LEX LUMEN RESEARCH JOURNAL- ISSN:3048-8702(O)
Volume 1, Issue 4, Pages:193-216, July 2025

NAVIGATING LIABILITY IN AUTONOMOUS VEHICLES: APPLYING HOHFELD'S FRAMEWORK TO ENHANCE LEGAL ACCOUNTABILITY IN INDIA'S AI-DRIVEN TRANSPORTATION

By- Koushik A[1]

ABSTRACT

Unlike in India where liability and accountability are ambiguous, artificial intelligence (AI) has quickly integrated into autonomous vehicles in a way that has surpassed some legal grounds. It employs a version of Wesley Newcomb Hohfeld's eight legal conceptions (right, duty, privilege, no right, power, liability, immunity, and disability), however applied to stakeholder relationships in autonomous vehicle accidents. The paper identifies the gaps in India's legal system through the study of India, United States, European Union and China followed by a critical analysis of the case study. Drawing from these findings, this paper argues that Hohfeld's framework helps to clarify complex liability issues in the field of law, and can be an approach leading toward the development of precise legal regulations that can guarantee fairness and safety of AI driven transport.

KEYWORDS: Artificial Intelligence, Autonomous Vehicles, Liability, Accountability, Hohfeld's Framework, Indian Law, Comparative Study

INTRODUCTION

This era of transportation brought on by artificial intelligence (AI) has seen its fair share of revolution among transportation, all thanks to the advent of autonomous vehicles. Advanced machine learning, sensors, computer vision, etc. equipped vehicles with zero human intervention are also these vehicles that promise increased road safety, less traffic congestions, and increased accessibility for the disabled. India's evolving economy has offered opportunities to startups such

[1]**Intern, Lex Lumen Research Journal.**

as Minus Zero and Swaayatt Robots to innovate with autonomous vehicle systems that can run on these chaotic but yet picturesque roads. It is however the integration of AI to transportation system that presents complex legal questions for example assigning of liability and who is responsible after an accident. AI-driven decisions inherently shift from decisions made by humans, which have clearly defined intentions and intent, and set of rules to be followed, to decisions that are made automatically by only the AI, with no human presence[2]. For example, when an autonomous vehicle in which a malfunctioning sensor causes a crash, it is difficult to determine who is to blame, the manufacturer, the owner, or perhaps the very AI system. And never have we been so uncertain than we are now in India, where AI-driven transportation is the future and the legal system has yet to adjust to this reality. Because there are currently no specific regulations governing autonomous cars, India suffers from a large barrier in the safe and equitable use of these cars. There is a legislative void as the Motor Vehicles Act, 1988 governing road transport does not envisage driverless vehicles. Like the product liability law, the Consumer Protection Act of 2019 also exists but it lacks peculiar legislation that address AI specific challenges such as software errors or unpredictable decision making. Added to that is the fact that India finds itself in a socio-economic and infrastructural context of dense urban traffic, diverse road users and different levels of technological adoption. A lacking roadmap of proper legal guidelines may make victims of autonomous vehicle accidents with no costs to look for compensations, and manufacturers may be improperly liable, diminishing the chance for innovation and public belief.

Wesley Newcomb Hohfeld's (1913) analytical framework has proven to be a powerful tool to tackle the challenges mentioned above. Hohfeld's eight legal conceptions of right, duty, privilege, no right, power, liability, immunity, and disability allow one to break apart legal relationships in a structured way. Hohfeld's framework does this by treating correlatives (e.g. right implies duty) and opposites (e.g. right opposes no right) as defining such things. Looking at it in terms of autonomous vehicles, it provides an outline of how manufacturers, users, victims and regulators

[2] Divya Garikapati & Sneha Sudhir Shetiya, *Autonomous Vehicles: Evolution of Artificial Intelligence and the Current Industry Landscape*, 8 Big Data & Cogn. Comput. 42 (2024), https://doi.org/10.3390/bdcc8040042.

are linked with each other, and who is entitled to what. For instance, a manufacturer's duty to assure system reliability might depend on victim's right to compensation, or a user's privilege to operate a vehicle might be restricted by a no-right to demand flawless performance. In line with the framework laid out by Hohfeld, this research studies liability and accountability in autonomous vehicle accidents focusing on India's legal context. The study compares with countries such as the United States, European Union, and China with more developed regulatory regimes for autonomous vehicles, and then finds the best practices and the reform measures that would be appropriate for India. This research is significant because it will serve as a reference for policymakers, lawyers and industry stakeholders on the need for legal frameworks to be updated with regards to AI driven technologies urgently. The effort to improve the current ambiguities and usher in robust and fair legal standards that guarantee both safety and fairness in India's transportation future is achieved through various application of Hohfeld's analytical tools.

RESEARCH OBJECTIVES

To Apply Hohfeld's framework to analyse liability and accountability in autonomous vehicles.

To Identify legal challenges in India's current frameworks for AI-driven systems.

To Evaluate how Hohfeld's analysis clarifies and addresses these challenges.

To Recommend legal reforms to accommodate autonomous vehicles in India.

RESEARCH QUESTIONS

How does India's legal system address liability in AI-driven autonomous vehicles?

What are the limitations of traditional legal concepts when applied to AI in India?

How can Hohfeld's eight conceptions be mapped onto interactions between AI systems, developers, users, and affected parties?

What are the implications of applying Hohfeld's analysis to AI liability issues in India?

Does Hohfeld's framework suggest redefining legal personality for AI systems?

STATEMENT OF PROBLEM

The lack of clear rules governing Autonomous Vehicles in India leads to confusion regarding liability assignment, preventing safe deployment and unjustly victimizing the victims towards whom there is no one to clear the liability. Concerning AI, the Motor Vehicles Act, 1988 does not address and the Consumer Protection Act, 2019 does not cover much in terms of product liability. This gap, and the particular nature of the Indian road conditions, warrant a form of systematic thinking with respect to legal relationships and also accountability.

