



The Normative Boundaries of Artificial Intelligence Liability in Autonomous Decision-Making: A Doctrinal Analysis of Emerging Legal Principles

Febryan Hidayat^{1*}, Danang Purnomo Jakti², Muttorik Alil Abasir³

¹ STAI Jajar Islamic Center, Indonesia

² Universitas Kristen Satya Wacana, Indonesia

³ Institut Islam Mambaul Ulum Surakarta, Indonesia

email: febryanhidayat@staijic.ac.id¹

Article Info :

Received:

18-05-2026

Revised:

26-05-2026

Accepted:

07-06-2026

Abstract

The rapid deployment of artificial intelligence (AI) within autonomous decision-making systems has generated profound challenges for traditional legal doctrines of liability, accountability, and responsibility attribution. This study examines the normative boundaries of AI liability through a doctrinal and normative legal research approach based on statutory regulations, international legal instruments, judicial decisions, regulatory frameworks, and contemporary legal scholarship. The analysis focuses on the evolving relationship between legal personhood, fault, foreseeability, risk allocation, and accountability within increasingly autonomous technological environments. The findings demonstrate that existing legal systems continue to reject the attribution of independent legal liability to AI systems despite their growing operational autonomy. Liability remains primarily attached to developers, deployers, operators, data controllers, and institutional actors whose decisions shape the design, governance, and deployment of AI technologies. Contemporary legal developments reveal a gradual shift from exclusively fault-based liability toward hybrid frameworks integrating risk management, preventive obligations, and accountability-based governance. The study concludes that the most coherent doctrinal model is a layered accountability framework in which responsibility is allocated according to governance capacity, control, risk creation, and regulatory obligations, thereby preserving legal certainty while accommodating technological transformation in autonomous decision-making ecosystems.

Keywords : Artificial Intelligence, Autonomous Decision-Making, Liability Attribution, Legal Accountability, Risk Governance.



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INTRODUCTION

The accelerated integration of artificial intelligence (AI) into autonomous decision-making environments has transformed the architecture of legal responsibility across both public and private spheres, generating unprecedented challenges for traditional doctrines of accountability, attribution, and legal personhood. Contemporary AI systems no longer operate merely as passive computational instruments but increasingly perform predictive, evaluative, and quasi-discretionary functions capable of producing legal, economic, and social consequences without continuous human intervention. This technological evolution has stimulated a global jurisprudential debate concerning the normative limits of liability allocation when harmful outcomes emerge from algorithmic decisions that are neither entirely human-generated nor wholly independent from human design structures. Existing scholarship has observed that AI is progressively reshaping legal institutions, professional legal practices, and governance mechanisms, compelling legal systems to reconsider foundational assumptions regarding agency, intent, fault, and responsibility (Taufiqurrohman, 2024). Similar concerns have emerged in discussions regarding AI's potential recognition within legal frameworks, where the increasing autonomy of intelligent systems challenges conventional classifications that historically distinguished legal subjects from legal objects (Jaya & Goh, 2021; Amboro & Komarhana, 2021). The growing deployment of AI across legislative support systems, educational environments, industrial processes, and decision-support infrastructures has consequently elevated the urgency of defining coherent liability boundaries capable of preserving legal certainty without obstructing technological innovation (Yudoprakoso, 2019; Nurahman & Pribadi, 2022; Halim, 2024).

A substantial body of literature has attempted to address these developments through diverse conceptual approaches, yet significant divergences remain concerning the appropriate normative framework for regulating autonomous systems. Several scholars argue that the increasing sophistication of AI necessitates a reconsideration of legal subjectivity, contending that traditional anthropocentric legal doctrines may become insufficient when intelligent systems perform functions previously reserved for human actors (Jaya & Goh, 2021; Amboro & Komarhana, 2021). Parallel studies have explored the possibility of extending specific legal capacities to AI, particularly in intellectual property contexts, where machine-generated innovation raises questions concerning authorship, inventorship, and entitlement to legal protection (Akbar & Sarifudin, 2024). Other contributions reject such expansionist approaches and instead emphasize the adaptability of existing legal doctrines, maintaining that accountability must remain anchored in human actors, institutions, or corporate entities responsible for the design, deployment, and supervision of technological systems (Kusumawardani, 2019). Collectively, these studies reveal an emerging consensus that AI challenges conventional legal categories while simultaneously exposing a deeper disagreement regarding whether legal evolution should proceed through doctrinal adaptation, regulatory innovation, or conceptual reconstruction of legal responsibility itself.

