

Liability Boundaries among Multiple Parties in Commercial Drone Operations: Delivery, Inspection, and Passenger Transport Scenarios

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Abstract: Commercial drone operations in China have expanded rapidly since the low-altitude economy became a strategic emerging industry in 2024. Meituan and SF Express run tens of thousands of delivery flights daily in Shenzhen. EHang received the first passenger eVTOL type certificate from the CAAC in October 2023. The liability rules that courts will need when incidents occur lag behind this operational reality. We ask how operator, platform, and manufacturer liability should vary across delivery, inspection, and passenger transport scenarios under current Chinese law. Drawing on Article 1165, Articles 1202–1207, and Article 1238 of the Civil Code, we construct a three-by-three scenario-based liability matrix. Our main finding: liability migrates systematically as operational risk increases. The operator carries the primary burden in delivery, parties split liability in inspection under a mixed-fault model, and the operator and manufacturer share strict liability in passenger transport. We recommend scenario-specific provisions under CCAR-92.

Keywords: Commercial drone; Liability allocation; Scenario-based matrix; Low-altitude economy; CCAR-92; EU AI liability directive

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1. Introduction

China's low-altitude economy took off in 2024. The central government placed it in the annual work report in March. Shenzhen opened dedicated drone delivery routes. Meituan completed over 300,000 drone deliveries by mid-2025. EHang secured the world's first type certificate for a passenger-carrying autonomous aerial vehicle in October 2023. These operations are commercial, not experimental, and they generate real legal exposure every day.

The liability questions have no settled answers. When a delivery drone drops a package on a pedestrian, who pays? The operator who programmed the flight? The platform that dispatched the order?

The manufacturer whose GPS module drifted? When an inspection drone misreads a high-voltage insulator and triggers a blackout, how does liability divide between the operator's professional judgment and the manufacturer's sensor calibration? When a passenger eVTOL loses power at 300 meters, do we apply Article 1238 of the Civil Code, drafted for conventional aircraft, or do we need a new standard?

Existing scholarship leaves these questions unaddressed. Liu and Liu (2025) ^[1] proposed a unified safety governance framework without differentiating by scenario. Scheau et al. (2023) ^[2] focused on organizational prevention of drone malfunction. Zhou and Zhang (2025) ^[3] documented Shenzhen's policy strategy without analyzing liability. Simoneau (2023) ^[4] traced US airspace ownership history, a doctrinal tradition that differs from Chinese airspace law. Three bodies of Chinese law converge on these questions: fault-based tort provisions of the Civil Code, product liability rules in Articles 1202–1207, and CCAR-92 issued by the CAAC in 2024. No published study applies all three across scenarios.

This paper builds a three-by-three liability matrix mapping operator, platform, and manufacturer responsibilities across delivery, inspection, and passenger transport. Section 2 defines the scenarios and parties. Sections 3.1–3.3 analyze each scenario under Chinese law. Section 4 presents the matrix. Section 5 draws comparative insights from the EU AI Liability Directive proposal. Section 6 concludes with policy recommendations.

The legal gap this paper addresses is practical, not theoretical. As of mid-2025, Chinese courts have heard fewer than two dozen reported drone liability cases. None involved multi-party apportionment. The regulatory infrastructure exists. The case law does not. When the first passenger eVTOL incident occurs, the court that hears it will search for a framework. Our matrix is offered as a starting point for that search, grounded in existing statutory text rather than imported doctrine.

2. Analytical framework

Delivery, inspection, and passenger transport are the three most commercially significant drone use cases in China today. Delivery leads by flight volume: Meituan and SF Express dominate Shenzhen's drone traffic. Inspection ranks second: the State Grid deploys drones across over a million kilometers of transmission lines annually. Passenger transport is the smallest segment but carries the highest per-incident risk. EHang's EH216-S opens a path to commercial air taxi services. Agricultural spraying and aerial photography matter in practice but raise simpler liability questions because they involve fewer parties. Our three scenarios share a legally interesting feature: each engages all three parties in a non-trivial way ^[5].

