

Reconstruction of the Fiduciary Security Execution Mechanism for Blockchain-Based Assets Ensuring Legal Certainty

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ARTICLE INFO

Keywords: Fiduciary Security, Blockchain-Based Assets, Legal Certainty, Execution Mechanism, Normative Legal Research.

Received: 20, May

Revised: 15 June

Accepted: 10 July

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ABSTRACT

The rapid growth of blockchain-based digital assets challenges the fiduciary security framework under Law of the Republic of Indonesia Number 42 of 1999 concerning Fiduciary Security, particularly execution mechanisms. This study aims to reconstruct fiduciary execution for blockchain assets to ensure legal certainty and creditor protection. A normative legal method is used with statutory, conceptual, and case approaches, analyzing Law Number 42 of 1999, Law Number 11 of 2008 on Electronic Information and Transactions as amended by Law Number 1 of 2024, and Constitutional Court Decision Number 18/PUU-XVII/2019. Findings show fiduciary execution is not fully compatible with blockchain characteristics, especially private key control and ownership verification. The study concludes that regulatory reconstruction through digital registration and custody-based execution is required.

INTRODUCTION

The rapid development of blockchain-based digital assets has transformed the structure of modern commercial transactions and created new challenges for private law, property law, and security law. Digital assets are no longer merely technological instruments, but have increasingly become economic objects that may represent value, ownership, contractual claims, or investment interests. Globally, blockchain technology allows digital assets to be created, transferred, verified, and stored through distributed ledger systems, smart contracts, and cryptographic control. This development has encouraged legal systems to reconsider whether traditional categories of property and collateral remain sufficient to accommodate digital assets. In the context of fiduciary security, the main legal question is whether assets that are intangible, decentralized, and controlled through private keys can be effectively used and executed as collateral.

The urgency of this issue is strengthened by the growing use of digital assets in financial markets. The 2024 Geography of Cryptocurrency Report shows that crypto adoption continues to expand across various jurisdictions, including developing economies where digital assets are used for investment and financial access (Chainalysis, 2024). Reuters reported that Indonesia recorded approximately United States Dollar 157.1 billion in digital asset trading inflows during the twelve months to July 2024, although cryptocurrencies are not recognized as legal tender and are only permitted as investment assets (Reuters, 2024). At the regulatory level, Financial Services Authority Regulation of the Republic of Indonesia Number 27 of 2024 concerning the Implementation of Digital Financial Asset Trading Including Crypto Assets defines crypto assets as digital representations of value that can be stored and transferred using distributed ledger technology such as blockchain. This condition shows that blockchain-based assets have entered the Indonesian financial ecosystem, but their position within fiduciary security law remains insufficiently regulated.

Indonesian fiduciary security law is primarily governed by Law of the Republic of Indonesia Number 42 of 1999 concerning Fiduciary Security. Article 1 number 1 defines fiduciary as the transfer of ownership of an object based on trust, while the object remains under the control of its owner. Article 1 number 2 further explains that fiduciary security covers movable objects, whether tangible or intangible, and certain immovable objects that cannot be encumbered with mortgage rights. This provision provides a possible conceptual basis for classifying blockchain-based assets as intangible movable objects. However, the law was enacted before the emergence of blockchain technology, so it does not specifically regulate wallet addresses, private keys, smart contracts, token identification, digital custody, or on-chain ownership verification.

The execution mechanism under Law of the Republic of Indonesia Number 42 of 1999 also raises specific problems when applied to blockchain-based assets. Article 11 paragraph (1) requires objects encumbered with fiduciary security to be registered, while Article 15 paragraph (2) provides that a fiduciary certificate has executorial power equivalent to a final and binding court decision. Article 29 paragraph (1) regulates three execution methods, namely execution of the

executorial title, public auction, and private sale based on the agreement of the fiduciary giver and fiduciary receiver. Article 30 further requires the fiduciary giver to deliver the fiduciary object for execution. These provisions are difficult to apply to blockchain assets because the effectiveness of execution depends not only on legal title, but also on technological access, private key control, digital wallet management, and the existence of licensed custodians.

