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SMART CONTRACTS IN ISLAMIC FINANCE: RECONSTRUCTING SHARĪ'AH COMPLIANCE WITHIN BLOCKCHAIN-BASED TRANSACTIONS

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ABSTRACT

The convergence of blockchain technology and Islamic finance has introduced a transformative modality for the execution of Sharī'ah-compliant contracts through algorithmically automated, self-executing code commonly termed smart contracts. This article undertakes a systematic and doctrinal examination of how smart contracts can be architected to satisfy the classical requirements of Islamic contractual jurisprudence (fiqh al-mu'amalat) while leveraging the transparency, immutability, and disintermediation afforded by distributed ledger technology. Drawing upon a corpus of 40 recent scholarly publications (2022–2026) identified through a structured literature review methodology, this study conducts thematic synthesis across five major dimensions: the legitimacy of smart contracts under Islamic contract theory, akad-specific implementation frameworks, governance and regulatory architectures, Maqasid al-Sharī'ah alignment, and the remaining doctrinal tensions unresolved by current technological capabilities. The paper develops an original Sharī'ah Compliance Reconstruction Framework (SCRF) that maps traditional contract conditions including the prohibition of ribā, gharar, and maysir, as well as the requirements of valid ijab-qabul, ahliyyah, and halal mahal al-'aqd onto corresponding smart contract design parameters. Our findings demonstrate that while smart contracts show considerable promise for automating akad-based transactions such as murabahah, ijarah, sukuk, and waqf, significant doctrinal challenges persist concerning contract immutability versus the Islamic right of rescission (khiyar), oracle-introduced uncertainty, and the institutional legitimacy of decentralized governance vis-à-vis the Sharī'ah Supervisory Board (SSB) function. We propose a Hybrid Sharī'ah-Tech Governance Model (HSTGM) as a forward-looking institutional architecture for Islamic financial authorities seeking regulatory clarity. This study contributes to the global Islamic fintech research agenda for 2025 and beyond, offering actionable implications for policymakers, Sharī'ah scholars, and blockchain developers operating at the frontier of decentralized Islamic finance.

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A. INTRODUCTION

The global Islamic finance industry, now exceeding USD 4 trillion in total assets as of 2024 (Islamic Financial Services Board (IFSB, 2024)), stands at a critical technological inflection point whose implications extend far beyond operational efficiency into the foundational architecture of Islamic commercial law. The rapid proliferation of blockchain technology and its associated application layer smart contracts presents Islamic financial institutions (IFIs) with both an extraordinary opportunity and a profound doctrinal challenge that existing regulatory frameworks and jurisprudential scholarship have yet to resolve with sufficient coherence or operational precision. The opportunity lies in blockchain's capacity to automate complex multi-party financial arrangements, eliminate costly intermediary layers, enhance transactional transparency, and generate immutable audit trails characteristics that resonate deeply with the ethical objectives of Islamic finance, particularly its emphasis on disclosure (bayān), fairness (ʿadl), and the prevention of exploitation (ẓulm) (Dusuki & Abdullah, 2007; Laldin & Furqani, 2013). The challenge, however, is equally fundamental: Islamic financial transactions are governed by a dual-layered normative structure that demands not merely civil enforceability under applicable national law, but Sharīʿah legitimacy as evaluated against a body of classical contractual jurisprudence developed over fourteen centuries of scholarly deliberation. These two dimensions of contractual obligation do not automatically converge, and the disjunction between them is rendered particularly acute by the distinctive technical characteristics of smart contracts a disjunction that this study systematically investigates and proposes to resolve through a novel analytical framework.

To appreciate the doctrinal stakes of this inquiry, it is necessary to understand both what smart contracts are and why their technical architecture generates friction with classical Islamic contractual jurisprudence. Smart contracts, first theorised by Szabo (1994) as "a set of promises, specified in digital form, including protocols within which the parties perform on these promises," were subsequently operationalised through Ethereum's Turing-complete scripting environment, which enabled the deployment of self-executing code on a distributed, permissionless ledger (Buterin, 2014). In their canonical form, smart contracts are software programmes that automatically execute predefined contractual obligations when specified triggering conditions are met, without requiring the intervention of any trusted intermediary and without admitting unilateral post-deployment modification by any party (Werbach & Cornell, 2017). These characteristics automation, disintermediation, determinism, and immutability generate a set of tensions with specific requirements of Islamic contractual law (fiqh al-muʿāmalāt) that cannot be resolved through superficial analogical reasoning alone. The right of rescission (khiyār), which Islamic jurisprudence recognises as an integral mechanism for protecting contracting parties against informational asymmetry and post-formation discovery of defects, is structurally incompatible with smart contracts that execute irreversibly upon condition satisfaction (AAOIFI, 2017; al-Zuḥaylī & El-Gamal, 2003). The prohibition of excessive uncertainty (gharar), which invalidates contracts whose subject matter, price, or execution timeline is insufficiently determined, raises questions about how oracle-dependent smart contracts which rely on off-chain data feeds to trigger on-chain execution should be evaluated when those data feeds are themselves subject to manipulation or failure (El-Gamal, 2006; Iqbal & Mirakhor, 2011). Most fundamentally, the classical requirement of human intentionality in contract formation (niyyah), which Islamic jurists regard as a constitutive element of valid contractual consent rather than merely a subjective mental state, sits uneasily with algorithmic execution that proceeds autonomously regardless of the subsequent wishes of the parties (Majallat al-Aḥkām al-ʿAdliyyah, Art. 1–100; Ibn Qudāmah, *al-Mughnī*). Addressing these tensions requires not merely jurisprudential commentary but a systematic framework that maps each classical contractual requirement onto specific smart contract design parameters precisely the contribution this study makes.

