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Legal Exploration of Traffic Safety in the Implementation of Self-Driving Car Technology in Indonesia

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A B S T R A C T

Self-driving car technology has the potential to address transportation challenges in Indonesia, such as traffic congestion and accidents, but requires legal reforms. Currently, Law No. 22 of 2009 does not specifically regulate autonomous vehicles. Indonesia can learn from developed countries that already have comprehensive regulations in place. This study employs a normative method with a descriptive-analytical approach to examine regulatory gaps and provide recommendations. Infrastructure, data protection, and law enforcement through the Electronic Traffic Law Enforcement (ETLE) system are also considered. Legal reforms are necessary to ensure that self-driving cars can be safely integrated, taking into account public safety and the interests of society.

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INTRODUCTION

In the current digital era, technology has become a major driver of change in various aspects of human life, including the transportation sector. One of the innovations undergoing significant transformation is the creation of self-driving cars. Car manufacturers respond to accident risks by introducing autopilot systems. This innovation has been introduced earlier in developed countries, while in Indonesia it is still in its introductory phase. Various trials have been conducted by the global automotive industry to develop autopilot systems with features that enhance vehicle safety (Nugroho, A., et al., 2023).

Land use changes in metropolitan areas bring both positive and negative impacts. Urbanization can improve access to public services, healthcare, education, and economic opportunities. The construction of new infrastructure, such as roads and public transport, enhances connectivity, mobility, economic productivity, and quality of life (Lasaiba, M. A., 2024). In recent years, autonomous vehicles (AVs) have become a major focus, given the enormous potential of vehicle automation, offering benefits such as increased mobility, reduced energy consumption, and emissions. Moreover, in the context of the pandemic, AVs play a key role as a transportation solution that enables better isolation and sterilization. Manufacturers are racing to introduce this technology as soon as possible (Othman, K., 2022). However, in Indonesia, the application of self-driving car technology faces regulatory and traffic safety legal challenges that are not yet prepared to anticipate this development. The legal sector in Indonesia is still catching up with the rapid advancements in autonomous vehicle technology, requiring further exploration to create appropriate and effective regulations to ensure safety and support the adoption of this technology.

Currently, traffic regulations in Indonesia still focus on conventional vehicles driven by human operators. Law No. 22 of 2009 on Traffic and Road Transport aims to establish safe, orderly, and smooth traffic and road transport that is integrated with other modes of transport to support the economy, welfare, national unity, and uphold the dignity of the country (Doly, D., 2016).

In addition, the government has issued Minister of Transportation Regulation No. 45 of 2020 on Electric Motor Vehicles and No. 44 of 2020 on Physical Type Testing of Electric Motor Vehicles. However, these regulations are considered insufficient as a legal framework for the operation of autopilot technology in four-wheeled vehicles. The regulations are not yet explicitly addressing the regulation of autonomous vehicles or self-driving cars in terms of operations, legal liability, or safety (Juliansyah, F. M., 2022).

The implementation of autonomous vehicle (self-driving car) technology in Indonesia presents new challenges in traffic safety regulations. Similar to corporate crimes involving large entities with widespread impact, legal arrangements for self-driving cars must encompass aspects of oversight, liability, and potential risks arising from their use. Traffic safety must be prioritized by establishing regulations that not only protect the public from accidents caused by technological failures but also ensure legal accountability for the developers and operators of such technology (Zarzani, T. R., Ismaidar, I.,

& Fahriza, W., 2024). A legal approach that emphasizes prevention and risk mitigation must be part of a broader regulatory framework, especially in the cross-border context of globalization, where this technology is widely adopted.

In the context of self-driving car technology application, legal liability is one of the critical issues that must be clearly regulated in legislation. Legal liability pertains to who should bear the legal consequences if an error or accident involving autonomous vehicles occurs. Relevant legal liability theories in this case include fault-based liability and strict liability (Asshiddiqie, J., & Safa'at, A., 2012).

Fault-based liability holds that someone can be held liable if there is an element of fault, as stipulated in Article 1365 of the Indonesian Civil Code, with four elements: unlawful act, fault, damage, and causal relationship. Meanwhile, the principle of strict liability (no-fault liability) holds that the accused party is responsible unless they can prove they did not cause the harm (Putriyana, N., & Puspita, S. D., 2014).

