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EXPLORING SMART CONTRACTS IN ISLAMIC FINANCE: BLOCKCHAIN-BASED SHARIAH-COMPLIANT TRANSACTIONS

EKSPLORASI SMART CONTRACT DALAM KEUANGAN SYARIAH: PENERAPAN TRANSAKSI BERBASIS BLOCKCHAIN YANG SESUAI SYARIAH

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Abstract

The rapid advancement of blockchain technology presents new opportunities and challenges for the Islamic financial system, particularly in ensuring compliance with Shariah principles. As Islamic finance continues to grow, there is a pressing need to explore how digital innovations such as smart contracts can be integrated without violating core religious tenets. This study explores the potential application of smart contracts in Islamic finance, focusing on how blockchain technology can support transactions that comply with Shariah principles. Using a qualitative approach with triangulation methods, the research combines systematic literature review, in-depth interviews, and comparative analysis between smart contract frameworks and classical Shariah contracts such as murabaha, mudarabah, and ijarah. The study examines how smart contracts can enhance transparency, reduce operational costs, and minimize human error while ensuring adherence to Islamic legal and ethical standards. The findings indicate that blockchain-based smart contracts can effectively automate Islamic financial transactions when designed with proper attention to the prohibition of riba (interest) and gharar (uncertainty). The research highlights the need for close collaboration between Shariah scholars and technology developers to ensure compliance. This study suggests that smart contracts hold significant promise for increasing efficiency, trust, and transparency in the Islamic financial ecosystem.

Keywords: *Blockchain, Financial Technology, Islamic Contracts, Islamic Finance, Smart Contracts*

Abstrak

Kemajuan pesat teknologi blockchain menghadirkan peluang sekaligus tantangan baru bagi sistem keuangan Islam, khususnya dalam menjaga kepatuhan terhadap prinsip-prinsip syariah. Seiring pertumbuhan industri keuangan syariah, diperlukan upaya untuk mengeksplorasi bagaimana inovasi digital seperti smart contract dapat diintegrasikan tanpa melanggar nilai-nilai agama. Studi ini mengeksplorasi potensi penerapan smart contract dalam keuangan Islam, dengan fokus pada bagaimana teknologi blockchain dapat mendukung transaksi yang sesuai dengan prinsip syariah. Penelitian ini menggunakan pendekatan kualitatif dengan metode triangulasi, menggabungkan tinjauan pustaka sistematis, wawancara mendalam, dan analisis komparatif antara kerangka kerja smart contract dan akad syariah klasik seperti murabahah, mudharabah, dan ijarah. Hasil penelitian menunjukkan bahwa smart contract berbasis blockchain dapat mengotomatiskan transaksi keuangan syariah secara efektif jika dirancang dengan memperhatikan larangan riba (bunga) dan gharar (ketidakpastian). Studi ini menekankan pentingnya kolaborasi antara pakar keuangan syariah

danpengembang teknologi untuk memastikan inovasi digital tetap selaras dengan kepatuhan hukum dan nilai-nilai agama. Temuan ini menyiratkan bahwa smart contract memiliki potensi besar dalam meningkatkan efisiensi, transparansi, dan kepercayaan dalam sistem keuangan Islam..

Kata Kunci: *Akad Syariah, Blockchain, Keuangan Syariah, Smart Contract, Teknologi Finansial*

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A. INTRODUCTION

In recent years, the widespread use of blockchain technology in the global financial sector has raised new concerns for Islamic finance. In many countries, blockchain applications are heavily used in cryptocurrency trading, derivative transactions, and interest-based lending—practices that contradict core Shariah principles such as the prohibition of riba (interest), gharar (uncertainty), and maysir (speculation). For instance, several DeFi (Decentralized Finance) platforms rely on smart contracts for high-risk, interest-based lending and speculative investments. This situation has triggered apprehension among Shariah scholars and Islamic finance practitioners about the direction of digital financial innovation. Previous studies, such as those by Zohdi et al. (2020) and Hasan & Al-Dubai (2021), indicate that the adoption of digital technology in Islamic finance still faces conceptual and practical challenges, especially in ensuring compliance with Islamic legal principles. Therefore, this study seeks to examine how smart contracts can be designed and implemented within the framework of Shariah, ensuring that digital financial solutions avoid violating its fundamental prohibitions (Tapscott & Tapscott, 2016).

