New innovation-new liability challenges: a comparative civil liability framework for eVTOL malfunction

International Journal of Law and Management

Sumaiya Firoz Nomani and Mohammad Rababa
College of Law, University of Dubai, Dubai, United Arab Emirates

Hussain Al-Ahmad
University of Dubai, Dubai, United Arab Emirates

Husameldin Mukhtar
College of Engineering and IT, University of Dubai, Dubai, United Arab Emirates

Nasiruddeen Muhammad
College of Law, University of Dubai, Dubai, United Arab Emirates

Saad Ali Amin
College of Engineering and IT, University of Dubai, Dubai, United Arab Emirates

Burkhard Schafer
School of Law, The University of Edinburgh, Edinburgh, UK, and

Karem Sayed Aboelazm
College of Law, United Arab Emirates University, Al Ain Abu Dhabi, United Arab Emirates

Received 27 March 2026
Revised 17 April 2026
Accepted 20 May 2026

Abstract

Purpose – This study aims to examine whether existing civil liability regimes are capable of responding adequately to accidents involving electric vertical take-off and landing aircraft (eVTOLs) and considers how liability allocation may be structured to support the safe and commercially viable deployment of urban air mobility services.

Design/methodology/approach – This study adopts a qualitative doctrinal and comparative approach. It analyses relevant principles of tort law, product liability and aviation liability across the USA, the European Union and the United Arab Emirates, with particular focus on harm arising from software malfunction, autonomous or semi-autonomous operations, infrastructure failure and multi-party service delivery models.

Findings – This study finds that existing liability frameworks are only partially equipped to address eVTOL-related harm. Conventional fault-based rules and existing aviation liability instruments were developed for more traditional forms of carriage and do not adequately reflect distributed operational control, algorithmic

Funding: The funding was not from any international institute. It was from the University of Dubai Internal Research Fund.

International Journal of Law and Management
Emerald Publishing Limited
1754-243X
DOI 10.1108/IJLMA-03-2026-0150

decision-making or the fragmented contractual structure of eVTOL markets. This study argues for a tiered liability framework based on functional control, under which manufacturers and software developers would bear strict liability for design and software defects, operators would remain responsible for operational and maintenance failures and infrastructure providers would face presumptive responsibility where vertiport or support system failures materially contribute to damage.

Originality/value – This study contributes to emerging eVTOL scholarship by framing civil liability as an element of market governance and risk allocation rather than merely a remedial mechanism. To the best of the authors' knowledge, it is the first of its kind to do so. It further advances a UAE-focused reform model combining presumption of causality, mandatory insurance and specialised dispute resolution.

Keywords Government policy, Government regulation, Policy and law, Law of tort

Paper type Research paper

1. Introduction

This article situates electric vertical take-off and landing aircraft (eVTOL) services as an emerging commercial mobility market rather than solely an advancement in aviation technology. The market involves manufacturers, software providers, operators, vertiport providers, maintenance contractors, insurers, financiers and consumer service platforms. For these stakeholders, civil liability serves as a market infrastructure that determines consumer trust, risk pricing, insurability and contract allocation.

While eVTOL services present a significant business opportunity, like new fleet operations, vertiport development, maintenance services, software and data services and insurance, commercial deployment depends on predictable liability exposure. Businesses offering eVTOL services must internalise that taxi malfunction and autonomous decision-making can produce severe harms, yet currently there is no settled case law and no dedicated statutory civil liability regime tailored to passenger eVTOL operations.

Urban air mobility (UAM), as a part of advanced air mobility (AAM), is increasingly being developed as a commercial mobility service for densely populated cities. Within this ecosystem, eVTOLs are positioned as passenger-focused flying taxi operations supported by vertiports, digital navigation infrastructure and multi-party service chains. As deployment moves from experimentation to commercial rollout, the primary obstacle is no longer merely technical feasibility, but the creation of market-ready legal infrastructure, particularly civil liability regulations that determine how accident risk is priced, insured, allocated and trusted by consumers. The commercial rationale for eVTOL services is driven by persistent traffic congestion, environmental challenges and the need for time-efficient mobility in urban settings.

Although eVTOLs are promoted as quieter and potentially more operationally efficient than traditional rotorcraft, their commercial viability depends on the ability of private manufacturers and regulators to convert safety aspirations into enforceable governance. In practical terms, companies and consumers will assess the viability of the flying taxi services based not only on performance but also whether there is clear accountability if a malfunction, operational error or infrastructure failure results in harm. Although national tort regimes and the Montreal Convention offer a basic regulatory structure for addressing harms arising from traditional aviation, they are insufficient when applied to the operational reality of eVTOL systems. For instance, the Montreal Convention provides limited guidance on liability for urban, short-range or autonomous air mobility services and is designed for international air carriage involving human pilots and fixed routes. Similarly, traditional tort law presumes human agency and apparent causality, which are challenging to apply when injuries are caused by judgments made by artificial intelligence AI or system failures. These blind spots underscore the need for specialised liability frameworks that take into account the software-driven and partially autonomous nature of eVTOL operations.

Three factors make the liability issue challenging: firstly, companies and insurers are deprived of reliable benchmarks due to the absence of any direct eVTOL accident case law. Secondly, traditional fault-based litigation is expensive and time consuming because victims cannot access software logs or proprietary decision routes, which makes causation evidentially complex. Thirdly, the ecosystem distributes accountability among several parties (manufacturers, operators, software provider, vertiport provider), which makes liability disputed and commercially destabilising.

The planned deployment of eVTOL services at the Paris Olympic Games 2024 serves as an example of how quickly commercial timelines can be disrupted when legal and procedural readiness is contested. Even in cases where aircraft development progresses, projects remain vulnerable to judicial scrutiny on public law requirements, including procedural transparency and environmental assessment, which delays market entry and creates investor uncertainty. This example emphasises that strong civil liability is a crucial component of the legal framework that determines whether eVTOL services can operate as a reliable commercial offering.

This article examines how the European Union (EU), the USA and the United Arab Emirates differ across tort, product liability and aviation frameworks, with a focus on civil liability resulting from eVTOL accidents, such as passenger injury, wrongful death and third-party ground damage. It will also illustrate why these frameworks are not prepared for autonomous operations. It will further evaluate the commercial law implications of liability uncertainty. Based on this, the article suggests a tiered civil liability model aligned with functional control, backed by a presumption of causality for AI-related malfunctions. Furthermore, it suggests a legislative blueprint for the UAE that would protect legitimate business activity while providing customer assurance, clearer risk allocation and faster compensation pathways. In a market where safety is crucial, depending on traditional litigation to discover workable liability standards would result in significant delays and transaction costs because passenger eVTOL operations have not yet started; therefore, there are no established precedent case laws. Thus, the framework developed in this article is presented as a transferable blueprint that jurisdictions can adapt ex ante to stabilise risk allocation, support underwriting and enable responsible commercial scaling of flying taxi services.

This article contributes to a market-oriented civil liability structure for passenger eVTOL services by translating doctrinal principles into an operation allocation model that regulators, insurers and service providers can use to provide passengers with predictable compensation while safeguarding lawful business activity. It recommends a tiered liability approach that is in line with functional control across manufacturers, software providers and operators. This model will provide a baseline for predictable passenger compensation while protecting business activity in the industry. Therefore, civil liability is not treated as a purely ex post dispute mechanism but as part of the governance infrastructure required for scalable commercial deployment.

Recent scholarship has increasingly addressed AI Liability, autonomous system governance and AAM regulation. However, a large portion of this literature is divided between general discussions on AI accountability, product liability reform and the public law governance of emerging aviation technologies (Bertolini, 2025) (Wiedemann *et al.*, 2024). Less attention has been given to how civil liability should be allocated in passenger eVTOL services as a multi-actor commercial ecosystem involving manufacturers, software developers and operators. This article addresses that gap by developing a comparative liability framework that links doctrinal allocation, evidentiary fairness and commercial viability in the context of autonomous and semi-autonomous eVTOL operations.

2. Methodology and data collection

This article uses a qualitative, doctrinal and comparative research methodology, informed by an interdisciplinary law-and-management perspective, to analyse the civil liability frameworks governing autonomous eVTOLs in the EU, USA and UAE. The study is exploratory, focusing on how legal systems allocate risk and responsibility in technologically complex, AI-driven aviation environments central to emerging UAM markets.

2.1 Doctrinal legal analysis

The primary methodological approach is doctrinal legal analysis, examining how existing civil liability, product liability and aviation law doctrines respond to harms arising from autonomous eVTOL operations. The research analyses primary legal sources, including legislation, aviation regulations and regulatory guidance. In the EU and USA, particular emphasis is placed on certification and safety frameworks developed by the European Union Aviation Safety Agency (EASA, 2024) and the Federal Aviation Administration, 2021 (FAA), alongside general tort and product liability regimes. In the UAE context, the analysis considers federal civil law provisions, aviation regulations and the principles of civil liability rules. This enables an assessment of how hybrid legal systems manage technological risk in rapidly developing innovation-driven sectors.

