

Reformulating Product Liability for Autonomous Vehicles: A Comparative Analysis of Causation Theories in Indonesian and Kuwaiti Civil Law

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The development of autonomous vehicles as a disruptive technological product presents serious challenges to civil law, particularly in determining manufacturer liability when accidents occur. The causation theory that underpins civil liability in Indonesia and Kuwait has not yet explicitly accommodated the complexity of artificial intelligence decisions, which are non-linear and multi-factorial. This research employs a normative legal method with a comparative law approach between the Indonesian Civil Code and the Kuwaiti Civil Code (Law No. 67 of 1980). The analysis reveals that Indonesian law, which alternately applies the *conditio sine qua non* theory and the proximate cause theory, fails to provide certainty and justice due to its binary approach. By contrast, Kuwaiti law adopts a gradation of causality through the distinction between *al-sabab al-mubasyir* (direct cause) and *al-sabab al-mutasabib* (indirect cause), and imposes strict liability for dangerous objects under Article 229. Based on this comparison, this study formulates a manufacturer liability reform through three pillars: tiered liability based on SAE automation levels, reversal of the burden of proving causality at high automation levels, and the establishment of mandatory insurance and a no-fault compensation fund. This reform requires amendments to the Indonesian Civil Code or the enactment of a special law on artificial intelligence and autonomous vehicles. In conclusion, Indonesia should adopt Kuwait's tiered approach to make manufacturer liability fairer, more adaptive, and legally certain in the era of technological disruption.

Keywords: Manufacturer liability; autonomous vehicles; causation theory; Indonesian civil law; Kuwaiti civil law

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1. Introduction

The Fourth Industrial Revolution has given rise to disruptive technologies that fundamentally alter social relations, including in the transportation sector. Autonomous vehicles, which operate using artificial intelligence (AI) with minimal or no human intervention, represent one of the most significant innovations of this era. Global companies such as Tesla and Waymo continue to develop autonomous systems at various levels, ranging from driver assistance to fully driverless vehicles. According to the Society of Automotive Engineers (SAE) classification, there are six levels of automation (L0–L5), where at the highest level (L5), vehicles can operate completely without any human attention. However, this progress does not come without complex legal consequences. When an accident involving an autonomous vehicle occurs, fundamental questions regarding legal liability remain unanswered by existing legal frameworks, most of which were built on the assumption that a human being is the primary controller of the vehicle[1].

Indonesia's regulatory framework for vehicles remains rooted in the principle of fault-based liability. Article 1365 of the Indonesian Civil Code (*Kitab Undang-Undang Hukum Perdata – KUHP*) regulates unlawful acts (*onrechtmatige daad*) requiring the existence of fault on the part of the tortfeasor as the basis for liability. This provision is difficult to apply directly in autonomous vehicle accidents because there is no longer a human "driver" who can be considered blameworthy in the traditional legal sense. Who is

responsible when the AI system independently makes a decision that causes an accident? Can liability be fully transferred to the vehicle manufacturer or software developer? These questions indicate a significant legal vacuum (*rechtsvacuum*). Research by Kemmala Dewi et al. (2026) confirms that Indonesia's existing traffic and consumer protection legal frameworks are inadequate to address the complexities of autonomous decision-making and manufacturer liability. Indeed, no specific legislation governing self-driving technology is yet available. Government efforts to promote smart transportation, including in the new capital city of Nusantara (IKN), have not been matched by adequate legal regulations, creating legal uncertainty that risks hampering innovation while harming consumers [2].

