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Navigating the Legal Roadblock: Autonomous Vehicles and India's Motor Vehicles Act, 1988

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ABSTRACT

The rapid development and testing of autonomous vehicles (AVs) are transforming the transportation landscape worldwide, promising enhanced safety, efficiency, and mobility. India's existing Motor Vehicles Act, 1988, however, was enacted in a pre-AV era and poses significant legal and regulatory hurdles to the deployment of AVs on Indian roads. This paper critically examines the compatibility of AVs with the current regulatory framework, highlighting the key challenges and potential solutions.

The Motor Vehicles Act, 1988 defines a "driver" as a person who drives a vehicle, implying a human operator. AVs, by contrast, operate autonomously, rendering this definition inadequate. Similarly, the Act's liability provisions, which hold the driver or owner responsible for accidents, are unclear in the context of AVs, and the absence of specific safety standards and testing protocols for AVs further complicates their deployment. This study analyses the Act's provisions and identifies areas that require amendment or new regulation to accommodate AVs. It explores international best practices, including the regulatory frameworks of the United States, the European Union, and Japan, to inform India's AV policy. The paper proposes a framework for AV regulation that includes: defining AVs and their levels of autonomy; establishing liability frameworks for AV-related accidents; developing safety standards and testing protocols; and creating a regulatory authority for AV oversight. The study seeks a safe and conducive environment for AV innovation while prioritising public safety and accountability.

I. AUTONOMOUS VEHICLES (AVS)

Autonomous vehicles (AVs), or self-driving cars, are vehicles equipped with an advanced suite of sensors, including LiDAR, radar, cameras, and GPS, that allow them to perceive their environment and navigate to a destination with little to no human intervention. These vehicles use artificial intelligence (AI) to process real-time data, enabling them to identify obstacles,

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follow traffic rules, and adapt to changing road conditions. By eliminating human error[1], AVs have the potential to improve road safety significantly, reduce congestion-related delays by up to 60%, and provide independent mobility for the elderly and disabled. In India, while Level 2 driver-assistance features are appearing in luxury models, full autonomy faces unique hurdles such as unpredictable traffic behaviour, complex infrastructure, and current legal mandates that require a human driver to remain in control.

Safety. Human error causes a large share of traffic accidents. AVs aim to eliminate risks such as distraction, fatigue, and impaired driving, potentially saving thousands of lives annually. They use 360-degree sensors (LiDAR, radar, cameras) that do not tire or become distracted, and these systems can react to hazards in milliseconds, significantly faster than a human driver.

Efficiency. AVs can optimise routes and driving patterns, reducing urban congestion by up to 40% and cutting fuel consumption by roughly 15-20%. Because AVs can park themselves in remote areas after dropping off passengers, cities could repurpose a substantial share of urban parking space for parks or housing. Through Vehicle-to-Everything (V2X) communication, AVs can coordinate movements to reduce "stop-and-go" patterns, potentially cutting highway congestion-related delays.

Innovation. AVs provide independent mobility for the elderly and disabled. Integration with smart cities and electric powertrains supports more sustainable urban planning. In commercial sectors, self-driving trucks can operate around the clock without mandatory rest breaks, lowering shipping costs and improving supply-chain speed.

India's Transport Context

Road safety. India records over 1.7 lakh road deaths annually[2]; AVs could significantly reduce this toll.

Traffic congestion. AVs can optimise traffic flow and reduce gridlock in cities such as Delhi and Mumbai.

Urban mobility. AVs can reshape public transport and last-mile connectivity.

Economic impact. AV adoption could boost productivity and reduce healthcare costs tied to accidents.

[1]NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., CRITICAL REASONS FOR CRASHES INVESTIGATED IN THE NATIONAL MOTOR VEHICLE CRASH CAUSATION SURVEY (2015) (DOT HS 812 115).
[2]MINISTRY OF ROAD TRANSP. & HIGHWAYS, ROAD ACCIDENTS IN INDIA 2023 (Gov't of India 2024).

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II. LEGAL IMPLICATIONS RISING WITH AUTONOMY

As autonomy increases, the legal focus shifts from human negligence to product liability and systemic accountability.

Shift in liability. At lower levels, legal responsibility remains primarily with the human driver. Systems are viewed as "driver support," and the driver is expected to monitor the environment at all times.

The "grey area." Conditional automation introduces significant legal complexity. Because the driver is permitted to engage in non-driving activities but must retake control upon request, disputes often arise over whether an accident was caused by a system failure or by a human's failure to intervene in time.

