HILL PUBLISHING

Engineering Advances, 2025, 5(4), 144-148
https://www.hillpublisher.com/journals/ea/
ISSN Online: 2768-7961

Challenges and Approaches to Transportation Safety in Platform-based Mobility

Siqi You

University of Southern California, Los Angeles, CA 90007, USA.

How to cite this paper: Siqi You. (2025) Challenges and Approaches to Transportation Safety in Platform-based Mobility. *Engineering Advances*, 5(4), 144-148.
DOI: 10.26855/ea.2025.10.002

Received: August 28, 2025
Accepted: September 26, 2025
Published: October 22, 2025

***Corresponding author:** Siqi You, University of Southern California, Los Angeles, CA 90007, USA.

Abstract

Transportation is a cornerstone of the United States' social and economic infrastructure. As one of the largest and most vehicle-dependent countries in the world, the U.S. faces enormous challenges in maintaining and improving road safety. As of 2023, the United States had over 290 million registered private and commercial motor vehicles, with industry analyses estimating nearly 298.7 million across all vehicle classes by early 2025. With such a vast fleet, even minor inefficiencies or lapses in compliance can lead to system-wide issues, from preventable accidents to economic losses and public resource strain. With the rapid growth of platform-based mobility services such as ridesharing and vehicle rentals, traditional traffic safety governance models are under pressure. The dynamic nature of fleet operations, characterized by large numbers of drivers and vehicles, dispersed across wide regions, presents new challenges in compliance management, identity verification, and risk control. This paper analyzes common transportation safety risks in modern mobility platforms and explores systematic approaches to addressing them, including dynamic eligibility models, automated document handling, unified identity services, and location-adaptive rule engines. It concludes by proposing that platform-based safety governance should move toward being proactive, data-driven, and scalable.

Keywords

Platform-based mobility; Transportation safety; Dynamic eligibility; Automated compliance; Identity verification; Risk-based governance; Scalable policy systems

1. Introduction

The landscape of transportation is undergoing a profound transformation. A distinct trend has emerged in recent years, marking a shift away from the conventional model of private vehicle ownership [1, 2]. This transition is characterized by an increasing reliance on platform-based coordination for mobility solutions [3]. These platforms have undeniably revolutionized the transportation sector, offering enhanced accessibility and improved efficiency compared to traditional methods. By connecting users with available vehicles and drivers through digital interfaces, these systems have streamlined the process of securing transportation, making it more convenient and readily available [4]. However, this paradigm shift also introduces a new set of challenges. Managing road safety and compliance in dynamic platform-based systems requires innovative solutions. Traditional fleet management struggles with decentralized operations involving thousands of drivers/vehicles across vast regions. Ensuring driver compliance and vehicle safety becomes intricate. Novel governance strategies are needed to manage safety and compliance in platform-based mobility, adapting to the changing landscape and addressing unique risks.

This paper argues that security governance in platform-based mobility systems must evolve toward a more proactive, data-driven, and scalable paradigm. Through a comprehensive analysis of prevalent safety risks in modern transportation platforms, it introduces a systematic approach to risk mitigation, encompassing dynamic eligibility assessment models, automated document verification, unified identity authentication, and real-time location synchronization via rule engines. These solutions collectively offer a robust technical framework for enhancing operational safety and regulatory compliance.

2. Emerging Challenges in Platform-based Transportation Safety

2.1 Risks of Standardized Driver Evaluation

In the United States, platform-based driver populations are already at a massive scale. Uber itself reports that more than 1 million drivers and couriers are active on its platform in the U.S. as of 2019 [5]. In platform-based mobility systems, driver evaluation processes are often inherited from or modeled after traditional approaches that rely on overly simplistic, rule-based criteria—such as fixed thresholds for driver activity or trip volume. However, such generalized standards often fail to account for contextual factors like regional demand differences, vehicle characteristics (e.g., electric vs. gas-powered), or nuanced driver behavior. This can lead to misaligned outcomes—for example, overlooking reliable drivers or incentivizing potentially unsafe driving patterns—ultimately impacting operational efficiency and public safety.

2.2 Manual Compliance Processes for Vehicle Documentation

The key compliance documents, including vehicle registration, inspection documents, and insurance certificates, are often uploaded and reviewed manually. This introduces inefficiencies and a high risk of human error, such as data entry mistakes or missed document renewals. In turn, these issues can lead to non-compliant vehicles operating unnoticed, posing serious regulatory and safety risks.

2.3 Fragmented Identity Verification Across Systems

Driver identity information is frequently stored inconsistently across systems or platforms. Without a unified identifier or verification interface, high-risk individuals may bypass restrictions by re-registering under different credentials, undermining enforcement and platform trust.