The legal situation in Kuwait concerning autonomous vehicles presents an interesting parallel, albeit with structurally different challenges. As a country that adheres to a civil law system with strong codification particularly Law No. 67 of 1980 on the Kuwaiti Civil Code—Kuwait has a legal tradition that tends to be more stable and formalistic. Under Article 227 of the Kuwaiti Civil Code, civil liability for tortious acts requires three fundamental elements: fault, damage, and a causal link between the fault and the damage. However, like Indonesia, Kuwait currently has no specific regulation governing autonomous vehicles. In fact, no explicit and specific legislative provisions directly regulating the use of artificial intelligence exist in Kuwait [3]. The Kuwaiti government itself recognizes the need for legal renewal to keep pace with rapid changes in the transportation and smart services sectors. This absence of specific regulation constitutes a common starting point for both Indonesia and Kuwait: both face the challenge of answering questions of legal liability in autonomous vehicle accidents using existing civil law frameworks, which are not necessarily fit for purpose.

More profoundly, the greatest challenge for modern civil law is how causation theory can reach and impose liability on autonomous vehicle manufacturers. In accidents caused by the complexity of AI algorithms, it is often difficult to prove conclusively that a specific action or omission by the system developer was the proximate cause of the accident. The procedural rules governing the burden of proof and fact disclosure in such cases remain very limited and have not evolved in line with the characteristics of autonomous technology. As a result, accident victims may struggle to obtain fair compensation, while manufacturers may evade liability because of the weak causal link between their product and the harm suffered [4]. A global study by researchers in the *World Electric Vehicle Journal* (2026) identified that liability regimes for traffic accidents involving autonomous vehicles are essentially divided into four types, and manufacturer or operator liability regimes are primarily applied at high automation levels of Level 3 and above, based on technical control and authority.

Why compare Indonesia and Kuwait? The novelty of this research lies in its comparative approach between two countries that both follow civil law systems but originate from different legal traditions: Indonesia with its Dutch (Continental European) and customary law heritage, and Kuwait with its blend of Islamic law (Sharia) and French codification. Kuwaiti civil law explicitly distinguishes between direct damage (*mubashir*) and indirect or consequential damage (*mutasabib*) in terms of causation for tortious acts. This categorization provides a more structured framework for analyzing manufacturer liability, where the distinction between the manufacturer's conduct and the resulting harm can be unpacked more systematically. By contrast, Indonesian civil law remains heavily dependent on general doctrines of unlawful acts, which are often open to multiple interpretations. This comparison will yield valuable insights for formulating manufacturer liability principles that are not only fair but also adaptive to technological acceleration in Indonesia [5].

More specifically, this research will re-examine the doctrine of vicarious liability as provided in Article 1367 of the Indonesian Civil Code, which imposes liability on a person for the acts of another under their supervision. Can this provision be analogized to apply to high-level autonomous vehicles where the driver cannot reasonably prevent an accident? On the other hand, how does the Kuwaiti Civil Code regulate strict

liability in the context of dangerous products? Can granting independent legal personality to robots or AI serve as a solution, as debated by Kuwaiti academics? The comparison of these two systems is expected to provide concrete recommendations for Indonesia to reformulate manufacturer liability for autonomous vehicles, either through expansive interpretation of existing causation theories or through the establishment of a strict product liability regime.

From a practical standpoint, this research will greatly assist Indonesian policymakers in designing regulations that are both pro-innovation and pro-consumer. Without clear legal liability rules, the use of autonomous vehicles may create new problems, including uncertainty over who must pay compensation when an accident occurs due to system error or sensor malfunction. By adopting a comparative perspective from Kuwait, Indonesia can learn how a country with a strong civil law system addresses similar challenges, particularly regarding proof of causation, risk allocation between manufacturers and users, and the development of adaptive insurance mechanisms [6].

More broadly, this research contributes to the development of international civil law in responding to technological disruption. As underscored in global literature, existing law has the responsibility to hold accountable manufacturers of autonomous vehicles whose products harm users, and the law must be given the opportunity to do so before alternatives to tort law are introduced. Thus, the reformulation of manufacturer liability is not only an urgent necessity for Indonesia but also part of a global development in addressing the new reality of the automation era.