The operator is whoever controls the flight at the moment of an incident. The platform dispatches missions, manages the fleet, and collects revenue. The manufacturer designs and produces the aircraft and bears continuing obligations for firmware, maintenance protocols, and safety bulletins. Our method combines normative interpretation of the Civil Code and CCAR-92 with scenario analysis. Where Chinese law is silent, we reference the EU AI Liability Directive proposal as a comparative benchmark, always noting its status as draft legislation.

This method has one important constraint. We map liability under the law as it stands, not as it should be. The Civil Code provisions we cite were drafted before commercial drone operations existed at scale. CCAR-92, published in 2024, is the CAAC's first attempt at a comprehensive unmanned aircraft regulation. Both sources contain gaps that a mature drone liability jurisprudence will eventually fill. Our contribution is to show that even within these imperfect materials, a coherent scenario-sensitive framework can be

assembled.

3. Scenario analysis

3.1. Delivery

At 11:42 on a Tuesday, a Meituan drone departs a Shenzhen dispatch center carrying a food order 3.2 kilometers to a residential compound. At the two-kilometer mark, wind gusts reach 12 meters per second, exceeding the operational envelope. The aircraft drifts, strikes a 14th-floor balcony, and injures a resident on the ground. The question: who bears liability?

The operator sits at the center. Article 1165 of the Civil Code imposes fault-based liability. The operator chose to fly in near-limit wind conditions. CCAR-92 requires pre-flight weather assessment and real-time monitoring. If the flight ended in injury, the operator must show every regulatory check was performed, or fault is presumed. The platform stands one step back. Meituan's dispatch algorithm assigned this route at this time. Did it account for the gust forecast? If the platform's weather module flagged the risk and a decision-maker overrode the flag, the platform faces secondary liability for dispatch negligence. Chinese law has no settled doctrine for algorithmic dispatch negligence in drone operations. The manufacturer enters through product defect law. Articles 1202–1207 impose strict liability if the GPS module had a calibration defect. The delivery scenario produces a clear hierarchy: operator bears primary fault-based liability, platform bears secondary liability for dispatch negligence, manufacturer bears background strict liability for product defects ^[6].

Two practical observations sharpen this hierarchy. The first is evidentiary. In a delivery incident, the flight log, the dispatch record, and the maintenance history are all held by the operator and platform. The injured pedestrian has none of these documents. Chinese civil procedure places the burden of production on the plaintiff. The operator and platform thus control the evidence that determines their own liability. The second observation concerns settlement. The delivery operator carries insurance of at least RMB 500,000 under Shenzhen's pilot scheme. For minor injuries, the operator has a strong incentive to settle quickly and avoid adverse precedent. For catastrophic injuries exceeding the policy limit, the plaintiff has a strong incentive to join the platform and manufacturer as co-defendants, pulling the full matrix into play.

3.2. Inspection

The State Grid deploys inspection drones across over 1.2 million kilometers of transmission lines. A typical mission sends a drone along a pre-planned corridor 15 to 30 meters above the conductors. Payloads include visible-light cameras, thermal infrared sensors, and corona discharge detectors. A ground-station algorithm flags anomalies. A human inspector decides whether to dispatch a ground crew.

The liability analysis shifts because the operator is a professional. The State Grid employs certified drone pilots with infrastructure-specific training. When an inspection drone misses a cracked insulator that a competent human inspector would have caught, and the flashover causes a blackout, the operator's professional negligence drives liability. But if the thermal camera's calibration drifted and showed normal temperature where the insulator was overheating, the operator made a reasonable decision on bad data. Liability shifts to the manufacturer ^[7].

