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# DECENTRALIZED ISLAMIC FINANCE: HARNESSING BLOCKCHAIN TECHNOLOGY

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***Abstract***

*This study aims to understand how blockchain technology can be used to build a decentralized Islamic financial system. The method used in this research is literature analysis, which is further validated by case studies. The data analysis process was conducted using Systematic Literature Review (SLR) methodology. The main data sources were scientific publications, academic journals, books, and other reputable materials relevant to the research problem. The results of this study show that Blockchain Technology has the potential to reduce the dangers of corruption, money laundering, and illicit activities in the Islamic financial system. Moreover, the use of blockchain technology in decentralized finance ensures equitable access to participation in the financial ecosystem, thereby promoting the inclusion of minority populations. The challenges in implementing blockchain technology within the context of Islamic banking are also highlighted in this study. The contribution and implementation of this research are expected to offer insights into the potential of blockchain technology in constructing a decentralized Islamic financial system, guiding practitioners and academics toward innovative and sustainable solutions in Islamic finance.*

**Keywords***: Islamic Finance; Blockchain Technology; Decentralized; Financial System; Innovation*

**Abstrak**

Tujuan dari penelitian ini untuk memahami secara komprehensif bagaimana teknologi blockchain dapat digunakan dalam membangun sistem keuangan syariah yang terdesentralisasi. Metode yang digunakan pada penelitian ini analisis literatur yang selanjutnya divalidasi dengan studi kasus. Proses analisis data dilakukan dengan metodologi Systematic Literature Review (SLR). Sumber data utama terdiri dari publikasi ilmiah,

jurnal akademik, buku, dan bahan bereputasi lainnya yang relevan dengan permasalahan penelitian. Hasil penelitian ini menjelaskan bahwa Teknologi Blockchain berpotensi mengurangi bahaya korupsi, pencucian uang, dan aktivitas terlarang dalam sistem keuangan Islam. Selain itu, pemanfaatan teknologi blockchain dalam keuangan terdesentralisasi memastikan akses yang adil bagi semua orang dan mendorong integrasi populasi yang minoritas. Tantangan dalam penerapan teknologi blockchain dalam konteks perbankan syariah juga disorot dalam penelitian ini. Kontribusi dan implimentasi dari 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

## INTRODUCTION

The Islamic finance industry has progressed over the past few years (Batorshyna et al., 2021). According to the Indonesia Financial Services Authority (2022), global Islamic finance assets were worth US$3.96 trillion in 2021, up from US$3.39 trillion in 2020, marking a 16.76% increase, in line with the positive trend in previous years. It is projected to reach US$5.90 trillion by 2026, assuming continued openness of the global economy. The Islamic finance sector recorded the most notable growth, with an increase of 33.7%, whereas 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 the total Islamic finance assets, recorded a growth of 17% during the year. Positive developments in new and emerging markets in Central Asia and North Africa, such as Kazakhstan, Tajikistan, and Algeria, have driven this growth. It expanded its market share with significant growth in countries such as Tajikistan (84%), Burkina Faso (27%), and Ethiopia (26%). Digitalization remains a key trend in Islamic banking. In 2021, Bank Negara Malaysia approved two digital Islamic banks as part of this effort (Indonesia Financial Services Authority, 2022). The Islamic insurance sector is also transforming into a technology-based system (Mitrev, 2023).

However, the digitization of the world, while bringing innovation, has yet to cope with the essential challenges confronted by Islamic finance (Nikolić, 2023). Therefore, blockchain technology must be considered as a viable solution. Blockchain technology has attracted significant interest. A blockchain is a decentralized system that employs a network to securely record and authenticate transactions in a transparent and unchangeable manner

(Gaikwad, 2020). It holds significant promise in establishing a decentralized Islamic financial system within the realm of Islamic finance (Dahdal et al., 2022). Utilizing this technology enhances the efficiency, transparency, and accountability of Islamic financial transactions (Chong 2021). Its decentralized system can facilitate broader financial inclusion for people and communities who have previously faced challenges in accessing financial services (Popescu, 2022). Blockchain, with its stable, transparent, and immutable decentralized community, provides a high-quality capacity to build a decentralized Islamic financial machine (Dahdal et al., 2022).