Fault liability theory and strict liability theory. Fault liability theory states that a person can only be held legally responsible if there is evidence that they have committed an error or negligence that caused harm. In contrast, strict liability theory states that a person can be held legally responsible without needing to prove fault (Putriyana, N., & Puspita, S. D., 2014). In the case of self-driving cars, responsibility may fall on the vehicle manufacturer or software developer if an accident occurs due to system failure, regardless of whether the fault was intentional.

In some developed countries, regulations on self-driving cars have already been implemented. For example, in the European Union, data privacy regulations for autonomous vehicles must comply with the General Data Protection Regulation (GDPR) or equivalent non-EU standards. AV manufacturers, as data controllers, must appoint a Data Protection Officer (DPO) and conduct Data Protection Impact Assessments (DPIA), including periodic data protection audits. These requirements apply not only to AVs but also to connected conventional vehicles (Fernández Llorca, D., & Gómez, E., 2021).

Presidential Regulation No. 55 of 2019 on the Acceleration of the Battery Electric Vehicle Program opens opportunities for the automotive industry to develop environmentally friendly vehicles, including self-driving cars, but requires significant investment in research and development. Existing regulations must support innovation so that the national automotive industry can compete globally. This study uses a normative and comparative approach to regulations in other countries, analyzing Law No. 22 of 2009 and Presidential Regulation No. 55 of 2019. Data were collected through literature studies and are expected to provide a basis for regulatory recommendations on the application of self-driving cars in Indonesia.

THEORETICAL REVIEW

Fault Liability & Strict Liability

The fault liability theory states that a person can only be held legally responsible if there is evidence that they have committed an error or negligence causing harm. The strict liability theory holds that a person can be held legally responsible without the need to prove fault (Putriyana, N., & Puspita, S. D., 2014).

Product Liability

Products are generally understood as tangible goods, which can be seen and held, whether movable or immovable. However, in the context of product liability, the definition of a product extends beyond physical goods to include intangible items. This is important because manufacturers must also be accountable for non-physical products, such as services or software, which, although intangible, can still pose risks or impacts to consumers (Rusli, T., 2012).

METHODOLOGY

This research is a normative legal study with a descriptive-analytical approach, aimed at examining and analyzing existing regulations concerning self-driving car technology in Indonesia. This type of research focuses on written legal rules and applicable legal doctrines to provide solutions to legal challenges arising from technological advancements. The descriptive part of the study involves outlining laws and government policies related to traffic safety, while the analysis discusses the strengths and weaknesses of existing regulations and compares them with regulations in other countries.

The approach used includes a statutory approach to understand the positive laws in force in Indonesia, as well as a comparative approach to compare Indonesia's regulations with those of countries that have already regulated self-driving cars. Secondary data from laws, scientific journals, and related documents were collected through a literature review and analyzed descriptively and analytically. This analysis aims to depict the current legal conditions, identify gaps, and provide recommendations for regulatory updates that support the safe and lawful implementation of self-driving car technology.

RESULTS AND DISCUSSION

Current Legal Regulation on Traffic Safety in Indonesia

The advancement of digital technology has significantly impacted various sectors, including transportation. The implementation of autonomous vehicle technology, or self-driving cars, requires a mature legal framework to regulate traffic safety. In this context, cyber law becomes relevant as self-driving cars heavily rely on networks and information technology for safe operation. To protect the public from potential risks, the law must ensure that this technology is governed by strict regulations regarding data, privacy, and potential cyber threats (Aspan, H., 2021). In Indonesia, foundational regulations for the digital economy, such as the Electronic Information and Transactions Law (UU ITE) and

related telematics regulations, exist, but their application in transportation safety needs further development to address the complexity of autonomous vehicles.

Law No. 22 of 2009 sets forth the goal of establishing safe, orderly, and integrated traffic and road transport services for all road users, including pedestrians, cyclists, and motor vehicles. The provisions of this law cover various aspects such as vehicle registration, roadworthiness testing, and the provision of safe infrastructure, which must meet safety standards and legal certainty. With technological developments such as self-driving cars, the scope of this law needs to be expanded to include new technologies and ensure the operational safety of autonomous vehicles through technical regulations and adequate infrastructure maintenance.

