

Sharia-Compliant Digital Transactions in Islamic Boarding Schools: A Legal and Accounting Framework for Smart Contract Implementation

Digital Transactions in
Islamic Boarding
Schools

1939

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ABSTRACT

Motivated by the need for greater efficiency and transparency in financial management, the research aims to explore how smart contracts can enhance operational practices while adhering to Islamic principles. This study examines the potential of blockchain-based smart contracts to facilitate Sharia-compliant digital transactions in Islamic boarding schools. A qualitative multiple-case study approach was employed, involving in-depth interviews with school leaders, business managers, and financial administrators from three major Islamic boarding schools, supported by analysis of financial records, transactional agreements, and regulatory documents. Findings indicate that smart contracts can significantly improve financial operations, particularly in managing business partnerships, charitable fund distribution, and educational fee structures. However, successful implementation requires addressing legal recognition of blockchain agreements, establishing accounting standards aligned with AAOIFI guidelines, and ensuring robust Sharia supervision consistent with National Sharia Council-Indonesian Ulema Council directives. The study also highlights variations in digital readiness across schools, emphasizing the need for a phased, context-sensitive adoption strategy. An integrated framework and readiness-based roadmap are proposed, offering a practical pathway for compliant and efficient digital financial management. This research contributes a novel conceptual framework bridging blockchain innovation and Islamic commercial jurisprudence, advancing the integration of Islamic fintech in traditional educational institutions.

Keywords: Blockchain, Digital Financial, Islamic Fintech, Smart Contracts, Sharia Compliance.

INTRODUCTION

The rapid digital transformation of financial services has fundamentally altered transactional paradigms across the globe, shifting traditional financial interactions toward more digital, automated, and data-driven systems. In this evolving landscape, Islamic financial institutions are increasingly embracing technological innovations to enhance operational efficiency, improve transparency, and expand financial inclusion, particularly among underserved populations (Ascarya & Sakti, 2022; Hassan et al., 2022). The emergence of Islamic fintech, defined as the convergence of Sharia-compliant financial principles with advanced digital technologies, has created new pathways for institutions to modernize their economic activities while maintaining adherence to Islamic ethical and legal frameworks (Lavelle, 2022). Beyond efficiency gains, this transformation also enables greater accessibility, reduces transaction costs, and supports real-time monitoring

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and accountability, which are essential for ensuring Sharia compliance. This technological integration holds particular significance for Indonesia, which hosts the world's largest Muslim population and has strategically positioned Islamic fintech as a key driver of national economic development and financial inclusion, supported by the rapid expansion of digital infrastructure and regulatory initiatives that further accelerate fintech adoption across sectors (Hudaefi, 2020).

Within Indonesia's socio-economic landscape, Islamic boarding schools (*Pesantren*) represent crucial institutions that combine religious education with community economic development (Ainissyifa et al., 2024; Kaplan, 2024). These traditional establishments maintain substantial economic operations, including business enterprises, charitable activities, and fee-based services, to support their pedagogical missions. The Global Islamic FinTech Report 2024/25 highlights that Indonesia ranks third globally in the Islamic fintech ecosystem, with the number of active fintech companies growing from 79 in 2017 to 297 in 2024 (DinarStandard & Elipses, 2025; Statista, 2025). This growth, coupled with the post-pandemic acceleration of digital adoption, creates both an imperative and an opportunity for technological modernization within these traditionally conservative institutions (Rabbani et al., 2020).

The emergence of blockchain technology and smart contracts presents a transformative potential for Islamic boarding schools' economic operations (Awini et al., 2024; Zhou & Yang, 2024). Smart contracts, self-executing contractual agreements with terms directly written into code, offer automated transaction processing, enhanced transparency, and reduced administrative costs (Feng et al., 2023). When properly structured, these digital mechanisms can align with core Islamic commercial principles, including the prohibition of *riba* (interest), *gharar* (excessive uncertainty), and *maysir* (gambling). This alignment creates an opportunity for developing standardized Sharia-compliant digital transaction frameworks tailored to the unique socio-economic characteristics of Islamic boarding schools (Jouti, 2019; Khusaini et al., 2022).

Despite this potential, significant research gaps persist. Current literature on Islamic FinTech has primarily focused on banking applications or macroeconomic analyses, with limited attention to the specific needs of educational institutions (He et al., 2025). Similarly, while scholarly work has examined the community economic role of Islamic boarding schools by Hudaefi and Heryani (2019) Few studies have investigated their digital transaction readiness.

This research addresses these gaps by examining the current transactional practices and operational challenges within Islamic boarding school economic activities, the design of smart contracts that align with Sharia principles while addressing these challenges, the legal and accounting frameworks required to support Sharia-compliant smart contract implementation, and the potential implementation challenges along with strategies for their mitigation. Thus, the research aims to explore how smart contracts can enhance operational practices while adhering to Islamic principles. The study's novelty derives from its interdisciplinary examination of technological innovation within traditional religious educational contexts, its development of an integrated legal-accounting framework for Sharia-compliant smart contracts, and its empirical focus on West Java's distinct Islamic boarding school ecosystem. By addressing these aspects, this research contributes to both academic literature and practical applications of Islamic fintech.