Despite their theoretical richness, existing studies exhibit several limitations that restrict their capacity to resolve liability questions arising from autonomous decision-making. Much of the current literature concentrates on the status of AI as a potential legal subject, ethical concerns surrounding technological deployment, or the institutional implications of automation, while comparatively limited attention has been devoted to identifying the precise normative thresholds at which liability should shift among developers, operators, deployers, users, and autonomous systems themselves (Akbar & Sarifudin, 2024; Yanto, 2025). The dominant discourse frequently conflates debates concerning legal personhood with questions of legal accountability, creating analytical ambiguity regarding whether recognition of legal status necessarily entails independent liability-bearing capacity (Jaya & Goh, 2021; Amboro & Komarhana, 2021). Equally problematic is the tendency to treat AI autonomy as a binary condition rather than a spectrum of operational independence, a simplification that obscures the complex causal chains through which algorithmic decisions are generated and executed. Such conceptual fragmentation has prevented the emergence of a coherent doctrinal framework capable of distinguishing between responsibility for system design, responsibility for system operation, and responsibility for emergent autonomous outcomes.

The persistence of these unresolved issues generates substantial scientific and practical consequences because liability uncertainty directly affects regulatory effectiveness, judicial consistency, technological governance, and public trust in AI-mediated decision-making systems. Autonomous algorithms increasingly influence domains involving legal interpretation, administrative governance, education, intellectual production, and socially consequential decision processes, creating scenarios in which harmful outcomes may arise without easily identifiable human fault (Taufiqurrohman, 2024; Yanto, 2025). Existing legal doctrines founded upon intention, negligence, foreseeability, and causation encounter significant difficulties when applied to systems capable of adaptive learning and partially unpredictable behavior. Scholarly discussions concerning AI-assisted legal reasoning, progressive legal adaptation, and technologically mediated decision structures demonstrate that conventional liability frameworks were largely developed for human actors operating within relatively transparent causal environments, whereas contemporary AI systems generate layered decision pathways that complicate attribution mechanisms and weaken traditional assumptions regarding control and foreseeability (Kusumawardani, 2019; Yudoprakoso, 2019; Halim, 2024). The absence of a principled framework for determining liability boundaries consequently risks producing regulatory gaps, inconsistent adjudication, and diminished legal legitimacy in technologically intensive contexts.

Positioned within this evolving scholarly landscape, the present study departs from debates primarily centered on legal personality and instead focuses on the doctrinal architecture governing liability allocation in autonomous decision-making systems. Existing research has generated valuable insights regarding AI's legal status, ethical implications, educational applications, and transformative effects on legal institutions, yet the normative principles that should delimit responsibility across interconnected human and technological actors remain insufficiently theorized (Taufiqurrohman, 2024; Jaya & Goh, 2021; Yanto, 2025). This study addresses that deficiency by examining how emerging

legal principles concerning causation, control, foreseeability, accountability, and risk distribution can be systematically interpreted within contemporary liability doctrine. The analysis seeks to move beyond categorical inquiries regarding whether AI should become a legal subject and instead interrogates the more foundational question of how legal systems should construct normative boundaries capable of allocating responsibility in environments characterized by varying degrees of machine autonomy, human oversight, and algorithmic unpredictability.

This research aims to develop a doctrinal understanding of the normative boundaries of artificial intelligence liability in autonomous decision-making by critically examining the conceptual foundations and emerging legal principles that govern responsibility attribution in technologically mediated environments. The study contributes theoretically by reconstructing the relationship between autonomy, accountability, and legal responsibility within contemporary liability doctrine, while contributing methodologically through a systematic doctrinal analysis that integrates fragmented debates into a coherent analytical framework for evaluating liability allocation across complex human–AI interactions. The resulting framework is intended to clarify unresolved questions concerning responsibility distribution, strengthen doctrinal coherence, and provide a foundation for future legal development in increasingly autonomous technological ecosystems.