2.4 Lack of Geographically Adaptive Rules

Most platforms apply uniform rules across all regions, despite wide differences in urban density, traffic volume, and mobility demand. This rigid model limits platforms' ability to adapt to localized conditions—such as seasonal demand spikes, city-specific safety regulations, or unexpected disruptions like natural disasters, public demonstrations, or emergency declarations.

3. Technical Strategies for Risk Mitigation

The study draws upon the author's practical experience in designing technical architectures for large-scale mobility systems, with a particular focus on automation in safety workflows, real-time compliance infrastructure, and intelligent, data-driven governance strategies. By integrating policy considerations with system-level engineering, the research provides actionable insights for the future of safety governance in the transportation sector.

3.1 Behavior-based and Context-aware Eligibility Systems

Static rules, although straightforward to implement, frequently fall short when it comes to capturing the nuanced realities of driver behavior. These rule-based approaches often rely on inflexible thresholds, such as minimum trip counts or fixed incident caps, that do not account for context or behavioral intent. As a result, they can inadvertently penalize responsible drivers who deviate from the norm due to exceptional but justifiable circumstances, while allowing high-risk individuals to remain active by superficially meeting baseline metrics.

To address these shortcomings, a more sophisticated and equitable strategy involves leveraging behavior-based and context-aware eligibility systems. One promising approach centers on the development of dynamic eligibility engines that evaluate drivers across a spectrum of variables, including trip frequency, vehicle usage patterns, incident history, and peer or passenger feedback, where applicable. Building on practical experience with prototyping decision-support models, this research incorporates a scoring-based eligibility framework that synthesizes diverse behavioral and compliance signals into a composite performance profile. By integrating multiple dimensions of driver activity, such frameworks move beyond binary qualification rules toward more continuous and probabilistic evaluations of driver suitability.

In tandem with risk controls, these systems can also embed positive incentives through qualification frameworks that actively recognize and reward safe driving practices. For example, drivers with sustained positive records could receive tangible benefits—such as extended rental windows, performance bonuses, or preferential access to high-demand zones. These reinforcement mechanisms not only improve safety outcomes but also contribute to long-term engagement and retention of high-performing drivers.

Crucially, such eligibility systems can be designed to evolve over time. By incorporating machine learning models that continuously retrain on updated behavioral data, platforms can fine-tune thresholds and response strategies to reflect emerging patterns. In doing so, these systems embody a more adaptive and resilient approach to governance, one that accounts for both individual trajectories and broader operational conditions.

Taken together, these behavior-aware frameworks represent a meaningful departure from legacy compliance models. They demonstrate how data-driven policy design can support more responsive, equitable, and scalable mobility ecosystems. As transportation platforms increasingly seek to balance safety, efficiency, and fairness, these innovations offer a path forward for next-generation driver management.

3.2 Automated Document Extraction and Validation

Ensuring vehicle document compliance is a paramount concern for mobility safety, yet it has historically been one of the most challenging and error-prone areas. In the pre-automation era, verifying and processing vehicle documents was a laborious and time-intensive task. In response to these challenges, automation-based solutions have emerged to streamline document processing workflows. Operations personnel were required to spend significant time manually searching for records and entering data, leading to frequent errors such as incorrectly inputting vehicle details (e.g., inaccurate Vehicle Identification Numbers or expiration dates) or mistakenly uploading the wrong compliance documents. Detecting and correcting such errors often took days, introducing not only operational inefficiencies but also safety and regulatory risks due to delays in rectifying non-compliance.

In response to these challenges, automation-based solutions have gained traction as a way to streamline document processing workflows. Notably, the global intelligent document processing market was valued at USD 2.30 billion in 2024 and is projected to reach USD 12.35 billion by 2030, underscoring both the scale of the challenge and the accelerating shift toward digitized compliance infrastructures [6]. Drawing on applied experience in designing compliance-support architectures, this research examines synchronization systems that leverage Optical Character Recognition (OCR) technologies and large language models (LLMs) to extract key metadata from structured documents such as registration certificates and inspection records. When integrated into backend governance processes, such approaches significantly improve accuracy, accelerate compliance verification, and reduce reliance on manual data entry.

Moreover, these systems incorporate downstream automation logic to track and manage document expiration dates. Extracted metadata can trigger proactive workflows—such as automated notifications, renewal validations, or temporary service restrictions—thereby minimizing the operational risk of non-compliant vehicles remaining active within the platform. These enhancements not only ensure continuous compliance but also reflect a broader industry trend toward digitized, scalable infrastructures for governance and safety assurance.

