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Regulating AI-driven Autonomous Vehicles

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Abstract

AI, or artificial intelligence, is turning into a formidable tool that allows machines to think and act like people. There is substantial empirical evidence to suggest that AI is "Cognitive Computing," in which machines, primarily computers, are programmed to infer, reason, perceive, think, sense, and behave in ways similar to humans. Autonomous Vehicles or Self-Driving Cars use AI to control the car and are dependent on sensors, actuators, complex algorithms, machine learning systems and powerful processors to implement software. Autonomous vehicles sense their surroundings using a range of sensors located throughout the vehicle. In India, the AV ecosystem is still in its infancy. According to KPMG's 2020 Autonomous Vehicle Readiness Index, India ranks 29th out of 30 countries on the list. However, coordinated efforts from the automotive and artificial intelligence industries are ongoing to achieve significant development in the subject. Self-driving vehicles (SDVs) hold immense potential to revolutionize transportation in India. Their disruptive and transformative nature necessitates a robust and comprehensive legal framework tailored to the country's unique driving conditions. While the widespread adoption of SDVs seems imminent, India currently lacks specific laws governing them. This article addresses the urgent need for legislative reform, exploring options like amending existing laws (Motor Vehicles Act, Consumer Protection Act, Indian Penal Code) or enacting new ones. Drawing from international examples, it emphasises the importance of stringent regulations and clear liability frameworks for accidents involving SDVs. Overall, India must embrace SDVs while ensuring safety and accountability through a carefully crafted legal infrastructure.

Introduction

The story is often told as follows: it's the year 2035, and you've just awakened to start your day. As you prepare for work—taking a shower, having breakfast, grabbing notes for the morning meeting—you contemplate the upcoming commute. Heading towards the car, you effortlessly enter, input the destination, and settle in for some light reading during the twenty-minute journey to work. Your car autonomously handles the drive, allowing you to daydream and read, while the commute has become faster, with traffic being a rare occurrence. Moreover, the safety of "driving" has significantly improved compared to the numerous crashes and fatalities of previous decades. This positive trend reaches its pinnacle with the advent of autonomous and connected vehicles, eliminating driver error as the primary cause of accidents. In the most advanced scenarios, once you arrive at work, the car proceeds to pick up another family member, such as an elderly parent or a child incapable of navigating the roadways independently. In truly groundbreaking examples, users don't own the car; instead, a municipality or private company possesses a fleet of vehicles that can be summoned instantly as needed.

In the realm of consumer technology, the self-driving vehicle (SDV) is frequently described as a **disruptive** and **transformative** force. Observers emphasize that SDVs have the potential to not only revolutionize driving habits but also reshape how time is utilized and influence the development of urban landscapes, garnering increased attention from the public. The narrative traces back to the 1997 COMDEX computer conference, where Bill Gates highlighted the transformative impact of the PC industry compared to the perceived lack of innovation and cost-effectiveness in the consumer automobile sector.[1] Despite such critiques, car manufacturers have progressively integrated more computer technology into vehicles, introducing features like backup

[1] Hafner, Katie. 1998. "Do Computers Have to Be Hard to Use?" The New York Times. https://www.nytimes.com/1998/05/28/technology/do-computers-have-to-be-hard-to-use.html.

cameras, assisted braking, GPS, and stability control systems as standard in many models, enhancing performance and safety. These incremental strides in smart vehicle technology suggest the prospect of a collaborative relationship between technology companies and car manufacturers in SDV development. With entities like Google working on self-driving technology for existing vehicle models, a shift toward a more computer-like driving experience is evident. This trend raises the possibility of traditional vehicles becoming obsolete, akin to the transition from horse-drawn carriages in centuries past, showcasing technology's transformative impact on transportation. While the anticipated time frame for widespread adoption of the next level of SDVs often centered around 2020, with broader integration expected between 2040 and 2050, several hurdles must be addressed to make this technology feasible, accessible, and acceptable. These challenges encompass developing cost-effective technology for the consumer market, establishing frameworks to navigate legal and insurance issues, adapting road infrastructure if necessary, and addressing concerns related to driver trust and acceptance of new technology. Additionally, there remains uncertainty regarding who will be deemed the "driver" in the realm of self-driving vehicles. This paper delves deeper, taking inspiration from the national discussions in the US and UK, but focusing specifically on India's unique driving statutes. We aim to equip Indian policymakers with a comprehensive legal guide as they navigate this transformative landscape. By analyzing existing motor vehicle regulations in India, alongside the exemplary legal frameworks crafted in the US and UK to accommodate autonomous vehicles, we hope to illuminate the means and necessity for robust legislation around liability in India.

History and Terminology

It was only a few decades after the introduction of the first Model T Ford, created by Ford Motor Company in 1908 and which is regarded as the first mass produced-affordable automobile for Americans that people began to think about an automated version of the passenger vehicle.[2] Over the ensuing decades, automotive and technology publications documented the potential of creating a "self-driving car," with researchers from major car brands in the 1950s exploring roadway and car modifications for this purpose. Concurrently, universities and governments undertook projects with the aim of achieving a fully autonomous vehicle.[3] While cars during this period advanced in areas like transmissions, engine power, and design, ambitious claims suggested that self-driving vehicles (SDVs) were on the horizon. In the 1960s, a U.S. federal government grant set a target of 1985 for a self-driving prototype, and in 1991, Congress directed the Department of Transportation (DOT) to conduct research on "intelligent vehicle-highway systems." This involved transferring technology to state and local governments and investing in nationwide research.[4] Notably, the Defense Research Advanced Projects Agency (DARPA) Grand Challenge in 2004, 2005, and 2007 played a pivotal role, offering a $1 million prize for a driverless vehicle. This initiative engaged teams globally, advancing technology not only in the United States but also in countries like Japan and Europe. Many participants in these challenges continue to be core researchers and engineers

[2] McCracken, Harry. 2010. "Look Ma, No Hands! A Brief History of Self-Driving Cars." Technologizer. https://technologizer.com/2010/10/09/google-self-driving-cars/.

[3] McCracken, Harry. 2010. *supra note 1.*

[4] Stetson, Damon. 1969. "CARS AND TRUCKS SHOW A 40% RISE; 9188000 Units Turned Out --Industry Gets Set for Another Banner Year CARS AND TRUCKS SHOW A 40% RISE (Published 1956)." The New York Times. https://www.nytimes.com/1956/01/03/archives/cars-and-trucks-show-a-40-rise-9188000-units-turned-out-industry.html.

dedicated to realizing SDVs[5]. While breakthroughs were anticipated for decades, it now seems that the moment has finally arrived. Given the diverse entities involved in self-driving technology, various terms like self-driving vehicles (SDV), driverless, autonomous, auto-pilot, or connected cars are used interchangeably, all suggesting that cars are processing environmental data and assuming a significant role in driving.

