Digital Transformation and Legal Sustainability in Land Deed Registration: A Comparative Study between Indonesia and Brazil

Vini Nurul Safriani[1*] and *Irma Rachmawati* Maruf[1]

[1]Universitas Pasundan, Bandung, Indonesia

Abstract. Digital transformation in land administration marks a new phase in legal modernisation. Indonesia has introduced an electronic land deed registration system to boost efficiency and transparency. However, this transition raises legal issues concerning the authenticity of electronic deeds and the continued role of public officials in ensuring legal certainty. This study aims to examine how electronic land deeds can remain legally authentic in Indonesia and how the Brazilian digital notarial system can serve as a model for sustainable and integrated land registration. The research adopts a normative-juridical and comparative legal approach by analysing relevant laws, regulations, and institutional frameworks in both countries. The findings indicate that Indonesia's regulatory system remains fragmented, whereas Brazil has successfully implemented a digital registration model supported by verified electronic signatures and coordinated institutional cooperation. The study concludes that Indonesia needs comprehensive legal and institutional reforms centred on a chain-of-trust framework to establish a sustainable and reliable electronic land registration system.

1 Introduction

The digitalisation of land administration is a crucial part of bureaucratic reform and public sector digital transformation, aimed at improving efficiency, transparency, and legal certainty in land services [11], [15]. In Indonesia, this initiative has progressed through the introduction of Electronic Land Certificates and Electronic Mortgage Rights by the Ministry of Agrarian Affairs and Spatial Planning/National Land Agency [5]. This policy marks a transition from a manual, paper-based registration system to a unified electronic system reliant on information technology. The deployment of Electronic Mortgage Rights seeks to simplify mortgage registration processes, lower transaction costs, and speed up the establishment of security rights in financing [13]. The system enables electronic document storage, uses certified electronic signatures, and offers online access to relevant parties such as land deed officials, creditors, and debtors [5]. Ideally, Electronic Mortgage Rights is designed to uphold

* Coresponding author : vinisafitriani66@gmail.com

principles of droit de preference and droit de suite, which form the foundation of security rights law within the civil law system.

Nonetheless, the practical implementation of Electronic Mortgage Rights faces significant legal and institutional hurdles. A key issue is the limited recognition of Electronic Mortgage Rights as valid collateral for credit by financial institutions [15]. Although Regulation of the Minister of National Land Agency No. 1 of 2021 provides a normative basis for Electronic Mortgage Rights, it has not been fully integrated with banking laws, evidentiary laws, or Supreme Court policies on electronic evidence [5]. This creates legal uncertainties and makes banks cautious about accepting Electronic Mortgage Rights as collateral for loans [10]. Beyond legal concerns, challenges also stem from data quality and infrastructure readiness. The Systematic Land Registration Programme, which serves as the main database for the electronic land system, continues to face issues such as inaccurate measurements, overlapping land parcel maps, and inadequate quality control during mapping and data validation [5]. [10] identifies limited human resources, insufficient technical training, and suboptimal use of spatial validation technologies as primary causes of these problems.

At the same time, social resistance and low levels of digital literacy further weaken trust in electronic land certificates and documents. Concerns about data security, system errors, and cybercrime risks, including hacking and the falsification of land ownership records, have slowed the adoption of digital land systems among the public and financial industry stakeholders [10]. The lack of sufficient public outreach and clear legal protections reinforces perceptions that electronic systems are not yet entirely secure or dependable. Similar trends are seen in other civil law jurisdictions, especially those following the Latin notarial tradition, such as Brazil, Italy, Spain, and the Netherlands [4]. Although these countries have implemented land registration and digitalised property transactions, notaries remain responsible for verifying the authenticity of documents and ensuring legal validity. For example, Brazil has established a digital notarial system that incorporates certified electronic signatures, electronic registries, and rigorous oversight, despite ongoing jurisdictional debates between notaries and land registrars.

