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Analysis of Legal Responsibility for Accidents Due to Malfunction of the Car Autopilot System According to Indonesian Criminal Law

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Abstract. *This study aims to analyze criminal liability for accidents caused by malfunctions in car autopilot systems from the perspective of Indonesian criminal law. The method used is normative legal research with statutory, conceptual, and comparative approaches. Data were obtained through a literature review of the Criminal Code, Law Number 22 of 2009 concerning Road Traffic and Transportation, Law Number 8 of 1999 concerning Consumer Protection, Law Number 11 of 2008 concerning Electronic Information and Transactions, and Presidential Regulation Number 55 of 2019 concerning the Electric Motor Vehicle Program. In addition, the legal regulations of other countries related to autopilot systems were also reviewed. The results of the study indicate that the national legal framework does not yet explicitly regulate criminal liability for accidents caused by autopilot systems, thus creating uncertainty in determining the legal subjects responsible, whether drivers, manufacturers, or technology developers. Countries such as the United States, Germany, and Japan have implemented the principles of strict liability and vicarious liability to ensure victim protection. The research recommendations include reforming criminal law regulations to encompass cross-actor accountability, establishing an autonomous technology oversight body for algorithm audits and certification, integrating humanitarian ethics into technological innovation, and enhancing law enforcement capacity and technological literacy for officials handling cases involving artificial intelligence. This adaptive model is expected to achieve legal certainty, protect the public, and encourage smart transportation innovation in Indonesia.*

Keywords: *Autopilot; Creating; Determining; Systems.*

1. Introduction

The development of autonomous vehicles with autopilot systems marks a new phase in the evolution of modern transportation technology. These systems enable vehicles to make decisions autonomously through sensor data processing and artificial intelligence algorithms, without direct human involvement in any decision-making. This transformation poses a serious challenge to the criminal justice system, which traditionally recognizes only humans as legal subjects liable for liability. The absence of regulations explicitly addressing responsibility for the actions of autonomous systems has created a regulatory gap in positive law.[1]The shift of control from humans to automated systems also raises questions about who should bear responsibility when losses occur due to technological malfunctions, given that the basic principles of criminal law require human error as the basis for liability.

These developments not only have theoretical implications but have also impacted global traffic practices. Numerous accidents involving autopilot vehicles demonstrate that automated systems still have limitations in accurately recognizing environmental conditions.[2]The crashes of an Uber test vehicle in Tempe, Arizona, and a Tesla Model X in California are examples of how the interaction between automated systems and human oversight is not yet fully balanced. The National Transportation Safety Board (NTSB) report revealed that the Uber crash was caused by the system's failure to detect pedestrians, while the Tesla crash was caused by the Autopilot system failing to recognize the median.[3]These incidents changed public perceptions of the safety of autopilot technology and exposed fundamental weaknesses in the division of responsibility between humans and machines.

A similar phenomenon has emerged in Asia, particularly China, which has seen a significant increase in the use of electric and semi-autonomous vehicles. Research shows that these vehicles have a higher fatality rate than conventional vehicles,

[1]Steven Van Uytsel, "Different Liability Regimes for Autonomous Vehicles: One Preferable Above the Other?", in Steven Van Uytsel and Danilo Vasconcellos Vargas (eds.), Autonomous Vehicles: Business, Technology and Law, Springer Nature Singapore, Singapore, 2021, p. 81.
[2]Praveena Penmetsa, Pezhman Sheinidashtegol, Aibek Musaev, Emmanuel Kofi Adanu, and Matthew Hudnall, "Effects of the Autonomous Vehicle Crashes on Public Perception of the Technology", IATSS Research, Vol. 45, no. 4 (2021), p. 485–492, url: https://doi.org/10.1016/j.iatssr.2021.04.003, accessed 13 November 2025.
[3]National Transportation Safety Board (NTSB), Accident Report – Collision Between Vehicles Controlled by Developmental Automated Driving*Systems and Pedestrian, Tempe, Arizona, March 18, 2018*, Report no. NTSB/HAR-19/03, Washington DC, 2019, url:https://www.ntsb.gov/investigations/AccidentReports/Reports/HAR1903.pdf,accessed November 12, 2025.

particularly when driver assistance systems fail.[4]China's market regulator has even ordered the recall of over one million vehicles due to potential malfunctions in its automated driving assistance systems. This situation underscores the importance of clear legal responsibilities for manufacturers developing autonomous technology, particularly in ensuring public safety and providing proportionate protection for accident victims.