Defining the Self-Driving Car

To make rules and regulations for self-driving cars, we first need to understand what self-driving car means. In 2013, the U.S. Department of Transportation created a five-level spectrum of vehicle autonomy, ranging from no driver assistance (Level 0) to no driver input (Level 4). Dissatisfied with these classifications, SAE International, a Society of Automotive Engineers International, published a six-level definition in 2016 that has become the industry standard and has also been adopted by the U.S. Department of Transportation. According to researchers, by 2025, there will be around 8 million autonomous or semi-autonomous vehicles on the road. Before they may drive on public roads, self-driving cars must first go through these six phases of driver aid technology innovation. What exactly are these levels? And where are we now?[6]

SAE defines 6 levels of driving automation ranging from Level 0 to 5:

[5] "The Grand Challenge." n.d. Darpa. https://www.darpa.mil/about-us/timeline/-grand-challenge-for-autonomous-vehicles.

[6] "The 6 Levels of Vehicle Autonomy Explained." n.d. Synopsys. Accessed December 27, 2023. https://www.synopsys.com/automotive/autonomous-driving-levels.html#1.

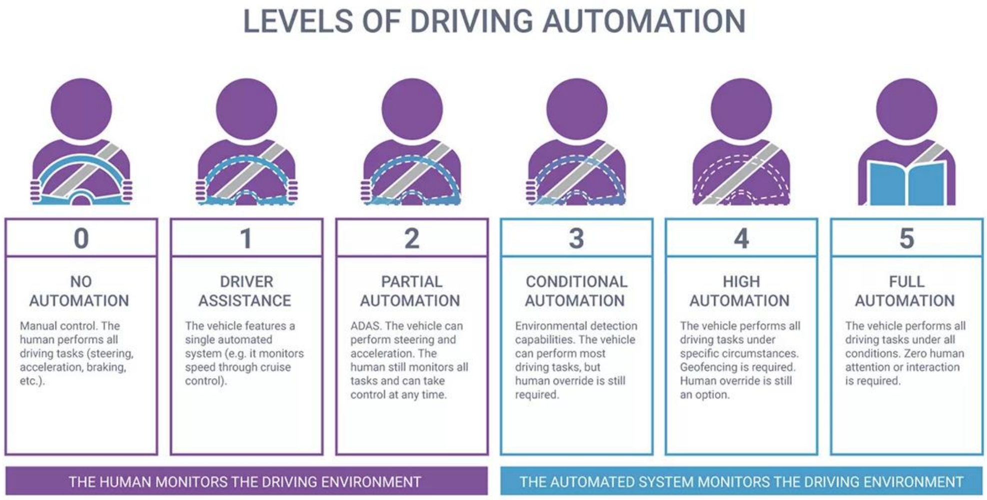

Figure.1[7]

Level 0 - (No Driving Automation)

The vast majority of automobiles on the road today are Level 0: manually controlled. Although there may be technology in place to assist the driver, the "dynamic driving task" is provided by the person. The emergency braking system, for example, does not qualify as automation because it does not literally "drive" the vehicle.

Level 1 - (Driver Assistance)

This is the lowest level of automation. The car is outfitted with a single automated system for driver assistance, such as steering and accelerating (cruise control). Adaptive cruise control, which keeps the vehicle a safe distance behind the next car, is classified as Level 1 since the human driver monitors other aspects of driving such as steering and braking.

Level 2 - (Partial Driving Automation)

This means advanced driver assistance systems or ADAS. The vehicle can control both steering and accelerating/decelerating. Here automation falls short of self-driving because a human sits in the driver's seat and can take control of the car at any time. Some of the vehicles meeting this standard (qualify as Level 2) are:

- **BMW's 2018 5 Series with Traffic Jam Assistant** autonomously navigates stop-and-go traffic and self-parking.
- Electric performance-car maker **Tesla Inc.'s 2016 Model S with Autopilot** was designed for highway driving — not city streets, country roads, or parking lots — though it self-parks on streets and can be hailed from the owner's private garage.
- **Mercedes-Benz's 2017 E-Class with Drive Pilot** sports advanced adaptive cruise control with an automated lane-change function.
- **Volvo Car's 2018 XC60 with Pilot Assist** steers, brakes and accelerates up to 80 mph. With steering support, it can dodge moving obstacles as big or bigger than large animals, Volvo said.

[7] "What is an Autonomous Car? – How Self-Driving Cars Work." n.d. Synopsys. Accessed January 9, 2024. https://www.synopsys.com/automotive/what-is-autonomous-car.html.

- **GM's Cadillac 2018 CT6 Platinum comes standard with Super Cruise**, a semi-autonomous function that can operate on more than 160,000 miles of divided, limited-access U.S. highways that GM has digitally mapped.

Level 3 - (Conditional Driving Automation)

The transition from Level 2 to Level 3 represents a significant technological leap but is relatively subtle or even inconspicuous from a human perspective. At Level 3, vehicles possess "environmental detection" capabilities, enabling them to autonomously make decisions, such as overtaking a slow-moving vehicle. However, human intervention is still necessary, requiring the driver to stay alert and prepared to take control if the system encounters difficulties. Audi (Volkswagen) announced in 2017 that their flagship sedan, the next-generation A8, would be the world's first commercially available Level 3 vehicle. The 2019 Audi A8L, equipped with Traffic Jam Pilot, integrating lidar scanning, advanced sensor fusion, and processing power, is set to reach commercial dealerships in late 2018. Despite Audi's engineering achievement, changes in U.S. regulatory processes shifted from federal guidance to state-specific mandates for autonomous vehicles during development. Consequently, the A8L is presently classified as a Level 2 vehicle in the United States, lacking key hardware and software necessary for Level 3 functionality. However, in Europe, Audi plans to introduce the fully equipped Level 3 A8L with Traffic Jam Pilot, initially in Germany.

Level 4 - (High Driving Automation)

The primary distinction between Level 3 and Level 4 automation is that Level 4 vehicles can intervene if something goes wrong or if the system fails. In this way, most of the time, these cars do not require human engagement. However, a human can still manually override the system. Level 4 vehicles can operate in self-driving mode. These vehicles can operate fully autonomously, but not in all driving situations. For example, the vehicles may not know how to handle a snowstorm, gravel road, or situations in which a large crowd — such as people leaving an outdoor concert — blocks the car. But until legislation and infrastructure evolve, they can only do so within a limited area (usually an urban environment where top speeds reach an average of 30mph). Technical challenges in reaching Level 4 remain daunting, particularly for road-safe artificial intelligence. This is known as geofencing. As such, most Level 4 vehicles in existence are geared toward ridesharing. For example:

- NAVYA, a French company, is already building and selling Level 4 shuttles and cabs in the U.S. that run fully on electric power and can reach a top speed of 55 mph.
- Tesla Inc. is working on developing Level 4 cars with its full self-driving (FSD) capabilities.
- Alphabet's Waymo unveiled a Level 4 self-driving taxi service in Arizona, where they had been testing driverless cars, without a safety driver in the seat, for more than 10 million miles.
- Canadian automotive supplier Magna has developed technology (MAX4) to enable Level 4 capabilities in both urban and highway environments. They are working with Lyft to supply high-tech kits that turn vehicles into self-driving cars.
- Volvo and Baidu announced a strategic partnership to jointly develop Level 4 electric vehicles that will serve the robotaxi market in China.

