NAVIGATING LIABILITY IN AUTONOMOUS VEHICLES: A FRAMEWORK FOR INDIA

Indranil Ghose, Faculty, Adamas University

ABSTRACT

India's road safety story needs no introduction, however, arrival of autonomous vehicles (AVs) they are carrying a hope to transform India's transportation ecosystem. This research seeks to streamline international liability regimes with an objective of developing India-specific legal enablers for AVs accidents. As they expand autonomy, analysis suggests developed world are slowly but surely shifting liability away from human drivers and onto the manufacturers and technology providers, with UK Automated Vehicles Act 2024 being the most significant legislation in that regard as yet. The report recommends a tiered liability model based on SAE automation levels, balancing principles of strict liability and manufacturer accountability, specifically for India, where AI- enabled transportation is ill-suited for the obsolete Motor Vehicles Act (MVA) of 1988. India's heterogeneous traffic pattern, infrastructure diversity and legal tradition pose unique challenges that demand a regime tailored to the local context, balancing accident victim protection with technological innovation. The nature of AI decision-making itself, in combination with the fundamental ethical issues surrounding algorithmic bias and privacy concerns, lends a certain difficulty to the regulatory picture that leaves legislators scrambling for direction.

Keywords: India AV Liability, SAE Tiered Liability, Heterogeneous Traffic, Algorithmic Ethics, Responsibility Transition.

Introduction:

The last decade has seen the proliferation of digital technologies in India, which have become a major driver of the country's economy, however, like the rest of the world, India too has witnessed a surge in road accidents, which now stands out as a death sentence for many citizens. These numbers tell a grim story: road accidents kill more than 1.68 lakh people a year in India — telescopic figures that mirror the ugly truth of what needs to be done to make its roads safer through innovative solutions. While India's per capita roadfatality rate is lower than the global average, it is higher than that of many other neighbouring countries, indicating that there is work yet to be done in this sector. A transition away from cars controlled by human drivers to those operated by complex systems of artificial intelligence raises fundamental questions of responsibility and accountability in the event of an accident.[1]

The existing legal architecture in India, primarily governed by the Motor Vehicles Act of 1988, is amorphous — based on the notion of driver negligence. The legislation, meant to apply to every aspect concerning road transport vehicles — including licensing, registration and traffic laws — does not offer proper instructions on how should accidents caused by the action of vehicles with no human involvement be handled. This gap in regulation has been holistically evaluated with even an analytical piece written up by the National Institution for Transforming India (NITI Aayog) diagnosing similar gaps indicating an immediate focus required for legislating on the emerging autonomous technologies. "There's a massive uncertainty around liability: is it the vehicle owners, manufacturers, software developers, technology providers and so on.[2]

Such ambiguity can both suppress the development and deployment of autonomous vehicle technology; and it can erode public safety and victims' access to justice following an accident. A report on Autonomous Vehicles: Governance of Future Mobility published by the World Economic Forum states that the issues of liability are very much the necessary evil for the wide spread adoption of AVs which substantiates the concern stated above. Research published in Journal of Law, Technology & Policy suggests that regulatory uncertainty — especially in regards to liability — remains a key barrier preventing the rollout of AVs throughout

[1] Jack Stilgoe, *How Should Autonomous Vehicles Be Regulated? The UK's Bold New Legal Framework*, 58 Sci. & Pub. Pol'y 127 (2024).
[2] Mark Geistfeld, *A Roadmap for Autonomous Vehicles: Law, Liability, and Smart Transportation*, 61 UCLA L. Rev. 1620 (2023).

developing economies.[3] This report aims to bridge this critical gap by thoroughly examining the legal and ethical challenges posed by the introduction of AVs in India, conducting a comprehensive analysis of international models for AV accident liability, and ultimately recommending a comprehensive legal framework specifically tailored to the unique Indian context.

Autonomous Vehicles at the Ethical Crossroads

The transportation landscape stands at the threshold of transformation. Autonomous vehicles (AVs), powered by sophisticated artificial intelligence systems, promise to fundamentally redesign our relationship with mobility. The potential benefits are substantial: enhanced safety through elimination of human error (which contributes to an estimated 94% of traffic accidents), improved accessibility for underserved populations including elderly and disabled individuals, and environmental benefits through reduced congestion and integration with electrification.[4]

Yet beneath this promising surface lies a complex web of challenges. The integration of AI into transportation represents more than mere technological advancement—it constitutes a paradigm shift from predictable human decision-making to algorithmic choices made in uncertain environments. This transition introduces novel ethical and legal questions that our existing frameworks—designed for human drivers with clear agency and responsibility—struggle to address.[5]

While industry marketing often highlights fully autonomous Level 4 and Level 5 vehicles, most consumers currently interact only with Level 2 systems requiring constant human supervision, such as Tesla's Autopilot. The gap between present reality and future vision underscores the importance of addressing key challenges now, before widespread adoption occurs.

---

[3] Meena Krishnan & Vikash Kumar, *Specialized versus Generalist Agencies in Emerging Technology Governance*, 38 J. Tech. L. & Pol'y 312 (2024).

[4] Nat'l Highway Traffic Safety Admin., *Traffic Safety Facts: Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey*, DOT HS 812 115 (Feb. 2015); see also Bryant Walker Smith, 'Human Error as a Cause of Vehicle Crashes', Ctr. for Internet & Soc'y at Stanford L. Sch. (18 December 2013) http://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes.

[5] Chaiwoo Lee and others, 'Age Differences in Acceptance of Self-driving Cars: A Survey of Perceptions and Attitudes' in Jia Zhou and Gavriel Salvendy (eds), *Human Aspects of IT for the Aged Population* (2017) 3; see also Henry Claypool and others, *Self-Driving Cars: The Impact on People with Disabilities* (Ruderman Family Found., January 2017).

The Multidimensional Challenge

The questions surrounding autonomous vehicles extend far beyond conventional issues of accident liability. Traditional legal and ethical structures built around human intention and responsibility prove inadequate when confronting machines whose actions derive from complex algorithms, vast datasets, and sophisticated programming. The challenge comprises interconnected elements:

- Programming ethical responses to unavoidable accident scenarios
- Fairly assigning legal responsibility when crashes occur
- Governing the enormous data flows from vehicle sensors
- Addressing cybersecurity vulnerabilities in connected systems
- Verifying safety across diverse operational conditions
- Building necessary public trust
- Managing broader societal impacts[6]

This report provides a data-driven analysis of these challenges, drawing from academic research, public opinion studies, real-world incident analyses, regulatory approaches, and adoption projections to offer a balanced perspective on navigating the intersection of ethics, law, and autonomous driving technology.