The international discourse on liability for autonomous vehicle accidents demonstrates a paradigm shift in modern criminal law. Legal systems in various countries are beginning to consider new liability models that adapt to the characteristics of technology that operates independently of humans. The principle of strict liability is one approach being seriously considered in the European Union to address the risk of accidents arising from malfunctions in autonomous vehicle systems.[5]This model places responsibility on the manufacturer, who has full control over the system's design and operation, without the need to prove fault. A similar approach has developed in Japan through the principle of vicarious liability, which places legal responsibility on the corporate entity controlling the autonomous system.[6]This comparison shows a global tendency to balance legal certainty, public safety, and technological innovation.

The development of autonomous vehicle systems in Indonesia is showing an increasing trend, as various automotive products have adopted Advanced Driver-Assistance Systems (ADAS). This technology enables vehicles to perform automatic steering and braking functions under the supervision of a human driver.[7]However, the national legal system lacks comprehensive regulations governing the use and responsibilities of these semi-autonomous vehicles. Law No. 22 of 2009 concerning Road Traffic and Transportation and Government Regulation No. 55 of 2012 concerning Vehicles still adhere to the paradigm that the human driver is solely responsible for controlling the vehicle. This normative gap demonstrates that national law has not kept pace with the rapid pace of

[4]Rongxian Long, et al., "Exploration of Crash Features of Electric Vehicles with Traffic Crash Data in Changshu, China", World Electric Vehicle Journal, Vol. 16, no. 3 (2025), p. 1–18, url: https://doi.org/10.3390/wevj16030185, accessed 20 November 2025.
[5]Caroline Cauffman, "Robo-liability: The European Union in Search of the Best Way to Deal with Liability for Damage Caused by Artificial Intelligence", The Maastricht Journal of European and Comparative Law, Vol. 25, no. 6 (2018), p. 527–545, url: https://doi.org/10.1177/1023263X18812333, accessed 12 November 2025.
[6]Maria Lillà Montagnani, et al., "The EU Regulatory Approach(es) to AI Liability, and Its Application to the Financial Services Market", Computer Law & Security Review, Vol. 53 (2024), p. 105123, url: https://doi.org/10.1016/j.clsr.2024.105984, accessed 12 November 2025.
[7]Dzaki Putra Prakosa, Iqbal Nur Hasyim, Anisa Putri, Viky Dwi Nugraha, Zufar Ahmad Fahrezi, and Nurul Fitriani, "Literature Review: Analysis of the Influence of Advanced Driver Assistance System (ADAS) Technology on Driving Safety", Journal of Technology and Information (JATI), Vol. 15, No. 2 (2025), url: https://doi.org/10.34010/jati.v15i2.16718, accessed December 2, 2025.

innovation in transportation technology.

The legal vacuum in regulating autonomous vehicles creates uncertainty regarding the legal subject responsible when an accident occurs due to system failure.[8]Existing legal provisions still emphasize the element of proof on human error as stipulated in Article 1365 of the Civil Code, making it difficult to apply to cases involving algorithmic or sensor failure. Investigative mechanisms at the institutional level, such as the Indonesian National Police Traffic Corps (Korlantas Polri) and the National Transportation Safety Committee (KNKT), are also not equipped with digital forensics-based technical guidelines for identifying software errors. This situation indicates that the national legal system needs to adapt the concept of criminal liability to accommodate the new legal relationship between users, manufacturers, and developers of autonomous systems. This study aims to examine the extent to which Indonesian positive law regulates criminal liability for accidents caused by malfunctioning car autopilot systems through a comparative analysis with legal practices in other countries, in order to formulate a model of liability and the direction of development of national criminal law that is adaptive to advances in autonomous vehicle technology.