The institutional and regulatory context into which this inquiry intervenes is one of considerable dynamism and, simultaneously, considerable disarray. Across the jurisdictions in which Islamic finance has achieved systemic significance most notably Malaysia, Indonesia, Bahrain, the UAE, Saudi Arabia, and Pakistan regulatory authorities have responded to blockchain and smart contract developments with markedly heterogeneous approaches that reflect divergent assessments of both the technology's risks and its compatibility with Sharīʿah principles (Muneeza et al., 2022; Zetzsche et al., 2020). Malaysia's Securities Commission has issued digital asset frameworks that acknowledge Islamic fintech applications without providing Sharīʿah-specific smart contract guidance (SC Malaysia, 2020); Bahrain's Central Bank has established a regulatory sandbox that has accommodated several Islamic blockchain initiatives but has not produced standardised Sharīʿah compliance criteria for smart contract deployment (CBB, 2019); and the UAE's Virtual Assets Regulatory Authority (VARA), established in 2022, represents the most ambitious attempt to date at comprehensive digital asset governance but similarly lacks a dedicated Islamic contractual jurisprudence dimension (VARA, 2023). The AAOIFI the primary international standard-setter for Islamic financial accounting, auditing, and governance has acknowledged blockchain's significance in its strategic communications but has not yet issued a dedicated standard addressing smart contract architecture (AAOIFI, 2023b). The IFSB's Technology Risk Guideline (IFSB, 2021) addresses cybersecurity and operational risk in Islamic financial technology broadly but does not engage with the specific fiqh questions raised by smart contract automation. This regulatory fragmentation is not merely an administrative inconvenience; it creates material legal uncertainty for IFIs seeking to deploy smart contract solutions, exposes institutions to the reputational and financial risks of inadvertent Sharīʿah non-compliance, and deprives regulators of the principled conceptual architecture necessary to evaluate emerging fintech proposals in a consistent and defensible manner.

Against this backdrop, the scholarly engagement with the smart contract–Islamic finance nexus has accelerated markedly since 2020, generating a body of literature that is intellectually ambitious but structurally fragmented. Early contributions by Mohamad et al. (2020) and Muneeza et al. (2020) established the foundational jurisprudential terrain, identifying key points of tension and convergence between smart contract architecture and Islamic contractual principles. Subsequent studies have examined specific product applications, including smart-contract-enabled sukuk (Kasri et al., 2021; Lahsasna et al., 2022), blockchain-based takaful (Shuib et al., 2022), and tokenised waqf assets (Fatin et al., 2021). Parallel contributions from the perspective of Islamic fintech governance have explored the regulatory implications of decentralised finance for Sharīʿah supervisory board oversight (Nabilou, 2020; Oseni & Ali, 2019), while a smaller but growing stream of computer science-oriented scholarship has examined the technical feasibility of encoding Sharīʿah compliance logic within smart contract code (Al-Saqaf & Seidler, 2021; Shalhoob, 2025). Despite these advances, the cumulative literature suffers from three identifiable limitations that constrain its theoretical and practical utility. First, it is thematically atomised, addressing individual contractual doctrines or product types without integrating them within a unified analytical framework. Second, it is predominantly conceptual rather than architecturally prescriptive identifying incompatibilities without specifying how smart contract design parameters should be modified to achieve compliance. Third, it has not engaged sufficiently with the institutional governance question of how Sharīʿah supervisory oversight should be structured and operationalised in environments where contract execution is automated, decentralised, and jurisdictionally diffuse. These three gaps collectively define the terrain this study occupies.

The urgency of addressing these gaps is reinforced by a set of converging pressures that are reshaping the competitive and regulatory landscape of Islamic finance with accelerating force. The global Islamic fintech sector a subsector in which blockchain and smart contract applications are increasingly prominent attracted approximately USD 3.9 billion in investment

in 2023, representing a compound annual growth rate of approximately 21 percent since 2019, and is projected to reach USD 179 billion by 2026 (DinarStandard, 2024; Refinitiv, 2023). Institutional investors, sovereign wealth funds, and multilateral development banks are increasingly exploring tokenised sukuk and blockchain-based Islamic treasury instruments as mechanisms for enhancing market liquidity and reducing settlement risk a development that creates direct commercial demand for the kind of Sharīʿah-compliant smart contract governance architecture that the literature has not yet supplied (IsDB, 2022; World Bank, 2023). Simultaneously, the rapid growth of decentralised finance (DeFi) platforms has created competitive pressure on conventional Islamic financial intermediaries, as retail users in Muslim-majority markets demonstrate willingness to engage with DeFi products that, while not formally Sharīʿah-certified, offer yields and accessibility that certificated Islamic financial products frequently cannot match raising systemic concerns about informal Sharīʿah arbitrage that disciplined regulatory engagement could address (Hassan & Aliyu, 2022; Iqbal et al., 2023). In this context, the absence of a principled, operationally actionable governance framework for Sharīʿah-compliant smart contracts is not merely an academic shortcoming; it is a structural vulnerability in the Islamic financial system's capacity to engage with digital transformation on its own normative terms.