LITERATURE REVIEW

Blockchain-Based Smart Contracts Adoption

Blockchain is a decentralized digital ledger technology that records transactions in an immutable and transparent manner, while smart contracts are self-executing agreements encoded on the blockchain that automatically enforce predefined rules. This technology has emerged as a promising infrastructure for enhancing the efficiency, transparency, and automation of digital financial transactions (Hussain et al., 2024; Kukman & Gričar, 2025; Hendratni, 2025). Its decentralized and tamper-proof nature reduces reliance on intermediaries, lowers operational costs, and minimizes information asymmetry, while

enabling faster and more reliable transaction processing. As a result, blockchain-based systems are increasingly being considered as a solution to improve governance and accountability in financial operations across various sectors.

In the context of Islamic finance, blockchain technology demonstrates strong compatibility with Sharia principles, as smart contracts can be designed to automate contractual conditions in accordance with Islamic rules while enhancing transparency and accountability (Fitri, 2023; Desky & Hye, 2025). The immutability of blockchain records aligns with key Islamic values such as justice (*'adl*) and trust (*amanah*), supporting more ethical and transparent financial practices (Sami, 2025; Dahlan, 2025). However, despite its potential, several challenges persist, including scalability issues, regulatory uncertainty, and varying levels of technological readiness, particularly in traditional institutions. Therefore, while blockchain-based smart contracts offer significant opportunities to improve institutional financial systems, their successful implementation requires careful adaptation to specific organizational contexts, such as Islamic boarding schools.

Sharia-Compliant Digital Transaction Effectiveness

Sharia compliance refers to the requirement that financial transactions adhere to Islamic law by avoiding prohibited elements such as *riba* (interest), *gharar* (excessive uncertainty), and unethical practices, while promoting justice (*'adl*) and public benefit (*maslahah*). In the context of rapid digital financial innovation, ensuring that emerging technologies such as blockchain and smart contracts align with Sharia principles has become an important focus in Islamic finance (Chong, 2021; Uula, 2025). Smart contracts, as automated and self-executing agreements, offer the ability to enforce predefined contractual terms with greater transparency and reduced ambiguity, which is essential for maintaining Sharia compliance in digital transactions (Norrahan, 2025). Furthermore, these contracts can be structured to replicate classical Islamic financial instruments such as *murabahah* and *mudarabah*, enabling clear mechanisms for profit-sharing, risk allocation, and contractual clarity in accordance with Islamic jurisprudence (Gunawan, 2025).

In addition, blockchain technology enhances auditability, transparency, and trust through its immutable and traceable transaction records, which strengthen accountability and governance in financial operations (Adewale et al., 2022; Asy'arie et al., 2025; Eyo-Udo et al., 2025). These features are particularly relevant for institutions such as Islamic boarding schools, where financial management must balance operational efficiency with strict adherence to religious principles. By integrating smart contract automation with blockchain-based transparency, such institutions have the potential to implement more efficient, accurate, and Sharia-compliant financial systems. This integration not only reduces the risk of human error and information asymmetry but also enhances stakeholder trust, thereby supporting sustainable and ethically grounded financial management aligned with Islamic commercial law.

RESEARCH METHODS

This study used a qualitative multiple-case study methodology to examine how Sharia-compliant smart contracts might be used at an Islamic boarding school (Houghton et al., 2015; Andrews & Aydin, 2020). This approach was selected for its suitability in exploring complex, real-world phenomena within their specific contexts, allowing for an in-depth understanding of the legal, accounting, and operational dimensions of technological adoption in these unique institutions. The research design integrates empirical data from three distinct Islamic boarding school cases in West Java with a normative legal analysis of Indonesia's regulatory framework and a systematic review of relevant academic literature.

Three Islamic boarding schools in West Java were selected as case studies based on their varying levels of digital adoption and economic operational models, providing a comparative basis for analysis. The selection criteria, adapted from Hudaefi and Heryani

(2019), included establishment history and educational model (traditional vs. modern), scale and diversity of business enterprises, and existing level of digital technology integration. The selected cases represent a spectrum of Islamic boarding school types, from traditional *salaf* institutions to innovative digital-enhanced schools.

Primary data was collected between January and June 2025 through semi-structured, in-depth interviews with key stakeholders at each Islamic boarding school. A total of 21 interviews were conducted with Islamic boarding school leaders (*kyai*), business unit managers, financial administrators, and IT personnel. Secondary data was gathered through a comprehensive review of internal documents from each Islamic boarding school, including annual financial reports, business partnership agreements, student fee schedules, and zakat/waqf distribution records. This documentary analysis provided a quantitative basis for understanding transactional volumes, revenue streams, and financial management complexities. A normative legal analysis was conducted on relevant Indonesian laws, the Financial Services Authority of Indonesia (*Otoritas Jasa Keuangan/OJK*), and the Central Bank of Indonesia and National Sharia Council-Indonesian Ulema Council (*Dewan Syariah Nasional-Majelis Ulama Indonesia/DSN-MUI*) fatwas about Islamic finance and digital transactions.

Data analysis was conducted through a multi-stage process. First, interview transcripts and documents were coded using thematic analysis to identify patterns related to transactional practices, Sharia compliance, and technological readiness, supported by qualitative analysis software. Second, a cross-case analysis compared findings across three Islamic boarding schools to identify shared themes and contextual differences, enabling the development of a generalized yet context-sensitive framework. Third, empirical findings were integrated with normative legal analysis and literature review to construct a conceptual framework for Sharia-compliant smart contract implementation, combining Islamic finance principles, blockchain requirements, and Indonesian regulatory considerations.

The final stage of the methodology involved developing a comprehensive implementation framework and a visual roadmap, which were then validated through a focus group discussion with a panel of experts. The panel included two Islamic finance scholars, one blockchain technology specialist, one legal expert in Indonesian commercial law, and two senior Islamic boarding school leaders not involved in the initial case studies. The feedback from this expert panel was used to refine the framework and ensure its practical relevance, theoretical soundness, and Sharia compliance.

RESULTS

Current Transactional Practices

This section presents the findings from the cross-case analysis of the three West Java Islamic boarding schools, followed by a detailed discussion of the proposed framework for Sharia-compliant smart contract implementation. The results are organized thematically to address the research questions concerning current transactional practices, the potential of smart contracts, and the required legal and accounting frameworks.

Table 1. Comparative Analysis of Three Islamic Boarding School Cases in West Java

Characteristics	Al-Mubarak Islamic Boarding School (Traditional <i>Salaf</i>)	Darul Fikri Islamic Boarding School (Integrated Modern)	Nurul Hidayah Islamic Boarding School (Innovative Digital)
Educational Model	Traditional Islamic education (<i>salaf</i>)	Integrated religious and modern curricula	Digital-enhanced Islamic education
Business Enterprises	Agricultural ventures (rice, vegetables), livestock, and traditional food production	Printing services, food manufacturing, technology services, and retail operations	Digital learning platforms, e-commerce, technology consulting, and online education services
Annual Revenue (IDR)	2.5 billion	8.7 billion	6.3 billion
Digital Adoption Level	Low (15% digitalized)	Medium (45% digitalized)	High (75% digitalized)

Characteristics	Al-Mubarak Islamic Boarding School (Traditional <i>Salaf</i>)	Darul Fikri Islamic Boarding School (Integrated Modern)	Nurul Hidayah Islamic Boarding School (Innovative Digital)
Current Payment Methods	Cash (85%), bank transfer (15%)	Cash (40%), bank transfer (45%), e-wallet (15%)	Cash (20%), bank transfer (30%), e-wallet (35%), digital platforms (15%)
Financial Management System	Manual bookkeeping, basic spreadsheets	Hybrid (manual + digital accounting software)	Fully integrated digital financial management system
Sharia Compliance Mechanism	Islamic boarding school leaders (<i>kyai</i>) oversight, informal fatwa consultation	Sharia advisory board, quarterly audits	Dedicated Sharia supervisory board, real-time compliance monitoring
Transaction Pain Points	Manual record-keeping errors, delayed reconciliation, and limited transparency	Coordination challenges between units, inconsistent documentation	Integration complexity, cybersecurity concerns, and digital literacy gaps
Smart Contract Readiness	Low (requires infrastructure development)	Medium (partial infrastructure available)	High (existing digital infrastructure)
Implementation Timeline	24-36 months	12-18 months	6-12 months
Estimated Implementation Cost (IDR)	450 million	350 million	200 million
Primary Stakeholders	Islamic boarding school leaders (<i>kyai</i>), business managers, students, and representatives	Board of trustees, business unit heads, IT department, Sharia board	Digital transformation team, fintech specialists, Sharia tech advisors

Table 1 shows, current transactional practices within the studied Islamic boarding schools, or Islamic boarding school, reveal a direct correlation between their level of digital adoption and the specific operational challenges they face (Tantowi et al., 2025). Empirical data delineates a clear spectrum across the three institutions, from traditional cash-based systems to advanced digital integration, each with its own distinct set of pain points that impede optimal financial management and operational efficiency. At one end of the spectrum lies Al-Mubarak Islamic boarding school, a traditional *salaf* institution where digital adoption is minimal. Here, over 85% of transactions are conducted in cash, with financial management entirely dependent on manual bookkeeping. This reliance on archaic methods creates significant systemic bottlenecks, fostering an environment ripe for operational inefficiencies and a concerning lack of financial clarity for its administration.

The consequences at Al-Mubarak are multifaceted and severe. The practice of reconciling financial records only weekly or even monthly results in a persistent lag in data, causing discrepancies and eliminating any capacity for real-time financial visibility (Ajibade, 2025). Furthermore, the dependence on physical ledgers inherently invites frequent human errors, which directly compromise the accuracy and reliability of all financial reporting. This cash-based, manual ecosystem also severely limits transparency, making it particularly difficult to provide accountable records for sensitive fund distributions such as zakat and waqf.

Islamic boarding schools exhibit varying levels of digital adoption, from hybrid systems like Darul Fikri, which combine digital tools with organizational challenges such as coordination and inconsistent documentation, to highly digital institutions that achieve greater efficiency but face complexities in system integration and cybersecurity risks. This progression shows that digital transformation introduces new challenges at each stage, shifting from manual inefficiencies to system coordination and data security concerns (Sharma et al., 2024). These findings highlight the need for a unified, transparent transactional system, as issues such as errors, lack of transparency, and reconciliation delays can potentially be addressed through blockchain-based smart contracts.

A Conceptual Framework for Sharia-Compliant Smart Contracts

To address the identified challenges while ensuring adherence to Islamic principles, this study proposes a comprehensive conceptual framework for a Sharia-compliant smart contract ecosystem, as illustrated in Figure 1. This multi-layered framework integrates regulatory requirements, Sharia governance, blockchain infrastructure, and stakeholder interfaces to create a holistic system for Islamic boarding schools' financial management.

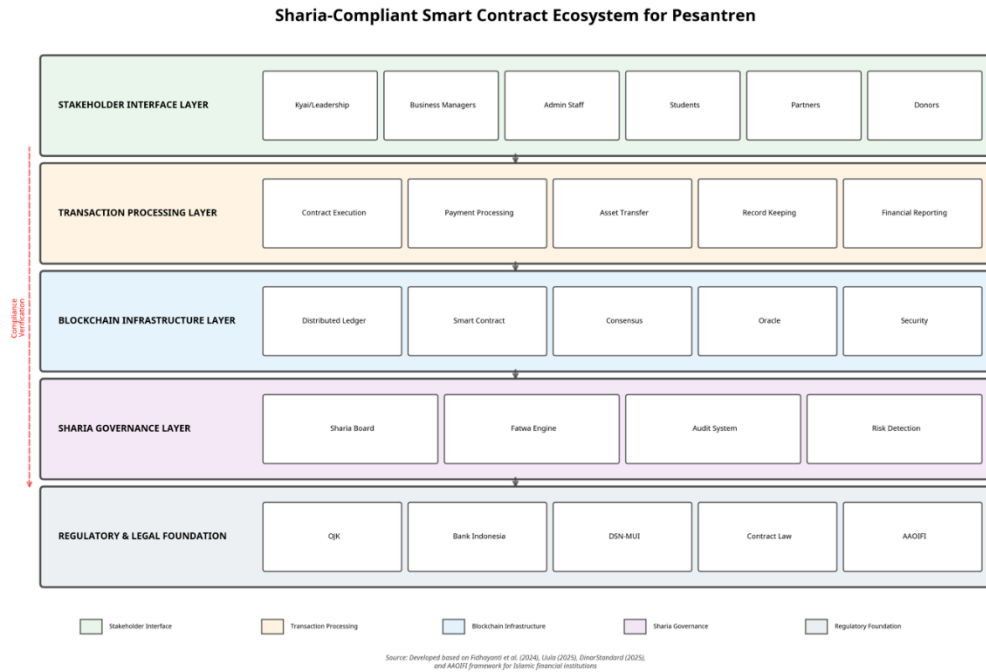


Figure 1. Sharia-Compliant Smart Contract Ecosystem for Islamic boarding schools

The proposed framework, illustrated in Figure 1, is structured across five interdependent layers that collectively support the implementation of Sharia-compliant smart contracts in Islamic boarding school financial operations. At the foundational level, the regulatory and legal layer ensures that all smart contract activities comply with Indonesian financial regulations issued by the Financial Services Authority of Indonesia and the central Bank of Indonesia as well as international Islamic accounting standards established by Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI), thereby providing the legal certainty necessary for smart contracts to be recognized as enforceable agreements. Building upon this foundation, the Sharia governance layer functions as the core mechanism for religious compliance by integrating a Sharia Supervisory Board with an AI-powered compliance engine capable of detecting and preventing transactions involving *riba*, *gharar*, or *maysir* in real time (Syarif, 2024).

Guided by DSN-MUI fatwas, this automated oversight mechanism enhances Sharia auditing beyond traditional periodic reviews. The blockchain infrastructure layer provides the technical backbone of the framework, consisting of a distributed ledger, smart contract code, and robust security protocols that ensure immutability, transparency, and data integrity (Rahman et al., 2022). Above this, the transaction processing layer enables the automated execution of financial activities, including partnership profit-sharing, student fee payments, and zakat distributions, in accordance with predefined smart contract rules. The stakeholder interface layer offers user-friendly dashboards that allow Islamic boarding schools' leadership, students, and business partners to access transaction records, monitor financial performance, and generate reports, thereby strengthening transparency and accountability across the system.

Table 2. Sharia Smart Contract Framework for Islamic boarding schools Transactions

Framework Component	Sharia Compliance Requirements	Technical Implementation	Key Performance Indicators
Legal Foundation	<ul style="list-style-type: none"> Compliance with OJK regulations Adherence to DSN-MUI fatwa Alignment with Indonesian contract law 	<ul style="list-style-type: none"> Digital signature integration Legal document templates Regulatory reporting modules 	<ul style="list-style-type: none"> Legal recognition rate: 100% Regulatory compliance score: $\geq 95\%$ Dispute resolution time: < 30 days
Sharia Governance Layer	<ul style="list-style-type: none"> Real-time <i>riba</i> detection <i>Gharar</i> minimization protocols <i>Maysir</i> prevention algorithms Halal transaction verification 	<ul style="list-style-type: none"> AI-powered Sharia compliance engine Automated fatwa checking Sharia supervisory board dashboard 	<ul style="list-style-type: none"> Sharia compliance rate: 100% Fatwa adherence: 100% Non-compliant transaction rejection: $< 0.1\%$
Transaction Automation	<ul style="list-style-type: none"> Clear contractual terms (no excessive uncertainty) Asset-backed transactions Transparent pricing mechanisms 	<ul style="list-style-type: none"> Ethereum/Hyperledger blockchain Smart contract code (Solidity) Oracle integration for external data 	<ul style="list-style-type: none"> Automation rate: $\geq 85\%$ Transaction processing time: < 5 minutes Error rate: $< 0.5\%$
Accounting Integration	<ul style="list-style-type: none"> AAOIFI standards compliance Transparent financial reporting Zakat calculation automation 	<ul style="list-style-type: none"> ERP system integration Real-time ledger updates Automated financial statements 	<ul style="list-style-type: none"> Accounting accuracy: $\geq 99.5\%$ Reporting timeliness: 100% Audit trail completeness: 100%
Security & Privacy	<ul style="list-style-type: none"> Confidentiality of sensitive data Protection of stakeholder rights - Ethical data usage 	<ul style="list-style-type: none"> Encryption (AES-256) Multi-signature authentication Privacy-preserving protocols 	<ul style="list-style-type: none"> Security breach incidents: 0 Data integrity: 100% Authentication success rate: $\geq 99.9\%$
Stakeholder Interface	<ul style="list-style-type: none"> Inclusive design (digital literacy consideration) Transparency for all parties Fair access to information 	<ul style="list-style-type: none"> Mobile-responsive interface Multi-language support User-friendly dashboard 	<ul style="list-style-type: none"> User satisfaction: $\geq 4.0/5.0$ Accessibility score: $\geq 90\%$ Training completion rate: $\geq 80\%$
Dispute Resolution	<ul style="list-style-type: none"> Islamic arbitration principles Fair and transparent process Timely resolution 	<ul style="list-style-type: none"> Smart contract modification protocols Arbitration module Rollback mechanisms 	<ul style="list-style-type: none"> Dispute occurrence rate: $< 2\%$ Resolution time: < 45 days Stakeholder satisfaction: $\geq 85\%$
Continuous Monitoring	<ul style="list-style-type: none"> Ongoing Sharia compliance verification Continuous improvement (<i>kaizen</i>) Accountability mechanisms 	<ul style="list-style-type: none"> Real-time analytics dashboard Automated alert systems Performance reporting tools 	<ul style="list-style-type: none"> Monitoring coverage: 100% Incident detection time: < 1 hour System uptime: $\geq 99.5\%$

The integrated framework for implementing Sharia-compliant smart contracts in Islamic boarding schools, as presented in Table 2, links technological, governance, performance, and regulatory dimensions. It begins with a legal foundation that ensures compliance with Financial Services Authority regulations and Indonesian contract law (Sari et al., 2024). The Sharia governance layer safeguards against *riba*, *gharar*, and *maysir* through real-time compliance mechanisms guided by authorized fatwas. Transaction automation and accounting integration translate Sharia principles into practice through transparent, asset-backed smart contracts and AAOIFI-compliant financial reporting. Supporting components include stakeholder interface design, data security and privacy

protection, and dispute resolution mechanisms to ensure accessibility, ethical standards, and fairness. Continuous monitoring functions to evaluate system performance, optimize processes, and maintain ongoing Sharia compliance.

Legal and Accounting Implications

The implementation of this framework carries significant legal and accounting implications. Legally, the primary challenge is the formal recognition of smart contracts as legally binding agreements under Indonesian law. While the Electronic Information and Transactions (ITE) Law provides a basis for recognizing digital signatures and electronic contracts, specific regulations clarifying the status of self-executing smart contracts are needed (Veerpalu et al., 2020). The framework addresses this by integrating digital signature protocols and legal document templates, ensuring that each smart contract corresponds to a legally recognizable agreement.

From an accounting perspective, the adoption of smart contracts requires a shift from traditional bookkeeping to real-time, automated financial reporting aligned with AAOIFI standards to ensure Sharia compliance. For instance, a *murabaha* smart contract would automate asset recognition and profit disclosure in accordance with these standards (Ahmed et al., 2016). The integration of blockchain with Islamic boarding schools' ERP systems also creates an immutable audit trail, improving the accuracy and reliability of financial statements. To support a comprehensive evaluation, a quantitative framework is developed to measure Sharia compliance, operational efficiency, institutional readiness, and overall feasibility. This approach provides measurable indicators that enable systematic analysis of smart contract performance while ensuring alignment between religious principles and operational objectives.

The foundational metric is the Sharia Compliance Index (SCI), which quantifies the degree to which a smart contract's code and operations adhere to Islamic financial principles. It is calculated as a weighted average of compliance across key criteria:

$$SCI = \frac{\sum_{i=1}^n \omega_i \cdot c_i}{\sum_{i=1}^n \omega_i} \times 100 \quad [1]$$

Where n is the number of criteria, ω_i is the weight of criterion i , and c_i is the binary compliance score (1 for compliant, 0 for non-compliant). The criteria, weighted by their relative importance, include *riba*-free transactions (0.25), *gharar* minimization (0.20), *maysir* avoidance (0.15), halal asset backing (0.15), transparent pricing (0.10), fair contract terms (0.10), and adherence to DSN-MUI fatwa (0.05). For instance, if a contract meets all seven criteria, the calculation is:

$$SCI = ((0.25 + 0.20 + 0.15 + 0.10 + 0.10 + 0.05))/1.00 \quad [2]$$

This perfect score of 100% provides a quantifiable assurance of Sharia compliance to stakeholders. To measure the operational improvements achieved through automation, the Smart Contract Efficiency Ratio (SCER) is employed. This ratio compares the time and cost efficiencies of smart contracts against manual processes, acknowledging that time savings are often more significant than direct cost reductions. The formula is:

$$SCER = \left[\alpha \left(1 - \frac{T_{SC}}{T_{manual}} \right) + \beta \left(1 - \frac{C_{SC}}{C_{manual}} \right) \right] \times 100 \quad [3]$$

Here, T represents processing time, and C represents cost, with the weights $\alpha=0.6$ and $\beta=0.4$. For example, reducing transaction time from 48 manual hours to 0.5 automated hours and cost from IDR 150,000 to IDR 25,000 yields:

$$SCER = [0.6(1 - 0.5/48) + \beta(1 - 25,000/150,000)] \times 100 \quad [4]$$

$$SCER = [0.6(0.9896) + 0.4(0.8333)] \times 100 = [0.5938 + 0.3333] \times 100 = 92.71\% \quad [5]$$

This 92.71% ratio indicates a profound near-total improvement in operational efficiency. Before implementation, an institution's preparedness must be gauged using the Implementation Readiness Score (IRS). This score evaluates critical dimensions of institutional capacity, each with a specific weight:

$$IRS = \sum_{j=1}^m \theta_j \cdot r_j \quad [6]$$

Financial capacity ($\theta_3=0.20$), organizational readiness ($\theta_4=0.15$), sharia governance ($\theta_5=0.10$), and regulatory compliance ($\theta_6=0.10$). Applying this to Islamic boarding schools, Darul Fikri, with respective readiness scores of 75, 60, 80, 70, 85, and 65, the calculation is:

$$IRS = (0.25 \times 75) + (0.20 \times 60) + (0.20 \times 80) + (0.15 \times 70) + (0.10 \times 85) + (0.10 \times 65) \quad [7]$$

$$IRS = 18.75 + 12.00 + 16.00 + 10.50 + 8.50 + 6.50 = 72.25 \quad [8]$$

An IRS of 72.25 classifies the institution as having medium readiness, recommending a 12-18 month implementation timeline to address existing gaps. The framework further incorporates metrics for transparency and financial viability. The Transaction Transparency Index (TTI) measures the auditability of transactions, calculated as:

$$TTI = \frac{N_{traceable}}{N_{total}} \times \left(\frac{D_{accessible}}{D_{required}} \right) \times 100 \quad [9]$$

When blockchain is used, a premium is applied: $TTI_{blockchain} = TTI_{base} \times (1 + \gamma)$, where γ is a 0.15-0.25 transparency premium. Concurrently, the financial viability is assessed through the Risk-Adjusted Return on Implementation (RAROI), which modifies the traditional return by incorporating a risk coefficient (σ_{risk}):

$$RAROI = \frac{NPV_{benefits} - NPV_{costs}}{NPV_{costs}} \times \frac{1}{1 + \sigma_{risk}} \quad [10]$$