Secondary sources: including research papers, regulatory impact assessments, policy reports and industry consultations that have been used to contextualise the legal analysis and to identify emerging governance trends relevant to autonomous systems and AI-enabled decision-making.

2.2 Comparative approach

The research adopts a comparative methodology, comparing how different jurisdictions address similar liability challenges rather than conducting a purely formal comparison of legal rules. The EU, USA and UAE are selected for their strategic importance in regulating AAM, their differing legal traditions and their influence on global aviation governance.

The comparison is structured around five criteria central to civil liability in autonomous eVTOL operations. It starts by looking at how different jurisdictions allocate responsibility among manufacturers, operators and software developers. Secondly, it examines whether current tort or product liability frameworks can accommodate software-related malfunctions and AI-enabled decision-making. Thirdly, it evaluates how each system addresses causation and evidentiary burdens where the harmful process is technically ambiguous to victims. Fourthly, it assesses whether existing rules support timely compensation for passengers and third parties. Fifthly, it considers the commercial implications of liability design, particularly for insurance, contractual risk transfer and operational scalability.

2.3 Limitation

This research is subject to several limitations. Firstly, because passenger eVTOL services have not yet generated a mature body of judicial decisions and case law, the analysis relies on doctrinal reasoning, comparative inference and analogy from adjacent fields such as product liability, aviation liability and autonomous systems governance. Secondly, the article focuses on civil liability for passenger injury, wrongful death and third-party ground damage and does not seek to provide a comprehensive account of criminal liability, certification law or public law licencing except where those areas materially influence private liability allocation. Thirdly, the proposed framework is normative and futuristic; it is meant to serve as an ex ante governance model rather than asserting a claim that the legal systems have already come to a consensus. Finally, although a tiered liability approach supported by a presumption of causality may offer a more practical model for eVTOL operations, it may also generate higher compliance burdens and increased documentation obligations.

3. Civil liability in eVTOL operations

3.1 Understanding civil liability

Civil liability concerns the obligation to compensate for harm caused to another individual or their property (Oman, 2014). In the context of eVTOL operations, civil liability has a market structuring role, it determines who is responsible for accident costs, how quickly victims can be compensated and how risk is allocated across manufacturers, operators, software providers and infrastructure actors. These questions are commercially decisive because they shape insurance underwriting, contractual allocation and consumer confidence in new mobility services. In the USA, civil liability is primarily managed through tort law, where negligence, product liability and vicarious liability are central pathways for claims following accidents (Abraham, 2021; Tilley, 2017). These doctrines presume relative human agency and traceable causation, which becomes harder to apply when harm results from automated decision-making systems. In such cases, litigation may turn to expert evidence, access to technical data and disputes over which party exercised functional control at the time of failure. In the EU, strict product liability has historically been a significant factor in compensating victims of defective products under the EU's Product Liability Directive, while member states also retain national tort law rules (Kleis, 2024). In contrast, the UAE has a layered framework that combines aviation law obligations, civil code tort principles and *Sharia*-influenced dimensions of compensation. Across all jurisdictions, the doctrinal tools to enforce accountability exist, but eVTOLs intensify the attribution problem because harm may result from a combination of factors such as design, software updates, maintenance, operational decisions or infrastructure failures, making traditional fault and causation analysis commercially uncertain and procedurally costly.

The key legal principles of civil liability are fault-based liability, strict liability and vicarious liability (Goudkamp, 2023). The first component of civil liability is fault, which is a violation of a legal obligation (Goldberg and Zipursky, 2016). Breaking any law or even a legal obligation that is not governed by the law might be seen as a fault. In strict liability, parties are held liable irrespective of fault (Goldberg and Zipursky, 2016). This idea is frequently used in pursuits that are known to be inherently dangerous and risky, like aviation, where there is a significant chance of mishap despite strict safety protocols (Schwab, 2025). When someone is held liable for harm done by a third party acting in the principal's best interest, it is known as vicarious liability. This form of liability is imposed irrespective of the principal's personal fault. Through this liability, employers or companies are held liable for the actions of their employees (Geistfeld, 2024). These principles form the doctrinal basis for assessing liability in new aviation contexts, including eVTOLs, where autonomous technologies complicate traditional assessments of causation and fault.

Table 1 provides the differences between civil liability principles in the three jurisdictions: the USA, the EU and the UAE.

3.2 Civil liability in the context of eVTOLs

The principles of civil liability become complex when applied to eVTOLs because they are envisioned to be autonomous in the future; therefore, determining liability in the event of a software malfunction or a system failure is challenging (Haertlein, 2018). It is difficult to know whom to blame for such a malfunction: the manufacturer, the software developer or the operator. Third-party liability for mishaps that impact persons and properties on the ground is further increased because eVTOLs will be flying over crowded urban areas (Sadrani *et al.*, 2025). In addition, as eVTOLs are a new technology, there is a lack of operating history and data, which creates uncertainties in risk evaluation and legal precedents.

Table 1. Difference between civil liability principles

Aspect	USA	European Union	UAE
Effect of tort law	Negligence-based: plaintiff must prove breach, causation, etc.	Fault-based and strict liability (as per the case)	A more flexible approach (judges may adjust liability based on fairness by integrating civil laws with *Sharia* principles)
Strict liability	Applies in product liability, consumer protection cases, etc.	Prevalent in consumer protection and defective product cases	Applies in contracts and product liability cases (Bhargava, 2023)
Limitations from contract	Liability may be limited by contracts	Certain liability exclusions are void	Courts review contracts and may alter agreed damages (Art. 390 UAE Civil Code 1985)

Source(s): Authors' elaboration

There are international conventions, such as the Montreal Convention of 1999, which address liability for international air carriers. The convention governs the international carriage of passengers, baggage and cargo (De Leon and Eyskens, 2001). It specifies airline liability in the event of passenger death or injury as well as delays, damage or loss of baggage and cargo (Aziz, 2017). It brings together various international treaties that have been established incrementally since 1929 and deal with airline liability. It is a global convention that regulates airline liability (Montreal Convention). However, its scope is limited to the "carriage of passengers, baggage and cargo" on international flights, and therefore, it does not automatically apply to domestic or urban eVTOL operations.

According to Articles 17–19 of the Montreal Convention, airlines are held strictly liable for three types of incidents: firstly, passenger death or injury; secondly, cargo damage; and lastly, damage caused by delays (Art. 17–19 Montreal Convention). However, the applicability of any international treaty or convention depends on ratification by a specific country. To date, 113 countries have ratified the Montreal Convention, including the USA, UAE and EU (International Civil Aviation Organisation, 1999). Despite being a comprehensive framework for international aviation, the Convention does not account for autonomous eVTOL operations, which creates gaps in liability rules (Abeyratne, 2024).

3.3 Commercialisation and risk transfer in the eVTOL market

Instead of using a single integrated supplier, eVTOL passenger services will be provided through multi-party commercial arrangements. Operators will contract with manufacturers for aircraft supplies and warranties, with software providers for autonomy functions and upgrades, with maintenance organisations for continuous airworthiness activities and with vertiport operators for infrastructure access and service-level performance. In this context, civil liability rules interact directly with contract design, including indemnities, limitation clauses, warranty carveouts and update obligations, which will determine whether risk is realistically transferable or merely displaced onto weaker parties.

Insurance is the practical link between liability rules and commercial deployment. When it is challenging to establish accident causation and liability is spread across several participants, underwriting becomes conservative and costly. A predictable liability allocation model, especially one that clarifies product defect exposure, operator negligence and infrastructure responsibility, supports more stable insurance pricing. This makes it easier for investors and operators to evaluate the financial viability of service scale and fleet size.

Consumer protection considerations also influence market acceptance. Passengers will expect clarity on autonomy level, safety assurances and compensation pathways if a malfunction occurs. If consumer-facing terms attempt to exclude liability or obscure redress, reputational and regulatory risk will increase. To maintain insurability and lower the risk of negligence, eVTOL services will also impose a compliance cost base beyond aircraft acquisition. Operational profitability depends on sustained investment in staff training, maintenance governance, incident reporting and audit-ready documentation.

In practical terms, civil liability in eVTOL operations is more likely to occur at identifiable operational points rather than in the abstract. These include software navigation errors, defective updates, battery or propulsion failures, negligent maintenance, vertiport charging or communications failures. Framing liability around these scenarios is essential because it shows that the question is not whether harm will be legally cognisable but how liability should be allocated where a single accident may involve layered technical and operational contributions.