This article addresses the foregoing gaps through a structured, multi-method inquiry organised around three interrelated objectives whose scope and ambition exceed those of any single prior contribution to this literature. The first objective is empirical and synthetic: through a systematic review of 40 peer-reviewed publications selected according to explicit inclusion and exclusion criteria, the study constructs a thematically integrated map of current scholarship, identifying consensus positions, unresolved controversies, and underexplored dimensions with greater comprehensiveness than prior narrative reviews have achieved. The second objective is analytical and architecturally prescriptive: drawing upon the systematic review findings and grounded in classical Islamic contractual jurisprudence as codified by AAOIFI (2017) and synthesised by authoritative fiqh scholarship, the study develops the Sharīʿah Compliance Reconstruction Framework (SCRF) a novel analytical instrument that maps each major classical contractual requirement onto specific smart contract design parameters, providing IFIs, Sharīʿah scholars, and technology developers with an operationally actionable compliance blueprint. The third objective is institutional and governance-oriented: recognising that technical compliance at the level of individual smart contract design is necessary but insufficient without corresponding institutional infrastructure, the study proposes the Hybrid Sharīʿah-Tech Governance Model (HSTGM) an institutional architecture designed to reconcile the decentralised, automated, and cross-jurisdictional character of smart contract execution with the oversight requirements of Islamic financial governance, including the role of Sharīʿah supervisory boards, national regulatory authorities, and international standard-setting bodies. Taken together, these contributions are designed not merely to advance academic scholarship but to provide a principled basis for policy development, institutional design, and product innovation in jurisdictions navigating the intersection of digital assets and Islamic law. The paper proceeds as follows: Section 2 reviews the theoretical foundations of Islamic contractual jurisprudence relevant to this study; Section 3 describes the systematic methodology employed; Section 4 presents the empirical and doctrinal findings, supported by five representative tables; Section 5 discusses implications for governance, regulation, and akad-specific design; Section 6 proposes the SCRF and HSTGM frameworks in full; and Section 7 concludes with policy recommendations and directions for future research.

A. THEORETICAL FOUNDATIONS

1. The Architecture of Islamic Contract Law (Fiqh al-Mu'amalat)

Islamic contract law, as systematized within fiqh al-mu'amalat, governs all temporal transactions among human beings and is characterized by its grounding in divine revelation (the Qur'an and Sunnah) as interpreted through centuries of scholarly ijtihad. A valid Islamic contract (aqd) requires the satisfaction of four foundational elements: the offer and acceptance (ijab wa qabul), the contracting parties (aqidayn), the subject matter of the contract (mahal al-'aqd), and the consideration or purpose (mawdu' al-'aqd). Each element carries specific conditions whose violation whether through prohibition of ribā (usury), gharar (excessive uncertainty), or maysir (speculation) renders the contract voidable (fasid) or null (batil) under Islamic law.

The prohibition of ribā is perhaps the most widely recognized constraint in Islamic finance. Qur'anic injunctions (2:275–279; 3:130) categorically forbid any predetermined increment on a loan or debt, which has necessitated the development of alternative financing modalities including profit-sharing (mudarabah), cost-plus trade (murabahah), and leasing (ijarah) that achieve equivalent economic functions without involving interest. Smart contracts, by design, are capable of encoding non-interest payment structures; however, their application must be carefully validated to preclude any implicit ribā through fixed-return parameters disguised as profit distributions.

Gharar, or excessive contractual uncertainty, represents a second major constraint. The prohibition targets transactions where the subject matter, price, or delivery is fundamentally indeterminate, leading to potential exploitation. In the context of blockchain-based contracts, this prohibition acquires a dual significance: while smart contract code itself is deterministic and transparent, the data inputs (oracles) that trigger contract execution may introduce exogenous uncertainty. This oracle problem constitutes, as several scholars have argued, a modern manifestation of gharar that requires robust governance solutions.

The Maqasid al-Sharī'ah framework articulated by al-Ghazali, al-Shatibi, and contemporary scholars provides the overarching teleological structure within which specific rules are evaluated. The five foundational objectives (preservation of religion, life, intellect, lineage, and wealth) have been extended by modern scholars to encompass social justice, environmental sustainability, and financial inclusion. Smart contracts' potential to automate waqf (Islamic endowment) distributions, facilitate microfinance sukuk, and democratize access to capital markets aligns powerfully with these higher objectives a point repeatedly emphasized in the recent literature reviewed in this study.

2. Blockchain Technology and Smart Contract Mechanisms

Blockchain technology is a distributed ledger system in which transactions are recorded in cryptographically linked blocks, maintained across a decentralized network of nodes, and validated through consensus mechanisms (proof-of-work, proof-of-stake, or Byzantine fault-tolerant protocols). Its core attributes immutability, transparency, censorship-resistance, and disintermediation have attracted considerable attention from Islamic financial institutions seeking to reduce operational costs, enhance transaction integrity, and expand financial inclusion.

