

EL DINAR Blockchain _Iman Rahma Rukhul 1

by N Gig

Submission date: 18-Aug-2023 06:11PM (UTC-0400)

Submission ID: 2147756530

File name: EL_DINAR_Blockchain__Iman_Rahma_Rukhul.docx (308.73K)

Word count: 7762

Character count: 50596

BUILDING A DECENTRALIZED ISLAMIC FINANCIAL SYSTEM WITH BLOCKCHAIN TECHNOLOGY

Iman Supriadi¹, Rahma Ulfa Maghfiroh², Rukhul Abadi³

¹ Faculty of Economics, STIE Mahardhika Surabaya

Jl. Wisata Menanggal No.41A, Surabaya, East Java, 60234, Indonesia

² Faculty of Islamic Economic and Business, Universitas Islam Negeri Sunan Ampel

Jl. Ahmad Yani No.117, Surabaya, East Java, 60237, Indonesia

³ Faculty of Islamic Economic and Business, STEBI Syaikhona Kholil Sidogiri Pasuruan

Jl. Sidogiri Rembang KM. 01 Sidogiri Pasuruan, East Java, 67152, Indonesia

✉ Corresponding Author:

Author's Name: Iman Supriadi

E-mail: iman@stiemahardhika.ac.id

Abstract

This paper discusses the potential and implementation of blockchain technology in building a decentralized Islamic financial system. Islamic finance is an economic system based on Islamic Sharia principles, while blockchain technology is a technology that uses decentralized networks to record and verify financial transactions. In this paper, the background of the importance of developing a decentralized Islamic economic system is outlined, and a review of previous research that has been done in this field is conducted. Research gaps can be filled, such as the limitations of empirical research and the need for a more in-depth analysis of the social and legal impacts of implementing blockchain technology in Islamic finance. This study aims to comprehensively understand how blockchain technology can be used in building a decentralized Islamic financial system. It analyzes the implementation of a blockchain-based Islamic economic system and identifies the associated benefits and challenges. In addition, recommendations for developing and using this technology in the context of Islamic finance are provided. This research is expected to give a better understanding of the potential of blockchain technology in building a decentralized Islamic financial system. This research can guide practitioners and academics in developing innovative and sustainable Islamic finance solutions.

Keywords: Islamic finance, blockchain technology, decentralized, financial system, innovation

Abstrak

Penelitian ini membahas tentang potensi dan implementasi teknologi blockchain dalam membangun sistem keuangan syariah yang terdesentralisasi. Keuangan syariah merupakan sistem keuangan yang

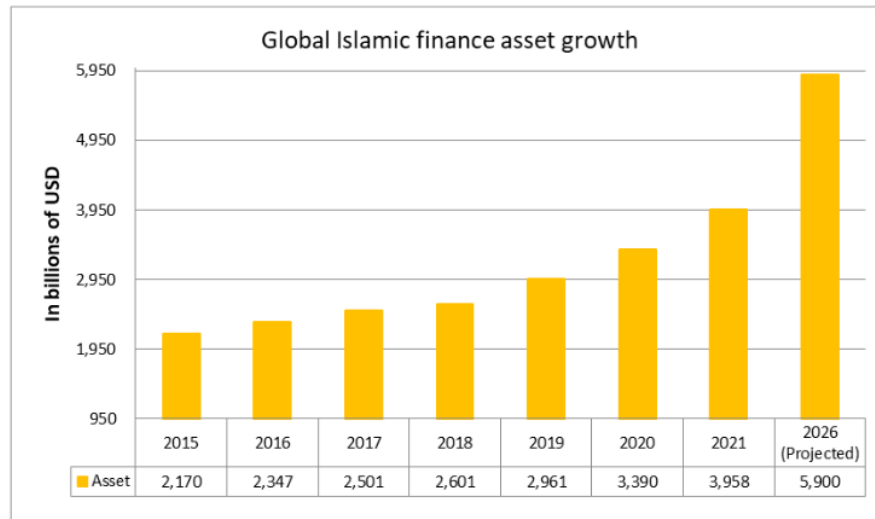


didasarkan pada prinsip-prinsip syariah Islam, sedangkan teknologi blockchain adalah teknologi yang menggunakan jaringan terdesentralisasi untuk mencatat dan memverifikasi transaksi keuangan. Dalam penelitian ini, diuraikan latar belakang pentingnya pengembangan sistem keuangan syariah yang terdesentralisasi dan dilakukan tinjauan terhadap penelitian-penelitian terdahulu yang telah dilakukan dalam bidang ini. Terdapat celah penelitian yang dapat diisi, seperti keterbatasan penelitian empiris dan perlunya analisis lebih mendalam mengenai dampak sosial dan hukum penerapan teknologi blockchain dalam keuangan syariah. Tujuan dari penelitian ini adalah untuk memahami secara komprehensif bagaimana teknologi blockchain dapat digunakan dalam membangun sistem keuangan syariah yang terdesentralisasi. Dilakukan analisis implementasi nyata dari sistem keuangan syariah berbasis blockchain dan mengidentifikasi manfaat serta tantangan yang terkait. Selain itu, diberikan juga rekomendasi untuk pengembangan dan penggunaan teknologi ini dalam konteks keuangan syariah. Melalui penelitian ini, diharapkan dapat memberikan pemahaman yang lebih baik tentang potensi teknologi blockchain dalam membangun sistem keuangan syariah yang terdesentralisasi. Penelitian ini dapat memberikan panduan bagi praktisi dan akademisi dalam mengembangkan solusi keuangan syariah yang inovatif dan berkelanjutan.

Kata kunci: Keuangan syariah, teknologi blockchain, desentralisasi, sistem keuangan, inovasi

PENDAHULUAN

The Islamic finance industry has experienced significant growth in recent years. The principles of Islamic finance, which are based on Islamic moral and ethical principles, have attracted the interest of many individuals and financial institutions seeking alternatives compatible with their religious values (Biancone, P. P., & Radwan, 2019). According to recent data, the value of global Islamic finance assets in 2021 reached US\$3.96 trillion, an increase of 16.76% compared to the previous year's US\$3.39 trillion. This indicates solid growth in the global Islamic finance industry, in line with the global economic recovery. Positive developments in new and emerging markets in Central Asia and North Africa, such as Kazakhstan, Tajikistan, and Algeria, drove this growth. Projections for the future suggest that the global Islamic finance industry could reach US\$5.90 trillion by 2026, assuming the continued openness of the global economy.



Picture 1.

Global Islamic finance asset growth chart with 5-year CAGR of 8.3%

Source: Islamic Finance Development Report 2022

The development of the Islamic financial sector in 2021 showed significant growth, in line with the positive trend in previous years. The Islamic funds sector recorded the most notable growth, with an increase of 33.7%, while the Takaful sector saw an increase of 17.7% in the same year. In particular, the Islamic banking sector, which accounts for around 70% of total Islamic finance assets, recorded a growth of 17% during the year. In addition to improving performance, the Islamic banking sector also expanded market share with significant growth in countries such as Tajikistan (84%), Burkina Faso (27%), and Ethiopia (26%). Digitalization continues to be a key trend in the Islamic banking industry in 2021. For example, Bank Negara Malaysia approved the establishment of two digital Islamic banks as a manifestation of its digitalization efforts. In addition, the digitalization trend has also impacted the Islamic insurance sector, which is transforming a more technology-based system.

Table 1. Global Islamic finance growth share

	Islamic Banking	Sukuk	Other LKS	Sharia Fund	Takaful
Total Asset (Milliar USD)	2,765	713	169	238	73
Portion (%)	70%	18%	4%	6%	2%
Number of institutions	566	4,426	778	1,903	335

Source: Islamic Finance Development Report 2022

However, along with this industry's growth, several challenges are faced, such as limitations in terms of transparency, efficiency, and security. Islamic finance is a financial system based on Islamic Sharia principles, prohibiting usury (interest), excessive speculation, and transactions involving usury (Muneeza & Mustapha, 2019). In today's digital era, technological developments have changed financial transactions. One technology that is gaining great attention is **blockchain technology**. **Blockchain is a technology that uses a decentralized network to record and verify transactions in a secure, transparent, and immutable way** (Gaikwad, 2020). In Islamic finance, blockchain technology offers great potential for building a decentralized Islamic financial system (Dahdal et al., 2022). By using this technology, Islamic financial transactions can be made more efficient, transparent, and accountable. The decentralized finance offered by blockchain can also provide wider access to individuals and communities that previously had difficulty obtaining financial services.

Several studies have been conducted to analyze how blockchain technology can be applied in the context of Islamic finance. One such study conducted by Antova & Tayachi, (2020) specifically uncovered the potential of blockchain technology in improving operational efficiency, transparency, and security in Islamic finance. They identified several benefits this technology could provide, including increased accessibility and public participation in Islamic finance. Furthermore, Alaeddin et al., (2021) conducted an in-depth literature review on blockchain technology in Islamic finance. They analyzed various proposed blockchain applications and evaluated their implications and benefits to the Islamic finance industry. Their research provides a more comprehensive insight into the potential application of blockchain technology in advancing the Islamic finance sector. Not only that, Abdeen et al., (2019) also conducted a study focusing on **the application of blockchain technology in Islamic finance**. They discussed **the potential** use of blockchain in microfinance, takaful (Islamic insurance), and asset management. This study provides a complete picture of the various blockchain applications in different sectors of Islamic finance. Finally, Moosavi et al., (2021) specifically uncover the potential of blockchain

technology in improving operational efficiency, transparency, and security in Islamic finance. They identify several advantages of this technology, including increased accessibility and public participation in Islamic finance.

Although several previous studies have identified the potential of blockchain technology in Islamic finance, there are still some research gaps that need to be filled to gain a deeper understanding so that several research gaps can be identified in this context. First, more focused research is needed on building a decentralized Islamic financial system using blockchain technology. In line with this, although there has been some discussion on the benefits of this technology in improving Islamic finance's transparency, security, and efficiency, research that specifically addresses the real implementation and challenges in building a decentralized Islamic financial system still needs to be improved. Furthermore, there are limitations in empirical research involving the actual implementation of blockchain-based Islamic financial systems. Although some studies have proposed models and concepts, only some have conducted practical implementations of blockchain-based Islamic financial systems on a larger scale. Therefore, more in-depth research involving concrete testing and evaluating such implementations is needed.

In addition, more extensive research is needed on the social, legal, and regulatory impacts of implementing blockchain technology in Islamic finance. While blockchain technology offers significant potential, the possible social changes, legal implications, and regulatory compliance with Shariah principles must also be considered. Therefore, research that studies the social impact, legal, and regulatory aspects is important in supporting the application of blockchain technology in the context of Islamic finance. Future research should focus on building a decentralized Islamic financial system using blockchain technology, involve real-world implementation, and analyze the associated social, legal, and regulatory impacts to fill the gaps in this study.

This paper aims to illustrate the potential use of blockchain technology in building a decentralized Islamic financial system. Blockchain technology, with its unique characteristics such as security, transparency, and inability to be manipulated, can provide solutions to some of the challenges the Islamic finance industry faces. This paper will discuss the basic concepts of Islamic finance, the introduction of blockchain technology, and how this technology can be applied in the Islamic finance industry. In addition, this paper will also analyze the advantages, challenges, and potential development and future of blockchain-based Islamic finance. This paper is expected to provide a better understanding of the potential use of blockchain technology in building a

decentralized Islamic financial system. It can contribute to overcoming the challenges the Islamic finance industry faces and opening up new opportunities for future development.

LITERATURE REVIEW

Basic Concepts of Islamic Finance

Islamic finance is based on principles established in Islam, which aim to regulate financial transactions by ensuring conformity with Sharia law (Naim et al., 2020). These principles form the moral and ethical foundation of Islamic finance practices, which are geared towards balancing economic aspects and social justice. One of the key principles in Islamic finance is the prohibition against usury. From the Islamic perspective, usury, which refers to interest or interest-bearing interest, is considered an impermissible practice (Harahap & Risfandy, 2022). This principle emphasizes the importance of fair sharing of risks and profits between parties involved in financial transactions. In addition, the principle of the prohibition against gharar is also a cornerstone of Islamic finance. Gharar refers to excessive uncertainty or vagueness in transactions. In Islamic finance, transactions must be transparent and clear about prices, goods traded, and other transaction terms (Abu Bakar et al., 2022). The third principle is the prohibition against maysir, which refers to the practice of gambling or speculation that is not by the principles of fairness. In Islamic finance, transactions should avoid unclear gambling and speculation elements and focus on fairness (Kanwal, 2022). Finally, Islamic finance also avoids investments or transactions that involve goods or activities that are forbidden in Islam, such as alcohol, pork, or practices that are considered unethical. This principle underscores the importance of selecting investments that align with Islamic values and the social responsibility that Islamic finance carries as a financial instrument that complies with Islamic principles.

Islamic finance offers a variety of products and instruments that are adapted to the principles of Sharia. One of the common products in Islamic finance is Mudarabah. Mudarabah is a cooperation contract involving investors or *rab al-maal* and managers or *mudarib* (Naim et al., 2020). In this contract, profit and risk sharing is carried out by the prior agreement between the parties. Musharakah is also an option in Islamic finance. This concept involves a form of partnership or cooperation between two or more parties for a particular business venture or project. Profits and risks in this transaction are also shared as agreed upon by both parties. Wakalah is a

financial instrument involving an agreement in which one party trusts another party to manage its assets or business activities (Rachmawaty et al., 2019). The party who gives trust is called the principal, while the party who acts as the manager is called the representative. Sukuk is an Islamic financial instrument that offers ownership or participation in productive assets (Naim et al., 2020). Sukuk is similar to conventional bonds but is directed by Sharia principles by ensuring that the income stream generated from the productive asset is Sharia-compliant. Through these various products and instruments, Islamic finance provides a Shariah-compliant alternative, allowing businesses to invest in a way that is part of fair and sustainable economic activity.

The Islamic finance industry faces a series of challenges that must be overcome to move the sector forward. The Islamic finance industry faces several key challenges. First, limitations in infrastructure are a significant challenge. Islamic finance requires infrastructure capable of properly supporting Islamic products and services. Challenges in building adequate infrastructure, such as payment systems and financial institutions specialized for Islamic finance, can affect the industry's overall development (Shinkafi et al., 2020).

Furthermore, regulation and standards are also an important challenge in Islamic finance. Clear and consistent regulations and standards are needed to ensure that financial transactions and products comply with Shariah principles. Challenges in developing and implementing appropriate regulations can hinder the growth and stability of the Islamic finance industry (Ibrahim, 2019). Awareness and education are also critical challenges in the Islamic finance industry. Wider awareness among industry players and the general public about the concepts and benefits of Islamic finance is essential. In addition, proper and systematic education on Islamic finance is key to better understanding and broadening its use base (Alfarisi et al., 2020). The challenges of raising awareness and providing sufficient education can affect the growth and acceptance of the Islamic finance industry in society. In the face of these challenges, the Islamic finance industry needs to take strategic steps to strengthen infrastructure, promote regulations that align with Sharia principles, and increase awareness and education in Islamic finance (Shinkafi et al., 2020). In this way, the Islamic finance industry can continue to grow and contribute to an inclusive and sustainable economy.

Introduction to Blockchain Technology

Blockchain is a technology based on distribution and transparency to record and verify transactions (Iftekhar et al., 2021). This is done through a

decentralized network of interconnected computers. Each transaction is collected and linked into blocks, which are then connected in chronological order to form a chain. Each block has a unique digital signature and immutable data (Liu et al., 2020). Thus, blockchain ensures data security and integrity and eliminates the need for a central authority to validate transactions. Blockchain technology can increase trust, transparency, and efficiency in various industries, including finance, logistics, and the public sector. The basic concepts of blockchain include (Zhai et al., 2019):

- a. Decentralized Data Structure: Blockchain uses a distributed network of computers called "nodes" to store identical copies of a decentralized database. Each node has a complete copy of all transactions that have ever occurred.
- b. Blockchain: A blockchain is a series of blocks that contain transaction information. Each block is connected to the previous block through a hash, forming an immutable chain of blocks.
- c. Security and Cryptography: Blockchain uses cryptographic techniques to protect data security. Each transaction is encrypted and authenticated using complex cryptographic keys

Applying blockchain technology in Islamic finance provides various benefits and significant potential (Dahdal et al., 2022). First, blockchain enables full transparency in Islamic finance transactions. Every transaction is permanently recorded and accessible to all parties involved. This increases trust and accountability in the Islamic financial system. Second, the solid cryptographic strength of blockchain offers a high level of security. Thus, Islamic financial transactions and data are protected from manipulation or attacks by unauthorized parties. In addition, blockchain also provides efficiency and cost reduction. By eliminating traditional intermediaries, the technology can reduce administrative costs associated with Islamic finance transactions. The transaction process can also be significantly accelerated, improving operational efficiency. Finally, blockchain can reduce the risk of arrears in Islamic finance transactions. Through intelligent contracts executed automatically according to predetermined conditions, blockchain facilitates the timely completion of transactions and reduces the risk of default or late payment. In conclusion, applying blockchain technology to the Islamic finance sector provides benefits in terms of transparency, security, efficiency, and reducing the risk of arrears. This strengthens trust in the Islamic financial system and has the potential to improve service quality and operational effectiveness.

The application of blockchain in Islamic finance has great potential, but it is also faced with several challenges and special considerations that need to

be considered (Alaeddin et al., 2021). First, compliance with Sharia principles is an essential factor in blockchain implementation. Every Islamic financial transaction and the product must comply with established principles, such as the prohibition of usury, gharar, and maysir. Furthermore, infrastructure and scalability are also important considerations in adopting blockchain technology. A blockchain system must be supported by adequate infrastructure and handle large transaction volumes efficiently. Good system scalability is necessary to maintain performance and reliability in Islamic finance operations. Finally, regulation and legal compliance are inevitable aspects. Clear regulations and proper compliance frameworks are necessary to ensure blockchain implementation in Islamic finance meets the requirements and provisions of applicable laws (Dahdal et al., 2022). Compliance with legal and ethical frameworks is also essential to maintain integrity and trust in the Islamic finance industry. In addressing the challenges and considering these factors, blockchain implementation in Islamic finance can effectively achieve its potential and reinforce the principles of Islamic finance that it upholds.

Decentralized Finance and Blockchain

Decentralized finance is a financial system that is not centralized and does not rely on a central authority or traditional intermediaries (Zetsche et al., 2020). In decentralized finance, transactions and asset management are carried out directly between the parties involved through decentralized computer networks. Blockchain plays an essential role in realizing decentralized finance. The following are some of the contributions of blockchain in decentralized finance:

- a. Data Security and Integrity: Using cryptographic technology and network consensus, blockchain provides high security and ensures data integrity in decentralized financial transactions (Bhattacharjee et al., 2020).
- b. Smart Contracts: Blockchain supports the implementation of smart contracts that serve as automated protocols to execute transactions based on predefined conditions, eliminating the need for third parties or intermediaries (Yadav et al., 2022).
- c. Transparency and Auditability: Every transaction on the blockchain is permanently recorded and accessible to all parties involved. This increases transparency and enables better auditability in decentralized finance (Cao et al., 2019).

- d. **Cost Reduction and Efficiency:** In decentralized finance, blockchain can reduce administrative costs and speed up the transaction process by eliminating traditional intermediaries (Wang et al., 2019).

Blockchain has seen some exciting implementations in decentralized Finance. One is DeFi (Decentralized Finance), which uses blockchain to provide various financial services without involving traditional financial institutions. Within the scope of DeFi, users can access services such as loans, asset exchanges, staking, and more by using blockchain as a secure and transparent infrastructure (Dos Santos et al., 2022). In addition, blockchain technology has also been applied to decentralized crowdfunding platforms. In these platforms, blockchain allows projects to connect directly with potential investors, eliminating the need for intermediaries and ensuring the security of funds involved in the fundraising process (Swamiraj Jadhav, 2022). Another example is the use of blockchain in decentralized remittances. By utilizing blockchain technology, cross-border remittances can be made at a lower cost and faster speed than traditional systems, as blockchain facilitates transactions directly between the parties involved, eliminating the need for intermediary banking institutions. Through these implementations, blockchain opens up new opportunities in decentralized Finance, providing more comprehensive access, higher efficiency, and increased transparency and security in the financial system.