2. Research Methods

This research uses a normative legal approach with a focus on analyzing Indonesian positive legal norms governing criminal liability for accidents caused by malfunctions in vehicle autopilot systems. This approach views law as a system of norms containing binding principles, principles, and rules, and serves to assess the extent to which national legislation is able to address the challenges arising from the development of autonomous vehicle technology. This type of research is descriptive-analytical with a prescriptive-normative orientation, namely describing applicable legal regulations, interpreting their conformity with modern criminal law theories, and providing recommendations for legal reform to be more adaptive to advances in transportation technology. The data used in this study are entirely secondary data obtained through a literature review of primary, secondary, and tertiary legal materials. Primary legal materials include national legislation and legal sources from other countries that have already regulated autopilot technology. Secondary legal materials include textbooks, scientific journals, and research results related to criminal law and autonomous technology, while tertiary legal materials such as legal dictionaries and official sources are used to strengthen terminological consistency. Data collection techniques are carried out through literature studies with validation using literature triangulation, while data analysis is conducted qualitatively normatively through systematic, grammatical, and teleological interpretation. The analysis is deductive, starting

[8]Alexander Hevelke and Julian Nida-Rümelin, “Responsibility for Crashes of Autonomous Vehicles: An Ethical Analysis”, Science and Engineering Ethics, Vol. 21, no. 3 (2014), p. 619–630, doi: 10.1007/s11948-014-9565-5, accessed 1 December 2025.

from general legal principles to their application in concrete cases, and is complemented by comparisons of international law to strengthen normative arguments in the context of criminal liability for autopilot technology.

3. Results and Discussion

3.1. Positive Legal Regulations in Indonesia and Their Comparison with Other Countries

The criminal law framework in Indonesia is still based on a traditional paradigm that places humans as the sole legal subject capable of criminal responsibility. Law No. 22 of 2009 concerning Road Traffic and Transportation and Government Regulation No. 55 of 2012 concerning Vehicles have not yet accommodated situations where automated systems are the direct cause of accidents. The absence of explicit norms governing accountability for artificial intelligence actions creates a legal vacuum that impacts uncertainty in law enforcement. The basic principle of criminal law, which still requires the element of human error (schuld), makes the national legal system incapable of addressing crimes stemming from the failure of autonomous technology.

The Indonesian legal approach also does not yet recognize the concept of multi-actor liability, so the entire legal burden tends to be directed at the driver even if the technical error originates from the autopilot system.[9]In the context of positive law, this situation creates a conflict between the empirical reality that autonomous vehicles operate based on algorithms and sensors, and legal norms that still focus on human behavior. Numerous cases abroad demonstrate that autonomous vehicle accidents are more often caused by the system's failure to recognize road conditions, rather than driver negligence.

Countries with more advanced technological developments have begun adapting their legal systems to the risks of autonomous vehicles. To provide a comprehensive overview of the comparison of liability models, the research results are presented in Table 1 below.

Table Comparison of Legal Liability Models for Autonomous Vehicle Accidents in Several Countries

Country Aspect	**United States of America**	**German**	**Japan**	**English**
Main Legal Basis	*Product Liability Law*, oversight by NHTSA & DOT	*Road Traffic Act (Straßenverkehrsgesetz)*, revised 2017; BMVI & Ethics Commission	*Product Liability Act 1994*, Road Transport Vehicle Act & Road Traffic Act (revised)	*Automated and Electric Vehicles Act of 2018*

[9]Untung Kurniadi, Yusriyadi, Ana Silviana, and Zico Junius Fernando, "Autonomous Vehicles and Legal Challenges: Navigating between Technology and Criminal Liability", Scientific Journal of Law and the State of Law, Vol. 15, No. 1 (June 2024), pp. 17–35, url: https://berkas.dpr.go.id/pusaka/files/jurnal_kepakaran/Negara%20Hukum-15-1-Juni-2024.pdf, accessed December 2, 2025.

