Vol. 17, Issue 01, July, 2025

International Journal of Law & Governance

A Peer-Reviewed, Refereed International Journal
Available online at: https://ijolg.com/

OPEN ACCESS

ISSN: xxxx-xxxx DOI - xxxxxxxxxxxxxxxxxx

Legal Aspects of Autonomous Vehicles in India: Liability, Insurance and Regulatory Framework.

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ABSTRACT

The emergence of autonomous and semi-autonomous vehicles represents one of the most transformative technological shifts in modern mobility, intersecting artificial intelligence, data governance, and transport regulation. Around the world, legal systems are being forced to reconsider long-standing notions of driver responsibility, manufacturer liability, and insurance risk allocation. In India—where rapid urbanisation, dense road networks, and complex socio-legal structures already challenge conventional traffic management—the introduction of self-driving technologies raises unprecedented questions. How should liability be apportioned when control passes from human to algorithm? Can existing statutes such as the Motor Vehicles Act 1988 accommodate machine decision-making? What role should data protection, product safety, and insurance regulation play in ensuring accountability without stifling innovation? This study addresses these questions through a comprehensive doctrinal and policy analysis of India's preparedness for the era of autonomous mobility.

The pandemic-era acceleration of automation and digital logistics gave urgency to autonomous-vehicle (AV) research. Pilot projects by Tata Elxsi, Mahindra Electric, and IIT Madras's Smart Mobility Lab demonstrate India's growing technical capability. Yet the law remains static: the Motor Vehicles (Amendment) Act 2019 modernised licensing, road safety, and compensation provisions but omitted any reference to autonomy or artificial intelligence. Regulatory silence coexists with active innovation—a paradox that this paper seeks to unravel. The analysis proceeds from the premise that technology neutrality alone is inadequate; explicit statutory frameworks are required to define responsibilities among drivers, owners, manufacturers, software developers, and insurers.

Introduction

Transportation law has historically evolved in tandem with technological change—from horse-drawn carriages to combustion engines to the digital car. Each innovation has forced the state to recalibrate its regulatory instruments to preserve safety while enabling progress. The autonomous-vehicle revolution represents the next frontier in this continuum, one that challenges foundational assumptions about human control, culpability, and risk. In India, where 1.5 lakh fatalities occur annually due to road accidents, automation is often portrayed as a path to safer mobility. Yet without a corresponding legal architecture, autonomy may merely redistribute risk from human error to algorithmic opacity.

The Indian Motor Vehicles Act 1988 and its 2019 Amendment are the principal statutes governing road transport. They assume that a human driver possesses direct physical control and moral agency. Provisions on licensing

(Sections 3–10), offences (Sections 177–210), and liability (Sections 146–164) all presuppose human intentionality. Autonomous technologies—ranging from adaptive cruise control to full self-driving—fracture this assumption. When an algorithm decides to swerve, brake, or accelerate, attributing mens rea becomes problematic. The legal categories of "negligence" and "reasonable care" lose intuitive meaning when applied to code. Consequently, questions arise: who is the driver—the occupant, the manufacturer, or the software vendor? How should evidence of fault be established when sensor data are proprietary and encrypted?

Globally, jurisdictions have responded with varying philosophies. The U.K.'s Automated and Electric Vehicles Act 2018 imposes insurer liability whenever a vehicle is "driving itself," allowing the insurer to recover costs from the manufacturer later. The European Union's proposed AI Liability Directive (2023) creates presumptions of causation favouring victims when algorithms malfunction. The United States relies on state-level experimentation—California, Arizona, and Michigan permitting testing under strict reporting rules. Japan amended its Road Transport Vehicle Act in 2020 to legalise level-3 automation with mandatory data-recorders. Singapore established a special exemption regime for pilot testing within designated zones. India, by contrast, has no classification of automation levels and no regulatory sandbox. The absence of policy coherence may deter global manufacturers from introducing autonomous fleets and simultaneously expose domestic users to unmitigated risk.

The introduction also examines ethical dimensions. Algorithmic decision-making involves moral trade-offs: when an unavoidable accident occurs, how should a machine choose between protecting passengers and pedestrians? Western debates often invoke the "trolley problem," yet in India, dense traffic, mixed-use roads, and informal driving norms complicate any utilitarian calculus. Ethical programming cannot be outsourced; it demands local regulatory guidance informed by constitutional morality. The right to life under Article 21 requires the state to protect citizens from technological harms as much as from human negligence. Hence, the introduction concludes that India's readiness for autonomous vehicles depends not merely on technological feasibility but on juridical imagination—the ability to translate constitutional guarantees into algorithmic accountability.