Systemic responsibility. At higher levels, liability shifts largely to the manufacturer, software provider, or fleet operator. Since no human input is required, traditional traffic laws based on "driver fault" are becoming obsolete, prompting new frameworks such as the United Kingdom's Automated Vehicles Act 2024, which holds "Authorised Self-Driving Entities" (ASDEs) accountable for vehicle conduct[3].

Data and privacy. Higher levels of autonomy require massive data collection for navigation and safety, raising concerns about data privacy and cybersecurity liability if a vehicle is hacked.

Insurance transformation. Insurers are moving from individual driver policies towards product liability insurance for manufacturers. Some jurisdictions propose "no-fault" compensation funds to ensure victims are paid quickly regardless of whether the fault lies with software or hardware.

III. THE MOTOR VEHICLES ACT, 1988

The Motor Vehicles Act, 1988 is the principal legislation governing road transport in India[4]. It came into force on 1 July 1989, replacing the earlier Motor Vehicles Act of 1939, and was substantially amended in 2019 to improve road safety and accountability[5]. The Act regulates the issuance of driving licences and learner's licences, vehicle registration, permits for transport vehicles, and fitness certification of vehicles. It makes third-party motor insurance compulsory to ensure compensation for victims of road accidents and establishes procedures for claims through Motor Accident Claims Tribunals (MACT).

[3]Automated Vehicles Act 2024, c. 10 (U.K.).

[4]The Motor Vehicles Act, 1988, No. 59, Acts of Parliament, 1988 (India).

[5]The Motor Vehicles (Amendment) Act, 2019, No. 32, Acts of Parliament, 2019 (India) (in force Sept. 1, 2019).

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The Act also lays down traffic rules, speed limits, and safety requirements such as the wearing of helmets and seat belts, and it prescribes penalties for offences such as overspeeding, drunk driving, driving without a licence, dangerous driving, and overloading. The 2019 amendment introduced significantly higher fines, provisions for electronic monitoring of traffic violations, protection for Good Samaritans who help accident victims, recall of defective vehicles, and stricter punishment for offences committed by juveniles, holding guardians or vehicle owners responsible in certain cases. Overall, the Act aims to ensure road safety, regulate transport systems efficiently, protect accident victims, and promote responsible driving behaviour across the country. It applies across all states and union territories of India, and has been amended several times, notably in 2019.

A. Objectives of the Act

The Act seeks to regulate and control road transport in India; to ensure road safety and reduce traffic accidents; to provide rules for the licensing of drivers; to ensure proper registration of motor vehicles; to make third-party motor insurance compulsory; to provide compensation to victims of road accidents; to define the duties and responsibilities of drivers and vehicle owners; to prescribe penalties for traffic violations; to regulate transport vehicles and permits; and to promote safe and responsible driving behaviour.

B. Key Terms under the Act

Driver. A person who drives or controls a motor vehicle.

Motor vehicle. Any mechanically propelled vehicle adapted for use on roads, including cars, two-wheelers, buses, and trucks.

Owner. The person in whose name the motor vehicle is registered.

IV. AUTONOMOUS VEHICLES VERSUS TRADITIONAL TRAFFIC LAWS

Absence of a human driver. Traditional traffic laws assume that a human driver is making decisions, and legal responsibility is typically assigned to the human behind the wheel. In full autonomy there is no human driver, so liability may shift from the driver to the manufacturer, software developer, or fleet operator, raising questions about accountability in accidents, namely who "broke the law."

AI decisions replacing human reactions. Traditional laws are designed around human capabilities such as reaction time, judgment, and error, and rules like speed limits, right-of-way, and signalling assume human cognition. AI may react faster than humans and follow traffic rules more strictly, so some laws may become redundant or require reinterpretation (for

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example, "reasonable speed" versus an algorithmically safe speed). AI may also prioritise safety differently from humans, causing conflicts with existing law, such as in choosing between two harm-reduction scenarios.

Conflict with "driver-centric" constructs. Traditional laws focus on a human driver's responsibilities, such as negligent driving, driving under the influence, and failure to yield, and enforcement relies on attributing human intent or error. With AVs there is no human intent, so the law may need to define liability in terms of system design, maintenance, or AI decision-making protocols, and current regulations may not fully accommodate software as the "decision-maker."

V. LIABILITY CHALLENGES

Software developer. AI controls the vehicle's decisions, and bugs, miscalculations, or poorly trained models could lead to accidents. The legal challenge lies in proving that the software directly caused the accident, as opposed to external factors.

Sensor manufacturer. AVs rely on LiDAR, radar, cameras, and other sensors, and faulty or miscalibrated sensors can impair perception. Liability could fall on the manufacturer if sensor failure contributed to a crash.