3.4 Civil liability in eVTOL operations: the USA

Because there are no specific eVTOL laws for liability, the US tort law will govern civil liability disputes. In case of negligence [1], it is essential to understand who is liable for it. In the aviation industry, negligence can take different forms, such as inadequate maintenance of aircraft, poor operational decision-making, poor training of staff, including pilots and failure to create a safe environment. Instances of negligence could include mishaps brought about by insufficient safety precautions or delays due to mechanical malfunctions. According to the type of negligence, the liability shall vary from airline companies to manufacturers and operators.

The liability of manufacturers and operators will mostly arise when there is a problem with the product. For example, in the case of eVTOL, if it were to crash in a public place due to a glitch in its software, the liability may fall on the manufacturer for the faulty software and the operator for not testing the eVTOL prior to usage, depending on the facts of the case and applicable standards of care.eVTOLs are often considered to be a part of the unmanned aerial system (UAS), except those that are piloted or semi-autonomous (Gennaro Ariante and Del Core, 2025). Their similarity to drones is undeniable, with both of them having electric propulsion, vertical take-off and landing, multiple rotors; however, they have slight differences, for example, eVTOLs can carry heavier loads, unlike drones, eVTOLs are designed for passenger or cargo transport, the range of flight and speed varies between the two with eVTOLs travelling for a longer time and at a higher speed.

Due to eVTOLs still being in the development phase, there are currently no liability cases that have taken place. Because of the parallel drawn between eVTOLs and drones, this section examines a few cases from the USA that involve drones. Civil liability may arise in similar ways because both are flown with the help of similar software, and they fly at a lower altitude than aeroplanes and helicopters.

Civil liabilities may arise in different forms in case of drones, for example, there could be invasion of privacy because drones are mounted by cameras so that the person flying it may be able to look around the surroundings, drones may cause personal injury, which could take place due to the user's negligence or system failure, like battery failure, defect, drone power shortage of the motor. There is also the issue of property damage if a drone trespasses or crashes on private property. Between October 2022 and June 2024, the FAA proposed approximately US$340,000 civil penalties on 27 people for drone violations (Federal Aviation Authority, 2024a, 2024b).

In the case of *Richard T. Jacky and Tamsin Jacky v Parrot, S.A. et al.* (Case No. 2017CVCV31101, 2026), an incident took place where the plaintiff's son was operating a drone, and an unguarded blade struck his father in the eye. He sustained a corneal cut, which necessitated surgery and a recuperation period. The plaintiff claimed that because of purported design flaws, the manufacturer was responsible for the injury. Furthermore, the lawsuit highlighted flaws in the drone, including software and shut-off flaws. The case was later settled. Similar to drones, eVTOLs also have multiple rotors and safety mechanisms like emergency landing systems and collision avoidance sensors. If these malfunction mid-air, manufacturers could be sued for software or design defects.

Therefore, it may be noted that in cases where drones are involved and there is a malfunction in the software, manufacturers have been held responsible. However, drone liability cases are scarce, and manufacturer liability is rarely tested in court, as most of them reach a settlement before their conclusion in court, similar to what happened in the above-mentioned case (Case No. 2017CVCV31101, 2026). From these observations, a parallel can be drawn between drones and eVTOLs. It is reasonable to infer that if an autonomous system malfunctions mid-air during an eVTOL flight, passengers may sue the manufacturer for negligence. Nevertheless, assuming that manufacturers would be solely responsible for any malfunctions with eVTOL systems would be simplistic. In contrast to drone operations, which are usually manufacturer focused and remote controlled, eVTOL deployment entails a much more intricate ecosystem, including operators like commercial aviation service providers and transport authorities, which are essential to maintaining system safety, training and regulatory compliance.

Traditional aircraft also share a similarity with eVTOLs, they both rely on automated systems, they have software-driven operations and will be using the same airspace only at different altitudes. Therefore, it is useful to consider a few cases of aeroplane accidents.

In 2019, Ethiopian Airlines, a Boeing 737 MAX 8, crashed soon after taking off. It resulted in the death of 157 people. According to investigations conducted later on, the airplane's Manoeuvring Characteristics Augmentation System was activated by a malfunctioning sensor, resulting in repeated nose-down instructions that the pilots were unable to stop. It was established that the catastrophe was primarily caused by a flaw in the software. Consequently, Boeing paid US$2.5bn in January 2021 to settle a criminal charge in the USA, claiming that the company defrauded regulators responsible for looking after the 737 MAX aircraft. Later, in September of the same year, Boeing was fined US$200m by the US Securities authorities for providing false claims regarding the said aircraft's safety in the wake of the fatal crash (Agence France Presse, 2023). eVTOLs will also be relying on automated flight control systems, and if a critical system like auto-stabilization, altitude control or collision avoidance fails, it could result in catastrophic damage.

The US aviation law also illustrates that even in a highly regulated aviation environment, product defect claims are available. In *Jill Sikkelee v Precision Airmotive Corp*, a case involving a fatal aircraft crash due to a defective carburettor, the Third Circuit held that federal aviation laws did not categorically pre-empt aircraft product liability claims and that such cases may proceed, subject to standard conflict pre-emption rules (No. 14-4193, 2016 U.S. App. LEXIS 7015 (3d Cir. Apr. 19, 2016)). Similarly, in *Martin ex rel. Heckman v Midwest Exp. Holdings*, the Ninth Circuit permitted a design defect claim relating to aircraft steps to proceed as a product liability action [555F.3d 806, 811 (9th Cir., 2009)]. These decisions are significant because they illustrate that the US law can recognise design and manufacturing liability in aviation, yet recovery may still remain procedurally complicated in cases where the source of fault is obscured by technical causation, certification history and overlapping federal safety regulations.

From a doctrinal perspective, the US position demonstrates both the flexibility and limits of the traditional tort law. Its strength lies in the availability of several avenues of action, such as vicarious liability, negligence, product liability and failure to warn. Its weakness lies in evidentiary fragmentation. In the context of eVTOL, a claimant may be able to identify the occurrence of harm, but they may face difficulty demonstrating whether the decisive fault lay in design architecture, software updates post-sale, operational handling, maintenance oversight or infrastructure coordination. Consequently, the US approach can recognise liability in principle while still making recovery procedurally complex and commercially uncertain in practice.

While the USA has long been at the forefront of aviation innovation, balancing technological advancement with public safety remains a persistent challenge. The regulatory landscape continues to evolve to support the smooth transition of eVTOLs into UAM. It is also important that a regulation be put forward regarding liabilities in case of eVTOL accidents, at least until there are no legal precedents for the same. This will help the courts in reaching quicker decisions that are just and legally sound.

A three-tiered liability model could allocate risk more equitably. Vertiport regulators could be held accountable under a presumption of causality [2] when infrastructure oversights cause accidents, manufacturers or software developers would be held strictly liable for design or code defects and operators would be subject to negligence standards for operational or maintenance errors.

While the USA primarily relies on tort law for liability in case of eVTOL malfunction, the EU has chosen a regulatory path by drafting the Product Liability Directive. The next section will examine how this evolving legal framework compares to the laws in the USA.

3.5 Civil liability in eVTOL operations: the European Union

In the EU, civil liability is not governed by a single legislation. It is regulated by a multidimensional framework that includes the EU regulations, directives and domestic laws of member states (European Commission). The Product Liability Directive and the Rome II Regulation are two examples of the comprehensive legal frameworks that the EU has developed to manage civil liability (Jay *et al.*, 2025). The goal of these frameworks is to harmonise laws across member states, guaranteeing uniform protection and legal clarity (Kennedy and Ryan, 2020).

The Product Liability Directive has established a strict liability system for manufacturers; accordingly, claimants only have to show that the product was flawed and caused harm, not that they were negligent (Amin and Turtle, 2024). If a product does not provide the level of safety a person is entitled to, the Directive defines it as defective (Covington, 2024). It is pertinent to note that originally, there was an exclusion of software from the Directive; however, in 2024, it was added to the Directive's purview. One of the primary changes introduced by the Product Liability Directive is to expand the definition of the product to include software. Despite the fact that the Directive has left the definition of software open-ended to accommodate future technical advancements, operating systems, computer programs, firmware, applications and AI systems are all examples of software under Recital 13 (Daly and Burke, 2024). This expansion is critical for eVTOL liability, as software failures are among the most likely causes of autonomous aviation accidents. By explicitly recognising software as a product, the Directive allows victims of AI malfunctions to pursue compensation under strict liability rather than proving negligence.

A team at the University of Melbourne looked into more than 150 drone incidents reported from the past nine years to identify the reason for mishaps. In their research, they discovered that the most frequent error that occurred in drone accidents was the loss of radio contact between the operator and the drone software (Science Daily, 2016). It may be observed from the above-stated research that the inclusion of software in the Product

Liability Directive was necessary so that liability claims are adjudicated with fairness and justice.