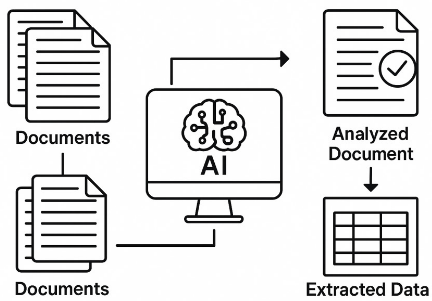

Figure 1. Automated Document Extraction and Validation Workflow.

3.3 Centralized Identity Lookup and Enforcement

Historically, high-risk drivers have been able to exploit weaknesses within fragmented identity systems to obscure their true identity. Common tactics included registering under altered credentials, reactivating outdated accounts that should have been deactivated, or exploiting inconsistencies across the databases of different partner organizations. Manual enforcement mechanisms, designed to prevent such behavior, were siloed and inefficient. Because driver profiles and records were maintained separately by each mobility platform, blind spots emerged that allowed disqualified drivers to circumvent restrictions and re-enter the ecosystem under new profiles.

This research builds on the author's applied work in cross-platform identity reconciliation, highlighting architectural strategies for creating systems that perform real-time identity consistency checks across fragmented datasets. The designs emphasized privacy-preserving linkage methods while maintaining the ability to surface suspicious duplication or evasion attempts within distributed rental and ridesharing environments.

When paired with real-time cross-checks, these frameworks enable proactive identification of fraud attempts, prior repossession events, or repeated safety violations. More advanced implementations incorporate probabilistic matching algorithms to detect identity obfuscation even when credentials have been altered. In some cases, multi-source corroboration methods validate driver identity across otherwise independent platforms, creating an additional layer of resilience against evasion tactics.

By aligning identity signals with risk profiles, mobility platforms can move toward consistent, automated enforcement practices—reducing dependency on reactive human review while improving response times. Machine learning classifiers trained on historical incident patterns can further strengthen the system, flagging anomalies in real time and supporting predictive risk management before unsafe behavior escalates.

These developments illustrate a broader industry shift toward unified identity frameworks that underpin scalable, data-driven compliance infrastructure. Looking ahead, techniques such as federated identity scoring and zero-knowledge verification may allow platforms to collaborate on shared safety goals without compromising privacy. As mobility networks grow more interconnected, such innovations could establish industry-wide safeguards spanning organizations, regions, and transportation modalities.

3.4 Geographically Adaptive Policy Systems

Mobility risks vary significantly by geographic region, yet many legacy trip eligibility policies have historically failed to reflect this complexity. Rigid frameworks often treat all locations as functionally equivalent, applying uniform rules regardless of local conditions. For instance, some operations relied on standard activity thresholds to evaluate driver engagement without accounting for disruptions in specific locales—unintentionally penalizing drivers in low-demand or high-risk areas. This blanket approach, while administratively convenient, frequently produced inequitable outcomes during periods of regional disruption such as severe weather events, civic protests, or infrastructure outages.

Drivers operating in affected areas—despite strong histories of compliance and reliability—could be penalized for failing to meet thresholds that were unrealistic under the circumstances. This mismatch between policy and context underscored the need for a more adaptive system capable of responding dynamically to real-world variability.

This research builds on the author’s applied work developing context-sensitive governance systems, including automated rules engines that ingest localized disruption indicators and dynamically recalibrate eligibility thresholds. By embedding geospatial intelligence into policy design, these systems enabled operational teams to apply region-specific calibrations in real time without relying on manual overrides. In high-disruption zones, thresholds can be automatically relaxed to preserve fairness, while in stable regions they can be elevated to reinforce accountability.

Beyond internal platform signals, these frameworks can be enhanced through integration with third-party datasets—such as public transit outage reports, geospatial risk maps, or congestion indices—combined with machine learning models. This data fusion allows predictive recalibration of eligibility criteria before disruptions escalate, enabling the system to not only react more equitably but also anticipate risk conditions in advance.

By embedding these adaptive mechanisms directly into governance infrastructure, platforms gain the ability to respond to emerging “risk hotspots” in real time, reducing reliance on exception-based workflows while lowering the administrative burden during crises. Automated rules management in this context enhances fairness, strengthens safety outcomes, and improves operational resilience.

Overall, this shift toward contextualized and responsive policy enforcement reflects a broader evolution in platform governance—one that values flexibility, equity, and data-informed decision-making. As U.S. cities experience increasingly dynamic mobility patterns, such adaptive infrastructures will become essential for achieving scalable and resilient transportation safety systems.