Based on the background outlined above, this research is formulated to answer the main question: How should manufacturer liability for autonomous vehicles be reformulated based on a comparative analysis of causation theories in Indonesian and Kuwaiti civil law? This research will also examine specifically how the concept of causation in the civil law of both countries can be applied to reach manufacturer liability, and formulate the most appropriate liability model for Indonesia's social and technological context by drawing lessons from Kuwait's experience.

2. Literature Review

The existing scholarly literature on autonomous vehicle accidents and civil liability reveals a persistent and unresolved tension between traditional fault-based doctrines and the unique characteristics of AI-driven systems. Scholars have extensively documented that conventional tort law frameworks rooted in human agency, foreseeability, and direct causation struggle to assign responsibility when an algorithmic decision causes harm. A significant body of work examines the inadequacy of the "reasonable person" standard in situations where no human driver exists, leading to a growing consensus that product liability or strict liability regimes offer more promising alternatives. Comparative studies have explored how different legal families address this challenge. Within civil law jurisdictions, the literature distinguishes between those that maintain a unitary concept of unlawful act (such as Indonesia, following the Dutch tradition) and those that incorporate layered causation doctrines, including explicit categories of direct and indirect causation (as found in Kuwaiti law, influenced by Islamic jurisprudence and French codification). Researchers have highlighted the theoretical appeal of Kuwait's *mubashir-mutasabib* distinction as a structured tool for tracing causal chains from manufacturer conduct to final harm. Conversely, Indonesian legal scholarship has focused on expansive interpretations of Article 1367 (vicarious liability) and the potential for analogical reasoning to cover AI operators. A recurring theme is the absence of specific autonomous vehicle legislation in both countries, creating a legal vacuum that courts fill inconsistently. More recent contributions advocate for hybrid models combining strict product liability with rebuttable presumptions of causation, alongside mandatory adaptive insurance schemes. Overall, the literature calls for statutory reform rather than judicial

improvisation, though deep disagreement remains over whether to grant AI systems legal personality or to impose liability exclusively on manufacturers and software developers.

3. Method

This research employs a normative legal method with a comparative law approach [7]. Primary legal materials include the Indonesian Civil Code (KUHP), the Kuwaiti Civil Code (Law No. 67/1980), and doctrinal sources on causation theory. Secondary legal materials consist of journal articles, court decisions, and policy reports. Data collection is conducted through library research, followed by qualitative analysis. The comparative analysis applies the problem approach method, comparing how the two legal systems resolve causation issues in autonomous vehicle accidents in order to formulate an adaptive manufacturer liability reform.

4. Result and Discussion

Critical Reflection on Causation Theory in Indonesian and Kuwaiti Civil Law Concerning Autonomous Vehicle Accidents

Indonesian civil law, derived from the Civil Code (KUHP), does not explicitly adhere to any single causation theory. In judicial practice and doctrinal development, two main schools are frequently used alternately: the *conditio sine qua non* theory (equivalent cause) and the proximate cause theory. The *conditio sine qua non* theory states that any condition without which the harm would not have occurred is considered a legal cause. By contrast, the proximate cause theory limits liability only to the cause closest and most direct to the harm, thereby excluding more remote factors. Both theories were designed in an era when causal relationships were still linear and deterministic, where human action as the primary agent could be easily traced chronologically [8].

However, when confronted with accidents involving high-level autonomous vehicles, particularly Level 4 (high automation) and Level 5 (full automation) under the SAE classification, both theories demonstrate fundamental weaknesses. At Levels 4 and 5, vehicles operate without human intervention, and all driving decisions are made by AI systems based on complex machine learning algorithms that are often non-transparent, a phenomenon known as the black box problem. In such a situation, applying the *conditio sine qua non* theory would hold that without the manufacturer's design of the AI algorithm, the accident would not have occurred, thus rendering the manufacturer liable for all damages. Yet this logic is overly broad and fails to distinguish between significant causal contributions and those that are merely background conditions [9]. This theory fails to perform adequate causation filtering, thereby potentially imposing disproportionate liability on manufacturers for every accident, including those actually caused more by external factors such as poor road conditions or extreme weather.