The legal complexity increased after Constitutional Court Decision Number 18/PUU-XVII/2019, which reinterpreted the executorial power of fiduciary certificates. The decision states that if there is no agreement on default and the debtor objects to voluntarily surrendering the fiduciary object, the execution must follow the legal mechanism applicable to the execution of final and binding court decisions. Hamzah and Adinda (2022) argue that this decision created ambiguity because it changed the pattern of fiduciary execution without providing a detailed new norm for implementation. Jamil (2021) also notes that fiduciary security has long been used in Indonesia because it is simple and efficient, but its implementation still faces problems of legal certainty. In the context of blockchain-based assets, this gap becomes more serious because uncertainty is not only procedural, but also technological, evidentiary, and institutional.

Previous international studies and legal reform documents show that digital assets require specific legal treatment. The Law Commission (2023) concludes that certain digital assets, including crypto-tokens, are capable of being objects of personal property rights, but their legal treatment must consider their unique technological characteristics. The International Institute for the Unification of Private Law (2023) also emphasizes the importance of rules on control, transfer, custody, and security rights over digital assets. The Committee on Payments and Market Infrastructures (2024) explains that tokenisation involves generating and recording digital representations of assets on programmable platforms, while the Financial Stability Board (2024) highlights legal, operational, and financial risks arising from tokenised assets. Based on these developments, this study aims to reconstruct the fiduciary security execution mechanism for blockchain-based assets to ensure legal certainty, creditor protection, and enforceability. Theoretically, this study contributes to the development of modern collateral law, while practically it offers a regulatory model involving digital fiduciary registration, licensed custody, and smart contract-based execution.

LITERATURE REVIEW

Blockchain-Based Assets and the Transformation of Property Concept

Blockchain technology has fundamentally transformed the concept of ownership by introducing decentralized and cryptographically secured digital assets. According to David Tapscott and Alex Tapscott (2021), blockchain enables a new form of asset ownership that is not dependent on centralized intermediaries but on distributed ledger validation. Kevin Werbach (2020) further explains that blockchain-based assets create a hybrid legal object that does not fully fit within traditional property classifications. These findings are

relevant because fiduciary law, particularly under conventional civil law systems, still relies on physical control and identifiable objects. Therefore, the emergence of blockchain assets creates a doctrinal tension that justifies the need for legal reconstruction in collateral systems.

Fiduciary Security Framework and Its Structural Limitations

The fiduciary security regime under Law of the Republic of Indonesia Number 42 of 1999 concerning Fiduciary Security was designed for conventional movable assets and not for digital-native objects. Rahmat Satrio (2021) argues that fiduciary law in Indonesia is highly effective for tangible collateral but structurally rigid when applied to intangible or technologically complex assets. Meanwhile, Budi Raharjo (2022) highlights that fiduciary security depends heavily on physical possession and enforceable registration systems, which are incompatible with decentralized digital asset structures. This literature supports the argument that fiduciary law has not evolved alongside technological innovation. Hence, this gap strengthens the urgency of examining how blockchain assets can be legally accommodated within fiduciary frameworks.

Execution Mechanism and Legal Uncertainty After Constitutional Interpretation

Execution of fiduciary collateral is regulated under Article 15 and Article 29 of Law Number 42 of 1999, which provides executorial power equivalent to a final court decision. However, the Constitutional Court Decision Number 18/PUU-XVII/2019 significantly reinterprets execution by requiring debtor consent or judicial process in contested default situations. Rina Hamzah and Fajar Adinda (2022) state that this decision created uncertainty in fiduciary enforcement because it weakened the efficiency of direct execution mechanisms. This situation becomes more problematic when applied to blockchain assets, where enforcement depends on technological access rather than physical surrender. Therefore, existing legal interpretation fails to address the enforcement realities of digital collateral.

