

Automated Transaction of Smart Contract: Technology and Sharia Discourse

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Abstract:

Smart contracts offer Islamic finance a new mechanism for executing transactions with greater transparency, efficiency and reduced Sharia non-compliance risk, yet their distinct technical features introduce Sharia challenges scholarly exploration. This paper aims to study the implementation of smart contracts from the Sharia Scholars' perspective and to analyze its operational challenges as well as Sharia-related issues that arise from integration in the realm of Islamic finance. Using a qualitative approach, data was collected from credible sources such as books, journals, and relevant websites, with strict inclusion criteria. The analysis employed inductive reasoning and an explanatory research method to explore the application and issues surrounding smart contracts. The study finds that smart contracts hold great potential and are generally Sharia-compliant. However, technical aspects, such as contract terms, coding, execution, and protocol consensus require further research. It also stresses the importance of having a Sharia committee or advisor to ensure compliance in products and operations.

Keywords:

blockchain; financial technology; Islamic finance; smart contract; Sharia

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Introduction

Technological innovation has undergone revolutionary changes since the First Industrial Revolution (IR 1.0) to the current fourth industrial revolution (IR 4.0). The advancements in technology have made human daily activities and financial needs easier to manage. Automation is a key element in current technologies and plays a significant role in IR 4.0 by enabling machines to perform various activities more efficiently. The advent of digital economy and automation is expected to accelerate in the future, driven by the products and services of companies and enterprises, leading to a shift from traditional to digital landscape.¹

Smart contract technology is one of the innovations of IR 4.0 that operates in the blockchain realm. It combines a contract and product as an operating mechanism and can reduce operating errors that might occur due to human error or mistakes by relying on smart contract codes to enforce contracts properly.² Smart contracts also enhance operational transparency due to the blockchain's inherent characteristic, where the smart contract operates.³

Smart contracts have a high potential to become the operating mechanism of Sharia contracts in Islamic financial institutions (IFIs). However, the intersection of classical Sharia discussions on transactions with the rapid advancement of technology necessitates a thorough understanding of the matter with a fresh and grounded perspective. The emergence of smart contracts introduces a nuanced challenge as it deviates from the traditional context of contractual agreements. Classical discussions regarding the essential components of a valid contract may not seamlessly reflect on the current automated and decentralized nature of smart contracts.⁴ Such discrepancy between the classical and modern smart contract raises crucial questions about

¹ Emilia Filippi, Mariasole Bannò, and Sandro Trento, "Automation Technologies and Their Impact on Employment: A Review, Synthesis and Future Research Agenda," *Technological Forecasting and Social Change* 191 (2023): 1–121, <https://doi.org/10.1016/j.techfore.2023.122448>.

² Son Nguyen, Peggy Shu-Ling Chen, and Yuquan Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping," *International Journal of Physical Distribution & Logistics Management* 51, no. 2 (2021): 126–48, <https://doi.org/10.1108/IJPDLM-01-2020-0036>.

³ Yusof Mahmoud Aljamos et al., "The Blockchain Technology from Maqasid Shari'ah Perspective," *Journal of Contemporary Maqasid Studies* 1, no. 2 (2022): 59–82, <https://doi.org/10.52100/jcms.v1i2.54>.

⁴ Qutb Muṣṭafā Sānū, "Al-'Uqūd al-Dhakiyya fi Ḍaw' al-'Uṣūl wa al-Maqāṣid wa al-Ma'ālāt Ru'yah Takhliyyah" in *International Islamic Fiqh Academy* (Dubai, 4–6 November 2019).

the compatibility of smart contracts within the established Sharia principles and guidelines adopted in IFIs.⁵ Moreover, such a facility also highlights the need for a comprehensive examination that addresses the unique features and implications of this technological innovation within the Islamic legal framework. Additionally this also requires critical discussion to ensure that IFIs can meet the future needs of the Islamic financial market without compromising the established Sharia principles.⁶

Existing scholarship including Laldin and Furqani,⁷ Muneeza and Zakariya,⁸ Roslan et al.,⁹ and Habib,¹⁰ El Amri et al.¹¹ has yet to provide a comprehensive examination of the intersection between smart contract technology and Sharia principles. Munawar¹² notes that although smart contracts align with certain Islamic legal requirements, their automated and decentralized nature raises concerns about human oversight, which is a critical component in traditional Islamic contracts. Similarly, Ahmad et al.¹³ identify a gap in how smart contracts differ from fundamental Islamic contract principles.¹⁴ Khamal discusses the

⁵ Azlin Alisa Ahmad, Mat Noor Mat Zain, and Nur Diyana Amanina Zakaria, "The Position of Smart Contracts in the Light of Islamic Contract Theory," *Samarah: Jurnal Hukum Keluarga dan Hukum Islam* 8, no. 1 (2024): 144–71, <https://doi.org/10.22373/sjhkv8i1.16372>.

⁶ Ahmad, Zain, and Zakaria, "The Position of Smart Contracts in the Light of Islamic Contract Theory."

⁷ Mohamad Akram Laldin and Hafas Furqani, "Fintech and Islamic Finance: Setting the Shari'ah Parameters," in *Fintech in Islamic Finance*, ed. Oseni, U. A. and Nazim Ali, S. (New York: Routledge, 2019), 113–19.

⁸ Aishath Muneeza and Zakariya Mustapha, "Blockchain and Its Shariah Compliant Structure," in *Halal Cryptocurrency Management*, ed. Billah, Mohd Ma'sum (Cham: Palgrave Macmillan, 2019), 69–106.

⁹ Muhammad Faruq Roslan et al., "Application of Tawarruq in Islamic Banking in Malaysia: Towards Smart Tawarruq," *International Journal of Management and Applied Research* 7, no. 2 (2020): 104–19, <https://doi.org/10.18646/2056.72.20-008>.

¹⁰ Farrukh Habib, "Smart Contracts for Islamic Financial Transaction," *IFIKR DIGEST*, 2019.

¹¹ Mohamed Cherif El Amri, Mustafa Omar Mohammed, and Ruslan Sabirzyanov, "The Potential of Smart Contracts for Murabahah Home Financing: Towards an Integrated Model," in *Fintech, Digital Currency and the Future of Islamic Finance: Strategic, Regulatory and Adoption Issues in the Gulf Cooperation Council*, ed. Nafis Alam, Syed Nazim Ali (Cham: Palgrave Macmillan, 2020), 49–76.

¹² Munawar Munawar, "The Legality of Smart Contract in the Perspectives of Indonesian Law and Islamic Law," *Al-Istinbath: Jurnal Hukum Islam* 7, no. 1 (2022): 265–86, <https://doi.org/10.29240/jhi.v7i1.4140>.

¹³ Ahmad, Zain, and Zakaria, "The Position of Smart Contracts in the Light of Islamic Contract Theory."

¹⁴ Muhammad Ayub, *Understanding Islamic Finance* (West Sussex: John Wiley & Sons Ltd, 2009), 57.

legal challenges surrounding the use of smart contracts, noting that their immutability and automation could complicate their application in Islamic finance, where flexibility and human judgment are crucial in ensuring Sharia compliance.¹⁵ According to Mohd. Zain and Mohamad, there is still a lack of comprehensive Sharia rulings on smart contracts, leading to uncertainty about their application within IFIs.¹⁶

Therefore, addressing these gaps, this research aims to study the implementation of smart contracts from the Sharia Scholars' perspective and to analyze its operational challenges as well as Sharia-related issues that arise from integration in the realm of Islamic finance. The absence of such analysis poses challenges to Sharia scholars, Islamic finance practitioners, and policymakers who seek to navigate this emerging technological landscape.¹⁷ This study offers a novel contribution by integrating Sharia scholarly discourse with the technical mechanisms of smart contracts while identifying operational-Sharia challenges unique to Islamic finance that have largely not been discussed previously.

To obtain the objectives of this study, a qualitative research methodology¹⁸ is adopted as it is suitable for in-depth explore the implementation of smart contracts from a Sharia perspective, particularly in the context of Islamic finance. Data were gathered through library research as guided by Merriam & Grenier, focusing on credible sources such as Scopus-indexed journals, classical and contemporary Sharia texts, smart contract publications, *fatwā*, conference papers, and reputable websites.¹⁹ The data were thematically examined based on relevant keywords. For analysis, the study employed inductive reasoning and

¹⁵ Ainul Azam Ahmad Khamal, "Digital Smart Contracts: Legal and Shari'ah Issues," in *Islamic Fintech: Insights and Solutions*, ed. Billah, M. M. (Cham: Palgrave Macmillan, 2021), 111–24.

¹⁶ Nor Razinah Mohd. Zain and Khairul Azmi Mohamad, "An Evaluation of Smart Contracts: Practices, Legality, and Shari'ah," in *Islamic Fintech: Insights and Solutions*, ed. Billah, Mohd Ma'sum (2021), 91–110.

¹⁷ Ilinka Antova and Tahar Tayachi, "Blockchain and Smart Contracts: A Risk Management Tool for Islamic Finance," *Journal of Islamic financial studies* 5, no. 1 (2019): 29–42, <https://doi.org/10.12785/jifs/050103>.

¹⁸ Patrik Aspers and Ugo Corte, "What Is Qualitative in Qualitative Research," *Qualitative sociology* 42, no. 2 (2019): 139–60, <https://doi.org/10.1007/s11133-019-9413-7>.

¹⁹ Sharan B Merriam and Robin S Grenier, *Qualitative Research in Practice: Examples for Discussion and Analysis* (San Francisco: John Wiley & Sons, 2019), 19.

explanatory research, enabling the researchers to identify key operational and Sharia issues and assess the potential of smart contract adoption in IFIs'.²⁰

The Concept of Smart Contract Technology

Smart contracts have been defined in various ways by researchers and practitioners. According to Nick Szabo,²¹ who originated the idea of smart contracts, they are computer code-based protocols that execute contract terms. Atzei, Bartoletti and Cimoli²² defines smart contracts as contracts that are fully executed automatically when they meet the conditions set in the form of computer code and enforced by a blockchain consensus mechanism. Mat Rahim et al.²³ also defines smart contracts as computer codes that run in a blockchain network. These codes contain a set of rules that bind parties involved in the transaction through smart contracts. Another definition by Habib²⁴ states that smart contracts are computer algorithm-based contracts that enforce contracts automatically when predetermined terms and conditions are met.

The above definitions help to derive two important concepts. First, smart contracts are computer code scripts created by programmers to represent a contractual term. Computer scripting can be understood as a set of "if-then" code that triggers a code when certain terms are met.²⁵

Figure 1 illustrates a general process of smart contract after encoding. An input is a component of a smart contract that refers to any provision contained in the smart contract code. For example, it can be a transaction request, a contract request, a date, or time. The contract interpreter is a smart contract code that checks the validity of the input it receives. If the input is not in line with the smart contract term or code, it will be rejected. On the other hand, if the input

²⁰ M.G. Lodico, D.T. Spaulding, and K.H. Voegtli, *Methods in Educational Research: From Theory to Practice* (New Jersey: John Wiley & Sons, 2010), 5.

²¹ Nick Szabo, "Formalizing and Securing Relationships on Public Networks," *UIC Journals* 2, no. 9 (1997), <https://doi.org/10.5210/fm.v2i9.548>.

²² Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, "A Survey of Attacks on Ethereum Smart Contracts (Sok)" (Conference paper, 6th International Conference on Principles of Security and Trust, Uppsala, Sweden, 22–29 April 2017), 164–86.

²³ Siti Rohaya Rahim et al., "Artificial Intelligence, Smart Contract and Islamic Finance," *Asian Social Science* 14, no. 2 (2018): 145–54, <https://doi.org/10.5539/ass.v14n2p145>.

²⁴ Habib, "Smart Contracts for Islamic Financial Transaction."

²⁵ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

is in line with the terms of the smart contract, it will be received and processed. The output is the result of the entered input. A valid input will produce the output specified in the smart contract code. A vending machine can explain the idea of smart contracts.

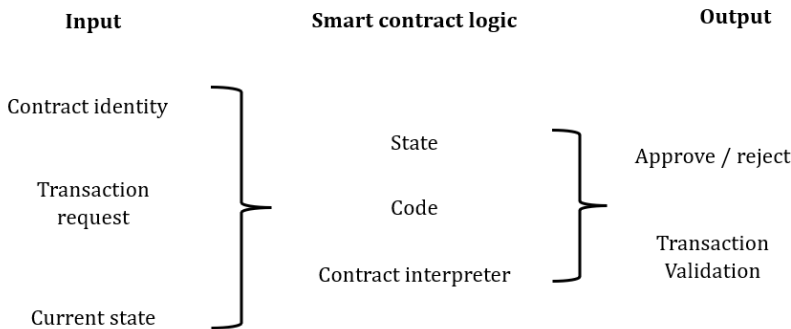


Figure 1.
Smart Contract Process after Encoding²⁶

Second, using blockchain as a platform to execute smart contract code. Blockchain technology is a digital ledger that consists of two crucial elements, namely a system for verifying transactions and a system for recording transactions.²⁷ This means that any data or transaction added to the blockchain will go through a verification process and be recorded on the blockchain platform.