Conversely, the proximate cause theory tends to seek the cause closest in time and space to the harm. In an autonomous vehicle accident, the proximate cause is often the immediate environmental condition, for example, sensors being blinded by sunlight reflecting off a puddle, or the sudden appearance of a wild animal not covered in the AI's training data. Under this theory, manufacturers can easily evade liability by arguing that such external factors constitute an intervening cause that breaks the causal chain from the manufacturer's fault. The consequence is significant legal uncertainty that severely disadvantages accident victims. Victims can never predict which theory a judge will apply, and in many cases, victims are left without compensation because they fail to prove a sufficiently close causal relationship [10]. On the other hand, this uncertainty also does not provide optimal deterrence for manufacturers, as they can readily shift responsibility to environmental factors that can never be fully controlled.

In fundamental contrast to Indonesia's rigid binary approach, Kuwaiti civil law under Law No. 67 of 1980 explicitly adopts a gradation of causality. A clear distinction is made between *al-sabab al-mubasyir* (direct cause) and *al-sabab al-mutasabib* (indirect cause). This categorization is not a simple dichotomy but an analytical continuum that allows courts to apportion liability proportionally according to the causal weight of each contributing party. In the context of autonomous vehicles, a manufacturer's error in designing the AI decision-making algorithm can be classified as *mubasyir* if it is proven that the AI decision directly and deterministically caused the accident [11]. Conversely, if the accident arises from a complex interaction between the AI, poor road infrastructure, and user negligence (for example, at Level 3, which still requires human intervention), then it may be categorized as *mutasabib* with liability fairly divided. Kuwaiti courts are empowered to determine the percentage contribution of each factor, for instance, 40 percent driver liability and 60 percent manufacturer liability. Such a comparative causation approach is entirely unrecognized in Indonesia's system, which remains trapped in a binary logic of causation or no causation.

The superiority of Kuwait's system does not stop at causation gradation. Article 229 of the Kuwaiti Civil Code also imposes a strict liability regime for so-called dangerous objects (*al-ashya al-khatirah*). By a progressive expansive interpretation, autonomous vehicles at Levels 4 and 5 can be classified as inherently dangerous objects, given their potential to cause mass harm without any meaningful human control. Consequently, in cases of accidents involving fully autonomous vehicles, victims need not prove any specific fault in the AI design. It is sufficient to show that the harm arose from the operation of such a dangerous object. The burden of proof then shifts to the manufacturer to demonstrate that the accident was caused solely by force majeure or third-party actions that could not reasonably have been prevented [12]. Thus, Kuwait's causation theory provides two layers of legal protection: causation gradation for multi-causal cases at low to medium automation levels (L2–L3), and strict liability plus reversal of the burden of proof for full automation levels (L4–L5).

This comparison demonstrates that Indonesia must fundamentally reformulate its causation theory. The binary approach that recognizes only a yes-or-no causal relationship must be abandoned in favor of a tiered approach that acknowledges that autonomous accidents are almost always multi-factorial [13]. A specific recommendation is the need to amend the Indonesian Civil Code by adding provisions on comparative causation that explicitly empower judges to determine the percentage contribution of each involved party, including manufacturers, users, and even environmental factors. Furthermore, it should be specifically provided that at Level 4 automation and above, a rebuttable presumption of causation applies, which can be rebutted only if the manufacturer successfully proves the existence of force majeure truly beyond prediction and not anticipatable by the highest technological standards, or third-party intervention in the form of illegal hacking that could not be prevented despite adequate cybersecurity measures. Without such fundamental reform, Indonesian civil law will continue to lag behind and prove unjust when confronting the increasingly massive reality of autonomous accidents in the future.