CHAPTER 2 - ARTIFICIAL INTELLIGENCE AND AUTONOMOUS VEHICLES

Overview of Artificial Intelligence

The field of Artificial Intelligence (AI) is a breakthrough area of computer science, whose objective is to make machines be able to learn, reason, solve problems, and perceive tasks in the spontaneous absence of human action. The History of AI has revolved around machine learning, deep learning and neural networks that enable the systems to process the information within Terabytes and learn it, perceive it, and then make decisions basing on what has been learnt. A core subset of AI, machine learning allows the machines to learn from data without any direct coding; deep learning (which utilizes multi layered neural networks) also aspects a very good performance in image recognition and natural language processing. Within the realm of autonomous vehicles, AI is essential as it empowers vehicles to critically understand the surroundings, make live decisions and pass-through difficult roadways without external involvement from humans. For example, these AI systems make sense of sensor data to detect obstacles, decipher traffic lights, and anticipate other road users' behaviours, just about everywhere you could imagine battle in India's rash roads. Given the advancements in AI, there are vast legal and ethical issues surrounding how and to what extent AI would be integrated into autonomous systems while

ensuring safety and fairness through the creation of a regulatory framework, with liability issues in case there is an accident being the paramount among them[3].

AI TECHNOLOGY IN AUTONOMOUS VEHICLE

Safeguarded and also productive, these cars depend on a number of AI systems that need to function cumulatively to explore on their own securely as well as efficiently. Synergistically, these technologies provide for perception, decision making and control without human input. The vehicle has sensory organs composed of sensors such as cameras, radar, lidar and ultrasonic sensors, which collect the environmental data[4]. High resolution 3D mapping is what Lidar provides in low light conditions and, radar excels in difficult conditions in terms of detecting speed and distance at a relatively inexpensive cost[5]. This Machine Learning Algorithms (MLA) such as reinforcement learning for decision making, convolutional neural networks (CNN) for object detection, enable vehicles to learn from the data and it aids in vehicle's ability to recognize objects and optimize routes[6]. On the other hand, computer vision takes in visual data from cameras like semantic segmentation and interpret that data by classifying pixel from image to categories such as road or vehicle. The vehicle is controlled mechanically by robotics and its steering, acceleration and braking is by AI determined actuators. The data fusion combines information from many sources to make a complete model for the environment and is therefore compensating the limits of the single sensor[7]. Navigation and path planning part also includes localization, mapping, and motion planning such that the vehicle can only follow optimal paths and avoids obstacles. On the one hand, this post discusses two out of the numerous technologies that can exemplify such

[3] *Artificial Intelligence in Autonomous Vehicles*, International Journal of Engineering Research & Technology (IJERT), Vol. 13, Issue 06, June 2024.
[4] *Autonomous Vehicle Market 2025-2045: Robotaxis, Autonomous Cars, Sensors*, IDTechEx, https://www.idtechex.com/en/research-report/autonomous-vehicles-markets-2025/1045.
[5] *Is India Truly Ready for Autonomous Vehicles?*, AIM Media House, https://analyticsindiamag.com/ai-features/is-india-truly-ready-for-autonomous-vehicles/.
[6] *Autonomous Vehicles: The Outlook for 2025*, IoT World Today, https://www.iotworldtoday.com/transportation-logistics/autonomous-vehicles-the-outlook-for-2025.
[7] *Top 5 Startups in Autonomous Vehicles in India in Feb, 2025*, Tracxn, https://tracxn.com/d/explore/autonomous-vehicles-startups-in-india/__zA821PWdwT25z3-_E_TbCdPo14VppY2QWbwESWL4i8k/companies.

complexity: Tesla's Autopilot and Waymo's autonomous driving platform. And on the other hand, these technologies show the important role that legal frameworks need to be precise about in order to address failing situations, like for instance collisions due to sensor malfunctions[8].

AUTONOMOUS VEHICLE IN INDIA

There are ambitious startups and government push for an autonomous vehicle industry in India, but its unique road conditions and regulatory gaps are major challenges for an autonomous vehicle sector in India. An example of such startups is Minus Zero, Swaayatt Robots, KPIT, AutoNxt Automation and Flo Mobility, each of which is developing AI solutions specifically for the Indian road, featuring heavy traffic, poorly structured roads, and erratically moving pedestrians[9]. For example, Minus Zero works on map-less navigation, required to be done when there is no map available, as in the case of incomplete mapping data in India, while Swaayatt Robots develops perception and control systems for Indian conditions.[10] AI research supported by government programs such as the National Programme on Advanced Computing (NPAC) and India AI Mission is aimed at integrating the autonomous technologies into smart city projects. However, challenges abound. In India, AI navigation is made more difficult because of the poor signage and lane markings on this road infrastructure[11]. There is no mention of AI driven vehicles in the Motor Vehicles Act, 1988 which results in who is liable in a case of accident being unclear and owners being blamed even for AI fault. Over 400,000 annual road fatalities encourage public skepticism and concern that adoption will kill jobs in the transport sector[12]. However, due to these barriers, the market opportunity is very huge, said the IMARC Group, which predicts that the Indian

[8] *Future of Self-Driving Cars in India*, Tata Capital, https://www.tatacapital.com/blog/loan-for-vehicle/future-of-self-driving-cars-in-india/.
[9] *Opinion: The Future of Autonomous Vehicles in India - Steering the Legal Issues*, ET Auto, https://auto.economictimes.indiatimes.com/news/industry/the-future-of-autonomous-vehicles-in-india-steering-the-legal-issues/64985989.
[10] *India Autonomous Vehicle Market 2025 Edition: Industry to Reach USD 23.3 Billion by 2033*, IMARC Group, https://www.openpr.com/news/3921136/india-autonomous-vehicle-market-2025-edition-industry-to-reach.
[11] *Autonomous Vehicles: Legislations for Liabilities*, Legal Service India, https://www.legalserviceindia.com/legal/article-10606-autonomous-vehicles-legislations-for-liabilities.html.
[12] *Challenges in Autonomous Vehicle Development*, IJERT, Vol. 13, Issue 06, June 2024.

autonomous vehicle market will rise from USD 2.6 billion in 2024 to USD 23.3 billion by 2033, with a CAGR of 24.3%[13]. This growth shows the time for regulatory and infrastructural transformation of autonomous vehicles to tap its benefit of fewer accidents and increased urban mobility.