Figure 2 indicates a transaction works in a blockchain platform when someone sends cryptocurrency from A to B. When A sends a certain amount of cryptocurrency to B, they also need to pay a fee to the node that confirms the transaction. The nodes in the blockchain work together to validate transactions based on a consensus protocol that's established within the blockchain ecosystem.²⁸ There are different types of consensus protocols in the blockchain, including proof-of-stake and proof-of-work. While each protocol has its unique

²⁶ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

²⁷ Antova and Tayachi, "Blockchain and Smart Contracts: A Risk Management Tool for Islamic Finance."

²⁸ Rizal Mohd Nor et al., "Blockchain Sadaqa Mechanism for Disaster Aid Crowd Funding" in *6th International Conference on Computing and Informatics: Embracing Eco-Friendly Computing* (Malaysia, 25–27 April 2017).

way of reaching consensus, the goal is the same: to verify and record transactions into the blockchain in a decentralized way.²⁹

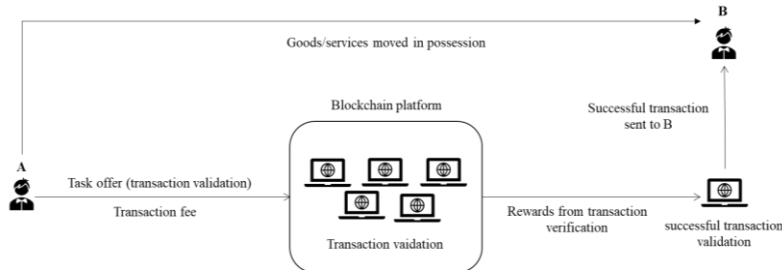


Figure 2.

Illustration of Blockchain Operations³⁰

Smart contracts and blockchain are two closely related terms that are often used interchangeably in the tech industry. This is because blockchain technology is the most suitable technology for enforcing smart contracts. In addition to blockchain's ability to execute cryptocurrency transactions, technology players have also introduced blockchain 2.0 innovations that focus on smart contracts. These contracts were inspired by Nick Szabo's work in 1997 and are now considered an efficient mechanism for executing contracts.³¹

The operation of smart contracts in the blockchain realm involves several cycles. Among the several cycles³², the researchers highlight five main cycle that is significant to acknowledge. Firstly, the contracting parties initially negotiate the contract terms until contract agreement is reached, including the subject

²⁹ Shijie Zhang and Jong-Hyouk Lee, "Analysis of the Main Consensus Protocols of Blockchain," *ICT express* 6, no. 2 (2020): 93–97, <https://doi.org/10.1016/j.icte.2019.08.001>.

³⁰ Peter Eze, Tochukwu Eziokwu, and Chinedu Okpara, "A Triplicate Smart Contract Model Using Blockchain Technology," *Circulation in Computer Science-Special Issue* Special Issue (2017): 1–10, <https://doi.org/10.22632/ccs-2017-cps-01>; Sheikh Ameer Bin Shaik Mohd Zeferi and Nik Abdul Rahim Nik Abdul Ghani, "Analisis Konsep Ganjaran di dalam Sistem Transaksi Matawang Digital Menurut Perspektif Islam," *Journal of Contemporary Islamic Law* 4, no. 2 (2019): 11–21, https://www.ukm.my/jcil/jcil-2019-42-article-2-2/?et_fb=1&PageSpeed=off&_ncforminfo=FAQOHwZFBRLxd9ppCh2-StPzmb4NkwKCHlDs84_e-01-paLgY4459paI-GaoTMNkm21X8YloTUHD58IzM1Jw60uRTsMID4BK.

³¹ Farhana Binti Md Hilal and Nor Faridah Binti Jamaludin, "Smart Contract in Islamic Trade Finance," in *Contemporary Management and Science Issues in the Halal Industry*, ed. Hassan, F. et al. (Cham: Springer, 2019), 431–37.

³² Tianyu Feng et al., "Smart Contract Model for Complex Reality Transaction," *International Journal of Crowd Science* 3, no. 2 (2019): 184–97, <https://doi.org/10.1108/IJCS-03-2019-0010>; Hilal and Jamaludin, "Smart Contract in Islamic Trade Finance."; Canghai Wu et al., "A Review on Recent Progress of Smart Contract in Blockchain," *IEEE Access* 10 (2022): 50839–63, <https://doi.org/10.1109/ACCESS.2022.3174052>.

matter, duration, price, action and liabilities in case of breach.³³ Secondly, programmers convert the signed contract into a smart contract using a specific code, arranging processes and conditions accordingly.³⁴

Thirdly, the smart contract is deployed on the blockchain, verified by the blockchain users, and becomes immutable, with the related assets also recorded and locked in the network.³⁵ Fourthly, contract execution follows an event-trigger mechanism. Once conditions are met, it runs automatically,³⁶ and validators confirm the transaction through the blockchain's consensus protocol.³⁷ Lastly, each executed transaction is recorded on the blockchain and distributed to all nodes, updating participants' ledgers with new blocks. All details of the deployment, execution, and modification of smart contracts are permanently stored on the blockchain.³⁸ Figure 3 illustrates the above-mentioned significant cycles of smart contracts in the blockchain ecosystem.

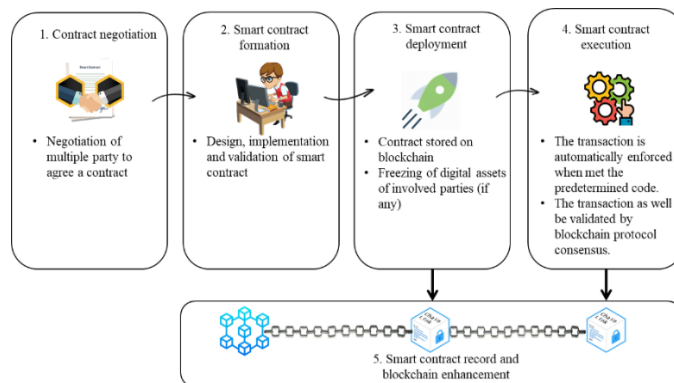


Figure 3.
Smart Contract Operation Cycle³⁹

³³ Feng et al, "Smart Contract Model for Complex Reality Transaction," 184–97.

³⁴ Wu et al, "A Review on Recent Progress of Smart Contract in Blockchain," 50839–63.

³⁵ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

³⁶ Wu et al, "A Review on Recent Progress of Smart Contract in Blockchain."

³⁷ Zibin Zheng et al, "An Overview on Smart Contracts: Challenges, Advances and Platforms," *Future Generation Computer Systems* 105 (2020): 475–91, <https://doi.org/10.1016/j.future.2019.12.019>.

³⁸ Shi-Yi Lin et al, "A Survey of Application Research Based on Blockchain Smart Contract," *Wireless Networks* 28, no. 2 (2022): 635–90, <https://doi.org/10.1007/s11276-021-02874-x>.

³⁹ Feng et al, "Smart Contract Model for Complex Reality Transaction."; Lin et al, "A Survey of Application Research Based on Blockchain Smart Contract."; Wu et al, "A Review on Recent Progress of Smart Contract in Blockchain."; Hilal and Jamaludin, "Smart Contract in Islamic Trade Finance."

Smart Contract's Distinction, Advantages and Challenges

Smart contracts constitute a major departure from traditional contractual forms owing to their capacity for automatic execution and enforcement. As argued by Hilal and Jamaludin,⁴⁰ unlike conventional agreements that require human oversight, smart contracts rely on self-executing code triggered by predefined inputs and outputs, thereby reducing the risk of human error. Their operation within blockchain environments further accentuates this distinction. Through consensus protocols, transactions are validated in a decentralized manner, immutably recorded, and disseminated across participating nodes.⁴¹ This mechanism, according to technology experts, enhances transparency, fosters trust, and minimizes susceptibility to manipulation or exploitation.⁴²

However, despite these promises, the literature highlights that smart contracts and blockchain technologies also present significant risks and limitations. Nguyen et al.⁴³ observe that technological errors, systemic complexity, and organizational adaptation requirements remain persistent obstacles to adoption. Scalability has been underscored as a particularly pressing issue: as Wang et al.⁴⁴ contend, increasing transaction volumes intensify computational and storage demands, resulting in higher costs, slower processing, and inefficiencies at scale. Interoperability challenges further compound these difficulties. Khan et al.⁴⁵ and Belchior et al.⁴⁶ emphasize that the absence of universally accepted standards hinders seamless integration across systems while simultaneously introducing new layers of security risk.

⁴⁰ Hilal and Jamaludin, "Smart Contract in Islamic Trade Finance."

⁴¹ Shahbaz Alam and Hina Noor, "Mined and Non-Mined Crypto Currencies: A Critical Analysis from Shariah Perspective," *International Journal of Innovative Science and Research Technology* 5, no. 3 (2020): 429–37, <https://ijisrt.com/assets/upload/files/IJISRT20MAR236.pdf>.

⁴² Eze, Eziokwu, and Okpara, "A Triplicate Smart Contract Model Using Blockchain Technology."

⁴³ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

⁴⁴ Yingli Wang, Jeong Hugh Han, and Paul Beynon-Davies, "Understanding Blockchain Technology for Future Supply Chains: A Systematic Literature Review and Research Agenda," *Supply Chain Management: An International Journal* 24, no. 1 (2019): 62–84, <https://doi.org/10.1108/SCM-03-2018-0148>.

⁴⁵ Sajjad Khan et al., "Towards Interoperable Blockchains: A Survey on the Role of Smart Contracts in Blockchain Interoperability," *Ieee Access* 9 (2021): 116672–91, <https://doi.org/10.1109/ACCESS.2021.3106384>.

⁴⁶ Rafael Belchior et al., "A Survey on Blockchain Interoperability: Past, Present, and Future Trends," *Acm Computing Surveys (CSUR)* 54, no. 8 (2021): 1–41, <https://doi.org/10.1145/3471140>.

In addition to technical challenges, legal and compliance considerations remain critical. Richards⁴⁷ and Osmani et al.⁴⁸ argue that the immutability of smart contracts complicates rectification when errors occur, raising enforceability concerns. While Osmani et al. further contend that blockchain adoption in finance could enhance efficiency by enabling faster and cheaper transactions, they caution that it may also expose institutions to novel forms of cyber threats and fraud. Similarly, Chen et al.⁴⁹ highlight macroeconomic risks, noting that volatility and uncertainty in cryptocurrency markets can undermine investment efficiency and lead to suboptimal financial outcomes.

Overall, the literature suggests that while smart contracts provide notable advantages in terms of automation, transparency, and security, they are accompanied by multifaceted technical, legal, and regulatory challenges. Addressing these challenges requires the establishment of robust governance frameworks, the development of international standards, and the implementation of strategic safeguards to ensure their responsible integration into contemporary socio-economic systems.

Smart Contract from the Legal Perspective

Although technologically advanced, smart contracts remain rooted in common law principles, which require offer, acceptance, consideration, and the intention to create legal relations.⁵⁰ Their primary distinction from traditional contracts lies in execution: while conventional contracts are written and signed, smart contracts are digitally executed and recorded on blockchain platforms.⁵¹ As Zain et al.⁵² observe, this introduces interpretive and enforcement challenges, yet they remain legally binding if core contractual elements are satisfied.

⁴⁷ Mina Richards, "Disruptive Innovations: Blockchain and Spinoffs," in *Advances in the Technology of Managing People: Contemporary Issues in Business*, ed. Gordon, P.A. and Overbey, J.A. (Leeds: Emerald Publishing Limited, 2019), 161–72.

⁴⁸ Mohamad Osmani et al., "Blockchain for Next Generation Services in Banking and Finance: Cost, Benefit, Risk and Opportunity Analysis," *Journal of Enterprise Information Management* 34, no. 3 (2021): 884–99, <https://doi.org/10.1108/JEIM-02-2020-0044>.

⁴⁹ Jiachi Chen et al., "Defining Smart Contract Defects on Ethereum," *IEEE Transactions on Software Engineering* 48, no. 1 (2020): 327–45, <https://doi.org/10.1109/TSE.2020.2989002>.

⁵⁰ Ahmad Khmal, "Digital Smart Contracts: Legal and Shari'ah Issues."

⁵¹ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

⁵² Mohd. Zain and Mohamad, "An Evaluation of Smart Contracts: Practices, Legality, and Shari'Ah."