The development of decentralized finance is faced with several challenges that need to be overcome in order for it to reach its full potential. One of the main challenges is blockchain scalability. Blockchain technology still needs to improve efficiently handling large transaction volumes (Biswas et al., 2019). This requires improvements in infrastructure and supporting technologies for blockchain to cope with the increasing transaction load. In addition, regulation is also a challenge that needs to be addressed. Decentralized finance is still in its infancy and has yet to be entirely governed by a clear regulatory framework. A consistent and transparent regulatory framework is needed to provide legal certainty and ensure compliance in decentralized finance operations (KR & K, 2022). Security is also an important aspect that needs to be considered in developing decentralized finance. Although blockchain has a high level of security, the risk of hacker attacks and data leakage remains a threat that needs to be faced. Improving security infrastructure, implementing robust encryption protocols, and adopting best practices are essential to protecting the decentralized finance system. By addressing these challenges, the development of decentralized finance can strengthen more inclusive, efficient, and secure finance in the future.

RESEARCH METHODOLOGY

In the research methodology chapter, systematic steps are described to achieve the objectives of this paper. A qualitative descriptive research approach was used to collect and analyze relevant literature and case studies (Williams et al., 2020). This approach aims to gain an in-depth understanding of the implementation of blockchain technology in the Islamic finance industry and compare it with the conventional financial system. The research involved reviewing literature that focused on the concept of Islamic finance, the principles that oversee it, and the development of blockchain technology in the financial industry. By understanding the outlook and pivotal role of Islamic finance in the economy, the research explored the potential application of blockchain technology in this context.

Furthermore, a detailed analysis of the use of blockchain technology in the Islamic finance industry will be conducted. Case studies will be engaged to investigate existing implementations and highlight the benefits and challenges in the application of blockchain technology in a decentralized Islamic financial system. Thus, this research can provide a comprehensive insight into the influence and advantages of a blockchain-based Islamic financial system. This research will also conduct a comparative analysis between blockchain-based Islamic financial systems and conventional financial systems. This approach allows for an in-depth evaluation of the benefits and drawbacks of these two systems. As such, this research can provide important insights for developing an innovative and decentralized Islamic financial system. Through this research approach, this study can provide proper guidance in building a decentralized Islamic financial system using blockchain technology and enhance our understanding of the potential and implications of deploying this technology in the context of Islamic finance.

RESULTS AND DISCUSSION

Blockchain-based Islamic Financial System Design

Blockchain is one of the promising technological innovations to improve the Islamic financial system's transparency, efficiency, and reliability. This chapter will discuss the design of a blockchain-based Islamic financial system by reviewing essential aspects such as system architecture and components, system security and reliability, and the application of smart contracts in Islamic finance.

a. System Architecture and Components

Blockchain-based Islamic Financial System is an exciting concept in the modern financial industry. To explain the architecture of this system, it is necessary to understand the definition and basic concepts of blockchain in the context of Islamic finance. Blockchain is a new technology that enables the creation and exchange of information in a decentralized, transparent, and secure manner. This technology can be applied in Islamic finance by considering the Sharia principles that govern finance.

Various types of blockchain architecture can be applied in Islamic finance, such as public, private, and consortium (Antova & Tayachi, 2020). Each type of architecture has advantages and disadvantages that must be considered in its implementation. The main difference between conventional and blockchain-based Islamic financial systems lies in the principles governing their operations. Islamic financial systems focus on fairness, sustainability, and accountability, while conventional systems are more profit-oriented.

Essential components of a blockchain-based Islamic financial system include the blockchain network and nodes, digital identity, and the use of tokens. The blockchain network forms the basis of the infrastructure that supports Islamic financial transactions. At the same time, digital identity and membership involve verifying and validating participants in the system (Aydar & Ayvaz, 2019). Creating and using tokens in a blockchain-based Islamic financial system provides convenience and transparency in preserving Sharia principles in every transaction.

b. System Security and Reliability

Blockchain-based Islamic Financial System Security is an important thing to understand in the context of Islamic finance today. The concept of security is the main foundation for building a modern Islamic financial system by utilizing blockchain technology. In such a system, blockchain network security and financial transaction data protection play a central role in securing digital assets and protecting data integrity (Song & Chen, 2021). A blockchain-based Islamic financial system must also identify and address specific security threats related to the Sharia principles that must be followed. The reliability of blockchain-based Islamic financial systems is critical in building trust and public acceptance of this technology. The consensus system of blockchain technology supports transaction reliability, ensuring that the distributed network has verified and approved every transaction (Li et al., 2019). The presence of fault tolerance and redundancy in blockchain-based Islamic financial systems helps mitigate potential problems in financial transactions.

System scalability and performance are essential in processing Islamic financial transactions (Dahdal et al., 2022). The system must cope with high transaction loads quickly and efficiently without compromising existing Sharia principles. The proper infrastructure and technology investment is required to ensure adequate scalability in a blockchain-based Islamic financial system. In order to build a secure and reliable blockchain-based Islamic financial system, it is necessary to study and implement appropriate measures to maintain the security, reliability, and performance required to process complex Islamic financial transactions.

c. Smart Contracts in the Context of Islamic Finance

Understanding and Conceptualizing Smart Contracts in Islamic Finance plays an essential role in understanding the potential of this technology in the context of Islamic finance. Smart contracts are computer programs that automatically executing agreements based on pre-set rules and conditions (Krytsula, 2022). In Islamic finance, smart contracts can implement the principles of Islamic finance using transparent and secure blockchain technology (Antova & Tayachi, 2020).

The advantages of smart contracts in Islamic finance lie in removing intermediaries and costs associated with traditional intermediation, thereby reducing complexity and potential usury (Hilal et al., 2019). The potential includes increased operational efficiency, improved access to financial services, and increased awareness and adherence to Islamic financial principles. Smart contracts in Islamic finance can be applied in various fields. In the Islamic banking system, smart contracts-based financing contracts enable automated financing, reduce bureaucracy and increase transparency. In the Islamic insurance industry, smart contracts can be used for insurance and takaful contracts to facilitate claims and payments by Sharia principles. In addition, investment and microfinance contracts are automatically applied in an intelligent contracts-based Islamic financial system, providing easier access for small communities to achieve fair and affordable financial services. The application of smart contracts in Islamic finance provides an excellent opportunity to optimize the principles of Islamic finance through innovative blockchain technology (Alaeddin et al., 2021). By using smart contracts, Islamic finance can become more efficient, transparent, and inclusive, enabling people to access financial services that comply with the principles of Islamic finance.

The design of blockchain-based Islamic financial systems offers excellent potential to improve transparency, efficiency, and security (Antova & Tayachi, 2020). In such designs, aspects of system architecture and components, security and reliability, and the application of intelligent

contracts play an essential role. By applying the principles of Islamic finance to blockchain technology, a modern Islamic financial system can be constructed on Islamic values. At least three Islamic financial products and instruments can utilize the blockchain system through smart contracts, namely sukuk, takaful, and Islamic social funds.

Smart contracts are a solution that can be used in Islamic financial instruments such as sukuk. The successful growth of sukuk depends on the standardization of Sharia interpretation and clear legal documentation. Using smart contracts will speed up the sukuk issuance process, which is currently complex and time-consuming. The blockchain system in innovative sukuk eliminates intermediaries, simplifies the documentation process, and strengthens trust between issuers and investors through increased transparency (Hamza, 2020). Innovative sukuk runs on the Ethereum blockchain system, implementing automated contracts for payments and ownership transfers, which is expected to reduce costs by 50-70%. With instant transaction clearing and settlement speed, sukuk trades can be done within 30 seconds instead of five days.

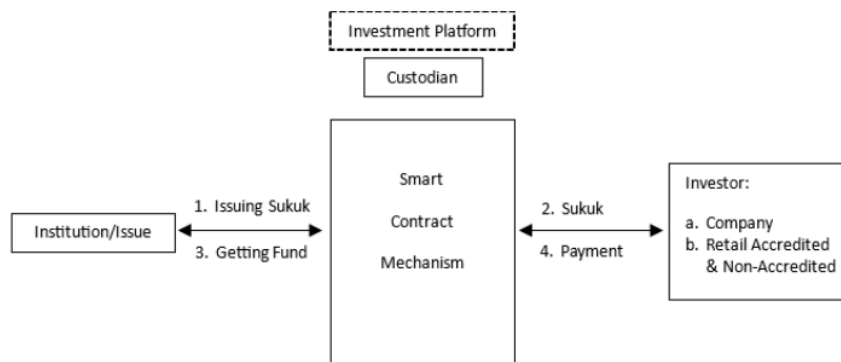


Figure 2. Smart contract system in Sukuk

Source: <https://alami.institute/learn/blockchain-untuk-keuangan-syariah>

The main benefits derived from blockchain are increased efficiency and transparency. Blockchain systems play an essential role in accelerating customer data verification and claims settlement, which in turn helps takaful companies improve their operational efficiency (Abdeen et al., 2019). With blockchain technology, processes related to customer data and claims can be carried out more quickly and efficiently, avoiding delays and reducing unnecessary bureaucracy. The takaful blockchain system connects

customers, takaful companies, and related partners such as healthcare providers. Prospective customers register through existing intelligent contracts. The takaful company collects the prospective customer's data, including medical records from the healthcare provider. After underwriting, the system approves the customer's registration. The customer pays the premium through the blockchain, and the company earns revenue from the wakalah fee. The company invests the collected funds to generate profits. Profits in general takaful are used to pay claims, while in family takaful, investment profits are given directly to customers. Takaful operators may receive performance fees as incentives. Claim payments can be made directly through the blockchain.

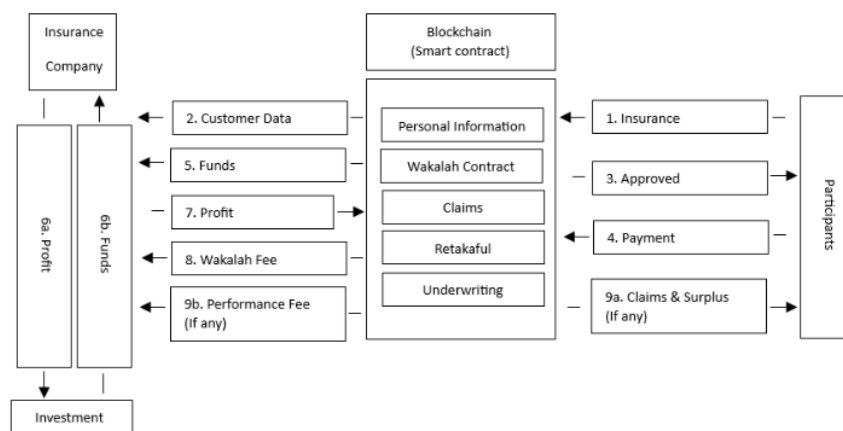


Figure 3. Smart contract system in takaful

Source: <https://alami.institute/learn/blockchain-untuk-keuangan-syariah>

An obstacle in the management of Zakat and Waqf is the need for more transparency and accountability of financial reports. Philanthropic organizations that collect money from the public must have high accountability. The implementation of blockchain in social fund management aims to create a single data source that stakeholders can use as a reference. Smart contracts make it easier for contributors such as Muzaki and Wakif to access and monitor the distribution of their social funds. Public trust in Amil and Nazir will also increase. Zakat and waqf institutions can reduce monitoring audit costs by using a simple monitoring system. Blockchain increases transparency by allowing donors to track their donations using a blockchain tracking system and receive notifications when donations reach

their intended recipients (Dubey et al., 2020). Blockchain increases the value and accelerates the receipt of zakat and waqf funds.

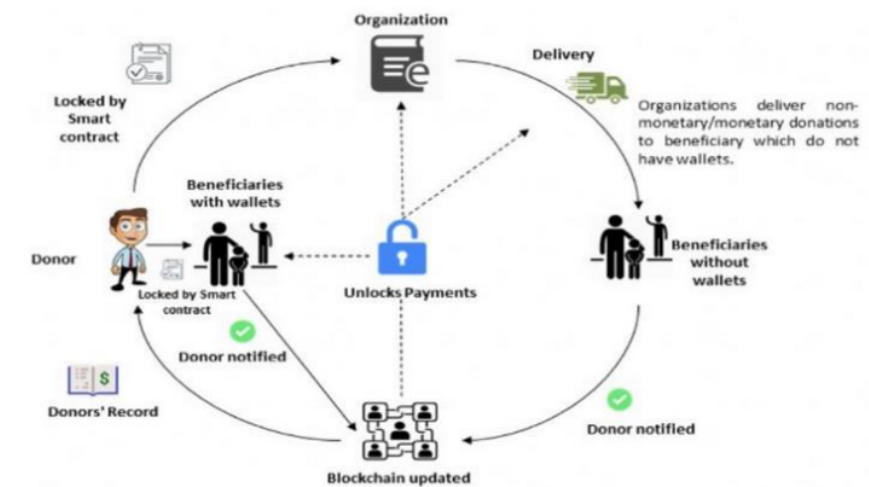


Figure 4. Smart contract system in the Sharia Social Fund

Source: <https://alami.institute/learn/blockchain-untuk-keuangan-syariah>

Challenges and Barriers to Implementation

Implementing a blockchain-based Islamic financial system faces several challenges that must be overcome (Elasrag, 2019). First, it requires adequate technological infrastructure, including a reliable blockchain network, high transaction speed, and guaranteed system security. To overcome this challenge, it is necessary to build a solid technological infrastructure and adopt blockchain technology that complies with the principles of Islamic finance. The next challenge is understanding and awareness of Islamic finance and blockchain technology. To overcome this, intensive education and socialization efforts are needed about Islamic finance and the benefits of using blockchain technology in Islamic finance. Collaboration between academics, practitioners, and regulators is also needed to increase this understanding and awareness.

Regulations that have yet to accommodate blockchain-based Islamic financial systems implementation fully are also challenging. Collaborative efforts between regulators, legal experts, and Islamic finance practitioners are needed to develop regulations that suit the needs of blockchain implementation in Islamic finance (Alaeddin et al., 2021). Trust and security

are also significant challenges. Robust security mechanisms, effective auditing systems, and fair and transparent fulfilment of Islamic finance principles are needed to build trust in implementing blockchain-based Islamic financial systems (Chong, 2021). By addressing these challenges, implementing a blockchain-based Islamic financial system can become more efficient, transparent, and compliant with the principles of fair Islamic finance.

Case Study: Blockchain Implementation Project in Islamic Finance

In this section, a case study will be taken that illustrates the implementation of blockchain technology in Islamic finance, namely "Al Hilal Bank: Transforming Sukuk Transactions with Blockchain". This case study will illustrate how blockchain technology can improve efficiency and transparency in Islamic finance.

Al Hilal Bank, a state-owned financial institution in the United Arab Emirates, made history as the first Islamic bank in the world to implement Sukuk transactions using blockchain technology. In a secondary market deal, Al Hilal Bank used a digital book of transactions (blockchain) to resell and repay a portion of its US\$0.5 billion sukuk issued two months ago. The scheduled maturity date of the Sukuk is September 2023. According to Alex Coelho, CEO of Al Hilal Bank, integrating blockchain in the Sukuk offering will enhance transaction security and ensure compliance with Sharia law. Furthermore, using smart contracts in the Sukuk provides additional benefits, such as more secure transactions, substantial Sharia compliance, and new opportunities opening up. Implementing innovative sukuk will also improve transaction efficiency and reduce overhead costs incurred during the issuance and settlement.

In this case study, an Islamic bank worked with a blockchain technology company to develop a platform that facilitates a more efficient and transparent Murabaha transaction process. Some of the key features of the project include:

1. **Digital Identity:** Through blockchain technology, each party involved in a Murabaha transaction will have a unique and verified digital identity. This helps ensure the legitimacy and authenticity of each transaction.
2. **Smart Contract:** Smart contracts are implemented in this platform to automate the Murabaha transaction process. These smart contracts ensure that all terms and conditions of the transaction are met automatically, reducing the need for human intervention.
3. **Distributed Transaction History:** Every Murabaha transaction is recorded in a distributed manner on the blockchain network. This

allows all interested parties, including customers, banks, and regulatory authorities, to monitor and verify transactions easily.

4. **Transparent Audit and Tracking:** The platform provides transparent auditing and tracking capabilities for every Murabaha transaction. Authorized parties can access and verify Information in the blockchain, increasing accountability and trust.

Through the implementation of Blockchain technology, Islamic banks, in this case, Al Hilal Bank, have succeeded in increasing the efficiency of the Murabaha transaction process, reducing administrative costs, and strengthening transparency in Islamic finance.

Comparative Analysis with Conventional Financial System

This section analyses the differences between blockchain-based financial systems in Islamic finance and conventional financial systems. This analysis will provide a better understanding of the benefits and advantages offered by blockchain technology in the context of Islamic finance. The following are some of the parameters of such comparison:

1. **Transparency and Auditability**

Conventional Financial System: Conventional financial systems often lack transparency. Information and transaction details are often complex for interested parties to access. The audit process can also be complicated and time-consuming. **Blockchain-based Financial System:** In blockchain-based financial systems, transparency is one of the critical characteristics. All authorised parties can access Every transaction permanently recorded in the blockchain. This allows for easier auditing, higher transparency, and increased trust between the parties involved (Dahdal et al., 2022).

2. **Data Security and Integrity**

Conventional Financial System: The conventional financial system is vulnerable to security risks and data manipulation. Irresponsible parties can alter or manipulate data quickly, resulting in financial losses and doubts. **Blockchain-Based Financial System:** Blockchain technology has a high level of security as every transaction is cryptographically recorded and connected in an immutable blockchain. Data manipulation becomes more complex as changes to one block affect the entire chain. This provides higher security and integrity to blockchain-based financial systems (Wibowo & Sumari, 2020).

3. **Efficiency and Cost**

Conventional Financial System: Conventional financial system processes often involve intermediaries and time-consuming stages. This results in increased operational costs and delays in transaction processing. **Blockchain-**

based Financial System: Blockchain technology can improve efficiency in the financial system. Transactions can be processed directly between the parties involved, eliminating unnecessary intermediaries. This reduces operational costs and speeds up the transaction process (Azimov, 2021).

4. Individual Empowerment

Conventional Financial System: Conventional financial systems often give excellent control to financial institutions and central authorities. Individuals tend to have a dependency on such institutions and authorities. Blockchain-based Financial System: Individuals have greater control over their assets and transactions in blockchain-based financial systems. They can directly access their data and assets, reducing dependence on institutions and authorities (Abojeib & Habib, 2021).

Development Potential and Future of Blockchain-Based Islamic Finance

Blockchain technology has great opportunities to transform and enrich the Islamic finance industry. Here are some of the potential developments and future developments that can be expected from the implementation of blockchain technology in Islamic finance:

1. Improved Accessibility and Speed.

Blockchain technology can increase the accessibility of Islamic financial services to a broader community (Rabbani et al., 2020). With the adoption of this technology, individuals can access Islamic financial services without geographical restrictions or administrative barriers. In addition, blockchain transactions can be processed more quickly and efficiently, reducing the time required for financial transaction processing.

2. High Security and Trust.

Blockchain-based Islamic finance offers high security and trust (Kamdzhlov, 2020). This technology uses strong cryptography to protect data and transactions, reducing the risk of manipulation and data leakage. In Islamic finance, security and trust are essential to ensure compliance with Shariah principles and integrity in the execution of transactions.

3. Removal of Intermediaries

Implementing blockchain technology in Islamic finance can eliminate unnecessary intermediaries in the financial process (Antova & Tayachi, 2020). Smart contracts allow parties to make transactions directly between themselves, reducing costs and dependence on traditional financial institutions. Smart contracts can promote financial inclusion, especially for people who do not have access to conventional financial institutions.

4. Traceability and Accountability.

Blockchain technology enables transparent and immutable recording of transactions (Khurshid, 2020). It provides the ability to trace the origin and journey of an asset or fund in Islamic finance. With openly verified transaction records, monitoring and auditing becomes easier. It also helps ensure compliance with Sharia principles in the execution of financial transactions. With the implementation of blockchain technology in Islamic finance, positive changes are expected in terms of accessibility, security, efficiency, and compliance with Sharia principles, which will contribute to advancing the Islamic finance industry in a more innovative and inclusive direction.

CONCLUSIONS

In the age of digital technology, Islamic markets face significant challenges and opportunities. The disruption of the Islamic market can bring positive and negative impacts depending on the strategies Islamic companies and businesses take. Some of the key challenges include changing patterns of Muslim consumers, intensifying competition, difficulties in adopting new technologies, and regulatory challenges. However, Islamic market disruption also provides excellent opportunities for businesses to improve operational efficiency, expand market reach, product and service innovation, and improve financial capabilities. To deal with Islamic market disruption in the era of digital technology, Islamic companies and businesses can implement several strategies, including increasing product and service innovation, building strategic partnerships with technology companies, improving skills and knowledge of technology, and improving communication and transparency. By adopting these strategies, Islamic companies and businesses can be better prepared to face the disruption of the Islamic market in the era of digital technology and take advantage of the opportunities for sustainable business growth.