The Net Present Value (NPV) of cash flows is calculated as:

$$NPV = \sum_{t=1}^T \frac{CF_t}{(1+r)^t} \quad [11]$$

Providing a realistic picture of financial returns after adjusting for implementation complexity. Finally, the technological and financial analysis is anchored by the human element, measured by the Stakeholder Acceptance Rate (SAR). This metric gauges the willingness of key groups to adopt the new system and is critical for success.

$$SAR = \frac{\sum_{k=1}^p n_k \cdot \alpha_k}{\sum_{k=1}^p n_k} \times 100 \quad [12]$$

The acceptance scores α_k Surveys of leadership, staff, teachers, students, and business partners are aggregated. A critical threshold of $SAR \geq 70\%$ is required to proceed, as even the most technically perfect system will fail without broad-based stakeholder support. This completes a robust, multi-faceted framework for assessing smart contract implementation in an Islamic boarding school context.

The developed formulas form an integrated framework to quantitatively assess smart contract implementation in Islamic boarding schools, ensuring Sharia compliance while

measuring efficiency and financial viability (Sabir et al., 2022; Hanning et al., 2024). By translating technical performance and religious adherence into measurable indicators, the framework supports data-driven decision-making and enables comparison across different institutional contexts. Ultimately, it embeds Islamic finance principles into technical metrics, aligning quantitative analysis with Sharia requirements (Rabbani et al., 2020; Uula, 2025).

A Phased Implementation Roadmap

Recognizing the diverse readiness levels of Islamic boarding schools, a one-size-fits-all implementation approach is not feasible (Ainissyifa et al., 2024). Therefore, this study proposes a phased implementation roadmap with three distinct tracks based on the Implementation Readiness Score (IRS), as depicted in Figure 2.

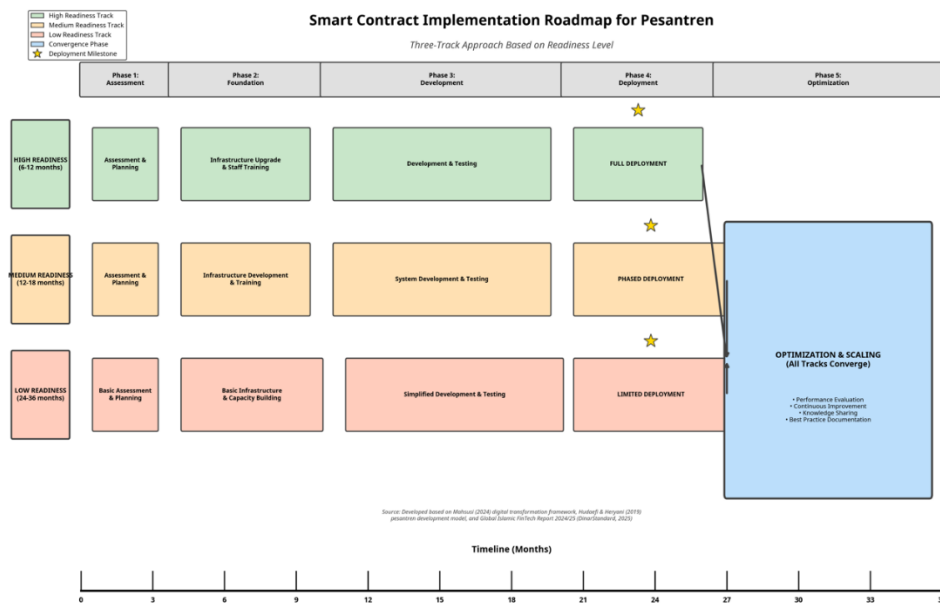


Figure 2. Smart Contract Implementation Roadmap for Islamic Boarding Schools

The implementation roadmap adopts a tiered readiness approach to ensure that blockchain-based smart contracts can be introduced effectively across Indonesian Islamic boarding schools with diverse institutional capacities (Figure 2). Institutions classified under the high readiness track (green), such as Nurul Hidayah, already possess adequate digital infrastructure and relatively high digital literacy among staff, allowing implementation within a 6–12 month period that emphasizes smart contract coding, system integration, and initial performance evaluation. The medium readiness track (yellow), represented by institutions like Darul Fikri, requires a longer 12–18 month timeline, as efforts must be directed toward strengthening basic infrastructure, formalizing standard operating procedures, and delivering comprehensive technical and Sharia-compliance training for administrators (Gunawan et al., 2025).

In contrast, the low readiness track (orange) applies to more traditional institutions such as Al-Mubarak, where implementation may span 24–36 months, starting with intensive capacity building, change management, and the installation of essential digital systems. This gradual and adaptive approach enables each Islamic boarding school to progress in accordance with its organizational readiness, thereby mitigating the risks of technological resistance and implementation failure. All tracks ultimately converge in an optimization and scaling phase, during which successful practices are documented and disseminated to encourage inter-institutional learning and collaboration, aligning with prior findings that organizational readiness and phased adoption are critical determinants

of sustainable blockchain implementation in educational and financial institutions (Norrahan & Asyari, 2022).