RESEARCH METHODS

This study constitutes a non-empirical legal research employing a doctrinal and normative approach to examine the evolving boundaries of artificial intelligence liability within autonomous decision-making systems. The research is primarily based on secondary legal materials comprising international legal instruments, statutory regulations, regulatory guidelines, judicial decisions, soft-law frameworks, and authoritative legal scholarship addressing artificial intelligence governance, legal responsibility, tort liability, algorithmic accountability, and emerging doctrines of technological regulation. The doctrinal inquiry is complemented by a comparative examination of regulatory and scholarly developments across multiple jurisdictions in order to identify converging and diverging legal approaches to responsibility attribution in AI-mediated environments. These sources are selected on the basis of their normative relevance, doctrinal authority, and contribution to contemporary debates concerning the allocation of liability in circumstances involving varying degrees of machine autonomy and human oversight.

The analytical framework is grounded in doctrinal legal reasoning and normative interpretation, employing conceptual analysis, systematic interpretation, and legal principle-based examination to assess the coherence and adequacy of existing liability doctrines when applied to autonomous artificial intelligence systems. The study interprets legal norms through the interconnected lenses of causation, foreseeability, control, accountability, fault, and risk allocation, enabling a critical evaluation of how emerging legal principles reshape traditional assumptions regarding responsibility attribution. Through a process of doctrinal synthesis, the research identifies normative patterns, conceptual tensions, and regulatory gaps within contemporary legal discourse, subsequently reconstructing a coherent analytical framework capable of delineating the boundaries of liability between developers, operators, deployers, and autonomous systems. This interpretative methodology facilitates a rigorous assessment of the extent to which existing legal doctrines remain capable of accommodating increasingly autonomous forms of technological decision-making.

RESULTS AND DISCUSSION

Doctrinal Construction of Liability Attribution in Autonomous Artificial Intelligence Decision-Making

The emergence of autonomous artificial intelligence systems has generated a fundamental doctrinal tension concerning the allocation of legal responsibility when decision-making processes are partially detached from direct human control. Classical liability doctrines in both civil law and common law traditions were historically constructed upon assumptions that harmful conduct originates from identifiable legal subjects possessing legally cognizable intention, negligence, or controllable behavior. Autonomous decision-making architectures challenge these assumptions because algorithmic outcomes may emerge through adaptive computational processes that neither developers nor operators can fully predict at the moment of deployment. Article 1365 of the Indonesian Civil Code requires the existence of an unlawful act attributable to a responsible actor, while Article 1366 extends liability to negligent

conduct, creating interpretative difficulties when causal chains involve machine learning systems whose outputs evolve through continuous data processing. Similar tensions appear within comparative legal discourse where the conceptual separation between instrumentality and agency increasingly becomes blurred as artificial intelligence performs functions previously associated with human discretion (Chesterman, 2020; Petit, 2017).

A grammatical interpretation of liability provisions demonstrates that contemporary legal systems predominantly continue to regard artificial intelligence as an object of law rather than an independent bearer of rights and obligations. Article 1 of Regulation (EU) 2024/1689 concerning the Artificial Intelligence Act adopts a risk-governance approach focused upon providers, deployers, importers, distributors, and users rather than attributing legal personality to artificial intelligence itself. Indonesian positive law likewise recognizes legal subjects through established categories consisting of natural persons and legal entities, a structure that has not been expanded to encompass autonomous computational systems. The doctrinal position articulated by Jaya and Goh (2021) indicates that artificial intelligence lacks normative standing within existing legal subject frameworks despite its increasing functional autonomy. Amboro and Komarhana (2021) similarly argue that doctrinal expansion toward artificial legal personhood encounters significant obstacles because legal accountability remains grounded in normative assumptions concerning rights, duties, and legal capacity.

The debate concerning artificial intelligence legal personality remains closely connected to broader questions regarding liability attribution because responsibility traditionally follows legal subjecthood. Akbar and Sarifudin (2024) demonstrate that controversies surrounding artificial intelligence inventorship within patent law reveal deeper uncertainties regarding the legal consequences of autonomous technological creativity. Tsoukalas (2025) argues that assigning obligations to autonomous systems without corresponding enforcement mechanisms produces conceptual inconsistencies that weaken legal coherence. Doctrinal analysis reveals that legal personality cannot be treated as a purely symbolic designation because the attribution of liability requires enforceable normative consequences and recognizable legal capacity. Existing legal systems continue to reserve these attributes for human and corporate actors despite the increasing sophistication of autonomous technologies.