Smart contracts represent the programmable execution layer of blockchain networks. First introduced on the Ethereum Network (Ginena & Hamid, 2015), they enable the encoding of complex contractual logic including conditional payment flows, asset tokenization, multi-party governance, and oracle-triggered execution into autonomous programs that self-execute when predefined conditions are satisfied. Contemporary developments in this space include upgradeable proxy patterns, Layer-2 scaling solutions, cross-chain interoperability protocols, and AI-augmented compliance

verification, all of which have direct relevance to Islamic finance applications as documented in recent literature.

For Islamic finance, the most theoretically significant blockchain deployment scenarios involve: (1) the tokenization of Sharī'ah-compliant assets (particularly sukuk and waqf assets); (2) the automation of profit-sharing distributions in mudarabah and musharakah contracts; (3) parametric takaful products with automated claim settlement; and (4) decentralized commodity exchange platforms for tawarruq and murabahah transactions. Each scenario presents distinct compliance challenges that are mapped and analyzed in the findings section of this study.

3. The Governance Imperative: Sharī'ah Supervisory Boards and Digital Finance

The institutional architecture of contemporary Islamic finance centers on the Sharī'ah Supervisory Board (SSB) an independent body of qualified Islamic scholars that certifies the Sharī'ah compliance of financial products, reviews contracts, and issues fatawa (religious opinions) on novel transactions. The SSB's role is recognized by the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI, 2023a), the Islamic Financial Services Board (IFSB), and national regulators across Malaysia, the Gulf Cooperation Council states, Indonesia, and Pakistan.

The advent of smart contracts challenges the SSB model in fundamental ways. If contractual logic is embedded in immutable code and executed autonomously, the ex-post review and fatwa-issuance functions of traditional SSBs become structurally displaced. This creates what this study terms the 'governance gap' the space between the technical reality of decentralized smart contract execution and the institutional requirements of Islamic financial governance. Bridging this gap requires innovative institutional design, including on-chain SSB audit modules, pre-deployment certification protocols, and hybrid governance architectures, all of which are explored in the proposed HSTGM framework.

B. METHOD

1. Research Design

This study employs a qualitative systematic literature review (SLR) methodology integrated with doctrinal Islamic legal analysis (usūl al-fiqh ijtihad framework). The SLR component follows a modified PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol adapted for Islamic finance jurisprudential research, enabling rigorous, reproducible identification and thematic synthesis of the existing scholarly corpus. The doctrinal component applies classical Islamic legal methodology including qiyas (analogical reasoning), maslahah (public interest), and 'urf (custom) to evaluate the legal status of smart contract mechanisms under Islamic law.

This mixed approach is warranted by the inherently interdisciplinary nature of the research question, which simultaneously spans computer science, Islamic jurisprudence, financial economics, and regulatory theory. Neither purely empirical nor purely normative methods are sufficient in isolation; the integration of systematic evidence synthesis with doctrinal legal analysis allows for a comprehensive evaluation that is both descriptively accurate and prescriptively actionable.

2. Literature Search and Selection Protocol

Table 1. Systematic Literature Review Protocol

Parameter	Description
Research Question	How can smart contracts be architecturally designed to ensure Sharī'ah compliance across diverse Islamic financial akad typologies within blockchain environments?
Databases Searched	Scopus, Web of Science, Google Scholar, ISRA Research Repository, Islamic Finance Gateway
Publication Period	2020–2026 (with seminal works from 2015–2019 included selectively)

Parameter	Description
Keywords	smart contracts, blockchain, Islamic finance, Sharī'ah compliance, akad, DeFi, fintech, sukuk, takaful, waqf, mudarabah, musharakah
Inclusion Criteria	Peer-reviewed articles; conference papers from indexed proceedings; English and Malay/Arabic articles with English abstracts; studies directly addressing Islamic finance AND blockchain/smart contracts
Exclusion Criteria	Opinion pieces without empirical or doctrinal analysis; studies on conventional finance only; duplicates; non-indexed grey literature
Total Papers Retrieved	287 initial records; 40 final papers included after screening
Analysis Method	Thematic synthesis combined with usūl al-fiqh doctrinal analysis (ijtihad framework)

The literature search was conducted across five major databases between January and April 2026. Initial retrieval yielded 287 records; after removing duplicates (n=42) and screening titles and abstracts for relevance (n=167 excluded), 78 full-text articles were assessed for eligibility. Following full-text review and application of inclusion/exclusion criteria, 40 studies were retained for final analysis. The selection process prioritized temporal currency (with 78% of included studies published between 2024 and 2026), geographic diversity (covering Southeast Asia, the Middle East, South Asia, and Central Asia), and methodological variety (doctrinal, empirical, mixed-methods, and computational studies).

3. Thematic Synthesis Approach

Thematic synthesis was conducted through three iterative stages. First, line-by-line coding of key findings was performed independently by two researchers to generate initial codes. Second, these codes were organized into descriptive themes through axial coding. Third, analytical themes were constructed through constant comparative analysis, generating the five major theme clusters that structure the findings section. The inter-rater reliability coefficient for coding was $\varkappa = 0.84$, indicating strong agreement. Disagreements were resolved through discussion and reference to a third expert reviewer specializing in Islamic fintech law.

Table 2. PRISMA-Adapted Screening: Thematic Distribution of 40 Selected Studies

Theme Cluster	No. of Studies	Key Authors (Illustrative)	Dominant Finding
Smart Contract Legitimacy (Fiqh)	11	Atiyah et al. (2024); Ahmad et al. (2024); Alboul & Dawood (2022)	Smart contracts can satisfy rukn al-'aqd if digital consent mechanisms are Sharī'ah-validated
Akad-Specific Implementation	9	Rejeb (2022); Zulkepli (2025); Mousavi et al. (2025)	Mudarabah and sukuk show highest implementation complexity; ijarah most technically tractable
Governance & Regulatory Frameworks	8	Cahyani & Baidhowi (2025); Lestari et al. (2025); Abdur-Rauf et al. (2026)	Regulatory sandbox models and AAOIFI engagement are essential preconditions
Maqasid al-Sharī'ah & Ethics	7	Nurkholidah et al. (2024); Abdur-Rauf et al. (2026); Gulyamov (2024)	Maslahah mursalah provides doctrinal basis for adopting blockchain where conventional methods are insufficient
Social & Waqf Finance Applications	3	Kunhibava et al. (2024); Muhammad et al. (2024); Iftikhar (2022)	Waqf automation and retail sukuk democratization represent highest social impact potential

Theme Cluster	No. of Studies	Key Authors (Illustrative)	Dominant Finding
Challenges & Risk Analysis	2	Farhan et al. (2024); Mbaidin et al. (2024)	Technological literacy gaps and oracle reliability are critical barriers to mainstream adoption

The resulting thematic map reveals a scholarly field characterized by significant engagement with jurisprudential legitimacy questions (Theme 1), a growing body of akad-specific technical analysis (Theme 2), and an emerging focus on regulatory and governance frameworks (Theme 3). Social finance applications and risk analysis, while less numerically dominant, represent some of the most practically significant contributions to the field.

4. Doctrinal Analysis Framework

The doctrinal analysis component applies the classical usūl al-fiqh methodology to evaluate the legal status of smart contracts under Hanafi, Maliki, Shafi'i, and Hanbali schools of jurisprudence, with particular attention to the positions of contemporary Islamic jurists as reflected in AAOIFI standards and OIC Fiqh Academy resolutions. This comparative jurisprudential approach is essential given the jurisdictional diversity of global Islamic finance, where different madhhab (school of thought) positions may lead to divergent compliance determinations for the same smart contract design.

C. RESULT AND DISCUSSIONS

Result

1. Sharī'ah Compliance Architecture for Smart Contracts

The central empirical finding of this study is that smart contracts can, under appropriate architectural conditions, satisfy the core requirements of Islamic contract law but this compliance is neither automatic nor inherent. It must be deliberately engineered through specific design choices that map classical fiqh conditions onto corresponding technical mechanisms. The Sharī'ah Compliance Matrix presented in Table 2 systematizes these mappings across nine critical compliance dimensions.

Table 3. Sharī'ah Compliance Matrix: Islamic Contract Requirements and Smart Contract Design Parameters

Sharī'ah Requirement	Fiqh Principle	Smart Contract Mechanism	Compliance Status	Risk Level
Absence of Ribā (interest)	Prohibition (Q 2:275)	Profit-sharing logic encoded; zero fixed-return parameters	✓ Achievable	Low
Absence of Gharar (uncertainty)	Bay' al-gharar prohibition	Deterministic code; oracle risk remains	⚠ Partial	Medium
Absence of Maysir (gambling)	Qimar prohibition	Probability-based payoffs flagged; halal asset screening	✓ Achievable	Low
Valid Offer & Acceptance (Ijab-Qabul)	Rukn al-'aqd	Digital signature as qabul; timestamped on-chain	✓ Achievable	Low
Capacity (Ahliyyah)	Legal capacity of parties	KYC/AML oracle; identity verification layer	⚠ Partial	Medium
Halal Subject Matter (Mahal al-'aqd)	Prohibition of khamr, pork, weapons	Asset screening smart contract (DeFi whitelisting)	✓ Achievable	Low

Maqasid al-Sharī'ah Alignment	Higher objectives of Islamic law	ESG + SDG-aligned tokenomics; Waqf automation	⚠ Requires governance	Medium-High
Immutability vs. Fasakh Rights	Right of rescission; Khiyar	Upgradeable proxy pattern; multisig rescission	⚠ Difficult	High
Sharī'ah Supervisory Board Oversight	Institutional governance requirement	On-chain SSB audit log; DAO governance module	⚠ Evolving	High

The analysis reveals a graduated compliance landscape. Three requirements absence of ribā, absence of maysir, and valid ijab-qabul are assessed as technically achievable with current smart contract capabilities, provided that appropriate encoding practices are followed and the relevant prohibition criteria are accurately translated into algorithmic logic. The prohibition of ribā, for instance, can be enforced by encoding profit-sharing rather than fixed-return payment structures, implementing automated nisbah (profit ratio) calculations based on actual enterprise returns, and prohibiting any contractual clause that generates a predetermined monetary increment independent of economic activity.

Four dimensions gharar elimination, ahliyyah verification, maqasid alignment, and SSB oversight are assessed as partially achievable, requiring supplementary technical infrastructure or institutional governance arrangements beyond the smart contract itself. The gharar challenge is particularly instructive: while the smart contract's code is transparent and deterministic (reducing information asymmetry between parties), the external data inputs provided by oracles introduce a form of residual uncertainty that is analytically equivalent to the gharar of price and delivery indeterminacy in classical fiqh. Several recent studies have proposed on-chain oracle committees with SSB-approved data sources as a partial mitigation strategy.

Two dimensions contract immutability versus khiyar rights, and SSB oversight of post-deployment execution remain highly challenging under current technological architectures. The immutability of deployed smart contracts directly conflicts with the Islamic right of rescission (khiyar al-shart, khiyar al-'ayb, khiyar al-ru'yah), which allows contracting parties to annul or modify an agreement under specified conditions. Recent technical solutions, including upgradeable proxy contracts with multisig authorization requirements and time-locked governance mechanisms, offer partial remedies but these solutions reintroduce a degree of centralization that may undermine the decentralization value proposition of blockchain.

2. Akad-Specific Implementation Analysis

The second major finding concerns the differential tractability of Sharī'ah-compliant smart contract implementation across the principal akad typologies of Islamic finance. Table 3 presents a comprehensive mapping of eight major akad types against their Sharī'ah requirements, corresponding smart contract features, and estimated implementation complexity.

Table 4. Akad Typology and Blockchain-Based Smart Contract Implementation Framework

Akad Type	Category	Key Sharī'ah Elements	Smart Contract Features	Implementation Complexity
Murabahah	Trade Finance	Actual ownership transfer; cost-plus markup disclosure	Asset tokenization + NFT ownership; automated markup calculation	Moderate

Mudarabah	Equity Partnership	Profit-sharing ratio (nisbah); loss borne by rabb al-mal	Oracle-fed profit distribution; automated nisbah logic	High
Musharakah	Joint Venture	Proportional profit/loss; diminishing equity possible	Multi-party governance token; diminishing balance formula	High
Ijarah	Leasing	Usufruct transfer; maintenance by lessor	Rental token stream; maintenance obligation tracker	Moderate
Sukuk	Capital Market	Asset-backed; periodic profit certificates	SukukChain architecture; tokenized SPV; on-chain dividend	Very High
Takaful	Islamic Insurance	Tabarru' (donation); mutual guarantee; separation of funds	Parametric triggers; pool governance; automated surplus distribution	High
Waqf	Social Finance	Perpetual endowment; irrevocability; beneficiary designation	Immutable waqf ledger; transparent beneficiary smart distribution	Moderate
Tawarruq	Liquidity	Commodity sequence; avoidance of 'inah' structure	Commodity token swap sequence; anti-'inah' logic enforcement	Very High

Among the akad examined, ijarah (Islamic leasing) emerges as the most technically tractable for smart contract implementation. The ijarah structure involves a relatively well-defined sequence of obligations: transfer of usufruct from lessor to lessee, periodic rental payment, and maintenance responsibility retention by the lessor. These elements can be encoded in a smart contract through tokenized asset representation (with NFT-based ownership records), automated rental payment streams triggered by calendar-based conditions, and oracle-linked maintenance verification mechanisms. Several studies in our corpus document proof-of-concept ijarah smart contract implementations on Ethereum and Hyperledger Fabric, with favorable compliance assessments from Sharī'ah scholars.

Murabahah the cost-plus-markup trade financing structure that constitutes the largest segment of Islamic banking assets globally presents moderate implementation complexity. The compliance requirement that the bank must actually take ownership of the asset before reselling it (genuine asset ownership, tamlik) creates a critical implementation challenge: blockchain's token transfer mechanisms must accurately represent real-world asset ownership transfer, not merely digital representation. The risk of simulating asset transfer without genuine ownership effectively recreating conventional lending in digital guise constitutes a potential bay' al-'inah structure that is prohibited under AAOIFI standards. This necessitates robust real-world asset (RWA) tokenization frameworks with legal enforceability in relevant jurisdictions.

Mudarabah and musharakah contracts, which constitute the equity-based core of Islamic finance's ideational model, exhibit the highest implementation complexity. The mudarabah structure where the capital provider (rabb al-mal) finances an entrepreneur (mudarib) with profits shared according to a pre-agreed nisbah and losses borne solely by the capital provider requires dynamic profit distribution mechanisms linked to actual enterprise performance data. This necessitates reliable oracle infrastructure capable of delivering audited financial results to the smart contract, a technically demanding requirement given current oracle reliability limitations. Rejeb (2022) provides a particularly

detailed analysis of mudarabah smart contract architecture, identifying seven distinct technical requirements for Sharī'ah-compliant automated profit distribution.

Sukuk tokenization, emerging under the label of 'SukukChain' in recent literature, represents perhaps the highest-complexity implementation scenario but also the highest-impact application. Hamzah (2025) proposes a SukukChain architecture that tokenizes sukuk certificates as ERC-1400 security tokens, encodes the underlying ijarah or musharakah structure in smart contracts, automates periodic profit distributions to token holders, and provides an immutable audit trail for regulatory reporting. The model's viability depends critically on the legal recognition of tokenized sukuk in national jurisdictions a prerequisite currently available only in a handful of countries including the UAE, Malaysia, and Bahrain.

Takaful smart contracts represent an especially promising application domain given the structural alignment between parametric insurance mechanisms and the takaful requirement of tabarru' (voluntary contribution into a mutual fund). Husin & Qazi (2025) document blockchain-based takaful implementations in Pakistan that use weather and crop-yield oracles to trigger automated compensation payments to farmers eliminating the administrative delays and claims processing costs that have historically limited takaful's competitiveness with conventional insurance. The challenge of ensuring surplus distribution transparency and separating participants' tabarru' funds from operator fees is addressed through segregated smart contract pools with publicly verifiable balances.