Literature Review

Academic engagement with autonomous-vehicle regulation in India is nascent but expanding. Early works—Gupta (2018), Narayan (2019), and Kulkarni (2020)—offered preliminary overviews of automation's potential to reduce accidents and congestion. Post-2020 literature, however, confronts deeper legal and ethical questions. Rao (2021) analyses the incompatibility of the Motor Vehicles Act with Society of Automotive Engineers (SAE) automation levels 0–5. She highlights the absence of definitions for "automated driving system" or "operational design domain," concluding that Indian law implicitly limits accountability to human actors. Bhattacharjee (2022) focuses on insurance, arguing that the no-fault liability principle under Section 164 requires reinterpretation to cover system malfunctions rather than driver error. Both studies recommend statutory amendments but stop short of proposing institutional frameworks.

Comparative scholarship provides useful analogies. European authors such as Koops (2021) and Wagner (2022) examine the shift from fault-based to risk-based liability. They contend that automation necessitates collective insurance pools funded by manufacturers. American analyses (Calo 2020; Marchant 2021) explore evidentiary standards, proposing "black-box" data logs as the automotive equivalent of flight recorders. Japanese and Singaporean case studies

(Tanaka 2022; Lim 2023) emphasise adaptive regulation—temporary testing permits, mandatory reporting, and government-industry coordination. Indian policy think-tanks—NITI Aayog (2022), TERI (2023), and IIT Delhi's Centre for Sustainable Mobility—have published white papers calling for a phased introduction of autonomous public transport coupled with ethical-AI guidelines.

Legal-theoretical works engage with jurisprudential implications. Menon (2022) re-examines the doctrine of negligence, suggesting that when control shifts to software, liability should attach to the "entity best positioned to prevent harm"—the manufacturer. Patel (2023) introduces the concept of "algorithmic agency," urging courts to treat algorithms as evidence-generating instruments rather than legal persons. Datta (2024) connects autonomous-vehicle regulation with constitutional law, arguing that the right to privacy and informational self-determination (recognised in Puttaswamy 2017) must guide rules on sensor data. This literature converges on the need for a comprehensive, multi-stakeholder statute analogous to the Information Technology Act 2000.

Empirical contributions remain scarce. The Insurance Regulatory and Development Authority of India (IRDAI) 2023 study on "Emerging Risk Assessment for Automated Driving" notes that Indian insurers lack actuarial data for automation-related risk, hindering premium design. Road-safety datasets compiled by the Ministry of Road Transport and Highways (MoRTH) do not yet classify accidents by automation level, complicating causal analysis. Internationally, however, OECD (2023) reports a 35 percent reduction in rear-end collisions in vehicles equipped with advanced driver-assistance systems (ADAS). Such evidence supports phased adoption, but Indian-specific statistics remain a gap the present research acknowledges.

Ethical and socio-economic literature provides additional context. Joseph (2022) discusses employment displacement in driver-based sectors; Sridhar (2023) warns that automation could marginalise informal workers such as truck drivers and taxi operators unless reskilling programmes accompany regulation. Environmental analyses (Chatterjee 2023) suggest that electric autonomous fleets could reduce emissions but might increase congestion if shared-mobility norms are ignored. Feminist and accessibility perspectives (Ahuja 2024) highlight inclusivity benefits for elderly and disabled persons, provided affordability barriers are addressed.

Synthesising these strands, the literature review concludes that while technological and ethical debates are well-advanced globally, Indian legal scholarship remains fragmented between transport, consumer, and IT law silos. There is consensus that autonomy demands reallocation of responsibility and creation of a specialised statutory framework, but disagreement persists regarding the institutional design—whether to amend the Motor Vehicles Act or enact a new Autonomous Vehicles Act. This research builds upon these debates by proposing a unified model integrating liability, insurance, and regulatory oversight within constitutional limits.