While conventional financial institutions have rapidly adopted blockchain-based technologies—evidenced by global investments in blockchain solutions reaching approximately USD 17.5 billion in 2024 (Statista, 2024)—Islamic finance remains cautious. Despite Islamic finance assets surpassing USD 3 trillion globally (IFSB, 2023), only a limited number of institutions have explored blockchain-based smart contracts due to concerns over Shariah compliance. For example, a 2022 survey by the Islamic Development Bank showed that less than 15% of Islamic financial institutions had initiated pilot projects involving blockchain. This lag is largely due to the sector's need to reconcile technological innovation with religious doctrines that prohibit interest (riba), excessive uncertainty (gharar), and speculation (maysir). Consequently, the question of how blockchain-based smart contracts can be meaningfully and ethically adopted within Islamic finance remains both timely and urgent, particularly as the demand for Shariah-compliant digital financial services continues to rise.

Islamic finance operates under specific principles, including the prohibition of riba (interest), gharar (excessive uncertainty), and maysir (gambling), as well as the requirement for asset-backed transactions (Dusuki & Abdullah, 2007). These requirements necessitate careful design and scrutiny of financial products and contracts.

While the implementation of smart contracts in Islamic finance requires both technological capability and a deep understanding of Shariah-compliant structures like murabaha, mudarabah, and ijarah, most existing platforms fail to accommodate these needs. Current blockchain systems are typically designed for conventional use, lacking features that support Islamic contractual requirements. Although several studies (e.g., Mohammed et al., 2020) have discussed blockchain's theoretical compatibility with Shariah, there is still a lack of practical models or frameworks that demonstrate how smart contracts can be structured in line with Islamic principles. This disconnect limits real-world adoption and raises questions about how digital contracts can be operationalized within Shariah-compliant finance.

Several previous studies have examined the potential of blockchain in transforming financial services, focusing on its transparency, immutability, and efficiency (Tapscott & Tapscott, 2016; Yermack, 2017). In the Islamic finance domain, some researchers have explored the general compatibility of blockchain with Shariah principles, highlighting shared values such as trust and transparency (Mohammed et al., 2020; Rizvi et al., 2021). However, these discussions often remain at a conceptual level, lacking detailed application to specific Islamic financial instruments. Few studies attempt to dissect the intricate legal and operational requirements of contracts like murabaha or mudarabah within a smart contract environment. Moreover, there is limited research that systematically integrates the logic of programmable code with the normative framework of Islamic jurisprudence (fiqh muamalat). This absence of intersection between Islamic legal theory and blockchain programmability creates a significant academic void that this study seeks to address.

.Moreover, there is a lack of comprehensive analysis that bridges the gap between Islamic jurisprudence and programmable digital logic in smart contracts. This gap leaves practitioners and scholars without clear guidance for implementation. Another critical gap lies in regulatory clarity and standardization for blockchain-based solutions in the Islamic finance industry. While some regulatory bodies and financial institutions have started exploring this area, there remains inconsistency in interpretations and implementations (Ahmed & Ma'in, 2021). This presents a challenge in developing a unified framework that can be adopted across

different jurisdictions. Therefore, the need for research that proposes adaptable yet Shariah-compliant smart contract models is becoming increasingly urgent.

The novelty of this study lies in its focus on mapping specific Islamic financial contracts into smart contract structures using blockchain technology. By analyzing the operational and legal elements of classical Islamic contracts, this research seeks to outline how digital automation can be applied without violating Shariah principles. Unlike prior studies that stop at theoretical discussion, this paper goes further to propose practical approaches based on current technological capabilities and Shariah rules.