Legal approaches vary across jurisdictions. The United States, Malta, and Australia have adopted supportive frameworks that encourage innovation while safeguarding legal integrity, whereas China and India have adopted restrictive policies due to concerns over cryptocurrencies and digital assets.⁵³

Drummer and Neumann⁵⁴ contend that legal challenges such as jurisdictional ambiguity, compliance, data protection, and contract immutability require international harmonization, standardized templates, and technological refinement. They stress collaboration among policymakers, legal scholars, and IT professionals to build a framework that enables smart contracts' integration into mainstream business within the context of the fourth industrial revolution.⁵⁵ Hence, while smart contracts offer notable benefits, their effective adoption relies on alignment with legal principles and a balanced regulatory environment that fosters innovation while addressing legal and ethical risks.

Sharia Scholars' Discussion on Automation of Smart Contract

Smart contract technology is a relatively new area that classical Sharia scholars did not address, while contemporary Sharia scholars are actively exploring its implications and applications. It is known that the classical Sharia scholars discussed the requirements that a contract must have. Among the conditions, the contracting parties must be in the same physical location where the transaction is executed.⁵⁶ Shaarani and Muhammad⁵⁷ found that smart contracts can be related to *bay' al-istijrār* (recurring sale)⁵⁸ and *bay' al-mu'allaq* (conditional sale).⁵⁹ In other words, smart contracts can be related to *bay' al-*

⁵³ Ahmad Khamal, "Digital Smart Contracts: Legal and Shari'ah Issues."

⁵⁴ Daniel Drummer and Dirk Neumann, "Is Code Law? Current Legal and Technical Adoption Issues and Remedies for Blockchain-Enabled Smart Contracts," *Journal of information technology* 35, no. 4 (2020): 337–60, <https://doi.org/10.1177/0268396220924669>.

⁵⁵ Omar Alaeddin, Mohanad Al Dakash, and Tawfik Azrak, "Implementing the Blockchain Technology in Islamic Financial Industry: Opportunities and Challenges," *Journal of Information Technology Management* 13, no. 3 (2021): 99–115, <https://doi.org/10.22059/jitm.2021.83116>.

⁵⁶ Sānū, "Al-'Uqūd al-Dhakiyya fi Ḍaw' al-'Uṣūl wa al-Maqāṣid wa al-Ma'ālāt Ru'ya Takhliīyya."

⁵⁷ Ahmad Zakirullah Mohamed Shaarani et al, "Smart Contract: Shariah Analysis and Parameter," *UMRAN-Journal of Islamic and Civilizational Studies* 10, no. 2 (2023): 1–14, <https://doi.org/10.11113/umran2023.10n2.638>.

⁵⁸ Wizāra al-Awqāf wa al-Shu'ūn al-Islāmiyya, *Al-Mawsū'a al-Fiqhiyya* (Kuwait: Wizāra al-Awqāf wa al-Shu'ūn al-Islāmiyya, 2000), vol. 43.

⁵⁹ Wahbah Al-Zuhaylī, *Al-Fiqh al-Islāmī wa Adillatuh*, 2nd ed. (Damaskus: Dār al-Fikr al-'Arabī, 1985), vol. 5.

mu'allaq by integrating conditional statements within their codes. Like *mu'allaq*, the completion of a sale in a smart contract is dependent on specific predefined conditions being met. This reflects the adaptability of smart contracts to dynamic scenarios. Similarly, smart contracts align with *bay' al-istijrār* by facilitating automated and recurring transactions. The programmable nature of smart contracts enables the automatic execution of predefined terms at regular intervals, thus streamlining the process of continuous sales.

There are three different views among Sharia scholars regarding the acceptability of smart contracts in IFIs. The first group of scholars prohibits the use of smart contracts in such transactions, not because they are inherently illegitimate, but because they are associated with cryptocurrencies like Bitcoin and Ethereum, which lack recognition from authorities and legal frameworks. Additionally, the concept of smart contracts is still ambiguous, and further research is needed to fully understand it. Therefore, a more detailed study is necessary, as the benefits of using smart contracts may outweigh the drawbacks.⁶⁰

The second group of scholars, based on the 2019 resolution No. 230 (1/24) of the Majma' Fiqh Academy, abstains from expressing an opinion on the permissibility of smart contracts in IFIs.⁶¹ This decision is due to the persistent ambiguity surrounding the concept of smart contracts. Therefore, the resolution calls for discussions with experts specializing in smart contracts and blockchain to achieve a better understanding.

The third group of scholars allows the use of smart contracts in IFIs. This viewpoint is based on several arguments, including the legal maxim: "the basic principle of *mu'āmala* (transaction) is permissibility".⁶² The smart contract is seen as a technological innovation that serves as a mechanism for executing contracts. According to this perspective, the legal maxim emphasizes the permissibility of innovation in transactions as long as it aligns with Sharia principles. This legal maxim not only allows for innovation but also offers flexibility in executing transactions, especially with the use of smart contracts.

⁶⁰ Abū Ghuddah, "Al-ʿuqūd al-Dhakiyya wa al-Bunūk al-Raqmiyya wa al-Bulūkshīn" in *24th Al-Baraka Symposium on Islamic Economics* (Jeddah, 13–14 May 2019).

⁶¹ International Islamic Fiqh Academy, *Smart Contracts: Activation and Reversal Methods* (Study of Smart Contracts and the Extent of Their Relation to Cryptocurrency), International Islamic Fiqh Academy (4–6 November 2021).

⁶² Sumaia Ali, "Smart Contracts and Related Collection Terms," *Shari'ah and Law Sciences* 51, no. 1 (2024): 97–107, <https://doi.org/10.35516/law.v51i1.2833>.

From a Sharia perspective, the enforcement of automated transactions seems acceptable as long as all transaction principles are maintained, including the contracting parties, offer and acceptance, and the subject matter of the contract.⁶³

Additionally, the integration of smart contracts into Islamic finance can be justified through *maqāṣid al-sharī'a* (objectives of Sharia), as blockchain⁶⁴ ensures transparency and security in validating and recording transactions. While transparency is not a core contractual element, it supports the principle of property custody, thereby reinforcing Sharia objectives alongside the contractual pillars.⁶⁵ Table 1 provides a summary of the scholars' views and resolutions on the permissibility of smart contracts.

Table 1.
Resolution and *Fatwā* of Smart Contracts

Resolution/ <i>Fatwā</i>	<i>Fatwā</i> organization/Scholars
<i>Impermissible</i>	• Abū Ghuddah⁶⁶ • Talib⁶⁷
<i>Abstain (tawaqquf)</i>	• International Islamic Fiqh Academy⁶⁸
<i>Permissible</i>	• Amanie⁶⁹ • Qahf⁷⁰ • Sānū⁷¹ • Al-Balushi⁷²

⁶³ Laldin and Furqani, "Fintech and Islamic Finance: Setting the Sharī 'Ah Parameters."

⁶⁴ Aljamos et al., "The Blockchain Technology from Maqasid Shari'ah Perspective."

⁶⁵ Muneeza and Mustapha, "Blockchain and Its Shariah Compliant Structure."

⁶⁶ Ghuddah, "Al-'uqūd al-Dhakiyya wa al-Bunūk al-Raqmiyya wa al-Bulūkshīn."

⁶⁷ Ghassan Saleem At-Talib, "Al-'Umlāt al-Raqmiyya wa 'Alāqatihā bi al-'Uqūd al-Dhakiyya" in *Al-Baraka Symposium on Islamic Economics* (Jeddah, 2019).

⁶⁸ International Islamic Fiqh Academy, *Smart Contracts: Activation and Reversal Methods* (Study of Smart Contracts and the Extent of Their Relation to Cryptocurrency).

⁶⁹ Amanie Advisors, *Shariah White Paper on Ether*, Amanie Advisors (8 December 2025 2019), <https://amanieadvisors.com/v4/wp-content/uploads/2019/08/Shariah-Whitepaper-Ether-v1.0.pdf>.

⁷⁰ Monzer Qahf, "Al-'Uqūd Al-Zakiyyah" in *International Islamic Fiqh Academy Conference*, (United Arab Emirates, 4–6 November 2019).

⁷¹ Sānū, "Al-'Uqūd al-Dhakiyya fi Ḍaw' al-'Uṣūl wa al-Maqāṣid wa al-Ma'ālāt Ru'ya Takhliīyya."

⁷² Aḥmad Khalid Balushi, "Muqaddima 'an al-'Uqūd al-Dhakiyya" in *Al-Baraka Symposium on Islamic Economics* (Jeddah, 2019).

Resolution/ <i>Fatwā</i>	<i>Fatwā</i> organization/Scholars
	• Al-‘Aqeel⁷³ • ‘Ayāshī⁷⁴ • Laldin and Furqani⁷⁵

Based on the above discussion, it is clear that there are three main approaches to the use of smart contracts in the financial system: impermissible, abstaining (*tawaqquf*), and permissible. It is worth noting that the objection from the first group is not about the legality of smart contracts, but rather the risks and uncertainties associated with this new technology, which calls for more thorough research. Although the concept of smart contracts is accepted, the supportive position emphasizes the need for additional research in a variety of settings. This highlights the importance of understanding the complexities and challenges involved in incorporating this technology into financial operations that adhere to Sharia law.

In support of the potential of smart contracts for Islamic finance, number of researchers also raise their concern. Munawar argues that smart contracts hold strong potential for Islamic finance amid fintech growth but require clear Sharia guidelines, safeguards against unethical elements, and adequate disclosure. He emphasizes the need for legal and regulatory frameworks to protect providers, users, and their wealth from fraud.⁷⁶ Similarly, Alam et al. find that smart contracts can be used for various purposes in IFIs as the nature of smart contracts does not allow *gharar* (uncertainty), *ḍarar* (harm), *maysir* (gambling), and other prohibited activities.⁷⁷ The objectives of smart contracts include satisfying contractual matters such as payment terms, confidentiality, and enforcement. Smart contracts also help lower fraud losses, arbitration costs, enforcement costs, and other transaction costs. These advantages are obtained through the use of blockchain technology. Considering these benefits, Alam et al.

⁷³ Abdullah Al-‘Aqeel, "Blockchain Technology and Its Jurisprudential Applications," *Islamic University Journal of Islamic Legal Sciences* 2, no. 94 (2020): 146–200, <https://doi.org/10.36046/2323-054-194-014>.

⁷⁴ Faddad Ayāshī, "Al-‘Uqūd al-Dhakiyya fī Ḍaw’ al-‘Uṣūl wa al-Maqāsid wa al-Ma’ālāt Ru’ya Tahliliyya" in *Proceedings of 24th International Islamic Fiqh Academy Conference* (Dubai, UAE, 2019).

⁷⁵ Laldin and Furqani, "Fintech and Islamic Finance: Setting the Shari‘Ah Parameters."

⁷⁶ Munawar, "The Legality of Smart Contract in the Perspectives of Indonesian Law and Islamic Law."

⁷⁷ Nafis Alam, Lokesh Gupta, and Abdolhossein Zamani, *Fintech and Islamic Finance* (Palgrave Macmillan, 2019).

advise ensuring transparency in asset definitions, pricing, mutual consent, and other Sharia principles of transactions in the use of smart contracts by IFIs.⁷⁸ Moreover, they find that many Islamic fintech experts believe smart contracts can fulfill *maqāṣid al-sharīʿa* in providing Sharia-compliant financial services.⁷⁹

Moreover, Ahmad et al.⁸⁰ find that smart contracts share features with Sharia contracts, particularly in *ijāb* (offer) and *qabūl* (acceptance), but diverge in party autonomy and potential manipulation, raising concerns of *gharar*. While offering transparency and security, they argue that risks of inadequate disclosure and non-compliant products can be mitigated through Sharia-based terms and guidelines, a view supported by Dawood Alboul and Yousef⁸¹, who stress the role of authorities and Sharia advisors.

According to the researchers, the use of smart contracts in Islamic financial products and services can be justified for several reasons. The potential of smart contracts for enhancing products and services is undeniable, and neglecting this tool may result in less convenience for consumers and users of Islamic financial services. Furthermore, the consent (*tarāḍī*) of the contracting parties is obtained during the transaction, which validates a contract as Sharia-compliant, provided that the subject matter and the transaction do not involve *ribāʿ* (interest), *gharar*, *maysir*, or any unethical activities. In this regard, the Holy al-Qurʿan instructs believers (4:29). Additionally, non-Sharia compliant activities can be avoided by imposing strict guidelines, terms, and conditions within the smart contract system. Consequently, smart contracts can enable various Sharia-compliant products and services, potentially boosting Islamic financial services worldwide.

Based on the above discussion, the authors adopt the view that smart contracts are permissible for use in Islamic financial operations. Smart contract meets the primary rule in Sharia which is the permissibility of something until it is proven prohibited. It is also supported by the *maqāṣid al-sharīʿa* of ensuring transparency, safeguarding wealth, and promoting operational efficiency.

⁷⁸ Alam, Gupta, and Zameni, *Fintech and Islamic Finance*.

⁷⁹ Laldin and Furqani, "Fintech and Islamic Finance: Setting the Sharīʿah Parameters."

⁸⁰ Ahmad, Zain, and Zakaria, "The Position of Smart Contracts in the Light of Islamic Contract Theory."

⁸¹ Saba Mohammed Mostafa–Dawood Alboul and Hayel Abd-al-Hafeez Yousef, "Smart Contracts Used in the Blockchain: A Juristic Study," *Dirasat, Shariʿa and Law Sciences* 49, no. 2 (2022): 47–70, <https://doi.org/10.35516/law.v49i2.1510>.

However, the authors emphasize that the permissibility and practice of such tools must be developed and monitored under proper Sharia oversight. The subsequent sections will highlight various aspects of smart contracts that IFIs can consider to understand the internal functions of smart contracts and the possibilities of adopting them into the Islamic financial system (IFS).

Application of Smart Contract in IFS

Within the scope of IFS, smart contract technology presents an opportunity to facilitate Sharia contract transactions.⁸² One of the innovative concepts is the application of *tawarruq* (monetization) based product through smart contracts that involve the enforcement and governance of *tawarruq* requirements via smart contract code as well as verification and recorded transactions through the blockchain platform. Figure 4 illustrates how *tawarruq* contract is used in blockchain-based smart contract system to facilitate a financing product. The illustrated model is based on prior research and the current practices of blockchain and smart contract providers across various products and services.

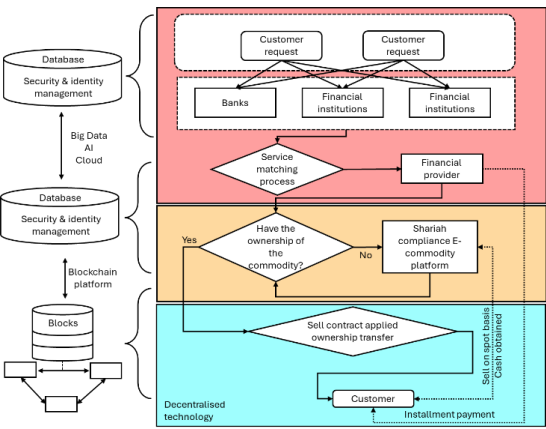


Figure 4.
Application of *Tawarruq* in Blockchain-Based Smart Contract⁸³

⁸² Mustafa Raza Rabbani et al, "Smart Contract-Based Islamic Fintech Model for Mudaraba Financing," *International Journal of Business Innovation and Research* 36, no. 2 (2025): 248–62, <https://doi.org/10.1504/IJBIR.2025.144391>; Susi Nurkholidah et al, "Implementation of Smart Contracts in Sharia Finance: Maslahah Mursalah's Perspective," *Journal of Mujaddid Nusantara* 1, no. 4 (2024): 211–21, <https://doi.org/10.62568/jomn.v1i4.198>; Aditya Jayeshkumar Bhatt and Kesha Sisodia, "Use of Blockchain in Islamic Finance," in *Leveraging Blockchain Technology* (Boca Raton: CRC Press, 2024), 184–95.

⁸³ Roslan et al, "Application of *Tawarruq* in Islamic Banking in Malaysia: Towards Smart *Tawarruq*."

Figure 4 shows how the *tawarruq* process works using blockchain-based smart contracts to manage financing. It illustrates the flow of activities, from the initial agreement to the completion of the transaction, all executed and recorded on the blockchain for transparency and efficiency.

The first stage involves the matching and agreement phase, where the client submits an application, undergoes risk assessment, and reaches a contract agreement with the financial provider. Technologies such as big data, artificial intelligence, and cloud computing facilitate these steps, enabling automation and enhanced decision-making.⁸⁴ Rejeb notes that blockchain allows these processes to occur in a decentralized, trust less environment.⁸⁵

In the second stage, the commodity is sold to the customer. The agreed terms are embedded in a smart contract and deployed on the blockchain. If the financial provider owns the commodity, the smart contract executes the sale. Otherwise, it triggers a purchase from a Sharia-compliant commodity platform. This ensures ownership transfer complies with Sharia before resale, with all actions enforced automatically and immutably recorded on the blockchain.

The third stage involves the customer selling the commodity to a third party to obtain cash. This sale, facilitated by the smart contract, is followed by automatic instalment payments to the financial provider according to the agreed schedule. The entire process is autonomous, ensuring compliance, accuracy, and reduced operational risk.

All transactions will be recorded on the blockchain, starting from the deployment of the agreement on the blockchain until the transaction is fully completed. The integration of smart contracts can enhance the operation of *tawarruq*-based financing products, including increasing the operation's transparency and managing the risks of error that usually happen in IFIs due to human intervention.⁸⁶ However, to ensure compliance with Sharia, the practice

⁸⁴ Natarajan Deepa et al., "A Survey on Blockchain for Big Data: Approaches, Opportunities, and Future Directions," *Future Generation Computer Systems* 131 (2022): 209–26, <https://doi.org/10.1016/j.future.2022.01.017>; Mohd Javaid et al., "Blockchain Technology Applications for Industry 4.0: A Literature-Based Review," *Blockchain: Research and Applications* 2, no. 4 (2021): 1–11, <https://doi.org/10.1016/j.bcr.2021.100027>.

⁸⁵ Dhiaeddine Rejeb, "Smart Contract's Contributions to Mudaraba," *Tazkia Islamic Finance and Business Review* 15, no. 1 (2021): 1–40, <https://doi.org/10.30993/tifbr.v15i1.236>.

⁸⁶ Roslan et al., "Application of Tawarruq in Islamic Banking in Malaysia: Towards Smart Tawarruq"; Muneeza and Mustapha, "Blockchain and Its Shariah Compliant Structure."

of *tawarruq*-based financing through smart contract technology needs to consider several aspects from the practical and Sharia perspective.

Researchers propose a viable model for adapting smart contracts in Islamic finance, supported by global implementations such as Blossom Finance's smart sukuk in Indonesia,⁸⁷ Wethaq's Corda-based sukuk in Saudi Arabia, and Astana International Financial Centre (AIFC) smart contract sukuk in Kazakhstan.⁸⁸ A pilot *murābaḥa* sukuk prototype on Ethereum further demonstrates the practical feasibility of blockchain-based applications.⁸⁹ In addition, Al Hilal Bank successfully executed a USD 500 million sukuk *murābaḥa* in the UAE using a smart contract to automate secondary market trading, resulting in faster settlement, greater transparency, and improved operational efficiency.⁹⁰ This real-world implementation thus offers empirical support for the feasibility of deploying smart contracts in Sharia-based contracts, including *tawarruq*, which constitutes a core structure across Islamic finance products such as financing and sukuk.

Next section discusses some challenges and difficulties in adopting smart contract within IFS and what require attention of practitioners and Sharia experts to consider in introducing a Sharia compliant product through smart contract.

Difficulties in the Implementation of Smart Contracts in IFS

Contract' Terms and Conditions

In order to process transactions through a smart contract, it is essential to obtain consent for the terms and conditions of the contract. This must be done before the contract is encoded and launched on the blockchain platform. Given the automated nature of smart contracts, which eliminates the need for human

⁸⁷ Khan et al., "Towards Interoperable Blockchains: A Survey on the Role of Smart Contracts in Blockchain Interoperability."

⁸⁸ Nida Khan et al., "Tokenization of Sukuk: Ethereum Case Study," *Global Finance Journal* 51 (2022): 1–16, <https://doi.org/10.1016/j.gfj.2020.100539>.

⁸⁹ Khan et al., "Tokenization of Sukuk: Ethereum Case Study."; Andrea Delle Foglie et al., "The Impact of the Blockchain Technology on the Global Sukuk Industry: Smart Contracts and Asset Tokenisation," *Technology Analysis & Strategic Management* 37, no. 4 (2025): 417–31, <https://doi.org/10.1080/09537325.2021.1939000>.

⁹⁰ Delle Foglie et al., "The Impact of the Blockchain Technology on the Global Sukuk Industry: Smart Contracts and Asset Tokenisation."

intervention to enforce the contract, securing this consent upfront ensures that the contract operates in accordance with the agreed terms once it is executed.⁹¹ Therefore, prior to engaging in any transactions, both parties involved in the contract must actively participate in a negotiation process to formulate the terms of the contract. This process involves specifying the conditions, responsibilities, and rights within the contract.

The explicit and clear agreement of all parties involved in a contract is not only important from a legal perspective, but it also holds significant value in terms of Sharia principles. This agreement represents the full acknowledgement and acceptance of the contract's terms and conditions. It goes beyond being a mere formality, as it demonstrates the willingness of all parties involved to fulfil the contract. This willingness is emphasized in the Holy al-Qur'an (4: 29), which states: "O you who believe! Eat not up your property among yourselves unjustly except it be a trade among you, by mutual consent". The verse (29) explicitly highlights the importance of consent in contractual agreements.⁹² This creates a foundation of trust and certainty in transaction execution. It is also important that the consent to the contract's terms adheres to Sharia principles, such as clarity, correctness, and fairness in the contract conditions, in order to align with the *maqāṣid al-sharī'a*

In order for *tawarruq*-based financing product to be executed using smart contracts, a comprehensive and legally enforceable contract must be agreed upon and in place. Abū Ghuddah suggests that a master agreement can be used to approve a contract and execute transactions using smart contracts.⁹³ This is a contract that includes the agreement of the parties involved for future transactions. For instance, in *tawarruq*-based financing products, which involve a series of transactions with various parties, the consent of all contracting parties must be obtained and verified in accordance with Sharia law.⁹⁴ It is essential that contracting parties fully understand what they are contracting for

⁹¹ Ahmad Khamal, "Digital Smart Contracts: Legal and Shari'ah Issues."; Mohd. Zain and Mohamad, "An Evaluation of Smart Contracts: Practices, Legality, and Shari'ah."

⁹² Ahmad Khamal, "Digital Smart Contracts: Legal and Shari'ah Issues."

⁹³ Ghuddah, "Al-'uqūd Al-Zakiyyah Wa Al-Bunūk Al-Raqamiyyah Wa Al-Bulūkshīn."

⁹⁴ Habib, "Smart Contracts for Islamic Financial Transaction."

before the execution of the contract, as emphasized by Azam⁹⁵ and Abū Ghudah.⁹⁶

Smart Contract's Term Coding

The process of coding the *tawarruq*-based financing product into smart contract is carried out after the contract is finalized. This process involves extensive research and implementation to ensure that the enforcement of the contract aligns with Sharia and the contract's objectives. According to Nguyen et al.⁹⁷ and Duran and Griffin,⁹⁸ the absence of a well-established operational mechanism in the process of coding and forming smart contracts poses risks of errors, exploitation, and code tampering. Therefore, from a Sharia perspective, several considerations need to be taken into account. Firstly, validation needs to be acquired from experts in technology, law,⁹⁹ and Sharia.¹⁰⁰ This ensures that the generated codes comply with technological principles, Sharia values, and are legally valid. In *tawarruq*-based financing products, smart contract developers need to ensure that the code they create can achieve the intended transaction goals within blockchain ecosystems. To help with this, platforms provide "testnets," which are testing environments where developers can check if their

⁹⁵ Ahmad Khamal, "Digital Smart Contracts: Legal and Shari'ah Issues."

⁹⁶ Ghuddah, "Al-'uqūd Al-Zakiyyah Wa Al-Bunūk Al-Raqamiyyah Wa Al-Bulūkshīn."

⁹⁷ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

⁹⁸ Randall E Duran and Paul Griffin, "Smart Contracts: Will Fintech Be the Catalyst for the Next Global Financial Crisis?," *Journal of Financial Regulation and Compliance* 29, no. 1 (2021): 104–22, <https://doi.org/10.1108/JFRC-09-2018-0122>.

⁹⁹ Alaeddin, Al Dakash, and Azrak, "Implementing the Blockchain Technology in Islamic Financial Industry: Opportunities and Challenges."; Eliza Mik, "Smart Contracts: Terminology, Technical Limitations and Real World Complexity," *Law, innovation and technology* 9, no. 2 (2017): 269–300, <https://doi.org/10.1080/17579961.2017.1378468>.