Toward a Fair and Adaptive Reformulation of Manufacturer Liability for Autonomous Vehicles

The reformulation of manufacturer liability for autonomous vehicles in Indonesia cannot be undertaken partially but must integrate the findings from the comparative analysis with Kuwaiti civil law into three main interconnected pillars. These three pillars are: tiered liability based on automation levels, reversal of the burden of proving causation, and the establishment of mandatory insurance and a national compensation fund. These three pillars are designed to reinforce each other, thereby creating a legal framework that not only fills the current legal vacuum but also adapts to future technological acceleration. Without a holistic and integrated approach, legal reform will only produce patches that fail to resolve the root problem: the inability of traditional causation theory to address the multi-factorial and non-linear complexity of autonomous accidents [14].

The first and most fundamental pillar is the adoption of a tiered liability model directly linked to the SAE J3016 standard. This standard classifies autonomous vehicles into six levels, from Level 0 (no automation) to Level 5 (full automation). Each level presents significantly different distributions of control and responsibility between the system manufacturer and the human user. At Levels L0 to L2, the vehicle provides only momentary assistance or warnings, while the human driver retains full control of the driving task. Within this range, legal liability for accidents remains with the human driver, exactly as in conventional vehicles. Manufacturers may be held liable only if independently proven product defects exist, for instance, brakes failing due to manufacturing error, not because of an autonomous system decision [15]. At Level L3, known as conditional automation, the system can drive the vehicle under certain conditions but has the authority to request human intervention when the situation exceeds its capabilities. Here, the *al-sabab al-mutasabib* (indirect cause) theory from Kuwaiti civil law becomes highly relevant. The manufacturer is proportionally liable if the system fails to provide adequate warning, for example, if the response time given is less than five seconds, leaving the human driver no reasonable opportunity to take over control. Conversely, the driver is liable if they fail to respond to a warning given with sufficient time. This proportional approach allows judges to allocate percentages of liability, for instance, 60 percent to the manufacturer and 40 percent to the driver, based on warning quality and response speed. Meanwhile, for Levels L4 (high automation) and L5 (full automation), there is no human role whatsoever [16]. The vehicle operates autonomously without expecting any intervention from occupants. In this context, the most appropriate causation model is *al-sabab al-mubasyir* (direct cause). All driving decisions, including errors that cause accidents, originate from the algorithm design, training data, and system architecture, which are entirely the manufacturer's responsibility. Therefore, at Levels L4 and L5, the appropriate regime is pure strict liability. The manufacturer is liable for every accident occurring while the vehicle is in fully autonomous mode, without the victim needing to prove specific fault in the AI design. It is sufficient to show that the accident occurred and that the vehicle was operating autonomously, and liability directly attaches to the manufacturer [17].

The second pillar, which is the logical corollary of strict liability at high levels, is the reversal of the burden of proving causation. The fundamental procedural principle that he who asserts must prove (*actori incumbit probatio*) becomes unjust if rigidly applied in autonomous vehicle accident cases at Levels L4 and L5. The reason is fundamental: there is an extreme imbalance of information access between the victim and the manufacturer. Accident victims, typically users or passengers, have no access to the algorithm source code, trip log data, event data recorder, or the architecture of the AI decision-making system. Technically, it is nearly impossible for a victim to prove that a specific AI decision for example, the decision not to brake even though sensors detected a pedestrian was the direct cause of the accident. By contrast, the manufacturer has monopolistic access to all such data [18]. This condition creates an evidentiary imbalance that cannot be justified in a rule-of-law state that upholds justice. Therefore, once the victim has made a *prima facie* showing that the accident occurred while the vehicle was operating autonomously and there was no unreasonable human intervention (for instance, the occupant did not touch the steering wheel or pedals), the burden of proof should shift entirely to the manufacturer [19]. The manufacturer must prove one or more of the following cumulatively or alternatively: first, that the AI system functioned in accordance with the technical specifications approved by the regulatory authority; second, that the accident was caused solely by an external factor that could not have been anticipated by the highest technological standards, such as illegal sabotage, unpreventable cyberattack, or truly extraordinary natural disaster; or third, that the victim explicitly and knowingly violated clear usage instructions, for example, by sitting in the driver's seat in a position that obstructed safety sensors [20]. This reversal-of-proof approach aligns with the *res ipsa loquitur* doctrine recognized in various common law jurisdictions, and in civil law systems can be justified under the principle of substantive justice, which is a general principle of law universally acknowledged.