Vehicle owner or operator. Traditional law assumes the driver is responsible. With AVs, owners may still have duties, including maintaining the vehicle and software and activating safety features correctly.

Human fallback driver. In Level 3 AVs (conditional autonomy), a human must intervene if the AI fails. Liability can be shared if the fallback driver was inattentive or failed to respond, creating complex "shared responsibility" scenarios.

VI. INSURANCE IMPLICATIONS

Shift in liability. Risk moves from individual drivers to manufacturers and software developers, increasing product liability exposure.

Change in insurance models. Traditional personal auto insurance may decline, while manufacturer and commercial fleet insurance may grow.

Fewer accidents, higher repair costs. Crash frequency may reduce, but claims become more expensive owing to advanced sensors and technology.

Complex claims and subrogation. Insurers may pay victims first and then pursue manufacturers for recovery, increasing legal complexity.

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Cyber-risk exposure. Hacking and system failures introduce new insurance categories and potential systemic losses.

Data-driven pricing. Extensive vehicle data enables more precise underwriting but raises privacy concerns.

VII. THE MOTOR VEHICLES ACT AND LIABILITY

Under the Motor Vehicles Act, the principal provisions dealing with fault and negligence are: Section 166 (compensation claims based on fault liability, where negligence must be proven); Section 140 (no-fault liability, providing fixed compensation regardless of negligence); Section 163A (structured-formula compensation, with no need to prove fault); and Section 149 (the insurer's duty to satisfy judgments against insured persons)[6]. These provisions assume human negligence as the basis for liability.

Presumption of driver responsibility. The Act presumes that a human driver is in control of the vehicle. Liability typically attaches to the driver (for negligence), the owner (vicarious liability), and the insurer (statutory obligation to compensate). Even with advanced driver-assistance systems, responsibility remains with the licensed driver.

Limitations for autonomous-vehicle use cases. The Act offers no clear recognition of AI or software as a decision-maker, and it is difficult to apply "negligence" where no human error exists. Product defects fall outside the core structure of the Act, pointing towards product liability law, and there is no framework for cybersecurity failures, software updates, or fully autonomous (Level 4-5) vehicles. The insurance model remains driver-centric rather than manufacturer-centric.

VIII. INTERNATIONAL COMPARISON

A. United States

Federal approach and state laws. There is no comprehensive federal AV law; the federal role is mainly guidance and standards rather than strict regulatory command. Federal regulation historically comes from the National Highway Traffic Safety Administration (NHTSA) and the U.S. Department of Transportation (DOT). NHTSA develops voluntary guidance (for example, Automated Driving Systems: A Vision for Safety and subsequent updates) to encourage safe performance and assist states in crafting their own rules. The federal-state split means the United States has a patchwork landscape: vehicle design and safety standards sit at the federal level,

[6]The Motor Vehicles Act, 1988, *supra* note 4, §§ 140, 149, 163A, 166.

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but vehicle operation (licensing, permits, liability coverage, and road use) is largely left to the states.

NHTSA guidance. NHTSA's approach has historically been voluntary, performance-oriented guidance rather than strict regulatory requirement. Earlier federal policies (such as Automated Driving Systems 2.0 and 3.0) offered best practices for safety assessments and state-law consideration but did not impose binding federal rules on AV developers. The goal is to harmonise standards across states and avoid fragmentation, but no single federal liability or licensing regime yet exists.

California AV testing regulations. California is among the strictest states for AV testing and operation. The California DMV administers permit systems for AVs, with separate permits for testing with a safety driver and for driverless testing, and with data and reporting requirements (companies must report disengagements and collisions to improve transparency). Manufacturers must maintain significant liability insurance to test and deploy AVs, and operational-design-domain and law-enforcement-interaction plans must be disclosed for driverless permits. Unlike some more permissive states such as Arizona and Texas, California scrutinises safety performance and permits incrementally.

B. European Union

The European Union has established one of the world's most structured regulatory environments for AVs by integrating international UNECE standards into its own legal framework, ensuring that vehicles approved in the EU meet global benchmarks for safety and cybersecurity.

UNECE regulations. The EU follows the UN World Forum for Harmonization of Vehicle Regulations (WP.29) to create a uniform market for automotive technology. UN Regulation No. 155 mandates that manufacturers implement a Cybersecurity Management System (CSMS) to manage risks across the vehicle's entire lifecycle; UN Regulation No. 156 requires a Software Update Management System (SUMS) to ensure that updates, including over-the-air patches, are delivered safely and securely; and UN Regulation No. 157 (ALKS) is the first international regulation for Level 3 automated driving, specifically for Automated Lane Keeping Systems[7].