Level 5 (Full Driving Automation)

The "dynamic driving task" is eliminated in Level 5 cars because it does not require human attention. Level 5 vehicles will not have steering wheels or accelerator/braking pedals. They will be geofenced-free, able to go anywhere and accomplish whatever that a skilled human driver can.

Fully autonomous vehicles are being tested in many parts of the world, but none are yet available to the general public. Getting from Level 4 to Level 5 autonomy requires sophisticated communications systems. Chief among the functions being probed at these locations are the three varieties of wireless communication along roads:

• Vehicle to vehicle (V2V)
• Vehicle to infrastructure (V2I)
• Vehicle to anything with an antenna (V2X)

Communication systems being tested likely use some combination of existing communicationstandards, including GPS and Wi-Fi — particularly the open-source dedicated short-range communication (DSRC) radio-frequency protocol.

Autonomous vs. Automated vs. Self-Driving: What's the Difference?

The SAE opts for the term "automated" rather than "autonomous" because autonomy implies a broader sense of self-awareness and independent decision-making beyond electromechanical functions. A truly autonomous car would have the ability to make its own choices, potentially being self aware. On the other hand, a fully automated car strictly follows given orders without independent decision-making, ensuring adherence to commands. Although the terms "self-driving" and "autonomous" are often used interchangeably, there is a slightly different . A self-driving car can navigate itself in some or all scenarios, but the presence of a human passenger ready to take control is essential. Such vehicles typically fall under Level 3 (conditional driving automation) or Level 4 (high driving automation), and they are typically bound by geofencing restrictions, unlike a Level 5 fully autonomous car that has the capability to operate anywhere without limitations.[8]

Technological Development

Though the future of self-driving vehicles envisions intricate webs of car-to-car and car-to-infrastructure communication, today's development focuses on building autonomous fortresses within each car. Sensory superpowers like LIDAR and camera vision equip these fortresses to navigate solo, while familiar features like GPS and adaptive cruise control lay the groundwork. The ultimate goal, however, is a seamless marriage of internal autonomy with external communication, creating a self-driving superorganism that not only navigates independently but also dances in sync with its environment, optimizing traffic flow, minimizing accidents, and ultimately transforming our transportation landscape from fragmented commutes to a harmonious ballet on asphalt. Buckle up, the self-driving revolution is just the first chapter in a much grander story, whisper-promising driverless dawns and traffic-free tomorrows.

Current Events Happening Around the World and India

This table summarizes the status of the various SDV projects and how the technology is currently being brought to market.

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[8] "What is an Autonomous Car? – How Self-Driving Cars Work." n.d. Synopsys. https://www.synopsys.com/automotive/what-is-autonomous-car.html.

Company	Product	Developments
Audi	"Traffic Jam Pilot"[9]	1) Level 3 self-driving system approved in Germany for specific highways. 2) Research on Level 4 autonomous driving systems for urban environments. 3) Testing advanced sensor fusion technology for improved environment perception.
BMW	"Drive Pilot"[10]	1) Level 3 conditional automation is available in select models in Germany and the US. 2) Continued focus on sensor fusion and AI algorithms for better decision-making. 3) Expanding Drive Pilot availability to more models and regions. 4) Collaborating with Mobileye on Level 4 autonomous driving software.
Ford	"BlueCruise"[11]	1) Level 2+ hands-free driver-assistance system available in several models. 2) Investment in Argo AI for Level 4 autonomous vehicle development. 3) Testing BlueCruise on commercial fleets for delivery and ride-sharing. 4. Exploring partnerships with cities for autonomous shuttles.
General Motors	"Super Cruise"[12]	1) GM-Carnegie Mellon University Autonomous Driving Collaborative Research Lab— partnership won DARPA in 2007. 2) Super Cruise in Cadillac semiautomated driving system. 3) Expansion of Super Cruise availability to more GM brands and models. Cruise testing robotaxis in San Francisco and other US cities.
Lexus	"Advanced Driver Assist System(ADAS)"[13]	1) Level 2 ADAS with features like adaptive cruise control and lane departure warning. 2) Research on Level 3 and 4 autonomy, leveraging Toyota's research and development. 3) Collaboration with Woven Planet, a Toyota subsidiary focused on autonomous driving platforms. 4) Exploring Level 4 robotaxi services in partnership with other companies.

[9] CarBuzz.. https://carbuzz.com/cars/audi/a6-e-tron.

[10] BMW Group Technology 2023 Press Kit: https://www.press.bmwgroup.com/global

[11] Ford:https://www.thedrive.com/news/ford-is-getting-back-into-self-driving-cars-again-this-time-without-vw

[12] GM Cruise website: https://getcruise.com/

[13] Lexus website: https://rts.i-car.com/oem-information/lexus/lexus-adas.html

Company	Product	Developments
Mercedes-Benz	"Mercedes-Benz Drive Pilot"[14]	1) Level 3 conditional automation available in select models in Germany and the US. 2) Development of Level 4 autonomous driving system for robotaxi services. 3) Testing DRIVE PILOT on long-distance highway routes in Europe. 4) Partnering with Waymo on Level 4 autonomous driving technology.
Nissan	"ProPILOT Assist"[15]	1) Level 2 ADAS with features like adaptive cruise control and lane keep assist. 2) Research on Level 3 and 4 autonomy, partnering with Nissan's Alliance partners. 3) Testing ProPILOT Assist 2.0 with hands-free highway driving capabilities. 4) Exploring collaborations with other companies for Level 4 robotaxi services.
Tesla	"AutoPilot & Full Self Driving (FSD)"[16]	1) Level 2 ADAS with advanced features like lane change assist and summon. 2) FSD beta program testing Level 3 and 4 capabilities in limited markets. 3) Ongoing controversies and regulatory scrutiny surrounding Autopilot and FSD safety. 4) Expansion of the FSD beta program to more Tesla owners.
Volkswagen's	"IQ.drive"[17]	1) Development of Level 3 and 4 autonomy through Cariad, the Group's software division. 2) Testing Level 3 autonomous driving system on highways in Germany. 3) Collaboration with Mobileye on Level 4 autonomous driving technology.
Volvo	"Pilot Assist"[18]	1) "'Drive Me' public pilot project – partnership with Volvo Car Group and Swedish Transport Administration to pinpoint benefits of autonomous driving" by using 100 test cars.
Google	"Waymo"[19]	1) Driven 20 million miles. 2) Prototypes in operation using retrofitted