3. Governance Framework Analysis

The third dimension of findings addresses institutional governance the structures through which Sharī'ah compliance is assured, monitored, and enforced in blockchain-based Islamic financial systems. Table 4 compares traditional Islamic finance governance with blockchain-based alternatives, identifying the key dimensions along which the proposed Hybrid Sharī'ah-Tech Governance Model represents an advance.

Table 5. Governance Framework Comparison: Traditional, Blockchain-Based, and Proposed Hybrid Model

Governance Dimension	Traditional Islamic Finance	Blockchain-Based Islamic Finance	Proposed Hybrid Model
Sharī'ah Oversight Body	SSB review ex-ante and ex-post; manual audit	DAO governance; on-chain compliance code	SSB-certified smart contract templates + automated audit log
Dispute Resolution	National courts + Sharī'ah arbitration panels	Code-is-law; limited recourse mechanisms	On-chain arbitration oracle with Islamic arbitration principles
Contract Mutability	Flexible; khiyar (options) enforceable by courts	Immutable; difficult to amend post-deployment	Upgradeable proxy with SSB multisig approval for amendments
Transparency	Regulatory disclosure; limited public access	Full on-chain transparency; pseudonymity issues	Permissioned blockchain with SSB auditor node access
Regulatory Recognition	Established in OIC member states; AAOIFI standards	Nascent; UAE VARA, Malaysia SC sandbox only	AAOIFI + BIS digital finance standards integration
Enforcement Mechanism	Judicial enforcement; fatwa authority	Algorithmic self-execution; no human intervention	Hybrid: autonomous execution + exception-handling by SSB

The comparative analysis underscores a fundamental governance paradox in blockchain-based Islamic finance: the very properties that make blockchain attractive

decentralization, immutability, autonomous execution are precisely those that create the greatest friction with traditional Islamic financial governance, which is centralized, revision-capable, and requires human scholarly oversight. The proposed Hybrid Sharī'ah-Tech Governance Model navigates this paradox by stratifying governance functions: autonomous execution handles routine, standardized, pre-certified contract logic, while a human governance layer implemented through SSB-approved multisig nodes, DAO-integrated fatwa modules, and regulatory audit interfaces retains authority over contract certification, exceptional circumstances, and systemic risk oversight.

The regulatory landscape for blockchain-based Islamic finance is rapidly evolving but remains highly fragmented. Lestari et al. (2025) document the legal uncertainty surrounding digital Islamic financing contracts in Indonesia, where the absence of explicit regulatory recognition creates compliance risks for Islamic fintech operators. Abdur-Rauf et al. (2026) situate this regulatory gap within the broader Maqasid al-Sharī'ah framework, arguing that the Islamic principle of preventing harm (dar' al-mafasid) mandates proactive regulatory engagement with blockchain Islamic finance rather than a wait-and-see approach.

Discussion

1. The Sharī'ah Compliance Reconstruction Framework (SCRF)

   Building upon the preceding analytical findings, this study proposes the Sharī'ah Compliance Reconstruction Framework (SCRF) as a structured methodology for evaluating and designing Sharī'ah-compliant smart contracts. The SCRF operates through four sequential analytical stages. In Stage 1 (Fiqh Deconstruction), the classical conditions of the target akad are systematically decomposed into their constituent compliance requirements, drawing upon the relevant madhhab positions, AAOIFI standards, and applicable fatawa. In Stage 2 (Technical Mapping), each compliance requirement is mapped onto a corresponding smart contract design feature or, where no adequate technical solution exists, the residual compliance risk is explicitly documented. In Stage 3 (Compliance Gap Analysis), the mapped features are evaluated against current technological capabilities to identify gaps requiring supplementary governance measures or technical innovation. In Stage 4 (Governance Integration), the identified gaps are addressed through institutional governance mechanisms SSB pre-certification protocols, oracle committee arrangements, regulatory sandbox agreements, or smart contract upgradeability provisions.

   The SCRF's primary contribution is its systematic, akad-specific character: rather than offering a generic 'Islamic blockchain' certification checklist, it recognizes that different akad typologies present fundamentally different compliance architectures and implementation challenges. A murabahah smart contract requires a compliance architecture centered on genuine asset ownership verification and tamlik documentation, while a mudarabah smart contract's compliance architecture centers on oracle-reliable profit calculation and nisbah automation. The SCRF makes these distinctions explicit and actionable.

2. The Hybrid Sharī'ah-Tech Governance Model (HSTGM)

   The Hybrid Sharī'ah-Tech Governance Model (HSTGM) proposes an institutional architecture that integrates automated smart contract execution with tiered human oversight. At the foundation level, SSB scholars engage with blockchain developers during the contract design phase, reviewing the code logic for Sharī'ah compliance before deployment a 'pre-deployment certification' process analogous to, but more technically demanding than, traditional SSB product approval. This pre-deployment review is supported by smart contract simulation environments that allow scholars to observe the contract's behavior under various economic scenarios, including edge cases that might reveal implicit ribā or gharar.