¹⁰⁰ Amanie Advisors, *Shariah White Paper on Ether*; Sarwar Sayeed, Hector Marco-Gisbert, and Tom Caira, "Smart Contract: Attacks and Protections," *Ieee Access* 8 (2020): 24416–27, <https://doi.org/10.1109/ACCESS.2020.2970495>; Sayeed, Marco-Gisbert, and Caira, "Smart Contract: Attacks and Protections."; Adnan Imeri, Nazim Agoulmine, and Djamel Khadraoui, "Smart Contract Modeling and Verification Techniques: A Survey" in *Conference paper, 8th International Workshop on ADVANCES in ICT Infrastructures and Services (ADVANCE 2020)* (Cancun, Mexico, 27–29 January 2020); Lodovica Marchesi et al., "Security Checklists for Ethereum Smart Contract Development: Patterns and Best Practices," *arXiv preprint arXiv:2008.04761* (2020): 1–13, <https://doi.org/10.48550/arXiv.2008.04761>, arXiv:2008.04761; Feng et al., "Smart Contract Model for Complex Reality Transaction."; Zheng et al., "An Overview on Smart Contracts: Challenges, Advances and Platforms."; Nor Razinah Binti Mohd Zain et al., "Smart Contract in Blockchain: An Exploration of Legal Framework in Malaysia," *Intellectual Discourse* 27, no. 2 (2019): 595–617, <https://doi.org/10.31436/id.v27i2.1435>.

code works as expected. Once the code is successfully tested on the testnet, it is then deployed to the actual blockchain network, called the “mainnet”.¹⁰¹

Developers must address vulnerabilities in smart contracts, such as reentrancy attacks and malicious minting, which can enable exploitation and unauthorized access to funds. The 2016 DAO case illustrates this risk, where a reentrancy flaw allowed repeated withdrawals before balances were updated. This underscores the need for secure coding practices, particularly updating state variables prior to external calls.¹⁰²

Therefore, it is crucial for developers to implement comprehensive testing and auditing practices to detect and fix vulnerabilities in the code before deployment. From a Sharia law perspective, transactions that involve deceit, uncertainty, or risk (*gharar*) are generally not permissible. Although the context is different, the principles of fairness, transparency, and mutual consent apply. Faulty smart contracts that can be tampered with or manipulated can cause uncertainty and risk in the transaction and are prohibited by Sharia principles.¹⁰³

When coding smart contracts, developers must anticipate potential changes to transaction terms, despite the immutability of blockchain once contracts are deployed.¹⁰⁴ While immutability enhances security, Shaarani et al. argue it conflicts with Islamic principles of tolerance (*tasāmuḥ*) and kindness (*iḥsān*), limiting the empathetic flexibility of IFIs toward clients.¹⁰⁵ Since products like *tawarruq* financing often allow amendments such as rebates or rescheduling, alternative mechanisms are required to accommodate such adjustments within smart contracts.¹⁰⁶

To mitigate the immutability of the system, developers can adopt the “upgradable proxy contract” approach to create smart contracts, allowing future

¹⁰¹ Wackerow, "Networks," Ethereum, 2025, accessed 2nd February, 2025, <https://ethereum.org/en/developers/docs/networks/>.

¹⁰² Chen et al., "Defining Smart Contract Defects on Ethereum."

¹⁰³ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."; Duran and Griffin, "Smart Contracts: Will Fintech Be the Catalyst for the Next Global Financial Crisis?."; Habib, "Smart Contracts for Islamic Financial Transaction."

¹⁰⁴ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

¹⁰⁵ Shaarani et al., "Smart Contract: Shariah Analysis and Parameter."

¹⁰⁶ Abdul Muneem et al., "Debt-Based Financing: A Case Study of Malaysian Islamic Banks," *Global Business and Economics Review* 30, no. 1 (2024): 39–55, <https://doi.org/10.1504/GBER.2024.135289>.

updates to the contract code if needed. According to Marchesi et al., an upgradable proxy contract involves creating new code while leaving the original code unchanged.¹⁰⁷ This approach offers flexibility to upgrade and customize the contract without directly modifying the original, maintaining the principles of immutability and integrity. By using this method, developers can better align with the Islamic principles of *tasāmuḥ* and *iḥsān*, addressing the needs of clients, users, or other stakeholders. However, careful consideration of Sharia compliance and technical operations is essential before implementing this approach.

Direct Implementation

In the context of Sharia, it is crucial to address the complexities of transactions that might arise. Similarly, the complexities of transactions in smart contracts also need to be clarified. For instance, the validity of transactions like *bay' al-mu'allaq*, *bay' al-istijrār*, and *tawarruq* is easier to establish in direct transactions, however, complex transactions require careful analysis before a decision can be made.¹⁰⁸ Additionally, Nazir raises concerns about smart contracts that use artificial intelligence in transactions with multiple factors, such as buying and selling stocks.¹⁰⁹ In such a case, it is important to determine whether decisions made by artificial intelligence and executed by smart contracts are valid contracts from the Sharia perspective. Furthermore, the question whether artificial intelligence is competent (*ahliyya al-adā'*) to carry out transactions is also significant. This situation presents legal and Sharia challenges that differ from those of traditional contracts and require further examination from technological, legal, and Sharia perspectives.

Transaction Outside the Blockchain Platform

Smart contract is a digital alternative to execute transactions on a blockchain network. However, according to Safina and Oseni and Nguyen et al., there are some important considerations when transactions carried out through smart contracts involve activities outside the blockchain network or include physical

¹⁰⁷ Marchesi et al., "Security Checklists for Ethereum Smart Contract Development: Patterns and Best Practices."

¹⁰⁸ Shaarani et al., "Smart Contract: Shariah Analysis and Parameter."

¹⁰⁹ Miyan Nazir, "Smart Contracts Islamic Jurisprudence Standpoint" (Conference paper, Al-Baraka Symposium on Islamic Economics, Jeddah, 2019).

commodities.¹¹⁰ This is due to the differences in coding languages. Based on their findings, the blockchain has limitations in identifying transactions outside its network. Therefore, Zain et al. suggests that smart contracts involving assets from both Sharia and legal perspectives should be thoroughly examined.¹¹¹ Particularly in *tawarruq*-based products, the underlying contract requires commodities located outside the blockchain network, such as crude palm oil (CPO) and airtime products.¹¹² To solve this issue, Pasdar et al. recommends implementing a mechanism that allows input into the blockchain for transactions occurring outside the network.¹¹³ This can be done using suitable Application Programming Interfaces (APIs). It aligns with technological operations and emphasizes the need for seamless integration in compliance with both Sharia and legal frameworks.

For instance, combining on-chain and off-chain data storage in blockchain systems can improve supply chain transparency and integrity. Cao et al. proposed a unified data governance framework that aligns stakeholders through both on-chain and off-chain governance mechanisms.¹¹⁴ In their proof-of-concept, they use multisignature¹¹⁵ (or also known as multisig) smart contracts on the STN Blockchain to enforce on-chain rules and the Polygon/Matic network for managing off-chain rules.¹¹⁶ This approach enables the secure

¹¹⁰ Leisan Safina and Umar A Oseni, "The Potentials of Smart Contract in Islamic Trade Finance," in *Fintech in Islamic Finance*, ed. Oseni, U. S. and Ali, S. N. (Routledge, 2019); Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."

¹¹¹ Zain et al., "Smart Contract in Blockchain: An Exploration of Legal Framework in Malaysia."

¹¹² Mohd Izuwan Mahyudin and Azizi Che Seman, "The Application of Bay'al-Tawarruq in Islamic Banking Institutions in Malaysia: A Study of Bank Muamalat Malaysia Berhad," in *New Developments in Islamic Economics*, ed. Ab Rahman, Asmak (Emerald Publishing Limited, 2018), 169–79; Muhammad Izzul Syahmi, Mohammad Taqiuddin Mohamad, and Mohd Anuar Ramli, "Experts' Views on Hiyal in Malaysian Islamic Banks: The Case of Tawarruq-Based Deposit Products," *ISRA International Journal of Islamic Finance* 14, no. 3 (2022): 289–302, <https://doi.org/10.1108/IJIF-02-2021-0042>.

¹¹³ Amirmohammad Pasdar, Young Choon Lee, and Zhongli Dong, "Connect Api with Blockchain: A Survey on Blockchain Oracle Implementation," *ACM Computing Surveys* 55, no. 10 (2023): 1–39, <https://doi.org/10.1145/3567582>.

¹¹⁴ Shoufeng Cao et al., "Integrating on-Chain and Off-Chain Governance for Supply Chain Transparency and Integrity," *arXiv preprint arXiv:2111.08455* (2021), <https://doi.org/10.48550/arXiv.2111.08455>.

¹¹⁵ Hazik Mohamed and Hassnain Ali, *Blockchain, Fintech, and Islamic Finance: Building the Future in the New Islamic Digital Economy*, Blockchain, Fintech, and Islamic Finance, (Berlin: Walter de Gruyter GmbH & Co KG, 2022).

¹¹⁶ Cao et al., "Integrating on-Chain and Off-Chain Governance for Supply Chain Transparency and Integrity."

inclusion of off-chain data, such as information about commodities in *tawarruq*-based contracts, into the blockchain. It ensures Sharia compliance while enhancing the system's reliability and trustworthiness.

It has been suggested that physical assets can be converted into tokens to enable the blockchain to identify them.¹¹⁷ However, there are regulatory aspects to consider when generating these tokens to ensure they align with the quantity of existing commodities. Moreover, the value of these physical commodities requires careful monitoring due to issues related to the quality of goods being sold.¹¹⁸

The Protocol Consensus

Smart contracts are implemented through blockchain technology, making it the most suitable platform for their execution to date.¹¹⁹ Blockchain comprises three essential components: transactions, transaction records, and a system for verifying and authorizing transactions.¹²⁰ For the verification element, blockchain involves a group of transaction validators, referred to as the consensus protocol process, which confirms the legitimacy of the transactions.¹²¹ This is a unique feature of blockchain technology, which operates as a decentralized system capable of validating and storing data without the need for centralized authorities. Participants can access data stored in the blockchain network in real-time, which enhances transparency. Furthermore, the consensus protocol feature improves the security of data storage, as the information stored in the blockchain network is immutable and almost impossible to modify or erase by

¹¹⁷ Roslan et al., "Application of Tawarruq in Islamic Banking in Malaysia: Towards Smart Tawarruq."

¹¹⁸ Amanie Advisors, *Shariah White Paper on Ether*; Zheng et al., "An Overview on Smart Contracts: Challenges, Advances and Platforms."; Maximilian Wohrer and Uwe Zdun, "Design Patterns for Smart Contracts in the Ethereum Ecosystem" in *IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData)* (Nova Scotia, Canada, 30 July 2018); Marchesi et al., "Security Checklists for Ethereum Smart Contract Development: Patterns and Best Practices."

¹¹⁹ Antova and Tayachi, "Blockchain and Smart Contracts: A Risk Management Tool for Islamic Finance."

¹²⁰ Rabbani et al., "Smart Contract-Based Islamic Fintech Model for Mudaraba Financing."

¹²¹ Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping." Daniel Macrinici, Cristian Cartoceanu, and Shang Gao, "Smart Contract Applications within Blockchain Technology: A Systematic Mapping Study," *Telematics and informatics* 35, no. 8 (2018): 2337–54, <https://doi.org/10.1016/j.tele.2018.10.004>.

any party.¹²² Technology developers are continuously designing new consensus protocol methods,¹²³ but these different methods share a common goal: ensuring that the transactions within the blockchain network are verified and accurately recorded.

From a Sharia perspective, this aspect corresponds to the Sharia objectives of preserving wealth (*hifz al-māl*).¹²⁴ The blockchain ecosystem allows consensus protocols to be executed by pseudonymous members. Considering the concerns raised by Ahmad et al.¹²⁵ regarding pseudonymous participants in blockchain networks, this research posits that if contracts are executed based on predetermined terms and clearly identified contracting parties, then the transactions are not pseudonymous and comply with Sharia principles. The blockchain committee, which runs the consensus protocol, can remain pseudonymous as they are not involved in the transactions themselves. Their role is limited to validating data according to the protocol, ensuring that the blockchain's objectives are well achieved.

However, Sharia concerns in this process revolve around the activities of transaction verifiers who verify transactions within the blockchain. Sharia scholars suggest that this aspect is technical and requires scholars to be well-versed in the technological operations to determine its Sharia compliance status. Amanie Advisers¹²⁶ issued Sharia resolutions for the proof-of-work and proof-of-stake consensus protocols. According to them, proof-of-work is aligned with the concept of success based on the amount of work done. In contrast, proof-of-stake, while rooted in a slightly different concept from proof-of-work, relies on success derived from the amount of capital invested.

However, based on research, the use of consensus protocol in the blockchain for Sharia-compliant smart contract transactions requires Sharia scrutiny and supervision from two perspectives. Firstly, the algorithmic process of the consensus protocol should not involve non-Sharia compliant activities, such as

¹²² Zhang and Lee, "Analysis of the Main Consensus Protocols of Blockchain."

¹²³ Nor et al., "Blockchain Sadaqa Mechanism for Disaster Aid Crowd Funding."

¹²⁴ Muneeza and Mustapha, "Blockchain and Its Shariah Compliant Structure."