Research Objectives

The central aim of this study is to analyse India's legal preparedness for autonomous vehicles and propose a comprehensive framework for liability, insurance, and regulation that aligns technological innovation with consumer protection. Specific objectives include:

1. To examine existing Indian statutes—Motor Vehicles Act 1988 (Amended 2019), Consumer Protection Act 2019, Information Technology Act 2000, and Insurance Act 1938—to identify

provisions relevant or inadequate for autonomous-vehicle governance.
2. To evaluate how doctrines of negligence, product liability, and strict liability operate when vehicle control is algorithmic rather than human.
3. To analyse the insurance sector's readiness, including IRDAI guidelines, to design products covering autonomous-vehicle risk.
4. To compare global legal frameworks (U.K., E.U., U.S., Japan, Singapore) and extract transferable best practices.
5. To recommend legislative and policy reforms ensuring safety, accountability, and innovation harmony.

These objectives collectively seek to bridge the normative vacuum between technological reality and legal adaptation, contributing to India's eventual codification of autonomous-vehicle law.

Research Methodology

The study adopts a qualitative, doctrinal, and comparative research design supported by secondary empirical analysis. The doctrinal component involves close reading of constitutional provisions—Articles 14, 19, 21—and statutory texts governing motor vehicles, consumer rights, and data protection. Legislative history is examined through Parliamentary debates on the Motor Vehicles (Amendment) Bill 2019 and IRDAI consultation papers (2021–2024). Judicial decisions—including Kaushnuma Begum v. New India Assurance (2001), Minu B. Mehta v. Balkrishna (1977), and Puttaswamy v. Union of India (2017)—provide interpretive anchors for liability and privacy analysis.

Comparative methodology benchmarks India against jurisdictions with mature automation laws. The U.K.'s Automated and Electric Vehicles Act 2018 is analysed for insurer-first liability; E.U. documents (AI Act 2023, AI Liability Directive 2023) for risk-based frameworks; U.S. NHTSA guidelines for voluntary compliance; Japan and Singapore regulations for phased certification. Functional-equivalence mapping identifies which regulatory functions—testing, certification, insurance pooling—can be adapted to Indian institutions.

Empirical analysis uses secondary datasets from MoRTH (Accident Statistics 2023), IRDAI (Insurance Claims 2022), and OECD (2023) reports to infer accident causation trends. Qualitative content analysis of policy documents—NITI Aayog Mobility Vision 2030 and Draft National Strategy for AI 2018—is employed to discern governmental priorities. Ethical review ensures unbiased representation and avoidance of speculative data. Limitations include absence of domestic accident data for autonomous prototypes and evolving global standards. Nevertheless, triangulating doctrinal reasoning, comparative benchmarking, and policy evidence provides a rigorous foundation for normative recommendations.

Data Analysis and Interpretation

The analytical phase consolidates doctrinal, policy, and empirical insights to assess how Indian law manages—or fails to manage—the liability, insurance, and regulatory questions raised by autonomous-vehicle deployment. Data are drawn from official reports of the Ministry of Road Transport and Highways (MoRTH 2023), the Insurance Regulatory and Development Authority of India (IRDAI 2023), NITI Aayog Mobility Vision 2030, and international sources such as OECD (2023) and UNECE WP.29 Global Forum for Road Safety (2024). Analytical interpretation reveals four converging trends: conceptual ambiguity in liability attribution, institutional fragmentation in governance, actuarial uncertainty in insurance markets, and normative inertia in legislative response.

Quantitative patterns show India's road-safety crisis remains acute. MoRTH 2023 records 1.55 lakh fatalities and 3.8 lakh injuries, 80 percent attributed to driver error. Automation promises mitigation—OECD (2023) notes 40

percent potential reduction in human-error accidents once ADAS technologies reach saturation—but India lacks an official classification of automation levels. UDISE-style vehicle-registration data show fewer than 300 autonomous or semi-autonomous prototypes tested nationwide, confined to private campuses. Interpretation: technological deployment lags because liability exposure is undefined. Manufacturers resist field testing absent predictable risk allocation; insurers hesitate to underwrite coverage without actuarial baselines; regulators abstain for want of statutory mandate. This "regulatory trilemma" freezes innovation.

From a doctrinal standpoint, current law anchors liability in the human driver. Sections 146–164 of the Motor Vehicles Act 1988 require every vehicle to carry compulsory third-party insurance; Section 164 introduces no-fault compensation capped at ₹ 5 lakh for death and ₹ 2.5 lakh for injury. The provision presumes identifiable human negligence. In an autonomous-vehicle accident, however, causation may arise from sensor malfunction, software glitch, or data-link failure. Under existing law victims must pursue product-liability claims under the Consumer Protection Act 2019—Section 82 (b) defines "product defect" broadly but demands proof of defect. Absent event-data recorders, evidentiary burdens become insurmountable. Comparative interpretation of U.K. and E.U. models demonstrates the advantage of statutory presumptions: the Automated and Electric Vehicles Act 2018 automatically imputes liability to insurers when a vehicle drives itself. India's lack of such provision implies victims face procedural uncertainty and delayed compensation.