Systematic interpretation of liability norms indicates that contemporary legal frameworks implicitly prioritize human-centered accountability even when algorithmic autonomy appears substantial. Product liability regimes, negligence doctrines, fiduciary obligations, and regulatory compliance structures consistently identify developers, manufacturers, operators, and deployers as legally relevant actors. The logic underlying this approach reflects the principle that technological systems remain embedded within human-created governance structures regardless of their operational complexity. Braun (2025) emphasizes that cognitive autonomy exhibited by advanced artificial intelligence systems does not automatically generate independent legal accountability because legal responsibility remains anchored in normative institutions rather than technical functionality. Rachum-Twaig (2019) reaches a comparable conclusion by demonstrating that ownership, control, and benefit relationships continue to influence judicial reasoning regarding responsibility allocation involving autonomous systems.

The doctrinal significance of causation becomes particularly evident when autonomous systems generate harmful outcomes that were not specifically intended by any identifiable actor. Traditional legal analysis generally requires a demonstrable connection between conduct and harm before liability can be imposed. Artificial intelligence systems complicate this requirement because learning processes may produce outcomes that differ substantially from original programming expectations. Kovac (2022) characterizes these situations as unanticipated hazards emerging from adaptive technological environments. Legal systems consequently face the challenge of determining whether liability should follow direct causation, foreseeable risk creation, or broader notions of regulatory responsibility.

The comparative evolution of international legal frameworks illustrates divergent approaches toward these causation problems. European regulatory instruments increasingly emphasize ex ante risk management obligations, whereas traditional tort regimes frequently focus upon ex post attribution of fault and damage. The distinction becomes significant because autonomous decision-making systems often create diffuse causal pathways involving data suppliers, software developers, platform operators, and end users. Karanasiou and Pinotsis (2017) observe that deep learning architectures produce multiple

layers of automated decision-making that complicate conventional legal assumptions regarding transparency and causal accountability.

Orwat et al. (2022) similarly identify normative difficulties arising from the interaction between algorithmic opacity and risk-regulation frameworks designed for more predictable technological environments. The normative structure emerging from comparative legal developments can be illustrated through the following doctrinal mapping:

Table 1. Comparative Typology of Liability Models for Autonomous Artificial Intelligence Systems

Liability Model	Primary Actor	Responsible	Legal Basis	Normative Limitation
Fault-Based Liability	Developer/Operator		Negligence and Due Care	Requires proof of breach
Product Liability	Manufacturer/Provider		Defect-Based Responsibility	Difficulty identifying AI defects
Regulatory Liability	Deployer/Institution		Compliance Obligations	Dependent on statutory duties
Strict Liability	Risk Creator		Hazard Principle	Allocation Scope remains contested

The table demonstrates that contemporary legal systems continue to locate accountability within human or institutional actors rather than autonomous technologies themselves. Leslie (2024) notes that jurisdictions adopting stricter liability standards frequently justify such approaches through risk-distribution principles rather than recognition of machine agency. Comparative analysis reveals a gradual movement toward hybrid liability structures combining fault-based and risk-based elements.

Teleological interpretation further supports human-centered accountability because the fundamental objectives of liability law include deterrence, compensation, corrective justice, and regulatory compliance. Artificial intelligence systems cannot presently internalize sanctions, compensate victims, or modify behavior in response to legal punishment in the same manner as legal subjects. Sonali and Parija (2026) demonstrate this limitation within criminal law by emphasizing the incompatibility between autonomous algorithmic behavior and traditional mens rea requirements. Similar concerns emerge within civil liability where responsibility presupposes a legally meaningful relationship between conduct and normative consequences. Functional autonomy therefore does not necessarily translate into juridical autonomy.

Theoretical developments within progressive legal thought provide additional insight into the adaptability of liability doctrines. Kusumawardani (2019) argues that technological transformation should not be viewed as a justification for abandoning fundamental legal principles but rather as a catalyst for doctrinal reinterpretation. Progressive legal reasoning permits the evolution of responsibility frameworks while preserving normative commitments to justice, accountability, and legal certainty. Such an approach accommodates technological innovation without prematurely recognizing artificial intelligence as an independent bearer of legal obligations. Taufiqurrohman (2024) similarly contends that legal institutions must adapt to automation through normative reconstruction rather than conceptual displacement of human responsibility.