It is essential to compare decentralized finance (DeFi) and centralized finance (CeFi), both of which utilize blockchain technology (Qin et al., 2021). Although CeFi also utilizes blockchain, there are significant differences to consider (Tariq et al., 2019). DeFi provides more open, transparent, and unmediated entry, while CeFi entails conventional economic institutions as intermediaries (Weingärtner et al., 2023). While DeFi emphasizes decentralization, CeFi ensures stability and clearer consumer safeguards, as it operates under the regulation of financial bodies (Qin et al., 2021). DeFi's decentralization enables broader participation from people who desire for 1/3-party involvement (Hari 2023). DeFi brings about advancements, reduced fees, for transactions, and wider accessibility for individuals who previously faced obstacles in accessing financial services (Inzirillo & de Quenetain 2022). By embracing DeFi, people can oversee their assets without depending on their establishments (Schueffel, 2021).

Decentralized finance could offer advantages in tackling industry hurdles (Chohan 2021). Key factors to consider when opting for DeFi encompass adherence to Shariah principles fostering inclusion and enhancing efficiency and transparency. DeF is decentralized in nature, and transparent processes can guarantee that each transaction abides by Shariah tenets (Majumdar & Gochhait, 2022). This helps decrease the chances of usury practices against Islam (Kwon, 2023). DeFi allows fairer access to services for individuals who struggle with traditional financial systems (Salami, 2021). Utilizing DeFi enhances transaction efficiency and transparency, leading to cost savings and boosting stakeholder trust in the financial sector (Jiang et al., 2023).

Several studies have been conducted on the application of blockchain technology to Islamic finance. Antova and Tayachi (2020) highlight the possibility of blockchain applications to enhance operational efficiency, transparency, and security with Islamic Finance. These include greater access and public engagement in Islamic finance. In addition, Alaeddin et al. (2021) reviewed different blockchain applications and examined their consequences and focal points in the Islamic account industry. Their research offers a more

detailed overview of how blockchain technology may have the potential to drive the development of the Islamic finance sector. Abdeen et al. (2019) offer a wide range of blockchain-use cases across various areas of Islamic finance. Moosavi et al. (2021) disclosed the promising future of blockchain technology in terms of efficiency, transparency, and security in the Islamic finance landscape, benefiting from wider accessibility to open participation in the Islamic finance sector.

It is important to note that while previous studies have highlighted blockchain's potential in Islamic finance, there are still research gaps to explore further, particularly in understanding anomaly indicators in this area. A separate study is needed to explore the priority research area of a blockchain-based decentralized Islamic financial system, focusing on tackling current implementation challenges and gaining deeper insights into scalability and potential benefits within the Islamic financial system context. Additionally, this study explores the social, legal, and regulatory factors that complement studies on how the application of blockchain in Islamic Finance may involve modifying strategies. A better proposition might pertain to the vast talent and knowledge of Sharia and scholars who seem to be able to explain even the most complex actions in terms of rights and obligations; however, they are also added to the novatus litterarum blockchain technology. As a result, research on social impact and legal and regulatory matters is critical for the successful application of blockchain technology in the field of Islamic finance.

This study explains the use of blockchain technology in constructing a decentralized Islamic economic gadget. The blockchain era, with its precise traits including protection, transparency, and incapability, can offer solutions to a number of challenges faced by Islamic finance enterprises. This paper discusses the basic concepts of Islamic finance, the introduction of blockchain technology, and its potential implementation in the Islamic finance industry, and analyzes the benefits, challenges, and future development of blockchain-based Islamic finance. This study aims to enhance the understanding of how blockchain technology can build a decentralized Islamic financial system, potentially addressing challenges and opening new avenues for growth in the Islamic finance industry.