		Guidelines		
Principle of Accountability	Product Liability – manufacturer's responsibility for product defects	Shared Liability – shared responsibility between driver & manufacturer	Strict Liability – the manufacturer is responsible without the need to prove fault.	Strict & Dual Liability – the insurer and the manufacturer share responsibility
Primary Responsible Party	Manufacturer (if system defect is proven)	Driver (if negligent) & Manufacturer (if system fails)	Manufacturer (loss due to system failure)	Insurance Companies (direct compensation) & Manufacturers (regression)
Role of Government / Regulator	NHTSA & DOT set standards for safety and data transparency	BMVI & independent audit institutions monitor the reliability of technology	MLIT carries out algorithm certification & AI system audits	The government establishes a list of autonomous vehicles & insurance claim mechanisms.
Driver's Role	Not criminally liable if safety standards are followed	Must remain alert and ready to take over control	Passive monitoring; no need to take over if the system meets certification	Not prioritized, focus on victim compensation
Regulatory Focus	Technical flaws & data transparency	Ethics, human safety, system audit	Public safety, AI certification, producer responsibility	Legal certainty & fast compensation for victims
Policy Orientation	Consumer protection & industrial innovation	Public safety & social responsibility	Technology accountability & state control	Victim protection & dispute efficiency

Source: Primary data, 2017 (Edited).

Table shows that each country has different characteristics in establishing a legal liability system for autonomous vehicle accidents. The United States emphasizes manufacturer responsibility through product liability, with a focus on technical defects and data transparency.[10]Meanwhile, Germany prioritizes a shared liability model that divides responsibility between drivers and manufacturers.[11]Japan applies strict liability, where producers are required to be responsible for losses without needing to prove fault.[12]while the UK uses a dual liability approach with a

[10]María Lubomira Kubica, "Autonomous Vehicles and Liability Law", The American Journal of Comparative Law, Vol. 70, Issue Supplement 1 (October 2022), p. i39–i69, doi: https://doi.org/10.1093/ajcl/avac015, accessed 2 December 2025.
[11]Ewa Jędrzejewska, "Autonomous Vehicles and the Issue of Liability for Damage Caused by the Movement of Such a Vehicle", Journal of Modern Science, Vol. 51, no. 2 (July 2023), p. 627–644, doi: https://doi.org/10.13166/jms/168065, accessed 3 December 2025.
[12]Alexandros Karaiskos, "Autonomous Driving and Civil Liability in Japan", in Hannes Steege, Isabella A. Caggiano, Maria C. Gaeta, and Benedikt von Bodungen (eds.), Autonomous Vehicles and Civil Liability in a Global Perspective, Data Science, Machine Intelligence, and Law, Vol. 3, Springer, Cham, 2024, doi: https://doi.org/10.1007/978-3-031-41992-8_7, accessed 3 December 2025.

direct compensation mechanism through insurance companies.[13]The roles of governments in these four countries also differ: the United States emphasizes safety standards and system audits by the National Highway Traffic Safety Administration (NHTSA) and the Department of Transportation (DOT); Germany relies on independent oversight; Japan requires algorithm certification and AI system audits; and the United Kingdom has established an official autonomous vehicle registry to ensure insurance claims. These differences in policy orientations demonstrate that developed countries have integrated due diligence and victim protection into their legal systems, while Indonesia still faces a lack of adequate norms to regulate legal liability for accidents involving autonomous systems.

3.2. Forms and Limits of Criminal Liability in Cases of Autopilot System Malfunction

The development of autonomous vehicles has created a paradigm shift in the criminal justice system, which has historically been based on the assumption that criminals are humans with consciousness and will. Autopilot systems introduce a new form of interaction between humans and technology, where some decisions are made by artificial intelligence algorithms. The driver or vehicle owner remains the primary legal subject as long as the autopilot system has not achieved full autonomy (full automation). The driver or vehicle owner can still be held liable for negligent vehicle supervision while the autopilot system is active, especially at the level of partial automation.[14]Such negligence falls under the category of culpa, as the driver still has a legal obligation to take over control when the system fails to recognize the road situation.