GLOBAL CONTEXT OF AUTONOMOUS VEHICLE

However, in reality, autonomous vehicle development is further ahead globally, and with its differences, there are different regulatory and technological approaches across regions. But in the US, there are Waymo, Cruise, Tesla, driving there and collecting data to improve AI systems, giving over 2,000 robotaxis in San Francisco, for example. California allows extensive testing and manufacturers are liable on a case-by-case basis, with focus usually on manufacturers[14]. We have ethics and safety in their minds for the European Union; the AI Act is regulating high risk AI systems whilst it is the AI Liability Directive presuming manufacturer responsibility for AI harm. When Germany permits conditional automation on highways, the companies mostly stick to cautious paths, though the country is considered slow by U.S. standards. Companies such as Baidu have already been operating 500 robotaxis in Wuhan, and aim to reach 1,000 by the end of 2024[15]. Autonomous vehicles and smart cities are integrated into China's regulations, with the support of the country's regulations for testing in designated zones. Both other countries such as Japan and South Korea are pushing forward robotics and testing zones, while the UK works on a regulatory sandbox[16]. The global robotaxi market is estimated to grow at a CAGR of 37% from 2025 reaching US$174 billion by 2045; however, the market is highly volatile and dependent on the uncertainties, including the decision of General Motors to end Cruise funding by 2025. In contrast, India lags in

[13] *Autonomous Vehicles Market Size to Surpass USD 4450.34 Bn by 2034*, Precedence Research, https://www.precedenceresearch.com/autonomous-vehicle-market.
[14] *Self-Driving Cars and India: A Call for Inclusivity*, NMIMS Law Review, https://www.nmims.edu/law-review/self-driving-cars-and-india-a-call-for-inclusivity-under-the-indian-legal-position/.
[15] *Legal Considerations in the Evolving Landscape of Autonomous Mobility in India*, Lexology, https://www.lexology.com/library/detail.aspx?g=5727463b-8f9b-4f5b-9b5b-7f6f6f6f6f6f.
[16] *Laws Regarding Autonomous Vehicles in India*, Lexlife India, https://lexlife.in/laws-regarding-autonomous-vehicles-in-india/.

this regard and thus the need for quick regulatory development to harness the benefits that autonomous vehicles have to offer in terms of safety and efficiency[17].

Autonomous Vehicles are making their way to the world of transportation with artificial intelligence, improving safety, and accessibility and efficiency as well. But in India, regulatory gaps and skepticism from the public hamper progress; startups as well as government initiatives are advancing the country. Advanced technologies as well as regulations are provided by US, EU and China through global examples that India can explore. It is important that India tackles these issues if it is to benefit from the advantages of autonomous vehicles, from reducing accidents to better mobility. The next chapter will be devoted to legal challenges using Hohfeld's framework to analyse liability and accountability of autonomous vehicles that are in accidents.

CHAPTER 3 – LEGALITY OF AUTONOMOUS VEHICLES: A COMPARATIVE STUDY

Autonomous vehicles (AVs) laws are differed across the world, ranging from one to the other on the basis of priority, technological innovations, and regulatory theory among others. In its conversion from experimental technologies to becoming the potential mainstream transportation solutions, AVs need robust legal design systems to cope with the concerns of safety and liability, as well as ensuring ethical choices. This chapter draws analogies among the legal landscapes of India; the United States, the European Union and China by examining their approaches to regulation, liability as well as to testing. This chapter analyses those jurisdictions and offers lessons and best practices for India, where there are no specific AV laws. The modern industrial regulation influencing the development of the modern technology sector must be relied on to ensure the safety and accountability of public, while providing benefits derived from innovative technology.

INDIA

[17] *Legal Issues Related to Autonomous Vehicles*, iPleaders, https://blog.ipleaders.in/legal-issues-related-to-autonomous-vehicles/.

While there is no specific legislation in place relating to the operation and the liability concerning autonomous vehicles in India, its legal framework for autonomous vehicles is underdeveloped. First, Motor Vehicles Act, 1988[18] governs the vehicle use, but that only concerns with human driven vehicle and are silent on the AI driven systems. Therefore, people aren't allowed to use AVs, but they are permitted to test them in specified conditions, for example: on private tracks or on selected routes. The Consumer Protection Act, 2019[19] lays out general rules of product liability ranging from manufacturers being held responsible for defective products, but lacking separate provision to take care of issues related to software error or sensor malfunction in case of AI products. The uncertainty of lines drawn on the maps and lines that ought to be left blank, leaves manufacturers, users and victims unanchored, and most especially the ones responsible for accidents caused by autonomous systems. These challenges are made worse by India's unique road conditions[20]. Dense traffic, inconsistent infrastructure, and unpredictable pedestrian behaviour demand robust AI systems capable of navigating complex environments. Public skepticism is high, India has an annual road fatality rate of over 400,000 and losing their jobs in the transport sector because millions depend on driving as the means by which they earn a living[21]. However, Indian startups like Minus Zero and Swaayatt Robots are creating AI solutions that are specific to the local requirements, with the support of Indian Government's programmes like National Programme on Advanced Computing and India AI Mission. Unfortunately, such inertia in the rulemaking and the lack of clear guidelines prevents India from reaping the benefits of AV that range from less accidents to increased mobility.