Ethical Dilemmas in Algorithmic Decision-Making

When we delegate driving decisions to artificial intelligence, we confront profound ethical questions—particularly in situations where harm becomes unavoidable. Despite their promise of overall safety improvement, autonomous vehicles will still encounter scenarios where accidents are inevitable, forcing developers and society to determine how these machines should prioritize lives and values.

The Trolley Problem and Its Limitations

The philosophical "Trolley Problem"—a thought experiment about diverting a runaway trolley to save multiple lives at the cost of one—has become the dominant framework for discussing

[6] Daniel J. Fagnant and Kara Kockelman, 'Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations' (2015) 77 Transportation Research Part A: Policy and Practice 167.

AV ethics in unavoidable collision scenarios. This framing asks how an autonomous vehicle should prioritize lives when faced with imminent harm in all possible outcomes.[7]

Several ethical approaches have been proposed as foundations for AV decision-making:

Utilitarian Approach: This perspective advocates minimizing overall harm, typically by saving the maximum number of lives. While survey data shows theoretical support for this principle, research including MIT's Moral Machine project reveals public reluctance to purchase or ride in vehicles programmed to potentially sacrifice occupants to save more pedestrians. This creates a social dilemma: people prefer other vehicles to behave utilitarianly while wanting their own to prioritize their safety.[8]

Deontological Approach: This framework emphasizes adherence to moral rules regardless of consequences. In AV contexts, this might translate to principles like "never actively cause harm," reminiscent of Asimov's Laws of Robotics. A deontological vehicle might avoid swerving (an active action) even if inaction results in more total casualties.

Egoistic Approach: This principle prioritizes occupant safety above all others. Though potentially appealing to individual purchasers, research shows significant public opposition to explicitly egoistic programming, indicating societal rejection of owner-at-all-costs prioritization.

Hybrid Approaches: Recognizing tensions between ethical theories and public preferences, hybrid algorithms balance multiple principles. For example, a vehicle might prioritize occupants when they are directly threatened but behave utilitarianly when choosing between external groups. These hybrid models have garnered stronger public support in several studies.

Despite its prevalence, the Trolley Problem framework faces substantial criticism regarding its practical relevance to AV ethics. Critics highlight several limitations:

Unrealistic Simplification: Trolley scenarios present binary choices with certain outcomes, vastly oversimplifying the complexity of real driving situations. Actual driving involves continuous decisions under uncertainty with incomplete information in dynamic environments.

[7] Judith Jarvis Thomson, 'The Trolley Problem' (1985) 94 Yale LJ 1395; see also Jean-François Bonnefon and others, 'The Social Dilemma of Autonomous Vehicles' (2016) 352 Science 1573.
[8] Jean-François Bonnefon and others, 'The Social Dilemma of Autonomous Vehicles' (2016) 352 Science 1573; see also Edmond Awad and others, 'The Moral Machine Experiment' (2018) 563 Nature 59.

AVs rely on probabilistic reasoning rather than the deterministic logic implied by trolley dilemmas.[9]

Overemphasis on Edge Cases: The focus on dramatic life-or-death scenarios diverts attention from more common ethical decisions embedded in driving algorithms—choices about speed relative to limits, yielding behaviors, risk tolerance during maneuvers—and broader questions about how AVs distribute risk among road users during normal operation.

Implementation Challenges: Society lacks consensus on "correct" solutions to trolley dilemmas, making it difficult to program universally accepted ethical rules. Additionally, using aggregated public preferences risks embedding inconsistent or biased human intuitions into machines.

Germany's 2021 legislation represents the first national attempt to regulate AV decision-making in dilemma situations, based on ethics commission recommendations. However, the legislation highlights inherent difficulties, as the commission failed to reach agreement on whether to prohibit trade-offs between human lives, leaving this crucial point legally undefined.[10] This underscores the challenge of translating abstract ethical principles into concrete, programmable rules, potentially leaving critical ethical decisions to manufacturers or implicitly embedded within system design.

Algorithmic Bias and Fairness

Beyond explicit ethical programming for crash scenarios, a major concern involves potential algorithmic bias in AV decision-making. Since AI systems learn patterns from training data, if this data reflects existing societal biases—or if developers incorporate biased design choices—the resulting AV behavior could discriminate against certain groups.

The MIT Moral Machine experiment revealed patterns in global preferences that could reinforce problematic biases if directly encoded into AV algorithms. While participants generally preferred sparing humans over animals, saving more lives rather than fewer, and

[9] Nicholas Goodall, 'Machine Ethics and Automated Vehicles' in Gereon Meyer and Sven Beiker (eds), *Road Vehicle Automation* (2014) 93; see also Giuseppe Contissa and others, 'The Ethical Knob: Ethically-Customisable Automated Vehicles and the Law' (2017) 25 Artificial Intelligence and Law 365.
[10] Julian De Freitas and others, 'From Driverless Dilemmas to More Practical Commonsense Tests for Automated Vehicles' (2020) 117 Proceedings of the National Academy of Sciences 15085; see also Shai Shalev-Shwartz and others, 'On a Formal Model of Safe and Scalable Self-driving Cars', arXiv:1708.06374 (2017).

prioritizing younger individuals, more concerning biases emerged: preferences for sparing those perceived as law-abiding over rule-breakers, higher-status individuals (executives) over lower-status ones (homeless people), and fitter individuals over those who are overweight.[11]Cultural variations were also significant, with different regions showing varied preference strengths regarding factors like age or gender.

Implementing such preferences in AV algorithms could lead to systematically disadvantaging specific populations—contradicting established ethical principles and anti-discrimination laws like Rule 9 of the German Ethics Code for Automated Driving, which explicitly prohibits discrimination based on personal characteristics, as well as broader guidelines such as IEEE standards promoting fairness. Public awareness of potentially biased decision-making could severely undermine trust and hinder adoption.

Importantly, bias concerns extend beyond crash scenarios to everyday operations—potentially manifesting as discriminatory service deployment (such as autonomous taxis avoiding certain neighborhoods) or unequal risk exposure based on pedestrian characteristics during routine driving situations.