Vehicle manufacturers can be held liable if an accident is caused by a design defect, a failure of safety testing, or negligence in the manufacturing process. The general principle is that manufacturers are liable for damages resulting from defective products, including software failures of autopilot systems.[15]Manufacturers' responsibilities include ensuring the safety of autonomous systems through certification, software updates, and audits of safety

[13]Department for Transport (DfT), Automated and Electric Vehicles Act 2018: Regulatory Report (July 2023 – December 2024), Government of the United Kingdom, London, 2024, url: https://assets.publishing.service.gov.uk/media/67cf248ed38a67eb3afaa669/automated-and-electric-vehicles-act-2018-regulatory-report-july-2023_december-2024.pdf, accessed 2 December 2025.
[14]Gavin Chang, "Liability of Autonomous Vehicles", Research Archive of Rising Scholars, June 2025, doi: 10.58445/rars.2655, accessed 3 December 2025 and Wade Shaver, "Accountability of Autopilot: Self-Driving Cars and Liability", Journal of High Technology Law, January 2025, url: https://sites.suffolk.edu/jhtl/2025/01/14/accountability-of-autopilot-self-driving-cars-and-liability/, accessed December 2, 2025.
[15]Miriam C. Buiten, "Product Liability for Defective AI", European Journal of Law and Economics, Vol. 57 (2024), p. 239–273, doi: https://doi.org/10.1007/s10657-024-09794-z, accessed 2 December 2025.

functions, which are important aspects considering that autopilots rely on software.[16]

The role of artificial intelligence system developers cannot be overlooked, as algorithms are at the heart of decision-making in autopilot systems. Design errors, omissions in data updates, or failure to detect anomalies can have fatal consequences that directly impact road user safety. Biczi's research demonstrates that determining liability in autonomous vehicles must consider the collective involvement of all actors in the chain of causation, including the software developers who built the automated decision-making system.[17]Huang added that the complexity of algorithmic networks gives rise to fragmentation of responsibility because final decisions are no longer the result of a single human will, but rather the product of systemic design.[18]In an ethical and legal context, Hevelke and Nida-Rümelin argue that when algorithms become decision-making entities, legal responsibility needs to be shifted proportionally to the parties who control the design and learning of the system.[19]This approach is in line with Gavin Chang's view that emphasizes the need for a distributed liability model—a mechanism for sharing responsibility between drivers, manufacturers, and algorithm developers based on the level of control and risk prevention capacity.[20]

The complex relationships between drivers, manufacturers, and system developers create an interconnected chain of legal responsibilities. Proving causality in the context of autonomous vehicles is no longer simple, as human actions or omissions often interact with automated algorithmic decisions. Criminal law needs to accommodate the concept of layered responsibility, where each actor is assessed based on their level of control and contribution to the outcome. However, clear boundaries are needed to ensure that the expansion of legal subjects does not lead to injustice. The principle of "geen straf zonder schuld" must be maintained to ensure that criminal liability is imposed only on parties with proven legal fault. This approach is crucial to prevent excessive criminalization of developers or manufacturers who have complied with safety standards, while maintaining a balance between legal certainty, victim protection, and technological innovation.

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[16]Michael L. Rustad, "Products Liability for Software Defects in Driverless Cars", Southern California Interdisciplinary Law Journal, Vol. 32 (2022), p. 170–247, url: https://gould.usc.edu/why/students/orgs/ilj/assets/docs/32-1-Rustad.pdf, accessed December 2, 2025.
[17]Dorottya Biczi, "Legal Challenges for Automated Decision-Making in Self-Driving Vehicles—Liability Issues and Remedies", Engineering Proceedings, Vol. 113, no. 1 (2025), p. 3032, doi: https://doi.org/10.3390/engproc2025113032, accessed 1 December 2025.
[18]Haoyu Huang. "Liability Allocation in Autonomous Vehicles: From Ethics to Law", Interdisciplinary Humanities and Communication Studies Vol 1, No 2 (2025), p. 1-4, url: https://doi.org/10.61173/ap42kp92, accessed 1 December 2025.
[19]Alexander Hevelke and Julian Nida-Rümelin.op.,cit.
[20]Gavin Chang, op.cit.