[14] Mercedes-Benz website: https://www.me.mercedes-benz.com/passengercars/mercedes-benz-cars/mercedes-me.html

[15] Nissan: https://www.nissan-global.com/EN/INNOVATION/TECHNOLOGY/ARCHIVE/ADVANCED_DRIVER_ASSISTANCE_TECH/

[16] Tesla: https://www.tesla.com/autopilot

[17] Volkswagen: https://www.motor1.com/news/623139/vw-autonomous-cars-mainstream-2030/

[18] Volvo Cars website: https://www.volvocars.com/us/v/safety/highlights

[19] Waymo website: https://waymo.com/

Company	Product	Developments
		LIDAR (Lexus and Prius models). 3) Developing own prototypes without steering wheels, brakes or accelerator pedals.
Bosch	"ADAS solutions"[20]	1) Provides technology for driver assistance functions like adaptive cruise control and high-performance assistance systems. 2) Partner with Stanford Center for Automotive Research and Stanford Law School.

Here are some of the notable startups and companies in India that are researching building autonomous vehicles for both on-road and other commercial applications.

1. Minus Zero - Founded in 2020 by two young boys from Punjab, Gagandeep Reehal and Gursimran Kalra, this claims to be the first startup in the world to be working towards building level 5 autonomy for unstructured Indian roads. Minus Zero envisions a culture of shared mobility for Indians to tackle the rising cost of owning a private car. In the short span of a year, the company has already developed several patentable proprietary technologies taking them closer to the dream of putting an autonomous car on Indian roads. They aim to achieve Level 5 autonomy by 2023, in partnership with an automotive OEM.[21]

2. Flux Auto - This Bangalore-based startup is building capabilities to transform commercial mobility in India. They develop autonomous driving for Indian highways, some of the most chaotic and unpredictable roadways in the world. The hardware and software technologies have been engineered from the ground up to democratise autonomous trucking. Most importantly, their technology can be retrofitted into existing trucks to upgrade them to driverless trucks.[22]

3. Swaayatt Robots - This is a Bhopal-based startup that is focused on developing Level-5 autonomous driving technology for adversarial traffic and unstructured environments. Their mission is to make connected autonomous driving technology accessible, affordable and available to everyone. The founder Sanjeev Sharma initiated his research in autonomous navigation in 2009 as an undergrad student at IIT Roorkee. Today, Swaayatt Robots is focused on highly stochastic traffic dynamics, for both the on- and off-road applications.[23]

4. Ati Motors - This is a Bangalore-based startup that has developed an autonomy stack for material movement in industrial environments. Ati Motors' Sherpa is the only autonomous industrial vehicle in this class globally that delivers autonomy for both indoor and outdoor scenarios. This increases the operational space from the factory floor to yard level autonomy

[20] Bosch: https://www.bosch-mobility.com/en/mobility-topics/adas/

[21] Mehra, Samiksha. 2021. "FIVE autonomous navigation initiatives by Indian government." India AI. https://indiaai.gov.in/article/five-autonomous-navigation-initiatives-by-indian-government.

[22] Id. note 20.

[23] Id note 20.

and also the in-campus road network. V Vinay, Saurabh Chandra and Saad Nasser founded Ati Motors in February 2017[24].

5. Fisheyebox - The team at Fisheyebox is fundamentally working on human-inspired driving. They have developed an all-in-one solution for an intelligent drive system that can be interfaced with any automotive-grade drive-by-wire platform in the world. It's the brain for autonomous and connected vehicles. Fisheyebox was founded in 2015 by Pinaki Laskar.[25]

6. Tata Motors - Established Autonomous Driving & Robotics Cell in 2018. Collaborates with Bosch and Israel's Technion Institute. Envisions Level 4 autonomous vehicles for public transport and fleet management.[26]

7. Mahindra & Mahindra - Partnered with Ford on autonomous driving research and development. Invested in Aurora, a US-based autonomous trucking technology company.[27]

8. MG Motor India - Committed to developing Level 4 autonomous driving technology within five years. Focuses on urban mobility solutions.[28]

Implications

Here are some of the implications that we could have with self-driving vehicles.

Safety

The primary concern emphasized by experts in the field of self-driving vehicles (SDVs) revolves around safety and convenience, with a long-standing focus on these aspects by individuals, car manufacturers, and governments. The potential to enhance safety stands out as a prominent and widely acknowledged advantage of SDVs. While the conveniences offered by SDVs are somewhat intangible and primarily benefit users, safety improvements are quantifiable and extend to various road users, including drivers, pedestrians, and society as a whole. The National Highway Traffic Safety Administration's (NHTSA) 2008 Crash Causation Survey revealed that nearly ninety percent of accidents result from driver errors, encompassing distractions, excessive speed, non-compliance with traffic rules, and misjudgment of road conditions.[29] These errors, collectively referred to as the "4Ds" by car manufacturer Volvo (distraction, drowsiness, drunkenness, and driver error), are within the driver's control.[30] The prevailing viewpoint is that SDVs, devoid of these vulnerabilities, can significantly reduce or eliminate human errors in driving, thereby contributing to preventing the substantial global toll of 1.24 million deaths annually, including 200,000 deaths with 300,000 fatal injuries in India, due to car accidents as per the Ministry of

[24] Id note 20.

[25] Id note 20.

[26] Tata Motor: https://www.tatamotors.com/

[27] Mahindra & Mahindra: https://auto.mahindra.com/

[28] https://www.mgmotor.co.in/

[29] Self-driving cars: The next revolution (cargroup.org)

[30] Kockelman, Kara. 2020. "(PDF) Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations." ResearchGate. https://www.researchgate.net/publication/277025982_Preparing_a_nation_for_autonomous_vehicles_Opportunities_barriers_and_policy_recommendations.

Road Transport and Highways (MoRTH).[31] While there have been limited efforts to quantify the value of individual and societal benefits arising from accident reduction with SDVs, estimates from industry research groups like the Eno Center for Transportation Studies suggest potential cost savings ranging from "$25 billion" to over "$450 billion," contingent on factors such as technology adoption rates and key assumptions related to automation levels, technology costs, capacity benefits, injury and crash cost savings, and fuel efficiency.[32] Although the potential for increased safety with SDVs is promising, human drivers are acknowledged for their high standards of decision-making and adaptability to changing circumstances. Drivers are tasked with complex responsibilities, including object recognition, resolution of conflicting messages, diverse driving mechanics, and real-time trip planning. For SDVs to enter roadways, they must meet and surpass these rigorous standards. While the consensus is that SDVs will enhance driving safety, challenges remain, and the NHTSA emphasizes the importance of understanding how humans interact with SDV systems and the seamless integration of these systems with diverse human thought processes. Ultimately, the impact of fully autonomous SDVs on safety improvements is expected to extend beyond driver assistance to bring about substantial advancements.