Comparative research indicates that the success of land administration digitalisation in civil law countries relies not only on technological advancements but also on institutional structure and the redefinition of legal officials' roles. [4] emphasises that blockchain and digital real estate systems cannot replace notarial functions; instead, they must complement legal authentication mechanisms to maintain legal certainty and protect rights. This perspective aligns with Wouda and Opdenakker (2019) and Baum (2017), who observe that the real estate sector, being the world's largest asset class, is generally slow to adopt new technologies due to its high requirement for legal certainty and data reliability.

Thus, the digitalisation of land documents and Electronic Mortgage Rights in Indonesia faces three main challenges: (1) legal framework flaws and regulatory fragmentation that hinder recognition of Electronic Mortgage Rights as credit collateral; (2) weaknesses in digital infrastructure and human resource capacity for managing electronic land data; and (3) limited trust among the public and industry actors towards electronic systems. Therefore, a detailed legal study is required to develop strategies for integrating Electronic Mortgage Rights that are legally recognised, institutionally effective, and acceptable to finance providers. Such strategies should draw lessons from best practices in countries within the Latin notarial system.

Previous research (**Table 1**) on land registration digitalisation in Indonesia has mostly concentrated on technical aspects of implementing Electronic Mortgage Rights [5], [10] or on the general role of notaries in electronic document systems [6]. Studies on Brazil's digital notarial system have focused on blockchain and smart contract architecture (Dias Menezes, de Araujo, & Nishijima, 2023) or on governance frameworks like the CNJ audit system [7].

However, based on Table 1, no research has systematically compared the two countries' legal standards, particularly regarding the trust chain necessary for Electronic Mortgage Rights to be considered reliable across banking, evidentiary, and enforcement laws. This study aims to fill that gap by constructing a comparative normative framework across five areas: document authenticity, digital identity, institutional coordination, data governance, and the evolving role of public officials. Its findings will offer practical insights into legal reform in Indonesia, rather than merely drawing descriptive parallels.

Table 1. Research Gap Matrix: Prior Studies and Contribution of the Present Article

Prior Study	Focus	Country	Gap Left Unaddressed
Hidayah S et al (2024)	Electronic certificate & Electronic Mortgage Rights implementation	Indonesia	No comparison with foreign models; no bankability analysis
Putri (2022)	Regulatory fragmentation & banking acceptance	Indonesia	No normative chain-of-trust framework proposed
Linhares, T. C. (2025).	Blockchain & CNJ governance	Brazil	No comparative implications for civil law developing countries
Dias Menezes et al. (2023);	Smart contract & PKI architecture	Brazil	Legal implications for Indonesian Electronic Mortgage Rights not examined
Garcia-Teruel (2021); Koos (2023)	Cyber notary & blockchain in civil law	Europe / Comparative	Indonesia-Brazil bilateral comparison not conducted
This article	Five-dimensional normative chain-of-trust comparison	Indonesia vs Brazil	Addresses all gaps above through integrated normative analysis with actionable reform implications

2 Method

This study utilises a normative-juridical and comparative legal research methodology. Normative legal research analyses law as a written system of norms derived from authoritative legal sources, including legislation, regulations, court decisions, and legal doctrines [9]. In this study, the normative approach is applied to explore the regulatory framework overseeing Electronic Mortgage Rights in Indonesia. The comparative legal approach examines legal rules, institutions, and processes across different jurisdictions to identify similarities, differences, and transferable lessons (Zweigert & Kotz, 1998). The jurisdiction selected for comparison is Brazil, chosen based on four criteria: (1) it operates within a civil law system with a Latin notarial tradition comparable to Indonesia's; (2) it has implemented blockchain technology and digital public key infrastructure (PKI) in notarial and land registration services at both pilot and national levels; (3) sufficient regulatory and scholarly documentation is available in English and Portuguese for normative analysis; and (4) it represents a developing economy navigating digital transformation in public administration, making its experience directly relevant for Indonesia. The comparative analysis is structured along five normative dimensions derived from the Brazil-Indonesia gap analysis: (1) document authenticity, (2) digital identity, (3) institutional coordination, (4) data governance, and (5) the reconstructed role of public officials. Each dimension is analysed for its regulatory completeness in Indonesia and compared with the Brazilian model to derive

normative implications for reform. The analytical results are presented through both narrative discussion and comparative tables to facilitate transparent and replicable assessment.

3 Results and discussion

3.1 Comparative Study on the Brazilian Digitalisation of Land Administration

Brazil is among the civil law nations with a Latin notarial legacy that has demonstrated considerable progressiveness in the adoption of digital technologies, including blockchain, for notarial services and land administration [1], [2]. This study adopts a comparative case-study methodology, with a focus on Brazil. In practical terms, Brazil has established various digital notarial platforms utilising diverse technological strategies [2]. Certain platforms, such as Notaris.com, continue to depend on manual validation by notaries to ensure the legal validity of digital documents [1]. This indicates that technology functions as a supportive tool rather than a replacement for notarial legal authority. Additional innovations, such as Open Notary, employ encrypted databases based on Structured Query Language (SQL) to store and manage notarial data internally, without direct reliance on public blockchain infrastructure [2].

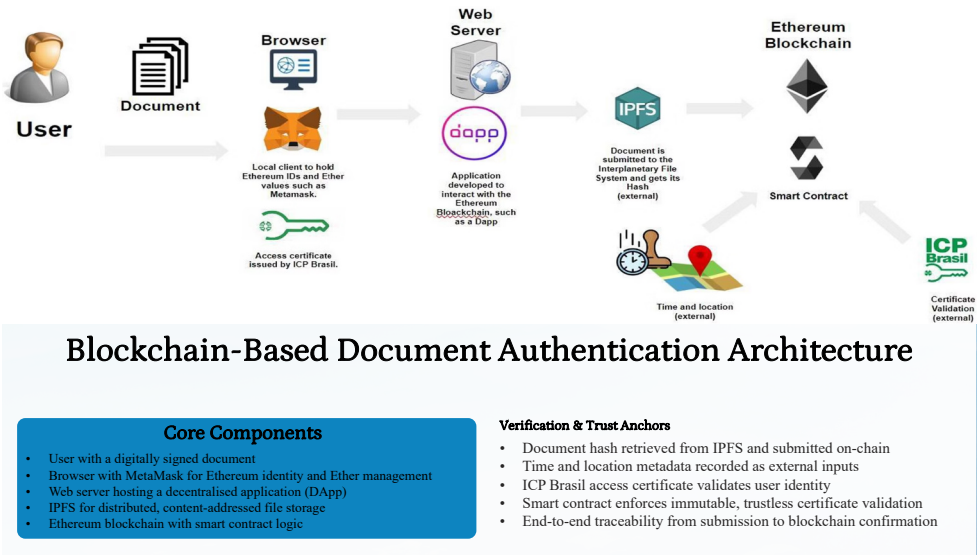

Fig. 1. Workflow of Blockchain-Based Notarial Authentication in Brazil: Source: [2], [12]

Fig 1 illustrates the workflow for blockchain-based notarial activities in Brazil. The process begins when a user (Client A) generates a digital document, uploads it to IPFS, and produces a hash of the document. This hash is then recorded on the blockchain. Thereafter, a different party (Client B) may examine or verify the document through authorisation mechanisms and digital signatures integrated with ICP-Brazil, under the oversight of judicial authorities such as the Conselho Nacional de Justiça (CNJ) [2].

From a legal and public policy perspective, the application of blockchain technology to Brazilian notarial services has significant implications. One notable potential use case involves automating tax collection through smart contracts. Under this framework, fiscal obligations arising from transactions can be automatically calculated and allocated to federal, state, and municipal authorities. Although this approach has sparked debates concerning

transaction costs and regulatory oversight, it enhances fiscal transparency and political accountability through real-time audit systems accessible to the CNJ and the public [7].

From an economic efficiency perspective, blockchain-enabled digital notarial systems in Brazil are comparatively sustainable, as operational infrastructure costs are borne by service users rather than the government. This model has demonstrated effectiveness in reducing document forgery risks, bolstering legal trust, and fostering the development of a more transparent and inclusive digital public service ecosystem (Wouda & Opdenakker, 2019). In the long term, investments in digital certification and electronic identity systems significantly influence legal security and the efficacy of public administration.

Furthermore, the Brazilian model is highly relevant for replication in other countries with civil law traditions and Latin notarial practices. Nations such as Indonesia, with a similar legal framework and comparable roles for notaries and Land Deed Officials, can derive valuable insights from Brazil's experiences. The advancement of decentralised digital certification systems presents an opportunity to strengthen the Electronic Land Certificate and Electronic Mortgage Rights ecosystem without necessitating costly state-owned infrastructure, thereby alleviating national budget burdens. This strategy aligns with Indonesia's objectives to expedite agrarian reform and modernise electronically based public services.

3.2 Institutional Resistance and Strategies for Adopting Electronic Mortgage Rights in the Financial Sector

Digital transformation through Electronic Mortgage Rights in Indonesia reflects a reform effort in the technology-based system of security rights. Although this innovation offers efficiency, transparency, and accountability, institutional resistance remains a major obstacle, particularly from financial institutions that continue to rely on physical documents as proof of ownership and legal security.

According to Linhares, T. C. (2025). the global property sector has historically been slow to adopt new technologies such as blockchain due to the complexity of transactions and the high value of underlying assets. Financial institutions, including banks and pension funds, maintain high expectations regarding the legal validity and verifiability of collateral documents. This explains why digital certificates, although normatively valid, have not yet been fully accepted in banking practice as collateral for mortgages.

Garcia-Teruel (2021) further notes that in civil law countries such as Spain, Italy, the Netherlands, and Brazil, the role of notaries has been preserved even as blockchain technology is being applied to land registration systems. Digital documents, such as electronic certificates, must still undergo institutional validation to be legally recognised in mortgage and financing processes.

In the context of developing countries, Mansoor et al. (2021) emphasise that inefficient, corrupt, and intermediary-heavy traditional land registration systems have hindered economic growth by undermining trust in asset ownership and limiting public access to financing. By adopting blockchain-based land registration systems, developing countries such as Indonesia may gain strategic benefits, including increased liquidity, reduced risk, and cost efficiency.

In Indonesia, the implementation of Electronic Land Certificates and Electronic Mortgage Rights by the National Land Agency represents an initial step toward the digitalisation of land administration [5], [15], [14]. However, the existing system remains centralised and heavily dependent on government infrastructure, which, in practice, often faces technical constraints, budgetary limitations, and institutional resistance from the notarial and banking sectors. Based on **Table 2**, Brazil's experience demonstrates that a digital land system can remain legally valid and secure without being entirely stored on state-owned servers,

provided that it is supported by publicly verifiable digital identity infrastructure and electronic signature mechanisms.

Table 2. Comparative Normative Framework: Indonesia vs Brazil across Five Dimensions

Normative Dimension	**Indonesia (Current Status)**	**Brazil (Reference Model)**	***Normative implication:***
1. Document Authenticity	Electronic Mortgage Rights recognized normatively under Reg. NLA No. 1/2021 but lacks binding presumption of authenticity for evidentiary and banking purposes	ICP-Brazil ensures certified electronic signatures generate a legal presumption of authenticity recognized across evidentiary, notarial, and banking law [2]	Indonesia requires clarification within binding norms, not just in technical policy, that designates Electronic Mortgage Rights as a security instrument with an operational presumption of authenticity for proof and enforcement
2. Digital Identity	No unified national trust framework for identity, authorization, and audit trail of Land Deed Officials and notaries in Electronic Mortgage Rights workflow	ICP-Brazil national provides legally recognized digital certificates; identity attribution is mandatory for all notarial acts [2],[12]	A binding national trust framework for Electronic Mortgage Rights is needed, encompassing standards for digital identity, authorisation, audit trails, and verification obligations for relevant officials.
3. Institutional Coordination	Fragmented: NLA regulations operate separately from banking law (OJK), evidentiary law, and Supreme Court policies on electronic evidence	Integrated: notarial, registry, ICP-Brazil certification authority, and CNJ oversight form an end-to-end chain of trust [1].	*Indonesia requires cross-sectoral harmonisation among the National Land Agency, the Banking Regulator and the Supreme Court to ensure Electronic Mortgage Rights are recognised as collateral, as evidence, and as a basis for enforcement*
4. Data Governance	Land parcel data quality weaknesses in PTSL (overlapping maps, inaccurate measurements) create foundational risks for Electronic Mortgage Rights security	Auditable digital trails via blockchain and CNJ real-time monitoring; data integrity is a system design requirement [2].	*Reform of Electronic Mortgage Rights must include data governance norms: quality standards, correction procedures, allocation of responsibility, and remedial mechanisms in the event of errors.*
5. Role of Public Officials	Land Deed Officials risk being reduced to 'system users' without clear normative duties for digital verification, due diligence, and accountability	Notaries reconstructed as digital gatekeepers: identity verifiers, document authenticators, and due diligence guarantors [1][4][8]	*Reconstruction of the norms governing the digital verification duties of Land Deed Officials and Notaries, Electronic Due Diligence Standards, and the legal consequences of negligence is required.*

Brazil has developed blockchain pilot projects for digital *cartorio* systems that link property registries with banking systems while maintaining legalistic structures and notarial involvement [1]. Although the role of notaries has not yet been fully integrated into a comprehensive digital framework, Brazil's gradual, evolutionary approach offers a model that other developing countries can adopt.

According to Brazil's best practices, Indonesia could learn five key experiences in implementing a sustainable digital land registration system:

3.2.1 Authenticity: from 'Electronic Documents' to 'Evidence and Authentic Deeds'

In the Brazilian model, the authenticity of digital documents is secured through the integration of electronic signatures validated by the national public key infrastructure (ICP-Brazil), combined with coordinated institutional controls [2], [7]. Normatively, this establishes a strong legal presumption: properly signed digital documents are regarded as reliable for evidentiary purposes, and the notarial function continues to serve as a mechanism for legitimising legal acts. Conversely, in Indonesia's Electronic Mortgage Rights system, existing norms already specify the use of electronic signatures and electronic documents, as reflected in the Regulation of the National Land Agency No. 1 of 2021 (Fauziah & Apriani, 2021) and in Royani, M. N., & Silviana, A. (2025). However, the comparative analysis shows that the core issue is not whether electronic documents are permissible, but rather their authentic force and binding effect within the financing ecosystem.

3.2.2 Digital Identity: A Functional Validity Requirement for Electronic Security Rights

Brazil addresses the limitations of blockchain and IPFS, which do not independently verify identity, through a state PKI: ICP-Brazil provides a publicly verifiable digital identity to ensure that a signature is properly attributed to the correct legal subject [2], [12]. This is crucial because security rights require accurate identification of the parties (creditor, debtor, or grantor) and help prevent disputes over the validity of legal acts. Meanwhile, Indonesia's Electronic Mortgage Rights system faces a normative challenge when electronic identity, access authorisation, and the authority of officials, namely Land Deed Officials and notaries, are not explicitly linked within a single trust framework.

3.2.3 Institutional Coordination: from 'Fragmentation' to 'Integrated Governance'

The strength of the Brazilian model lies in institutional coordination among the notarial registry, certification authority, and oversight bodies [1], [2]. This enables an end-to-end chain of trust. In Indonesia, Electronic Mortgage Rights operates in what is often described as a fragmented space: land law norms, electronic evidence rules, banking policies, and enforcement needs do not consistently converge within a single design.

3.2.4 Validity of Foundational Data as the Normative 'Bottleneck' of Electronic Mortgage Rights

Brazil emphasises auditability and system integrity through auditable digital trails, enabling real-time monitoring by the Conselho Nacional de Justica (CNJ) [1], [2]. Indonesia faces a distinct problem: the quality of foundational data parcel maps, measurements, and validation that underpins electronic certificates. Normatively, if foundational data are prone to dispute,

Electronic Mortgage Rights is likewise affected, because security rights demand a clear and defect-free object.

3.2.5 The Role of Notaries and Land Deed Officials: Not Eliminated, but Reconstructed

Latin notarial systems demonstrate that digitalisation does not equate to eliminating public officials; rather, authentic officials are reconstructed as digital gatekeepers, identity verifiers, capacity assessors, and guarantors of due diligence functions that automated systems cannot fully replace [4], [6]. Based on **Table 3**, in Indonesia's Electronic Mortgage Rights framework, the normative issue is the reconfiguration of the role of Land Deed Officials and notaries so that they remain guarantors of legal certainty rather than mere 'system users.' Without a clear normative basis, an accountability gap may arise when disputes arise, and it becomes unclear who bears responsibility for verification.

Table 3. E-Mortgage Rights Reform Requirements Derived from Comparative Analysis

Reform Area	Required Normative Action	Applicable Brazilian Lesson
Authentication Framework	Enact binding regulation conferring presumption of authenticity on Electronic Mortgage Rights documents for court and banking use	ICP-Brazil certified signature generates legal authenticity presumption across all regimes
National Trust Framework	Establish unified PKI-based digital identity standards for Land Deed Officials and notaries operating within the Electronic Mortgage Rights system	ICP-Brazil identity layer resolves attribution gaps in blockchain-IPFS systems
Cross-Sectoral Harmonization	Align NLA, OJK banking regulations, and Supreme Court e-evidence policy under a single Electronic Mortgage Rights recognition framework	CNJ coordinates notarial, registry, and certification authority through institutional governance protocols
Data Governance Norms	Legislate PTSL data quality standards, correction procedures, and liability allocation for foundational land data errors	Blockchain-based audit trail as a system design requirement, not voluntary reporting
Cyber Notary Standards	Define digital verification duties, electronic due diligence standards, and liability norms for Land Deed Officials and notaries in the Electronic Mortgage Rights process	Notaries reconstructed as digital gatekeepers with preserved public official status

Brazil's experience demonstrates that integration between technology, legal legitimacy, and economic efficiency in land systems can occur without modifying the foundations of the civil law system. Although Brazil's legal and digital readiness scores remain limited, the country has made strides in developing a digital land system architecture using permissioned blockchain approaches compatible with notarial institutions and property financing systems. This shows that progress is driven not solely by ideal regulation, but by institutional synergy and well-managed technological experimentation.

For Indonesia, which records the lowest legal readiness score and faces challenges in digital infrastructure and institutional fragmentation, blockchain adoption is not merely a technical transformation, but an opportunity to redesign national land governance and credit financing systems. In this context, Notaries and Land Deed Officials are key as transition agents towards cyber notary practices: legal professionals who utilise digital legitimacy to connect legal validity with the efficiency of electronic systems. Therefore, Indonesia should pursue not only technical modernisation but also the development of a legal and institutional

framework that integrates e-certificates with credit security systems, smart contracts, and a blockchain-based national land administration system.

4 Conclusion

Based on the Brazil-Indonesia comparison, it can be affirmed that Electronic Mortgage Rights requires a normative reconstruction based on a 'chain of trust': validated digital identity, authentication that produces a presumption of authenticity, cross-sectoral institutional coordination, auditable data governance, and the strengthening of the role of Land Deed Officials and notaries as guardians of digital legality. Without these elements, Electronic Mortgage Rights is likely to remain at an administrative level and will not reach the level of a bankable electronic security right that is robust in proof and enforcement.

The comparative analysis demonstrates that Brazil's model, anchored in ICP-Brazil, CNJ oversight, and the reconstructed role of notaries as digital gatekeepers, provides a coherent normative template that Indonesia can adapt without abandoning its civil law foundations. The five normative dimensions identified in this study provide a structured reform agenda: an authenticity framework, a national trust framework, cross-sectoral harmonisation, data governance norms, and cyber notary standards. Future research should examine the empirical acceptance of Electronic Mortgage Rights among Indonesian financial institutions and the feasibility of integrating PKI-based digital identity within the existing National Land Agency infrastructure.