DISCUSSION

This study extends the Islamic fintech literature by demonstrating that institutional readiness is a decisive factor in shaping the feasibility and governance of Sharia-compliant smart contract implementation within Islamic boarding schools. Consistent with Hudaefi and Heryani (2019), the cross-case analysis confirms that Islamic boarding schools differ substantially in organizational maturity, business scale, and digital capacity, which in turn influences both transactional challenges and technological outcomes.

The findings from Islamic Boarding School Al-Mubarak reinforce earlier evidence that manual, cash-based financial systems generate persistent inefficiencies and accountability gaps. Ajibade (2025) similarly notes that delayed reconciliation and manual bookkeeping undermine transparency, particularly in the management of zakat and waqf funds. This study adds empirical depth by showing that such structural limitations not only reduce operational efficiency but also weaken institutional trust among stakeholders, making capacity building and infrastructure development a prerequisite for digital transformation.

At the intermediate level, Islamic Boarding School Darul Fikri illustrates that partial digitalization often replaces manual inefficiencies with coordination and documentation challenges. This observation supports Tantowi et al. (2025), who argue that hybrid systems frequently suffer from fragmented data flows across organizational units. By operationalizing readiness through the IRS, this study provides a measurable justification for phased adoption timelines, offering a practical tool for managerial decision-making rather than relying solely on qualitative assessments, as emphasized by Ainissyifa et al. (2024).

Meanwhile, the case of Nurul Hidayah Islamic Boarding School confirms that advanced digital adoption enhances efficiency and transparency but introduces new risks related to cybersecurity and system integration. These findings align with Rahman et al. (2022) and Kukman and Gričar (2025), who highlight security and interoperability as central challenges in blockchain-based financial systems. Importantly, this study demonstrates that such risks can be mitigated through layered security protocols, continuous monitoring, and clear governance structures, reinforcing the trust-enhancing role of blockchain identified by Rabbani et al. (2020) and Hassan et al. (2022).

A major contribution of this research lies in embedding Sharia compliance directly into system architecture. While prior studies have discussed the Sharia-compliant smart contracts conceptually, this study advances the discussion by introducing quantifiable compliance indicators, including the Sharia Compliance Index (SCI), supported by real-time governance mechanisms guided by fatwas issued by the National Sharia Council of the Indonesian Ulema Council (Fitri, 2023; Uula, 2025). This shift from periodic review to continuous oversight strengthens the Sharia compliance management model proposed by Syarif (2024) and enhances stakeholder confidence in digital financial practices.

From a regulatory perspective, aligning smart contract operations with regulations issued by the Financial Services Authority of Indonesia and Bank Indonesia enhances legal certainty, addressing enforceability concerns raised by Veerpalu et al. (2020) and Sari et al. (2024). In accounting terms, integration with standards issued by the Accounting and Auditing Organization for Islamic Financial Institutions supports transparent and auditable reporting, consistent with Ahmed et al. (2016) and Asy'arie et al. (2025). The findings suggest that Sharia-compliant smart contracts can function not merely as technological tools but as integrated governance mechanisms that strengthen efficiency, accountability, and religious compliance in Islamic boarding schools, provided that implementation strategies remain aligned with institutional readiness and long-term sustainability.

CONCLUSION

This study demonstrates the potential of blockchain-based smart contracts to enhance financial management in Indonesian Islamic boarding schools by improving efficiency, transparency, and accountability while ensuring Sharia compliance. The research identifies major transactional challenges in current practices, including manual errors, delayed reconciliation, and limited transparency, and addresses them through a comprehensive technology-driven framework. The proposed multi-layered framework integrates legal, Sharia governance, and technical components to support the implementation of a Sharia-compliant smart contract ecosystem. Supported by a phased implementation roadmap aligned with varying levels of digital readiness, the framework offers practical guidance for sustainable adoption. Grounded in empirical evidence from West Java and aligned with Indonesian regulatory requirements and international Islamic accounting standards, this study presents a solution that is both contextually relevant and theoretically robust.

This research contributes to Islamic fintech literature by showing that Sharia compliance can be embedded directly into smart contract systems through structured governance and measurable indicators. The proposed framework offers guidance for Islamic boarding school administrators, fintech developers, and regulators in adopting Sharia-compliant digital financial systems in a sustainable and context-sensitive manner. This study is limited by its qualitative design and focus on three Islamic boarding schools in West Java, which may restrict generalizability. The framework has not yet been validated through full-scale implementation. Future research should employ quantitative or mixed-method approaches across broader institutional contexts and conduct longitudinal evaluations to assess operational performance, regulatory effectiveness, and stakeholder acceptance.

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