Capacity

Among the commonly cited benefits by experts in the field, capacity improvements emerge as a significant advantage. While the common belief is that more lanes automatically translate to reduced traffic, this is not necessarily accurate. Enhancements in roadway capacity typically involve optimizing throughput, which refers to the maximum number of cars per hour per lane on a roadway. These improvements may extend to various capacity-related aspects, including the potential for requiring fewer lanes due to increased throughput, the possibility of narrower lanes due to the precision and control of self-driving vehicles (SDVs), and a reduction in infrastructure wear and tear owing to fewer accidents. The underlying concept is that vehicles equipped with communication capabilities can closely follow one another at reduced distances, manage and adjust speed more efficiently, execute lane changes and merges more effectively, and even benefit from drafting behind other vehicles. In terms of traffic management, SDVs have the potential to revolutionize intersection use by adopting a "reservation-based" approach facilitated by SDV and infrastructure technology, replacing the conventional system of stoplights. The anticipated increases in capacity translate into more convenient travel and a reduction in congestion, a prevalent issue that currently incurs a cost of ₹60,000 Crore or approximately $22 billion in wasted fuel and lost time for Indians, according to a study by the Transport Corporation of India, IIM (Calcutta), and the World Health Organization.[33]

Mobility and Access

The current access to car transportation is primarily limited to vehicle owners who can physically drive or individuals who can find someone else to drive for them. Although there have been supplemental transportation programs and senior shuttles in recent decades, the advent of self-driving vehicles (SDVs) holds the potential to broaden the user base of cars, especially including

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[31] "India tops the world with 11% of global death in road accidents: World Bank report." 2021. The Economic Times. https://economictimes.indiatimes.com/news/politics-and-nation/india-tops-the-world-with-11-of-global-death-in-road-accidents-world-bank-report/articleshow/80906857.cms.

[32] FAGNANT & KOCKELMAN, supra note 29,

[33] Dash, Dipak K. 2012. "India loses Rs 60,000 crore due to traffic congestion: Study | India News - Times of India." The Times of India. https://timesofindia.indiatimes.com/india/india-loses-rs-60000-crore-due-to-traffic-congestion-study/articleshow/13678560.cms?from=mdr.

those who are typically unable to drive themselves such as the elderly, disabled, and even children. This expansion could bring about benefits like increased independence and reduced travel costs for these new users. Beyond enhancing mobility for new users, it also introduces flexibility for those who traditionally served as drivers. Activities like airport or mall drop-offs may become obsolete, offering more time for individuals to be productive, active, or to rest.

Cost of Ownership

The current calculation of car ownership costs encompasses six factors: depreciation, fuel, interest, insurance, maintenance, and repair. Self-driving vehicles (SDVs) are likely to influence each of these costs in various ways, broadly categorized into changes in the ownership model and shifts in operating costs.

Ownership Model: The prevailing model of car ownership revolves around individual or family ownership, where cars serve personal transportation needs. However, a significant portion of the day sees these vehicles sitting idle in various locations. The autonomy of SDVs to navigate themselves to different destinations opens up the possibility of utilizing these idle hours for the benefit of others. This could involve reduced car ownership within a family, as the same vehicle is shared among family members, or within a community where communal ownership becomes prevalent. Car-sharing services like Uber, Ola, and Lyft have already demonstrated the feasibility of communal vehicle usage, making the transition to SDVs a natural progression. Various ownership forms could emerge, such as private entities offering rental services per mile, car-sharing cooperatives, or publicly-owned fleets. If an SDV is not individually owned, costs like depreciation, car loan interest, and taxes would be shifted to the entity owning the vehicle. The impact on these costs remains uncertain, as depreciation is influenced by factors like model appeal and durability. SDVs might depreciate at a slower rate due to increased desirability, reduced accidents, and diminished wear and tear associated with their usage.

Operating Cost: SDVs could significantly influence the operating costs of vehicles, particularly impacting car repair and maintenance expenses due to a decrease in accidents and improved vehicle operation efficiency. Overall safer vehicles could exert downward pressure on insurance prices if policies continue to be traded as they are presently. Additionally, some experts suggest a connection between more efficient driving habits facilitated by SDVs and potential fuel savings. Adhering to speed limits and adopting drafting techniques, as SDVs are capable of, may lead to reduced fuel costs. Furthermore, if SDVs contribute to lighter vehicle designs, the baseline miles per gallon could see an increase.

Land Use, Parking and City Planning

One of the primary advantages emphasized is the potential for increased productivity during commuting time. Transforming commuting hours into productive or restful time in a vehicle could alleviate the pressure for workers to reside near city centers. This shift may have significant implications for city and regional planning, influencing urban sprawl and the necessity to live in close proximity to urban hubs. Commuter trains and rapid bus routes have already enabled exurban living, and self-driving vehicles (SDVs) could further contribute to this trend. While the precise impact of this technology on urbanization trends is uncertain, there is a possibility that commuting distances may extend. On the contrary, various reports highlight the significant amount of time vehicles spend parked and the substantial portion of urban landscapes dedicated to parking spaces, lots, and ramps. If SDVs can utilize idle time or autonomously park outside city centers, the demand for parking spaces within urban areas may decrease. This reduction in parking needs could result in increased available space, potentially repurposing it for housing or commercial activities. In such a scenario, SDVs could play a role in mitigating urban sprawl and unlocking valuable land for more purposeful use, such as living spaces.

Technology Cost

Discussions surrounding the implications of self-driving vehicles (SDVs) have primarily emphasized their public and private benefits, it's crucial to acknowledge the embedded public and private costs. SDVs currently represent an expensive technology, with components like LIDAR and related adaptations costing tens of thousands for each vehicle. While there's an expectation among developers and manufacturers that technology costs will decrease with mass production, these adaptations remain an additional expense likely reflected in the purchase price of such vehicles. Moreover, when considering the combined impact of capacity, mobility, and travel behavior, there's ambiguity regarding the overall effects. While existing roadways may accommodate increased throughput with SDVs, the expanded user base and reduced travel costs could potentially offset the congestion benefits associated with increased capacity. Another potential cost involves job displacement, potentially affecting roles such as taxi drivers, parking attendants, valet parkers, car mechanics, meter attendants, traffic officers, and potentially bus and freight drivers. The transformative nature of SDVs poses both opportunities and challenges, with economic and societal implications that need careful consideration..