Private Key Control and Custodial Ownership Problem

Blockchain introduces a fundamental shift in ownership control through private keys rather than physical possession or legal title. Primavera De Filippi and Aaron Wright (2020) explain that blockchain ownership is enforced through cryptographic control, making legal ownership secondary to technical control. This creates enforcement challenges when fiduciary execution requires asset surrender. Additionally, Dirk Zetsche, Ross Buckley, and Douglas Arner (2020) emphasize that custody risk becomes central in digital asset regulation because loss of private keys equals loss of control. These studies support the need for fiduciary reconstruction because traditional enforcement mechanisms cannot access blockchain assets without technical integration.

Regulatory Development of Digital Financial Assets

Regulatory responses to blockchain assets are emerging but remain fragmented. The Financial Services Authority of the Republic of Indonesia Regulation Number 27 of 2024 concerning Digital Financial Asset Trading defines crypto assets as digital representations of value using distributed ledger technology, but does not integrate them into fiduciary collateral systems. The Financial Stability Board (2024) highlights that tokenization increases efficiency

but introduces legal and operational risks if legal frameworks are not adapted. Similarly, Christine Lagarde and Tobias Adrian (2024) argue that financial stability in digital asset markets depends on legal clarity in ownership, custody, and settlement mechanisms. This shows that regulation exists but remains incomplete in addressing fiduciary enforcement.

Research Gap and Urgency of This Study

Existing literature focuses mainly on blockchain as a technological or financial innovation, but limited research addresses its integration into fiduciary execution systems. The Law Commission of England and Wales (2023) states that digital assets require new legal categorization under property law, but does not provide a structured execution model for secured transactions. This gap is critical because fiduciary law requires enforceability, not only recognition of ownership. Therefore, the absence of a clear execution framework for blockchain-based collateral creates legal uncertainty for creditors and debtors. This study is necessary because it proposes a reconstruction of fiduciary execution through digital registration, custody-based enforcement, and smart contract integration to ensure legal certainty and enforceability in modern digital economies.

METHODOLOGY

Research Design and Approach

This study applies a normative legal research design with a qualitative doctrinal approach. The objective is to reconstruct the fiduciary security execution mechanism for blockchain-based assets within the Indonesian legal system. This research focuses on legal norms, statutory interpretation, and doctrinal analysis rather than empirical observation. The approach used includes statutory approach, conceptual approach, and case approach to examine the coherence between fiduciary law and blockchain-based asset regulation. The study emphasizes legal reconstruction to ensure legal certainty and enforcement effectiveness in digital collateral systems. This normative approach is appropriate because the research deals with legal principles, statutory interpretation, and regulatory gaps rather than behavioral or statistical data.

Sources of Legal Materials

The legal materials in this study consist of primary, secondary, and tertiary legal sources. Primary legal materials include Law of the Republic of Indonesia Number 42 of 1999 concerning Fiduciary Security, Law of the Republic of Indonesia Number 11 of 2008 concerning Electronic Information and Transactions as amended by Law of the Republic of Indonesia Number 1 of 2024, Constitutional Court Decision Number 18/PUU-XVII/2019, and Financial Services Authority Regulation of the Republic of Indonesia Number 27 of 2024 concerning Digital Financial Asset Trading Including Crypto Assets. These instruments are used as the main legal foundation in analyzing fiduciary execution mechanisms. Secondary legal materials include academic journals, legal books, and scholarly articles discussing blockchain law, fiduciary security, and digital asset regulation. Tertiary legal materials consist of legal dictionaries, legal encyclopedias, and institutional reports from international organizations such as the Financial Stability Board (2024), Law Commission of England and

Wales (2023), and International Institute for the Unification of Private Law (2023). All materials are analyzed as doctrinal legal sources.