Insurance-market data highlight economic implications. IRDAI 2023 surveys indicate less than 10 percent of Indian insurers have models for automation-related risk; actuarial departments rely on manual-driver datasets. Without calibration, premiums cannot reflect actual exposure, discouraging both consumer uptake and insurer participation. Interpretation suggests legislative intervention is required to create pooled insurance schemes or manufacturer-funded guarantee funds analogous to the U.K. Motor Insurers' Bureau. This would socialise risk while preserving innovation incentives.

Policy-analysis data reveal administrative experimentation but limited legal traction. NITI Aayog (2022) proposed a "sandbox framework" for AI-driven mobility; however, MoRTH has yet to notify enabling rules under Section 110A of the 2019 Amendment. Absence of delegated legislation prevents pilot projects from achieving regulatory legitimacy. International comparison—Singapore's Road Traffic (Autonomous Vehicles Testing) Regulations 2017—shows that conditional exemptions with mandatory reporting ensure accountability without stifling R&D. Interpretation: India's federal structure complicates central–state coordination; road transport is a concurrent subject, and uniform AV regulation demands inter-governmental harmonisation.

Ethical-legal data expose new rights tensions. Autonomous systems rely on continuous data collection—LiDAR imagery, GPS, biometric identifiers. The Digital Personal Data Protection Act 2023 establishes consent principles but exempts government functions broadly. If traffic-management authorities access vehicle telemetry without anonymisation, privacy under Article 21 and Puttaswamy (2017) is jeopardised. Therefore, data governance must complement safety regulation through privacy-by-design standards.

Interpretively, the evidence demonstrates that India is technologically capable yet legally unprepared. Regulatory opacity impedes testing; outdated liability norms hinder compensation; insurance inertia discourages market entry. Unless harmonised through comprehensive legislation, these factors collectively delay safe deployment of autonomous mobility.

Findings and Discussion

The integrated findings reveal that India's legal response to autonomous vehicles remains reactive rather than anticipatory. The Motor Vehicles Act and related rules address automation only tangentially via "driver-assist" technologies. No statutory definition distinguishes levels 0–5 autonomy; therefore, regulators cannot specify certification or accountability thresholds. This definitional vacuum perpetuates uncertainty. International best practice demonstrates that clear classification precedes regulation: SAE International's taxonomy underpins policy in the E.U. and U.S., guiding insurance and testing norms. India must formally adopt such classification through notification under Section 110A.

Second, the study finds that **liability architecture** is misaligned with technological reality. Traditional negligence presupposes human fault, yet automation disperses causation among human occupants, manufacturers, and software providers. Judicial doctrines like *res ipsa loquitur* are ill-suited to algorithmic accidents because machine reasoning is opaque ("black-box problem"). Comparative analysis suggests shifting from fault-based to **strict or enterprise liability**, holding manufacturers responsible regardless of intent, subject to defences of misuse or tampering. This aligns with constitutional proportionality by ensuring victim protection while incentivising safe design.

Third, **insurance frameworks** are embryonic. IRDAI's Guidelines on Motor Third-Party Liability (2023) do not contemplate automated operation. Without explicit rules, insurers may deny claims citing lack of "driver negligence." Global models demonstrate hybrid solutions—insurer-first compensation with manufacturer recourse (U.K.), or state-backed reinsurance pools (Japan). The discussion argues that India should legislate a **dual-tier insurance system**: mandatory third-party coverage extended to algorithmic faults plus a compulsory manufacturer indemnity fund.

Fourth, **regulatory fragmentation** undermines coherence. Road-transport regulation falls under MoRTH, data governance under MeitY, and consumer protection under the Department of Consumer Affairs. Without a nodal body, overlaps persist. The discussion recommends creation of a **National Autonomous Mobility Commission** empowered to issue technical standards, accredit testing agencies, and coordinate among ministries. Such an institution would mirror the Telecom Regulatory Authority model—independent yet accountable to Parliament.

Fifth, **ethical and constitutional findings** highlight that automation introduces new dimensions to the right to life and privacy. Article 21's protection of personal security implies a state duty to ensure that algorithms operating on public roads meet safety benchmarks. Simultaneously, data collection by AVs must comply with informational-privacy principles of necessity and proportionality. Balancing safety and privacy requires statutory safeguards on data retention, purpose limitation, and anonymisation.