¹²⁵ Ahmad, Zain, and Zakaria, "The Position of Smart Contracts in the Light of Islamic Contract Theory."

¹²⁶ Amanie Advisors, *Shariah White Paper on Ether*.

maysir. Secondly, the rewards payment to transaction verifiers and their rights in the consensus protocol must adhere to Sharia principles.¹²⁷

Feasibility and Limitations of the Proposed Solutions

The application of smart contract technology in the IFI ecosystem has great potential. Even the proposed solutions based on the technological perspective, the concept remain largely theoretical, as there are no documented cases of their implementation within the context of IFIs' products. This discrepancy underscores the need for dedicated research, development, and experimentation to determine the viability of these technologies within the unique framework of IFI. The adoption process demands significant effort, particularly in terms of building the necessary infrastructure, allocating substantial financial resources, and acquiring technical expertise. IFIs must invest in training programs to enhance the technological literacy of their workforce and ensure they can navigate the complexities of blockchain technology and smart contract operations.

Despite the proposed solutions, the technological challenges that have been discussed in the previous sections need to be well-managed as it may impede their widespread adoption in IFIs, including technology errors, system complexity, and changes,¹²⁸ scalability issue,¹²⁹ security risks,¹³⁰ cyber threats issue,¹³¹ and the costs related to develop and manage the smart contract and blockchain infrastructure within IFI ecosystem.¹³²

¹²⁷ Ali, "Smart Contracts and Related Collection Terms."; Tasneem Darwish et al, "Comparative Analysis of Blockchain Consensus Algorithms from Shariah Perspective," *Journal of Contemporary Islamic Studies* 6, no. 1 (2020): 1–21, <https://ir.uitm.edu.my/id/eprint/42962/1/42962.pdf>; Ghuddah, "Al-ʿuqūd al-Dhakiyya wa al-Bunūk al-Raqmiyya wa al-Bulūkshīn."

¹²⁸ Richards, "Disruptive Innovations: Blockchain and Spinoffs."; Nguyen, Chen, and Du, "Risk Identification and Modeling for Blockchain-Enabled Container Shipping."; Osmani et al, "Blockchain for Next Generation Services in Banking and Finance: Cost, Benefit, Risk and Opportunity Analysis."

¹²⁹ Wanyi Chen, Kang He, and Lanfang Wang, "Blockchain Technology, Macroeconomic Uncertainty and Investment Efficiency," *International Journal of Emerging Markets* 18, no. 7 (2021): 1493–514, <https://doi.org/10.1108/IJOEM-10-2020-1250>.

¹³⁰ Khan et al., "Towards Interoperable Blockchains: A Survey on the Role of Smart Contracts in Blockchain Interoperability."

¹³¹ Fadele Ayotunde Alaba et al., "Smart Contracts Security Application and Challenges: A Review," *Cloud Computing and Data Science* 5, no. 1 (2024): 15–41, <https://doi.org/10.37256/ccds.5120243271>.

¹³² Chen et al., "Defining Smart Contract Defects on Ethereum."

The regulatory landscape for blockchain and smart contract technologies presents another significant limitation. A major challenge is the lack of universally accepted standards for these technologies.¹³³ Belchior et al. note that jurisdictional differences across countries can complicate the enforceability of smart contracts, particularly in the context of cross-border transactions.¹³⁴ Additionally, regulatory bodies in many jurisdictions have yet to fully embrace or define the legal status of blockchain and smart contracts, further adding to the uncertainty surrounding their adoption. In IFI, this challenge is compounded by the need to align these technologies with Sharia principles, requiring a dual focus on both regulatory and Sharia compliance.¹³⁵

Potential Economic and Societal Benefits of Smart Contracts in IFIs

Smart contracts mark a significant advancement in digital transactions, offering efficiency, security, reliability, cost savings, and faster execution compared to traditional contracts. Hosted on public blockchains, they enhance transparency by allowing all parties to access and verify terms, reducing disputes and eliminating the need for third-party trust. Their encryption and decentralized structure ensure tamper-resistance, while automated “if/then” logic enables precise, error-free execution of actions such as payments. By removing intermediaries and paperwork, smart contracts streamline processes, save resources, and enhance both productivity and customer experience, while also supporting sustainability through reduced reliance on paper and travel.¹³⁶ Figure 5 illustrates number of benefits of smart contracts.

¹³³ Zain et al., "Smart Contract in Blockchain: An Exploration of Legal Framework in Malaysia."

¹³⁴ Belchior et al., "A Survey on Blockchain Interoperability: Past, Present, and Future Trends."

¹³⁵ Mohd. Zain and Mohamad, "An Evaluation of Smart Contracts: Practices, Legality, and Shari‘Ah."

¹³⁶ Yue Su, Poh-Chuin Teo, and Haliyana Khalid, "An Analytical Study of Blockchain Technology on Consumers' Perceived Value and Loyalty Response in Retail Industry under Sor Theory," *Environment and Social Psychology* 9, no. 11 (2024): 1–15, <https://doi.org/10.59429/esp.v9i11.3158>; Silas Mutie Nzuva, "Smart Contracts Implementation, Applications, Benefits, and Limitations," *Journal of Information Engineering and Applications* 9, no. 5 (2019): 63–75, <https://doi.org/10.7176/JIEA/9-5-07>; Muneeza and Mustapha, "Blockchain and Its Shariah Compliant Structure."

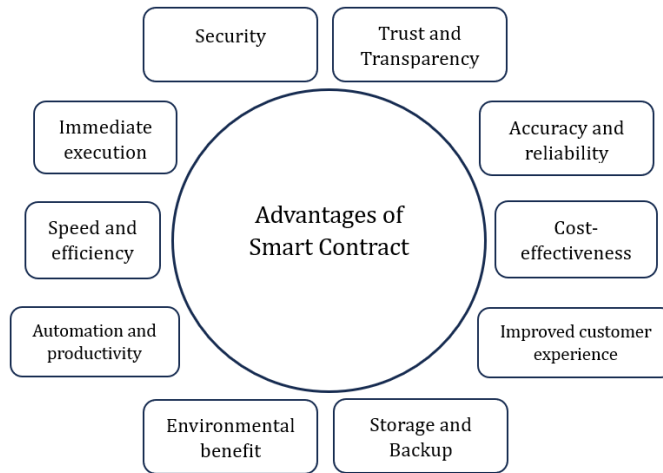


Figure 5.
The Advantages of Smart Contracts

Scholars consistently highlight the pivotal role of blockchain-based smart contracts in enabling various services and products within IFIs, ultimately contributing to economic growth and delivering significant advantages to the broader community. The use of smart contract will enhance transparency, efficiency and security of operations while reducing the potential risk of Sharia non-compliance for various sectors, such as Islamic banking system, *takāful*, endowments (*waqf*), *zakāt*, and *halāl* markets.¹³⁷

Scholars increasingly advocate integrating smart contracts into Islamic finance, viewing them as efficient and Sharia-compliant tools that minimize operational errors. For instance, in *tawarruq*, smart contracts can enforce the correct sequence of transactions by withholding funds until the commodity sale is completed.¹³⁸ Mohamed and Ali stress that adopting such technologies is vital

¹³⁷ Alaeddin, Al Dakash, and Azrak, "Implementing the Blockchain Technology in Islamic Financial Industry: Opportunities and Challenges."; Muneeza and Mustapha, "Blockchain and Its Shariah Compliant Structure." Mohammad Abdeen et al, "Employing Takaful Islamic Banking through State of the Art Blockchain: A Case Study," *International Journal of Advanced Computer Science and Applications* 10, no. 12 (2019): 648–54, <https://doi.org/10.14569/IJACSA.2019.0101283>.

¹³⁸ Mohammad Mahbubi Ali and Rusni Hassan, "Survey on Sharī'ah Non-Compliant Events in Islamic Banks in the Practice of Tawarruq Financing in Malaysia," *ISRA International Journal of Islamic Finance* 12, no. 2 (2020): 151–69, <https://doi.org/10.1108/IJIF-07-2018-0075>. Roslan et al, "Application of Tawarruq in Islamic Banking in Malaysia: Towards Smart Tawarruq."

for IFIs to remain competitive,¹³⁹ while Zulkepli et al. highlight their role in enhancing Sharia compliance and customer trust by avoiding *ribā'* and *gharar*.¹⁴⁰ In the context of Islamic social finance, Saleh et al.¹⁴¹ and Megat et al.¹⁴² identify blockchain-based smart contracts as transformative for *waqf*, improving efficiency, transparency, and community contributions. Similarly, Kunhibava et al.¹⁴³ argue that blockchain adoption is inevitable and well aligned with Islamic social finance, with the potential to drive significant sectoral growth. Collectively, the literature suggests that adopting smart contracts in Islamic finance is both unavoidable and essential for economic advancement and societal benefit.

Conclusion

This study finds that smart contract technology holds great potential for improving efficiency and transparency in IFIs and is generally Sharia-compliant when proper oversight and guidelines are in place, grounded in legal maxim “the basic principle of *mu‘āmalāt* is permissibility”, reinforced by the protection of wealth as according to *maqāṣid al-sharī‘a*. However, several operational and Sharia-related challenges, such as contract coding, transaction execution, and consensus protocols require thorough scrutiny and structured governance. The research highlights the importance of involving Sharia scholars and technical experts to ensure compliance and functionality.

This study offers practical implications for regulators, Sharia boards, and fintech developers in shaping future frameworks. Moving forward, empirical studies, particularly case-based and interview-driven research, are

¹³⁹ Mohamed and Ali, *Blockchain, Fintech, and Islamic Finance: Building the Future in the New Islamic Digital Economy*.

¹⁴⁰ Muhammad Izzul Syahmi Zulkepli, Mohammad Taquiuddin Mohamad, and Saaidal Razalli Azzuhri, "Leveraging Blockchain-Based Smart Contract in Islamic Financial Institutions: Issue and Relevant Solution," *International Journal of Islamic Economics and Finance Research* 6, no. 1 (2023): 18–28, <https://doi.org/10.53840/ijiefer96>.

¹⁴¹ Abdulmajid Obaid Hasan Saleh, Deden Misbahudin Muayyad, and Al-Shaghdari Fahd, "The Potential of Using Smart Contracts in Cash Waqf on Blockchain," *al-Qanatir: International Journal of Islamic Studies* 32, no. 2 (2023): 50–59, <https://al-qanatir.com/aq/article/view/741>.

¹⁴² Puteri Aina Megat et al., "Assessing the Predictive Benefits of Waqftech Smart Contracts on Corporate Waqf Crowdfunding among Malaysian Enterprises," *Journal of Islamic marketing* 15, no. 5 (2024): 1303–25, <https://doi.org/10.1108/JIMA-08-2023-0262>.

¹⁴³ Sherin Kunhibava et al., "Blockchain Use Case in Islamic Social Finance," *ISRA International Journal of Islamic Finance* 16, no. 1 (2024): 93–110, <https://doi.org/10.55188/ijifv16i1.659>.

recommended to develop standardized, Sharia-aligned smart contract applications tailored for Islamic finance.[a]

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Author Contribution Statement

Muhammad Izzul Syahmi Zulkepli: Conceptualization; Data Curation; Formal Analysis; Investigation; Methodology; Project Administration; Resources; Validation; Visualization; Writing Original Draft; Writing, Review & Editing.

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Mohd Shahid Mohd Noh: Data Curation; Methodology; Resources; Validation.

Mohammad Taqiuddin Mohamad: Data Curation; Methodology; Resources; Supervision; Validation.

Saaidal Razalli Azzuhri: Resources; Supervision; Validation; Visualisation.

BIBLIOGRAPHY

- Abdeen, Mohammad, Jan Salman, Sohail Khan, and Toqeer Ali. "Employing Takaful Islamic Banking through State of the Art Blockchain: A Case Study." *International Journal of Advanced Computer Science and Applications* 10, no. 12 (2019): 648–54. <https://doi.org/10.14569/IJACSA.2019.0101283>.
- Ahmad, Azlin Alisa, Mat Noor Mat Zain, and Nur Diyana Amanina Zakaria. "The Position of Smart Contracts in the Light of Islamic Contract Theory." *Samarah: Jurnal Hukum Keluarga dan Hukum Islam* 8, no. 1 (2024): 144–71. <https://doi.org/10.22373/sjhk.v8i1.16372>.
- Ahmad Khamal, Ainul Azam. "Digital Smart Contracts: Legal and Shari'ah Issues." In *Islamic Fintech: Insights and Solutions*, edited by M. M. Billah, 111–24. Cham: Palgrave Macmillan, 2021.