References

1. Almeida, M. P. M. de. (2025). New technologies in the context of notary offices: an analysis of the implementation of electronic notarial acts through the e-Notariado platform in light of the territorial jurisdiction established by law in Brazil. *Brazilian Journal of Law, Technology and Innovation*, *3*(2), 192–208. https://doi.org/10.59224/bjlti.v3i2.192-208
2. Dias Menezes, L., de Araújo, L.V. & Nishijima, M. (2023). Blockchain and smart contract architecture for notary services under civil law: a Brazilian experience. *Int. J. Inf. Secur.* **22**, 869–880 https://doi.org/10.1007/s10207-023-00673-3
3. Espinosa, V. I., & Pino, A. (2025). E-Government as a development strategy: The case of Estonia. *International Journal of Public Administration*, *48*(2), 86–99.
4. García-Teruel, R. M. (2020). Legal challenges and opportunities of blockchain technology in the real estate sector. *Journal of Property, Planning and Environmental Law*, *12*(2), 129–145.
5. Hidayat, F. A., & Silvie, A. S. (2025). Analysis of the regulation of electronic land certificates in the Regulation of the Minister of Agrarian and Spatial Planning/Head of the National Land Agency Number 3 of 2023 concerning the Issuance of Electronic Documents. *Jurnal Meta-Yuridis*, *8*(1), 23–28.
6. Isnaini, H., & Utomo, W. (2019). The existence of the notary and notarial deeds within private procedural law in the era of the Industrial Revolution 4.0. *International Journal of Innovation, Creativity and Change*, *10*(3), 128–39.
7. Linhares, T. C. (2025). Notary Offices In The Digital Age: Between The Efficiency Of Blockchain And The Risks Of Lgpd–An Urgent Debate For Public Policies. *Editora Impacto Científico*, 107–121.

8. Koos, S. (2023). The Digitisation of Notarial Tasks: A Comparative Overview and Outlook of 'Cyber Notary'In Indonesia and Germany. *The Indonesian Journal of Socio-Legal Studies*, *2*(2), 1.
9. Mansoor, M. A., Ali, M., Mateen, A., Kaleem, M., & Nazir, S. (2023, November). Blockchain technology for land registry management in developing countries. In *2023, the 2nd International Conference on Emerging Trends in Electrical, Control, and Telecommunication Engineering (ETECTE)* (pp. 1–6). IEEE.
10. Putri, U. T., Sirojudin, M. R., & Oktasari, S. (2023). Legal Analysis of Smart Contracts for Land Registration in the Digital Era in Indonesia. *Fundamental: Jurnal Ilmiah Hukum*, *12*(1), 103–115.
11. Rodima-Taylor, D. (2021). Digitalising land administration: The geographies and temporalities of infrastructural promise. *Geoforum*, *122*, 140–151.
12. N. Sangeeta, & Nam, S. Y. (2023). Blockchain and Interplanetary File System (IPFS)-Based Data Storage System for Vehicular Networks with Keyword Search Capability. *Electronics*, *12*(7), 1545. https://doi.org/10.3390/electronics12071545
13. Shende, A., Kathiriya, S., & Sinha, A. (2022). Navigating the digital frontier: Strategies for securing personal and financial data in mortgage applications. *Journal of Artificial Intelligence & Cloud Computing*, *1*(2), 1–5.
14. Silva, C., Mairesse Siluk, J. C., & Rediske, G. Blockchain-Based Institutional Innovation in National Title Registration Systems: A Theoretical-Conceptual Framework for the Brazilian National Innovation System. *Available at SSRN 5705726*.
15. Krismantoro, D. (2023). The urgency of electronic land certificates in Indonesia's land registration legal system. *Journal of Law and Sustainable Development*, *11*(10), e1808-e1808.