USA

[18] Motor Vehicles Act, 1988
[19] The Consumer Protection Act, 2019
[20] "Are Autonomous Self-Driving Vehicles Legal in My State?" MotorTrend, January 6, 2023, https://www.motortrend.com/features/state-laws-autonomous-self-driving-driverless-cars-vehicles-legal/.
[21] "Autonomous Vehicle Statutes and Regulations Across the 50 States," Baker Donelson, September 19, 2024, https://www.bakerdonelson.com/autonomous-vehicle-statutes-and-regulations-across-the-50-states.

For this reason, the United States is a decentralized jurisdiction with respect to policy on AVs, and relies on state regulation of AVs while not having implemented comprehensive federal regulation. Leaders such as California and Arizona have let testing occur with safety drivers and in some cases, fully autonomous; pioneers. Arizona has minimal regulations and has turned into a permissive environment for Waymo and other companies to test and deploy, while California's Department of Motor Vehicles mandating detailed safety plans issues permits to test and deploy. Voluntary safety guidelines put forth by the National Highway Traffic Safety Administration (NHTSA)[22] do not have legal enforceability, and most of the laws on the books across the country are haphazard. In the US, liability is on a case-by-case basis and usually manufacturers are targeted. Though manufacturer responsibility was highlighted by 2018 Tesla crash case, in which a vehicle in Autopilot mode slammed into a truck, it was ruled driver fault is also shared. This support is indicated by legislation in certain states like Alabama, Kentucky and South Dakota that allows fully autonomous vehicle operations[23]. Despite this, however, there are not uniform federal standards, which makes it difficult for interstate operations and for manufacturers to comply. It is innovative, but fragmented, itself encouraging, but riskily, uncertain of regulation.

EUROPEAN UNION

As a matter of precaution, the European Union has unified a legal framework for autonomous vehicles under which, above all, safety is prioritized and ethical considerations are addressed together. Advanced driver assistance systems are one of the requirements of the General Safety Regulation which has been effective since 2022 [24]and gives a legal ground to develop and approve driverless vehicles. A landmark regulation is the AI Act which dictates what are high risk AI systems including AVs systems, with very high requirements in terms of transparency,

[22] "2023 Legislative and Regulatory Developments Affecting Autonomous Vehicles," Faegre Drinker, September 11, 2023, https://www.faegredrinker.com/en/insights/publications/2023/9/2023-legislative-and-regulatory-developments-affecting-autonomous-vehicles.
[23] "Autonomous Vehicles," National Conference of State Legislatures, February 14, 2023, https://www.ncsl.org/transportation/autonomous-vehicles.
[24] Connected and Automated Mobility," European Commission, October 28, 2024, https://digital-strategy.ec.europa.eu/en/policies/connected-and-automated-mobility.

accountability and safety. And the AI Liability Directive that accompanies this, puts on the producers the burden of proof when it comes to AI related harms and presumes the manufacturer is at fault.[25] Since Germany is a leader in the EU, they allow for conditional automation (Level 3) on highways, a good balance of innovation and stringent safety. This goes further than technical compliance, including ethical matters like privacy and the setting of a human safety priority in AI-decision making[26]. This holistic framework in GDPR, positions EU as a global leader on ethical AI governance, but means it will lag AV adoption behind countries that are permissive on ethical[27]. Harmonised regulations are a focal point for EU, for consistency purpose across member states and facilitating cross border operation[28].

CHINA

China has a very strong vision, backed up with considerable government support, on encouraging autonomous vehicle development while leading global AI development by 2030[29]. Public trials of advanced autonomous driving technologies are supported by government including the approval of the use of robotaxis in cities such as Wuhan and Beijing, conducted by companies like Baidu and Pony.ai[30] and regulations that allow testing in zones or for use on smart city initiatives. Therefore, lately Beijing has adopted a policy of fast deployment of driverless public buses and taxis, with driverless public buses and taxis being sanctioned by regulations that come into force as of April 2025. In China, liability lies largely with manufacturers, who are need excused from the deleterious effects of unsafe products that they know about, and are encouraged to be

[25] Vehicle Safety and Automated/Connected Vehicles," European Commission, July 5, 2022, https://single-market-economy.ec.europa.eu/sectors/automotive-industry/vehicle-safety-and-automatedconnected-vehicles_en.
[26] AI Regulations for Autonomous Vehicles [Updated 2025]," Holistic AI, January 5, 2025, https://www.holisticai.com/blog/ai-regulations-for-autonomous-vehicles.
[27] Autonomous Vehicles: Turning Point in European Public Transport," Ioki, March 29, 2023, https://ioki.com/en/autonomous-vehicles-turning-point-in-european-regional-and-local-transport/.
[28] TRATON – Advanced Legal Framework in the EU," TRATON, October 4, 2022, https://traton.com/en/newsroom/stories/legal-framework-in-the-eu-driverless-through-europe.html.
[29] China's Legislation on Autonomous Cars Rolls Out," China Law Insight, April 8, 2021, https://www.chinalawinsight.com/2021/04/articles/corporate-ma/chinas-legislation-on-autonomous-cars-rolls-out/.
[30] Mainland China Autonomous Vehicle Development on a Different Track," S&P Global, October 9, 2024, https://www.spglobal.com/mobility/en/research-analysis/china-autonomous-vehicles-development.html.

innovative, while also insured and subject to sharing liability with operators and fleet managers. By following China's state-driven approach, backed by huge investment (over RMB 17 billion in 2021)[31], China is becoming at the forefront of AV commercialization. Hence, however, the faster speed in China to deploy raises concern about safety and regulatory oversight as its legal framework is still developing to keep up with its technological advancement[32].