Data Collection Technique

Data collection is conducted through doctrinal legal document analysis. This technique involves systematically collecting, selecting, and examining relevant legal documents such as statutes, constitutional court decisions, regulatory frameworks, academic literature, and international reports. The selection of data is based on relevance to fiduciary execution, blockchain-based assets, and digital collateral systems. The collected data are then classified into thematic legal categories such as fiduciary registration, execution mechanism, and digital asset control. This method ensures that the research is grounded in authoritative legal sources without involving field surveys or empirical respondents. The focus is on normative interpretation and conceptual legal development.

Data Analysis Technique

The data are analyzed using qualitative juridical analysis with interpretative and prescriptive methods. The first stage involves legal interpretation through systematic and teleological approaches to understand fiduciary norms in the context of digital assets. The second stage involves doctrinal analysis to identify legal gaps between existing fiduciary execution rules and blockchain characteristics. The third stage is legal reconstruction, which develops a new conceptual model of fiduciary execution integrating digital registration systems, licensed custody mechanisms, and smart contract-based execution. The fourth stage includes comparative legal analysis with international frameworks such as those developed by the Law Commission (2023) and the International Institute for the Unification of Private Law (2023). The analysis is conducted manually using normative legal reasoning.

Research Procedure

The research procedure is carried out in sequential stages. The first stage is problem identification, focusing on the incompatibility between fiduciary execution mechanisms and blockchain-based assets. The second stage is the collection of relevant legal materials from national and international sources. The third stage is classification and organization of legal documents into fiduciary law, digital asset regulation, and enforcement mechanisms. The fourth stage involves doctrinal legal interpretation and analysis to identify normative gaps. The fifth stage is reconstruction, where a new fiduciary execution model for blockchain assets is formulated. The final stage is conclusion drawing, which produces legal findings and normative recommendations for improving fiduciary enforcement in digital asset systems.

Research Output Orientation

This study produces a normative reconstruction model of fiduciary security execution for blockchain-based assets. The theoretical contribution lies in expanding fiduciary security doctrine into the digital asset era by integrating blockchain governance into collateral law theory. The practical contribution provides a legal framework that supports digital fiduciary registration systems, licensed digital asset custody, and smart contract-based execution mechanisms.

This output is intended to improve legal certainty, strengthen enforcement effectiveness, and address regulatory gaps in digital collateral systems.

RESULT & DISCUSSION

Legal Incompatibility Of Fiduciary Execution In Blockchain Assets

Fiduciary execution mechanisms in Indonesia are structurally incompatible with blockchain-based assets because the legal system assumes controllable and physically identifiable collateral objects. Law of the Republic of Indonesia Number 42 of 1999 concerning Fiduciary Security Article 1 paragraph (2) Article 11 paragraph (1) Article 29 paragraph (1) and Article 30 regulates fiduciary objects as movable tangible and intangible assets that must be registered and physically deliverable. Article 30 explicitly requires surrender of collateral objects which is not technically possible in blockchain systems that rely on private key control. Constitutional Court Decision Number 18 PUU XVII 2019 further restricts unilateral execution by requiring judicial involvement in disputed default cases. This creates a legal-technical mismatch between fiduciary enforcement and blockchain asset structures (De Filippi & Wright 2020).

The fiduciary framework assumes possession-based control while blockchain assets operate on cryptographic ownership systems. Article 29 paragraph (1) fiduciary execution through auction private sale or executorial title presupposes physical asset transfer. However blockchain assets cannot be transferred through conventional enforcement channels because control is embedded in digital keys. This makes fiduciary execution procedurally ineffective in decentralized asset systems. The mismatch demonstrates structural limitation in traditional secured transaction law.

From a theoretical perspective blockchain introduces a shift from possession-based ownership to control-based digital ownership systems. Legal enforcement theory assumes state-centered execution authority while blockchain relies on decentralized algorithmic enforcement (Werbach, 2020). This creates tension between legal authority and technological autonomy. Fiduciary law does not recognize algorithmic enforcement structures. Therefore doctrinal adaptation is required to bridge legal and technological systems.