3.3. Application of the Theory of Criminal Responsibility

The form and extent of criminal liability in cases of autopilot system malfunction involving drivers, manufacturers, and technology developers require a strong theoretical basis to ensure that the determination of responsibility is not subjective. The theory of criminal liability provides a normative framework for assessing legal culpability that can be imposed on each legal subject based on the relationship between intent, action, and resulting consequences.[21]This concept becomes problematic when applied to autonomous vehicles, because decisions that lead to legal consequences do not always originate from humans, but rather from artificial intelligence systems operating independently through algorithms. This situation challenges the validity of classical theories that require an element of fault (schuld) as a basis for criminal punishment, because artificial intelligence systems lack the moral consciousness or free will that characterize traditional legal subjects. Hevelke and Nida-Rümelin assert that the shift in control from humans to automated systems creates both a moral and legal dilemma, because there is no subject who can be held accountable based on free will.[22]The application of traditional criminal liability theories is limited when autopilot systems operate beyond human control, given that the element of fault is no longer directly attached to the individual.

The development of modern criminal law has shifted the individual approach toward a collective responsibility model that recognizes the involvement of multiple actors in the commission of a crime. This model opens up the possibility of applying the theories of vicarious liability and corporate criminal liability, which place responsibility on parties with oversight authority, such as technology manufacturers or developers, if proven negligent in ensuring system security.[23]This principle demonstrates that responsibility is not solely imposed on individuals but can also be transferred to legal entities that actually have control over the risks arising from autonomous technology. This change reflects a shift in the criminal law paradigm from liability based on personal will to a form of structural liability that considers the institutional role in the causation of crimes or accidents.

The shift in the criminal liability paradigm toward a collective model demands changes in legal norms that can accommodate the complexity of the relationship

[21]Jeremy Horder. Ashworth's Principles of Criminal Law. Oxford: Oxford University Press, 2016, p. 131-176.
[22]Alexander Hevelke and Julian Nida-Rümelin.op.cit.
[23]Vincenzo Mongillo. "Corporate Criminal Liability for AI-Related Crimes: Possible Legal Techniques and Obstacles", RIDP – International Review of Penal Law, Vol. 94, no. 1 (2023), p. 77-90, in L. Picotti & B. Panattoni (eds.), Traditional Criminal Law Categories and AI: Crisis or Palingenesis?, accessed 2 December 2025. Igor Vuletic. "Corporate Criminal Liability: An Overview of the Croatian Model after 20 Years of Practice", Laws, Vol. 12, no. 2 (2023), p. 27, url: https://doi.org/10.3390/laws12020027, accessed 2 December 2025.

between humans, technology, and corporate entities. The positive legal system, which is still oriented towards individual culpability, does not yet provide adequate legal instruments to assess the legal consequences of algorithms or corporate technological policies. Adaptation of criminal law norms is necessary so that traditional principles, such as the principle of "geen straf zonder schuld," can continue to be applied without ignoring the unique characteristics of autonomous technology. Normative reform can be achieved by expanding the definition of legal subjects in the Criminal Code (KUHP) and the Road Traffic and Transportation Law (LLAJ Law), by recognizing corporations and developers of artificial intelligence systems as parties that can be held criminally liable if proven to have committed systemic negligence. The use of artificial intelligence in the public sector, as outlined in a recent study, shows that the integration of technology without a clear legal framework has the potential to create imbalances in accountability and the risk of abuse of authority.[24]The principle of strict liability can be a solution to ensure victim protection, as it places responsibility on those who derive economic benefits and control over autonomous systems. Reformulation of criminal law norms that incorporate technological dimensions is needed to ensure a balance between legal certainty, justice for victims, and support for sustainable innovation in intelligent transportation.

The development of autonomous vehicle technology demands an update to national criminal law to adapt to social changes and advances in artificial intelligence. Indonesia's legal system needs legal updates that are not only normative but also substantive in regulating the relationship between humans and automated systems. The regulatory gap between advances in transportation technology and positive legal norms creates uncertainty in determining legal responsibility when accidents are caused by algorithmic malfunctions. Satjipto Rahardjo's progressive legal principle emphasizes that the law should move with the dynamics of society and technology, not the other way around.[25]Therefore, criminal law reform needs to be directed towards creating a legal system that is responsive, flexible, and able to anticipate the impacts of the widespread use of autonomous technology in society.

The development of criminal law in Indonesia needs to consider the integration of the principles of strict liability and corporate criminal liability to address the issue of criminal responsibility for autonomous system failures. The principle of strict

[24]Septy Dwi Diantika Mulyasari and Dodi Jaya Wardana. "The Urgency of Using Artificial Intelligence (AI) in Public Services", Jurnal Daulat Hukum, Vol. 8, No. 3 (September 2025), p. 421, url: https://jurnal.unissula.ac.id/index.php/RH/article/view/48658/14085, accessed December 2, 2025.

[25]Satjipto Rahardjo. "Progressive Law: Law that Liberates", Progressive Law Journal, Vol. 1, No. 1 (July 2011), pp. 1–24, url:https://doi.org/10.14710/hp.1.1.1-24, accessed December 2, 2025 and M. Zulfa Aulia. "Progressive Law from Satjipto Rahardjo: History, Urgency, and Relevance", Undang: Jurnal Hukum, Vol. 1, No. 1 (2018), p. 159–185, DOI: 10.22437/ujh.1.1.159-185, accessed December 2, 2025.

liability allows victims to obtain protection without having to prove fault, while corporate criminal liability opens the way for criminal penalties against technology manufacturers or developers who are negligent in ensuring system safety. This type of liability model has been progressively implemented in the European Union and Japan to ensure legal certainty and justice for victims of autonomous vehicle accidents. Caroline Cauffman stated that the burden of responsibility should ideally be placed on the party that controls the design and derives economic benefits from the technology, rather than on the user who has no control over the system.[26]This approach can be an inspiration for Indonesia in building a criminal law system that is fair and adaptive to technological developments.

In addition to legal substance reform, strengthening the technical aspects of law enforcement is also essential. Investigating autonomous vehicle accidents requires new methods such as digital forensics, algorithmic audits, and data transparency obligations. In the United States, agencies such as the National Highway Traffic Safety Administration (NHTSA) and the Department of Transportation (DOT) have implemented audits of algorithmic systems and vehicle software testing before obtaining a marketing authorization.[27]Indonesia could emulate this approach by establishing a technology-based investigation unit under the coordination of the Indonesian National Police and the National Transportation Safety Committee (KNKT), so that any accident involving automated systems can be investigated through a scientific and digital data-driven approach.

The next strategic step that needs to be taken is the creation of specific regulations regarding autonomous vehicles and autopilot systems, or at least a revision to Law Number 22 of 2009 concerning Road Traffic and Transportation. These regulations should include provisions regarding the definition of autonomous vehicles, the division of responsibilities between drivers, manufacturers, and developers, mandatory incident reporting based on system data, and government algorithm certification standards. These regulations must reflect a balance between public safety, victim protection, and the sustainability of innovation in the national automotive industry. Reformulating criminal law norms that include the dimensions of autonomous technology is expected to encourage the formation of a legal system that is progressive, equitable, and adaptive to the challenges of the digital era.