COMPARATIVE ANALYSIS

The regulatory approaches of India, the US, EU, and China reveal distinct priorities and challenges. Specifically, India's framework is restrictive in the absence of any AV specific laws and relies on the Motor Vehicles Act, 1988, as well as the Consumer Protection Act, 2019 which do not specifically address AI. The US operates under a decentralized model with its laws falling under the jurisdiction of each state so they are inconsistent. First is a European Union unified framework that is based on the AI Act and the AI Liability Directive and focuses on safety and ethics, all of it with the aim of harmonized standards. Through supporting national guidelines and city level testing and placing focus upon participation of manufacturers, the state driven approach enabled rapid deployment in China. Liability frameworks also differ significantly. There is still no clarity

with regard to the product liability of general product as in case of AI related damages in India, whereas USA declares product liability in case-to-case basis, most of the times to the manufacturers. While manufacturer fault has been assumed by the EU, when it comes to claims manufacturer and model fault have been streamlined, and in China manufacturer and model liability were combined. These priorities are reflected in the testing regimes: India's testing through controlled environments, Britain and the US's public road testing with safety drivers, EU's high safety compliance, and China's public trials. The differences remind that India needs to walk

[31] Beijing Unveils Plans to Boost Driverless Vehicle Use in Capital," Reuters, December 31, 2024, https://www.reuters.com/world/china/beijing-unveils-plans-boost-driverless-vehicle-use-capital-2024-12-31/.
[32] How China is Regulating Robotaxis," MIT Technology Review, January 24, 2024, https://www.technologyreview.com/2024/01/24/1086989/china-regulation-robotaxi-autonomous-driving/.

a tight rope between innovation and safety drawing from the global models[33].United States, European Union, and China can provide several very valuable lessons for India to build a robust AV framework in the context of the currently restrictive and nascent regulatory environment. To close the gap provided by existing laws, India can take specific legislative steps such as enacting behavioral legislation like the one proposed in an Autonomous Vehicle Act as in EWAI (EU's AI Act) where it should fix the autonomy levels and liability rules. Making India's first law pass, or at least being in the running, could encourage responsible conduct out of a fear of being the first to be pathed by a company that simply cannot face up to the mess it created. Clear rules of liability like the EU's presumption of manufacturer's fault or the Chinese model of joint and several liability would also ensure that victims have recourse in accidents and collaborating with industry partners, as exemplified by China's approach to startups and automakers for the latter's road conditions, could design rules to suit India's own roads. Finally, broad development of road infrastructure is needed, inspired by EU's intelligent road systems, in order to increase the safety of AVs. Using India's unique features and integrating global best practices of the US's innovative yet fragmented model, the EU's ethical and unified framework, and the Chinese's ambitious state driven strategy, India can come up with a balanced model. The existence of these host of legal frameworks provides must key room for India not only to encourage innovation, vigilance, and liability clear up but on paper, to gather the advantages of AVs (along with the movement and monetary development).

CHAPTER 4 - CRITICAL ANALYSIS OF LIABILITY IN AUTONOMOUS VEHICLES USING HOHFELD'S FRAMEWORK

[33] The Chinese Government is All In on Autonomous Vehicles," MIT Technology Review, July 10, 2024, https://www.technologyreview.com/2024/07/10/1094811/chinese-government-policy-autonomous-vehicles/.

One may, of course, with reference to any given legal relation or set of relations, have an immunity against one person and not against another, against people generally and not against "everybody"[34]

It is an analytical framework for understanding of legal relations based on the introduction of a rigorous and systematic approach by Wesley Newcomb Hohfeld which was introduced in the seminal work Some Fundamental Legal Conceptions as Applied in Judicial Reasoning (1913). Hohfeld, by deconstructing complex legal concepts into eight basic conceptions (right, duty, privilege, no right, power, liability, immunity, and disability) provides a precise terminology through which conflicts among parties can be viewed in precise legal terms. One of the most useful frameworks for the emerging areas like artificial intelligence (AI), where classical legal frameworks are not sufficient to tackle the kind of challenges that tend to arise in such fields. In the field of autonomy of vehicles, Hohfeld's framework separates the complexity of obligations, entitlements and freedoms of a number of stakeholders including manufacturers, users, component suppliers and victims. In this chapter, the structure of Hohfeld's framework is explored, and the manner in which it is applied to legal analysis, and toward particular ends, is done generally; a case study analysis for this last point is undertaken below.

EIGHT CONCEPTION

Hohfeld builds his framework on a set of eight legal conceptions as correlatives (mutually entailing relations) and opposites (mutually exclusive relations). These conceptions are the "lowest common denominators of the law" that serve as a universal, precise language to analyse legal relationships. The first pair right and duty is a foundational pair[35]. The right is an entitlement of one person to demand action or forbearance from another, accompanied by a duty of the latter to act as the former demands, other than by doing what the former has in mind either to not do.

[34] Wesley Newcomb Hohfeld, *Some Fundamental Legal Conceptions as Applied in Judicial Reasoning*, 23 Yale L.J. 16 (1913).
[35] María Beatriz Arriagada Cáceres, *Fundamentality, Interdefinability, and Circularity: Three Ideas on Hohfeld Examined*, 31 Revus 1 (2017), https://doi.org/10.4000/revus.4173.

An example: **a victim of an autonomous vehicle accident has a right to be compensated and that right correlates with the manufacturer's duty to ensure safe vehicle. A no right is what is the opposite of a right, i.e. in the absence of an entitlement to demand an action, in comparison a privilege is the opposite of a duty or obligation to act.**

Therefore, if the user of the autonomous vehicle acts correctly, she has a privilege to do so, and the other parties do not have any right to intervene. Second set of conceptions revolve around the topic of power and liability. The power of one to affect legal relations concerning another is a power or the liability to which such changes may lead is a liability[36]. For example, the greater a manufacturer's liability for defective risk-related AI systems contribute to the manufacturer's design power to produce safe systems. And the opposites of disability (impossibility to change legal relations) and immunity (protection from such change in one's legal relations). The victim is disabled in its ability to change the manufacturer's legal position if the victim cannot hold him liable for unforeseeable defects[37]. Legal positions are dynamic and may vary because of actions, contracts, and decisions of the courts. In referring to Hohfeld's framework, one often thinks of it as a cube with correlatives represented by vertical lines and opposites by diagonal, showing the logical structure of the legal relations[38].