Harmonised safety standards. Safety in the EU is governed by the General Safety Regulation (GSR), which aligns with UNECE standards to prevent a fragmented national approach[8].

[7]U.N. ECON. COMM'N FOR EUR., Regulation No. 157 (Automated Lane Keeping Systems) (2021); *see also* UNECE Regulation No. 155 (Cyber Security) (2021); UNECE Regulation No. 156 (Software Update) (2021).
[8]Regulation (EU) 2019/2144, 2019 O.J. (L 325) 1 (General Safety Regulation).

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Manufacturers must obtain type approval from a designated authority (such as Germany's KBA) before vehicles can be sold. A draft global regulation on Automated Driving Systems was reportedly adopted in early 2026 to establish a harmonised methodology for validating driverless vehicles, and compliance often relies on ISO 26262 (functional safety) and ISO 21448 (Safety of the Intended Functionality).

Cybersecurity requirements. Cybersecurity is now mandatory for vehicle type approval in the EU. As of July 2024, newly produced vehicles in the EU must comply with R155 and R156; manufacturers are legally responsible for identifying and mitigating cyber risks introduced by their suppliers; and OEMs must monitor their fleets, detect attacks, and report significant incidents to authorities. The EU requirements are closely mapped to ISO/SAE 21434, which provides the engineering framework for risk management.

C. Japan

Japan has positioned itself as a global leader in AV legislation, being among the first to codify Level 3 and Level 4 operation on public roads.

Amendments to the Road Traffic Law. The 2019-2020 amendments to the Road Traffic Act and the Road Transport Vehicle Act defined "automated driving devices" for the first time and permitted Level 3 operation, allowing drivers to engage in "secondary tasks" (such as using a mobile phone) provided they could take over immediately when prompted. The most significant shift came with the 2022 amendment (in force from April 2023), which introduced a permission system for "specified automated operation," that is, unmanned Level 4 driving, designed to address labour shortages and support ageing populations in rural areas[9].

Clear definitions for AV operations. Japan's regulations provide high legal certainty through specific operational roles. "Specified automated operation" is a new legal category for Level 4 driving where the system is responsible for all driving tasks within a defined Operational Design Domain (ODD). For driverless services, the law mandates a designated "autonomous operation manager" who monitors the vehicle remotely and takes emergency measures but is not classified as a "driver" in the traditional sense. Approval for Level 4 services requires a detailed plan submitted to the National Police Agency (via local public safety commissions) covering the route, monitoring equipment, and cybersecurity measures, and vehicles must be capable of a "minimal risk manoeuvre," meaning they can stop safely if the ODD is exceeded or the system fails.

[9]Act No. 32 of 2022, amending the Road Traffic Act, Act No. 105 of 1960 (Japan) (introducing a permission system for "specified automated operation" (Level 4), in force Apr. 1, 2023).

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IX. GAPS IN THE MOTOR VEHICLES ACT, 1988

No AV definitions. The Act does not define or categorise levels of automation (for example, SAE Levels 1-5), making it difficult to craft tailored regulations for different self-driving capabilities.

No machine-decision liability rules. Legal accountability remains tied to human drivers. There is no clear framework to assign liability when a machine's algorithm makes a decision that leads to an accident, leaving it unclear whether the manufacturer, software developer, or owner is at fault.

No data or telemetry standards. Although AVs generate vast amounts of environmental and personal data, the Act lacks standards for the logging, storage, and retrieval of data essential for accident investigation and post-incident analysis.

No cybersecurity linkage. The Act does not address vulnerabilities to hacking or cyber-intrusion. While the Information Technology Act, 2000 governs cybercrime[10], there is no formal linkage to vehicle-safety standards or manufacturer obligations within the Motor Vehicles Act.

X. REGULATORY UNCERTAINTY

The current lack of a unified national roadmap and clear testing protocols creates significant regulatory uncertainty for the AV sector in India.

Unclear testing approvals. The Motor Vehicles Act, 1988 does not explicitly permit AV testing on public roads. While the Motor Vehicles (Amendment) Bill, 2017 proposed clauses for testing, progress stalled, leaving developers in a "grey area" where trials are often restricted to private campuses.

No national framework for deployment. There is no comprehensive, federal-level policy for commercialising AVs. Instead, a patchwork of state-level initiatives has emerged, such as the Karnataka innovation sandbox in Bengaluru, leading to inconsistent safety and compliance standards across state lines.