The implementation of blockchain technology in Islamic finance has significant implications. First, it can address corruption, money laundering, and illegal transactions. Financial transactions are recorded transparently and reliably, reducing the risk of data manipulation. Second, decentralized finance provides fair opportunities for individual participation. Blockchain-based systems enable direct transactions and the inclusion of previously neglected communities. Third, blockchain-based Sharia design increases transparency and accountability. The immutable recording of transactions facilitates monitoring and auditing. Shariah principle compliance can be maintained, and trust built in Islamic financial transactions. Several

recommendations can be used as guidelines for developing blockchain-based Islamic finance: First, regulators and financial institutions should proactively study and create appropriate regulations so that Islamic finance can safely use blockchain technology and comply with Sharia principles. Second, increase collaboration between the Islamic finance industry, academia, and the blockchain community for research, knowledge, and testing of innovative concepts. Finally, raise awareness through education campaigns and training for practitioners, academics, and the public to understand blockchain technology's potential, benefits, challenges and risks in Islamic finance.

REFERENCES

- Abdeen, M., Jan, S., Khan, S., & Ali, T. (2019). Employing Takaful Islamic banking through state of the art blockchain: A case study. *International Journal of Advanced Computer Science and Applications*, 10(12), 648–654. <https://doi.org/10.14569/ijacsa.2019.0101283>
- Abojeib, M., & Habib, F. (2021). Blockchain for Islamic Social Responsibility Institutions. *Research Anthology on Blockchain Technology in Business, Healthcare, Education, and Government*. <https://api.semanticscholar.org/CorpusID:159680571>
- Abu Bakar, R., Abd Aziz, N., & Rosley, R. Z. (2022). Awareness of Gharar in Sale and Purchase Contracts Among Kuala Nerus Society. *Journal of Islamic, Social, Economics and Development*, 7(43), 29–39. <https://doi.org/10.55573/jised.074303>
- Alaeddin, O., Dakash, M. Al, & Azrak, T. (2021). Implementing the Blockchain Technology in Islamic Financial Industry: Opportunities and Challenges. *Journal of Information Technology Management*, 13(3), 99–115. <https://doi.org/10.22059/JITM.2021.83116>
- Alfarisi, M. F., Agestayani, A., & Delfiani, S. (2020). The Impact of Islamic Economics and Finance Courses on Islamic Financial Literacy. *Iqtishadia*, 13(2), 197. <https://doi.org/10.21043/iqtishadia.v13i2.7757>
- Antova, I., & Tayachi, T. (2020). Blockchain and Smart Contracts: A Risk Management Tool for Islamic Finance. *Journal of Islamic Financial Studies*, 05(01), 29–42. <https://doi.org/10.12785/jifs/050103>
- Aydar, M., & Ayvaz, S. (2019). Towards a Blockchain based digital identity verification, record attestation and record sharing system. *ArXiv, abs/1906.0*. <https://api.semanticscholar.org/CorpusID:195345355>
- Azimov, D. (2021). Analysis of the international experience of implementing blockchain technology. *IEEE Access*, 2, 138–149. <https://api.semanticscholar.org/CorpusID:236574873>
- Bhattacharjee, A., Badsha, S., Shahid, A. R., Livani, H., & Sengupta, S. (2020). Block-Phasor: A Decentralized Blockchain Framework to Enhance

- Security of Synchrophasor. *2020 IEEE Kansas Power and Energy Conference (KPEC)*, 1–6.
<https://doi.org/10.1109/KPEC47870.2020.9167676>
- Biancone, P. P., & Radwan, M. (2019). Social Finance and Financing Social Enterprises. *EJIF : European Journal of Islamic Finance*, 0(0), 50–61.
- Biswas, S., Sharif, K., Li, F., Nour, B., & Wang, Y. (2019). A Scalable Blockchain Framework for Secure Transactions in IoT. *IEEE Internet of Things Journal*, 6(3), 4650–4659.
<https://doi.org/10.1109/JIOT.2018.2874095>
- Cao, S., William Cong, L., & Yang, B. (2019). Financial Reporting and Blockchains: Audit Pricing, Misstatements, and Regulation. *Regulation of Financial Institutions Ejournal*, June.
<https://ssrn.com/abstract=3248002>
- Chong, F. H. L. (2021). Enhancing trust through digital Islamic finance and blockchain technology. *Qualitative Research in Financial Markets*, 13(3), 328–341. <https://doi.org/10.1108/QRFM-05-2020-0076>
- Dahdal, A., Truby, J., & Ismailov, O. (2022). The Role and Potential of Blockchain Technology in Islamic Finance. *European Business Law Review*, 175–192.
<http://www.kluwerlawonline.com/api/Product/CitationPDFURL?file=Journals%5CEULR%5CEULR2022005.pdf>
- Dos Santos, S., Singh, J., Thulasiram, R. K., Kamali, S., Sirico, L., & Loud, L. (2022). A New Era of Blockchain-Powered Decentralized Finance (DeFi) - A Review. *2022 IEEE 46th Annual Computers, Software, and Applications Conference (COMPSAC)*, 1286–1292.
<https://doi.org/10.1109/COMPSAC54236.2022.00203>
- Dubey, R., Gunasekaran, A., Bryde, D. J., Dwivedi, Y. K., & Papadopoulos, T. (2020). Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. *International Journal of Production Research*, 58(11), 3381–3398.
<https://doi.org/10.1080/00207543.2020.1722860>
- Elasrag, H. (2019). Blockchains for Islamic finance: Obstacles & Challenges. *Munich Personal RePEc Archive*, 03, 1–39. <https://mpra.ub.uni-muenchen.de/92676/>
- Gaikwad, A. S. (2020). Overview of Blockchain. *International Journal for Research in Applied Science and Engineering Technology*, 8(6), 2268–2270. <https://doi.org/10.22214/ijraset.2020.6364>
- Hamza, O. (2020). Smart Sukuk Structure from Sharia Perspective and Financing Benefits: Proposed Application of Smart Sukuk through Blockchain Technology in Islamic Banks within Turkey. *EJIF – European Journal of Islamic Finance, Second Special Issue*, 1–8.
<https://www.ojs.unito.it/index.php/EJIF/article/view/3983>
- Harahap, B., & Risfandy, T. (2022). Islamic Organization and the Perception of riba (Usury) and Conventional Banks Among Muslims: Evidence From