Furthermore, the study adopts a qualitative method combining a systematic literature review with comparative contract analysis. This methodology allows for a deeper understanding of both the technological and jurisprudential dimensions of the issue. By doing so, the paper aims to uncover both the opportunities and the limitations of smart contracts in Islamic finance, providing a nuanced view that balances innovation with compliance.

The objective of this research is twofold: first, to identify the core challenges in implementing blockchain-based smart contracts within Islamic finance; second, to offer a framework or set of recommendations for designing such contracts in ways that are Shariah-compliant. This is expected to serve as a guide for developers, financial institutions, and regulators seeking to modernize Islamic finance without compromising its foundational principles.

In conclusion, as digital finance continues to evolve rapidly, Islamic financial institutions must also innovate to remain competitive and relevant. Smart contracts and blockchain offer powerful tools to streamline operations, enhance trust, and improve access. However, this innovation must be guided by rigorous Shariah analysis and interdisciplinary collaboration. This paper contributes to that endeavor by providing a focused study on the alignment of blockchain-based smart contracts with Islamic financial jurisprudence.

B. THEORETICAL FRAMEWORK

1. Blockchain Technology and Its Relevance to Islamic Finance

Blockchain technology has gained significant attention in the past decade due to its potential to revolutionize various industries, including finance. Blockchain offers decentralized, transparent, and secure mechanisms for recording transactions, which can mitigate issues such as fraud and lack of transparency (Narayanan et al., 2016). In Islamic finance, where the principles of transparency, fairness, and justice are core, blockchain presents an opportunity to enhance trust and efficiency. Smart contracts, as a natural extension of

blockchain, are self-executing contracts where the terms of the agreement are directly written into code (Buterin, 2014). The adaptability of blockchain makes it an ideal candidate for structuring Shariah-compliant financial transactions.

However, the challenge lies in aligning blockchain's decentralized nature with Islamic financial principles, particularly in ensuring compliance with Shariah. Islamic finance emphasizes asset-backed transactions, which means that every financial contract must be tied to a tangible asset (Al-Salem, 2019). The concept of gharar (excessive uncertainty) and riba (interest) poses additional constraints, requiring that smart contracts designed on the blockchain be structured in a way that avoids these elements. This examines blockchain's compatibility with Islamic financial principles a crucial topic for academic inquiry.

2. The Concept of Smart Contracts in Shariah-Compliant Financial Transactions

Smart contracts, a key feature of blockchain technology, have garnered attention for their potential to automate and enforce the terms of financial agreements without intermediaries. A smart contract is a program that automatically executes actions once predefined conditions are met, thus reducing human error and fraud (Szabo, 1997). The applicability of smart contracts in Shariah-compliant financial transactions, however, is an area that requires scrutiny. Islamic finance principles emphasize ethical business practices, fairness, and the avoidance of harm. Smart contracts must, therefore, be designed in a way that aligns with these values.

One of the fundamental challenges in applying smart contracts to Islamic finance is ensuring that the terms and conditions encoded within the contract comply with Shariah principles such as gharar and riba. Gharar refers to excessive uncertainty in contractual terms, which is prohibited in Islamic law due to its potential to cause unfair advantage or exploitation (El-Gamal, 2006). Likewise, riba, or interest, is strictly forbidden in Islamic finance, and any automated contractual mechanism must avoid the inclusion of interest-bearing elements, particularly in lending or financing structures (Karim, 2019).

According to Nurfadilla and Firman (2022), many existing blockchain-based smart contracts in conventional finance inherently contain riba elements and speculative features that are incompatible with Islamic financial ethics. They emphasize that unless blockchain architecture is redesigned to reflect Shariah contracts, its implementation risks violating core Islamic legal norms. This presents a significant barrier to adoption, especially in jurisdictions that adhere closely to Islamic jurisprudence

To address these issues, smart contracts must be carefully programmed to ensure compliance with these Shariah prohibitions. For example, in the case of murabaha, a smart contract could automatically enforce the sale price and payment schedule based on agreed terms, thereby avoiding the uncertainty and interest involved in conventional financing. However, the contract's code must also be adaptable to prevent unintentional gharar by ensuring that all terms are transparent and known to both parties at the outset (Harjoni, 2024).