While EASA certification and EU product liability reforms are positive steps forward, they prioritise technical compliance. However, traditional liability frameworks assume clear causation and central human control, which are difficult to apply to AI-driven eVTOLs, where autonomous decision-making can obscure the chain of responsibility. Therefore, the EU has taken a step further and drafted the "AI Liability Directive" to address challenges in holding manufacturers accountable for products involving AI, including drones and possibly eVTOLs (European Commission, 2022). This is their attempt at harmonising liability rules across the EU and making it easier for victims to seek compensation.

According to the draft regulation, victims can file a lawsuit to recover damages for harm to their property, health, life and privacy caused by the negligence or failure of an AI technology provider, developer or consumer. A "presumption of causality" clause is included in the guidelines in an attempt to reduce the burden of proof for victims. Accordingly, the complainants will only have to demonstrate that the injury was caused by a manufacturer or operator's failure to adhere to specific requirements and subsequently connect this to the AI technology in use (Chee, 2022). Extending a presumption of causality to eVTOL operations could help bridge evidentiary gaps where autonomous decision-making veils fault. However, the AI Liability Directive has since been withdrawn from consideration and, for the time being, will remain a draft legislation (Andrews, 2025).

Although the proposed AI Liability Directive has been withdrawn for the time being, its significance remains doctrinally important. It reflects a broader understanding that conventional private law rules may impose disproportionate evidentiary burdens on victims where causation depends on complex algorithmic processes or inaccessible technical logs. For eVTOL operations, this insight remains highly relevant. The legal issue is not whether a malfunction can be classified as a defect but whether a claimant can realistically prove how and why the autonomous system failed. In this regard, the reasoning behind a presumption of causality continues to offer a persuasive model for future aviation liability reform.

Existing EU case law also illustrates a more claimant-sensitive approach to defect and causation in technically complex product liability disputes. In *Boston Scientific Medizintechnik GmbH v AOK Sachsen-Anhalt – Die Gesundheitskasse*, the court of justice of the European union (CJEU) held that where products belonging to the same production series present a potential defect, all products in that group may be considered defective without requiring proof of an individual defect in each item (Joined Cases C-503/13 and C-504/13, 2026). In *N.W v Sanofi Pasteur MSD SNC*, the CJEU further acknowledged that, in the absence of scientific certainty, defect and causation may in some cases be inferred from some serious, specific and consistent evidence (C-621/15, 2026). Even though these cases arose outside aviation, they are highly relevant to eVTOL operations because they demonstrate that EU law is already willing, in principle, to soften traditional proof burdens where safety-critical products and technical uncertainty make direct proof unusually difficult. This reinforces the relevance of a presumption of causality model for autonomous aviation systems.

In May 2015, an Airbus A400M aircraft crashed in Spain, killing four crew members and severely injuring two other crew members. A private report by Spanish military investigators brought about information regarding the engines being hacked by erasing data. The plane froze the power at maximum because it could not figure out how to run the engines due to insufficient data, which caused the aircraft to fly higher and faster. The engine-makers had warned Airbus and the EASA beforehand, in 2014, that mistakes made during software installation could result in the loss of engine data and the personnel may not be alerted about it before take-off (Tim Hepher, 2017). This case highlights the catastrophic consequences that can arise from software-related defects in aviation. eVTOLs also heavily depend on sophisticated software for navigation and flight control; such an issue in an autonomous aircraft can lead to catastrophic outcomes. Given that the risk was identified in advance, liability in such scenarios would likely focus on those responsible for implementing, verifying and certifying the software, typically the manufacturer and operator, rather than the component supplier.

In another such catastrophe, Qantas Flight 72 almost led to the death of 350 passengers due to a software malfunction in 2008. Over 100 passengers were injured during the flight, which was saved by the pilots (Beresnevicius, 2020). This brought about changes to the safety-critical systems on board.

In the EU, there are harmonised regulations that deal with general tort liability, but there are no particular rules for liability in UASs (Scott and Hartmann, 2024). The lack of regulation is similar to what was seen in the early years of civil aviation. It became evident in the 1920s that an international framework was required to regulate air carrier liability as air travel increased in popularity. The resulting conventions limited carrier liability in specific situations, protecting passenger rights while also ensuring the aviation industry's sustainable growth. (Scott and Hartmann, 2024). Similar safeguards might now be necessary for eVTOL developers and manufacturers to promote innovation without exposing businesses to excessive liability risks in the event of software-related mishaps.

Recent UAS safety data further supports the need for a balanced approach. In the year 2023, there was one death and one serious injury caused by a UAS. Only 2 out of the 12 accidents involved piloted aircraft (Unmanned Airspace, 2024). This suggests that autonomous aircraft are more susceptible to accidents than crewed aircraft. A malfunction could have a significant impact on third-party liability, public safety and legal accountability because eVTOLs are anticipated to operate in crowded urban airspace and depend on sophisticated AI algorithms for navigation and decision-making.

In conclusion, the EU has improved legal redress procedures in the context of eVTOL operations by making significant progress in modifying its civil liability framework to accommodate software and AI-driven technology. Although the amended Product Liability Directive is a positive move, there is ambiguity because there is no legally enforceable regulation that is specifically suited to AI and autonomous aerial vehicles. To guarantee that victims are safeguarded, innovation is promoted and justice is administered uniformly across member states, the EU may need to review and improve AI Liability proposals in the future.

3.6 Civil liability in eVTOL operations: the UAE

In the UAE, civil liability analysis for eVTOL accidents is best understood as a layered interaction between general tort principles under the civil law framework, sector-specific aviation obligations and established compensation expectations in fatal harm scenarios. Even though these sources can already support civil claims following aviation-related injury, they were not designed around autonomy-driven causation uncertainty or multi-actor service delivery chains. The outcome is a gap in sector-specific allocation and evidential rules capable of producing predictable outcomes at commercial scales.

Civil liability in the UAE is governed by Federal Law No. 5 of 1985a, 1985b, commonly referred to as the UAE Civil Code. Article 282 of the law sets out the foundational principle of tort liability, it states, "Any harm done to another shall render the actor, even though not a person of discretion, liable to make good the harm".

According to the UAE Civil Code, the framework of liability for a harmful act has three elements: fault, damage and causation. The defendant's wrongdoing, whether deliberate or the result of negligence, is referred to as fault. Damages include any harm the plaintiff has experienced, including financial, emotional and physical harm. Causation connects the defendant's wrongful conduct to the plaintiff's injury and requires that the harm be a direct result of the fault.

When it comes to eVTOLs, these elements are especially important because liability can arise from a variety of causes, such as operator negligence, software faults, hardware malfunctions or non-compliance with regulations. When AI-powered autonomous or semi-autonomous systems are used for flight navigation and decision-making, the issue of liability becomes even more complex. Determining liability situations among owners, operators and manufacturers necessitates a technologically informed contextualised approach to attribution.

This attribution becomes more pronounced where the aircraft's harmful conduct is mediated by autonomous decision-making. The main challenge is not the complete absence of legal responsibility but the absence of a sufficiently adapted framework for identifying the legally relevant controlling actor where harm is caused by distributed technological agency (Abdou, 2026). In the context of eVTOLs, this encourages a functional approach to liability allocation. Rather than presuming that responsibility lies exclusively with the owner or operator, the legal analysis must differentiate between control over design, software behaviour, operational deployment and supporting infrastructure.

Accordingly, Article 5 of the UAE Civil Aviation Law states that it is the owner's responsibility to ensure that the aircraft is operated in compliance with the law. It states:

- Aircraft are moveable property in relation to the application of the laws, rules and regulations in force in the State.
- Aircraft registered on the national registry may not be legally transferred to another person by sale, mortgage, lease or otherwise except with the consent of the Competent Authority. The owner of the aircraft shall, in all cases, remain responsible for the operation of the aircraft in accordance with the provisions of this law.

This makes the owner responsible for ensuring that the aircraft complies with safety and operational regulations. In practice, liability may extend beyond the owner to manufacturers and operators, particularly where control over AI software systems and operational decision-making is shared. Such an interpretation is consistent with international norms allocating operational responsibility to the party exercising functional control over the aircraft.

Apart from its domestic liability regulations, the UAE is also a signatory to the Montreal Convention (1999), which regulates international air travel (International Civil Aviation Organisation, 1999). The UAE's aviation liability structure has been significantly shaped by the Convention, which was incorporated into the domestic law through Federal Decree No. 13 of 2000, reinforcing strict liability principles for international carriers (Abu Tayeh, 2015). Despite being mostly relevant to international air travel, the UAE courts are increasingly relying on its liability framework when interpreting passenger rights, safety requirements and damage claims. Together with the UAE Civil Code, the Montreal Convention provides a standardised framework that may guide domestic liability analysis in the evolving environment of eVTOL operations. Its integration promotes consistency with global aviation standards in cases involving cargo disputes, wrongful death and personal injury.