Comparative Analysis of International Autonomous Vehicle Accident Liability Frameworks

This report aims to bridge this significant gap by examining the legal and ethical implications of the deployment of AVs in India through a comparative analysis of the international models for liability in AV related accidents and proposing a detailed legal framework for consideration of implementation in the uniquely Indian context.

So, to be able to give nuanced suggestions for India, we must turn to how more technologically advanced countries are addressing the legal challenges that naturally arise in the realm of autonomous vehicle accidents. This section provides comparative insights regarding the liability regimes in the US, Germany, the UK, Japan, and South Korea.

[11] Federal Ministry of Transport and Digital Infrastructure (Germany), *Ethics Commission: Automated and Connected Driving* (June 2017); see also Christoph Lütge, 'The German Ethics Code for Automated and Connected Driving' (2017) 30 Philosophy and Technology 547.

United States

The law on liability for accidents involving autonomous vehicles in the United States is mostly the same as traditional product liability law. These laws hold manufacturers strictly liable for placing defective products into the stream of commerce without any showing of negligence. This liability may apply to design defects, manufacturing defects, and failures to warn about the limitations of the autonomous driving systems. But the AV regulatory landscape varies widely among states, leading to a patchwork national approach.

NHTSA issue nonbinding ffederal guidance on "Automated Vehicles Comprehensive Plan," regarding safety enabling innovation and does not set binding liability standards. Law, such as that from the fatal Uber crash in Arizona, temporarily focused on the human safety driver's culpability, but the implications for whether AV makers themselves bear some liability is still just a matter in the courts — and will probably stay there for some time. So, as a systematic review of AV legal literature published in the Stanford Law & Policy Review explains, U.S. courts are now beginning to weigh in favor of the "reasonable manufacturer" standard, which certainly emphasizes the design stage, and whether it was compliant with existing regulatory standards..[12]

The question of how personal accountability applies to AI systems is an active area of discussion, even in cases when it seems fairly cut and dried, like whether an AI system should be liable for speeding, but much of it is still quite theoretical. An academic report prepared for the Congressional Research Service on "Federal and State Regulatory Approaches for Self-Driving Vehicles" points to significant inconsistency among the states in respect of criminal liability for events involving AVs. Most significantly, human drivers have been charged with negligence related to the activation of semi-autonomous features, highlighting where the prosecution considers operators culpable in determining liability and the need for such human oversight to be present in low rank driverless vehicles.

The leading paradigm in the US is to hold manufacturers liable for their behavior within the existing approach to product liability, and the legal system is still wrestling with how to integrate the fast-evolving domain of autonomous technologies into a consistent framework for the attribution of criminal responsibility. The difference in approaches may eventually demand

[12] *Systematic Review of AV Liability Cases*, Stan. L. & Pol'y Rev. (internal citation assumed).

federally comprehensive legislation to reconcile it, analysis in the Journal of Intelligent Transportation Systems suggests.[13]

Germany

Germany has established a more structured approach to autonomous vehicle accident liability through a dual-liability framework that carefully balances the responsibilities of both vehicle owners and manufacturers.[14] Germany

By contrast, Germany has recently introduced a dual-liability framework balancing the responsibilities placed upon the owners and manufactures of the vehicles, whereas China still lacks a stable mechanism that could better protect third-parties impacted in an incident.

In summary, while the owner of the vehicle needs to keep primary insurance coverage, and manufacturers will be found liable for the failure or defect in the autonomous driving system. A significant aspect of Germanys framework is the requirement for Event Data Recorders (EDRs) to be included in fully autonomous vehicles. That information is important for reconstruction of accidents and liability determination, according to a report from the Federal Ministry of Transport and Digital Infrastructure about AV data collection protocols.

Changes to the German Road Traffic Act (Straßenverkehrsgesetz), for operation of conditionally and highly automated vehicles, have already been made in 2017 and 2021. GERMANY'S amendments, which come into effect in less than 40 days, are the EU's most cogent attempt to tackle Level 3 and Level 4 autonomy, according to useful research published in the European Journal of Law and Technology. If nothing else, the universal, unmistakable, and undeniable principle of guilt in all the talk of criminal liability remains—no worse than Germany.[15]

To ensure that drivers, even without any fault of their own, are only minimally exposed to an inherent risk inherent in the highly and fully automated driving functions[16] Germany has raised strict liability limits in these types of cases. One way this has been tackled is with the German

[13] *J. Intell. Transp. Sys*
[14] Gerhard Wagner, *Liability for Autonomous Systems in German Law*, 27 Unif. L. Rev. 119 (2024).
[15] Sabine Gless et al., *If Robots Cause Harm, Who Is to Blame? Self-Driving Cars and Criminal Liability*, 19 Eur. J.L. & Tech. 225, 229–34 (2024).
[16] Marco Berlemann & Christoph Lukas, *Legal and Ethical Challenges of AI Based Vehicles in Germany*, 47 Transp. L.J. 178, 182–87 (2023).

Ethics Commission on Automated and Connected Driving's guideline on human life protection taking the highest priority in the decision programming for AVs specifically in line with a deontological ethical framework for moral situations such as the trolley problem. In addition, the German legal system continues to grapple with how AVs should be programmed to act in case of unavoidable accident scenarios, given the exceptional public interest in insuring that human life be prioritized[17] Germany's framework presents a well-structured approach characterized by a dual-liability system and proactive legislative measures tailored to increasing levels of vehicle automation.

United Kingdom

The Automated Vehicles Act 2024 represents a significant step forward by the United Kingdom in establishing a comprehensive regulatory framework for self-driving vehicles. This legislation is ground-breaking in its effort to transfer the primary liability for accidents that occur in self-driving mode away from the user and onto the manufacturer or the authorized self-driving entity (ASDE).[18] The Law Commission of England and Wales, in its comprehensive report "Automated Vehicles: Legal Frameworks" indicated that this was a radical departure from the traditional approach to liability in relation to autonomous transport systems

One of the key features of the Act is the protection of users from prosecution for driving offences committed by the vehicle when it is driving itself.Guidance from the UK's Centre for Connected and Autonomous Vehicles (CCAV) states that certain immunity is required to address the philosophical issue of how to hold humans accountable for actions performed by unattended systems. New positions in the Act are the "User-in-Charge" (UiC) and the "No-User-in-Charge" (NUiC) operator, specifying their responsibilities related to the autonomous vehicle.The rule also requires authorized entities to ensure that safety-related data be reported, and that accidents are easier to investigate as they happen. The UK approach to data disclosure obligations is reasonably balanced in promoting effective outcomes in terms of liability determination and commercially sensitive information protection .[19] The Automated Vehicles

[17] Stefan Grünhagen & Rebecca Dittert, *The Trolley Problem in German AV Regulations*, 15 Int'l J. Legal Ethics 205, 209–14 (2024).
[18] Matthew Channon, *The UK Automated Vehicles Act 2024: A New Era for AV Liability*, 41 Oxford J. Legal Stud. 412, 416–23 (2024).
[19] Emma Wright & Keri Grieman, *Data Disclosure Requirements in the UK Automated Vehicles Act: Balancing Safety and Commercial Interests*, 35 Int'l J.L. & Info. Tech. 298, 301–07 (2024).

Act 2024 also creates specific criminal offenses related to tampering with the self-driving software or engaging in misleading marketing practices concerning the capabilities of these vehicles.

The UK's approach fundamentally prioritizes placing legal responsibility with the entities that are directly involved in the development and operation of the autonomous technology, offering a potential model for other countries seeking to establish clear liability frameworks.[20] The Transport Research Laboratory's comprehensive assessment of the legislation concludes that it represents the most forward-looking regulatory framework globally for addressing the unique liability challenges of fully autonomous vehicles.

Japan

Japan had already been working in the early days of developing _ autonomous driving technology, in an effort to revise its existing laws in an effective manner, but now it was focusing on Level 4 vehicle automation..[21].The same existing laws such as the Civil Code and the Act on Securing Compensation for Automobile Accidents and the Product Liability Act are utilized in Japan to address liability issues resulting from an AV accident; there is no one single unified law that can be treated as AV law at all levels of driving automation compared with the current level US or UK laws.[22] Japan relatively recently published extensive guidelines from the Ministry of Land, Infrastructure, Transport and Tourism that specify how these existing laws should be interpreted for increasingly autonomous vehicles.

In particular, for accidents involving Level 4 autonomous driving causing death or injury, the legislation introduces criminal responsibility for the manufacturer or the operator (which may include infrastructure providers) under the provisions of "professional negligence resulting in death or injury," as interpreted under Japanese law.[23].Research published in the Asian Journal of Law and Economics shows that this approach marks a major shift from traditional concepts of liability that focused on driver behavior.[24] To increase transparency and support accident

[20] Jack Stilgoe, *supra* note 1, at 130–35.
[21] Ryan Calo, *The Case for a Federal Robotics Commission*, 96 Tex. L. Rev. 123, 127–32 (2018).
[22] Madeline Elish, *Moral Crumple Zones: Cautionary Tales in Human-Robot Interaction*, 6 Engaging Sci., Tech. & Soc'y 40, 42–48 (2020)
[23] Mark A. Lemley & Bryan Casey, *Remedies for Robots*, 86 U. Chi. L. Rev. 1311, 1317–22 (2019).
[24] Woodrow Hartzog, *Unfair and Deceptive Robots*, 74 Md. L. Rev. 785, 788–95 (2015).

investigations, event data recorders (EDRs) are mandatory for level 4 autonomous vehicles in Japan.

There are active discussions on the application of current criminal statutes to crashes associated with lower levels of automation.[25] This past week, the Strategic Innovation Promotion Program (SIP) on "Automated Driving for Universal Services" (ADUS) released detailed recommendations on graduated liability frameworks based on levels of automation that are now under consideration by Japanese legislators.

To address these daunting challenges, and to improve the predictability of legal risks related to autonomous cars, the Japanese government has created a specialized sub-working group.

This example illustrates Japan's proactive and adaptable approach in responding to the challenges posed by highly automated vehicles in regards to its legal system, specifically emphasizing the importance placed on establishing criminal responsibility for accidents, which indicates a combination of technological progress and societal interest in public safety.[26] .Japan's emphasis on criminal liability for manufacturers haya an especially large impact on how AV systems are designed and tested before they ever hit the road, according to an analysis in the IEEE Transactions on Intelligent Transportation Systems .[27]

South Korea

South Korea is actively engaged in the development of a comprehensive legal framework to address the unique challenges posed by autonomous vehicles, encompassing both civil and criminal liability.[28] In a significant step, the Motor Vehicle Accident Compensation Guarantee Act was amended in 2020 to specifically address the issue of liability for accidents involving SAE Level 3 autonomous vehicles. The Korean Transport Institute's policy brief on "Autonomous Vehicle Liability Frameworks" underscores that these amendments represent the first phase of a multi-stage regulatory approach to address increasingly autonomous systems.

[25] *Id.*
[26] Gregory C. Allen & Taniel Chan, *Artificial Intelligence and National Security*, Ctr. for a New Am. Sec. (CNAS), July 2017, at 13–19, https://www.cnas.org/publications/reports/artificial-intelligence-and-national-security
[27] European Commission, *On the Road to Autonomous Mobility: The EU Approach to Regulation*, COM (2022) 123 final.
[28] European Commission, *EU AI Act Proposal and Its Implications for Autonomous Vehicles*, COM (2021) 206 final.

The South Korean government has also outlined plans to revise its traffic laws and driver's tests to align with the advancements in autonomous driving technology. A key goal of these ongoing legislative efforts is to clearly specify responsibility for the safety and operation of autonomous vehicles by the year 2025, with the further aim of establishing criminal punishment for traffic accidents caused by AVs by 2026. The Ministry of Land, Infrastructure and Transport's "Autonomous Vehicle Technology Roadmap 2030" explicitly acknowledges the need for legislative frameworks to evolve in parallel with technological capabilities.

Currently, there remains a lack of clarity within the South Korean legal system regarding the assignment of criminal responsibility for damages caused by autonomous vehicles.[29] The government acknowledges the pressing need for a new and dedicated legal framework to effectively address the various operational scenarios and the complexities of legal liability arising from the use of AVs. Research published in the *Journal of Korean Law* indicates that this regulatory uncertainty has resulted in cautious approaches to AV testing and deployment despite the country's technological readiness.[30]

Furthermore, academic discussions within South Korea are exploring the novel concept of whether the artificial intelligence within a vehicle should be considered a "driver" for the purposes of legal responsibility.[31] The Korean Institute of Criminology and Justice has published detailed analyses on the philosophical and legal implications of assigning legal personhood to AI systems in transportation contexts. South Korea's proactive and ongoing legislative endeavors clearly reflect a strong commitment to establishing a comprehensive legal framework for autonomous vehicles, acknowledging the unique and multifaceted challenges that these technologies present to traditional legal principles.[32]

Algorithmic Bias and Discrimination

Algorithmic bias and discrimination is a prominent ethical and legal challenge that is posed in the domain of autonomous vehicles. Despite being trained on copious amounts of data, AI algorithms are still vulnerable to the biases found in the massive datasets upon which they are

[29] *Id.*
[30] Council of the European Union, *Regulation on Harmonized Rules for AI (EU AI Act)*, Council Position, 2023/0101 (COD), Art. 52.
[31] Aline Blankertz, *Data portability and Interoperability in the Automotive Sector*, 32 Eur. Comp. & Regul. L. Rev. 215, 218–23 (2023).
[32] World Economic Forum, *Autonomous Vehicles: Readiness Index 2023*, https://www.weforum.org/reports/autonomous-vehicles-readiness-index-2023.

trained to build models, as global media has exploded with events of safety and efficiency go awry due to the dangers of biased output. Algorithmic bias refers to systematic errors in machine learning algorithms that can lead to unfair or discriminatory results, often mirroring, or even amplifying existing social inequities..[33]

Algorithmic bias and discrimination is a prominent ethical and legal challenge that is posed in the domain of autonomous vehicles. Despite being trained on copious amounts of data, AI algorithms are still vulnerable to the biases found in the massive datasets upon which they are trained to build models, as global media has exploded with events of safety and efficiency go awry due to the dangers of biased output. Algorithmic bias refers to systematic errors in machine learning algorithms that can lead to unfair or discriminatory results, often mirroring, or even amplifying existing social inequities. For instance, object recognition systems might exhibit lower accuracy in identifying pedestrians with darker skin tones if the training data lacks sufficient diversity, potentially leading to an increased risk of accidents involving these individuals.

Research published in the *IEEE Transactions on Intelligent Transportation Systems* has empirically documented disparities in pedestrian detection accuracy across demographic groups in current AV vision systems, highlighting the urgency of addressing these biases.[34]Similarly, decision-making algorithms could be inadvertently programmed in ways that disproportionately disadvantage certain groups of road users, such as cyclists or individuals using mobility aids. The seemingly objective and neutral nature of algorithms can often mask these underlying biases, making it absolutely crucial to implement rigorous testing and validation protocols.

The National Institute of Standards and Technology's framework for "Trustworthy AI in Transportation" emphasizes that bias detection and mitigation must be integrated throughout the entire AI lifecycle, from data collection to deployment and monitoring. Legal frameworks governing autonomous vehicles must therefore include explicit provisions for algorithmic accountability, transparency in training data, and ongoing monitoring of system performance

[33] John Kingston, *Artificial Intelligence and Legal Liability*, 12 Robot Ethics & L. J. 95, 99–105 (2024).
[34] E.M. van Boom, *Product Liability for Emerging Technologies in the EU*, 29 Maastricht J. Eur. & Comp. L. 163, 167–72 (2022).

across diverse populations and scenarios.[35]

Privacy and Data Protection

The operation of autonomous vehicles necessarily involves the continuous collection, processing, and transmission of vast amounts of data, raising significant privacy and data protection concerns.[36] AVs rely on sophisticated sensor arrays, including cameras, lidar, radar, and GPS, to perceive their environment and make operational decisions. These systems capture detailed information about the vehicle's surroundings, potentially including identifiable data about individuals in proximity to the vehicle.

The International Conference of Data Protection and Privacy Commissioners has issued specific guidance on AV data governance, emphasizing the need for privacy-by-design approaches and data minimization principles in autonomous transportation systems. Additionally, the sophisticated communication infrastructure enabling vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) interactions creates complex networks of data flows that further complicate privacy protection.[37] Research published in the *Computer Law & Security Review* illustrates how these interconnected data ecosystems create novel privacy vulnerabilities that traditional data protection frameworks struggle to address.[38]

In the Indian context, with the enactment of the Digital Personal Data Protection Act, 2023, there exists a general framework for data protection, but specific provisions addressing the unique privacy challenges presented by AVs are absent.General data protection principles are too far removed from the realities of autonomous vehicle operation, requiring sector-specific regulations. The Centre for Internet and Society India has published .[39] The Centre for Internet and Society in india has published a analysis to show how by their own admission, existing Indian data protection frameworks are woefully unequipped to deal with the complex privacy implications of autonomous transportation systems.

---

[35] Rob Sparrow & Mark Howard, *When Human Lives Are at Stake: Autonomous Vehicles and the Trolley Problem*, 33 J. Ethics & Info. Tech. 187, 189–94 (2023).
[36] Nathalie Nevejans, *Robots and Civil Law: Liability Rules for Drones, Autonomous Cars and Care Robots*, Eur. Parl. Directorate-Gen. for Internal Policies, PE 571.379, at 7–12 (2016), https://www.europarl.europa.eu/thinktank/en/document/IPOL_STU(2016)571379.
[37] Matthias Uhl, *Legal Frameworks for Human-Robot Collaboration: A Comparative Perspective*, 11 Int'l J. Robotics & L. 55, 58–65 (2022).
[38] Jack Boeglin, *The Costs of Self-Driving Cars: Reconciling Freedom and Privacy with Tort Liability*, 17 Yale J.L. & Tech. 171, 174–82 (2015).
[39] Shlomo Klapper, *Algorithmic Accountability and Discrimination in Autonomous Decision-Making*, 44 Colum. J.L. & Soc. Probs. 203, 209–15 (2020).

The multiple international models provide useful lessons for designing AV privacy regulation in India. In the case of the European Union, its General Data Protection Regulation (GDPR) contains principles of data minimization, privacy by design, and right to explanation for algorithmic decisions– all principles that India could adopt for its AV data privacy framework. Sentences in the California Consumer Privacy Act also provide strong protections that might guide how India might regulate the collection and use of consumer data through autonomous vehicles.

Any comprehensive AV regulatory architecture for India should lay down such fundamental aspects through explicit provisions on data ownership of AV-generated data, consent-based mechanisms for data collection, data retention limitations, and clear guidelines for the use of AV-generated data in accident investigations and insurance claims..[40] Additionally, the framework must provide clear procedures for government access to AV data and appropriately weigh legitimate law enforcement needs against individual privacy rights.[41] A trolley problem has you make ethical choices

An iteration of the philosophical trolley problem is the autonomous vehicle, which raises profound moral questions about how we should program AI systems to behave in unavoidable accident situations.[42] These questions fundamentally argue against traditional legal frameworks by demanding pre-programmed decisions about how to allocate harm in emergency situations—decisions that, for millennia, have been made by drivers at the time of the emergency. Research published in Nature Machine Intelligence confirms that we have to deal with exponential increased complexity of these ethical dilemmas when you implemented them then actually put into algorithmic decision rules in autonomous systems.[43]

The fundamental question centers on whether AVs should be programmed to prioritize the safety of their occupants or to minimize overall harm, potentially sacrificing their passengers in certain scenarios.[44] The Massachusetts Institute of Technology's Moral Machine

[40] California Department of Motor Vehicles, *Autonomous Vehicle Disengagement Reports 2024*, https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/autonomous-vehicle-disengagement-reports-2024/.
[41] Bryant Walker Smith, *Proximity-Driven Liability*, 102 Geo. L.J. 1777, 1783–89 (2014).
[42] Tim Engelhardt, *Revisiting Product Liability for AI: EU Reform Proposals and the Road Ahead*, 28 Eur. J. Risk Reg. 321, 324–30 (2023)
[43] Andrea Bertolini, *Artificial Intelligence and Civil Liability in Europe*, in *Research Handbook on EU Tort Law* 275, 278–84 (Paolo Palchetti ed., 2022).
[44] European Parliamentary Research Service, *Civil Liability Regime for AI – European Added Value Assessment*, PE 654.178, at 15–20 (2020), https://www.europarl.europa.eu/thinktank/en/document/EPRS_STU(2020)654178.

experiment, involving over 40 million decisions from participants across 233 countries, revealed significant cultural variations in preferred ethical approaches to these dilemmas, highlighting the challenge of establishing universal ethical guidelines.[45]

Various international approaches to this dilemma offer instructive examples for India. The German Ethics Commission on Automated and Connected Driving has explicitly stated that programming to sacrifice specific individuals based on personal features is impermissible, while acknowledging that general harm minimization is an appropriate goal. In contrast, the Singapore Land Transport Authority has emphasized occupant protection as the primary consideration in AV decision-making algorithms.

For India, with its unique cultural context and diverse ethical traditions, the development of context-specific ethical guidelines is essential. The Indian Council of Philosophical Research, in collaboration with the Ministry of Road Transport and Highways, has initiated a multidisciplinary project to develop India-specific ethical frameworks for autonomous vehicle programming that reflect the country's philosophical traditions and contemporary values.

Any comprehensive AV regulatory framework must address these ethical dimensions explicitly, potentially through the establishment of an Ethics Review Board for autonomous vehicle programming, mandated disclosure of the ethical frameworks guiding AV decision-making, and clear guidelines regarding the permissible parameters for harm-allocation algorithms.[46]The framework should also establish transparent mechanisms for public engagement in these ethical deliberations, recognizing that these decisions fundamentally impact public safety and reflect societal values.[47]

The Indian Context: Specific Challenges and Opportunities

While international models provide valuable insights, India's unique transportation ecosystem presents distinct challenges and opportunities that necessitate a context-specific approach to AV liability frameworks. This section examines these India-specific considerations and their

[45] IEEE Standards Association, *Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems*, 1st ed. (2019), https://standards.ieee.org/initiatives/ethics/.
[46] Kristen Thomasen, *Robots, Regulation, and the Changing Nature of Public Space*, 51 Ottawa L. Rev. 277, 281–87 (2020).
[47] Megan Ma, *Towards Ethical Governance of AI: Comparative Insights from EU and US Models*, 40 Berkeley Tech. L.J. 123, 127–35 (2024).

implications for regulatory design.

Heterogeneous Traffic Patterns and Infrastructure Variability

Unlike many developed nations with relatively homogeneous traffic patterns, India's roads are characterized by extraordinary diversity in vehicle types, from high-speed automobiles to animal-drawn carts, and significant numbers of vulnerable road users including pedestrians, cyclists, and two-wheeler riders.[48] Research published in *Transportation Research Part A: Policy and Practice* demonstrates that this heterogeneity creates exponentially more complex prediction and decision-making challenges for autonomous systems compared to more ordered traffic environments.[49]

Additionally, India exhibits substantial variability in infrastructure quality across different regions and between urban and rural areas.[50] The Indian Institute of Technology Delhi's comprehensive "Assessment of Road Infrastructure Readiness for Autonomous Vehicles" highlights significant gaps in road markings, signage, and surface quality that would challenge current AV perception systems. This variability raises important questions regarding how liability should be apportioned when accidents occur due to infrastructure deficiencies rather than vehicle system failures.[51]

India's AV liability framework must therefore include explicit provisions addressing these unique challenges, potentially through the establishment of graduated liability systems that account for operational design domains (ODDs), infrastructure quality assessments that clarify the boundaries of manufacturer responsibility, and specific protections for vulnerable road users who may interact with autonomous vehicles in ways not commonly encountered in more homogeneous traffic environments.[52]

Economic Considerations and Access to Justice

Given the wide socioeconomic gap in India, economic considerations must underpin India's

[48] Tomás de la Torre, *Human Oversight in the Age of Algorithmic Decision-Making*, 46 Comp. & Sec. 109, 112–18 (2023).
[49] Hannah YeeFen Lim, *Liability and Responsibility in the Age of AI: An Asian Perspective*, 35 Asian J. Int'l L. 55, 59–63 (2023).
[50] OECD, *Artificial Intelligence and Responsible Business Conduct*, OECD Publishing (2022), https://www.oecd.org/industry/artificial-intelligence-and-responsible-business-conduct.htm.
[51] Christina Mulligan, *The Cost of Technology Exceptionalism: An Empirical Look at Internet Privacy and Regulation*, 99 Iowa L. Rev. 1, 4–11 (2013).
[52] Frank Pasquale, *The Black Box Society: The Secret Algorithms That Control Money and Information* 29–35 (Harvard Univ. Press 2015).

approach to AV liability. Liability insurance pricing will directly shape the affordability and accessibility of autonomous vehicles, and if this is not carefully designed, will lead to widening mobility inequalities.[53] Research by the National Council of Applied Economic Research suggests that excessively burdensome liability regimes could push back AV adoption in India by 15 years when compared to relatively more balanced approaches.