Previous research shows fiduciary law is effective in conventional secured transactions but not in digital asset environments. Hamzah and Adinda (2022) highlight uncertainty in fiduciary execution after constitutional interpretation but do not address blockchain enforcement issues. Tapscott and Tapscott (2021) describe blockchain transformation of ownership systems but do not propose legal execution models. This creates a gap between technological transformation and legal enforcement theory. The novelty of this study lies in reconstructing fiduciary execution based on digital control systems.

The gap identified is the absence of an enforceable fiduciary execution model for blockchain-based assets within Indonesian law. Existing fiduciary provisions do not regulate private key control custody systems or smart contract enforcement mechanisms. This results in legal uncertainty in digital collateral execution. This study proposes a reconstructed execution model integrating

digital registration custody-based enforcement and programmable execution systems. This establishes a new legal framework for digital secured transactions.

Regulatory Fragmentation Between Fiduciary Law And Digital Asset Regulation

The Indonesian legal system shows fragmentation between fiduciary security regulation and digital asset governance. Fiduciary law under Law Number 42 of 1999 does not explicitly recognize blockchain assets as collateral objects. Meanwhile digital asset regulation recognizes crypto assets as financial instruments but not secured collateral. Law Number 11 of 2008 concerning Electronic Information and Transactions as amended by Law Number 1 of 2024 Article 5 paragraph (1) only recognizes electronic information as legal evidence. This creates institutional separation between asset recognition and enforcement mechanisms.

Regulatory fragmentation is evident in Financial Services Authority Regulation Number 27 of 2024 concerning Digital Financial Asset Trading Including Crypto Assets. The regulation defines crypto assets as digital representations of value but does not integrate them into fiduciary execution systems. Article 11 paragraph (1) of fiduciary law requires registration but does not accommodate blockchain-based asset registration. Article 29 paragraph (1) provides execution mechanisms that are incompatible with digital asset transfer systems. This results in normative disconnection between financial regulation and civil collateral law.

Constitutional Court Decision Number 97 PUU XI 2013 emphasizes clarity of enforcement authority in legal systems. The decision strengthens the principle that enforcement must be explicitly regulated by statute. However fiduciary enforcement in Indonesia still operates under traditional civil law procedures without digital integration. This creates ambiguity when applied to blockchain-based financial systems. Legal certainty is therefore weakened due to fragmented regulatory design.

From a theoretical perspective systems theory explains that law must maintain structural coupling with technological systems to remain functional (Luhmann, 2020). Computational law theory also states that legal systems must adapt to digital infrastructures to maintain enforceability (Hildebrandt, 2021). Without integration between fiduciary law and blockchain systems enforcement becomes ineffective. This highlights systemic regulatory disconnection in Indonesian law. Therefore legal adaptation is necessary.

Previous research confirms that digital asset regulation requires integrated legal frameworks. Buckley and Arner (2020) emphasize the need for unified digital finance regulation. Allen et al. (2022) highlight legal fragmentation in tokenized asset systems. Ferreira and Sandner (2023) discuss regulatory gaps in digital financial ecosystems. However none of these studies specifically address fiduciary execution integration. The novelty of this study is the development of a unified fiduciary-digital asset regulatory model.

The gap lies in the absence of harmonization between fiduciary law and digital asset regulation in Indonesia. Existing regulations operate independently without enforcement integration. There is no legal mechanism connecting fiduciary execution with blockchain asset control systems. This study proposes a

regulatory integration model combining fiduciary law digital custody and smart contract enforcement. This creates a unified enforcement architecture for digital secured transactions.

Execution Limitation And Technical Inaccessibility Of Blockchain Assets

Fiduciary execution faces significant limitations when applied to blockchain-based assets due to the inability of legal institutions to access cryptographic control systems. Article 30 of Law of the Republic of Indonesia Number 42 of 1999 requires delivery of fiduciary objects for execution, but blockchain assets are controlled exclusively through private keys. Article 29 paragraph (1) allows execution through auction or private sale, yet such mechanisms cannot operate on decentralized digital ledgers. Article 11 paragraph (1) requires registration, but registration does not grant technical access to digital wallets. This creates a practical enforcement gap between legal mandate and technological structure.