Doctrinal synthesis indicates that the normative boundary of artificial intelligence liability remains anchored in the principle that autonomous systems function as legally significant sources of risk rather than autonomous bearers of legal responsibility. Comparative legislation, judicial reasoning, international regulatory instruments, and scholarly doctrine consistently reveal resistance toward attributing independent liability to artificial intelligence despite growing operational autonomy. Emerging legal principles increasingly emphasize control, foreseeability, risk creation, compliance obligations, and benefit allocation as determinants of responsibility attribution. The analytical trajectory observable across contemporary legal systems points toward expanded obligations for developers, deployers, and institutional actors rather than recognition of artificial intelligence as a fully autonomous

legal subject. This doctrinal configuration establishes the foundational architecture upon which subsequent analyses concerning fault, risk allocation, and emerging liability models must be constructed.

Fault, Foreseeability, and Risk Allocation as Emerging Normative Boundaries of Artificial Intelligence Liability

The doctrinal evolution of artificial intelligence liability increasingly revolves around the relationship between fault, foreseeability, and risk allocation, three concepts that have become central determinants in contemporary attempts to define the normative limits of responsibility within autonomous decision-making environments. Traditional liability doctrines were developed upon the assumption that harmful consequences can generally be traced to identifiable acts or omissions committed by legal subjects capable of exercising meaningful control over their conduct. Autonomous artificial intelligence systems disrupt this assumption because algorithmic outputs frequently emerge from probabilistic learning processes that cannot be reduced to linear causal sequences. Article 1365 and Article 1366 of the Indonesian Civil Code continue to require demonstrable fault or negligence as foundational elements of liability, while comparative legal developments increasingly recognize situations in which harmful outcomes may arise despite the absence of readily identifiable human misconduct. The resulting doctrinal tension concerns whether fault remains the primary basis of liability or whether responsibility should be reconstructed through broader risk-allocation mechanisms capable of addressing technologically generated uncertainty.

The principle of foreseeability occupies a particularly significant position within this debate because legal responsibility has historically been linked to the capacity of actors to anticipate and prevent reasonably predictable harm. Artificial intelligence systems challenge this principle by introducing adaptive behaviors that may evolve beyond the precise expectations of developers and deployers after deployment. Chesterman (2020) notes that autonomy should not be understood merely as operational independence but as a condition that complicates predictive assessments concerning future conduct and resulting legal consequences. European legal developments increasingly acknowledge that machine learning systems can generate outcomes that remain partially unforeseeable despite rigorous design and testing procedures. Judicial and regulatory institutions consequently face the difficult task of determining the threshold at which unpredictability becomes sufficient to limit fault-based liability without undermining the protective functions of private law.

Comparative analysis demonstrates that jurisdictions adopting risk-oriented regulatory approaches frequently reinterpret foreseeability through the lens of *ex ante* responsibility rather than *ex post* certainty. Regulation (EU) 2024/1689 concerning Artificial Intelligence establishes obligations relating to risk assessment, transparency, data governance, human oversight, and post-market monitoring, reflecting a normative assumption that actors introducing artificial intelligence into society bear responsibility for foreseeable categories of risk even when specific harmful outcomes remain uncertain. The legal significance of this framework lies in its departure from conventional fault paradigms centered exclusively upon identifiable negligent conduct. Orwat et al. (2022) argue that contemporary risk regulation increasingly focuses upon systemic vulnerabilities rather than individualized fault because complex technological systems produce harms that emerge from interconnected institutional and technical conditions. Such developments indicate a gradual transition from retrospective blame attribution toward prospective governance obligations.

The relationship between fault and risk becomes particularly complex when autonomous systems produce harmful decisions through interactions among multiple actors operating within distributed technological ecosystems. Developers design algorithms, data providers contribute informational inputs, deployers determine operational contexts, and users interact with outputs that may subsequently influence consequential decisions. No single participant necessarily exercises comprehensive control over every stage of algorithmic functionality. Braun (2025) argues that cognitive autonomy exhibited by advanced reasoning systems weakens traditional assumptions that liability should correspond directly to immediate operational control. Legal analysis consequently requires a more sophisticated understanding of responsibility capable of accommodating fragmented forms of technological governance.

The doctrinal implications of these developments become evident when examining liability models associated with high-risk artificial intelligence applications. Autonomous vehicles, predictive

healthcare systems, financial algorithms, and automated employment screening technologies illustrate contexts in which harmful outcomes may arise despite compliance with prevailing technical standards. Von Ungern-Sternberg (2018) demonstrates that autonomous driving systems generate scenarios involving tragic choices where every available option produces legally relevant harm.