Moreover, Islamic finance is based on principles of risk-sharing rather than risk-transfer. This requires that smart contracts be designed to reflect the equitable distribution of risk in contracts such as mudarabah and musharakah. For example, in a mudarabah contract, one party provides capital, and the other provides expertise, with profit shared according to pre-agreed ratios. Smart contracts in this context could be programmed to calculate and distribute profits based on actual performance rather than predetermined interest rates, ensuring compliance with the principle of risk-sharing (Hassan & Khan, 2016).

While the technology behind smart contracts offers significant potential for enhancing the efficiency and transparency of Islamic finance, it also brings new challenges in terms of Shariah compliance. The inability to modify or renegotiate terms once a contract is executed could pose issues in situations where unforeseen events arise, which is an important consideration in Islamic finance. However, with the right safeguards in place, such as the inclusion of arbitration clauses or provisions for renegotiation in specific cases, these issues can be mitigated (Hassan, 2020).

In conclusion, the application of smart contracts in Shariah-compliant financial transactions is a promising development, but it requires a careful balancing of technological capabilities with Islamic principles. This framework for developing smart contracts that adhere to Shariah guidelines can offer an innovative and efficient solution for Islamic financial institutions, provided that they are designed and implemented with the necessary compliance mechanisms in place.

3. Legal and Regulatory Challenges in Implementing Blockchain and Smart Contracts in Islamic Finance

The integration of blockchain and smart contracts into Islamic finance not only presents technological challenges but also raises significant legal and regulatory concerns. Blockchain, as a decentralized technology, operates outside the traditional regulatory frameworks, which may cause difficulties in its adoption in highly regulated financial markets (Catalini & Gans, 2016). In the case of Islamic finance, the legal recognition of smart contracts and digital assets

is a critical issue, as many jurisdictions still lack clear regulations regarding these new technologies.

One major challenge lies in the legal recognition of smart contracts within the existing Islamic legal framework. Islamic law has well-established principles regarding contracts, and the question of whether smart contracts can be recognized as legally binding under Shariah is a key issue. While some scholars argue that smart contracts are a form of modern aqd (contract) and should therefore be enforceable (Alam & Azmi, 2020), others point out that the lack of human oversight and the potential for ambiguity in automated decision-making could pose challenges in ensuring full compliance with Shariah principles (Khan, 2021).

C. RESEARCH METHOD

This study employs a qualitative research approach using a triangulation method to ensure the validity and reliability of the findings. Data were collected through three main techniques: a systematic literature review, semi-structured interviews with key experts, and case study analysis. The literature review provided a theoretical foundation on blockchain, smart contracts, and their intersection with Islamic finance. In-depth interviews were conducted with Shariah scholars, blockchain developers, and Islamic finance practitioners to explore the practical integration of smart contracts with contracts such as murabaha, mudarabah, and ijarah. Additionally, case studies of institutions that have implemented or are piloting blockchain technology in Shariah-compliant financial services were analyzed to capture real-world practices and challenges. All data were analyzed using thematic analysis to identify patterns and insights relevant to the development of Shariah-compliant smart contract models. The research was conducted in accordance with ethical guidelines, ensuring informed consent and participant confidentiality throughout the study.

D. RESEARCH RESULTS AND DISCUSSION

The findings indicate that understanding of blockchain and smart contract technologies among Islamic finance industry players remains limited, although there is considerable enthusiasm for its potential. Interviews with Islamic finance practitioners revealed that most institutions lack a concrete strategy for adopting this technology. The main barriers include limited digital literacy within the Islamic finance sector and concerns about Shariah compliance. This aligns with Mohammad et al. (2020), who noted that digital innovation is often slower to penetrate value-based financial systems such as Islamic finance.