4. Governance Recommendations for Safer Mobility Platforms

To cultivate and maintain sustainable safety practices within platform-based transportation systems, it is crucial that governance strategies progress beyond simply reacting to incidents and enforcing existing regulations. Future endeavors should prioritize a proactive and forward-thinking approach, emphasizing the following three fundamental principles to ensure a safer and more reliable transportation ecosystem:

(1) Proactivity: Build systems that detect risk patterns early and enable preemptive interventions.

(2) Digitization: Replace manual workflows with AI-powered tools to improve data quality and reduce compliance gaps.

(3) Scalability: Design adaptable frameworks capable of supporting rapid platform growth and policy responsiveness across regions.

The technical architecture outlined in this paper provides the foundational elements necessary for alignment with crucial U.S. transportation policy initiatives, specifically creating the essential groundwork that will enable seamless future integration with the National Highway Traffic Safety Administration's (NHTSA) overarching vision for "data-driven safety governance" [7]. Furthermore, it actively supports and contributes to the U.S. Department of Transportation's ambitious goals for automation and infrastructure modernization [8], ensuring adherence to safety regulations and promoting a safer transportation landscape for all.

Importantly, the proposed framework not only aligns at a conceptual level but also maps directly to actionable policy instruments. For example, the U.S. Department of Transportation's FY 2022–2026 Strategic Plan explicitly calls for improving data-sharing infrastructure and equity in transportation access; the proposed unified identity authentication and adaptive policy systems offer a direct mechanism for fulfilling those requirements. Likewise, the Bipartisan Infrastructure Law (IIJA) allocates significant funding for digital transformation and intelligent infrastructure; the compliance document automation and monitoring systems described here represent concrete applications of such federally supported modernization initiatives.

Specifically, the framework's emphasis on unified identity authentication and adaptive policy systems supports the National Highway Traffic Safety Administration's (NHTSA) long-term vision of "data-driven safety governance" as articulated in Automated Driving Systems 2.0: A Vision for Safety. By enabling real-time risk detection, machine learning-based eligibility scoring, and automation in compliance verification, the proposed system lays the foundational technical architecture for embedding safety logic into the very operation of platform-based mobility networks.

In this regard, the research serves not only as a response to existing platform governance challenges, but also as a blueprint for modernizing transportation safety in alignment with national interests—supporting federal strategic objectives for safer, smarter, and more resilient mobility systems.

5. Conclusion

In the evolving landscape of platform-driven transportation, ensuring safety transcends traditional roadside enforcement methods, becoming deeply intertwined with system design and robust data governance practices. As mobility solutions increasingly embrace digital technologies, decentralization, and demand-responsive models, it is of paramount importance to integrate safety considerations into the fundamental architecture of platform infrastructure. This proactive approach necessitates the development and deployment of automated, scalable, and regionally aware safety systems. This paper analyzes common transportation safety risks in modern mobility platforms and explores systematic approaches to addressing them, including dynamic eligibility models, automated document handling, unified identity services, and location-sensitive rule engines. By leveraging these advanced systems, mobility providers can significantly enhance public safety outcomes, effectively mitigate operational risks, and contribute to the creation of a more resilient and secure transportation environment for all stakeholders.

References

[1] Federal Highway Administration. State Motor-Vehicle Registrations – 2023. Highway Statistics Series. U.S. Department of Transportation; 2025. https://www.fhwa.dot.gov/policyinformation/statistics/2023/mv1.cfm

[2] Hedges & Company. US Vehicle Registration Statistics (January 2025 Estimation). 2025. https://hedgescompany.com/blog/2022/10/how-many-vehicles-are-in-the-us/

[3] Clewlow RR, Mishra GS. Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States. UC Davis, 2017. https://escholarship.org/content/qt82w2z91j/qt82w2z91j.pdf

[4] Shaheen S, Chan N. Mobility and the Sharing Economy: Potential to Overcome First- and Last-Mile Public Transit Connections. Transportation Sustainability Research Center, University of California, Berkeley; 2016. https://tsrc.berkeley.edu/publications/mobility-and-sharing-economy-potential-overcome-first-and-last-mile-public-transit

[5] Uber Technologies. A First Step Toward a New Model for Independent Platform Work. 2020. https://www.uber.com/newsroom/working-together-priorities/

[6] Grand View Research. Intelligent Document Processing Market Size, Share & Trends Analysis Report. 2024. https://www.grandviewresearch.com/industry-analysis/intelligent-document-processing-market-report

[7] United States Department of Transportation. U.S. Department of Transportation Strategic Plan: FY 2022–2026. 2022. https://rosap.ntl.bts.gov/view/dot/66380

[8] National Highway Traffic Safety Administration. A Vision for Safety (Automated Driving Systems 2.0). 2017. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf