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BLOCKCHAIN-BASED LAND OWNERSHIP SYSTEM FOR MARRIAGE AGREEMENTS IN INDONESIA

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Abstract

Indonesia's conventional land administration systems lack the efficiency and transparency to manage dynamic post-marital property agreements sanctioned by Constitutional Court Ruling No. 69/PUU-XIII/2015, creating a significant legal certainty gap. This study aims to design a conceptual framework for a permissioned blockchain-based land ownership system to securely and transparently administer these postnuptial agreements, thereby reinforcing legal certainty. The research employs a qualitative, conceptual methodology, integrating doctrinal legal analysis with a review of blockchain architecture and smart contract protocols to construct a normative system model. The proposed framework features a multi-layered architecture (Application, Smart Contract, Network, Data) and a defined process flow where smart contracts automate the verification, ratification, and registration of post-marital agreements. This design ensures immutable record-keeping and transparent, near-instantaneous updates to digital land titles. The blockchain-based system offers a robust, efficient, and transparent alternative to traditional land administration, providing a pathway to digitally reconstruct legal certainty for post-marital property rights in Indonesia.

Keywords: Blockchain, Constitutional court, Indonesia, Land administration, Post-marital agreements.

1. Introduction

Indonesia's land administration system has long been a subject of critical discourse, characterized by persistent challenges of inefficiency, data fragmentation, and susceptibility to corruption [1]. These issues not only impede economic development by creating uncertainty in property transactions but also foster social disputes over land ownership [2, 3]. The conventional, often paper-based, processes are cumbersome, involving multiple agencies and a lack of a unified, transparent ledger, which undermines the principle of legal certainty, a cornerstone of the Indonesian legal system [4].

The foundational link between secure property rights and socio-economic development is universally recognized, with an effective Land Administration System (LAS) serving as its critical institutional pillar [5-7]. In Indonesia, however, the traditional LAS grapples with systemic inefficiencies - characterized by data silos, manual processes, and a lack of transparency - that erode the very legal certainty (*kepastian hukum*) it is designed to uphold [8]. These structural vulnerabilities create a landscape prone to disputes, fraud, and administrative delays, directly hindering economic activity and social stability [9]. This longstanding challenge has been fundamentally complicated by a significant legal evolution: the Constitutional Court's landmark Ruling No. 69/PUU-XIII/2015, which permits "marriage agreements in the bonds of marriage" [10, 11].

This judicial expansion of contractual freedom allows married couples to dynamically re-define their property regimes, presenting a profound administrative test. The ruling necessitates a LAS capable of verifying, recording, and instantaneously reflecting complex changes in ownership status derived from postnuptial agreements [5]. Traditional, centralized systems, burdened by sequential, paper-based workflows [8], are inherently ill-suited to this demand for dynamic, secure, and transparent updates, thereby creating a tangible "legal certainty gap" between a legally valid agreement and its execution in the official land register. It is within this nexus of legal innovation and administrative obsolescence that blockchain technology and smart contracts emerge as a transformative solution.

Blockchain, as a decentralized, immutable, and transparent digital ledger, offers a paradigm shift in how property rights can be recorded and managed [12]. Its integration with smart contracts - self-executing code that automates processes upon predefined conditions - enables the creation of a system where legal agreements can be directly and reliably linked to administrative action [13]. The stark contrast between the incumbent model and a potential blockchain-based framework is illustrated in the following comparison:

Table 1. Comparative traditional vs. blockchain-based land administration.

Feature	Traditional System	Blockchain-Based System
Ledger Structure	Centralized, controlled by a single authority (e.g., BPN).	Decentralized, shared and synchronized across a permissioned network.
Data Integrity & Security	Vulnerable to unilateral alteration, fraud, and physical loss.	Immutable; records are cryptographically secured and tamper-evident.
Process Transparency	Opaque, process-driven with limited access for stakeholders.	Transparent, with all authorized participants viewing an identical transaction history.

Transaction Execution	Manual, sequential, requiring multiple intermediaries, leading to delays.	Automated via smart contracts, reducing friction and enabling near-instantaneous updates.
Basis of Trust	Relies on trust in institutions and intermediaries.	Relies on cryptographic proof and network consensus.

Therefore, this research aims to design and propose a conceptual framework for a blockchain-based land ownership system specifically engineered to secure and automate the administration of postnuptial marriage agreements. The primary objectives are: (1) to architect a permissioned blockchain model that integrates seamlessly with Indonesia's existing legal and land administration identity; (2) to develop smart contract protocols that can formally encode the conditions of post-marital agreements and trigger autonomous updates to digital land titles; and (3) to analyse the resulting system's capacity to close the legal certainty gap by enhancing security, transparency, and efficiency.

The novelty of this study lies in its targeted focus on the intersection of a specific, progressive legal ruling (Constitutional Court Ruling Number 69/PUU-XIII/2015) [14] and a disruptive digital technology [15, 16], proposing a tailored socio-technical system rather than a generic blockchain application for land registry [17]. However, the research is consciously bounded by several limitations. It is primarily a conceptual and exploratory design study, meaning technical implementation details, full-scale architecture, and comprehensive cost-benefit analysis are beyond its immediate scope. Furthermore, it acknowledges that the proposed system's ultimate efficacy is contingent upon unresolved external factors, including the development of a supportive legal framework for digital evidence and smart contracts, and the achievement of broad institutional and societal adoption.

2. Methodology

This research adopts a qualitative, conceptual methodology, eschewing empirical data collection in favour of constructing a robust theoretical model through critical synthesis [18]. The primary objective is to generate a novel framework by integrating and analysing disparate strands of knowledge from legal, technological, and administrative domains [19, 20]. This approach is expressly chosen to navigate the nascent intersection of specific legal innovation and disruptive digital technology, where precedent is limited and the need for foundational structural thinking is paramount. Consequently, the study is positioned as an exploratory design exercise aimed at mapping the theoretical feasibility and architecture of a proposed system.

2.1. System design protocol

The development of the conceptual framework followed a structured, multi-stage protocol typical of engineering design studies. The process began with a rigorous doctrinal legal analysis of the Indonesian regulatory landscape, focusing on the 1974 Marriage Law and Constitutional Court Ruling No. 69/PUU-XIII/2015. This established the precise functional and non-functional requirements for the system. Subsequently, an interdisciplinary literature review was conducted across blockchain architecture, smart contract protocols, and digital governance to identify suitable technologies. The core of the methodology was the iterative design of a normative model, mapping system components - such as a permissioned blockchain

architecture, consensus mechanism, and smart contract logic - onto the identified legal and administrative requirements. This culminated in a theoretically coherent blueprint where technological execution is directly responsive to legal triggers.

2.2. Proposed technical architecture

To address the identified requirements, we propose a permissioned Distributed Ledger Technology (DLT) network [21], leveraging a platform such as Hyperledger Fabric [22, 23]. This choice is predicated on its modular architecture, robust permission capabilities, and support for private transactions, which are essential for handling sensitive land ownership data.

2.2.1. Node and consensus

The network's architecture is designed as a permissioned consortium, where participation is restricted to a group of vetted stakeholders. This ensures regulatory compliance and a high degree of trust. The primary nodes in this network are operated by key institutional actors: the National Land Agency (BPN), which serves as the main administrative authority; certified notaries, who are responsible for drafting and validating legal agreements; and relevant judicial bodies, which provide legal oversight and ratification. To maintain a consistent and immutable ledger across these distributed nodes, a crash fault-tolerant (CFT) consensus mechanism is proposed. Specifically, the Raft algorithm is selected due to its suitability for permissioned networks where the participants are known and trusted [24]. Unlike more computationally intensive Byzantine Fault Tolerant (BFT) algorithms designed for adversarial public networks [25], Raft offers an optimal balance between high performance, low latency, and robust fault tolerance, making it an efficient and reliable choice for ensuring that all transactions are correctly ordered and agreed upon before being committed to the blockchain. As illustrated in Fig. 1, each stakeholder node maintains its own validator and a complete copy of the ledger, participating in the Raft consensus process through leader election, log replication, and safety mechanisms that guarantee consistency across the entire network.

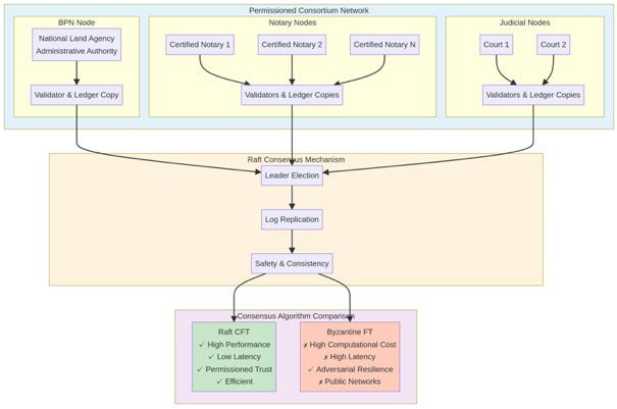

Fig. 1. Node and consensus mechanism architecture.

The diagram depicts the permissioned consortium network comprising BPN, Notary, and Judicial nodes, each maintaining validators and ledger copies. The Raft

consensus mechanism operates through three phases: (1) Leader Election, where one node is elected to coordinate transactions; (2) Log Replication, where the leader replicates transaction logs to all follower nodes; and (3) Safety & Consistency, ensuring all nodes maintain an identical, immutable ledger. The comparison panel highlights why Raft CFT is superior to Byzantine FT for this permissioned context: high performance, low latency, efficient operation, and trust-based architecture versus the computational overhead and latency of BFT algorithms designed for adversarial public networks.

2.2.2. Smart contract and API design

The system's core logic is encapsulated within smart contracts - referred to as chaincode in a Hyperledger Fabric context - which programmatically define and enforce the state transitions of a digital land title [22]. These self-executing contracts serve as the backbone of the automated workflow, containing key functions such as *createPostMaritalAgreement(agreementDetails)* to initiate a new agreement on the ledger, *addJudicialRatification(agreementID, courtSignature)* to record judicial approval, and updateLandTitle(agreementID, bpnSignature) to finalize the title update upon BPN verification. To ensure secure and simplified interaction with the blockchain, these functions are not exposed directly. Instead, they are accessed through a secure API gateway that provides a standardized RESTful interface [26]. This abstraction layer allows the Application Layer, including web portals for notaries and BPN officials, to trigger complex blockchain transactions via simple API calls, effectively decoupling the front-end from the underlying network complexity and enhancing both security and usability. As illustrated in Fig. 2, the API Gateway Layer incorporates authentication, authorization, and request validation mechanisms before routing calls to the appropriate smart contract functions, ensuring that only authorized stakeholders can invoke specific operations and that all transactions maintain legal and technical integrity.

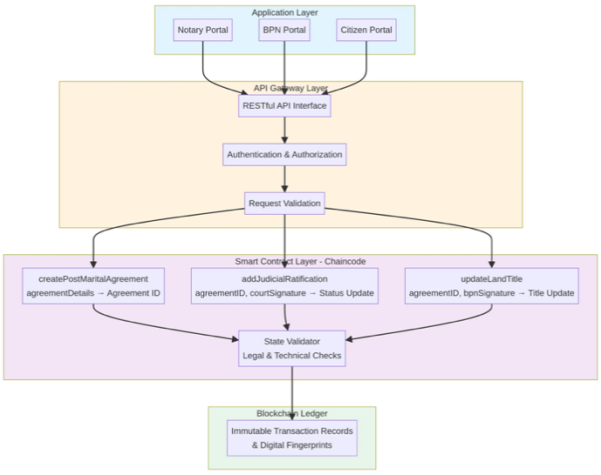

Fig. 2. Smart contract and API design architecture.

The diagram illustrates the layered interaction model: user-facing applications (Notary, BPN, and Citizen Portals) communicate through a secure RESTful API gateway, which enforces authentication and validation before routing requests to

the Smart Contract Layer. The chaincode functions (*createPostMaritalAgreement, addJudicialRatification, updateLandTitle*) process these requests, validate state transitions against legal requirements, and record immutable transactions on the blockchain ledger.

2.3. Validation strategy and performance metrics

While this study remains conceptual, a rigorous validation strategy is defined to guide future implementation and ensure the system's real-world viability. The proposed framework's efficacy would be assessed through a multi-faceted evaluation of a functional prototype deployed in a controlled environment, focusing on three core pillars of engineering-oriented testing. First, performance metrics will be established by measuring transaction throughput (transactions per second) and latency (time from submission to finality) under simulated workloads, which is critical to confirm the system's capacity to handle projected registration volumes. Second, scalability tests will assess the system's ability to maintain performance as the network grows by incrementally increasing the number of nodes, concurrent users, and transaction loads. Finally, security validation will involve comprehensive security audits, including penetration testing of the API gateway to identify external threats and formal verification of the smart contract code to prevent internal vulnerabilities such as re-entrancy attacks or improper access control. As depicted in Fig. 3, this three-pronged approach ensures that the system is not only functionally correct but also robust, scalable, and secure, meeting the stringent demands of a national land administration system.

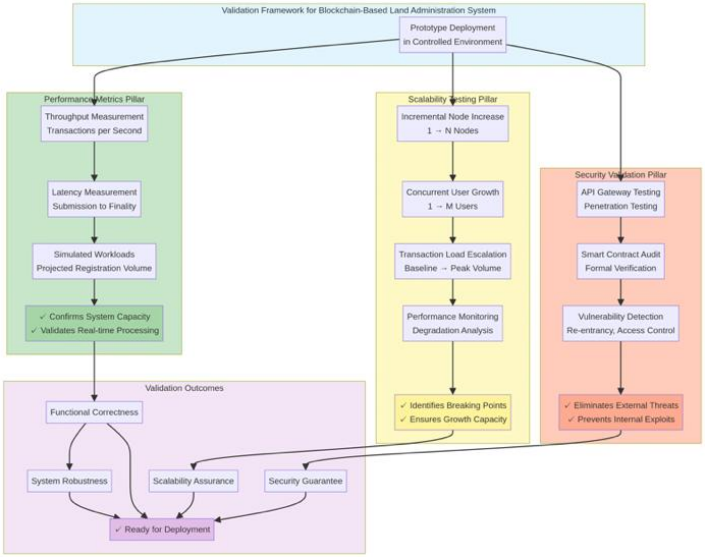

Fig. 3. Validation framework and performance metrics for the blockchain-based land administration system.

Figure 3 illustrates the comprehensive testing strategy deployed on a prototype in a controlled environment, organized into three parallel pillars: (1) Performance Metrics Pillar, measuring throughput and latency under simulated workloads to confirm system capacity; (2) Scalability Testing Pillar, incrementally increasing

nodes, concurrent users, and transaction loads to identify breaking points and ensure growth capacity; and (3) Security Validation Pillar, conducting penetration testing and formal verification to eliminate external threats and prevent internal exploits. All three pillars converge on validation outcomes - Functional Correctness, System Robustness, Scalability Assurance, and Security Guarantee - culminating in the confirmation that the system is ready for deployment in a production environment.

3. Results and Discussion

We propose a permissioned blockchain system. Unlike public blockchains (e.g., Bitcoin), where anyone can participate, a permissioned blockchain restricts access to a known and vetted set of participants. In this context, stakeholders would include the National Land Agency (BPN), certified notaries, the Judiciary (relevant courts), and the citizens themselves, each with defined roles and permissions [27].

3.1. Conceptual architecture

The proposed framework is predicated on a structured, multi-layered architecture, designed to segregate concerns, enhance security, and ensure scalable maintainability. This hierarchical design facilitates a seamless integration of user interaction, automated business logic, decentralized consensus, and secure data management. Each layer operates independently yet interdependently, creating a cohesive system where technological execution is directly aligned with legal and administrative requirements.

Figure 4. delineates the four foundational layers - Application, Smart Contract, Network, and Data - that together create a secure, transparent, and automated ecosystem for administering land titles and post-marital agreements.

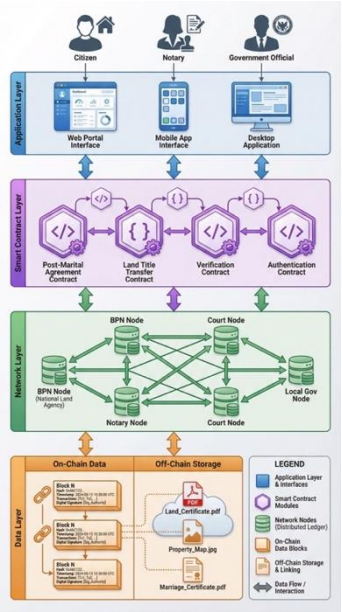

Fig. 4. Conceptual architecture of the integrated blockchain-based system.

3.1.1. Application layer

At the apex, the Application Layer provides the critical user interface, manifesting as role-specific web portals and mobile applications. This tier tailors the user experience: citizens can securely view property rights and initiate requests, while notaries and government officials access specialized interfaces for verification, notarization, and approval workflows.

3.1.2. Smart contract layer

Directly beneath, the Smart Contract Layer constitutes the system's autonomic nervous system, encoding the core business and legal logic. Here, self-executing contracts automate the entire lifecycle of a post-marital agreement - from initial validation against legal parameters to the final, immutable update of land ownership on the ledger, thereby eliminating procedural ambiguity and intermediary-driven delays.

3.1.3. Network and data layers

The foundational integrity of the system is established by the Network and Data Layers. The Network Layer is realized as a permissioned Distributed Ledger Technology (DLT) network, where nodes operated by vetted stakeholders (e.g., BPN, courts, notarial boards) achieve consensus on all transactions, ensuring decentralization without compromising regulatory oversight. Finally, the Data Layer employs a sophisticated hybrid model for optimal efficiency and security. Immutable transaction hashes, digital fingerprints of documents, and essential metadata are permanently recorded on-chain, providing a cryptographically auditable trail. The voluminous supporting documents themselves are stored in secure, decentralized off-chain storage, cryptographically linked to the blockchain. This ensures data integrity and availability while preventing ledger bloat, creating a system that is both permanently verifiable and operationally efficient.

3.2. Process flow for post-marital agreements

The proposed system re-engineers the post-marital agreement process into a secure, event-driven digital workflow, fundamentally transforming a traditionally protracted and opaque administrative procedure. This streamlined sequence, as detailed in Fig. 5, initiates with a couple consulting a notary - a registered node on the network - who drafts the agreement [28]. The foundational act of cryptographic digital signing by all parties, timestamped and immutably recorded, moves the agreement from a paper document to a verifiable digital asset, establishing an unforgeable provenance from the outset and triggering the automated logic of the platform [29].

Figure 5 illustrates the event-driven workflow from digital signing to the final, automated update of the land title on the blockchain. Following this initiation, the process enters its core automated phase. The notary's upload of the signed agreement's cryptographic hash to the permissioned ledger instantaneously deploys a dedicated "Post-Marital Agreement Smart Contract." This contract acts as an autonomous, rule-bound agent that manages the agreement's lifecycle, creating a transparent, pending record [30]. It then programmatically orchestrates the critical verification stages, first by routing the agreement for Judicial Ratification if

required [31, 32]. Here, a judge reviews the digital dossier and applies a court's digital signature, an action that updates the smart contract's state and embeds judicial approval directly into the process's immutable audit trail.

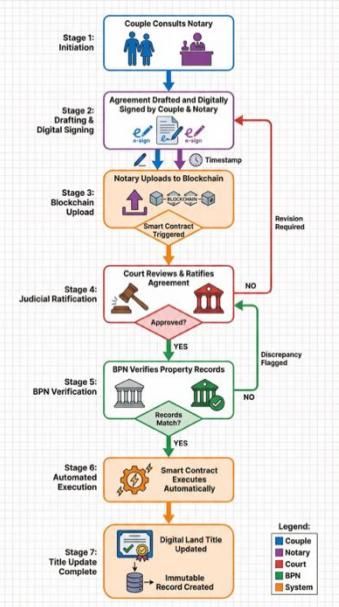

Fig. 5. Process flow for post-marital agreement registration and land title update.

Concurrently, the smart contract notifies the National Land Agency (BPN) for Official Verification. A BPN official verifies the congruence between the agreement's property details and the existing digital titles on the ledger. This dual-layer verification - judicial and administrative - ensures that the agreement is both legally sound and administratively feasible before any change to the land title is executed. Once all conditions are met, the smart contract automatically executes the final state change, updating the land title on the blockchain to reflect the new ownership structure defined in the post-marital agreement. This final transaction is immutable, transparent, and serves as the single source of truth for the property's legal status.

3.3. Engineering-oriented validation

The proposed framework's primary contribution is its capacity to enhance legal certainty through robust engineering design. The system's integrity is grounded in its immutability, where cryptographically linked blocks create a tamper-evident audit trail, directly addressing the risks of fraud and unilateral alteration prevalent in traditional systems. Performance and scalability, critical for nationwide adoption, are addressed by the choice of a permissioned DLT with a CFT consensus mechanism. Unlike proof-of-work systems, this architecture provides high transaction throughput and low latency, ensuring that land title updates can be processed efficiently. The modularity of the proposed architecture, separating the application, smart contract, network, and data layers, allows for independent upgrades and maintenance, ensuring long-term system viability and adaptability to future regulatory changes.

4. Implementation and Roadmap

4.1. Stakeholder engagement and governance

Successful implementation of a blockchain-based land administration system requires robust stakeholder engagement and clear governance structures. The primary stakeholders include the National Land Agency (BPN), the Indonesian Notary Association (INI), the Ministry of Justice and Human Rights, the Judiciary, and civil society organizations representing citizens' interests. Each stakeholder group has distinct concerns and requirements that must be addressed in the system design as shown in Fig. 6.

Fig. 6. Stakeholder ecosystem and interactions on the blockchain platform.

Figure 6 illustrates the collaborative and decentralized nature of the system, with the blockchain platform serving as the central hub for secure and transparent interactions among all key participants.

The proposed framework establishes an integrated ecosystem where the Blockchain Land Administration Platform acts as the single source of truth, connecting all relevant stakeholders in a secure and transparent network. At the core, the platform facilitates interactions between Citizens, who can manage their property and initiate agreements; the National Land Agency (BPN), which oversees data verification and title issuance; Notaries, who authenticate documents and provide legal validation; and the Judiciary, which handles agreement ratification and dispute resolution. The system also extends to include Local Governments for regional data synchronization and Financial Institutions, which can leverage the trusted data for mortgage processing and collateral assessment. Interactions such as agreement drafting, ratification requests, and title updates are executed as secure transactions, governed by smart contracts and validated through digital signatures, ensuring that all parties operate with a unified and trusted dataset.

The BPN, as the primary custodian of land records, must be at the centre of the governance structure. Its role would evolve from a centralized authority to a network

participant, albeit one with significant responsibilities for data verification and system oversight. The transition requires a fundamental shift in organizational culture and technical capability. The BPN would need to invest in training its personnel in blockchain technology and digital processes, establish new protocols for data management, and develop contingency plans for system failures or security breaches.

Notaries, who play a crucial role in authenticating documents and certifying agreements in Indonesia, would become critical nodes in the blockchain network. Their digital signatures would carry legal weight, and they would be responsible for ensuring that the documents they notarize conform to legal requirements. This requires establishing standards for digital notarization, training notaries in the use of the system, and creating mechanisms for professional oversight and accountability.

The Judiciary's role would be to provide the final layer of legal validation. In cases where post-marital agreements require court approval or when disputes arise, the courts would need to interact with the blockchain system. This requires developing new procedures for digital evidence handling, training judges in blockchain technology, and establishing clear protocols for digital signature verification and document authenticity.

4.2. Technical infrastructure and interoperability

The technical infrastructure supporting the blockchain system must be robust, scalable, and interoperable with existing government systems. Indonesia's land administration currently relies on a patchwork of databases maintained by the BPN and local government agencies. A blockchain-based system must be able to integrate with these existing systems, ensuring that legacy data is migrated securely and that new data is synchronized across all platforms.

Interoperability is particularly critical in the Indonesian context, where land administration is a shared responsibility between the national government and local governments. The blockchain system must support hierarchical governance structures, allowing local governments to maintain certain autonomies while ensuring consistency with national standards. This might involve the use of sidechains or layer-two solutions that allow local governments to maintain their own ledgers while remaining connected to a national backbone.

Data migration from legacy systems to the blockchain presents significant technical and legal challenges. The BPN maintains millions of land records, many of which are incomplete, inconsistent, or disputed. A phased migration approach would be necessary, starting with a pilot program in a limited geographic area or for a specific category of land (e.g., urban residential property). This allows for testing and refinement of processes before scaling to the national level.

4.3. Regulatory and legal Framework development

The transition from a theoretical model to an operational, legally recognized system is wholly contingent upon the parallel development of a supportive and explicit regulatory and legal framework. Indonesia's existing legal architecture, designed for a paper-based paradigm, lacks the necessary provisions to confer validity upon blockchain-based records, smart contracts, and digital authentication methods. Therefore, successful implementation is not merely a technological deployment but a profound legal engineering project, requiring the deliberate enactment and amendment of laws to

bridge the gap between innovative digital processes and established judicial recognition. This legal scaffolding must be constructed proactively, as the system's legitimacy and enforceability will be challenged in its absence.

At the core of this required legal evolution is the need to establish Digital Signature and Authentication within a blockchain context. Current electronic signature laws require clarification and extension to explicitly recognize cryptographic signatures and hashes stored on a distributed ledger as possessing the highest degree of legal validity, ensuring non-repudiation and authenticity. This necessitates amendments to the ITE Law and supporting regulations to provide courts and officials with unambiguous standards for evaluating digital evidence sourced from a permissioned blockchain, thereby making the ledger's entries intrinsically admissible.

Concurrently, the Enforceability of Smart Contracts must be resolved. Legislation must move beyond ambiguity to definitively state that a correctly executed smart contract constitutes a binding legal agreement. This involves codifying the conditions under which code equals contract - such as the clear identification of parties, offer, acceptance, and lawful object - and establishing legal procedures for dispute resolution, including remedies for bugs or unforeseen outputs.

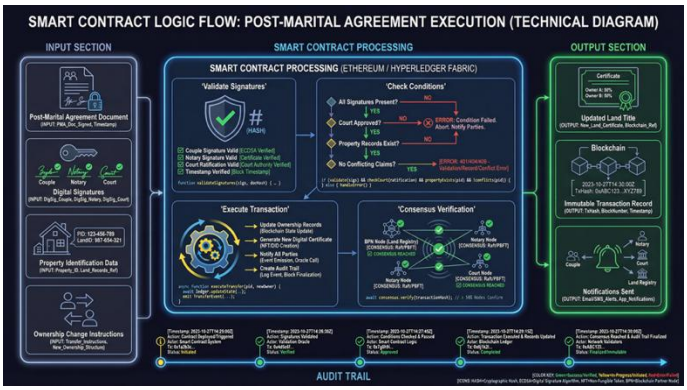

Fig. 7. Technical diagram of the smart contract logic flow.

The deterministic logic of these contracts, as visualized in Fig. 7 underscores this need; the diagram illustrates the automated sequence from input validation to execution, highlighting that legal accountability must be mapped onto this automated process.

Furthermore, the framework must innovatively reconcile the inherent Transparency of blockchain with data privacy obligations. Legal reforms must mandate and standardize privacy-by-design architectures, such as the use of off-chain storage for sensitive documents and the exploration of advanced cryptographic techniques like zero-knowledge proofs [33]. This ensures compliance with data protection laws by allowing the blockchain to provide verifiable proof of a transaction's validity and integrity without exposing the underlying personal data on the public ledger.

Finally, comprehensive rules for Liability and Accountability are essential to manage systemic risk. The law must preemptively allocate responsibility for various failure modes, such as coding errors in smart contracts, network consensus

failures, or security breaches. Clear answers are needed for critical questions: Is liability held by the software developer, the node operators, the overseeing government agency, or a combination? Establishing these parameters is crucial for building trust among all stakeholders, as it provides a clear recourse mechanism and defines the boundaries of responsibility for maintaining the integrity of this critical public digital infrastructure.

4.4. Risk analysis and mitigation strategies

Implementing a blockchain-based land administration system involves significant risks that must be carefully managed. The proposed framework transcends a purely technical upgrade, representing a fundamental recalibration of Indonesia's legal and administrative paradigm. Its efficacy is predicated on interlocking considerations: the imperative for a robust legal architecture that confers unambiguous validity to digital records and smart contracts, a governance model that clearly allocates accountability among stakeholders, and proactive measures to bridge the digital divide, ensuring the system's benefits are equitably distributed rather than exacerbating existing inequalities. This multi-faceted nature underscores that the core challenge is systemic integration, not merely software deployment.

Critical to this integration is the alignment with and evolution of Indonesia's existing regulatory ecosystem. The system must be consciously architected within the boundaries and aspirations of national law, while also informing necessary legal innovations. Table 2 delineates key regulatory instruments pertinent to this endeavour:

Table 2. Regulatory Instruments in Indonesia.

Regulation / Legal Instrument	Relevance to Blockchain-Based Land Administration
Basic Agrarian Law [*Undang-Undang Pokok Agraria (UUPA)*]	The foundational agrarian law: any system must uphold its principles of state control, social function of land, and legal certainty for rights holders.
PP No. 24 of 1997 on Land Registration	Governs current registration procedures; a new system would necessitate amendments or a new regulation to recognize blockchain-ledger entries as the primary register.
UU ITE (Electronic Information & Transactions Law)	Provides a legal foundation for electronic signatures and records; its provisions on electronic evidence are crucial for judicial acceptance of blockchain data.
Draft Law on Personal Data Protection	Will dictate how sensitive citizen data (even if stored off-chain) linked to land parcels is collected, processed, and protected within the new system.
Financial Services Authority (OJK) Regulations on Crypto Assets	While land tokens are not cryptocurrencies, these regulations inform the treatment of digital assets and may influence the design of any tokenized rights representation.

Therefore, the implementation journey is necessarily an iterative process of technological calibration, legal adaptation, and societal engagement. Drawing from international precedents, Indonesia must tailor its approach to its unique socio-legal context, treating the identified technical, legal, and adoption risks not as fatal flaws but as manageable design constraints. Success will hinge on sustained political

commitment and collaborative governance. Ultimately, a successfully implemented blockchain-based LAS would establish a critical digital infrastructure pillar, offering a replicable model for modernizing other public registries and positioning Indonesia as a strategic innovator in 21st-century governance.

5. Conclusion

This paper has proposed a conceptual framework for a blockchain-based land administration system tailored to the unique legal and administrative challenges posed by post-marital agreements in Indonesia. By integrating a permissioned blockchain architecture with self-executing smart contracts, the system offers a pathway to reconstruct legal certainty in a digital environment. The framework directly addresses the core weaknesses of the incumbent system - inefficiency, opacity, and vulnerability to fraud - by introducing a decentralized, immutable, and transparent ledger. The automated process flow for registering and executing post-marital agreements significantly reduces bureaucratic friction and enhances security, providing a single source of truth for all stakeholders. While the study acknowledges the limitations of its conceptual nature and the external dependencies on legal and institutional adoption, it provides a robust technical and theoretical blueprint for a more resilient and trustworthy land administration paradigm in Indonesia. Future work should focus on developing and testing a functional prototype based on the proposed architecture to empirically validate its performance, scalability, and security.

Abbreviations

BPN	National Land Agency (*Badan Pertanahan Nasional*).
DLT	Distributed Ledger Technology.
UUPA	Basic Agrarian Law (*Undang-Undang Pokok Agraria*).

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