## LITERATURE REVIEW

### Basic Concepts of Islamic Finance

Islamic finance refers to banking principles rooted in Islam that aim to regulate financial transactions in accordance with the Sharia law (Naim et al., 2020; Monzur-E-Elahi & Alam, 2022). It adheres to the moral and ethical standpoint of Islamic finance practices to regulate and harmonize economic

aspects and social justice (Ayub et al., 2023). Transactions in Islamic finance are expected to be transparent, disclosing prices, goods being traded, and all other transaction terms (Bakar et al., 2022). Islamic transactions should shy away from dubious gambling and speculations, and be upright against one and all (Kanwal, 2022).

The first and main principle of Islamic finance is a ban on usury. Usury refers to the interest or riba (Harahap & Risfandy, 2022). The prohibition against gharar, excessive uncertainty, and vagueness in transactions (Kuznetsova & Tenberga, 2022) is another main principle in Islamic finance (Farikhin & Mulyasari, 2022). In addition, maysir is prohibited, which is a term used for gambling or speculative practices (Simanjuntak et al., 2023). Lastly, Islamic finance prohibits investment or business activities involving goods or activities that are prohibited in Islam, such as business in alcohol, pork, or unethical practices (Budiyanti et al., 2021). This reflects the basic principle that demonstrates the demand for a compatible investment in an Islamic way of life and the social liability that Islamic finance brings about as an Islamic finance product (Osman & Elamin, 2023

Islamic finance provides a range of products that adhere to Sharia principles (Faruq 2021). One is Mudarabah, which is a collaborative agreement between investors (rab al maal) and managers (mudarib) (Naim et al., 2020), where profit and risk sharing are determined through agreement between the parties (Bakti et al., 2022). Another option is Musharakah, which entails partnership or cooperation among parties for specific business ventures or projects (Ishak et al., 2023). Both parties share profits and risks (Ishak et al. 2023). Wakalah is a tool in which one party entrusts another party to oversee its assets or business operations (Rachmawaty et al., 2019). The individual granting trust is known as the principal, while the one managing it is called the representative (Musjtari & Kencana 2020). Sukuk represents an instrument that provides ownership or involvement in productive assets (Naim et al., 2020). Sukuk is directed by Sharia principles, ensuring that the income circulation generated from the efficient asset is Sharia-compliant (Bakar et al., 2023). Islamic finance offers Shariah-compliant alternatives through various products and contracts, enabling businesses to invest in a manner that promotes fair and sustainable financial practices (Budiyanti et al., 2021).

According to Dawood et al. (2022), the Islamic finance industry is facing several obstacles. One of the most critical challenges is the limited infrastructure (Muhammad & Lanaula, 2019), which is capable of adequately supporting Islamic products and services (Hassan et al., 2022; Shinkafi et al., 2020). Another challenge is the growth and enforcement of suitable

regulations (Ibrahim 2019). Regulation and standards are important undertakings in Islamic finance (Hassan et al., 2019). Clear and steady rules and standards are needed to ensure that economic transactions and products comply with the Shariah standards (Muryanto, 2022). Awareness and education are crucial challenges in the Islamic finance industry, requiring a broader understanding of its principles and benefits among industry stakeholders and the public. Proper and systematic training in Islamic finance is fundamental to improving expertise and broadening its use base (Alfarisi et al., 2020).

## Blockchain Technology

Blockchain is a decentralized and transparent technology used to record and validate transactions (Iftekhar et al., 2021) using a distributed network of interconnected computers. Every transaction is gathered and interconnected in blocks to create a chain. Each block possesses a distinct digital signature and contains unchangeable data (Liu et al., 2020). Therefore, blockchain technology guarantees the protection and accuracy of data while eliminating the requirement of a central governing body to verify transactions. The utilization of blockchain technology in Islamic finance offers several advantages (Dahdal et al. 2022). Blockchain technology has the potential to enhance trust, transparency, and efficiency across multiple industries such as finance, logistics, and the public sector. The fundamental principles of blockchain include decentralized data structure, blockchain technology, security, and cryptography (Zhai et al., 2019). All transactions are permanently documented and can be accessed by all parties involved. This enhances confidence and responsibility in the Islamic banking system. Furthermore, the robust cryptographic capabilities of blockchain provide a superior level of security for monitoring transactions, and data are safeguarded against manipulation or illegal attacks. It also offers enhanced efficiency and reduced costs. Blockchain technology has the potential to minimize the likelihood of default. By utilizing smart contracts that are automatically performed based on specified criteria, blockchain technology enables transactions to be completed promptly and minimizes the likelihood of default or delayed payments. Ultimately, the integration of blockchain technology into the Islamic financial industry yields advantages in terms of enhanced transparency, heightened security, improved efficiency, and diminished arrears' risk. This enhances confidence in the Islamic financial system, and has the capacity to enhance service quality and operational efficiency.

The utilization of blockchain technology in Islamic finance holds significant promise (Alaeddin et al., 2021). Compliance with Sharia rules is

crucial in implementing blockchain technology in Islamic finance, ensuring adherence to norms, such as the prohibition of usury, gharar, and maysir.

An effective blockchain system requires sufficient infrastructure and the ability to process high transaction volumes efficiently. Optimal system scalability is crucial for upholding performance and dependability in Islamic banking. Compliance with Sharia rules is crucial in implementing blockchain technology in Islamic finance, ensuring adherence to norms like the prohibition of usury, gharar, and maysir. Establishing unambiguous regulations and robust compliance frameworks is crucial to ensure that the integration of blockchain technology into Islamic banking adheres to the stipulations and conditions of relevant legislation (Dahdal et al., 2022). Considering these elements, the deployment of blockchain technology in Islamic finance can successfully realize its full potential and strengthen the fundamental principles of Islamic finance.

## Decentralized Finance and Blockchain

Decentralized finance refers to a financial system that operates without centralization and does not depend on central authority or traditional intermediaries (Zetzsche et al., 2020). Decentralized finance involves the direct execution of transactions and administration of assets between parties using decentralized computer networks. Blockchain has made several notable contributions to decentralized finance: a) blockchain ensures high security and maintains data integrity in decentralized financial transactions through the use of cryptographic technology and network consensus (Bhattacharjee et al., 2020); b) smart contracts, enabled by blockchain, automate transaction execution based on predefined conditions, eliminating the need for intermediaries or third parties (Yadav et al., 2022); and c) blockchain records and makes every transaction permanently accessible to all parties involved, ensuring transparency and auditability. Decentralized finance benefits from increased transparency and improved auditability (Cao et al., 2019). This reduces administrative costs and accelerates transactions by eliminating conventional intermediaries (Wang et al., 2019).

DeFi utilizes blockchain technology to offer a wide range of financial services, without the need for traditional financial institutions. DeFi encompasses several services including loans, asset swaps, and staking. These services are accessible to consumers through blockchain, which provides safe and transparent infrastructure (Dos Santos et al., 2022). Blockchain technology enables cross-border remittances to be conducted with reduced costs and increased speed compared with traditional systems. This is achieved

by facilitating direct transactions between interested parties, thus eliminating the need for intermediary banking institutions.

Efficient management of large transaction volumes is an area in which blockchain technology still requires improvement (Biswas et al., 2019). To handle the growing transaction volume, it is necessary to enhance the infrastructure and supporting technologies of blockchain. Furthermore, the issue of regulation must be addressed. Decentralized finance is currently in its early stages and has not yet been fully regulated by a comprehensive framework. To establish legal certainty and maintain compliance with decentralized finance activities, it is imperative to have a uniform and transparent regulatory framework. Security is another crucial factor that must be considered when establishing decentralized finance. Despite the robust security measures of blockchain, the persistent danger of cyberattacks and data breaches necessitates proactive measures. Enhancing the security architecture, deploying strong encryption methods, and adhering to best practices are crucial for safeguarding decentralized banking systems.