APPLICATION OF LAW

Hohfeld has been the keystone in terms of legal theory with respect to areas of contract, property, and constitutional law, whose model of precise delimitation of rights and obligations is important[39]. For example, in contract law, a party's right to payment corresponds with the other's duty to pay; and a privilege to terminate a contract may enjoins the other of that right of

[36] Alexander Hevelke & Julian Nida-Rümelin, *Responsibility for Crashes of Autonomous Vehicles: An Ethical Analysis*, 21 Sci. & Eng'g Ethics 619 (2015).
[37] *Questions and Answers: EU-U.S. Data Privacy Framework*, Eur. Comm'n (Oct. 7, 2022), https://ec.europa.eu/commission/presscorner/detail/en/qanda_22_5793.
[38] Nikolai Lazarev, *Hohfeld's Analysis of Rights: An Essential Approach to a Conceptual and Practical Understanding of the Nature of Rights*, 2005 Murdoch U. E.J.L. 9, https://classic.austlii.edu.au/au/journals/MurUEJL/2005/9.html.
[39] Allen Thomas O'Rourke, *Refuge from a Jurisprudence of Doubt: Hohfeldian Analysis of Constitutional Law*, 61 S.C. L. Rev. 141 (2009).

enforcement. On the other hand, property law matches an owner's right to exclude others with a non-owner's duty not to trespass and between making the owner immune from certain types of claims[40]. By eliminating sloppy reasoning, the framework makes sense of (or clarifies) ambiguous legal terms in the way that Hohfeld conceived. It has influenced opinions of US Supreme Court and Restatement of Property rendering it still relevant.

Hohfeld's framework is particularly useful in emerging legal domains like AI and technology law because there is much complexity in the interaction of the stakeholders. The problem of liability for these scenarios where AI systems operate alone is a novel one that traditional legal concepts make little progress in accommodating given these AI systems behave as if they are autonomous beings. The structured approach which Hohfeld's conceptions provide map these relationships and free us of such vagueness in terms of assignments of responsibilities[41]. For example, Hohfeld's framework enables precise legal analysis of questions such as whether the manufacturer of an AI-driven accident has a duty correlated to the victim's right or whether the victim's right to use the AI imposes a separate liability on them.

CASE STUDY - RELEVANCE TO AUTONOMOUS VEHICLE

The case study is of a minor collision in India due to malfunctioning of a sensor in an autonomous vehicle that leads to the autonomous vehicle hitting another vehicle, causing fender damage and scratches. The vehicles are both insured and the damage to the two vehicles includes damage to the owner's own vehicle. While this scenario may appear relatively simple, these types of situations with the capacity to accrue into highly important economic and social costs are the type of scenario which demands clean liability rules. Using Hohfeld's framework brings light over the legal relationships between the parties involved in this case.

HOHFELD'S ANALYSIS

[40] Kenneth M. Murchison, *The Fourth Amendment*, 44 Clev. St. L. Rev. 319 (1996).
[41] Kramer, Matthew H., 'The Hohfeldian Analysis of Legal and Moral Relationships', *Rights and Right-Holding: A Philosophical Investigation* (Oxford, 2024; online edn, Oxford Academic, 22 Aug. 2024), https://doi.org/10.1093/oso/9780198891222.003.0002,

Hohfeld's scheme provides a coherent framework to assess the legal entitlements of parties involved in the accident. Generally, entitlements consist of a right-duty pair. In this scenario, ownership of the damaged vehicle (victim) establishes a right to compensation for the damages incurred in the accident. This right links to the duties of the vehicle manufacturer to ensure that critical parts (e.g., any sensors) are reliable. Under the Consumer Protection Act, 2019, a manufacturer is liable for a defective product, which would solidify the duties if the malfunctioning sensor causes a defect due to being defectively designed or manufactured in either case. Following the example of **Jones v. W+ W Automation, Inc**.[42], however, the component parts doctrine complicates matters for the owner of a defective vehicle as it may protect the manufacturer of non-defective components integrated into a defectively designed system. This implies that the sensor manufacturer may have shared responsibility concerning if the sensor component incorrectly functioned, while being a non-defective component of the vehicle[43].

The privilege-no-right pair deals with the user's legal position. The vehicle owner has a privilege to operate the autonomous car as long as they operate it according to the guidelines provided by the manufacturer, which means that he has no duty to avoid using the vehicle. The privilege corresponds with the no-right of other parties, the victim included, to interfere with the use of the autonomous vehicle unless the victim can prove that the user was using the autonomous vehicle improperly. For example, if the user overrode the AI system, then the user's privilege may go away, and potentially impose a duty to avoid harm. The victim does have no-right to be harmed, and this reaffirms their right to safety, also meeting the manufacturer's duty to prevent certain systems from being defective. The power/liability pair takes the perspective of the manufacturer. The manufacturer has the power to design and safety as well as implement an AI system; the liability that flows from their failure to do so means they are liable for any harm that occurs as a result. For example, suppose the manufacturer of the vehicle that relied on the sensor supplied by the sensor

[42] 2006 NY Slip Op 05398
[43] Theories of Rights: Hohfeld's Analysis, Legal Bites, https://www.legalbites.in/theories-of-rights-hohfelds-analysis/.

manufacturer was damaged in an accident because the sensor did not give proper warnings as set out in Section 87(2) of the Consumer Protection Act, 2019[44]. The sensor manufacturer is liable for a failure to warn, without being able to shirk their power into liability. The obstacle for the vehicle manufacturer is being able to sue the sensor manufacturer, which creates a second layer of liability. To the point, it is important to understand the legal domino effect that an entire AI system can represent, as there are lots of layers where multiple parties can have liability.

Ultimately, the immunity-disability pair relates to defences. A vehicle manufacturer may claim immunity from liability if it is proven that the defect in the sensors was unforeseeable, which would mean they are insulated from changes to their legal standing because of claims from the victim. The immunity relates to the victim's disability to impose liability upon a manufacturer who would otherwise face liability for a defect in the vehicle. Under this system, a sensor manufacturer is disabled from claiming immunity if they failed to provide adequate warnings and, as such, have no recourse for immunity from liability. These connections elucidate not only the technical relationship between the immunity-disability pair, but also the complex relationships within AV accidents for both manufacturers and victims.

HYPOTHETICAL SCENARIO – ETHICAL DILEMMA

To demonstrate Hohfeld's conception, consider an imaginative situation in which an autonomous vehicle is faced with an unavoidable accident, deciding whether to hit a pedestrian or to swerve into oncoming traffic. This "trolley problem" illustrates the ethical and legal implication of decision making by AI.

The manufacturer's responsibility to program AI that minimizes harm relates to the public's claim to safety, creating an obligation to construct algorithms that put human lives over everything. The user's right to operate the vehicle is constrained, in part, along a no-right of the user to maintain that the AI make certain decisions, since the user typically does not have control over the AI choice

[44] Consumer Protection Act, 2019, § 87(2) (India).

in real time[45]. In this power-liability dynamic, the manufacturer is the focal point of the relationship, as they maintain the power to map and algorithmize the AI decisions, and as such they are liable (or responsible) for the outcome, notwithstanding the irrational decisions that AI makes could potentially leave them blameless in limiting cases. For example, IM provides no support to an instance if the AI chooses to swerve as a user becomes aware of imminent impact to avoid the impact, and because this action minimized overall harm, the manufacturer may have potential access to immunity. It is not lost, either, that the public, on its side, experiences disability by not being able to some claim absolute liability for some of the user's choices. This conversation is significant, mandating a legal code to galvanize programs and AI for the purpose of making ethical decisions, documenting the acceptable three themes and criteria of AI decisions.

NEED FOR REFORMATION

Underneath, the critical analysis has a number of implications for India's legal system. Pressure for legislation is acute, qualifying an Autonomous Vehicles Act under which legal liabilities of AI would be specified, including an anticipated strict liability model for manufacturers, to facilitate victims compensation. Regulatory standards appear to be required, such as ARAI's responsibility to, inter alia, provide a safety certification for autonomous vehicles relaying the reliability of AI and including malfunctioning sensors. Insurance provisions must adapt to accommodate models related to AI, distributing liability between manufacturers, users and their insurers, which seems emerging as a global best practice. Hohfeld's method supports all of the necessary changes to the legal infrastructure by providing a precise terminology capable of more definitively portraying parties' legal duties. This improves clarity in interpreting statutes and judicial decisions. For example, while the duty to the manufacturer and the right of the victim can be codified in statute, it is also important in eliminating arguments over liability distribution and unfairly allocated harm.

[45] Ethical Dilemmas in Autonomous Vehicle Decision-Making, Frontiers in Robotics and AI, https://www.frontiersin.org/articles/10.3389/frobt.2020.00059/full.

Hohfeld's framework clarifies the liabilities in accidents involving autonomous vehicles, providing a governance model for the assignment of rights, duties, and liabilities to parties. As used in the case study, it clearly identifies the victim's right to compensation, the manufacturer's duty, and adds complexity with component suppliers. However, the Indian legal framework based on the Consumer Protection Act, 2019 and the Motor Vehicles Act, 1988 lacks the specificity necessary to address the complexities of AI, particularly within ethical dilemmas intricately woven into the AI-legal parameters. Hohfeld's conceptions can support India in developing a series of meaningful reforms (legislation, safety and insurance models) to ensure moral accountability among manufacturers and public safety in the implementation of autonomous vehicles.

CHAPTER 5 – FINDINGS AND RECOMMENDATIONS

FINDINGS

The use of artificial intelligence (AI) in autonomous vehicles (AVs) represents a leadership opportunity in transportation, with promises of better safety, less traffic congestion, and enhanced mobility. However, this study uncovered significant issues in India's legal infrastructure that present challenges to enabling safe and equitable use of AVs. First, there are clear gaps in regulation, since India's primary statutes, namely the Motor Vehicles Act, 1988, and the Consumer Protection Act, 2019, do not include any liability issues around AI. The Motor Vehicles Act was designed for vehicles with human drivers, and does not anticipate AI making autonomous decisions, and therefore leaves no clear pathway for liability in accidents involving an AI system. The Consumer Protection Act does provide a general framework for product liability, but no provisions for the uncertainty posed by AI, like understanding the root cause of a software bug or how sensor malfunction complicates the situation for manufacturers, users, and victims. These regulatory ambiguities are critical for other reasons, as India has a unique road context with traffic amounts that make potential collision issues acute, significant variances in road conditions and surrounding infrastructure make vehicle operation unpredictable, and tragically high accident rates present significant risks in deploying anything represented as AVs on Indian roads.

Second, the usefulness of Hohfeld for analysing AV liability is a primary conclusion. Wesley Newcomb Hohfeld's eight legal conceptions of right, duty, privilege, no-right, power, liability, immunity, and disability, offers a precise tool to delineate stakeholder relationships. Once we able to relate this conception to AV accidents, such as the sensor-initiated collision in the case study, the framework is capable of identifying expertise that the victim has a right to compensation, while the manufacturer has duties to ensure no harm, and the user has privileges to operate the vehicle. This way, Hohfeld's various relations provide clarity to what would otherwise be ambiguous liability assignments that would challenge existing Indian law, offering a more systematic approach to resolving disputes. The framework's cube format provides additional spatial representation to support the visualization of the interactions of legal relations so as to allow legislators and courts to work through the complex reality of law.