- Al-'Aqeel, Abdullah. "Blockchain Technology and Its Jurisprudential Applications." *Islamic University Journal of Islamic Legal Sciences* 2, no. 94 (2020): 146–200. <https://doi.org/10.36046/2323-054-194-014>.
- Alaba, Fadele Ayotunde, Hakeem Adewale Sulaimon, Madu Ifeyinwa Marisa, and Owamoyo Najeem. "Smart Contracts Security Application and Challenges: A Review." *Cloud Computing and Data Science* 5, no. 1 (2024): 15–41. <https://doi.org/10.37256/ccds.5120243271>.
- Alaeddin, Omar, Mohanad Al Dakash, and Tawfik Azrak. "Implementing the Blockchain Technology in Islamic Financial Industry: Opportunities and Challenges." *Journal of Information Technology Management* 13, no. 3 (2021): 99–115. <https://doi.org/10.22059/jitm.2021.83116>.
- Alam, Nafis, Lokesh Gupta, and Abdolhossein Zameni. *Fintech and Islamic Finance*. Palgrave Macmillan, 2019.
- Alam, Shahbaz, and Hina Noor. "Mined and Non-Mined Crypto Currencies: A Critical Analysis from Shariah Perspective." *International Journal of Innovative Science and Research Technology* 5, no. 3 (2020): 429–37. <https://ijisrt.com/assets/upload/files/IJISRT20MAR236.pdf>.
- Alboul, Saba Mohammed Mostafa–Dawood, and Hayel Abd-al-Hafeez Yousef. "Smart Contracts Used in the Blockchain: A Juristic Study." *Dirasat, Shari'a and Law Sciences* 49, no. 2 (2022): 47–70. <https://doi.org/10.35516/law.v49i2.1510>.
- Ali, Mohammad Mahbubi, and Rusni Hassan. "Survey on Sharī'ah Non-Compliant Events in Islamic Banks in the Practice of Tawarruq Financing in Malaysia." *ISRA International Journal of Islamic Finance* 12, no. 2 (2020): 151–69. <https://doi.org/10.1108/IJIF-07-2018-0075>.
- Ali, Sumaia. "Smart Contracts and Related Collection Terms." *Shari'ah and Law Sciences* 51, no. 1 (2024): 97–107. <https://doi.org/10.35516/law.v51i1.2833>.
- Aljamos, Yusof Mahmoud, Azman Mohd Noor, Mohamad Shafiq Mohd Aswadi, and Ahmad Syukran Baharuddin. "The Blockchain Technology from Maqasid Shari'ah Perspective." *Journal of Contemporary Maqasid Studies* 1, no. 2 (2022): 59–82. <https://doi.org/10.52100/jcms.v1i2.54>.
- Amanie Advisors. *Shariah White Paper on Ether*. Amanie Advisors (8 December 2025 2019). <https://amanieadvisors.com/v4/wp-content/uploads/2019/08/Shariah-Whitepaper-Ether-v1.0.pdf>.
- Antova, Ilinka, and Tahar Tayachi. "Blockchain and Smart Contracts: A Risk Management Tool for Islamic Finance." *Journal of Islamic financial studies* 5, no. 1 (2019): 29–42. <https://doi.org/10.12785/jifs/050103>.
- Aspers, Patrik, and Ugo Corte. "What Is Qualitative in Qualitative Research." *Qualitative sociology* 42, no. 2 (2019): 139–60. <https://doi.org/10.1007/s11133-019-9413-7>.

- At-Talib, Ghassan Saleem. "Al-'Umlāt al-Raqmiyya wa 'Alāqatihā bi al-'Uqūd al-Dhakiyya." in *Al-Baraka Symposium on Islamic Economics*. Jeddah, 2019.
- Atzei, Nicola, Massimo Bartoletti, and Tiziana Cimoli. "A Survey of Attacks on Ethereum Smart Contracts (Sok)." in *6th International Conference on Principles of Security and Trust*. Uppsala, Sweden, 22–29 April 2017.
- Ayāshī, Faddad. "Al-'Uqūd al-Dhakiyya fi Ḍaw' al-'Uṣūl wa al-Maqāṣid wa al-Ma'ālat Ru'ya Takhliliyya." in *24th International Islamic Fiqh Academy Conference*. Dubai, UAE, 2019.
- Ayub, Muhammad. *Understanding Islamic Finance*. West Sussex: John Wiley & Sons Ltd, 2009.
- Balushi, Aḥmad Khalid. "Muqaddima 'an al-'Uqūd al-Dhakiyya." in *Al-Baraka Symposium on Islamic Economics*. Jeddah, 2019.
- Belchior, Rafael, André Vasconcelos, Sérgio Guerreiro, and Miguel Correia. "A Survey on Blockchain Interoperability: Past, Present, and Future Trends." *Acm Computing Surveys (CSUR)* 54, no. 8 (2021): 1–41. <https://doi.org/10.1145/3471140>.
- Bhatt, Aditya Jayeshkumar, and Keshu Sisodia. "Use of Blockchain in Islamic Finance." In *Leveraging Blockchain Technology*, 184–95. Boca Raton: CRC Press, 2024.
- Cao, Shoufeng, Thomas Miller, Marcus Foth, Warwick Powell, Xavier Boyen, and Charles Turner-Morris. "Integrating on-Chain and Off-Chain Governance for Supply Chain Transparency and Integrity." *arXiv preprint arXiv:2111.08455* (2021). <https://doi.org/10.48550/arXiv.2111.08455>.
- Chen, Jiachi, Xin Xia, David Lo, John Grundy, Xiapu Luo, and Ting Chen. "Defining Smart Contract Defects on Ethereum." *IEEE Transactions on Software Engineering* 48, no. 1 (2020): 327–45. <https://doi.org/10.1109/TSE.2020.2989002>.
- Chen, Wanyi, Kang He, and Lanfang Wang. "Blockchain Technology, Macroeconomic Uncertainty and Investment Efficiency." *International Journal of Emerging Markets* 18, no. 7 (2021): 1493–514. <https://doi.org/10.1108/IJOEM-10-2020-1250>.
- Darwish, Tasneem, Kamalrulnizam Abu Bakar, Gen Matsuda, Ahmed Aliyu, Abdul Hanan Abdullah, Abdul Samad Ismail, Ahmad Fadhil Yusof, *et al.* "Comparative Analysis of Blockchain Consensus Algorithms from Shariah Perspective." *Journal of Contemporary Islamic Studies* 6, no. 1 (2020): 1–21. <https://ir.uitm.edu.my/id/eprint/42962/1/42962.pdf>.
- Deepa, Natarajan, Quoc-Viet Pham, Dinh C Nguyen, Sweta Bhattacharya, B Prabadevi, Thippa Reddy Gadekallu, Praveen Kumar Reddy Maddikunta, Fang Fang, and Pubudu N Pathirana. "A Survey on Blockchain for Big Data: Approaches, Opportunities, and Future Directions." *Future*

- Generation Computer Systems* 131 (2022): 209–26. <https://doi.org/10.1016/j.future.2022.01.017>.
- Delle Foglie, Andrea, Ida Claudia Panetta, Elias Boukrami, and Gianfranco Vento. "The Impact of the Blockchain Technology on the Global Sukuk Industry: Smart Contracts and Asset Tokenisation." *Technology Analysis & Strategic Management* 37, no. 4 (2025): 417–31. <https://doi.org/10.1080/09537325.2021.1939000>.
- Drummer, Daniel, and Dirk Neumann. "Is Code Law? Current Legal and Technical Adoption Issues and Remedies for Blockchain-Enabled Smart Contracts." *Journal of information technology* 35, no. 4 (2020): 337–60. <https://doi.org/10.1177/0268396220924669>.
- Duran, Randall E, and Paul Griffin. "Smart Contracts: Will Fintech Be the Catalyst for the Next Global Financial Crisis?". *Journal of Financial Regulation and Compliance* 29, no. 1 (2021): 104–22. <https://doi.org/10.1108/JFRC-09-2018-0122>.
- El Amri, Mohamed Cherif, Mustafa Omar Mohammed, and Ruslan Sabirzyanov. "The Potential of Smart Contracts for Murabahah Home Financing: Towards an Integrated Model." In *Fintech, Digital Currency and the Future of Islamic Finance: Strategic, Regulatory and Adoption Issues in the Gulf Cooperation Council*, edited by Syed Nazim Ali Nafis Alam, 49–76. Cham: Palgrave Macmillan, 2020.
- Eze, Peter, Tochukwu Eziokwu, and Chinedu Okpara. "A Triplicate Smart Contract Model Using Blockchain Technology." *Circulation in Computer Science-Special Issue* Special Issue (2017): 1–10. <https://doi.org/10.22632/ccs-2017-cps-01>.
- Feng, Tianyu, Xiao Yu, Yueting Chai, and Yi Liu. "Smart Contract Model for Complex Reality Transaction." *International Journal of Crowd Science* 3, no. 2 (2019): 184–97. <https://doi.org/10.1108/IJCS-03-2019-0010>.
- Filippi, Emilia, Mariasole Bannò, and Sandro Trento. "Automation Technologies and Their Impact on Employment: A Review, Synthesis and Future Research Agenda." *Technological Forecasting and Social Change* 191 (2023): 1–121. <https://doi.org/10.1016/j.techfore.2023.122448>.
- Ghuddah, Abū. "Al-ʿuqūd al-Dhakiyya wa al-Bunūk al-Raqmiyya wa al-Bulūkshīn." In *Al-Baraka Symposium on Islamic Economics*. Jeddah, 13–14 May 2019.
- Habib, Farrukh. "Smart Contracts for Islamic Financial Transaction." *IFIKR DIGEST*, 2019, 10–15.
- Hilal, Farhana Binti Md, and Nor Faridah Binti Jamaludin. "Smart Contract in Islamic Trade Finance." In *Contemporary Management and Science Issues in the Halal Industry*, edited by F. Hassan, I. Osman, E. Kassim, B. Haris and R. Hassan, 431–37. Cham: Springer, 2019.

- Imeri, Adnan, Nazim Agoulmine, and Djamel Khadraoui. "Smart Contract Modeling and Verification Techniques: A Survey." In *the 8th International Workshop on ADVANCES in ICT Infrastructures and Services (ADVANCE 2020)*. Cancun, Mexico, 27–29 January 2020 2020.
- International Islamic Fiqh Academy. *Smart Contracts: Activation and Reversal Methods* (Study of Smart Contracts and the Extent of Their Relation to Cryptocurrency). International Islamic Fiqh Academy (4–6 November 2021).
- International Shariah Research Academy for Islamic Finance. *Compendium for Islamic Financial Terms*. Kuala Lumpur, Malaysia: International Shariah Research Academy for Islamic Finance, 2010.
- Javaid, Mohd, Abid Haleem, Ravi Pratap Singh, Shahbaz Khan, and Rajiv Suman. "Blockchain Technology Applications for Industry 4.0: A Literature-Based Review." *Blockchain: Research and Applications* 2, no. 4 (2021): 1–11. <https://doi.org/10.1016/j.bcr.2021.100027>.
- Khan, Nida, Bilal Kchouri, Nissar Ahmad Yattoo, Zsofia Kräussl, Anass Patel, and Radu State. "Tokenization of Sukuk: Ethereum Case Study." *Global Finance Journal* 51 (2022): 1–16. <https://doi.org/10.1016/j.gfj.2020.100539>.
- Khan, Sajjad, Muhammad Bilal Amin, Ahmad Taher Azar, and Sheraz Aslam. "Towards Interoperable Blockchains: A Survey on the Role of Smart Contracts in Blockchain Interoperability." *Ieee Access* 9 (2021): 116672–91. <https://doi.org/10.1109/ACCESS.2021.3106384>.
- Kunhibava, Sherin, Aishath Muneeza, Zakariya Mustapha, and Maryam Khalid. "Blockchain Use Case in Islamic Social Finance." *ISRA International Journal of Islamic Finance* 16, no. 1 (2024): 93–110. <https://doi.org/10.55188/ijif.v16i1.659>.
- Laldin, Mohamad Akram, and Hafas Furqani. "Fintech and Islamic Finance: Setting the Shari'ah Parameters." In *Fintech in Islamic Finance*, edited by U. A. Oseni and S. Nazim Ali, 113–19. New York: Routledge, 2019.
- Lin, Shi-Yi, Lei Zhang, Jing Li, Li-li Ji, and Yue Sun. "A Survey of Application Research Based on Blockchain Smart Contract." *Wireless Networks* 28, no. 2 (2022): 635–90. <https://doi.org/10.1007/s11276-021-02874-x>.
- Lodico, M.G., D.T. Spaulding, and K.H. Voegtler. *Methods in Educational Research: From Theory to Practice*. New Jersey: John Wiley & Sons, 2010.
- Macrinici, Daniel, Cristian Cartoceanu, and Shang Gao. "Smart Contract Applications within Blockchain Technology: A Systematic Mapping Study." *Telematics and informatics* 35, no. 8 (2018): 2337–54. <https://doi.org/10.1016/j.tele.2018.10.004>.
- Mahyudin, Mohd Izuwan, and Azizi Che Seman. "The Application of Bay'al-Tawarruq in Islamic Banking Institutions in Malaysia: A Study of Bank

