



Reforming Intellectual Property Management in Vietnam through Blockchain Technology

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ABSTRACT

Research purpose: *This study aims to examine the structural challenges in Vietnam's intellectual property (IP) management system and to propose a blockchain-based governance model that enhances transparency, legal traceability, and systemic accountability across the IP lifecycle.*

Research motivation: *Vietnam's current IP management framework faces persistent bottlenecks, including fragmented databases, lengthy registration processes, and limited enforcement capacity, which hinders innovation and international competitiveness. The rapid advancement of blockchain technology offers an opportunity to address these gaps in line with the country's digital transformation strategy.*

Research design, approach, and method: *The research adopts a qualitative approach, combining literature review, analysis of regulatory documents, and synthesis of international best practices. The study develops a conceptual model of a permissioned blockchain-based IP ecosystem, detailing its technical architecture, operational workflows, and implementation requirements specific to Vietnam.*

Main findings: *The proposed model introduces a multi-tiered, permissioned blockchain infrastructure integrating smart contracts, oracles, and NFT-based IP certificates to streamline registration, licensing, and transfer processes. It addresses current inefficiencies by enabling secure data interoperability, real-time verification, and automated contract execution, while maintaining regulatory oversight and compliance.*

Practical/managerial implications: *Adoption of the model could significantly improve IP protection and commercialization in Vietnam, reduce administrative burdens, and foster trust in digital IP transactions. The study recommends pilot testing under controlled conditions to assess technological feasibility, legal admissibility, and user acceptance, thereby providing actionable insights for policymakers, IP offices, and technology providers.*

Keywords: Blockchain technology, smart contracts, intellectual property rights, oracles.

1. INTRODUCTION

Intellectual property (IP) management plays a critical role in fostering innovation, particularly in the context of digital transformation and the globalization of technology commercialization. However, conventional IP systems face significant challenges, especially in managing intangible assets, due to legal, technical, and institutional limitations (World Intellectual Property Organization, 2020). These constraints not only reduce the effectiveness of IP protection but also hinder the commercialization and investment potential in innovation. First, traditional IP systems, including the establishment, licensing, transfer, and royalty distribution of IP rights, are often characterized by complex, costly, and non-transparent procedures, which involves numerous intermediaries such as law firms or IP agencies (Kumar & Suthar, 2024). Consequently, small enterprises and individual innovators often lack the resources to navigate these procedures effectively. In many cases, the registration process can take months or years, rendering the protected technology obsolete before formal rights are granted (Bamakan et al., 2022).

Another significant challenge lies in the limited access to IP-related information, including details on ownership, licensing terms, and usage rights. Such limitations not only hinder transparency but also contribute to disputes and enforcement difficulties, particularly in collaborative projects and co-ownership arrangements (Alqarni, 2024; Gürkaynak et al., 2018). These issues are further compounded by legal discrepancies between countries, which create additional complexity in international IP management. For example, separate registrations are often required across different

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jurisdictions, a process that is both burdensome and costly, especially for small and medium-sized enterprises (SMEs). Moreover, existing IP databases tend to be fragmented and lack interoperability, making it difficult to obtain comprehensive and timely information (World Intellectual Property Organization, 2020; Gürkaynak et al., 2018).

A further limitation of the current IP system concerns the protection of non-registrable IP assets—such as trade secrets, unpublished technical solutions, and pre-patent research data—which are inherently difficult to safeguard within existing legal frameworks (Wagner et al., 2025). These intangible assets often lack verifiable evidence of authorship or creation time. This is a major challenge in open innovation contexts where early disclosure precedes formal protection. The absence of reliable, legally recognized, and real-time records creates a substantial barrier to trust, thereby discouraging active participation in collaborative innovation models. Furthermore, current systems also lack capacity to dynamically track ownership changes, manage transactions throughout the IP lifecycle, and ensure transparent benefit-sharing among co-owners (Bamakan et al., 2022). In practice, IP assets such as patents, digital creative works, or research outputs are frequently transferred, licensed, or jointly developed. Yet, without robust mechanisms for real-time traceability, commercialization is often delayed, legal uncertainty persists, and profit distribution may become inequitable (Gürkaynak et al., 2018).

In this context, blockchain technology offers a promising solution. Its decentralized, immutable, and transparent ledger capabilities enable legal verification of ownership, timestamping of IP creation, and automated execution of transactions via smart contracts. Such features reduce reliance on intermediaries, lower transaction costs, and provide real-time, cross-border traceability for IP assets (World Intellectual Property Organization, 2020).

In Vietnam, however, the application of blockchain in IP governance remains limited. Current adoption has been concentrated primarily in finance, supply chain management, and digital identity, leaving its potential for IP management largely untapped. Nevertheless, recent policy initiatives, such as Decision No. 2117/QĐ-TTg on priority technologies for the Fourth Industrial Revolution and Decision No. 1236/QĐ-TTg on the national strategy for blockchain development, have identified blockchain as a strategic digital infrastructure. Furthermore, the establishment of national blockchain platforms, namely NDAChain, reflects growing institutional readiness to apply blockchain-based verification in IP-related transactions.