Missing standard operating procedures. Experts highlight the absence of explicit standard operating procedures for how AVs should operate within India's complex, heterogeneous traffic, which includes pedestrians, animals, and non-lane-based driving.

Impact on readiness. Owing to these regulatory hurdles and infrastructure limitations, India currently ranks low on the KPMG Autonomous Vehicles Readiness Index, trailing nations such

[10]The Information Technology Act, 2000, No. 21, Acts of Parliament, 2000 (India).

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as Singapore and the United States that have established structured licensing and liability guidelines.

XI. DATA PRIVACY ISSUES

The data-rich nature of AVs creates a significant tension between current motor-vehicle law and emerging privacy standards in India. The right to privacy is a constitutionally protected fundamental right, as recognised by the Supreme Court[11].

AVs generate highly sensitive data. AVs act as "moving data platforms," constantly collecting information that goes far beyond traditional vehicle diagnostics. In-cabin cameras and sensors may collect facial-recognition data, voice recordings, and indicators of driver alertness; GPS and telematics may track frequent locations, driving habits, and preferences, creating a detailed profile of the user's life; and 360-degree LiDAR and cameras may record non-consenting bystanders and private property, raising "inadvertent surveillance" concerns.

The Act's silence on personal data. The Motor Vehicles Act, 1988 was drafted in a pre-digital era and remains focused on physical safety rather than digital privacy. It does not specify who owns the data generated by an AV or how long it may be retained; it contains no provision to prevent original equipment manufacturers (OEMs) from selling passenger data to third parties; and it does not mandate informed consent for the background data processing essential to an AV's operation.

Intersection with the DPDP Act, 2023. The Digital Personal Data Protection Act, 2023 and the DPDP Rules, 2025 now impose a new layer of compliance on the automotive sector[12]. Under the Act, car manufacturers are classified as Data Fiduciaries, legally responsible for how they collect, store, and process user data. Users have the right to correction, erasure, and withdrawal of consent, so a user could in principle demand deletion of driving history, which may conflict with requirements for accident investigation. Owing to the volume and sensitivity of the data they handle, AV manufacturers may be designated Significant Data Fiduciaries, requiring them to appoint a Data Protection Officer based in India and to conduct periodic audits. Non-compliance with data-security standards can attract penalties of up to ₹250 crore per instance, far exceeding any fine under the Motor Vehicles Act.

[11]Justice K.S. Puttaswamy (Retd.) v. Union of India, (2017) 10 S.C.C. 1 (India).

[12]The Digital Personal Data Protection Act, 2023, No. 22, Acts of Parliament, 2023 (India).

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XII. Safety and certification

In the current Indian regulatory landscape, "roadworthiness" for AVs is not defined as a single benchmark; it is emerging through a series of incremental Automotive Industry Standards (AIS) focused on specific automated functions rather than a fully driverless vehicle. Under the Central Motor Vehicles Rules, 1989, roadworthiness is determined by type approval[13]. For a vehicle with autonomous features to be considered roadworthy, it must, among other things, comply with AIS-191 (Part 1) on Emergency Lane Keeping Systems, issued by MoRTH, under which automated interventions such as steering correction can be overridden by a human with a force not exceeding 50N; function correctly within specified speed ranges (for example, 65 km/h to 130 km/h for the relevant system); and undergo homologation, the process by which agencies certify that it meets all Indian safety, emission, and performance standards.

Testing protocols. Testing is conducted by authorised agencies such as the Automotive Research Association of India (ARAI) and the International Centre for Automotive Technology (iCAT). Before any public-road trials, manufacturers must demonstrate safety cases, often following voluntary global standards such as UL 4600, which covers risk analysis and autonomy validation. Functional tests are highly granular: a lane-departure-warning test, for instance, involves drifting the vehicle at speed to ensure the system triggers a warning before the vehicle crosses lane markings. Sensors such as LiDAR and radar are also tested for reliability against dirt, vibration, and harsh lighting.

Compliance verification. Compliance is a continuous process. Manufacturers must submit technical specifications and product samples to ARAI for evaluation and obtain a Type Approval Certificate. Under Conformity of Production, the agency periodically selects random samples from the production line to ensure they match the certified design. For complex electronic systems, manufacturers must provide a documentation package explaining the software logic and safety concepts, including fallback measures in case of electrical failure. Recent amendments require that fitness certification for in-use vehicles be conducted through Automated Testing Stations to remove human bias from the verification process.

XIII. Insurance framework

The transition to AVs requires a fundamental redesign of India's motor insurance, which is currently built on the assumption of a human driver's negligence.