Judicial practice in the UAE demonstrates that aviation liability rules are not merely theoretical. In a 2016 judgement of the Abu Dhabi Court of First Instance, a passenger injury claim against an international airline was defended through the framework of the Montreal Convention, illustrating the practical role of convention-based liability analysis in the UAE courts (Almobideen, 2016). Similarly, a Dubai Court of First Instance ruling treated the Montreal Convention's two-year limitation period as absolute in aviation claims. These authorities are significant because they reaffirm that the UAE courts already apply international aviation liability rules in a structured manner.

In incidents involving death, the *Sharia* dimension of the UAE legal system adds a unique compensation element. In the context of wrongful death, the UAE law recognises diya (blood money) as a fixed compensatory component payable to heirs, alongside broader civil assessment where applicable. For eVTOL operations, this strengthens the policy imperative for a clear liability pathway. In the event of death, compensation expectations may arise quickly, while attribution of fault between manufacturer, operator and software provider may remain contested. Therefore, in the context of the UAE, a liability framework that clarifies liability while preserving prompt victim redress is both commercially and socially necessary. Combined, these sources of law form a distinctively layered framework. The Civil Code establishes fault-based liability, *Sharia* principles provide diya in cases of death and the Montreal Convention enforces strict liability in international carriage. Courts in the UAE do not apply these regimes in isolation but pragmatically blend them, for example, by limiting contractual exceptions when fairness demands it or awarding diya while also assessing negligence under Article 282. This arrangement illustrates how a balance between codified statutes, religious principles and international conventions is likely to shape eVTOL liability in the UAE.

Determining liability in the context of eVTOL operations requires careful analysis of the co-existence of these two legal systems, one based on codified statutes and the other on religious principles. Operating autonomous or semi-autonomous eVTOLs could lead to novel situations in which several parties, such as the operator, manufacturer and software developers, may contribute to a malfunction and legal responsibility becomes ambiguous.

The UAE's ongoing efforts to operationalise eVTOLs highlight the urgency of addressing these legal uncertainties. For instance, the united parcel service was granted a temporary licence by the UAE Regulations Lab to test eVTOL aircraft for freight operations, demonstrating regulatory flexibility. This programme highlights the UAE's dedication to deploying sustainable aircraft technologies within a robust legal framework (Regulations Lab, 2023). Simultaneously, the 2023 Vertiport Regulation offers comprehensive guidelines for the categorisation, security standards and operational protocols for vertiport infrastructure, demonstrating the nation's preparedness to integrate AAM systems into its broader transportation infrastructure.

Therefore, it may be observed that both the civil law and *Sharia* principles will come into effect in case of an eVTOL malfunction in the UAE. A region-specific tiered liability framework, supported by a presumption of causality, would align with the principles of fairness in *Sharia* law by not overburdening a single party and would provide clear guidance to manufacturers, operators and regulators.

4. Proposed civil liability framework for autonomous eVTOL operations

In a safety-critical mobility market relying on ordinary civil litigation to establish liability ex post is commercially inefficient. Civil claims involving autonomous malfunction are slow, expert-reliant and evidentially imbalanced, particularly where technical logs and decision pathways are controlled by defendants. This delay is commercially significant because prolonged attribution disputes can disrupt service continuity, increase governance costs and undermine consumer trust. The tiered approach is therefore proposed as an ex ante liability architecture to accelerate compensation, reduce dispute costs and stabilise market expectations.

As mentioned in previous sections, recent scholarship on liability in autonomous systems increasingly supports the view that the central challenge is not merely in choosing between fault and strict liability but designing a framework that protects access to justice where harm is caused by technologically complex systems. In such situations, claimants often face evidentiary asymmetry, informational dependence of defendants and uncertainty as to which actor exercised legally relevant control over the source of harm. The proposed tiered liability model responds to this by organising liability around functional control rather than treating all contributors to harm as doctrinally interchangeable.

The comparative analysis of the USA, EU and the UAE reveals that although each jurisdiction has well-developed principles governing civil liability, none of them adequately address the real-world challenges of autonomous eVTOL operations. These aircraft rely on complex software, interconnected digital infrastructure and varying degrees of automated decision-making. It is challenging to attribute liability in such an ecosystem when an accident happens, particularly when several parties are involved in the aircraft's safe operation. To address these issues, this section proposes a tiered civil liability framework that reflects the technological structure of eVTOL systems while remaining compatible with legal traditions and principles of the jurisdictions analysed in this article.

The framework is built on three fundamental ideas from the article's preceding sections. Firstly, liability should correspond to the amount of control an actor realistically exercises. A fair system must acknowledge all the different ways through which software developers, manufacturers and operators affect the safety of eVTOLs. Secondly, traditional notions of causation are challenged when applied to autonomous systems. Simply put, victims cannot access internal software processes or algorithmic decision paths. Therefore, measures that remedy this evidentiary imbalance are necessary for a workable liability model. Thirdly, despite the differences in the legal systems of the USA, EU and the UAE, all three systems share an underlying commitment to safety, fairness, justice and consumer protection. A flexible, principle-based model can operate across these varying contexts.

4.1 Tiered liability model

4.1.1 Manufacturers and software developers. The first tier assigns responsibility to those who design, build and update the aircraft and its software system. Manufacturers and software developers should be strictly liable for design flaws, software errors, update failures and predictable cybersecurity vulnerabilities because they have control over coding and cybersecurity. This is in line with well-established EU product liability rules that are also widely recognised in the USA and the UAE. It avoids putting victims under unreasonable pressure to demonstrate how an AI system failed when they have no access to technical logs or proprietary software.

4.1.2 Operators and service providers. The second tier concerns the entities that operate the eVTOL on a daily basis, airlines, fleet managers and vertiport operators. They are responsible for safe operation, maintenance, training and regulatory compliance. A negligent standard is appropriate here as operators should be liable when accidents stem from poor maintenance, disregard for operation procedures and insufficient training. This approach mirrors general tort principles in the USA, EU and the UAE; it acknowledges that operators are not accountable for software errors, but they do have control over how and when the eVTOL is used. From a commercial perspective, this shifts compliance and training into a measurable operational cost, which must be priced into service models and insurance arrangements.

4.1.3 Infrastructure and vertiport providers. Supporting infrastructure such as communication networks, charging stations and vertiports is crucial to modern eVTOL operations. The third tier imposes liability on these actors because a malfunction in these systems may directly compromise flight safety. However, this tier supports the use of a rebuttable presumption of liability in cases where infrastructure failure is plausibly linked to the accident because it is often difficult to distinguish between aircraft and infrastructure failures. This encourages providers to maintain high safety standards and proper documentation but does not impose strict liability.

4.2 Presumption of causality in AI-related malfunctions

The framework will incorporate an additional instrument, which is the presumption of causality in cases involving autonomous systems. When an accident occurs during an automated phase of flight, victims should not have to reconstruct algorithmic behaviour or demonstrate how a software error could have occurred. Instead, liability should be assigned as per the tiered liability model, shifting the burden to the manufacturers, operators or vertiport providers, as the case may be, to demonstrate that the malfunction was not attributable to them. This mechanism prevents unfair outcomes, is consistent with the reasoning behind the EU's formerly proposed AI Liability Directive and resonates with the fairness objectives embedded in the UAE tort and *Sharia* principles. Furthermore, it encourages operators and manufacturers to maintain transparent systems for logging, record-keeping and safety monitoring.

Notwithstanding its advantages, the proposed framework is not flawless. A presumption of causality may improve the causation of justice, but it may also increase compliance burdens for businesses and may be criticised as overly deterrent if applied without careful thresholds. Similarly, it may reduce blame diffusion, yet overlapping issues may arise where a single accident reflects both product defect and operational negligence. However, these limitations do not weaken the case for reform, they demonstrate that any eVTOL liability framework must combine clearer allocation rules, balanced rebuttal mechanisms and proportionate evidentiary obligations.

4.3 UAE legislative blueprint for eVTOL civil liability and market assurance

A dedicated UAE civil liability statute for passenger eVTOL services would serve as a tool for market assurance. It would reduce uncertainty for customers by providing predictable compensation pathways after accidents while giving businesses clearer liability boundaries that support insurability and responsible commercial scaling. The object is not to dilute accountability but to make responsibility apparent in an autonomy-dependent ecosystem where traditional litigation may be slow, and causation is technically inaccessible.

Such legislation would define its scope to cover passenger injury, wrongful death and third-party ground damage arising from eVTOL operations. This will include harm caused by software malfunction, maintenance failures and digital or vertiport infrastructure disruption. It should establish a presumption of causality where autonomy and proprietary logs create evidentiary inconsistencies, codify tiered liability in line with functional control, impose incident logging and disclosure obligations proportionate to safety-critical operations and require mandatory insurance coverage with minimum thresholds and timelines for handling claims. To prevent prolonged litigation from undermining market confidence, it should also incorporate consumer protection safeguards through transparency requirements on the autonomy level and compensation rights. Furthermore, it should provide expedited technical dispute resolution through specialised procedures or mandatory expert determination.