Nogaroli (2025) similarly highlights the challenges associated with medical liability when algorithmic recommendations influence clinical decisions yet remain partially opaque to healthcare professionals. These examples reveal that fault-based doctrines frequently encounter difficulties when attempting to identify a singular point of legal failure within complex technological environments. The comparative doctrinal approaches emerging across different legal systems may be summarized through the following normative classification:

Table 2. Comparative Assessment of Fault-Based, Risk-Based, and Hybrid Liability Approaches in Artificial Intelligence Governance

Liability Criterion	Fault-Based Model	Risk-Based Model	Hybrid Model
Primary Focus	Negligent Conduct	Risk Creation	Combined Assessment
Burden of Proof	Claimant	Shared/Modified	Context Dependent
Foreseeability Function	Element of Fault	Element of Risk Governance	Dual Function
AI Autonomy Relevance	Limited	Significant	Significant
Regulatory Compatibility	Moderate	High	High

The table illustrates that contemporary legal developments increasingly favor hybrid approaches capable of integrating traditional fault concepts with broader risk-management obligations. Leslie (2024) observes that neither pure strict liability nor conventional negligence frameworks adequately address the unique characteristics of autonomous artificial intelligence systems. Hybrid structures attempt to preserve fairness while ensuring effective victim protection and technological accountability.

Risk allocation theory provides an additional analytical framework for understanding these developments because responsibility may be assigned to actors who are best positioned to prevent harm, absorb losses, or distribute costs. Product liability regimes historically employed similar reasoning when allocating responsibility to manufacturers possessing superior knowledge and control over product design. Artificial intelligence governance increasingly adopts analogous logic by imposing obligations upon entities responsible for developing, deploying, or benefiting from algorithmic systems.

Rachum-Twaig (2019) argues that liability attribution should reflect relationships of ownership, economic benefit, and operational authority rather than metaphysical debates concerning machine agency. Such reasoning shifts doctrinal attention toward institutional capacity and risk governance rather than abstract inquiries into technological autonomy.

The interaction between data governance and liability allocation further demonstrates the limitations of purely fault-based approaches. Artificial intelligence systems depend upon extensive datasets whose quality, legality, and representativeness directly influence algorithmic outcomes. Regulatory instruments such as the European Union General Data Protection Regulation and emerging artificial intelligence legislation impose obligations concerning data accuracy, transparency, accountability, and fairness. Kirana and Silalahi (2025) note that personal data protection frameworks increasingly intersect with artificial intelligence governance because algorithmic harms frequently originate from deficiencies in data management rather than coding errors alone. Liability analysis must therefore encompass informational infrastructures that contribute to autonomous decision-making processes.

Theoretical perspectives derived from legal ethics and technological governance reinforce the necessity of integrating fault and risk considerations within a unified analytical framework. Magrani (2019) contends that emerging artificial intelligence systems require legal responses capable of addressing ethical and normative concerns extending beyond conventional liability categories. Yanto (2025) similarly emphasizes that accountability mechanisms remain indispensable in environments where algorithmic technologies increasingly influence professional and institutional decision-making. Halim (2024) identifies comparable challenges within contemporary legal-religious reasoning, where

artificial intelligence may assist interpretative processes while remaining incapable of assuming normative responsibility for resulting conclusions. These perspectives collectively suggest that responsibility should continue to reside within human and institutional structures despite increasing levels of technological sophistication.

Doctrinal synthesis reveals that fault, foreseeability, and risk allocation operate not as competing principles but as complementary normative boundaries shaping contemporary artificial intelligence liability. Comparative legislation, judicial reasoning, and scholarly doctrine increasingly recognize that autonomous decision-making systems require liability frameworks capable of addressing both identifiable misconduct and structurally generated technological risks. Emerging legal models do not eliminate fault as a foundational concept, yet they reinterpret fault within broader governance architectures emphasizing preventive obligations, institutional accountability, and risk management. Foreseeability functions less as a requirement of precise prediction and more as a standard for evaluating whether responsible actors implemented adequate safeguards against reasonably anticipated categories of harm. The resulting doctrinal trajectory reflects a transition toward integrated liability frameworks in which accountability is determined through the combined assessment of control, precaution, benefit, and risk creation within technologically mediated environments.