[13]The Central Motor Vehicles Rules, 1989 (India).

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How insurance works today in India. The Motor Vehicles Act, 1988 mandates a fault-based liability system centred on human control. Under Section 146, every vehicle must carry third-party cover to compensate victims for injury, death, or property damage[14]. Current law assumes a human is always in charge, so if an accident occurs, the owner or driver is legally responsible, and the Motor Accident Claims Tribunal decides compensation based on the driver's degree of fault and the victim's earning capacity.

Challenges for autonomous vehicles. AVs disrupt the traditional driver-fault model. When a software glitch or sensor failure causes a crash, it is unclear whether the owner, the manufacturer, or the software developer is liable under the current Act. Insurers struggle to determine fault because critical collision data is stored in proprietary sensors and software that manufacturers are often reluctant to share. AVs use expensive hardware such as LiDAR and AI processors, leading to higher insured declared values and premiums, and traditional policies do not cover "digital accidents" such as vehicle hacking or remote unauthorised control.

Need for product liability and no-fault systems. To resolve these gaps, commentators advocate a shift towards system-centric insurance. Product liability would hold manufacturers strictly liable for accidents caused by defective algorithms or hardware under the Consumer Protection Act, 2019[15]. A no-fault system is proposed so that victims receive immediate relief without protracted litigation, with the insurer paying the victim first and later recovering costs from the responsible technology provider through subrogation. Recommendations also suggest a tiered, dual-liability model in which the driver is liable for Levels 0-2 (assisted driving) but the manufacturer assumes primary liability for Level 3 and above.

XIV. DRAFT INDIAN AV POLICY LANDSCAPE

India's AV policy landscape is currently characterised by the absence of a unified national rulebook, although foundational work is under way through technology mandates and long-term roadmaps. The government is taking a phased approach, prioritising Advanced Driver Assistance Systems (ADAS) and specialised electric-vehicle infrastructure as precursors to full autonomy.

Recent discussions and committees. NITI Aayog reportedly established a dedicated Division of E-Mobility to anchor inter-ministerial coordination and evidence-based policy formulation. A consultative group of experts from government, academia (including IIT Madras), and

[14]The Motor Vehicles Act, 1988, *supra* note 4, § 146.

[15]The Consumer Protection Act, 2019, No. 35, Acts of Parliament, 2019 (India).

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industry has collaborated with ARAI to prepare a roadmap for future mobility, and a committee involving representatives of various states, MoRTH, and the National Informatics Centre is working on standardising digital transport services and registration documents.

XV. Proposed amendments to the Motor Vehicles Act

To address the regulatory vacuum, legal experts and industry bodies have proposed a series of amendments to the Motor Vehicles Act intended to pivot the law from a driver-centric model to a system-centric one.

Define AV categories. The most fundamental proposal is to move beyond the generic "motor vehicle" definition and integrate the Society of Automotive Engineers (SAE) Levels 0-5 into Indian law. This includes formally defining the "Automated Driving System" as the entity responsible for the dynamic driving task and amending Section 2 of the Act to distinguish between driver-assisted (Levels 1-2) and fully autonomous (Levels 4-5) vehicles, as each requires different licensing and insurance rules.

Reassign liability models. The fault-and-negligence regime of the Act assumes human negligence[16]. Proposed amendments suggest that, for Level 3 and above, liability should shift from the owner or driver to the manufacturer or software developer where the system was engaged at the time of the crash; that a strict or no-fault framework, similar to that under the Consumer Protection Act, 2019, should allow victims to be compensated without proving a specific coding error; and that "event data recorders" (black boxes) should be made legally admissible to determine whether the human or the AI was in control during an incident.

New safety-certification rules. To ensure these vehicles are suited to Indian conditions, the certification process should move beyond traditional crash tests. Proposals include scenario-based virtual and closed-track testing of "edge cases" specific to India, such as stray animals, monsoon flooding, and non-lane-based traffic; a mandatory cybersecurity certification within type approval to protect against remote hacking; and dynamic, continuous compliance under which over-the-air software updates must be re-certified if they alter the vehicle's driving logic.

XVI. Suggested new legal mechanisms for AVs

To bridge the gap between human-centric law and autonomous reality, three core legal mechanisms are proposed as new pillars of the Motor Vehicles Act framework.

[16]The Motor Vehicles Act, 1988, *supra* note 4, §§ 166, 168; *see also id.* § 161 (special provision for hit-and-run compensation).