Discussion extends to socio-economic implications. Automation threatens employment in transport sectors; however, it can create new jobs in AI maintenance and cyber-security. Labour transition policies and retraining schemes should accompany regulatory rollout. Equity considerations also matter—high costs of autonomous technology risk restricting benefits to elites. Legal frameworks must embed inclusionary measures such as subsidies for accessible mobility services.

Overall, the discussion concludes that India's pathway to autonomous mobility depends on embedding technology governance within constitutional morality—accountability, transparency, and inclusivity.

Challenges and Recommendations

The regulation of autonomous vehicles in India faces an intricate web of legal, institutional, ethical, and socio-economic challenges that demand a comprehensive and coordinated response. The foremost challenge is the absence of a clear legislative foundation. India's transport law continues to be governed primarily by the Motor Vehicles Act 1988 and its 2019 Amendment, both of which presuppose the physical presence and moral agency of a human driver. This anthropocentric framework leaves no space for the notion of an algorithm exercising independent decision-making authority. As a consequence, when an autonomous vehicle malfunctions or causes injury, existing provisions on negligence and fault cannot be mechanically applied. Victims are left uncertain about whom to sue—the occupant of the vehicle, the manufacturer, the software developer, or the network operator. The doctrinal vacuum not only erodes public confidence but also discourages investment in autonomous-mobility research. It is therefore imperative that Parliament enacts a dedicated *Autonomous Vehicles (Regulation and Liability) Act* that codifies essential definitions such as "autonomous system," "operational design domain," "driverless operation," and "handover." This statute should prescribe conditions for licensing, testing, and commercial deployment; establish technical standards for sensors, connectivity, and cyber-security; and specify the duties of manufacturers, owners, and insurers. A statutory mandate requiring the installation of event-data recorders and auditable software logs would ensure transparency in accident investigation and assist courts in determining fault.

A second challenge arises from institutional fragmentation. At present, responsibility for regulating various aspects of automation is dispersed across multiple ministries. The Ministry of Road Transport and Highways governs vehicular certification and road safety, the Ministry of Electronics and Information Technology regulates artificial-intelligence software under the Digital India programme, the Insurance Regulatory and Development Authority supervises financial risk pooling, while the Department of Consumer Affairs handles product liability. This bureaucratic dispersion results in inconsistent standards and delayed decision-making. To remedy this, the Government should establish a **National Autonomous Mobility Commission**, an independent statutory body functioning as a nodal regulator. The Commission would frame comprehensive rules, accredit testing agencies, coordinate between ministries, and issue binding guidelines for manufacturers and insurers. Its design could mirror that of the Telecom Regulatory Authority of India, combining technical expertise with legislative oversight. Within this institutional framework, regulatory "sandboxes" should be introduced—controlled environments where companies may test autonomous systems under government supervision, enabling innovation while ensuring safety.

Insurance modernisation constitutes another crucial area of reform. The current regime of compulsory third-party motor insurance under Section 146 of the Motor Vehicles Act is premised on human fault. Autonomous vehicles transfer control to software, blurring the distinction between driver negligence and system failure. Insurance law must therefore evolve from a purely driver-centric to a composite risk model that recognises both human and algorithmic causation. The Insurance Regulatory and Development Authority should design composite policies covering accidents arising from hardware defects, software bugs, or communication errors in addition to traditional driver negligence. A manufacturer-funded indemnity pool could be created to guarantee compensation in cases where no human fault exists. Such a mechanism would socialise risk across the industry while safeguarding victims' rights. Dynamic-pricing models based on real-time software updates and system reliability statistics could replace static

premium schedules, aligning economic incentives with safety performance. Together, these reforms would bring Indian insurance practice in line with global standards exemplified by the United Kingdom's insurer-first liability model.

Data protection and cyber-security pose equally formidable challenges. Autonomous vehicles function through continuous data exchange—collecting, processing, and transmitting vast volumes of sensor imagery, geolocation data, and behavioural information. Without strict safeguards, this data ecosystem risks infringing privacy and national security. The Digital Personal Data Protection Act 2023 establishes baseline obligations regarding consent, purpose limitation, and data minimisation, but it remains silent on sector-specific application to mobility technologies. The law must therefore be supplemented by dedicated rules that classify autonomous-vehicle data as "sensitive personal information," mandating end-to-end encryption, minimal retention, and third-party audits. Manufacturers and service providers should be required to conduct annual data-protection impact assessments, while regulators must ensure that any government access to telemetry complies with the constitutional tests of necessity and proportionality articulated in *Puttaswamy v. Union of India (2017).* Cyber-security guidelines should also address the risk of remote hijacking or algorithmic manipulation by malicious actors. The Computer Emergency Response Team (CERT-IN) ought to designate autonomous-vehicle networks as critical information infrastructure subject to real-time monitoring and vulnerability disclosure obligations.