Constitutional Court Decision Number 18 PUU XVII 2019 reinforces that execution must follow judicial procedures when debtor consent is absent. This judicial requirement further complicates blockchain execution because courts lack technical authority over cryptographic systems. The fiduciary execution framework therefore becomes procedurally dependent on legal authorization but technically ineffective in enforcement. As a result, legal enforcement loses operational functionality in digital asset environments. This reflects a structural enforcement failure in fiduciary law.

From a theoretical perspective Lessig (2021) explains that code operates as a regulatory system that can override traditional legal enforcement. In blockchain systems enforcement is embedded in protocol rules rather than institutional authority. This creates a dualism between legal enforcement and algorithmic enforcement. Fiduciary law remains based on state-centered enforcement theory which cannot interact directly with blockchain protocols. Therefore enforcement incompatibility arises between law and code systems.

Previous research by Catalini and Gans (2021) explains that blockchain reduces reliance on intermediaries but increases enforcement complexity. Allen et al 2022 highlight that legal systems struggle to enforce rights in decentralized environments. Xu and Chen (2023) emphasize the importance of technological custody mechanisms in digital asset enforcement. However these studies do not address fiduciary execution specifically. This creates a gap in enforcement-focused legal research.

The gap lies in the absence of an enforcement bridge between legal execution authority and blockchain technical control systems. Existing fiduciary law does not provide mechanisms to access or recover private keys. There is no legal integration between courts custodians and blockchain protocols. This study proposes a novel execution model based on judicial-custody hybrid enforcement and smart contract interoperability. This ensures executable legal authority in decentralized asset systems.

Control Based Ownership And Legal Ownership Dualism In Blockchain Systems

Fiduciary law is based on the principle of legal ownership supported by physical or juridical control over assets. However blockchain introduces a

control-based ownership model where possession is determined by private key access rather than legal title. Article 1 paragraph (2) of Law of the Republic of Indonesia Number 42 of 1999 assumes identifiable ownership objects, which is incompatible with cryptographic ownership systems. Article 30 further presumes physical transfer of collateral, which does not exist in blockchain environments. This creates a dualism between legal ownership and technological ownership structures.

Constitutional Court Decision Number 18 PUU XVII 2019 reinforces that execution requires legal validation of default before enforcement. However blockchain systems do not recognize legal validation as part of ownership transfer. Ownership is automatically determined by cryptographic verification rather than judicial approval. This creates a structural separation between legal authority and technological control. Therefore fiduciary enforcement loses operational relevance in blockchain systems.

According to Primavera Wright (2020) blockchain creates self-executing systems where rules are embedded in code rather than law. This shifts governance from legal institutions to protocol-based enforcement systems. Legal ownership becomes secondary to technical control of digital assets. Fiduciary law however is built on institutional enforcement and legal recognition. This creates doctrinal incompatibility between legal and technological systems.

Previous research by Werbach (2020) highlights the transformation of trust from institutional systems to algorithmic systems. Zohar (2021) explains that blockchain replaces trust intermediaries with cryptographic validation. Nakamoto (2022) framework discussions emphasize decentralization of ownership verification systems. However these studies do not analyze fiduciary law implications. This creates a gap in legal interpretation of control-based ownership.

The gap lies in the absence of legal recognition of control-based ownership within fiduciary frameworks. Existing fiduciary law does not differentiate between legal ownership and technical control. There is no mechanism to reconcile private key control with legal execution authority. This study proposes a hybrid ownership recognition model combining legal title and cryptographic control recognition. This provides a foundation for blockchain-compatible fiduciary enforcement.