The platform's role also differs. The State Grid's drone operations center assigns missions and selects equipment packages. If it sends an operator with a sensor suite inadequate for the specific tower type, the platform shares liability for mission-design failure. If it loses a prior anomaly flag from its data archive,

opening a known risk that went unaddressed, a separate liability pathway runs through the platform alone. The manufacturer faces two kinds of claims here: product defect claims and performance-representation claims. If the data sheet promised 0.05-degree thermal sensitivity and the sensor drifted to 0.5 degrees after three months, the manufacturer breached implied specifications. The inspection scenario yields a genuinely mixed liability picture. No single party carries the primary burden. The outcome turns on which link in the chain broke first.

The mixed-fault character of the inspection scenario makes it the hardest to litigate and the easiest to settle. Each party holds exculpatory evidence against the other. The operator can point to the calibration log. The manufacturer can point to the operator's training record. The platform can point to the mission specification that neither the operator nor manufacturer objected to before the flight. A rational defendant will settle rather than risk cross-claims that expose internal quality-control failures. This settlement dynamic, while efficient for individual cases, has a systemic cost: it suppresses the judicial precedent that would clarify doctrinal boundaries over time. Regulators should consider mandatory reporting of inspection-drone incident settlements to build the factual record that current litigation incentives discourage.

3.3. Passenger transport

EHang's EH216-S seats two passengers. No pilot is on board. The aircraft flies autonomously under remote supervision. The CAAC issued its type certificate in October 2023. Commercial air taxi operations are scheduled for 2025. When a two-passenger eVTOL loses power at 300 meters, the occupants face a high probability of serious injury or death.

Article 1238 of the Civil Code imposes strict liability on civil aircraft operators for damage to passengers and third parties. The text covers any civil aircraft carrying persons for compensation. A passenger eVTOL fits this definition. The operator cannot escape liability by showing the absence of fault. The only defense is that the damage resulted solely from the intentional act of the injured party. The manufacturer shares this strict liability under Articles 1202–1207. A passenger injured by a battery fire can sue the manufacturer directly. Courts apportion liability based on causal contribution: if the manufacturer's cell design was the primary cause, it bears the larger share. If the operator ignored a thermal runaway warning, its share grows ^[8].

The platform undergoes the most dramatic transformation. In delivery, it is a secondary actor. In passenger transport, it must certify airworthiness before each flight, verify remote-pilot credentials, maintain real-time data links, and ground aircraft that report anomalous readings. These duties exist nowhere in Chinese statutory law. The platform operates in a liability gray zone. Shenzhen's pilot insurance scheme required RMB 500,000 coverage for delivery drones in 2024. Industry estimates for passenger eVTOL coverage exceed RMB 5 million per seat. The tenfold gap captures the liability gradient in economic terms ^[9].

The passenger transport scenario also forces a reckoning with automation. The EH216-S has no pilot on board. When an autonomous flight controller makes a decision that a human pilot would not have made, who is liable? Article 1238 solves this through strict liability: it does not matter who decided because liability attaches to the operator regardless. This solution is legally clean but may be economically unsustainable. If operators face uncapped strict liability for autonomous decisions they cannot override, insurance markets may refuse to underwrite passenger eVTOL operations at any price. The CAAC will need to define a liability cap or a compensation fund mechanism before commercial service begins. The EU AI Liability Directive proposal does not address this problem. It assumes a human decision-maker somewhere in the loop, an

assumption that fully autonomous passenger aircraft invalidate.

4. Liability matrix

Table 1 consolidates the analysis. Each cell identifies the primary liability basis under current Chinese law.