Reconstructing a Normative Framework for Artificial Intelligence Liability in Autonomous Decision-Making Systems

The continuing expansion of autonomous artificial intelligence systems has exposed structural limitations within traditional liability doctrines, creating the necessity for a reconstructed normative framework capable of preserving legal certainty while accommodating increasingly complex forms of technological autonomy. Existing legal regimes were designed within institutional contexts where human actors occupied the center of decision-making processes, allowing responsibility to be linked directly to intention, negligence, control, or omission. Contemporary artificial intelligence systems increasingly challenge this architecture because significant legal consequences may emerge from algorithmic operations involving distributed data infrastructures, adaptive learning mechanisms, and multiple layers of human and institutional participation. The central juridical question concerns whether existing doctrines can be interpreted expansively to accommodate these developments or whether an independent liability framework is required to address autonomous technological decision-making. Comparative legal developments indicate that doctrinal adaptation remains preferable to radical conceptual transformation because established principles continue to provide normative foundations capable of supporting technological governance.

The reconstruction of liability doctrine requires careful consideration of the distinction between functional autonomy and juridical autonomy. Autonomous systems may perform sophisticated analytical, predictive, and decision-support functions without possessing the normative attributes traditionally associated with legal personhood. Article 15 of the International Covenant on Civil and Political Rights, principles embedded within civil liability systems, and established doctrines concerning legal capacity all presuppose the existence of actors capable of bearing enforceable legal obligations. Artificial intelligence systems presently lack the institutional characteristics necessary for independent participation in legal relations. Tsoukalas (2025) argues that extending legal personality to autonomous systems without corresponding mechanisms for rights enforcement, asset ownership, and normative accountability would generate significant doctrinal inconsistencies rather than resolve existing liability challenges.

A systematic interpretation of comparative legal developments reveals an emerging preference for responsibility frameworks grounded in layered accountability rather than artificial legal personhood. Regulation (EU) 2024/1689 concerning Artificial Intelligence imposes differentiated obligations upon providers, deployers, importers, distributors, and users according to their respective roles within technological ecosystems. The normative significance of this approach lies in its recognition that responsibility should correspond to the capacity of actors to influence risk creation, risk mitigation, and operational governance. Kovac (2022) observes that autonomous technologies generate novel categories of unanticipated hazards requiring regulatory structures capable of addressing uncertainty without abandoning established principles of accountability. Such developments suggest that the future of artificial intelligence liability lies in refined responsibility allocation rather than the creation of autonomous technological legal subjects.

The doctrinal relevance of control remains particularly significant within this reconstructed framework because liability traditionally reflects the capacity of actors to influence legally relevant outcomes. Artificial intelligence systems frequently operate within environments where control is distributed among developers, software providers, data managers, deployers, and institutional decision-makers. Complete operational control may not exist at any singular point within the technological chain. Karanasiou and Pinotsis (2017) emphasize that deep learning architectures introduce multiple layers of automated decision-making that complicate conventional assumptions regarding transparency and direct supervision. Legal analysis consequently requires a more nuanced understanding of control based upon governance capacity rather than immediate operational intervention.

The principle of accountability offers an alternative normative foundation capable of addressing these challenges without abandoning established legal doctrine. Accountability extends beyond narrow notions of fault by incorporating obligations relating to transparency, oversight, documentation, auditing, compliance, and corrective action. Regulatory instruments increasingly employ accountability-based approaches to govern high-risk artificial intelligence systems.

Taufiqurrohman (2024) notes that the growing integration of automation within legal institutions requires mechanisms ensuring that technologically mediated decisions remain subject to meaningful human responsibility. Similar arguments appear within discussions concerning artificial intelligence ethics, where institutional accountability functions as a safeguard against the erosion of normative oversight (Yanto, 2025). The emerging structure of liability allocation can be illustrated through the following doctrinal matrix:

Table 3. Normative Allocation of Legal Responsibility in Autonomous Artificial Intelligence Ecosystems

Actor Category	Primary Obligation	Legal Liability Trigger	Normative Basis
Developer	Safe Design and Testing	Design Defect	Due Care Principle
Data Controller	Lawful Data Governance	Data-Related Harm	Accountability Principle
Deployer	Operational Oversight	Improper Implementation	Risk Management Principle
User	Appropriate Utilization	Misuse of System	Fault Principle
Regulator	Supervisory Governance	Regulatory Failure	Public Responsibility Principle

The matrix demonstrates that contemporary liability frameworks increasingly rely upon differentiated obligations corresponding to specific institutional functions. Responsibility is distributed according to governance capacity rather than technological autonomy. Comparative legal analysis reveals growing convergence around this model across multiple regulatory systems.