India’s Perspective on AI-Driven Cars

The concern is not whether India is in the position to accommodate Autonomous vehicles, but whether Indian Laws are capable of tackling the problem arising out of it i.e., liability for accidents. This research delves into the critical question: can India's existing laws handle the legal complexities of accidents involving self-driving cars? By studying its current motor vehicle framework and advancements in the UK, USA and Germany, this section aims to determine if new regulations are needed and, if so, what form they should take. By studying both, India's current framework and legal advancements in the aim to pave the way for a safe and accountable future for autonomous vehicles on Indian roads.

Legislation in the UK and Germany

In the United Kingdom, Heathrow Airport has used electric driverless pods for over a decade now. The U.K. is now working on building an autonomous vehicle-friendly environment for the public testing of these vehicles in four different cities. In 2021, it has been working on a legal proposal to allow self-driving automated lane-keeping systems up to 37 mph just after getting very mixed reactions from the experts in 2020. This would allow drivers to take back control during unplanned situations like weather-related emergencies and road constructions. The UK is one of the most developed countries in the world and also it is the most fast forward country to regulate Autonomous Vehicle or Self-Driven Cars. In 2018, the Automated and Electric Vehicles Act, 2018 was passed. Section 2(2) of the statute (iii) explicitly mentions that the owner of the vehicle will be held liable for any accident involved. The same principle applies in case of death due to an accident. Further, Section 4 of this act specifically mentions that if the autonomous vehicle is insured and the accident is caused, the liability of the owner decreases. In short, the act does not mention the liability of the manufacturer of the car and who has developed the AI system but it clearly mentions that the liability is on the owner of the car even if it's a fault of AI. This is a problem because this does not only create problems for the owner of the car but also for the administration of Justice. But in early 2022, the proposed plan of the UK of 2025 for Self-Driven

Cars mentions that the manufacturer and not the owner will be held liable for any accidents involved while driving it in self-driven mode.
Germany, In 2021 July, the Federal Act Amending the Road Traffic Act and the Compulsory Insurance Act came into effect which allows autonomous cars to operate on their own without the presence of a driver in specified areas on public roads.

Legislation in the USA

In the United States of America, Nevada was the first state in the world to allow autonomous vehicles on public roads. Nevada law defines an autonomous vehicles as a motor vehicle that uses artificial intelligence, sensors and global positioning system coordinates to drive itself without the active intervention of a human operator. The law states that the driver would not have to pay attention to the driving while the vehicle is on autopilot mode. Whereas in California, the law states that humans are supposed to be present while the autonomous vehicle is on autopilot just in case of emergencies and he/she has to take control over the car. In the U.S., 29 states have successfully enacted laws for the regulation of autonomous vehicles. In the United States of America, the NHTSA of USA released its "Federal Automated Vehicles Policy" in September 2016, which would also be updated annually. Section 2 of the guidance, the model delineates federal versus state authority. While the federal government is held responsible for setting up motor vehicle safety standards, the state remains the lead regulator when it comes to licensing, registration, traffic law enforcement, safety inspections, infrastructure and insurance and liability. Eleven states and the District of Columbia have passed legislation related to autonomous vehicles but all these vary in their scope. States in the US play a more important role than the federal for the regulation of Autonomous vehicles. The most common in a few of the states is that if the vehicle is on autopilot, then the owner may not be liable and the liability may arise on the part of the manufacturer.
The fatal Uber accident in Arizona, where the car was being driven on autopilot and at the speed of 39 mph, collided with an old woman on a bicycle aged 49. The US National Transportation Safety Board (NTSB) commented that the driver was watching a TV show on his mobile phone and his eyes were off to the road a few seconds before the incident. The NTSB found that human error was mostly to blame for the accident and the driver was held liable in the 1st appearance in the court.

What does the Current Indian Law says about autonomous vehicles? Does it allow it?
Legislations in India

The Indian Government has not reacted or made any decision regarding the Autonomous vehicle as its impact is not fully understood. For this reason alone, drones have been outlawed, and Google is not even permitted to use "street view," which allows users to view 360-degree panoramic street imagery.India, being a country, which is in the process of development is trying its best to be at par with modern technology. There is currently no explicit legislation in India to control Autonomous Vehicles or Self-Driven Cars.
At present, any instances of accidents where a motor vehicle is involved are regulated by "The Indian Penal Code, 1960" (IPC) and the "Motor Vehicle Act, 1988" (MV ACT). The operation of vehicles is regulated by the MV Act. It does not allow license or usage of Autonomous Vehicle in India. As in the question of liability for Death and Permanent Disablement, the MV Act follows the principle of 'No Fault' liability as per section 140. The owner of the vehicle is held liable for the compensation to the aggrieved party. In case of speeding or in a manner dangerous to the

public, the owner is liable for imprisonment for six months, or 2 years depending on the situation and the number of times such offence is committed as per section 184 of MV Act.

But there is another latent question whether the principle of 'No Fault Liability', according to which, the owner of the car will be held liable, should be applied to accidents involving self-driven cars? Section 144 of MV Act, 1988 prescribes the amount of compensation of Rs. 50000 for Death and Rs. 25000 for permanent disability. But in the case of Haji Zakaria v. Naoshir Cama, a very important question arose, whether the defendant can be held liable for compensation even with no rash or negligent driving involved? The Supreme Court was of the view that no liability can be imposed on the owner of the vehicle if Negligence is absent. So, if we apply this judgment to the accidents involving self-driven cars, the negligence is done by the manufacturer and not by the owner of the car. The proposed amendment for MV Act, 2016 is still pending which allows and seeks to exempt certain vehicles from the MV Act to foster research, development and innovation. As per IPC, various laws related to Rash Driving (section 279), causing death by negligence (section 304A), causing hurt (section 319) and causing grievous hurt (section 322). The SC while deciding the case The State of Arunachal Pradesh v. Ramchandra Ravidas[34] In 2019, the SC penned down the judgement and held that, both the statutes are different from each other. The IPC has a broader approach to criminal wrongdoings and MV is to maintain road safety standards, also a person can be held liable for both of them but the crucial point is that both of them do not include self-driven cars.[35]

Employment Issue of India

With large companies such as Google and Uber pushing for the development and implementation of autonomous vehicles, what does that mean for people who make a living as drivers?

India has become one of the first countries to announce the possibility of banning autonomous cars out of concerns for job losses. “We won’t allow driverless cars in India…In a country where you have unemployment, you can’t have a technology that ends up taking people’s jobs,” said Nitin Gadkari, India’s transport and highways minister.

Job displacement anxieties cast a shadow across India, as industries from fast food and banking to grocery stores prepare for the potential automation wave. This fear fuels the race among tech giants like Google, Tesla, Apple, and Ford to develop and test self-driving cars, a technology promising both job losses and effortless commutes. An estimated 4.1 million driver jobs could be at risk in coming years, with 77% of those jobs belonging to delivery and freight truck drivers in America. Other jobs at risk include bus drivers, taxi drivers, and chauffeurs. Fortunately, job automation is not approaching as soon as we believe. Drivers will have plenty of time to adjust due to factors such as high costs and regulations, as their industries fight to finance the initial expenses of autonomous vehicles, and as regulations and traffic rules struggle to keep up with new technologies.