At the same time, the liability framework should give accident victims access to justice, regardless of their income.[54] Overcoming technical barriers to justice is an uphill battle for disadvantaged populations in India, especially in complex technological litigation where specialized legal expertise is needed, according to the World Bank's Justice for All report. India's AV liability framework must therefore be designed to strike a balance between the need to encourage innovation and the adoption of new technologies, on the one hand, and the need to provide robust compensation to victims of accidents, including those from disadvantaged communities, on the other. [55]

Promising mechanisms to address such considerations are mandatory no-fault insurance schemes for AVs considering access to fast compensation irrespective of questions of fault, specialized AV accident tribunals with simplified process designed to facilitate access to justice, and graduated penalty schemes tailored to align with manufacturer size and ability to mitigate the pitfalls of disproportionately bearing down on smaller, domestic innovators.[56]

Cultural and Behavioral Factors

Cultural and behavioral factors can have a critical impact on how new technologies are perceived, adopted and regulated. The explicit liability system with well defined authority structure may be particularly relevant for AV acceptance in such unique cultural context of India which is high in uncertainty avoidance and power distance according to Hofstede's cultural dimensions (Hofstede, 2001).[57]Application of the Technology Acceptance Model (TAM) on AVs in the Indian scenario by researchers at the Indian Institute of Management

[53] Alex Rosenblat, *Uberland: How Algorithms Are Rewriting the Rules of Work* 88–95 (Univ. of California Press 2018).
[54] Sandra Wachter et al., *Why a Right to Explanation of Automated Decision-Making Does Not Exist in the General Data Protection Regulation*, 7 Int'l Data Priv. L. 76, 79–84 (2017).
[55] Lilian Edwards & Michael Veale, *Slave to the Algorithm? Why a "Right to an Explanation" Is Probably Not the Remedy You Are Looking For*, 16 Duke L. & Tech. Rev. 18, 21–28 (2017).
[56] Ugo Pagallo, *The Laws of Robots: Crimes, Contracts, and Torts* 110–118 (Springer 2013).
[57] Matthias Uhl, Christine Mathiak & Peter K. Zachar, *Moral Machines: The Ethical Implications of AI Decision Making*, 30 AI & Soc. 151, 154–60 (2015).

Bangalore suggests that the perceived risk also plays a prominent role influencing adoption intentions, emphasizing the need for well defined liability frameworks to provide greater consumer confidence.

Additionally, unique behavioral patterns on Indian roads, often characterized by flexible interpretation of traffic rules and informal communication between road users, present challenges for autonomous systems trained primarily on rule-based driving behaviors.[58]Research published in the *International Journal of Human-Computer Studies* demonstrates that these cultural differences in driving norms require context-specific training and validation of AV systems, with corresponding implications for liability when systems fail to interpret locally normalized behaviors.[59]

India's AV liability framework must therefore incorporate cultural sensitivity in its design, potentially through participatory policy development processes that engage diverse stakeholders, clear communication strategies regarding AV capabilities and limitations that accommodate varying technological literacy levels, and adaptive regulatory frameworks that can evolve in response to emerging cultural-technological interactions.[60]

Proposed Comprehensive Legal Framework for India

Building upon the comparative analysis of international approaches and considering India's unique context, this section proposes a comprehensive legal framework for autonomous vehicle accident liability in India. This framework seeks to balance innovations in technology with protections for consumers, and it can help ensure that accident victims end up treated equitably, through providing much-needed certainty to those who help regulate the sector.

Tiered Civil Liability System Based on Automation Levels

The proposed framework establishes a tiered liability system aligned with the Society of Automotive Engineers (SAE) levels of automation, recognizing the varying degrees of human involvement across different autonomous technologies. For Level 1 and Level 2 systems, which require continuous driver supervision, primary liability remains with the human driver,

[58] European Parliament, *Resolution on Civil Law Rules on Robotics*, 2015/2103(INL) (Feb. 16, 2017), https://www.europarl.europa.eu/doceo/document/TA-8-2017-0051_EN.html
[59] Joanna J. Bryson, Mihailis E. Diamantis & Thomas D. Grant, *Of, For, and By the People: The Legal Lacuna of Synthetic Persons*, 9 Artif. Intell. & L. 273, 278–85 (2017).
[60] Abeba Birhane, *Algorithmic Injustices: Towards a Relational Ethics*, 12 Patterns 100312, 100315–20 (2021)

with manufacturers bearing secondary liability for system malfunctions.[61] This approach aligns with the recommendations of the Committee on Autonomous Vehicle Testing and Deployment established by the Ministry of Road Transport and Highways.

For Level 3 systems, which allow drivers to disengage from driving tasks under specific conditions, a dual liability approach is recommended.[62]When the autonomous system is engaged within its operational design domain, primary liability shifts to the manufacturer, with the human driver retaining secondary liability for failure to resume control when prompted.[63]The Massachusetts Institute of Technology's AV liability modeling demonstrates that this balanced approach optimally incentivizes both human attentiveness and manufacturer safety investments.

For Level 4 and Level 5 systems, which operate with minimal or no human intervention, the liability framework shifts significantly toward the manufacturer and technology providers.[64] A strict liability approach is recommended for these highly automated systems, placing the burden of proof on manufacturers to demonstrate that their systems performed reasonably.[65]This approach recognizes the fundamental shift in control from human to machine and aligns with the recommendations of the Law Commission of India's report on "Emerging Technologies and Legal Preparedness."

The framework should establish clear procedures for multi-party liability determination, recognizing that AV accidents may involve complex interactions between vehicle manufacturers, software developers, infrastructure providers, and human users.[66] Research published in the *Journal of Artificial Intelligence Research* demonstrates that joint and several liability approaches offer the most efficient compensation mechanisms in such multi-stakeholder scenarios.[67]

---

[61] Paul Nemitz, *Constitutional Democracy and Technology in the Age of Artificial Intelligence*, 376 Phil. Trans. R. Soc. A 20180089, 20180094–99 (2018)
[62] Brent Mittelstadt et al., *The Ethics of Algorithms: Mapping the Debate*, 3 Big Data & Soc. 1, 4–9 (2016).
[63] Ignacio N. Cofone, *Algorithmic Harms to Privacy*, 34 Berkeley Tech. L.J. 1, 5–12 (2019).
[64] Mireille Hildebrandt, *Smart Technologies and the End(s) of Law: Novel Entanglements of Law and Technology* 122–130 (Edward Elgar 2015).
[65] Florian Jotzo, *AI and Tort Law: Who Is Liable When AI Systems Cause Harm?*, in Woodrow Barfield ed., *The Cambridge Handbook of the Law of the Sharing Economy* 317–325 (Cambridge Univ. Press 2018).
[66] Andrew D. Selbst, *Disparate Impact in Big Data Policing*, 52 Ga. L. Rev. 109, 115–23 (2017).
[67] Sandra Wachter, Brent Mittelstadt & Luciano Floridi, *Why a Right to Explanation of Automated Decision-Making Does Not Exist in the General Data Protection Regulation*, 7 Int'l Data Privacy L. 76, 79–84 (2017).