## METHOD

This study focused on a literature review conducted through a case study. We employ a qualitative descriptive research methodology to gather and examine pertinent literature and case studies (Williams et al., 2020) to investigate how blockchain technology can be employed to construct a decentralized Islamic financial system. A systematic literature review (SLR) was conducted to identify gaps in the current research and provide insights for advancing future studies. The findings of this study are expected to contribute to recommendations for improvement and future development, including further research paths, practical implementation, and enhanced utilization of blockchain technology in the Islamic banking industry.

Data were collected through a methodological and comprehensive review of the existing literature. The main sources of data included scientific publications, academic journals, books, and other reputable materials relevant to the research topic, totaling 80 references. The data search was performed using electronic databases like Google Scholar, https://consensus.app, https://www.perplexity.ai/, and https://elicit.org/. The utilized keywords encompassed 'Islamic finance,' 'blockchain technology,' 'decentralized finance,' and similar terms.

A systematic literature review (SLR) methodology was used for data analysis. These stages involved identification, screening, evaluation, synthesis, and interpretation. Identification entails careful selection and identification of

data sources that are pertinent to the research topic. Screening refers to the process of evaluating and selecting data based on specific criteria for inclusion or exclusion. The evaluation involves assessing the quality and usefulness of each chosen data source. Synthesis is the process of amalgamating information from multiple sources to generate comprehensive insight. Interpretation refers to the process of analyzing findings and drawing conclusions based on the analysis conducted. To ensure the accuracy and reliability of the research, measures such as data triangulation and peer review were implemented to guarantee the precision of the results and suitability of the research approach according to relevant academic criteria.

## RESULTS AND DISCUSSION

### Blockchain-based Islamic Financial System Design

This section examines the development of a blockchain-based Islamic financial system by analyzing key elements, such as system architecture and components, system security and dependability, and the implementation of smart contracts in Islamic finance.

### System Architecture and Components

The concept of a blockchain-based Islamic financial system is a captivating idea in contemporary financial business. Blockchain is an emerging technology that facilitates data generation and transfer in a decentralized, transparent, and highly secure manner. The application of this technology in Islamic finance involves adherence to the Sharia principles that regulate financial transactions. The primary distinction between traditional and blockchain-based Islamic financial systems is the rules that govern their operations. Islamic financial systems prioritize the principles of equity, durability, and responsibility, whereas conventional systems prioritize profit maximization. Islamic finance can utilize many blockchain architectures, including public, private, and consortium structures (Antova and Tayachi, 2020). Every architectural style possesses both benefits and drawbacks, which must be carefully evaluated throughout its implementation.

The fundamental elements of a blockchain-based Islamic financial system encompass the blockchain network and its nodes, digital identification, and utilization of tokens. The blockchain network serves as the foundation for the infrastructure that sustains Islamic financial transactions. Simultaneously, digital identity and membership encompass the process of confirming and authenticating individuals within a system (Aydar & Ayvaz, 2019). Utilizing tokens in a blockchain-based Islamic financial system offers convenience and transparency in upholding Sharia standards for all transactions.

### System Security and Reliability

Blockchain network security and preservation of financial transaction data are crucial for ensuring the security of digital assets and maintaining data integrity (Song & Chen, 2021). An Islamic financial system that utilizes blockchain technology must also recognize and tackle the security risks associated with the Sharia principles, which must adhere to establish confidence and gain public approval of this technology. The consensus mechanism of blockchain technology ensures the dependability of transactions by requiring a distributed network to verify and approve each transaction (Li et al. 2019). The incorporation of fault tolerance and redundancy into blockchain-based Islamic financial systems effectively mitigates any issues that may arise during financial transactions.