- Muamalat Malaysia Berhad." In *New Developments in Islamic Economics*, edited by Asmak Ab Rahman, 169–79: Emerald Publishing Limited, 2018.
- Marchesi, Lodovica, Michele Marchesi, Livio Pompianu, and Roberto Tonelli. "Security Checklists for Ethereum Smart Contract Development: Patterns and Best Practices." *arXiv preprint arXiv:2008.04761* (2020): 1–13. <https://doi.org/10.48550/arXiv.2008.04761>.
- Megat, Puteri Aina, Fahd Al-Shaghdari, Besar Bin Ngah, and Sami Samir Abdelfattah. "Assessing the Predictive Benefits of Waqftech Smart Contracts on Corporate Waqf Crowdfunding among Malaysian Enterprises." *Journal of Islamic marketing* 15, no. 5 (2024): 1303–25. <https://doi.org/10.1108/JIMA-08-2023-0262>.
- Merriam, Sharan B, and Robin S Grenier. *Qualitative Research in Practice: Examples for Discussion and Analysis*. San Francisco: John Wiley & Sons, 2019.
- Mik, Eliza. "Smart Contracts: Terminology, Technical Limitations and Real World Complexity." *Law, innovation and technology* 9, no. 2 (2017): 269–300. <https://doi.org/10.1080/17579961.2017.1378468>.
- Mohamed, Hazik, and Hassnian Ali. *Blockchain, Fintech, and Islamic Finance: Building the Future in the New Islamic Digital Economy*. Blockchain, Fintech, and Islamic Finance. Berlin: Walter de Gruyter GmbH & Co KG, 2022. <http://doi.org/10.1515/9783110745016>.
- Mohd. Zain, Nor Razinah, and Khairul Azmi Mohamad. "An Evaluation of Smart Contracts: Practices, Legality, and Shari'ah." In *Islamic Fintech: Insights and Solutions*, edited by Mohd Ma'sum Billah, 91–110, 2021.
- Munawar, Munawar. "The Legality of Smart Contract in the Perspectives of Indonesian Law and Islamic Law." *Al-Istinbath: Jurnal Hukum Islam* 7, no. 1 (2022): 265–86. <https://doi.org/10.29240/jhi.v7i1.4140>.
- Muneem, Abdul, Nor Fahimah Binti Mohd Razif, Abdul Karim Bin Ali, and Muhammad Ikhlas Rosele. "Debt-Based Financing: A Case Study of Malaysian Islamic Banks." *Global Business and Economics Review* 30, no. 1 (2024): 39–55. <https://doi.org/10.1504/GBER.2024.135289>.
- Muneeza, Aishath, and Zakariya Mustapha. "Blockchain and Its Shariah Compliant Structure." In *Halal Cryptocurrency Management*, edited by Mohd Ma'sum Billah, 69–106. Cham: Palgrave Macmillan, 2019.
- Nazir, Miyan. "Smart Contracts Islamic Jurisprudence Standpoint." In *Al-Baraka Symposium on Islamic Economics*. Jeddah, 2019.
- Nguyen, Son, Peggy Shu-Ling Chen, and Yuquan Du. "Risk Identification and Modeling for Blockchain-Enabled Container Shipping." *International Journal of Physical Distribution & Logistics Management* 51, no. 2 (2021): 126–48. <https://doi.org/10.1108/IJPDLM-01-2020-0036>.

- Nor, Rizal Mohd, MM Rahman, Towfique Rahman, and Adam Abdullah. "Blockchain Sadaqa Mechanism for Disaster Aid Crowd Funding." In *6th International Conference on Computing and Informatics: Embracing Eco-Friendly Computing*. Malaysia, 25–27 April 2017.
- Nurkholidah, Susi, Fadillah Mursid, Andi Martina Kamaruddin, and Swadia Gandhi Mahardika. "Implementation of Smart Contracts in Sharia Finance: Masalah Mursalah's Perspective." *Journal of Mujaddid Nusantara* 1, no. 4 (2024): 211–21. <https://doi.org/10.62568/jomn.v1i4.198>.
- Nzuva, Silas Mutie. "Smart Contracts Implementation, Applications, Benefits, and Limitations." *Journal of Information Engineering and Applications* 9, no. 5 (2019): 63–75. <https://doi.org/10.7176/JIEA/9-5-07>.
- Osmani, Mohamad, Ramzi El-Haddadeh, Nitham Hindi, Marijn Janssen, and Vishanth Weerakkody. "Blockchain for Next Generation Services in Banking and Finance: Cost, Benefit, Risk and Opportunity Analysis." *Journal of Enterprise Information Management* 34, no. 3 (2021): 884–99. <https://doi.org/10.1108/JEIM-02-2020-0044>.
- Pasdar, Amirmohammad, Young Choon Lee, and Zhongli Dong. "Connect Api with Blockchain: A Survey on Blockchain Oracle Implementation." *ACM Computing Surveys* 55, no. 10 (2023): 1–39. <https://doi.org/10.1145/3567582>.
- Qahf, Monzer. "Al-'Uqūd al-Dhakiyya." in *International Islamic Fiqh Academy Conference*. United Arab Emirates, 4–6 November 2019.
- Rabbani, Mustafa Raza, Hana Bawazir, Shahnawaz Khan, Sitara Karim, and Daouia Chebab. "Smart Contract-Based Islamic Fintech Model for Mudaraba Financing." *International Journal of Business Innovation and Research* 36, no. 2 (2025): 248–62. <https://doi.org/10.1504/IJBIR.2025.144391>.
- Rahim, Siti Rohaya, Zam Zuriyati Mohamad, Juliana Abu Bakar, Farhana Hanim Mohsin, and Norhayati Md Isa. "Artificial Intelligence, Smart Contract and Islamic Finance." *Asian Social Science* 14, no. 2 (2018): 145–54. <https://doi.org/10.5539/ass.v14n2p145>.
- Rejeb, Dhiaeddine. "Smart Contract's Contributions to Mudaraba." *Tazkia Islamic Finance and Business Review* 15, no. 1 (2021): 1–40. <https://doi.org/10.30993/tifbr.v15i1.236>.
- Richards, Mina. "Disruptive Innovations: Blockchain and Spinoffs." In *Advances in the Technology of Managing People: Contemporary Issues in Business*, edited by P.A. and Overbey Gordon, J.A., 161–72. Leeds: Emerald Publishing Limited, 2019.
- Roslan, Muhammad Faruq, Omar Bamahriz, Aishath Muneeza, J Chu, Zakariya Mustapha, and Mohamad Zabidi Ahmad. "Application of Tawarruq in Islamic Banking in Malaysia: Towards Smart Tawarruq." *International*

- Journal of Management and Applied Research* 7, no. 2 (2020): 104–19. <https://doi.org/10.18646/2056.72.20-008>.
- Safina, Leisan, and Umar A Oseni. "The Potentials of Smart Contract in Islamic Trade Finance." In *Fintech in Islamic Finance*, edited by U. S. Oseni and S. N. Ali, 215–30: Routledge, 2019.
- Saleh, Abdulmajid Obaid Hasan, Deden Misbahudin Muayyad, and Al-Shaghdari Fahd. "The Potential of Using Smart Contracts in Cash Waqf on Blockchain." *al-Qanatir: International Journal of Islamic Studies* 32, no. 2 (2023): 50–59. <https://al-qanatir.com/aq/article/view/741>.
- Sānū, Qutb Mustafā. "Al-'Uqūd al-Dhakiyya fi Daw' al-'Uṣūl wa al-Maqāṣid wa al-Ma'ālāt Ru'ya Takhlīliyya." In *International Islamic Fiqh Academy*. Dubai, 4–6 November 2019.
- Sayeed, Sarwar, Hector Marco-Gisbert, and Tom Caira. "Smart Contract: Attacks and Protections." *Ieee Access* 8 (2020): 24416–27. <https://doi.org/10.1109/ACCESS.2020.2970495>.
- Shaarani, Ahmad Zakirullah Mohamed, Fidlizan Muhammad, Azman Mohd Noor, and Mohd Farihal Osman. "Smart Contract: Shariah Analysis and Parameter." *UMRAN-Journal of Islamic and Civilizational Studies* 10, no. 2 (2023): 1–14. <https://doi.org/10.11113/umran2023.10n2.638>.
- Su, Yue , Poh-Chuin Teo, and Haliyana Khalid. "An Analytical Study of Blockchain Technology on Consumers' Perceived Value and Loyalty Response in Retail Industry under Sor Theory." *Environment and Social Psychology* 9, no. 11 (2024): 1–15. <https://doi.org/10.59429/esp.v9i11.3158>.
- Syahmi, Muhammad Izzul, Mohammad Taqiuddin Mohamad, and Mohd Anuar Ramli. "Experts' Views on Hiyal in Malaysian Islamic Banks: The Case of Tawarruq-Based Deposit Products." *ISRA International Journal of Islamic Finance* 14, no. 3 (2022): 289–302. <https://doi.org/10.1108/IJIF-02-2021-0042>.
- Szabo, Nick. "Formalizing and Securing Relationships on Public Networks." *UIC Journals* 2, no. 9 (1997). <https://doi.org/10.5210/fm.v2i9.548>.
- Wackerow. "Networks." Ethereum, 2025, accessed 2nd February, 2025, <https://ethereum.org/en/developers/docs/networks/>.
- Wang, Yingli, Jeong Hugh Han, and Paul Beynon-Davies. "Understanding Blockchain Technology for Future Supply Chains: A Systematic Literature Review and Research Agenda." *Supply Chain Management: An International Journal* 24, no. 1 (2019): 62–84. <https://doi.org/10.1108/SCM-03-2018-0148>.
- Wizāra al-Awqāf wa al-Shu'ūn al-Islāmiyya. *Al-Mawsū'a al-Fiqhiyya*. Kuwait: Wizāra al-Awqāf wa al-Shu'ūn al-Islāmiyya, 2000.

- Wohrer, Maximilian, and Uwe Zdun. "Design Patterns for Smart Contracts in the Ethereum Ecosystem." In *IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData)*. Nova Scotia, Canada, 30 July 2018.
- Wu, Canghai, Jie Xiong, Huanliang Xiong, Yingding Zhao, and Wenlong Yi. "A Review on Recent Progress of Smart Contract in Blockchain." *IEEE Access* 10 (2022): 50839–63. <https://doi.org/10.1109/ACCESS.2022.3174052>.
- Zain, Nor Razinah Binti Mohd, Engku Rabiah Adawiah Engku Ali, Adewale Abideen, and Hamizah Abdul Rahman. "Smart Contract in Blockchain: An Exploration of Legal Framework in Malaysia." *Intellectual Discourse* 27, no. 2 (2019): 595–617. <https://doi.org/10.31436/id.v27i2.1435>.
- Zeferi, Sheikh Ameer Bin Shaik Mohd, and Nik Abdul Rahim Nik Abdul Ghani. "Analisis Konsep Ganjaran di dalam Sistem Transaksi Matawang Digital Menurut Perspektif Islam." *Journal of Contemporary Islamic Law* 4, no. 2 (2019): 11–21. https://www.ukm.my/jcil/jcil-2019-42-article-2-2/?et_fb=1&PageSpeed=off&_ncforminfo=FAQOHwZFBLRxd9ppCh2-StPzmb4NkwKCHlDs84_e-01-paLgY4459paI-GaoTMNkm21X8YloTUHD58IzM1Jw60uRTsMID4BK.
- Zhang, Shijie, and Jong-Hyoun Lee. "Analysis of the Main Consensus Protocols of Blockchain." *ICT express* 6, no. 2 (2020): 93–97. <https://doi.org/10.1016/j.icte.2019.08.001>.
- Zheng, Zibin, Shaoan Xie, Hong-Ning Dai, Weili Chen, Xiangping Chen, Jian Weng, and Muhammad Imran. "An Overview on Smart Contracts: Challenges, Advances and Platforms." *Future Generation Computer Systems* 105 (2020): 475–91. <https://doi.org/10.1016/j.future.2019.12.019>.
- Al-Zuhaylī, Wahbah. *Al-Fiqh al-Islāmī wa Adillatuh*. 2nd ed. Damaskus: Dār al-Fikr al-'Arabī, 1985.
- Zulkepli, Muhammad Izzul Syahmi, Mohammad Taqiuddin Mohamad, and Saaidal Razalli Azzuhri. "Leveraging Blockchain-Based Smart Contract in Islamic Financial Institutions: Issue and Relevant Solution." *International Journal of Islamic Economics and Finance Research* 6, no. 1 (2023): 18–28. <https://doi.org/10.53840/ijiefer96>.