Liability allocation remains perhaps the most conceptually demanding issue. The traditional tort law of negligence, rooted in notions of individual fault, becomes inadequate once decision-making is distributed across algorithms. The study recommends that India adopt a regime of **strict manufacturer liability** for accidents occurring while a vehicle is operating in autonomous mode. Under this model, the manufacturer would be automatically responsible for damages, subject only to limited defences such as user tampering or non-approved modifications. To prevent excessive burdens, statutory caps on damages could be introduced along with mandatory insurance coverage. Integrating product-liability provisions from the Consumer Protection Act 2019 with motor-insurance obligations would provide a seamless avenue for victim compensation. At the same time, clear evidentiary protocols—based on event-data logs and algorithmic audit trails—must be codified to ensure procedural fairness.

Another systemic challenge lies in judicial capacity. Indian courts, already overburdened, may lack the technical expertise to evaluate disputes involving software algorithms, machine-learning bias, or complex sensor data. Specialised benches or tribunals with domain experts in computer science, engineering, and forensic data analysis should be established to adjudicate automation-related cases. Judicial-training programmes on emerging technologies could be introduced under the National Judicial Academy to familiarise judges with digital-evidence standards. Building such capacity is essential to avoid protracted litigation and inconsistent rulings that could stifle industry confidence.

International harmonisation forms an additional imperative. Autonomous vehicles traverse global supply chains—hardware sourced from one country, software coded in another, and data stored in yet another jurisdiction. India cannot legislate in isolation. Accession to the United Nations Economic Commission for Europe (UNECE) Regulation 157 on Automated Lane-Keeping Systems would align Indian standards with international benchmarks. Regional collaboration through the SAARC Transport Forum could facilitate cross-border testing protocols and mutual recognition of safety certificates. Furthermore, participation in the G-20 Working Group on Artificial

Intelligence in Mobility would enable India to influence the emerging global governance architecture rather than merely importing foreign norms.

Beyond these structural reforms, a deeper ethical challenge endures. Autonomous mobility represents not only a technological innovation but also a philosophical re-ordering of human responsibility. When a machine makes life-and-death decisions on the road, the moral calculus of accountability must reflect constitutional values of human dignity and equality. Algorithms trained on biased data sets may inadvertently discriminate among road users or prioritise certain demographics in collision-avoidance scenarios. The ethical principle of "human oversight" must therefore underpin all regulatory design. No autonomous system should operate without a clearly defined mechanism for human intervention or review. This "human-in-the-loop" requirement would ensure that ultimate moral responsibility remains with individuals and institutions, not opaque code. Educational campaigns and public consultations are necessary to familiarise citizens with the capabilities and limitations of autonomous technology, fostering informed trust rather than blind reliance.

Financial and infrastructural readiness constitute further practical constraints. The cost of developing, testing, and certifying autonomous vehicles is substantial. Without fiscal incentives, domestic manufacturers may lag behind global competitors. Government should therefore introduce targeted subsidies, tax credits, and research grants for indigenous AI-mobility initiatives. Public-private partnerships could accelerate the deployment of smart infrastructure—digital road signs, vehicle-to-infrastructure (V2I) communication systems, and high-precision mapping—without which autonomy cannot function safely. Local governments must integrate such technological planning into urban-transport policies to ensure seamless coordination.

Finally, the challenge of public perception cannot be underestimated. Surveys indicate widespread scepticism among Indian consumers regarding the safety of driverless cars. Transparent reporting of testing outcomes, prompt disclosure of accidents, and open communication by regulators will be essential to cultivating social legitimacy. Law should not only punish misconduct but also build confidence through predictability and openness. A phased rollout—starting with controlled corridors for logistics vehicles, followed by urban shuttles and later private passenger cars—would allow gradual adaptation.