5. Managerial and commercial implications

The deployment of eVTOLs as flying taxis is not only a regulatory or safety project but a commercial service proposition that depends on predictable liability exposure. Players involved in the market face higher transaction costs when liability rules are unclear, for example, insurers price uncertainty conservatively, investors subsidise projects with unresolved catastrophic loss exposure and operators struggle to allocate responsibility through contracts across manufacturers, software providers and vertiport operators. In this sense, civil liability design functions as a market infrastructure that enables scalable operations.

According to the analysis, traditional civil litigation procedures are ill-suited as the primary mechanism for establishing liability norms in this sector. Autonomous malfunction disputes are likely to be slow, involving experts and evidentiary inconsistencies, particularly where technical logs and decision pathways are controlled by defendants. Prolonged liability disputes have the potential to disrupt service continuity, inflate compliance overheads and undermine consumer trust.

The proposed tiered liability model is intended to transform legal uncertainty into an operationally usable risk allocation mechanism. By aligning responsibility with functional control, the model facilitates clearer insurance structuring and more reliable contracting allocation. It supports faster compensation outcomes by reducing the scope for blame diffusion across multiple actors.

From a commercial perspective, the framework also clarifies that the cost base of eVTOL services is not limited to fleet acquisition and infrastructure development. Operators and businesses must invest in compliance systems, staff training, incident reporting protocols and audit-ready documentation to avoid negligence exposure and preserve insurability. Once these costs are internalised and priced, eVTOL services can remain commercially viable; however, it is important to keep in mind that profitability depends on aligning operational governance with the liability architecture rather than treating legal compliance as an afterthought.

6. Conclusion and recommendations

In the realm of transportation innovation, the incorporation of eVTOLs into the UAM ecosystem represents a turning point. Beyond sustainability and traffic congestion reduction, passenger eVTOL services introduce a commercially decisive legal challenge, civil liability regulations must be sufficiently clear to support insurability, consumer trust and scalable operations. This article's comparative study of the USA, EU and UAE has demonstrated that the current legal systems are still fragmented and frequently inadequate for autonomous eVTOL services.

In the USA, civil liability will likely be channelled through tort and product liability doctrines, with negligence, vicarious liability and defect-based claims serving as primary pathways. However, where failure arises from software, system interaction or unclear autonomous decision-making, traditional litigation becomes slow. In a safety-critical market, relying on case law alone to generate workable liability standards ex post creates delay and transaction costs that directly undermine the commercial feasibility of eVTOLs as a passenger service and the trust of consumers.

With provisions like the Product Liability Directive (which was recently extended to cover software) and the formerly proposed AI Liability Directive, the EU provides a more proactive regulatory framework. By acknowledging the technological complexity of AI systems, these initiatives seek to transfer the burden of proof from victims to manufacturers and operators. However, the EU's proposed AI Liability Directive was ultimately withdrawn in 2025, reflecting the continuing difficulty of designing AI-specific civil liability regulations. Consequently, EU readiness increasingly depends on how product liability, national tort laws and evidentiary mechanisms are combined to allocate liability across manufacturers, operators and service providers.

The UAE is a prime example of a hybrid legal system, where civil regulations blend with *Sharia* principles. The country's ambitious adoption of eVTOL technology, demonstrated by its partnerships with companies like Joby Aviation and Archer Aviation and its investment in vertiports, indicates a visionary approach to policy. But, the UAE's liability framework is still in its infancy and applying conventional aviation standards to eVTOL operations could lead to interpretation ambiguity, especially in cases where automation and AI-driven actions make it more difficult to assign liability. As Dubai positions itself as an early mover in the commercial deployment of eVTOLs, legal certainty becomes a competitiveness tool, a targeted civil liability framework can assure consumers while protecting the business environment by clarifying liability boundaries, compliance duties and evidence requirements.

Therefore, even though the operational readiness of eVTOLs is accelerating, the legal infrastructure remains incomplete for commercially scaled passenger services. Targeted legal reforms and cross-jurisdictional harmonisation are desperately needed to enable the safe, accountable and economically feasible use of this technology.

The following recommendations are put forth in light of the comparative legal analysis:

- Adopt proportional or tiered liability model: Assign civil liability according to functional control across manufacturers and software providers for design, code, updates and predictable cybersecurity vulnerabilities; operators and service providers for training, maintenance and operational compliance failures; and infrastructure and vertiport providers where infrastructure disruption plausibly contributes to harm.
- Introduce "presumption of causality" in AI malfunction cases: To enable more equitable outcomes in high-tech liability cases, follow the EU's example by reducing the evidentiary burden on complainants/victims when AI or software is involved.
- Enact a UAE eVTOL civil liability and market assurance law: Establish a sector-specific statute that defines scope; codifies the tiered liability model; mandates insurance baseline and claims-handling expectations; embeds consumer protection through transparency on autonomy level and compensation rights; creates compliance obligations like training certification, maintenance governance and incident reporting; and provides expedited technical dispute resolution to prevent prolonged litigation from undermining market confidence.
- Support soft precedents and regulatory sandboxes: To simulate eVTOL mishaps and liability situations, set up regulatory sandboxes [3] at domestic and regional levels. In the absence of case law, these can dictate legislative growth and act as a foundation for soft precedent.
- Integrate cultural, religious and ethical norms: In nations such as the UAE, liability frameworks ought to integrate contemporary tort theories with *Sharia*-compliant concepts like diya and personal accountability to guarantee both social acceptability and legal legitimacy.
- Update and harmonise product liability laws to include AI: Expand the concept of "product defects" to encompass errors in software patches, algorithms and decision-making processes. This is particularly crucial for autonomous eVTOLs that depend on remote monitoring.
- Ensure involvement of stakeholders in legal development: When creating legislation, work together with manufacturers, operators, regulators and consumer protection organisations to draft laws that are both technically sound and practically applicable.

In conclusion, eVTOLs signify the next stage of legal responsibility in addition to an important breakthrough in transportation. The tiered liability model, paired with a UAE legislative blueprint, can operate as a transferable framework that other jurisdictions may adapt to commercialise flying taxi services responsibly while preserving victim protection, business certainty and market confidence.

Notes

[1.] Thomas Reuters defines negligence as "any act or omission which falls short of the standard to be expected of the reasonable person".

[2.] According to this legal principle, the causation between a wrongful act and the resulting harm is presumed rather than needing to be specifically proven.

[3.] Regulatory sandbox helps in temporarily testing out new innovations by keeping it as close to the real world as possible, in a safe environment with the help of authorities.

References

9th Cir (2009), "555 F.3d 806, 811".

Abdou, M. (2026), "Custodian of autonomous AI systems in the UAE: an adapted legal framework", *Laws*, Vol. 15 No. 1, pp. 2-14.

Abeyratne, R. (2024), "Advanced air mobility: transcending the frontiers of aviation law", *Frontiers in Law*, Vol. 3, pp. 99-100.

Abraham, K. (2021), "Conceptualizing tort law: the continuous (and continuing) struggle", *Maryland Law Review*, Vol. 80, pp. 294-296.

Abu Tayeh, B. (2015), "Limits to liability under Montreal 1999 in the UAE", available at: www.tamimi.com/law-update-articles/limits-to-liability-under-montreal-1999-in-the-uae/

Agence France Presse (2023), "Inquiry into 2019 Ethiopian air crash confirms software failure", available at: www.barrons.com/news/inquiry-into-2019-ethiopian-air-crash-confirms-software-failure-01671821708

Almobideen, S. (2016), "Death or bodily injury on board the aircraft: a UAE perspective", available at: www.tamimi.com/law-update-articles/death-or-bodily-injury-on-board-the-aircraft-a-uae-perspective/

Amin, A. and Turtle, E. (2024), "EU product liability reforms represent a major shakeup", available at: www.cooley.com/news/insight/2024/2024-02-08-eu-product-liability-reforms-represent-a-major-shakeup

Andrews, C. (2025), "European commission withdraws AI liability directive from consideration", available at: https://iapp.org/news/a/european-commission-withdraws-ai-liability-directive-from-consideration

Aziz, S. (2017), "The international air carrier liability (an analytical study of Warsaw convention 1929 and Montreal convention 1999)", *(LLM Thesis*, *Yakin Dogu Universitesi*, *Near East University*, *Sosyal Bilimler Enstitüsü*, *Graduate School of Social Sciences 2017)*, pp. 1-31.

Beresnevicius, R. (2020), "When automation fails: remembering Qantas flight 72", available at: www.aerotime.aero/articles/26101-remembering-qantas-flight-72

Bertolini, A. (2025), "Artificial intelligence and civil liability", available at: www.europarl.europa.eu/RegData/etudes/STUD/2025/776426/IUST_STU%282025%29776426_EN.pdf

Bhargava, K. (2023), "Product liability laws and regulations in the UAE", available at: https://thelawreporters.com/product-liability-laws-and-regulations-in-the-uae

C-621/15 (2026), "Case".

Case No. 2017CVCV31101 (2026).

Chee, F.Y. (2022), "EU draft rules to make it easier to sue drone makers, AI systems", available at: www.reuters.com/technology/eu-draft-rules-make-it-easier-sue-drone-makers-ai-systems-2022-09-27/

Covington (2024), "What can you expect from the new product liability directive?", available at: www.cov.com/en/news-and-insights/insights/2024/10/what-can-you-expect-from-the-new-product-liability-directive

Daly, M. and Burke, L. (2024), “Revised EU product liability regime expands to AI software providers”, available at: www.pinsentmasons.com/out-law/analysis/revised-eu-product-liability-regime-expands-ai-software-providers

De Leon, P. and Eyskens, W. (2001), “The Montreal convention: analysis of some aspects of the attempted modernization and consolidation of the Warsaw system”, *Journal of Air Law and Commerce*, Vol. 66, pp. 1156-1158.

EASA (2024), “Special condition for VTOL and means of compliance”, available at: www.easa.europa.eu/en/document-library/product-certification-consultations/special-condition-vtol

European Commission (2022), “Questions and answers: AI liability directive”, available at: https://ec.europa.eu/commission/presscorner/detail/en/qanda_22_5793

Federal Aviation Administration (2021), “A brief history of the FAA”, available at: www.faa.gov/about/history/brief_history

Federal Aviation Authority (2024a), “With new rule, FAA is ready for air travel of the future”, available at: www.faa.gov/newsroom/new-rule-faa-ready-air-travel-future

Federal Aviation Authority (2024b), “FAA proposed $341,413 in civil penalties against drone operators”, available at: www.faa.gov/newsroom/faa-proposed-341413-civil-penalties-against-drone-operators

Federal Law No. (5) of (1985a), “Concerning the issuance of the civil transactions law of the United Arab Emirates’, ‘Art. 282”.

Federal Law No. (5) of (1985b), “Concerning the issuance of the civil transactions law of the United Arab Emirates’, ‘Art. 390”.

Geistfeld, M. (2024), “Reformulating vicarious liability in terms of basic tort doctrine: the example of employer liability for sexual assaults in the workplace”, *NYU Law Review*, Vol. 99, pp. 578-580.

Gennaro Ariante, G. and Del Core, G. (2025), “Unmanned aircraft systems (UASs): current state, emerging technologies, and future trends”, *Drones*, Vol. 9 No. 1, pp. 1-2.

Goldberg, J. and Zipursky, B. (2016), “The strict liability in fault and the fault in strict liability”, *Fordham Law Review*, Vol. 85, pp. 743-745.

Goudkamp, J. (2023), “Rethinking fault liability and strict liability in the law of torts”, *Law Quarterly Review*, Vol. 139, p. 269.

Haertlein, L. (2018), *An Alternative Liability System for Autonomous Aircraft. The Air and Space Lawyer*, Vol. 31, pp. 1-3.

International Civil Aviation Organisation (1999), “List of parties to the Montreal convention 1999”, available at: www.icao.int/secretariat/legal/list%20of%20parties/mtl99_en.pdf

Jay, J., McAtominey, S., Moille, C., Scott, G. and Watt, G. (2025), “EU updates its product liability regime: important considerations for providers of AI systems and software”, available at: www.goodwinlaw.com/en/insights/publications/2025/02/alerts-practices-aiml-eu-updates-its-product-liability-regime

Joined Cases C-503/13 and C-504/13 (2026).

Kennedy, H. and Ryan, A. (2020), “Jurisdiction and governing law – Rome II”, available at: https://kennedyslaw.com/en/thought-leadership/article/jurisdiction-and-governing-law-rome-ii/

Kleis, J. (2024), “EU brings product liability rules in line with digital age and circular economy”, available at: www.consilium.europa.eu/en/press/press-releases/2024/10/10/eu-brings-product-liability-rules-in-line-with-digital-age-and-circular-economy/

Montreal Convention (1999), “Arts. 17-19”.

No. 14-4193 (2016), “U.S. App. LEXIS 7015 (3d cir. Apr. 19, 2016)”.

Oman, N. (2014), “A theory of civil liability’ college of William and Mary law school faculty publications”, p. 381.

Regulations Lab (2023), "UAE regulations lab issues licence for electric vertical takeoff and landing aircraft", available at: https://reglab.gov.ae/en/news-details/uae-regulations-lab-issues-licence-for-electric-vertical-takeoff-and-landing-aircraft-1

Sadrani, M., Adamidis, F., Garrow, L. and Antoniou, C. (2025), "Challenges in urban air mobility implementation: a comparative analysis of barriers in Germany and the United States", *Journal of Air Transport Management*, Vol. 126, pp. 2-13.

Schwab, E. (2025), "How safe is safe enough? Analyzing the incentive structure of the products liability scheme on commercial aviation manufacturers", *University of Miami Law Review*, Vol. 79, pp. 398-422.

Science Daily (2016), "Tech issues cause most drone accidents, study finds", available at: www.sciencedaily.com/releases/2016/08/160823124913.htm

Scott, B. and Hartmann, J. (2024), "'International aviation law on liability' in Jacques Hartmann, Benjamyn I. Scott, Steven Truxal, Andrea Bertolini, and Anna Masutti (eds)", *Civil Regulation of Autonomous Unmanned Aircraft Systems in Europe*, pp. 12-13.

Tilley, C. (2017), "Tort law inside out", *The Yale Law Journal*, Vol. 126, pp. 1324-1327.

Tim Hepher, T. (2017), "Airbus knew of software vulnerability before A400M crash", available at: www.reuters.com/article/business/airbus-knew-of-software-vulnerability-before-a400m-crash-idUSKBN1D81BG/

Unmanned Airspace (2024), "EASA publishes new data on serious drone accidents and incidents for 2023 in the EU", available at: www.unmannedairspace.info/uncategorized/easa-publishes-new-data-on-serious-drone-accidents-and-incidents-for-2023-in-the-eu/

Wiedemann, M., Liang, M., Keremane, G. and Quigley, K. (2024), "Advanced air mobility: a comparative review of policies from around the world—lessons for Australia", *Transportation Research Interdisciplinary Perspectives*, Vol. 24, pp. 1-7.

Further reading

Al-Rubaye, S., Tsourdos, A. and Namuduri, K. (2023), "Advanced air mobility operation and infrastructure for sustainable connected eVTOL vehicle", *Drones*, Vol. 7 No. 5, p. 1.

AP News (2024), "Flying air taxis move closer to US takeoff with issuing of FAA rule", available at: https://apnews.com/article/faa-air-taxis-regulation-electric-aviation-85fd3c8b905a003eff64590afb5da339

Archer Aviation Press Release (2025), "Archer secures design approval for UAE's first hybrid heliport", available at: https://verticalmag.com/press-releases/archer-secures-design-approval-for-uaes-first-hybrid-heliport/

Attia, F. (2012), "Can We really limit liability?", available at: www.tamimi.com/law-update-articles/can-we-really-limit-liability/#:~:text=ivil%20liability%20under%20UAE%20law,limited%2C%20subject%20to%20certain%20exceptions

BuiltIn (2024), "What are eVTOLs? Are they the future of aviation?", available at: https://builtin.com/articles/evtol-aircraft

Butterworth-Hayes, P. (2025), "UAE's GCAA grants technical design approval for first commercial vertiport", available at: www.urbanairmobilitynews.com/vertiports/uaes-gcaa-grants-technical-design-approval-for-first-commercial-vertiport/

Chapter III-2 "vertiport certificate and landing area acceptance".

Elshamy, A. (2024), "Air taxis failed to get certified for the Paris Olympics. There's still hope for LA 2028", available at: https://apnews.com/article/olympics-2024-paris-flying-taxis-82af3b21726dc6ebbc99da076b98d14b

Daleo, J. (2024), "Air taxis missed Paris Olympics goal—could they soar in LA?", available at: www.flyingmag.com/modern/air-taxis-missed-paris-olympics-goal-could-they-soar-in-la/

Datumate (2024), “Unlocking solutions: a comprehensive guide to urban air mobility (UAM) and traffic management”, available at: www.datumate.com/blog/urban-air-mobility/

Ding, J. and Rodriguez, O. (2025), “Man agrees to plead guilty for flying drone that damaged firefighting aircraft in LA wildfire”, available at: https://apnews.com/article/california-wildfires-los-angeles-guilty-drone-8406f5ed22b73bd597fc6978eba54dc9

EASA “United Arab Emirates”, available at: www.easa.europa.eu/en/domains/international-cooperation/easa-by-country/countries/united-arab-emirates

Ehab Yehia Law Firm (2024), “Key elements and principles of civil liability understanding legal responsibility”, available at: www.lexology.com/library/detail.aspx?g87dc-ba17-4625-98eb-e7a079c29b34

European Commission “Types of EU law”, available at: https://commission.europa.eu/law/law-making-process/types-eu-law_en

Faheem, H., El Shorbagy, A. and Gabr, M. (2024), “Impact of traffic congestion on transportation system: challenges and remediations - a review”, *Mansoura Engineering Journal*, Vol. 49 No. 2, p. 1.