The research findings indicate that Indonesia's criminal justice system needs to be oriented toward a more adaptive model to the development of autonomous

[26]Caroline Cauffman, op., cit.
[27]US Department of Transportation. Preparing for the Future of Transportation: Automated Vehicles 3.0, Washington DC, 2018, p. 7–10; National Highway Traffic Safety Administration (NHTSA). “Automated Vehicles for Safety”, url:https://www.nhtsa.gov/vehicle-safety/automated-vehicles-safety, accessed November 24, 2025.

vehicle technology. Positive legal provisions, which are still oriented toward human behavior, are no longer adequate to address the complex legal relationships between drivers, manufacturers, and developers of artificial intelligence systems. The development of autonomous technology demands a comprehensive reform of criminal law, encompassing normative, institutional, and ethical aspects of technology, so that the national legal system can provide certainty, justice, and protection for society in the digital era.

The first recommendation relates to reform of criminal law regulations. Revisions to the Criminal Code (KUHP) and Law No. 22 of 2009 concerning Road Traffic and Transportation are urgently needed to accommodate cross-actor criminal liability. These legal updates should include regulations on algorithmic liability, mandatory audits of artificial intelligence systems, and transparency mechanisms for autonomous vehicle operational data as evidence in legal proceedings. These adaptations are necessary to fill legal gaps and ensure the criminal justice system can respond to new challenges arising from developments in AI-based transportation technology.

The second recommendation emphasizes the need to implement a multi-actor accountability model. The criminal justice system should be designed to divide responsibility among drivers, manufacturers, and algorithm developers based on their level of control and risk. The principle of corporate criminal liability should be integrated to affirm the criminal responsibility of corporations that fail to ensure the safety of autonomous systems and cause public harm. This model not only provides justice for accident victims but also creates legal certainty for technology industry players who have met compliance obligations and safety standards.

The third recommendation concerns the establishment of an Autonomous Technology Oversight Agency (L-PTO), which would have the authority to certify, audit, and investigate autonomous vehicle technology. This agency should involve various ministries, such as the Ministry of Transportation, the Ministry of Communication and Information Technology, and the Ministry of Industry. The L-PTO will strengthen the state's oversight mechanism for transportation technology by ensuring regular testing of vehicle software, sensors, and algorithms before they are operated on public roads.

The fourth recommendation emphasizes the integration of ethics and human values into every stage of autonomous vehicle technology development. The principle of la dharara wa la dhirar (do not cause harm to oneself or others) and the precautionary principle should serve as the normative basis for testing and implementing autopilot systems. Ethical testing of the technology must be conducted before autonomous vehicles are permitted to operate in public spaces to ensure human safety is the highest priority and to ensure that technological innovation does not compromise moral values.

The fifth recommendation focuses on strengthening law enforcement capacity and technological literacy. Handling cases involving artificial intelligence requires law enforcement officers who understand technical aspects, such as algorithms, digital forensics, and data-based legal liability. Therefore, regular technical training for investigators, prosecutors, and judges is necessary. National legal education must also be updated to include materials on technology law, algorithm ethics, and artificial intelligence governance to create legal human resources prepared to face the challenges of the digital era.

Through these five recommendations, the direction of strengthening national criminal law regarding autonomous vehicles will move toward an adaptive, equitable, and innovation-based system. Comprehensive legal reform will ensure a balance between legal certainty, public safety, and advances in transportation technology in Indonesia.

4. Conclusion

The Indonesian criminal law system is not yet fully capable of accommodating criminal liability for accidents caused by malfunctions in autonomous vehicle autopilot systems. Positive legal provisions, which are still oriented towards human behavior, create a legal vacuum in determining who is responsible, whether the driver, the manufacturer, or the developer of the artificial intelligence system. Comparative analysis shows that countries such as the United States, Germany, and Japan have implemented the principles of strict liability and vicarious liability to ensure legal certainty and victim protection. Therefore, national criminal law reform is necessary through regulatory reforms that address cross-actor responsibility, the implementation of a collective accountability model, and the recognition of corporate responsibility in the context of autonomous technology. Furthermore, it is necessary to establish an autonomous technology oversight body, strengthen law enforcement capacity based on digital forensics, and integrate humanitarian ethics into technological innovation to create a criminal law system that is adaptive, just, and aligned with the development of artificial intelligence in Indonesia.

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