- Indonesia. *SAGE Open*, 12(2).
<https://doi.org/10.1177/21582440221097931>
- Hilal, F. B., Faridah, N., & Jamaludin, B. (2019). Contemporary Management and Science Issues in the Halal Industry. In *Contemporary Management and Science Issues in the Halal Industry*. Springer Singapore. <https://doi.org/10.1007/978-981-13-2677-6>
- Ibrahim, M. H. (2019). Capital regulation and islamic banking performance: Panel evidence. *Buletin Ekonomi Moneter Dan Perbankan*, 22(1), 47–67. <https://doi.org/10.21098/bemp.v22i1.1029>
- Iftekhar, A., Cui, X., & Yang, Y. (2021). Blockchain technology for trustworthy operations in the management of strategic grain reserves. *Foods*, 10(10). <https://doi.org/10.3390/foods10102323>
- Kamdzhlov, M. (2020). Islamic Finance and the New Technology Challenges. *European Journal of Islamic Finance*, May 2020, 1–5. <http://ezproxy.lib.swin.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=142574990&site=ehost-live&scope=site>
- Kanwal, A. (2022). The prohibition of speculation in Islamic finance: fairness and framing. *International Journal of Islamic and Middle Eastern Finance and Management*, 15(1), 146–157. <https://doi.org/10.1108/IMEFM-01-2021-0034>
- Khurshid, A. (2020). Applying blockchain technology to address the crisis of trust during the COVID-19 pandemic. *JMIR Medical Informatics*, 8(9), 1–9. <https://doi.org/10.2196/20477>
- KR, D. V., & K, M. (2022). The Emergence of Decentralized Business Models: Blockchain Interruption and Decentralized Finance. *International Journal for Research in Applied Science and Engineering Technology*, 10(6), 2165–2171. <https://doi.org/10.22214/ijraset.2022.44168>
- Krytsula, A. A. (2022). Legal Regulation of Smart Contracts. *Rossiiskoe Pravosudie*. <https://api.semanticscholar.org/CorpusID:254902780>
- Li, S., Zhao, S., Yang, P., Andriotis, P., Xu, L., & Sun, Q. (2019). Distributed Consensus Algorithm for Events Detection in Cyber-Physical Systems. *IEEE Internet of Things Journal*, 6(2), 2299–2308. <https://doi.org/10.1109/JIOT.2019.2906157>
- Liu, B., Xiao, L., Long, J., Tang, M., & Hosam, O. (2020). Secure Digital Certificate-Based Data Access Control Scheme in Blockchain. *IEEE Access*, 8, 91751–91760. <https://doi.org/10.1109/ACCESS.2020.2993921>
- Moosavi, J., Naeni, L. M., Fathollahi-Fard, A. M., & Fiore, U. (2021). Blockchain in supply chain management: a review, bibliometric, and network analysis. *Environmental Science and Pollution Research*. <https://doi.org/10.1007/s11356-021-13094-3>
- Muneeza, A., & Mustapha, Z. (2019). Halal Cryptocurrency Management. In *Halal Cryptocurrency Management*. Springer International Publishing.

- <https://doi.org/10.1007/978-3-030-10749-9>
- Naim, A. M., Isa, M. Y., & Hamid, M. L. (2020). *Islamic Finance: Legal Frameworks, Practices and Shariah Criteria Review* (UUM Press). Penerbit Universiti Utara Malaysia.
- <https://books.google.com.my/books?id=jdAOEAAAQBAJ>
- Rabbani, M. R., Khan, S., & Thalassinou, E. I. (2020). FinTech, Blockchain and Islamic Finance: An Extensive Literature Review. *International Journal of Economics and Business Administration*. <https://api.semanticscholar.org/CorpusID:213543684>
- Rachmawaty, R., Pandaya, K. D., & Mohammed Al Azab, A. J. (2019). The Implementation of Wakalah Contract by Multifinance Companies in Indonesia. *International Journal of Islamic Economics*, 1(01), 79. <https://doi.org/10.32332/ijie.v1i01.1577>
- Shinkafi, A. A., Yahaya, S., & Sani, T. A. (2020). Realising financial inclusion in Islamic finance. *Journal of Islamic Marketing*, 11(1), 143–160. <https://doi.org/10.1108/JIMA-02-2017-0020>
- Song, H., & Chen, Y. (2021). Digital Financial Transaction Security Based on Blockchain Technology. *Journal of Physics: Conference Series*, 1744(3). <https://doi.org/10.1088/1742-6596/1744/3/032029>
- Swamiraj Jadhav. (2022). Blockchain Based Crowdfunding System. *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, 10(XII). <https://medium.com/@arifwicaksanaa/pengertian-use-case-a7e576e1b6bf>
- Wang, B., Dabbaghjamesh, M., Kavousi-Fard, A., & Mehraeen, S. (2019). Cybersecurity Enhancement of Power Trading Within the Networked Microgrids Based on Blockchain and Directed Acyclic Graph Approach. *IEEE Transactions on Industry Applications*, 55(6), 7300–7309. <https://doi.org/10.1109/TIA.2019.2919820>
- Wibowo, S. N., & Sumari, A. D. W. (2020). The Utilization of Blockchain for Enhancing Big Data Security and Veracity. *Advanced Sciences and Technologies for Security Applications*. <https://api.semanticscholar.org/CorpusID:219961040>
- Williams, V., Boylan, A. M., & Nunan, D. (2020). Critical appraisal of qualitative research: Necessity, partialities and the issue of bias. *BMJ Evidence-Based Medicine*, 25(1), 9–11. <https://doi.org/10.1136/bmjebm-2018-111132>
- Yadav, S. P., Agrawal, K. K., Bhati, B. S., Al-Turjman, F., & Mostarda, L. (2022). Blockchain-Based Cryptocurrency Regulation: An Overview. *Computational Economics*, 59(4), 1659–1675. <https://doi.org/10.1007/s10614-020-10050-0>
- Zetzsche, D. A., Arner, D. W., & Buckley, R. P. (2020). Decentralized finance. *Journal of Financial Regulation*, 6(2), 172–203. <https://doi.org/10.1093/jfr/fjaa010>



Zhai, S., Yang, Y., Li, J., Qiu, C., & Zhao, J. (2019). Research on the Application of Cryptography on the Blockchain. *Journal of Physics: Conference Series*, 1168(3). <https://doi.org/10.1088/1742-6596/1168/3/032077>

EL DINAR Blockchain _Iman Rahma Rukhul 1

ORIGINALITY REPORT

7%

SIMILARITY INDEX

2%

INTERNET SOURCES

3%

PUBLICATIONS

4%

STUDENT PAPERS

PRIMARY SOURCES

1

Submitted to Universitas Islam Indonesia

Student Paper

4%

2

www.mdpi.com

Internet Source

1%

3

pure.port.ac.uk

Internet Source

1%

4

James Simon Watkins. "Islamic Finance and Global Capitalism", Springer Science and Business Media LLC, 2020

Publication

1%

5

"Fintech, Digital Currency and the Future of Islamic Finance", Springer Science and Business Media LLC, 2021

Publication

1%

Exclude quotes On

Exclude matches < 1%

Exclude bibliography On

EL DINAR Blockchain _Iman Rahma Rukhul 1

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25