Fayyada, M. and Byttebier, K. (2021), “Scope and conditions of damages for air carrier’s liability caused by delay in terms of the travel contract issued by emirate airlines”, *International Journal of Innovation*, *Creativity and Change*, Vol. 15, p. 670.

Federal Law by Decree No. (31) of (2021), “Promulgating the crimes and penalties law 2021, art. 30”.

Federal Law Issuing the Civil Aviation Act (1991), “Art. 5”.

Goyal, R. and Cohen, A. (2022), “Advanced air mobility: opportunities and challenges deploying eVTOLs for air ambulance service”, *Applied Sciences*, Vol. 12 No. 3, pp. 1-2.

Hussein, S., Muhammad, N., Al-Ahmad, H., Mukhtar, H., Rababa, M., Amin, S., Schafer, B. and Abu Shabab, E. (2024), “Harmonizing liability: exploring carrier responsibilities in transportation contracts and their application to autonomous vehicle services under the UAE law”, *Law, Innovation and Technology*, Vol. 16 No. 2, p. 741.

IATA “The Montreal convention”, available at: www.iata.org/en/programs/passenger/mc99/

INRIX Traffic Scorecard Report (2024), available at: https://inrix.com/scorecard-city/?city=Dubai&index=153#form-download-the-full-report

International Civil Aviation Organisation, “Twentieth meeting of the middle east air navigation planning and implementation regional group tenth meeting of the regional aviation safety group (may 2023)”.

Ison, D. (2023), “Public opinion concerning the siting of vertiports”, *International Journal of Aviation*, *Aeronautics*, *and Aerospace*, Vol. 10 No. 4, p. 1.

Joby Aviation (2024), “Joby to launch air taxi service in UAE”, available at: www.jobyaviation.com/news/joby-to-launch-air-taxi-service-uae/

Karp, A. (2024), “FAA’s powered-lift SFAR provides clarity for eVTOL developers”, available at: https://verticalmag.com/news/faas-powered-lift-sfar-provides-clarity-for-evtol-developers/

Khan, M. (2018), “Modern product liability law: juridical basis in Islamic law”, *Hamdard Islamicus*, Vol. 41, pp. 7-18.

Kim Wasson and others (2022), “Functional hazard assessment for the eVTOL aircraft supporting urban air mobility (UAM) applications: exploratory demonstrations (20210024234)”, available at: https://ntrs.nasa.gov/api/citations/20210024234/downloads/NASA-TM-20210024234.pdf

Laura, B., Ronja, K., Jochen, F. and Eike, S. (2024), “Study on public acceptance of eVTOL: safety and noise”, available at: https://publikationen.dglr.de/?tx_dglrpublications_pi1%5bdocument_id%5d=610319

Meaker, M. (2024), “The Paris Olympics promised flying taxis—here’s why they failed to launch”, available at: www.wired.com/story/the-dream-of-flying-taxis-in-paris-failed-to-take-off/#:~:text=et%20after%20years%20of%20planning,but%20it%20had%20no%20passengers

Mercan, T., Yavas, V., Can, D. and Mercan, Y. (2025), "Vertiport location selection criteria for urban air mobility", *Journal of Air Transport Management*, Vol. 124, pp. 1-3.

Moller, T., Padhi, A., Pinner, D. and Tschiesner, A. (2019), "The future of mobility at our doorstep", available at: www.mckinsey.com/industries/travel-logistics-and-infrastructure/our-insights/the-future-of-mobility-is-at-our-doorstep#/

Monteleone, F., Nithya, D., Pedretti, O., Rylko, A., Berlingieri, F., Quaranta, G. and Setti, G. (2024), "An interdisciplinary research perspective for tackling vertiport design and developmental challenges", available at: https://re.public.polimi.it/bitstream/11311/1266707/1/MONTF01-24.pdf

Moradi, N., Wang, C. and Mafakheri, F. (2024), "Urban air mobility for last-mile transportation: a review", *Vehicles*, Vol. 6 No. 3, p. 1383.

Natsvaladze, A. (2016), "Characteristic of vicarious liability", *European Scientific Journal*, pp. 78-80.

Office of Manufacturing and Energy Supply Chains (2025), "Delivering a government-enabled, private-sector led manufacturing renaissance", available at: www.energy.gov/mesc/articles/delivering-government-enabled-private-sector-led-manufacturing-renaissance

Pons-Prats, J., Živojinović, T. and Kuljanin, J. (2022), "On the understanding of the current status of urban air mobility development and its future prospects: commuting in a flying vehicle as a new paradigm", *Transportation Research Part E*, Vol. 166, p. 1.

Pukhova, A., Llorca, C., Moreno, A., Staves, C., Zhang, Q. and Moeckel, R. (2021), "Flying taxis revived: can urban air mobility reduce road congestion?", *Journal of Urban Mobility*, Vol. 1, p. 1.

Rohrßen, B. (2024), "Product liability directive – adoption by European council", available at: www.taylorwessing.com/en/insights-and-events/insights/2024/10/product-liability-directive

Scerri, A. (2024), "Peeling back the layers of EASA and FAA's eVTOL certification standards", available at: https://verticalmag.com/features/peeling-back-the-layers-of-easa-and-faas-evtol-certification-standards/

Schweiger, K. and Preis, L. (2022), "Urban air mobility: systematic review of scientific publications and regulations for vertiport design and operations", *Drones*, Vol. 6 No. 7, pp. 1-11.

Shaheen, S. and Cohen, A. (2021), "Urban air mobility: opportunities and obstacles", available at: https://escholarship.org/uc/item/0r23p1gm#main

Skybraby, "Unmanned aerial systems (UAS)", available at: https://skybrary.aero/articles/unmanned-aerial-systems-uas

Slechter Law Firm (2024), "What rights do passengers have against airline negligence?", available at: www.kytrialfirm.com/blog/what-rights-do-passengers-have-against-airline-negligence/

Speier, G., Jackson, C. and Norsetter, J. (2024), "Soaring in the United States: FAA eVTOL regulatory update", available at: https://viewpoints.reedsmith.com/post/102jmmy/soaring-in-the-united-states-faa-evtol-regulatory-update

STA Law Firm (2019), "International carrier regulations", available at: www.stalawfirm.com/en/blogs/view/the-montreal-convention.html

Thanvi, I. (2024), "Challenges in harmonization of Shariah and civil law: a case study of the United Arab Emirates", *Law and Political Review*, Vol. 9, pp. 1-21.

The White House: office of the Press Secretary (2015), "FACT SHEET: the white house releases new strategy for American innovation, announces areas of opportunity from self-driving cars to smart cities", available at: https://obamawhitehouse.archives.gov/the-press-office/2015/10/21/fact-sheet-white-house-releases-new-strategy-american-innovation

UK Civil Aviation Authority (2022), "UK determines certification standards for new electric vertical take-off and landing aircraft", available at: www.caa.co.uk/newsroom/news/uk-determines-certification-standards-for-new-electric-vertical-take-off-and-landing-aircraft/

United States Courts "Federal rules of civil procedure", available at: www.uscourts.gov/forms-rules/current-rules-practice-procedure/federal-rules-civil-procedure

Xiong, B., Jiang, R., Wang, K., Tang, X., Shang, Y. and Qu, X. (2025), "Utilizing eVTOL aircraft to alleviate traffic congestion on an arterial road", in *IEEE Transactions on Intelligent Transportation Systems*, Vol. 26 No. 7, pp. 10415-10416.

Zahy, S. (2023), "United Arab Emirates legal system: tradition, modernization, and cultural sensitivity", *Journal of Afro-Asian Studies*, p. 330.

Zhang, J., Liu, Y. and Zheng, Y. (2024), "Overall eVTOL aircraft design for urban air mobility", *Green Energy and Intelligent Transportation*, Vol. 3 No. 2, pp. 1-2.

Zilbar, A. (2025), "Amazon suspends commercial drone deliveries in Texas, Arizona after Two crashes in rainy weather", available at: https://nypost.com/2025/01/20/business/amazon-suspends-commercial-drone-deliveries-in-Texas-and-Arizona/

Corresponding author
Sumaiya Firoz Nomani can be contacted at: snomani@ud.ac.ae