This law also regulates the government's obligation to maintain roadworthiness, infrastructure maintenance, and motor vehicle safety equipment. There is a legal gap in vehicle regulation in Indonesia, particularly regarding Article 77 of Law on Traffic and Road Transport and Article 15 (2) of Government Regulation No. 37 of 2017, which still focus on conventional vehicles. The development of modern vehicles, such as electric and technology-based vehicles, has not yet been fully regulated, necessitating a review to protect users. Regulations in countries like the United States and Germany, which already protect users through independent physical testing and special oversight, can serve as a reference for Indonesia to update its laws and ensure more comprehensive protection (Aritonang, R. Y., 2023).

The use of autopilot technology in vehicles may lead to violations and accidents, so appropriate regulations are necessary. In the event of a violation or negligence leading to an accident, the driver remains liable under Law No. 22 of 2009 on Traffic and Road Transport. However, vehicles with autopilot technology require further review regarding potential legal events, given that their characteristics differ from conventional vehicles (Destyarini, N., 2020).

Additionally, criminal law concerning negligence represents a form of fault of a lesser degree than intent. While intent involves a desire for the resulting consequences, negligence refers to unintended outcomes that could have been foreseen by the offender (Siagian, A. A., 2020). This definition of negligence may not be fully relevant in the context of self-driving cars, as these vehicles could experience technological failures rather than human negligence.

Data protection and cybersecurity are also critical issues in the implementation of self-driving cars. These vehicles generate large amounts of data, and the law must ensure that such data is protected from hacking or misuse. Legal certainty in this area is crucial to maintaining road safety and preventing disruptions that could result from cyberattacks on autonomous vehicle systems.

Electronic Traffic Law Enforcement (ETLE) is an IT-based traffic law enforcement system that uses electronic devices, such as CCTV cameras, to detect various types of traffic violations (Nindyaningrum, S. P., Gayo, S., & Hakim, L., 2023). In the context of legal exploration on traffic safety concerning the implementation of self-driving car technology in Indonesia, ETLE can play a significant role as supporting infrastructure. The ETLE system, which already

detects various traffic violations, could be integrated with self-driving technology to ensure autonomous vehicles' compliance with traffic regulations and enhance road safety. Through this collaboration, traffic safety regulations can be adapted to technological advancements, including legal responsibility in accidents involving driverless vehicles.

Thus, Law No. 22 of 2009 needs to be updated to ensure that self-driving cars can operate safely and in accordance with prevailing legal certainty. Without these updates, legal uncertainty will arise, potentially hindering the implementation of this new technology. Clear and firm legal reforms are essential to maintaining road safety and ensuring that all parties involved in operating autonomous vehicles understand their responsibilities.

Legal Reform for Traffic Safety in the Implementation of Self-Driving Car Technology in Indonesia

The implementation of self-driving car technology in Indonesia requires significant changes to the traffic safety legal system. This technology has the potential to reduce accidents caused by human error; however, to achieve this, the Indonesian government must urgently establish new regulations regarding the use of self-driving cars in Indonesia (Sanjaya, P. D. P., 2021). Currently, Law No. 22 of 2009 on Traffic and Road Transport serves as the foundation for road safety regulations in Indonesia but does not fully cover autonomous vehicle technology. Therefore, significant legal reforms are necessary, accompanied by lessons learned from other countries' experiences in regulating self-driving cars.

Traffic safety laws related to the application of autonomous vehicle technology (self-driving cars) in Indonesia must be based on the principle of protecting public interests and individual rights, including road safety. From a criminal law perspective, legal protection must include clear rules and strict sanctions against violations that may endanger public safety. Legal developments in this area require a preventive approach, where technology must be accompanied by regulations governing the use, supervision, and responsibility for accidents or violations caused by autonomous vehicles (Aspan, H., et al., 2024). This approach aligns with the criminal law's goal of protecting society's rights and ensuring security in the use of new technologies.

The United States, particularly the states of California and Arizona, has pioneered the development and regulation of autonomous vehicles. California enforces stringent California Autonomous Vehicle Regulations to ensure public safety. Each vehicle must undergo thorough testing before being allowed to operate on public roads under the supervision of regulators. This regulation provides legal certainty for manufacturers and consumers while ensuring safety. Indonesia can consider this approach as a reference when establishing similar safety standards (Soriano, B. C., et al., 2014).