Therefore, this study proposes a blockchain-based model for IP management and commercialization that is specifically adapted to Vietnam's digital transformation and institutional conditions. By addressing existing limitations in transparency, legal verifiability, and operational efficiency, this model aims to align Vietnam's IP infrastructure with the requirements of the global knowledge economy. In line with this context, the paper is structured as follows. Section 2 presents a literature review about prior research on blockchain applications in IP management and identifying relevant theoretical foundations. Section 3 examines the structural challenges in Vietnam's current IP management system, highlighting technical, legal, and institutional barriers. Section 4 introduces the proposed blockchain-based IP governance model. Finally, Section 5 discusses the key conditions required for successful implementation, including technological readiness, legal adaptation, and capacity-building initiatives.

2. LITERATURE REVIEW

A growing body of research has explored blockchain-based solutions for various aspects of IP management, ranging from registration and licensing to infringement monitoring and copyright protection in digital environments. However, most existing studies remain limited to technical simulations, small-scale pilot implementations, or sector-specific applications, and a truly comprehensive blockchain-based IP management ecosystem has yet to materialize.

Frameworks integrating smart contracts to automate licensing and royalty payments have been developed by several researchers. Nizamuddin et al. (2019) introduced a blockchain-based publishing framework built on the Ethereum platform, where smart contracts function as the core mechanism for enforcing agreements between authors and publishers. This model enables automated royalty distribution in cryptocurrency and aims to establish a transparent, traceable global ledger for digital asset transactions. Similarly, Showkatramani et al. (2019) employed the Hyperledger Fabric framework to develop a cross-border digital trademark registration and authentication system. The platform supports registration, renewal, validation, and certification issuance across jurisdictions.

Other studies have examined the integration of non-fungible tokens (NFTs) into IP management. Alqarni (2024) proposed an ecosystem that combines NFTs, smart contracts, oracles, and decentralized governance, in which IP rights are tokenized to ensure uniqueness, provenance, and traceability. Bamakan et al. (2022) developed a multi-layered patent NFT model incorporating authentication, storage, and smart contract layers. This model transforms IP rights into traceable and tradable assets governed by programmable legal terms which offers cost reductions and new commercialization opportunities for SMEs.

Blockchain architecture and security enhancements for IP systems have been emphasized in other contributions. Sha et al. (2022) developed a heterogeneous multi-chain model using the Polkadot framework for industrial IP validation

and protection. Zhang and Xu (2023) introduced a policy-updatable attribute encryption algorithm to improve access control within blockchain-enabled IP service platforms, while Zhu et al. (2023) implemented a blockchain-based provenance system to secure and authenticate original innovations. Additionally, Garba et al. (2020) and Gao (2023) applied a Partial Byzantine Fault Tolerant (PBFT) consensus algorithm to enhance content protection and system scalability.

Several other studies, such as those by Jing et al. (2021), Lee et al. (2021), and Savelyev (2018), have extended the research scope to areas such as source code protection, digital content marketplaces, and legal framework analysis. These works underscore the transformative potential of blockchain, while also acknowledging persistent challenges such as the legal recognition of ownership transfers under traditional legal frameworks and the ongoing debate over storing IP data on-chain versus off-chain.

In the Vietnamese context, current research on blockchain applications in IP management remains relatively nascent but has gained increasing attention in recent years. Existing studies primarily address the potential of blockchain as a distributed ledger for storing and authenticating IP rights (Đạt, 2022; Mai et al., 2022). Nguyen et al. (2025) also point to the role of blockchain in creating digital fingerprints for IP assets, supporting anti-counterfeiting and transparency in ownership. Other studies, such as those by Nguyen et al. (2025), have explored have explored NFT-related trademark protection in the United States to draw implications for legal reforms in Vietnam.

It can be seen that while international frameworks have proposed blockchain-based systems for IP management, they generally concentrate on sector-specific use cases, technical prototypes, or cross-border trademark solutions (e.g., Nizamuddin et al., 2019; Showkatramani et al., 2019; Alqami, 2024; Bamakan et al., 2022). These models offer valuable insights but are often designed for contexts with advanced digital infrastructures and mature legal frameworks. More comprehensive models have also been proposed; for instance, the World Intellectual Property Organization (2020) outlined a detailed workflow for each stage of IP management. However, their main limitation is the presumption of a fully on-chain environment, requiring all users to have blockchain accounts and interact exclusively on the platform. In contrast, the Vietnamese context presents a unique combination of challenges not directly addressed by prior frameworks, including fragmented databases, limited enforcement capacity, evolving regulatory standards, and the technological constraints associated with blockchain's recent introduction to the country. To the best of our knowledge, no prior study has proposed a detailed system for applying blockchain IP management that is specifically adapted to the Vietnamese context. This gap underscores the need for interdisciplinary approaches that integrate technology, law, and governance in order to design blockchain-based IP management systems that are both feasible and sustainable. Therefore, the present study proposes a comprehensive blockchain-based model for IP management in Vietnam. Specifically, it addresses three questions:

- (1) What structural limitations exist in Vietnam’s current IP governance system, and what are their root causes?
- (2) How can a blockchain-based ecosystem for IP management be designed to address these limitations?.
- (3) What legal and technological prerequisites must be met for effective implementation?