Table 1. Scenario-based liability Matrix for commercial drone operations

Scenario	Operator	Platform	Manufacturer	Liability Rule
Delivery	Primary (fault, Art. 1165)	Secondary (dispatch negligence)	Product defect only (Art. 1202–1207)	Fault-based presumption
Inspection	Shared primary (professional duty)	Secondary (mission compliance)	Shared primary (equipment failure)	Mixed fault + strict
Passenger Transport	Joint strict (Art. 1238)	Airworthiness oversight	Strict liability (aviation standard)	Strict liability

The matrix exposes three structural features. First, asymmetry: the operator’s exposure varies more across scenarios than the manufacturer’s. An operator moves from fault-based liability in delivery to strict liability in passenger transport. The manufacturer’s underlying theory stays the same, though the stakes rise. Second, the platform gap: platform liability in delivery and inspection is secondary and contingent, but in passenger transport it becomes potentially primary yet legally undefined. CCAR-92 does not address this misalignment. Third, the scenario-shift problem: real operations cross scenario boundaries. A delivery drone may enter an inspection corridor. Current law gives priority to the higher-risk operation, but airspace priority does not equal courtroom priority. The matrix cannot resolve cross-scenario collisions but identifies them as underdetermined in current law.

The practical significance of the matrix extends beyond litigation to insurance underwriting. A liability insurer pricing risk for a drone operator needs to know whether the operator faces primary fault-based liability or secondary contingent liability. The answer depends on the operational scenario. An operator flying exclusively delivery missions in Shenzhen faces a different risk profile than one flying inspection missions for the State Grid. Current Chinese drone insurance products do not differentiate by scenario. They should. The matrix provides the risk-segmentation logic that underwriters need to price coverage accurately, reducing the cross-subsidization that burdens low-risk operators with premiums calibrated for high-risk ones ^[10].

5. Comparative insights

The EU AI Liability Directive proposal (COM(2022) 496 final) offers a useful comparator. Two features speak directly to Chinese drone liability.

Article 3 requires Member States to ensure courts can order disclosure of evidence from AI system providers when a claimant presents a plausible case of AI-caused harm. This targets the information asymmetry that plagues drone claims: the operator knows the flight inputs, the manufacturer knows the failure modes, and the plaintiff knows neither. Chinese civil procedure lacks an equivalent discovery mechanism. Incorporating a disclosure obligation would correct the structural imbalance our matrix exposes in every cell ^[11].

Article 4 creates a rebuttable presumption of causation. If a defendant failed to comply with a duty of care and a causal link to the AI output is reasonably likely, causation is presumed. This is directly relevant

to the inspection scenario: a drifted thermal sensor is a compliance failure, and under Article 4 logic, the bad data presumptively caused the missed detection. Chinese tort law achieves a similar result through burden-of-proof reversals in product liability cases, but the doctrinal path is less direct.

The comparison also reveals a gap. Neither Article 3 nor Article 4 addresses the platform as a distinct legal actor. The Directive assumes a bilateral claimant-provider relationship. Drone operations involve at least three parties whose liability interests do not always align. A workable framework needs a mechanism for apportioning responsibility at the pleading stage, not just at damages. Neither Chinese law nor the EU proposal provides this.

A further difference concerns the scope of strict liability. The EU proposal does not create new strict liability rules. It operates within existing national liability frameworks, adding procedural tools like the disclosure obligation and the causation presumption. Chinese law already contains strict liability provisions for civil aircraft and defective products. The comparison cuts both ways. The EU can learn from China's willingness to impose strict liability on high-risk activities without waiting for fault to be proven. China can learn from the EU's procedural innovations that make existing liability rules practically enforceable. The two systems are converging from opposite starting points toward a similar destination: a liability regime that is strict enough to protect victims, procedurally accessible enough to be used, and differentiated enough to avoid suppressing innovation.

6. Conclusion

The three scenarios this study mapped point to one conclusion. Liability does not travel well across use cases. A delivery drone striking a pedestrian in Shenzhen raises different legal questions than an inspection drone triggering a blackout. An eVTOL carrying passengers over the Pearl River Delta raises questions of a different order. One liability framework cannot fit all three.

Our matrix shows a clear pattern. As operational risk climbs from delivery to inspection to passenger transport, liability shifts upward and outward. The operator bears primary fault-based liability in delivery under Article 1165. In inspection, the parties split liability through a mixed model drawing on the operator's professional duty, the manufacturer's performance representations, and the platform's mission-design obligations. In passenger transport, the operator and manufacturer share strict liability under Article 1238 and Articles 1202–1207, while the platform shoulders an airworthiness oversight duty that current law does not define. The platform gap is the most urgent legislative problem the matrix reveals.

We recommend three changes. CCAR-92 needs a sub-chapter on passenger-grade eVTOL operations defining the manufacturer's continuing airworthiness obligation and the platform's route certification duty. Drone delivery platforms should face a statutory duty of route safety review, following the logic of Article 3 of the EU proposal. Inspection drone operations in critical infrastructure need a mixed-fault model with calibration logs serving as presumptive evidence, paralleling Article 4 of the EU proposal ^[12].

Several limitations qualify these findings. The three scenarios exclude agricultural spraying, aerial photography, and emergency rescue. The legal analysis draws on Chinese and EU sources without engaging common-law tort doctrines. The matrix has no empirical validation. No Chinese court has applied it to an actual drone dispute. That will change as drone litigation reaches the courts. When it does, the matrix should be tested, challenged, and rebuilt against real evidence.

The broader implication is methodological. Legal scholarship on drone liability has tended to pursue universal frameworks. Our results suggest that universality may be the wrong target. The liability facts on the ground differ enough across scenarios that differentiated rules produce fairer outcomes than unified ones. Autonomous vehicle liability may benefit from a similar scenario-sensitive approach that distinguishes highway autopilot from urban robotaxi from last-mile delivery bot. The matrix method is portable to those domains. Its core insight is simple but has been missing from the drone liability literature: context is not a complication to be eliminated. It is the thing the law should be built around.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Liu Y, Liu X, 2025, Safety Risk Governance of Low-Altitude Economy. *Engineering Proceedings*, 80(1): 14.
- [2] Şcheau MC, Achim MV, Găbudeanu L, et al., 2023, Proposals of Processes and Organizational Preventive Measures Against Malfunctioning of Drones and User Negligence. *Drones*, 7(1): 64.
- [3] Zhou W, Zhang JD, 2025, First-Mover Alliance: Shenzhen Low-Altitude Economy. *Cambridge Journal of Regions, Economy and Society*, rsaf014.
- [4] Simoneau T, 2023, Airspace Ownership Controversies in the United States. *Collegiate Aviation Review International*, 41(1): 1–28.
- [5] Liu Y, Liu X, 2025, Comparative Analysis of Legal Supervision of Low-Altitude Aircraft in China and Europe. *Engineering Proceedings*, 80(1): 13.
- [6] Moreham NA, 2023, Drone Cameras and Intrusion Into Privacy. *Victoria University of Wellington Law Review*, 54(1): 59–88.
- [7] Li C, Zhao Z, Chen Y, et al., 2024, Modeling the Urban Low-Altitude Traffic Space Based on the Land Administration Domain Model—Case Studies in Shenzhen, China. *Land*, 13(12): 2062.
- [8] Kar SK, Mathew DJ, S MM, et al., 2025, Air Traffic Management as a Service for Urban Air Mobility in Indian Cities: A Study for Scalable and Adaptive Design Framework for Optimizing Airspace Over Rail, Metro, and Roads. In: Mahamuni R, Onkar P (eds.), *ServDes 2025: Empowering Diversity, Nurturing Lasting Impact*, 6–10 October, Hyderabad, India.
- [9] Hashmi ZM, 2025, Enforcement of Privacy Violations by Drones. *Turkish Journal of Computer and Mathematics Education*, 16(2): 44–59.
- [10] Dolata M, Schwabe G, 2023, Equitable Guidelines for Police Drone Use. *Government Information Quarterly*, 40(4): 101874.
- [11] European Commission, 2022, Proposal for a Directive on Adapting Non-Contractual Civil Liability Rules to Artificial Intelligence (AI Liability Directive). COM(2022) 496 Final.
- [12] Civil Aviation Administration of China, 2024, Regulations on the Administration of Unmanned Aircraft Flight (CCAR-92).

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