The European Union, on the other hand, enforces the General Data Protection Regulation (GDPR), which provides strict protection for personal data. Self-driving car technology collects vast amounts of user data, and the GDPR ensures this data is protected from misuse. Additionally, Regulation (EU) 2018/858 sets standards for homologation and market oversight for motor vehicles, including self-driving cars. Legal reforms in Indonesia can refer to the

European Union's approach in protecting user data and preventing hacking of autonomous vehicle systems (General Data Protection Regulation, 2016).

Research by Karaiskos, A. (2024) reveals that in Japan, there is no specific law governing civil liability for autonomous driving. This issue is addressed within the framework of existing laws for conventional driving, such as the Civil Code, Motor Vehicle Accident Compensation Act, and Product Liability Act. Most losses are covered by insurance under the accident compensation law, making the Product Liability Act and tort liability secondary. Since the current legal framework is not specific to autonomous driving, various issues arise, and future legislative developments are anticipated (Karaiskos, A., 2024).

Meanwhile, Beijing has proposed proactive regulations for a new law governing the autonomous vehicle sector, a crucial step in addressing the potential risks and operational challenges on public roads. These proactive regulations aim to ensure safety, reliability, and compliance with security standards, so self-driving technology can gain broad acceptance. Additionally, clear and structured regulations will provide confidence for investors and industry players while minimizing the potential for accidents and technical errors. By promoting a mature legal framework, Beijing strives to create an innovation ecosystem that balances technological advancements with public protection (Xinhua., 2024, October 20).

Neighboring Indonesia, Singapore has implemented the Autonomous Vehicle Technology Roadmap, which allows autonomous vehicle testing in limited areas. In Singapore, autonomous vehicles must undergo rigorous safety assessments at the CETRAN Test Center before operating on public roads, with input from the LTA and Traffic Police. These vehicles must have a qualified safety operator who can take control if necessary, and can only operate without an operator after passing stringent tests. Additionally, autonomous vehicles must comply with comprehensive insurance regulations, be equipped with data recorders, and transmit their location and status to LTA's OLIVE System. These regulations governing autonomous vehicle trials are outlined in the 2017 Road Traffic Act (AV Safety & Testing, 27 March 2024).

In Germany, on June 21, 2017, Germany passed a law legalizing autonomous vehicles and amended the Road Traffic Act to establish requirements for highly and fully automated vehicles on public roads, as well as the rights and obligations of drivers when using automated driving modes. Although the law does not alter the concept of liability in German law, both the driver and owner remain liable when the vehicle is in automatic mode unless the driver can prove the legitimate use of the automatic mode. Automated vehicles must be equipped with black boxes to determine whether the driver or system was in control during an accident, which may affect product liability rules and the relationship between insurers and car manufacturers. Additionally, there are still legal questions to be resolved, particularly concerning data privacy, while the boundaries of “intended use” will become a key differentiator among car manufacturers in Germany (Theissen, C. M., 2018).

This comparative study shows that countries more advanced in regulating self-driving cars have strict regulations covering safety, data security, and legal liability. Indonesia can tailor these approaches to local needs, ensuring that the regulations implemented provide legal certainty for the public, manufacturers, and autonomous vehicle users.

Table: Analysis of Legal Reform for Self-Driving Cars in Indonesia

ASPECT	DESCRIPTION	OBJECTIVE OF THE REFORM
Implementation of Self-Driving Cars in Indonesia	Requires a legal framework that supports and adapts to new technologies.	Support safety, legal responsibility, and certainty in the use of autonomous vehicles.
Current Legal Framework (Law No. 22/2009)	Provides the legal basis for traffic safety but does not yet cover autonomous technology.	Ensure public safety, traffic order, and protection of road users.
Necessary Legal Reforms	Updates are needed to address aspects of liability, safety, and data security.	Ensure all parties understand their responsibilities and rights in the autonomous vehicle ecosystem.
Comparative Study of Other Countries	Learn from countries that are advanced in regulating self-driving cars.	Develop comprehensive regulations based on international best practices.
Electronic Law Enforcement	ETLE as the foundation for autonomous vehicle law enforcement.	Ensure compliance of autonomous vehicles with applicable laws.
Legal Responsibility	Clarity is needed on who is responsible in case of an accident.	Avoid ambiguity in cases of accidents involving autonomous vehicles.
Cybersecurity & Data Protection	Protection of user data and prevention of hacking of vehicle systems.	Safeguard user privacy and the operational security of vehicles.