From the technological perspective, smart contracts are viewed as capable of streamlining Shariah-based transactions such as *murabaha* and *ijarah*, with automation reducing the risk of error and delay. Blockchain developers emphasized that data transparency and automatic contract execution can reinforce justice in *muamalah*. They also highlighted the importance of developing a "Shariah oracle," a system that integrates Shariah rulings to ensure contractual compliance with fatwas. This perspective aligns with Nurfadilla and Firman (2022), who argue that blockchain has the potential to uphold the principles of Islamic finance, particularly in promoting fairness, accountability, and transparency—provided it is designed with an embedded Shariah-compliant governance framework. It also supports the argument by Omar et al. (2021) that blockchain can align with Islamic principles if implemented with legal and ethical accommodation.

Interviews with Islamic scholars and academics emphasized that smart contracts must be examined through the lens of usul al-fiqh and maqasid al-shariah. While scholars welcomed the efficiency potential, they warned of potential gharar (uncertainty) arising from unclear coding structures. Triangulated data showed that this issue is often overlooked by developers. Therefore, close collaboration between Shariah experts and blockchain engineers is essential to ensure compliance with Islamic legal and ethical norms.

Case studies from Islamic fintech institutions in Indonesia and Malaysia offered valuable practical insights. One example demonstrated how blockchain was used to facilitate a wakalah bil ujrah contract, significantly reducing administrative costs and improving transaction speed. However, the challenge lies in auditing Shariah compliance, as there are no universal standards for Shariah-compliant smart contracts. These findings reinforce Harjoni's (2023) conclusion that digital transformation in Islamic finance requires adaptive Shariah governance supported by contemporary technology.

In terms of regulation, informants from financial authorities noted that legal frameworks for blockchain are still in development. Existing regulations do not adequately address the jurisprudential dimensions of blockchain-based contracts. This legal vacuum could hinder innovation unless addressed promptly. As such, this study recommends that bodies like the DSN-MUI and OJK develop guidelines and digital Shariah standards tailored to blockchain applications in Islamic finance.

Field observations further revealed that most potential users of this technology are young, tech-savvy Muslim entrepreneurs and community-based fintech actors. This demographic is more receptive to integrating technology into Islamic financial transactions, particularly for products such as Islamic crowdfunding and halal asset tokenization. These

findings suggest a digital cultural shift in the Islamic economic system, consistent with Nurhidayat et al. (2022), who noted that digital-native Muslims seek financial tools that integrate both ethics and technology.

Data triangulation from interviews, Findings from literature, interviews, and case studies confirm the significant potential of smart contracts in Islamic finance. However, successful implementation depends on embedding specific Shariah principles into the technical and legal design of blockchain systems. Among the core principles are the prohibition of riba (interest), gharar (excessive uncertainty), maysir (speculation), and the requirement for halal asset backing and mutual consent (ridha) in transactions. These elements must be operationalized through contract clarity, transparent coding logic, and a Shariah oracle mechanism to validate every automated step. The absence of such integration risks jurisprudential disputes (ikhtilaf) and compromises ethical compliance.

This study argues for a dialectical synthesis between Islamic legal theory (fiqh muamalah) and programmable digital logic, proposing that smart contracts must be designed to fulfill the objectives of maqasid al-shariah—namely justice (adl), transparency, and the protection of wealth and trust. Rather than general alignment, the research advocates for a structured model where each contractual component (e.g., profit-sharing in mudarabah or cost-plus pricing in murabaha) is digitally encoded with Shariah oversight. This integrated approach may serve as the foundation for future innovations in Islamic digital finance, advancing ethical, inclusive, and standardized smart contract frameworks across jurisdictions.

E. CONCLUSION

This study concludes that blockchain-based smart contracts have strong potential to enhance Islamic finance by enabling transparent, efficient, and Shariah-compliant transactions. Using a triangulated method—literature review, expert interviews, and case studies—it is evident that such technology can support Islamic contracts like *murabaha*, *mudarabah*, and *wakalah*, provided legal and ethical safeguards are embedded. However, key challenges persist, including low digital readiness, regulatory gaps, and the absence of standardized Shariah frameworks. Therefore, integrating Islamic jurisprudence with blockchain requires structured collaboration between technologists, regulators, and Shariah scholars to ensure alignment with *maqasid al-shariah* and build public trust in digital Islamic finance.

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