The significance of this approach becomes particularly apparent when examining sectors characterized by elevated risks and substantial public interests. Medical decision-support systems, autonomous transportation technologies, algorithmic financial services, and predictive legal analytics all involve circumstances where technological errors may generate severe consequences. Nogaroli (2025) demonstrates that medical liability disputes involving artificial intelligence frequently require evaluation of interactions among healthcare professionals, software developers, healthcare institutions, and data infrastructures. Faathurrahman and Priowirjanto (2022) identify comparable complexities in cases involving deepfake technologies, where harmful outcomes emerge through combinations of technological capability and human misuse. Liability frameworks grounded exclusively in individual fault encounter substantial difficulties when addressing these multifactorial environments.

The relationship between accountability and legal certainty further strengthens the argument for doctrinal reconstruction rather than doctrinal replacement. Legal certainty requires that actors understand the circumstances under which responsibility may arise and the standards governing their conduct. Artificial intelligence systems characterized by adaptive learning and algorithmic opacity increase uncertainty regarding causal attribution and normative expectations. Anovanko, Wijaya, and

Nugraha (2025) demonstrate that commercial contractual relationships involving artificial intelligence increasingly depend upon carefully structured allocations of risk and responsibility because traditional assumptions regarding predictability no longer fully apply. Regulatory frameworks must consequently provide clear standards capable of guiding behavior before harm occurs rather than relying exclusively upon retrospective adjudication.

Teleological interpretation of liability law reinforces this conclusion because the fundamental objectives of compensation, deterrence, corrective justice, and risk prevention remain applicable despite technological transformation. Artificial intelligence does not eliminate the social need for accountability, victim protection, or normative guidance. Magrani (2019) argues that legal systems confronting emerging technologies should focus upon preserving fundamental values while adapting institutional mechanisms to new contexts. Yudoprakoso (2019) similarly emphasizes that technological advancement within legal processes requires normative safeguards capable of maintaining legitimacy and public trust. These perspectives support the development of adaptive liability doctrines grounded in continuity rather than disruption.

Doctrinal synthesis indicates that the normative boundaries of artificial intelligence liability should be reconstructed through a layered accountability framework integrating principles of control, foreseeability, risk creation, compliance, transparency, and institutional responsibility. Comparative legislation, judicial developments, international legal standards, and contemporary legal scholarship consistently reject simplistic approaches based either upon complete human immunity or autonomous machine liability. Emerging legal principles increasingly favor differentiated responsibility structures in which liability follows governance capacity, risk contribution, and regulatory obligations. Autonomous decision-making systems remain legally significant sources of risk, yet responsibility continues to reside within the human and institutional networks that create, deploy, supervise, and benefit from those systems. This reconstructed framework contributes to doctrinal coherence by preserving the foundational logic of liability law while accommodating the realities of increasingly autonomous technological environments.

CONCLUSION

The doctrinal examination demonstrates that the normative boundaries of artificial intelligence liability cannot be adequately determined through traditional conceptions of legal personality or exclusive reliance upon fault-based responsibility. Autonomous decision-making systems increasingly challenge established assumptions regarding causation, control, foreseeability, and accountability, yet contemporary legal developments across national and international frameworks consistently maintain that artificial intelligence remains a legally significant source of risk rather than an independent bearer of legal obligations. Comparative analysis reveals that emerging liability regimes increasingly integrate fault, foreseeability, risk allocation, compliance duties, and accountability principles into a coherent governance structure capable of addressing the complexities of algorithmic autonomy. The most sustainable normative approach is a layered accountability framework that allocates responsibility according to governance capacity, risk contribution, operational control, and institutional oversight among developers, deployers, operators, data controllers, and other relevant actors. Such a framework preserves the foundational objectives of liability law, including legal certainty, corrective justice, deterrence, victim protection, and regulatory effectiveness, while simultaneously enabling legal systems to respond adaptively to the expanding role of artificial intelligence within contemporary autonomous decision-making environments.

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