Third, valuable global lessons from jurisdictions, especially United States, the European Union, and China, provide useful models for India. The European Union's AI Liability Directive, which presumes manufacturer fault for AI harms, simplifies the process of compensation for victims of AI harms and the EU's AI Act provides high-risk systems with stricter standards. The US uses a decentralized approach to regulations through laws passed by individual states such as California and Arizona, thus maintaining and focusing on innovation but needing to move towards uniform rules and legislation to avoid fragmentation. China's state-oriented strategy incorporates national guidance complemented with an extensive testing within proximity of large cities such as Beijing, and in addition to achieving voluntary state standards, the Chinese strategy has demonstrated the benefits of a unified push for industry deployment and collaboration across sectors. The strategies of the EU, the US, and China all identified a need for specific legislation, certainty around liability, and improvements to carrying out AI, and in order for India to compete at a global level, India needs to have similar strategies.

In conclusion, the need for reforms is obvious. The lack of appropriate regulations will not only slow down the deployment of AVs but present a potential safety risk for the traveling public and cost delays in the economic sense, as even the case study's minor accident, damaging a fender adds cost to the overall value. If we consider avocado vines grow as the market forecast expects India to reach USD 23.3 billion by 2033 for AV vehicles. Clearly there are economic stakes here that

should be viable and reform is critical. India cannot remain behind when the world is leading with AVs that advance road safety and allow greater mobility. Reform is necessary.

RECOMMENDATIONS

India should develop an Autonomous Vehicles Act, inspired by the EU's AI Act, to establish a comprehensive regulatory framework. Legislation should outline the levels of autonomy of vehicles, such as provision of SAE International autonomy Levels 3, 4, and 5, also address liability rules for accidents involving AI, and outline safety requirements. Manufacturers should remain primary liable for defects in the system, in the same way that the EU introduces 'presumption of liability'; victims will be afforded clarification in terms of recourse as well as encouraging robust design in AI. Legislation should also introduce a legal standard for ethical dilemmas when accidents cannot be avoided, such as specifying that AI must keep a transparent conceptual formula for their decision making.

The Autonomous Vehicles Act could also utilize Hohfeld's conceptions in order to create exact definitions of obligations for stakeholders. For example, explicitly defining the manufacturer's obligation to ensure the AI has reasonable reliability, and the entitlement of victims to be compensated, would eliminate ambiguity when issues arise with respect to liability. Additionally, explicitly describing the user's privilege to operate AVs, and their no-right to interfere or countermand essential AI functionalities, would clarify responsibilities when misuse occurs. If Hohfeld's specific vocabulary is applied to statutory language, India could enact a legal framework that is substantive enough to survive judicial challenges and will bring consistency of application and understanding of risks to stakeholders.

The Automotive Research Association of India (ARAI) should be made responsible for developing a regulation for mandatory safety standards for AVs operating in Indian traffic conditions. These regulations should include requirements for an appropriate level of testing for the sensors, software, and decision making - such as when a sensor fails in the case study. We can look to the EU's General Safety Regulation, which mandated requirements for advanced safety systems for AVs. Audits and re-certification on a regular basis could help establish confidence in AVs, and reduce the level of risk by confirming AVs are in compliance.

India must create collaborations amongst regulators, startups, and OEMs - or, Original Equipment Manufacturers - like China has done, to enable the creation of AI based solutions that are fit for Indian challenges. Recently collaborations with startup companies Minus Zero and Swaayatt Robots have begun to inform regulations that account for India's congested traffic and unpredictable infrastructure. Public private partnerships could also be leveraged to establish upgraded infrastructure such as intelligent traffic systems, which are essential for navigating AVs.

The insurance industry must respond to Autonomous Vehicle specific risks by developing AI-specific insurance products. These products should account for liabilities caused by software failures, sensor malfunctions, or ethical choices, with risks being shared between manufacturers, users, and insurers. In common with many countries of the world (for example, the UK's automated vehicle insurance approaches), India could provide adequate coverage that both protects victims of AV-related crashes and provides an incentivized safety regime that benefits road users.

CONCLUSION

The emergence of AI-enabled autonomous vehicles offers opportunities and challenges for India's legal system. Emerging from the precedent of AI-specific regulations, and the limitations of the Motor Vehicles Act, 1988, and the Consumer Protection Act, 2019, creates ambiguity which undermines safe deployment. Nevertheless, Hohfeld's legal framework presents a valuable way forward, enabling a precise and systematic assigning of rights, duties, and liabilities among the parties involved. This paper applied Hohfeld's legal framework to a case study and hypothetical scenarios to establish that it has the capacity to develop coherent and consistent solutions to tricky liability issues, from sensor failures to ethical dilemmas. On top of this, international best practices from the EU, US and China provide tangible frameworks of action for India, all stressing the need for particular legislation, clearly defined liability and collaborative partnerships between the industry and Government. The realignment of the regulatory environment in India takes a significant amount of targeted law reform: an Autonomous Vehicles Act, Hohfeldian-inspired definitions of legal rights, safety standards from the Automotive Research Association of India (ARAI), industry consortia, and innovative insurance systems. Together, these reforms could build robust regulatory frameworks that enable the safe and equitable imposition of autonomous

technologies, thus mitigating accidents, improving mobility and positioning India as a leader in AI-supported transportation solutions. Ultimately, clarifying legal systems (legislation) as technologies mature, enables India to maximize the social value of autonomous vehicles while still adhering to socially accountable forms of justice.