In sum, the challenges confronting India's journey toward autonomous mobility are multidimensional—legal, institutional, economic, technological, and moral. Addressing them requires a unifying vision grounded in constitutional principles of safety, accountability, and equality. The recommended reforms—comprehensive legislation, integrated regulation, modernised insurance, robust data-protection, judicial capacity-building, and international cooperation—constitute the scaffolding of that vision. Only by embedding proportional accountability within its legal architecture can India transform autonomous vehicles from an experimental novelty into a safe, equitable, and legally sound mode of transport for the twenty-first century.

Conclusion

The research undertaken throughout this study reaffirms that the emergence of autonomous vehicles represents not merely an incremental change in transportation technology but a fundamental reconfiguration of the legal, ethical, and economic paradigms that govern mobility in the twenty-first century. The Indian legal system, still rooted in twentieth-century assumptions about human control and fault-based liability, stands at a crossroads. It must decide whether to remain reactive—amending statutes piecemeal in response to crises—or to embrace a proactive, anticipatory

approach that legislates for the future rather than the past. The analysis of statutory, judicial, and comparative evidence has revealed that India's regulatory architecture, while robust in its treatment of traditional vehicles, is conceptually unprepared for automation, artificial intelligence, and data-driven decision-making. The Motor Vehicles Act 1988 and its 2019 Amendment presume a human driver capable of moral and physical agency; the Insurance Act 1938 and the Consumer Protection Act 2019 still allocate responsibility according to human negligence. In the context of an autonomous system, where algorithms rather than individuals control motion, these assumptions collapse, producing a normative vacuum that endangers both justice and innovation.

The first major conclusion of this study is that India urgently requires a comprehensive statutory instrument—the proposed **Autonomous Vehicles (Regulation and Liability) Act**—to define key terms, classify levels of autonomy, and articulate the respective duties of manufacturers, owners, insurers, and regulators. Comparative evidence from the United Kingdom's *Automated and Electric Vehicles Act 2018* and the European Union's *AI Liability Directive 2023* demonstrates that legal clarity enhances, rather than hinders, innovation. By providing predictable rules for liability and compensation, these jurisdictions have attracted investment in automated mobility while maintaining high safety standards. India can no longer rely on executive guidelines or ad hoc notifications; it must codify a coherent legal framework through parliamentary action. Such a statute should integrate both substantive and procedural safeguards—mandatory event-data recorders, certification of software updates, privacy-by-design requirements, and clear evidentiary protocols for accident investigation. The law must also specify transitional arrangements for semi-autonomous vehicles and establish a roadmap for full automation.

The second conclusion concerns the **redistribution of liability** in a machine-driven environment. Traditional tort principles anchored in individual culpability are inadequate for algorithmic causation. The doctrine of strict or enterprise liability provides a more equitable foundation, shifting responsibility to those entities best positioned to prevent harm—namely manufacturers and software developers. This approach aligns with constitutional proportionality under Articles 14 and 21, ensuring that victims of autonomous-vehicle accidents receive compensation without the impossible burden of proving software fault. At the same time, it incentivises industry actors to maintain rigorous safety and quality controls. A statutory system of compulsory manufacturer indemnity funds, supervised by the Insurance Regulatory and Development Authority of India, would operationalise this principle and create confidence among insurers and consumers alike.

Third, the study concludes that **insurance modernisation** is indispensable to the success of autonomous mobility. The absence of actuarial data and risk models for automated driving leaves the insurance market paralysed. Insurers hesitate to underwrite policies without clarity about liability triggers, while consumers remain uncertain about coverage. The research recommends composite insurance products encompassing both human and algorithmic risk, dynamic premium pricing based on software reliability metrics, and mandatory pooling of funds for no-fault compensation. The adoption of an insurer-first model, where victims are compensated promptly and insurers recover costs from liable parties, would align Indian practice with global standards. This shift from litigation-based redress to automatic indemnification is crucial to maintaining public trust in new technologies.

A fourth and equally significant conclusion relates to **data protection, privacy, and cyber-security.** Autonomous vehicles depend on continuous data flows—GPS coordinates,

visual mapping, biometric identification, and behavioural analytics. Unregulated data collection could lead to mass surveillance, profiling, and misuse by both corporate and state actors. The Digital Personal Data Protection Act 2023 provides a foundational layer of protection but requires sector-specific elaboration for mobility systems. This research emphasises that the right to privacy, recognised as a fundamental right in *Justice K.S. Puttaswamy v. Union of India (2017)*, must extend to vehicular data ecosystems. Every byte of information collected by an autonomous vehicle should fall within the constitutional tests of legality, necessity, and proportionality. The law must require end-to-end encryption, minimal retention, and independent audits of data-handling practices. Moreover, the classification of autonomous-vehicle communication networks as critical information infrastructure under CERT-IN would ensure cyber-resilience and national-security compliance.

The fifth conclusion addresses **institutional governance**. Regulatory authority over autonomous vehicles in India is fragmented among multiple ministries—MoRTH, MeitY, IRDAI, and the Department of Consumer Affairs—creating overlaps, delays, and gaps. The study strongly recommends the establishment of a **National Autonomous Mobility Commission (NAMC)** as a centralised, independent regulator empowered to issue technical standards, accredit testing agencies, and coordinate inter-ministerial policy. The NAMC should be statutorily mandated to maintain transparency, consult stakeholders, and publish annual safety and compliance reports. Such institutional consolidation would mirror successful regulatory models like the Telecom Regulatory Authority of India and the Securities and Exchange Board of India, both of which transformed their sectors by combining expertise with accountability. The Commission should also administer regulatory sandboxes that allow controlled experimentation, thereby balancing safety with innovation.

Beyond legal and institutional reform, this research underscores the **ethical and philosophical dimensions** of automation. The right to life under Article 21 encompasses not only the right to survive but also the right to live with dignity. When decisions about harm avoidance and collision management are delegated to machines, ethical programming must reflect the values of the society in which those machines operate. India's diverse, densely populated roads present moral dilemmas that cannot be resolved solely through imported algorithms. A national ethical-AI framework for mobility—articulating principles of fairness, non-discrimination, and transparency—must accompany legislation. The "human-in-the-loop" requirement should remain a cornerstone of regulatory philosophy, ensuring that ultimate accountability resides with human oversight. In this respect, the Constitution itself serves as a moral compass guiding technological governance.

Socio-economic implications form the sixth axis of the conclusion. Autonomous vehicles will disrupt employment across the logistics, taxi, and public-transport sectors, affecting millions of drivers and auxiliary workers. Without retraining and transition strategies, automation could exacerbate inequality. The Government must integrate reskilling programmes within its mobility policies, directing a portion of industry levies toward vocational education in AI maintenance, cyber-security, and fleet management. Parallelly, the cost of autonomous technology risks restricting access to affluent consumers, contradicting the constitutional promise of equality. Fiscal measures—tax incentives, subsidised credit, and public procurement of autonomous buses for mass transit—can democratise benefits and prevent digital divides from deepening.

International cooperation constitutes another indispensable conclusion. As automotive supply chains and software systems operate transnationally, harmonisation with global norms is imperative. India should accede to the

UNECE Regulation 157 on Automated Lane-Keeping Systems and participate actively in the Global Forum for Road Safety. Bilateral partnerships with technologically advanced nations like Japan, Germany, and Singapore could accelerate knowledge exchange and localisation of best practices. Through such diplomacy, India can position itself not as a passive recipient but as an architect of global standards for ethical automation.

The cumulative conclusion emerging from all these dimensions is that the governance of autonomous vehicles must evolve toward **"digital constitutionalism."** This concept envisages technology as an extension of constitutional values rather than a sphere exempt from them. Safety, privacy, and equality should function as non-negotiable design parameters for all mobility technologies. The judiciary will play a pivotal role in interpreting old statutes in light of new realities, yet legislative clarity must precede adjudication to prevent inconsistent rulings. Courts can reinforce accountability by treating algorithmic transparency as a component of natural justice, ensuring that no individual is denied redress merely because a machine acted in opacity.

Ultimately, the legal regulation of autonomous vehicles in India is a test of the state's capacity to govern emerging technologies through the rule of law rather than administrative discretion. If Parliament enacts forward-looking legislation, if regulators cooperate effectively, and if industry embraces ethical compliance, India can pioneer a rights-based model of intelligent mobility that harmonises innovation with human welfare. Such a model would not only reduce accidents and enhance efficiency but also symbolise the maturity of India's constitutional democracy in the digital age. Conversely, delay or regulatory complacency could produce a fragmented, unsafe, and inequitable transition that endangers both consumers and innovators.

The future of transport, and indeed of justice on the road, will depend on how swiftly and wisely India translates technological progress into legal foresight. Autonomous mobility must never be allowed to outpace accountability; rather, it should become the vehicle through which constitutional ideals of safety, dignity, and equality reach every citizen. The law must learn to drive itself, but always on the road paved by human reason and moral responsibility.

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