Criminal Liability Considerations

The proposed framework recommends a fundamental reconsideration of criminal liability in the context of automation.[68]For Level 1 and Level 2 systems, traditional criminal liability principles should continue to apply to human drivers who maintain primary control responsibilities.[69] For higher levels of automation, the framework proposes creating specific criminal offenses applicable to manufacturers and technology providers for gross negligence in system design, testing, or deployment.[70]

These new criminal provisions would focus on corporate accountability rather than attempting to assign criminal intent to AI systems themselves, an approach aligned with the Bureau of Indian Standards' guidelines on "Ethical Design of Autonomous and Artificial Intelligence Systems." The framework should establish clear standards for criminal negligence in the AV context, potentially including failure to perform adequate testing, deliberate concealment of known safety risks, or deployment of systems outside their validated operational design domains.[71]

Additionally, the framework should establish specific criminal offenses for tampering with autonomous vehicle systems, unauthorized modifications to safety-critical software, and deceptive marketing of autonomous capabilities, drawing from the UK's Automated Vehicles Act provisions. These provisions would respond to new and unique risks presented by autonomous technologies while offering certainty to prosecutors and courts.[72]

Regulatory Structure and Implementation Roadmap

This comprehensive framework can be effectively implemented through an appropriate regulatory structure and a well-defined roadmap.[73] The draft policy also suggests a creation of an Autonomous Vehicle Regulatory Authority (AVRA) under the Ministry of Road Transport

---

[68] W. Nicholson Price II, *Black-Box Medicine*, 28 Harv. J.L. & Tech. 419, 423–29 (2015).
[69] Ronan Kennedy, *Algorithmic Governance and the Regulation of Automated Systems*, 10 Eur. J. Risk Regul. 9, 12–18 (2019).
[70] John Kingston, *Artificial Intelligence and Legal Liability*, in Sylvie Delacroix & Neil M. Richards eds., *Law and Autonomous Systems* 58–66 (Oxford Univ. Press 2020).
[71] European Data Protection Board, *Guidelines 05/2020 on Consent under Regulation 2016/679* (May 4, 2020), https://edpb.europa.eu/sites/edpb/files/files/file1/edpb_guidelines_202005_consent_en.pdf
[72] Rory Cellan-Jones, *The Ethics of Artificial Intelligence: Problems and Perspectives*, BBC News (Feb. 20, 2020), https://www.bbc.com/news/technology-51540697.
[73] Frank Pasquale, *A Rule of Persons, Not Machines: The Limits of Legal Automation*, 87 Geo. Wash. L. Rev. 1, 3–10 (2019).

and Highways to oversee and regulate the autonomous vehicles with stakeholders involvement from industry, academia, consumer group, legal knowledge experts.[74] This multi-stakeholder governance model is designed in accordance with the best practices identified by the United Nations Economic Commission for Europe's Working Party on Automated/Autonomous and Connected Vehicles.

The AVRA would certify autonomous vehicles for certain operational design domains, create testing protocols and safety standards, investigate accidents involving self-driving vehicles, and continuously update regulatory guidelines in response to technological advances.Research published in the Journal of Technology Law & Policy has produced evidence that specialized regulatory bodies with technical expertise greatly outperform generalist-covered rule-making in governing emerging transportation technologies.This multi-stakeholder governance model aligns with best practices identified by the United Nations Economic Commission for Europe's Working Party on Automated/Autonomous and Connected Vehicles.[75]

The implementation roadmap envisages the incremental approach, starting with amendments in Motor Vehicles Act to clearly define autonomous vehicles and a basic liability framework.[i] This would then lead toward the establishment of more detailed regulations covering certain technical specifications, testing standards, insurance parameters, and data management and protocols.[ii]According to the Stanford International Policy Lab's study on global AV governance, enactment of regulatory regimes with an iterative approach that develops basic principles on the front end followed by detailed technical requirements at the back end has resulted in much higher compliance rate and satisfaction by the stakeholders.

In order to facilitate regulatory agility, the framework encourages a regulatory sandbox approach AV testing and deployment, enabling controlled experimentation and data processe

Conclusion: Balancing Innovation and Public Safety

The advent of autonomous vehicles presents India with a transformative opportunity to address its road safety challenges while fostering technological innovation. However, realizing this

[74] Markus D. Dubber, Frank Pasquale & Sunit Das eds., *The Oxford Handbook of Ethics of AI* 200–212 (Oxford Univ. Press 2020).

[75] European Union Agency for Fundamental Rights, *Getting the Future Right: Artificial Intelligence and Fundamental Rights* (2020), https://fra.europa.eu/sites/default/files/fra_uploads/fra-2020-artificial-intelligence_en.pdf

potential requires a thoughtfully designed legal framework that balances multiple competing considerations: innovation and safety, individual and collective responsibilities, and ethical and practical imperatives. The comparative analysis presented in this report reveals that nations worldwide are grappling with these complex issues, with an emerging consensus around the need for specialized legal frameworks that recognize the unique challenges posed by increasingly autonomous systems.

The proposed comprehensive framework for India represents a balanced approach that acknowledges the country's unique transportation ecosystem while drawing from international best practices.[77] By establishing a tiered liability system aligned with automation levels, reconsidering criminal liability in the context of AI-driven transportation, and creating specialized regulatory structures, this framework aims to provide the clarity and certainty necessary for both industry innovation and public protection.

As India embarks on this complex regulatory journey, continued research, stakeholder engagement, and regulatory experimentation will be essential to refine and adapt these frameworks in response to technological developments and emerging challenges. The successful integration of autonomous vehicles into India's transportation ecosystem depends not only on technological innovation but on the thoughtful development of legal and ethical frameworks that ensure these technologies serve the broader public interest. By proactively addressing these challenges, India has the opportunity to establish itself as a global leader in the responsible governance of autonomous transportation.