By examining the components and operational processes of the proposed ecosystem, this study aims to establish a practical foundation for piloting a blockchain-based IP governance model in Vietnam. The goal is to support the modernization and transparency of IP management in alignment with the demands of the digital economy.

3. STRUCTURAL CHALLENGES IN VIETNAM’S IP MANAGEMENT

As Vietnam moves toward a knowledge-driven and innovation-based economy, the effectiveness of its IP management systems becomes a decisive factor in safeguarding, exploiting, and commercializing the nation’s scientific and creative outputs. An efficient IP system not only protects the rights of creators and innovators but also incentivizes continued investment in research and development. However, Vietnam’s current IP management framework faces a range of structural deficiencies that significantly limit its ability to respond to the growing complexity and volume of innovation activities. These challenges compromise both public administration efficiency and societal incentives for innovation, constraining the country’s capacity for global economic integration.

The first and most visible challenge is administrative overload. Table 1 illustrates this trend over the period 2020–2023, during which total filings grew markedly from approximately 125,000 in 2020 to over 156,000 in 2023—an increase of nearly 25% within just four years. This rapid growth reflects both domestic innovation dynamics and the intensifying role of foreign applicants in Vietnam’s innovation ecosystem.

Table 1. Trends in IP applications and processed applications in Vietnam (2020–2023)

	2020	2021	2022	2023
No. of applications	125,689	131,440	140,903	156,413

	2020	2021	2022	2023
No. of processed applications	113,476	121,422	113,906	125,778
Percentage	90.3%	92.4%	80.9%	80.4%

(Source: Intellectual Property Office of Vietnam (2024), (2023), (2022), (2021))

It is noteworthy that the proportion of processed applications has remained relatively high, typically ranging from 80–90% of annual filings, yet it shows a declining trend over the period. However, the persistence of unprocessed applications each year means that unresolved cases accumulate over time, creating a growing backlog. This cumulative effect is particularly concerning in the context of continuously rising application volumes. Even when the processing ratio appears stable, the absolute number of unresolved applications annually can exert long-term pressure on examination capacity.

The structural implications of this backlog are significant. Statutory deadlines stipulated under Article 119 of Vietnam’s IP Law—for instance, 18 months for patents and 9 months for trademarks—are rarely met in practice, with actual examination times extending to an average of 3.5 years for trademarks and more than 6 years for patents (Minh K. Q., 2018). This delay is exacerbated by the limitations of the current Industrial Property Administration System (IPAS), which lacks the scalability, interoperability, and data analytics capabilities necessary for efficient examination and real-time data retrieval (Minh K. Q., 2018). The consequences are not merely procedural: prolonged registration times can deprive innovators of first-mover advantages, hinder investment attraction, and diminish the commercial value of time-sensitive inventions.

A second critical weakness concerns enforcement capacity, particularly in relation to the rapid escalation of industrial property rights infringements. As presented in Table 2, the number of infringement cases rose dramatically to 3,049 in 2023, representing a 213% increase compared to 2022 (Intellectual Property Office of Vietnam, 2024). The rise of digital and cross-border infringement has further complicated enforcement efforts, exposing the inadequacy of existing mechanisms for provenance tracking and ownership verification in digital environments. Providing evidence of rights establishment, transfer history, or actual use often requires lengthy investigation and still yields uncertain outcomes. In cross-border disputes, rights holders may face years of litigation before obtaining a definitive judgment (Van, 2024).

Table 2. industrial property rights infringements in Vietnam (2020–2023)

Year	2020	2021	2022	2023
No. of applications	2455	1,109	1,430	3,049

(Source: Intellectual Property Office of Vietnam (2024), (2023), (2022), (2021))

Third, commercialization of IP assets remains fragmented and inefficient. While Vietnam’s legal framework has been provided for licensing, valuation, and technology transfer, practical implementation is often opaque and inconsistent (Minh K. Q., 2022). According to Nguyen et al. (2020), the absence of standardized IP valuation mechanisms and functioning IP marketplaces prevents IP from being leveraged as financial assets. Research institutions, universities, and SMEs, who are key actors in the innovation ecosystem, frequently lack both the incentives and structural support needed to transform research outcomes into commercially viable products. This lack of transparency, standardization, and trust in commercialization processes not only limits the economic potential of IP assets but also highlights the urgent need for innovative technological solutions to ensure reliability and efficiency.

Finally, Vietnam’s IP system exhibits limited harmonization with international legal standards, despite the country’s commitments under trade agreements such as the CPTPP and EVFTA (Anh & Thao, 2019). These technical and legal gaps hinder the development of digital IP infrastructure, reducing legal certainty for foreign investors and impeding Vietnam’s integration into global innovation networks. Furthermore, although the commercialization of intangible assets such as software, databases, and creative digital content is expanding rapidly, Vietnam’s IP law and enforcement mechanisms remain heavily oriented toward tangible, traditional forms of IP (Kim et al., 2024). This regulatory lag results in critical gaps in establishing ownership, defining protection scopes, tracing transactions, and managing redistribution rights in digital environments, thereby reducing trust and limiting enforcement effectiveness (Nguyen et al., 2023).

Given these constraints, blockchain technology offers a promising alternative for modernizing Vietnam’s IP management. As discussed in previous sections, blockchain’s ability to provide immutable, time-stamped, and decentralized records can address registration bottlenecks, enhance rights verification in digital contexts, and facilitate secure cross-border enforcement. Moreover, tokenization of IP assets via blockchain can open new channels for commercialization, including the trading of IP-backed digital securities or NFTs, while reducing reliance on

intermediaries. These capabilities underscores the need for a comprehensive blockchain-based IP management model tailored to Vietnam's regulatory and technological context to bridge current gaps and enable effective IP governance in the digital economy.

4. DEVELOPING A BLOCKCHAIN-ENABLED IP MANAGEMENT ECOSYSTEM

4.1. Design principles of the proposed model

The proposed blockchain-based ecosystem for IP management in Vietnam aims to modernize two critical components of the current system: (i) the registration and formal recognition of IP rights and (ii) the licensing, transfer, and broader commercialization of those rights. This model is designed to address key limitations of the existing infrastructure and enhance the overall governance of intangible assets by leveraging the technical advantages of blockchain technology. The system architecture rests on four design principles, each responding to specific deficiencies identified in Vietnam's current IP regime.

First, the model aims to automate and increase transparency across IP management procedures. By embedding smart contracts into core workflows, such as application submission, rights confirmation, fee payment, and ownership transfer, the system can execute predefined legal and administrative actions automatically. This reduces human intervention, shortens processing times, and enhances data traceability. Moreover, automation lowers the risk of inconsistent decision-making and mitigates the possibility of duplicate or conflicting registrations, which is a recurring problem in paper-based or siloed digital systems.

Second, the model strengthens the reliability and enforceability of rights establishment. Blockchain's tamper-proof ledger enables each IP asset, whether a technical document, image, software, or creative work, to be registered with a unique cryptographic hash which functions as a verifiable digital fingerprint. This characteristic ensures that any alteration to the asset can be instantly detected and provides an incontrovertible timestamp for ownership claims. In addition, the system records the full lifecycle of legal events, including licensing, transfers, and disputes. This record, stored in a distributed and immutable format, can enhance the admissibility of evidence in court and strengthen Vietnam's ability to address cross-border infringement cases where proof of ownership is often contested.

Third, the model promotes more dynamic and accessible commercialization of IP assets through tokenization. By representing each registered IP asset as a NFT, the system enables digital property rights to be embedded directly into the token's metadata with legally binding terms such as scope of use, geographic coverage, duration, and revenue-sharing arrangements. Tokenization not only facilitates frictionless licensing and secondary trading but also enables innovative financing models such as fractional ownership and global crowdfunding for IP-backed ventures. Therefore, it opens new revenue streams, particularly for SMEs and research institutions that often lack access to traditional capital markets.

Finally, the model is built to facilitate multi-stakeholder collaboration and cross-border interoperability. It is designed to integrate with existing national platforms such as the IPAS, national digital identity systems, and government databases for taxation and population records. Through standardized APIs and harmonized data formats, it can also connect to international IP systems (e.g., WIPO, ASEAN IP, EUIPO), which reduces duplication of effort and streamlines international filings and enforcement actions. Furthermore, the model provides tiered access controls for different stakeholders, such as research institutes, arbitration centers, and verification bodies, so that sensitive information is shared securely while still enabling coordinated rights examination, valuation, and dispute resolution.

4.2. System architecture and core components

4.2.1. Key limitations of blockchain technology

Although blockchain technology holds significant promise, it also exhibits inherent limitations, especially when applied to public services such as IP management and licensing. A key challenge lies in translating complex legal rules into rigid smart contracts. Godfrey and Burdon (2024) describe this "legal translation" as the process of turning legal text into machine-executable code, which contains interpretive ambiguities that contrast sharply with the deterministic nature of code. Legal rules, like natural language more broadly, are inherently ambiguous and context-dependent, and this indeterminacy is especially evident in statutory and contractual provisions. Therefore, transposing contractual semantics from natural language into binary algorithmic form entails the risk of losing the original intent and mutual understanding of the contracting parties (Bassan & Rabitti, 2024). While self-executing by design, such contracts struggle to handle exceptional events that require discretionary judgment or renegotiation.

Furthermore, for smart contracts to achieve legal enforceability, they cannot exist in isolation but must operate within a broader contractual and legislative framework (Cadogan, 2023). This dependence creates challenges, as programmers must fix one interpretation of ambiguous clauses while excluding alternatives. Such disambiguation can yield computationally deterministic but legally inaccurate outcomes, creating tension between technological execution and legal validity.

Another major issue in blockchain systems is the “*oracle problem*”, which arises from the reliance on external data. For blockchain to interact with the real world, it depends on data feeds from external sources called oracles (Pasdar et al., 2023). Oracles act as intermediaries between the blockchain and the outside world, collecting, verifying, and transmitting off-chain information to smart contracts (Werner et al., 2023). However, an oracle is not the original data source but a third-party service or digital agent. This reliance reintroduces problems that blockchain was meant to solve which are centralization, single points of failure, and the need to trust an external party. The oracle problem undermines the trustless nature of blockchain, as the reliability of decentralized applications depends on the integrity of their oracles (Hassan et al., 2023; Ezzat et al., 2022). If an oracle provides false or manipulated data, smart contracts will execute based on this flawed input, which can result in irreversible errors and a loss of trust in the network.

Finally, scalability is one of the most persistent challenges in blockchain adoption and has direct implications for its long-term sustainability in intellectual property (IP) management. Research on public blockchains such as Bitcoin and Ethereum shows that they face fundamental performance constraints. These include low transaction throughput, high latency, growing storage demands, and high energy consumption, all of which limit their ability to support large-scale applications in domains beyond cryptocurrency (Khan et al., 2021; Nasir et al., 2022). In the context of IP management, these concerns are amplified, as national and cross-border systems must handle large volumes of registrations, licensing transactions, and enforcement actions in near real time. Similarly, Li (2025) further notes that while blockchain offers potential benefits in transparency, anti-counterfeiting, and cross-border IP trade, adoption is hindered by infrastructure limitations and high implementation costs, both closely linked to scalability. Addressing scalability is therefore not only a technical requirement but also a condition for building blockchain-based IP systems that are sustainable, efficient, and capable of meeting long-term institutional and economic demands.

Recognizing these challenges is a critical step in system design, as addressing them through appropriate technical solutions is necessary to ensure reliable performance and robust security.

4.2.2. Technical aspects of the model

To operationalize the proposed blockchain-based IP management ecosystem in Vietnam while ensuring transparency, security, and regulatory compliance, the system architecture integrates several interdependent technical components. Each element is carefully selected to balance decentralized integrity with centralized oversight, reflecting the unique legal, institutional, and infrastructural realities of Vietnam’s IP landscape. The overall system architecture is illustrated in Figure 1.

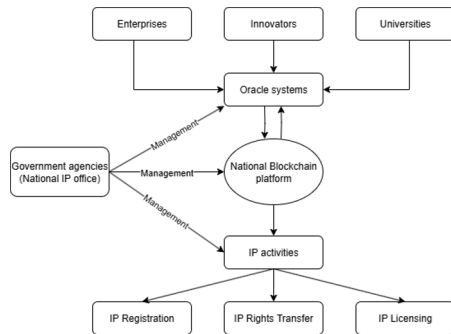


Fig. 1. Relationships of different stakeholders in the proposed blockchain-based IP management system

Regarding the type of blockchain, the proposed model adopts a permissioned blockchain infrastructure combined with non-mining consensus mechanisms. In such a network, only pre-authorized nodes can perform essential operations such as data validation, transaction submission, and block generation. This arrangement not only preserves the integrity of records but also ensures that participants are accountable to existing laws and institutional mandates. The validator network is structured around four categories of stakeholders: (i) the Intellectual Property Office of Vietnam (IP Office), serving as the principal regulatory authority responsible for platform governance, reviewing and approving IP registration applications, and ensuring legal conformity; (ii) market surveillance and customs agencies, monitoring market behavior, detecting potential infringement, and coordinating cross-border enforcement efforts; (iii) specialized verification institutions and public research organizations, providing expert assessments on the validity, originality, and economic value of IP assets, particularly for highly technical or scientific innovations; and (iv) authorized technology partners, including blockchain infrastructure providers such as VNPT, FPT, and Viettel, tasked with managing system operations,

ensuring cybersecurity, and enabling interoperability between on-chain records and off-chain data systems. This hybrid governance structure combines the credibility and regulatory control of public authorities with the efficiency and technical capacity of private technology operators, thereby safeguarding institutional trust while enabling distributed verification.

Given the sensitive and high-value nature of IP transactions, the model prioritizes consensus algorithms that maximize security, speed, and institutional accountability without relying on energy-intensive mining. Two consensus algorithms are considered most suitable. Practical Byzantine Fault Tolerance (PBFT) ensures resilience in networks with pre-defined participants, providing rapid consensus even with up to one-third faulty nodes. Alternatively, proof of authority (PoA) delegates validation responsibilities to trusted nodes, ensuring accountability through identity verification and legal liability. Both PBFT and PoA enhance scalability, reduce energy consumption, and ensure predictable performance.

To support interoperability with Vietnam’s existing administrative and financial systems, the model integrates oracle mechanisms that act as trusted data bridges between the blockchain and external systems. Oracles serve as trusted intermediaries that relay verified external data, such as payment confirmations, legal documentation, or identity verification, from conventional systems (e.g., banking platforms, e-wallets, or digital identity databases) into the blockchain environment. This feature is particularly critical during the transition phase, when Vietnam’s digital currency framework and national data standards are still evolving. In the long term, the adoption of a Central Bank Digital Currency (CBDC) could enable fully on-chain financial transactions, reducing dependency on intermediaries and further enhancing transparency and auditability. To reduce trust-related risks, oracle operations should be limited to accredited entities. In Vietnam, this role could be assigned to national providers such as VNPT or Viettel, whose reputational standing and regulatory oversight enhance data integrity and system reliability.

Finally, to maintain both data security and operational flexibility, the model adopts a role-based access architecture. Users are categorized into distinct groups, including regulatory bodies, technical support entities, IP rightsholders, authorized intermediaries, and public users, each with defined access rights. This approach balances data security with operational flexibility, enabling controlled collaboration among stakeholders. By clearly delineating access rights, the system reduces the risk of unauthorized disclosure and strengthens overall compliance with both domestic laws and international IP protection standards.

4.3. Operational workflow of the proposed ecosystem

4.3.1. For IP registration workflow

The proposed blockchain-based IP registration process comprises three core stages: (i) application preparation and submission, (ii) fee payment and confirmation, and (iii) examination, certification and issuance of digital IP rights. Each stage is designed to build upon the previous one, ensuring that all inputs - legal, technical, and financial - are verified before the rights are granted. Figure 2 illustrates the detailed workflow of the blockchain-enabled IP registration process, highlighting the interactions among applicants, authorities, and the blockchain infrastructure.

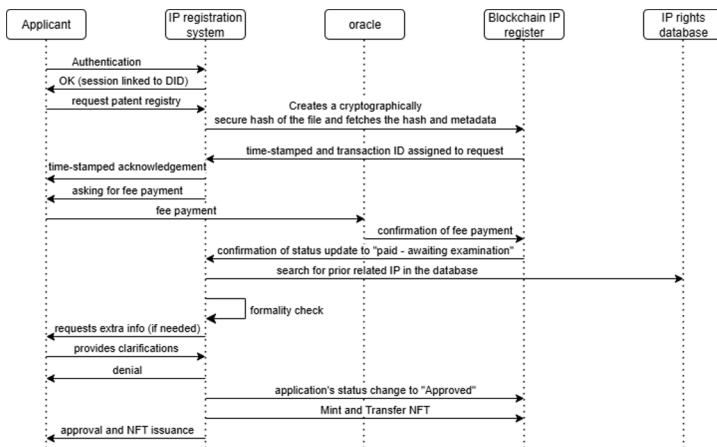


Fig. 2. IP registration process

a) Stage 1: IP application preparation and submission

Applicants begin by accessing an integrated online IP registration portal, which serves as the primary entry point to the blockchain-based system. To reduce duplication and infringement risks, the portal provides structured search functions that reference public hash values of all registered IP assets. Applicants are guided step-by-step to prepare asset-related documentation, including technical drawings, ownership proofs, and supporting identifiers. These materials are processed through cryptographic hashing to create tamper-proof identifiers that can be uploaded to the blockchain without disclosing the original content. All sensitive information and detailed contents of the IP application are securely stored in the dedicated servers of the IP Office. Applicants also provide structured metadata, such as personal or organizational identity, legal declarations, intended commercial use, and indicative market value.

Upon submission, the platform generates a “preliminary block”, which is a time-stamped, blockchain-stored record with a pending status. This entry ensures an immutable proof of submission while allowing applicants to track the progress of their application in real time. However, the record only advances to formal examination once payment is confirmed.

b) Stage 2: Fee payment

Payments are processed off-chain using Vietnam’s existing banking and e-wallet infrastructure to ensure accessibility. To link these payments to the blockchain record, a permissioned oracle operated by a government agency or authorized technology partner validates the transaction. Once payment is confirmed, the oracle generates a hash of payment metadata (including transaction ID, timestamp, and payer identity), records it on-chain, and then automatically updates the application status to “Paid – Awaiting Examination”. This function ensures financial proof is securely embedded in the blockchain, reducing disputes over payment compliance.

c) Stage 3: Examination and certification

At this stage, IP Office officials retrieve the application’s hashed data and metadata directly from the blockchain. Automated hash comparison with internal and public databases facilitates the detection of duplicates or infringement. In complex or highly technical cases, the IP Office can request expert verification from certified institutions or public research bodies to ensure the decision is evidence-based.

Once an application passes legal and technical examination, the IP office makes an official off-chain decision to either grant or reject protection. If the application is approved, the decision is recorded on-chain through a new blockchain transaction referencing the original application. This transaction is signed with the private key of an authorized IP office, providing cryptographic proof that the change of status originates from the legitimate authority. Once broadcast to the blockchain network, embedded smart contracts verify the signature and update the application’s status from “Paid – Awaiting Examination” to “Approved/Granted.”

Following confirmation of approval, the system generates a NFT that functions as the digital certificate of IP rights. This NFT incorporates structured metadata including the certificate number, a digital representation of the official document, issuance and expiration dates, the owner’s name and decentralized identifier (DID), and a secure hash linking to detailed descriptive records stored off-chain. The NFT is first created in the IPO’s digital wallet and then transferred to the applicant’s verified wallet. The NFT format facilitates future transactions such as licensing or transfers without requiring re-registration. Conversely, if the application is rejected or requires amendment, the decision is recorded on-chain with legal references and technical justifications. Applicants may resubmit revised applications that remain cryptographically linked to the original record, thereby preserving transparency, accountability, and traceability across the entire lifecycle of IP rights management.

Across all stages, every action including application submission, payment confirmation, status updates, approval, or rejection, is irreversibly logged on the blockchain. Public users can access only non-sensitive metadata such as application ID, current status, and asset hash to protect applicants’ commercial interests while maintaining systemic transparency.

4.3.2. For licensing and transfer of IP assets

Once an IP asset is registered and tokenized as an NFT, the platform supports its commercial exploitation through smart contract-enabled licensing or ownership transfers. Figure 3 shows the IP licensing process, which begins with the licensor offering defined licensing terms and progresses through negotiation, contract formation, payment verification, and issuance of license tokens.

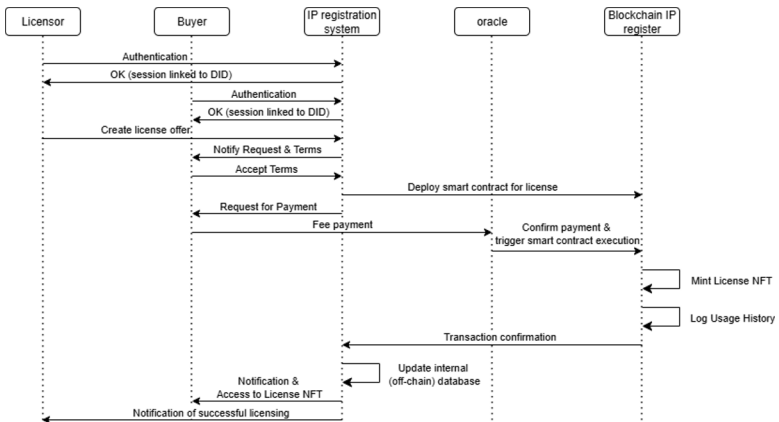


Fig. 3. IP licensing process

Within the proposed model, licensing can be implemented through the issuance of license NFTs, a subordinate token that represent specific, limited usage rights tied to the original asset. These rights are defined by duration, geography, functional scope, or sector of use, based on the negotiated agreement between the IP owner and licensee. Once the licensor and licensee agree on conditions, these terms are encoded into a smart contract linked to the original NFT. The licensee completes the financial transaction via conventional payment systems, and the oracle verifies the transaction before triggering the execution of the smart contract. The system then automatically issues a license NFT to the licensee and logs the transaction in the original NFT’s usage history. License NFTs can expire, be revoked, or be renewed automatically based on predefined rules, giving rights holders dynamic control over asset exploitation.

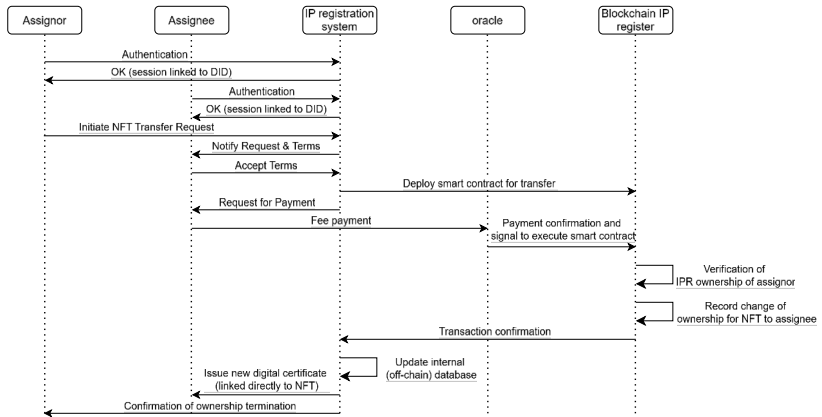


Fig. 4. IP transfer process

The IP ownership transfer process follows a structure similar to licensing, as depicted in Figure 4. After legal and financial terms are agreed upon and payment is verified, the smart contract executes three actions: (i) transfer the original NFT from the transferor’s wallet to the transferee’s; (ii) updates on-chain ownership metadata with timestamp and transaction details; and (iii) submits a request to the registering authority (e.g., the Intellectual Property Office) to issue an updated digital certificate directly linked to the existing NFT. This automated process minimizes administrative delays, ensures that all ownership changes are verifiable, and greatly reduces the risk of certificate forgery which is a persistent challenge in traditional paper-based systems.

5. REQUIREMENTS FOR IMPLEMENTATION OF THE MODEL IN VIETNAM

The integration of blockchain technology into Vietnam's IP management system presents significant potential to improve registration, protection, and commercialization. Yet, realizing this potential requires more than simply deploying new software as it demands a comprehensive alignment of governance, legal, technical, security, operational, and policy conditions. Without such systemic preparation, blockchain adoption risks becoming fragmented, underutilized, or even counterproductive.

5.1. Technical Standards and Interoperability

A blockchain-based IP ecosystem can only be effective if its architecture adheres to clear technical standards and achieves seamless interoperability with both domestic and international systems. The blockchain platform must integrate with existing data systems such as: (i) the IPAS, used by WIPO member states; (ii) the National Office of Intellectual Property's digital portals for processing and publishing IP registrations; (iii) Global and regional IP databases, such as the WIPO Global Brand Database and the ASEAN IP Portal. Such integration is essential to avoid "digital silos" that could prevent Vietnam's IP records from being recognized abroad or synchronized with partner jurisdictions.

In parallel, smart contracts should follow standardized templates for common IP transactions. A robust open API framework is essential for integration with third-party verification or registry services, for example, enabling a copyright protection agency in Australia to verify the legal status of a work registered in Vietnam through WIPO-compliant protocols.

Furthermore, off-chain data connectivity, facilitated by blockchain oracles, must also be both secure and verifiable. Oracles should reliably access payment systems, usage metrics, and digital content platforms, while operating under state-supervised governance with strong identity verification and independent audits. This approach ensures that the bridge between real-world events and blockchain records is both trustworthy and tamper-resistant.

5.2. Legal and Institutional Framework

Legal recognition of blockchain-based records is a prerequisite for an effective IP governance. The National Blockchain Development Strategy (Decision No. 1236/QĐ-TTg, dated 22 October 2024) has identified several legal priorities that must be addressed:

- Legal status of blockchain records: Current IP laws do not explicitly recognize blockchain-generated evidence (e.g., hash values, transaction logs, digital certificates) as admissible proof in administrative or judicial proceedings. Without codification, such records may hold little weight in enforcement disputes;

- Recognition of smart contracts: Vietnam's Civil Code and sector-specific laws lack clarity on whether smart contracts are equivalent to traditional written contracts. This gap leaves uncertainty around enforceability, error handling, and dispute resolution. Explicit provisions are needed to legitimize smart contract executions and clarify their legal effects.

- Legal classification of NFTs: NFTs must be formally recognized as a legitimate category of digital asset. Currently, NFTs are not classified under any of the four asset types in the Civil Code, which impedes IP-related transactions such as licensing or transfer. Regulation should also address risks of speculation and fraud, and establish technical standards and compliance mechanisms.

- Integration with digital identity systems: Blockchain's anonymous nature poses challenges for law enforcement and rightsholder identification. Integration with government-issued digital ID systems (as mandated in Decree No. 69/2024/ND-CP on e-identification and authentication) is essential to ensure legal traceability and accountability of IP transactions.

By addressing these legal and institutional gaps, Vietnam can ensure that blockchain-based IP rights are not only technologically valid but also legally enforceable both domestically and in cross-border contexts.

5.3. ICT Capacity-Building Policies

Even with technical and legal readiness, the system's effectiveness will ultimately depend on human and institutional capacity. A blockchain-enabled IP ecosystem requires new skills, upgraded infrastructure, and sustained institutional learning. The first step is a baseline assessment of existing IP-related institutions to evaluate their technical infrastructure, staff capabilities, and digital readiness. From this foundation, targeted capacity-building programs can be developed to equip workforce with necessary skills to manage and apply blockchain technologies effectively. In alignment with the National Blockchain Development Strategy, such efforts should include: (i) integrating blockchain education into formal curricula at universities and vocational schools; (ii) establishing open-access online training platforms for continuous upskilling; (iii) fostering communities of specialized experts to support peer learning and problem-solving; and (iv) raising awareness among government officials, enterprises, and the general public about blockchain's role in IP management.

Special attention should be given to SMEs, the source of innovation but constrained in technological adoption. Support measures could include financial incentives, subsidized blockchain services, and tailored advisory programs. SMEs should also be guided in restructuring their business models for a decentralized IP environment, where smart contracts and tokenized rights management become the norm. Together, these policies will build the human capital, institutional resilience, and technological agility needed to sustain a transparent, secure, and internationally compatible blockchain-based IP ecosystem which is fully aligned with Vietnam's broader digital transformation agenda.

6. CONCLUSION

In this study, we have examined the current state of IP management in Vietnam and identified critical limitations such as procedural delays, fragmented data systems, and weak enforcement mechanisms. Building on this assessment, we have proposed a blockchain-based IP governance ecosystem model tailored to Vietnam's digital transformation agenda. This proposed framework is designed as a structured, multi-tiered system that integrates blockchain technology into every stage of the IP lifecycle, covering registration, examination, licensing, transfer, and commercialization. It aims to enhance procedural transparency, legal traceability, and systemic accountability across the IP lifecycle, thereby creating a more trustworthy and efficient environment for rights holders and market participants alike.

This study makes a distinct contribution that moves beyond existing international frameworks discussed in the literature. While foundational models like those by Nizamuddin et al. (2019) and Alqarni (2024) have demonstrated the feasibility of automating specific processes or tokenizing assets with NFTs, they often remain conceptual or are designed for contexts with different institutional structures. Our model, by contrast, is uniquely characterized by its state-centric hybrid governance structure, which aligns with Vietnam's regulatory realities by positioning the IP Office as the core authority. Furthermore, unlike architecturally self-contained systems, it is designed for deep integration with national infrastructure, including: (1) legacy systems like IPAS; (2) emerging digital identity platforms; and (3) using oracles as a pragmatic bridge to existing payment networks. This profound contextualization constitutes its primary novelty, offering a practical and institutionally viable solution rather than a purely technical one.

While the model is currently conceptual, its successful adoption could be transformative for Vietnam's IP landscape. It not only addresses long-standing administrative bottlenecks but also provides a foundation for a dynamic and trust-based digital innovation ecosystem. Future research should focus on pilot programs conducted in controlled environments to rigorously assess the model's technological feasibility, legal admissibility, and stakeholder acceptance. Such pilots could include practical trials of smart contract-enabled licensing, simulated transactions involving NFT-based IP rights transfers, and full-scale integration testing with existing IP databases and national payment infrastructures. These steps will be essential to ensure that the proposed ecosystem is not only technically sound but also legally robust and operationally sustainable in Vietnam's evolving innovation landscape.

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