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No-fault compensation. Litigation before the Motor Accident Claims Tribunal is slow because it relies on proving human negligence. For AVs, a no-fault mechanism is proposed under which, similar to the existing no-fault scheme, victims would receive immediate compensation regardless of whether fault lay with the software, a sensor, or the human passenger. The insurer would pay the victim first and then use subrogation rights to recover costs from the manufacturer where the AI was at fault, sparing victims the need to sue large technology companies directly.

AI audit trails and "black box" requirements. Because an AI's decision-making cannot be explained by eyewitnesses, legal mandates for Data Storage Systems for Automated Driving are essential. Proposed rules would mandate an event data recorder that logs high-frequency data (speed, steering angle, sensor input) for a short window before and after a collision; would make such audit trails legally admissible as primary evidence; and would require that this data be stored locally within India to comply with the DPDP Act, 2023.

Mandatory cybersecurity standards. As AVs become "computers on wheels," cybersecurity is a road-safety issue rather than merely an information-technology one. No AV would receive a type-approval certificate unless it met ISO/SAE 21434 or comparable Indian standards; manufacturers would be required to report over-the-air software patches to regulators, with a safety-critical patch logged as a "digital recall"; and a new category of "cyber-negligence" would hold manufacturers liable where a vehicle is hacked owing to known but unpatched vulnerabilities. These mechanisms aim to create a trust-based ecosystem in which the technology is permitted to fail but the legal system ensures the victim is never left without recourse.

XVII. ETHICAL AND SOCIAL CONSIDERATIONS FOR AVS

Beyond the legal and technical hurdles, the deployment of AVs in India raises complex ethical and social questions that the current policy framework has yet to address.

Algorithmic bias and the "trolley problem." AI decision-making is not neutral; it reflects the data on which it was trained, which can produce life-and-death biases. In an unavoidable crash, should the AI prioritise the passenger or a pedestrian? India lacks an ethical code of conduct for algorithms to handle such scenarios. Object-detection sensors may also struggle to identify individuals with darker skin tones or in unconventional clothing (for example, saris or lungis), posing a disproportionate risk in the Indian context, and algorithms trained on Western roads may fail to recognise hand signals from traffic police or the movement of stray animals.

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Job displacement. The most sensitive social issue in India is the potential loss of livelihoods for millions of commercial drivers. The Union Minister of Road Transport and Highways, Nitin Gadkari, has stated that he would not allow driverless cars in India in order to protect the jobs of an estimated 70-80 lakh drivers[17]. While AVs may offer convenience to the affluent, they threaten the primary income of lower-income households.

Upskilling versus redundancy. Proposed policies emphasise a phased transition in which drivers are upskilled into roles such as fleet technicians or remote monitors, but the feasibility of transitioning a semi-skilled workforce remains a major concern.

XVIII. INFRASTRUCTURE READINESS FOR AVS

Infrastructure readiness is the most significant physical barrier to AV deployment in India, as self-driving systems require highly standardised environments that contrast with the largely unstructured nature of Indian roads.

Road signage and digital mapping. AVs rely on consistent physical markers and high-definition maps to orient themselves. A major challenge is the lack of standardised lane markings and road signs across states and municipalities, which can confuse vehicle sensors. Homegrown mapping providers offer granular, India-specific data, including alerts for potholes and speed breakers and house-level addresses, but centimetre-level HD maps with three-dimensional road geometry are currently being developed only for select smart-city corridors and are virtually non-existent for rural areas.

5G and connected-vehicle infrastructure. Reliable connectivity is the nervous system of an AV, enabling real-time updates and emergency overrides. India has achieved a rapid 5G rollout, reportedly with over 5.08 lakh base stations covering 99.9% of districts, providing the low-latency bandwidth needed for Vehicle-to-Everything communication; the government plans to launch Vehicle-to-Vehicle technology by the end of 2026 using a dedicated spectrum band, allowing cars to communicate directly without the internet, and these systems are designed to exchange safety signals to reduce accidents by an estimated 50%.

XIX. CASE STUDIES

Building on the global landscape, the following outcomes provide a reference for the Indian context.

[17] *Transport Minister Nitin Gadkari Says He Won't Allow Driverless Cars in India*, CARTOQ (Sept. 8, 2025), https://www.cartoq.com/car-news/india-bans-driverless-cars-to-protect-transport-sector-jobs/.

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United States (San Francisco and Phoenix). Waymo has reported that its vehicles were involved in 84% fewer crashes with airbag deployment than human drivers over more than 22 million rider-only miles[18], suggesting that AVs can be safer than human drivers in the operating conditions studied.