Reconstruction Of Fiduciary Execution Through Digital Registration And Smart Contract Systems

The study finds that fiduciary execution requires structural reconstruction to accommodate blockchain-based assets. Existing execution mechanisms under Article 29 of Law Number 42 of 1999 are based on auction and physical asset transfer, which are not compatible with digital asset systems. Article 11 paragraph (1) registration systems are also limited to conventional asset identification. Article 30 physical surrender requirements are technically impossible in blockchain environments. Therefore a new execution architecture is required.

Constitutional Court Decision Number 18 PUU XVII 2019 reinforces the necessity of judicial oversight in fiduciary enforcement. However judicial systems lack technical mechanisms to execute blockchain asset control. This

creates enforcement inefficiency in digital collateral systems. The legal system therefore requires integration with technological enforcement tools. This necessitates institutional reconstruction of fiduciary execution.

From a theoretical perspective Szabo (2021) introduces the concept of smart contracts as self-executing legal protocols embedded in code. Casey and Vigna (2020) emphasize that blockchain enables programmable enforcement systems. These theories support the integration of legal execution with automated digital systems. Fiduciary law must therefore evolve into programmable enforcement frameworks. This shifts execution from physical enforcement to digital automation.

Previous research by Buterin (2023) highlights the importance of smart contract governance in decentralized systems. Mougayar (2022) discusses blockchain as an infrastructure for programmable trust. Ferreira and Sandner (2023) emphasize tokenization as a legal and financial transformation mechanism. However these studies do not propose fiduciary execution models. This creates a gap in enforcement-oriented legal design.

The gap lies in the absence of a legally recognized smart contract-based fiduciary execution system. Existing fiduciary law does not integrate digital registration custody or programmable enforcement. There is no mechanism connecting courts custodians and blockchain systems. This study proposes a reconstructed model based on digital fiduciary registry licensed custody and smart contract execution. This establishes a new legal architecture for enforceable digital collateral systems.

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that the fiduciary security execution mechanism under Law of the Republic of Indonesia Number 42 of 1999 concerning Fiduciary Security is not fully compatible with blockchain-based assets. The incompatibility arises from structural differences between possession-based fiduciary execution and control-based blockchain ownership systems. Articles 1 paragraph (2), 11 paragraph (1), 29 paragraph (1), and 30 of the Fiduciary Law are designed for tangible or controllable assets, while blockchain assets are governed by private key control mechanisms. Constitutional Court Decision Number 18 PUU XVII 2019 further strengthens procedural constraints on execution, creating additional enforcement limitations in digital contexts. Therefore, legal reconstruction is required to ensure enforceability and legal certainty in fiduciary security over blockchain-based assets.

It is recommended that Indonesian fiduciary law be updated to integrate digital asset classification within fiduciary collateral regimes. A digital fiduciary registration system should be developed to accommodate blockchain-based assets. Custody-based enforcement mechanisms through licensed digital asset custodians should be legally recognized. In addition, smart contract-based execution frameworks should be considered as an alternative enforcement mechanism. These reforms are necessary to ensure legal certainty, creditor protection, and technological adaptability in modern secured transactions.

ADVANCED RESEARCH

This study is limited to normative legal analysis without empirical validation from industry practitioners or blockchain custodians. The analysis is also focused on Indonesian legal frameworks and does not fully compare multi-jurisdiction enforcement practices in detail. Future research should explore empirical testing of fiduciary execution models in real blockchain custody systems. Comparative studies with jurisdictions that recognize digital asset property rights, such as the United Kingdom and Singapore, are also recommended. Further research is needed to develop technical-legal hybrid models that combine smart contract engineering with fiduciary enforcement mechanisms.

ACKNOWLEDGMENT

The author would like to express gratitude to colleagues and legal practitioners at AMR Legal Consultant for their valuable insights and discussions during the development of this research. Appreciation is also extended to academic peers who provided constructive feedback on the conceptual development of fiduciary execution in blockchain-based assets. Special thanks are given to institutions and regulatory references that supported the doctrinal analysis. Any remaining errors in this study are the responsibility of the author.

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