Legal and Policy Issues/ Model Law Recommendation

From national acts on motor vehicles to liability, privacy, and insurance rules, policymakers and lawmakers will need to carefully consider and modify current laws to accommodate contemporary

[34]The State of Arunachal Pradesh v. Ramchandra Ravidas, 2019

[35] “Whether There Is A Need To Regulate Autonomous Vehicles At This Nascent Stage Of Its Development?” n.d. Legal Service India. https://www.legalserviceindia.com/legal/article-8031-whether-there-is-a-need-to-regulate-autonomous-vehicles-at-this-nascent-stage-of-its-development-.html.

issues. A fair amount has been written and continues to be written on the legal context in which SDVs will operate. These questions can become complex as the current legal system can accommodate SDVs but will need additional clarity from lawmakers or courts to address many areas of uncertainty.

1. Legalty

There appears to be an emerging agreement that SDVs are likely legal to operate in the United States, but most current state laws do not fully address the specific challenges presented. Law changes and regulatory action are most likely required to ensure the safety of SDV makers, operators, and others on the road. According to Bryant Walker Smith of Stanford Law School's Center for Internet and Society, state statutes appear to presuppose the presence of a human driver at all times, and the codes establish legislation specifying particular objects such as "following distance" with that in mind.[36]

2. Insurance and Liability

A significant area of concern revolves around the anticipated impact of self-driving vehicles (SDVs) on legal liability and insurance policies. The key questions include whether insurance will cover accidents involving SDVs, and if so, who will be held responsible - the operator, the owner, or the manufacturer? Liability rules for SDVs need to establish roles, determine fault, and set compensation for harm, mirroring current legal frameworks for non-automated vehicles. Typically, automobile accident liability cases are decided based on negligence or strict liability theories, including the application of no-fault statutes in some US states. In cases where the driver is deemed negligent, the insurance company covers the driver's negligence, and the driver may face criminal penalties. However, if a self-driving car is found to have malfunctioned, the responsibility could potentially fall under product liability principles, placing the vehicle manufacturer or the automation system manufacturer at fault. Negligence aims to assign fault based on specific case conditions and criteria defining the relationship between involved parties, while strict liability assigns fault primarily based on the existence of a violation under the law. Nevertheless, in strict liability automobile accident cases, US courts often incorporate some form of reasonableness standard, aligning them more with a negligence framework. Consequently, the legal framework governing SDVs is likely to lean towards negligence.
The theory of negligence comprises five elements: duty of care, breach of duty of care, cause of harm, physical harm, and proximate cause. For SDVs, the crucial question within this framework revolves around determining who bears the duty of care and the consequences of breaching that duty. Depending on how these questions are addressed by the courts or legislators, the liability landscape for SDVs could adopt a product liability orientation, holding manufacturers accountable, or shift liability to corporate entities providing or owning SDVs for rent. Alternatively, liability might be transferred to the operator or private owner at the time of the accident. The resolution of these legal and liability issues will significantly shape the future landscape of SDV adoption and use.

3. Operator Responsibility

The extent of automation under consideration is bound to have an impact on these legal issues. For example, in levels where the driver retains significant control of the vehicle, it is less probable that

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36 Kahneman, Daniel. n.d. "Extraneous factors in judicial decisions." Stanford Law School. https://law.stanford.edu/index.php?webauth-document=publication/330099/doc/slspublic/2012-Smith-AutomatedVehiclesAreProbablyLegalinTheUS_0.pdf.

a new legal precedent will be established. Current precedent may even apply to levels of automation in which the driver receives warnings and is expected to take over if the SDV system needs to be disengaged, however whether a human "fail safe" may be realistically expected is debatable. However, full automation opens the door to operators who are not physically capable of driving. Responsibility, negligence, and accountability may be less evident in such instances.

4. Data Privacy and National Security

A lot of data is generated in our 21st century interconnected, internet-enabled, media and information-rich lives. A critical commercial and policy topic throughout the world is "big data," or very huge data sets generated by the content and information shared via the use of technology in a variety of businesses. The sleek promise of self-driving vehicles (SDVs) hums with a double-edged potential: revolutionizing convenience while unleashing a “data flood”. Every sensor and camera churns out information, weaving a detailed view of your travel habits, including information on GPS location, routes, speed, traffic, weather conditions, road conditions, information about other road users around the operator, and even glimpses into your personal life. How to protect or use that data is an open question being debated. This data treasure trove, alluring for personalized ads and targeted manipulation, demands stringent regulations and ethical data practices. Imagine insurance premiums soaring based on a late-night drive recorded by your SDV – a chilling preview of a privacy nightmare woven into the fabric of this technology. Policymakers must measure the expenses of protecting manufacturers and business owners against the advantages to operators or individuals as they examine how to add privacy safeguards for SDV data obligations. Policymakers may examine options such as limiting secondary usage of SDV data or establishing time restrictions for data preservation. Until politicians intervene, **industry-provided privacy and information protection will be the default**. A possible option would be to provide consumers with privacy rules that include opt-in methods or information about how data would be collected and utilized.

But the dangers stretch further than individual privacy. **National security** shivers at the thought of compromised navigation systems transforming SDVs into weaponized pawns. This threat, multifaceted and insidious, demands immediate attention before our autonomous future becomes a foreseen nightmare. At the heart of the issue lies vulnerability, SDVs, intricately woven with complex software and sensor networks, are ripe targets for cyberattacks. Imagine malicious actors infiltrating navigation systems, transforming these once-convenient vessels into weapons wreaking havoc on military convoys or critical infrastructure. The potential for coordinated attacks, with weaponized SDVs detonating in vulnerable locations, paints a terrifying picture of national vulnerability.Foreign adversaries could exploit it to track troop movements, identify weaknesses in critical infrastructure, or launch targeted disinformation campaigns. The chilling implications extend beyond military applications; personal information gleaned from SDVs could be used for identity theft, blackmail, or even social manipulation, effectively rendering citizens vulnerable within their own vehicles. Further aggravating this precarious landscape is the dependence on foreign technology. Many SDV components and software originate from outside our borders, creating a critical dependency that leaves us vulnerable to supply chain disruptions. Imagine hostile nations crippling our SDV development by restricting access to vital components, compromising national mobility and jeopardising military logistics. Moreover, this dependence could fuel an autonomous arms race, where adversaries leverage their own SDV advancements for military aggression, leading to a terrifying future of robot versus robot warfare. To navigate this treacherous landscape, a multi-pronged approach is crucial. Robust cybersecurity measures, encompassing penetration testing and vulnerability patching, are vital to shield SDVs from malicious actors. Data privacy regulations, empowering citizens and safeguarding sensitive information, must be implemented with rigor. Investment in domestic SDV research and development is paramount, fostering self-sufficiency and mitigating vulnerability to foreign control. Collaboration with allies on international SDV standards can further create a secure and responsible environment for technological advancement. Ignoring these threats is tantamount to inviting a Trojan horse into our critical infrastructure. By proactively addressing these vulnerabilities, we can harness the transformative potential of SDVs while simultaneously safeguarding the nation's security interests.