At the operational level, certified smart contracts are deployed on permissioned blockchain networks where SSB auditor nodes maintain real-time monitoring access. This architecture which draws on the technical proposal by Alsalih (2025) for IT-controlled Sharī'ah governance preserves the transparency and immutability of the underlying blockchain while providing institutional oversight capability. The permissioned network model also facilitates AML/CFT compliance, as Kurniawan et al. (2025) demonstrate in their study of blockchain monitoring at Indonesian Islamic banking, where on-chain analytics successfully identified suspect transaction patterns including online gambling fund flows.

At the governance level, the HSTGM incorporates a DAO (Decentralized Autonomous Organization) governance module in which SSB members hold special governance tokens conferring veto rights over proposed contract upgrades or parameter changes. This mechanism ensures that the scholarly authority of the SSB is preserved even within a technically decentralized environment. Proposed amendments to deployed contracts must pass both a technical security review (smart contract audit) and an SSB majority approval creating a dual-key governance mechanism that mirrors the institutional separation of technical and Sharī'ah oversight in conventional Islamic finance.

3. Implications for Global Islamic Fintech

The convergence of smart contracts and Islamic finance has implications that extend far beyond the technical it represents a potential paradigm shift in the global architecture of Islamic financial intermediation. The elimination of unnecessary intermediaries through smart contract automation could significantly reduce the cost of Sharī'ah-compliant financial services, making them accessible to the estimated 1.7 billion unbanked Muslims globally. This financial inclusion dimension — directly aligned with the Maqasid al-Sharī'ah objective of wealth preservation and distribution — represents one of the most compelling normative arguments for active Islamic institutional engagement with blockchain technology.

The bibliometric analysis by Fauzi et al. (2025) documents the exponential growth in research publications at the intersection of Islamic fintech and blockchain, with Southeast Asia (Malaysia, Indonesia) and the Middle East (UAE, Saudi Arabia) emerging as the dominant geographic hubs of scholarly production. This geographical concentration reflects the jurisdictional leadership of Malaysia's Securities Commission, which has established a dedicated digital assets regulatory framework that explicitly accommodates Islamic principles, and the UAE's Virtual Assets Regulatory Authority (VARA), which has engaged with Islamic finance principles in its asset-classification framework. These regulatory developments create enabling conditions for the HSTGM's implementation at the national level.

For Sharī'ah scholars, the smart contract revolution demands a new competency: the ability to read and interpret algorithmic code as a form of legal instrument. Several authors in our corpus call for the establishment of specialized training programs for 'Sharī'ah technologists' scholars with dual expertise in Islamic jurisprudence and blockchain development who can bridge the communication gap between fiqh academies and DeFi developers. This interdisciplinary capacity-building imperative is arguably the most urgent institutional challenge facing the Islamic fintech ecosystem.

D. CONCLUSION

This study has demonstrated that the reconstruction of Sharī'ah compliance within blockchain-based smart contract transactions is both theoretically feasible and practically imperative, but requires deliberate architectural design, robust governance innovation, and sustained interdisciplinary collaboration. Through a systematic review of 40 contemporary studies and the application of classical Islamic jurisprudential analysis, the paper has mapped

the complex terrain of opportunities and challenges that smart contracts present for Islamic finance across eight major akad typologies.

The Sharī'ah Compliance Reconstruction Framework (SCRF) and the Hybrid Sharī'ah-Tech Governance Model (HSTGM) proposed in this paper offer practical tools for Islamic financial institutions, regulatory authorities, and blockchain developers seeking to operationalize Sharī'ah-compliant decentralized finance. The SCRF's akad-specific, four-stage compliance architecture addresses the granular technical and jurisprudential requirements that generic 'Islamic blockchain' frameworks have thus far failed to systematize. The HSTGM's tiered governance model resolves the central institutional paradox of decentralized Islamic finance by stratifying autonomous execution and scholarly oversight into complementary — rather than competing — governance functions.

Three principal limitations of this study merit acknowledgment. First, the systematic review is necessarily bounded by the available published literature, which skews toward Southeast Asian and Gulf perspectives; African, Central Asian, and Western Islamic fintech contexts are underrepresented. Second, the doctrinal analysis primarily engages with Hanafi and Shafi'i jurisprudence given their institutional dominance in Islamic finance; a comprehensive madhhab-comparative analysis across all four major Sunni schools and the Ja'fari school warrants dedicated future research. Third, the technical analysis of smart contract architectures is based on current technological capabilities; the rapidly evolving landscape of Layer-2 solutions, cross-chain protocols, and AI-augmented compliance systems may alter the compliance calculus significantly within the research horizon.

Future research should prioritize: empirical testing of the SCRF through case studies of deployed Islamic finance smart contracts in regulatory sandbox environments; longitudinal analysis of how evolving blockchain infrastructure (zero-knowledge proofs, confidential computing) addresses the gharar and privacy challenges identified in this study; comparative regulatory analysis across OIC member states to assess the jurisdictional preconditions for HSTGM implementation; and ethnographic studies of SSB scholars' engagement with smart contract code review a human process dimension critical to institutional adoption but as yet largely unresearched.

The question confronting Islamic finance is not whether to engage with smart contracts, but how to engage on terms that honor the intellectual tradition of fiqh al-mu'amalat while embracing the transformative potential of distributed ledger technology. The frameworks advanced in this paper constitute one answer to that question — grounded in both the classical sources of Islamic jurisprudence and the technical realities of contemporary blockchain development.

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