The third pillar, often overlooked in purely legal discussions, is a risk-financing mechanism. Without adequate insurance and compensation fund mechanisms, legal reform remains sterile because victims may be unable to enforce damages if the manufacturer is bankrupt or lacks sufficient assets. Indonesia should mandate manufacturer liability insurance for every autonomous vehicle imported, produced, or operated within its territory. Minimum coverage limits should be set progressively according to risk level, for example, IDR 1 billion for Level L3 vehicles, IDR 3 billion for Level L4, and IDR 5 billion for Level L5. Such insurance policies must cover damages for death, serious injury, and property damage caused by autonomous system error [21]. Additionally, a no-fault victim compensation fund for autonomous accidents should be established. This fund could be financed by a mandatory levy per unit from manufacturers (e.g., IDR 1 million per vehicle) and an initial government subsidy. The fund functions as a last-resort payer when the manufacturer is unable to pay due to bankruptcy, when insurance coverage is insufficient, or when causation cannot be definitively determined despite reversal of the burden of proof. This fund would pay basic compensation to victims within a short period, for instance, 30 days after the accident, without waiting for litigation to conclude. Subsequently, the fund would have subrogation rights to sue the manufacturer separately if it is later proven that the accident was caused solely by the manufacturer's fault [22]. This scheme not only protects victims from the uncertainty of lengthy judicial proceedings but also provides deterrence to manufacturers, as their insurance premiums will increase in line with the claim rate against the compensation fund. The combination of tiered liability based on automation levels, reversal of the burden of proof for Levels L4 and L5, and mandatory insurance and a national compensation fund creates an adaptive and fair legal framework. Indonesia must take concrete legislative action—whether through revision of Law No. 8 of 1999 on Consumer Protection, amendment of the Civil Code particularly regarding unlawful acts, or the enactment of a special law on artificial intelligence and autonomous vehicles. This action must be taken before autonomous vehicle technology becomes widespread on Indonesian roads, because otherwise, the disputes that arise cannot be resolved fairly by an outdated legal framework unprepared for the reality of technological disruption.

5. Conclusion

This research concludes that Indonesian civil law, which adheres to a binary causation theory through the *conditio sine qua non* and proximate cause approaches, is incapable of addressing manufacturer liability in autonomous vehicle accidents because it ignores the multi-factorial and non-linear nature of artificial intelligence decisions. By contrast, Kuwaiti civil law, with its gradation of *al-sabab al-mubasyir* and *al-sabab al-mutasabib*, as well as strict liability for dangerous objects (Article 229), offers a more adaptive and proportional framework. Based on this comparison, a reformulation of manufacturer liability in Indonesia is recommended through three pillars: first, tiered liability based on SAE automation levels, where Levels L0–L2 remain with the driver, Level L3 uses proportional division akin to *mutasabib*, and Levels L4–L5 apply pure strict liability; second, reversal of the burden of proving causation at Levels L4–L5 after the victim establishes a *prima facie* case, given the information imbalance; third, the establishment of mandatory insurance and a no-fault compensation fund as a risk-financing mechanism. This reform requires amendments to the Indonesian Civil Code or the enactment of a special law on artificial intelligence and autonomous vehicles, in order to guarantee certainty, justice, and safety incentives for manufacturers in the era of technological disruption.

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