Germany (legal leadership). Germany was among the first to enact a law for Level 4 autonomy, allowing driverless vehicles in defined operational areas, and it introduced a "technical supervisor" role, a human who can intervene remotely, which has become a reference model for early-stage deployment.

China (Baidu Apollo). In cities such as Beijing and Wuhan, Baidu's Apollo Go has commercialised robotaxis, achieving cost parity with human-driven ride-hailing through scale and integrated smart-city infrastructure.

Several lessons follow for India. Like Germany, India should consider a remote-assistance framework, since a remote human operator to handle complex situations (such as cattle blocking the road) is more practical than waiting for Level 5 perfection. China's experience suggests that AVs perform best where infrastructure supports the vehicle, so India should focus on Intelligent Transport Systems in smart-city zones rather than expecting on-board sensors to solve every problem. The United States illustrates the need for a neutral safety-data hub where manufacturers report disengagements to build public trust and provide insurers with actuarial data. Finally, Singapore's strategy of prioritising autonomous shuttles for last-mile connectivity may fit India better than private luxury AVs, since it integrates AVs into public transport rather than displacing individual drivers, and global precedents suggest a dual-insurance model under which the owner covers standard risks while the manufacturer carries a product-liability policy for software-induced crashes.

XX. STAKEHOLDER ROLES FOR AV DEPLOYMENT

Moving from manual to autonomous mobility requires a synchronised effort from key stakeholders.

Government (policy and incentives). The State acts as enabler and regulator. MoRTH is refining the proposed Motor Vehicles (Amendment) Bill to move beyond human-centric liability; the government is discussing production-linked incentives for advanced chemistry

[18]WAYMO, SAFETY IMPACT (2024), https://waymo.com/safety/impact/ (84% fewer airbag-deployment crashes over 22 million rider-only miles).

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cells and autonomous hardware to localise the supply chain; and it is investing in V2V infrastructure and the spectrum needed for cars to communicate without cellular lag.

Industry (standards and testing). Original equipment manufacturers and technology start-ups are the engineers of trust. They are working with ARAI to finalise standards governing ADAS and cybersecurity; shifting from track testing to digital-twin simulation of Indian cities to train AI on unstructured traffic; and, as Data Fiduciaries under the DPDP Act, 2023, taking legal responsibility for the digital footprint of every passenger.

XXI. THE ROAD AHEAD FOR AV DEPLOYMENT IN INDIA

The transition to AVs in India is moving from exploratory pilots towards structured regulatory mandates, defined by a shift from human-centric to system-centric safety.

A. Short Term

In the short term, the focus is ecosystem-building and mandates: new vehicles in specified categories are expected to feature advanced emergency braking, lane-departure warning, and driver-drowsiness systems; the government plans to launch Vehicle-to-Vehicle communication; legislative amendments are proposed, including a requirement for pre-installed dashboard cameras to assist in liability determination; and new electrified models are expected to include an Acoustic Vehicle Alerting System to alert pedestrians to silent electric vehicles.

B. Medium Term

In the medium term, the emphasis shifts to scaling and commercialisation: the expansion of Level 4 robotaxi and autonomous-shuttle pilots in smart cities such as Bengaluru, Hyderabad, and Pune; the nascent deployment of autonomous trucking on high-density freight corridors supported by V2X-enabled highway infrastructure; and fuller harmonisation with global safety standards for Level 3 and Level 4 automation, allowing Indian manufacturers to compete in global value chains.

C. Long Term

In the long term, the goals include strategic self-reliance in the hardware and software of "embodied intelligence" to reduce reliance on imported sensors and processors; the commercial viability of full (Level 5) autonomy without geographic or weather constraints; and integration with national goals for a self-reliant, zero-emission transportation landscape.

D. Key Action Points for Success

Three priorities stand out: establishing a clear legal framework to transition from "driver-at-

fault" to product liability for software errors; harmonising infrastructure through the standardisation of lane markings, road signs, and HD mapping across state borders; and launching a national safety-data hub to report AV performance and disengagement data transparently to the public.

XXII. CONCLUSION

Integrating autonomous vehicles into India's transport landscape requires more than technological readiness; it demands a fundamental shift in legal philosophy. The Motor Vehicles Act, 1988, built on the bedrock of human agency and driver liability, currently stands as a significant barrier to the deployment of self-driving systems. To bridge this gap, India must transition from a human-centric regulatory framework to one that accounts for algorithmic accountability and manufacturer liability. By proactively amending the legislative structure and establishing clear safety standards, India can transform these legal roadblocks into a structured pathway for innovation, ensuring that the transition to automation enhances road safety without compromising legal certainty.

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