Source: Processed.

Indonesia also needs to consider electronic law enforcement, such as Electronic Traffic Law Enforcement (ETLE), which has been implemented in various countries. The ETLE system can monitor autonomous vehicles and ensure their compliance with traffic regulations. By adopting this technology, Indonesia can enforce laws more effectively without relying on manual supervision.

The implementation of self-driving car technology requires strict legal regulation concerning traffic safety. This aligns with the principles of justice and fairness in law, where regulations must be designed to protect public interests while ensuring accountability for new technologies. The application of autonomous technology not only demands legal certainty but must also be based on the principle of justice that prioritizes road user safety. Therefore, specific regulations are needed to balance technological innovation with public protection, so that the law continues to serve as a guardian of truth and justice (Fitrianto, B., Zarzani, T. R., & Simanjuntak, A., 2021).

Legal reforms that refer to best practices from these countries are crucial to ensuring that Indonesia can safely and effectively integrate self-driving car

technology. Without comprehensive reform, challenges in legal responsibility, data protection, and traffic safety will be difficult to overcome. Thorough legal reforms also ensure that Indonesia's legal system can support technological innovation while maintaining order and safety on the roads.

The application of autonomous vehicle technology requires clear and comprehensive legal certainty. Self-driving cars operate using artificial intelligence (AI) that must comply with traffic regulations, as stipulated in Article 106 of Law No. 22 of 2009. Legal updates must ensure that the AI systems in autonomous vehicles can understand and adhere to applicable regulations to maintain road safety. Additionally, safety must also be reviewed from the perspective of infrastructure. Self-driving cars require adequate road infrastructure, as regulated by Articles 22 and 23 of Law No. 22 of 2009. The government must ensure the quality of roads, signs, and road markings to allow autonomous vehicles to navigate safely.

The issue of legal liability in traffic accidents presents another challenge in these legal reforms. Currently, liability in accidents typically rests on human drivers, but with the introduction of self-driving cars, responsibility may shift to manufacturers or technology developers. Therefore, legal reforms must provide clarity on who is liable in accidents involving autonomous vehicles. Thus, the implementation of autonomous vehicles in Indonesia requires comprehensive legal reforms, referring to best practices from other countries to ensure operations comply with regulations and provide legal certainty for society.

CONCLUSIONS AND RECOMMENDATIONS

Traffic safety law in Indonesia is currently governed by Law No. 22 of 2009, which aims to ensure security and order on the roads for all users. This law covers various aspects, such as vehicle registration, roadworthiness tests, infrastructure maintenance, and safety equipment. However, with the development of self-driving car technology, this law needs to be updated to accommodate such advancements. These updates are essential to ensure that autonomous vehicles can operate safely in accordance with the prevailing legal certainty.

The experiences of other countries, such as the United States, the European Union, Japan, and Singapore, show that comprehensive regulations are necessary to protect the public from potential risks posed by autonomous vehicles. These countries implement strict safety standards, data protection, and clear legal responsibility regulations. For instance, California requires thorough testing of autonomous vehicles, while the European Union ensures data security through the GDPR. Indonesia can learn from these practices to formulate regulations that support the safe and responsible development of self-driving cars.

In addition to safety, legal updates must also consider legal responsibility and cybersecurity. In Indonesia, liability for accidents currently falls on human drivers. However, with self-driving cars, liability may extend to manufacturers or technology developers. Legal reforms are therefore needed to provide certainty regarding who is responsible in accidents involving autonomous vehicles.

Additionally, protecting user data and preventing hacking must also be a priority, so that self-driving car technology can be implemented safely while enhancing transportation efficiency in Indonesia.

FURTHER STUDY

Research specific safety protocols and testing requirements for self-driving cars that ensure their readiness for Indonesian road conditions, including urban traffic, rural roads, and extreme weather scenarios.

Examine the role of regulatory agencies in monitoring compliance with safety standards and the integration of real-time monitoring systems.

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