5. Regulator Oversight

As previously stated, the National Highway Traffic Safety Administration issued a policy statement explaining its definition of SDVs and related technology, its thoughts on the consequences for highway safety, and recommendations for state policymakers. The NHTSA advised state politicians to exclusively create laws governing testing within their own states. The policy statement's considerations are explored more below, and they essentially encompass who should be deemed a qualified operator, where vehicle testing should be permitted, and the key components of a safe SDV.

1. "Ensure that the Driver Understands How to Operate a Self-Driving Vehicle Safely" through a driver licensing program.
2. "Ensure that On-road Testing of Self-driving Vehicles Minimises Risks to Other Road Users." This includes certifying that "the vehicle has already operated for a certain number of kilometres in a self-driving mode without incident" before testing "the vehicle on public roads."
3. "Limit Testing Operations to Roadway, Traffic and Environmental Conditions Suitable for the Capabilities of the Tested Self-Driving Vehicles." We encourage regulators to "consider appropriate limitations on the conditions in which a vehicle may be operated in self-driving mode."
4. "Establish Reporting Requirements to Monitor the Performance of Self-Driving Technology during Testing."
5. "Ensure that the Process for Transitioning from Self Driving Mode to Driver Control is Safe, Simple and Timely."
6. Ensure that test vehicles have the capability to detect, record, and inform the driver that the automated systems have malfunctioned.
7. "Ensure that Installation and Operation of any Self Driving Vehicle Technologies Does not Disable any Federally Required Safety Features or Systems." Federal law prohibits "making inoperative any federally required safety system" and the "installation of self-driving technologies should not degrade the performance of any of those federally required systems or the overall safety of the vehicle."
8. "Ensure that Self-Driving Vehicles Record Information about the Status of the Automated Control Technologies in the Event of a Crash or Loss of Vehicle Control."[37] Furthermore, the NHTSA has lately indicated the directions of its research and its attention in the subject of vehicle automation. NHTSA may have sought to focus on short-term safety objectives in this action, or it may have wished to leave manufacturers and developers to focus on SDV technology, or it may

[37] https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/automated_vehicles_policy.pdf.

not believe SDVs are feasible enough at this time to warrant its efforts. Whatever the goal, only time will tell if the correct option was made in this policy decision.

7. Penalties and Enforcement

In formulating legal policies for penalties and enforcement related to Autonomous AI-driven vehicles (AAVs) in India, it is imperative to establish a robust regulatory framework that ensures safety and compliance. Penalties for violations should be clearly defined, taking into account the severity of infractions. Potential penalties might include fines, suspension of testing permits, or even criminal charges for reckless behaviour resulting in harm. Additionally, a tiered approach to penalties, considering factors such as the size of the manufacturer and the degree of non-compliance, could be instituted to promote fairness. Enforcement mechanisms should involve a collaboration between relevant government agencies, law enforcement, and technology experts to effectively monitor AAV operations. Regular audits and inspections, coupled with advanced tracking technologies, can contribute to ensuring compliance with established regulations. Public awareness campaigns on the legal consequences of violations can also play a crucial role. Establishing a clear reporting mechanism for incidents involving AAVs and a responsive dispute resolution process would further enhance the effectiveness of enforcement. Collaborative efforts with international regulatory bodies can facilitate the exchange of best practices and contribute to the development of a comprehensive and globally aligned regulatory framework for AAVs in India.

8. Other Policymaking

Other policy areas that might need to be addressed for SDVs in India include environmental regulations, transportation planning, and zoning. India does not currently have stringent emissions rules for all vehicles on its roadways, although plans for tighter standards like Bharat Stage VI (BS-VI) exist. As a result, the implications for SDVs on the emissions front are still complex and evolving. However, India has set clean energy goals in the past, including promoting electric vehicles, which could pave the way for the adoption of clean SDVs. SDVs may help to achieve this goal to the extent that they allow for more efficient use of fossil fuels. Transportation planning and management are critical policy areas for SDVs, and many of the technology's benefits accrue in this area. India's Ministry of Road Transport and Highways (MoRTH) policies and guidelines, like the National Road Safety Policy and National Highways Development Project (NHDP), echo certain potential benefits of SDVs, including minimizing road fatalities and injuries, ensuring 'reasonable travel times,' maintaining infrastructure, promoting low-emission vehicles, and curbing greenhouse gas emissions. While embracing self-driving vehicles (SDVs) could help India achieve clean energy goals by reducing pollution, proactive planning is crucial. Incorporating SDVs into India's National Highways Development Project can improve future transportation predictions, but initial occupancy due to cautious driving may need to be factored in. Freed-up parking spaces from driverless cars could be repurposed for parks and amenities, aligning with India's Smart Cities Mission. Similar to transit-oriented development, cities could plan infrastructure around dedicated SDV lanes, improving efficiency and access. Beyond traffic regulations, SDVs have wider implications: new jobs in manufacturing and data analysis could emerge, while traditional driving jobs may decline, requiring reskilling programs. Importantly, SDVs could provide accessible transportation for the disabled and those in remote areas, furthering social inclusion. However, extensive data collection raises concerns about privacy and security, necessitating robust regulations and ethical frameworks. Overall, SDVs present both challenges and opportunities for India's future. Proactive planning, policy updates, and social considerations are key to unlocking their potential for a cleaner, safer, and more equitable transportation landscape. Policymakers will need to amend or adopt policies to address and impact these broad consequences as technology improves, testing becomes more prevalent, and models become available for consumer use.

Conclusion

AI is taking hold of this world in every sphere whether it be transport, services, agriculture, healthcare, etc. The increase in the use of self-driven cars shows that very soon, the use of such cars will become a norm. The USA and UK have many legislations related to Autonomous Vehicles as compared to India where there are no legal provisions for such vehicles so Indian lawmakers have to amend the MV Act, 1988, the Consumer Protection Act, 1986 and the IPC, 1960 for regulation and liability of Autonomous Vehicles or they have to make new laws for Autonomous Vehicles in India. In order to investigate the problem in the case of India, it is required to address the relevant laws. To accommodate Autonomous Vehicles in India, Indian laws must be stringent in cases of accidents using Autonomous Vehicles and the subject of liability deriving from such accidents, taking into account varied laws passed by other countries. Overall SDVs are needed in this country and the whole world should adapt as their perks are larger than their cons.

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