factor in the long-term success of urban air mobility—the UAE should incorporate explicit community protection measures into vertiport planning. This includes establishing guidelines for noise management, such as requiring vertiport designs to incorporate noise abatement features (e.g., acoustic barriers or placements that minimize overflights of residential areas) and ensuring that eVTOL operations adhere to specified noise thresholds. The UAE could adopt metrics from ICAO's helicopter noise standards or those being developed specifically for eVTOLs. This is critical, as public surveys identify noise as one of the primary concerns regarding vertiport development (Biehle, 2022, p. 9312). Additionally, vertiport regulations could mandate community outreach—informing residents about new vertiport developments and addressing their concerns—as part of the certification process.

On the environmental front, while eVTOLs produce zero operational emissions, construction and power generation remain significant factors. Life-cycle analyses indicate that fully occupied eVTOL flights can yield significantly lower greenhouse gas emissions per passenger-kilometer than equivalent car trips (Kasliwal et al., 2019, p. 1555), reinforcing the importance of powering vertiports and vehicles with clean energy. Therefore, encouraging sustainable vertiport design—such as solar panels and green building practices—within the regulatory framework would align with best practices. The GCAA might collaborate with the Ministry of Energy to ensure that vertiports leverage renewable energy whenever possible (indeed, some conceptual vertiports have solar-paneled roofing). These measures will help maintain public support and align vertiport deployment with the UAE's sustainability and smart city objectives.

8. Encourage Regional and Global Collaboration: Finally, the UAE should consider extending its influence by collaborating with neighboring countries in the GCC and the broader Middle East to promote harmonized vertiport regulations. As AAM grows, cross-border eVTOL operations might emerge (for example, future air taxi routes between Dubai and Abu Dhabi or Dubai and Oman). Having com-

mon or mutually recognized vertiport standards in the region would facilitate such operations. The UAE can lead a regional initiative under ICAO's MID Office to share its CAR-HVD framework as a template. The UAE could offer technical assistance or pursue bilateral agreements for vertiport certification with regional allies. This not only cements the UAE's role as a center of excellence in advanced air mobility regulation, vertiport infrastructure development, and urban airspace integration, but also ensures that vertiport safety does not stop at the border. In the same vein, building partnerships with international standards bodies (ASTM, ISO) on vertiport infrastructure standards could provide the UAE with early access to new developments and a voice in their creation.

Through the implementation of these recommendations, the UAE can enhance its vertiport regulatory regime to be even more adaptive, inclusive, and future-ready. The overarching strategy is to maintain the high safety standards set by current laws while improving flexibility and integration. Through global engagement and continuous improvement, UAE vertiport regulations will not only keep pace with the Advanced Air Mobility (AAM) industry but also actively drive it towards safe and efficient maturation.

Conclusion

The UAE's vertiport regulations (CAR-HVD and related policies) represent a pioneering and comprehensive approach to enabling advanced air mobility infrastructure. This research has examined the key facets of the UAE framework—from stringent certification requirements for both public and private vertiports to detailed design and safety standards (encompassing VLO personnel, obstacle-free airspace, emergency response, and charging systems) to the integration of vertiports into the national airspace and power grid. In comparing these rules with the evolving standards of the FAA, EASA, and ICAO, the analysis indicates that the UAE's regulatory framework is largely aligned with global best practices and is frequently advanced in its implementation. While the FAA and EASA have laid out forward-looking guidance, the UAE has operationalized those concepts into enforceable law, thereby offering a valuable case study to the world.

The case studies of vertiport projects in Dubai and Abu Dhabi underline how a robust legal framework can translate into on-the-ground progress as the UAE races toward launching air taxi services. International examples from the U.S., Europe, and Asia provide context and highlight the importance of regulatory support in advancing vertiport initiatives. The UAE's laws demonstrate both alignment (in technical standards and safety objectives) and some divergence (in the strictness of regulatory control) compared to those of other regions; however, these differences serve the goal of achieving a safe Urban Air Mobility (UAM) ecosystem and will likely narrow as global standards catch up.

Going forward, the UAE's challenge will be to maintain its leadership while harmonizing with international norms and refining its regulations in light of new knowledge. The recommendations offered—spanning global coordination, iterative regulatory updates, multi-agency integration, digital airspace management, training ecosystems, proportional compliance, community engagement, and regional partnerships—are aimed at strengthening the UAE's vertiport regulatory framework. By adopting these measures, the UAE can ensure that its laws remain at the forefront of safety and innovation, providing a model framework for vertiports that other nations can emulate. In doing so, the UAE will not only achieve its own urban mobility ambitions but also contribute significantly to the worldwide adoption of advanced air mobility, helping to usher in a new era of cleaner, faster, and smarter transportation.

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