Ensuring the ability of a system to handle increasing workloads and maintain efficient operations is crucial for processing Islamic financial transactions (Dahdal et al., 2022). The system must efficiently handle large transaction volumes without undermining existing Sharia principles. Appropriate infrastructure and technological investment are required. To construct a robust and trustworthy blockchain-driven Islamic financial system, it is imperative to examine and execute suitable methods to uphold the security, dependability, and efficiency required to handle intricate Islamic financial transactions.

### Smart Contracts in the Context of Islamic Finance

Smart Contracts are computer programs that automatically execute agreements based on preset rules and conditions (Krytsula, 2022). Smart contracts can effectively apply Islamic finance principles with transparent and secure blockchain technology, as highlighted by Antova and Tayachi (2020). The benefits of smart contracts in Islamic finance derive from the elimination of intermediaries and the related expenses of traditional intermediation, resulting in reduced complexity and the possibility of usury (Hilal et al., 2019). This potential encompasses enhanced operational efficiency, improved accessibility to financial services, and heightened awareness and adherence to Islamic financial principles. Smart contracts can be utilized across multiple domains in Islamic finance. It facilitates automated financing, streamlines administrative processes, and enhances transparency. It can be employed in the Islamic insurance sector to streamline the process of making claims and payments in accordance with Sharia requirements for insurance and Takaful contracts. Furthermore, it automatically implements investment and microfinance agreements, thereby facilitating the provision of equitable and accessible financial services to the underserved areas.

The utilization of smart contracts in Islamic finance presents a promising opportunity to enhance its principles of Islamic finance by leveraging cutting-edge blockchain technology (Alaeddin et al., 2021). Through the use of smart contracts, Islamic finance can enhance its efficiency (Antova & Tayachi, 2020), transparency, and inclusivity, thereby facilitating individuals' access to financial services that adhere to the principles of Islamic finance. By integrating the concepts of Islamic finance with blockchain technology, it is possible to develop a contemporary Islamic financial system that aligns with Islamic ideas.

At least three Islamic financial products and instruments can utilize the blockchain system through smart contracts: sukuk, takaful, and Islamic social funds. The successful growth of sukuk depends on the standardization of Sharia interpretation and clear legal documentation. Smart contracts accelerate the sukuk issuance process, which is complex and time consuming (Figure 1). The blockchain system in innovative sukuk eliminates intermediaries, simplifies the documentation process, and strengthens the 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 performed within 30 instead of five days. The main benefits of blockchain are increased efficiency and transparency. Blockchain systems play an essential role in accelerating customer data verification and claim 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, thereby avoiding delays and reducing unnecessary bureaucracy.

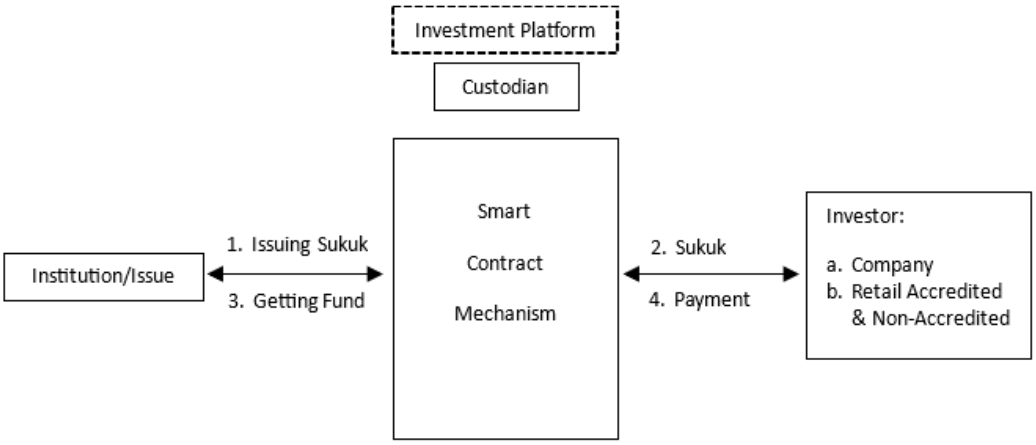
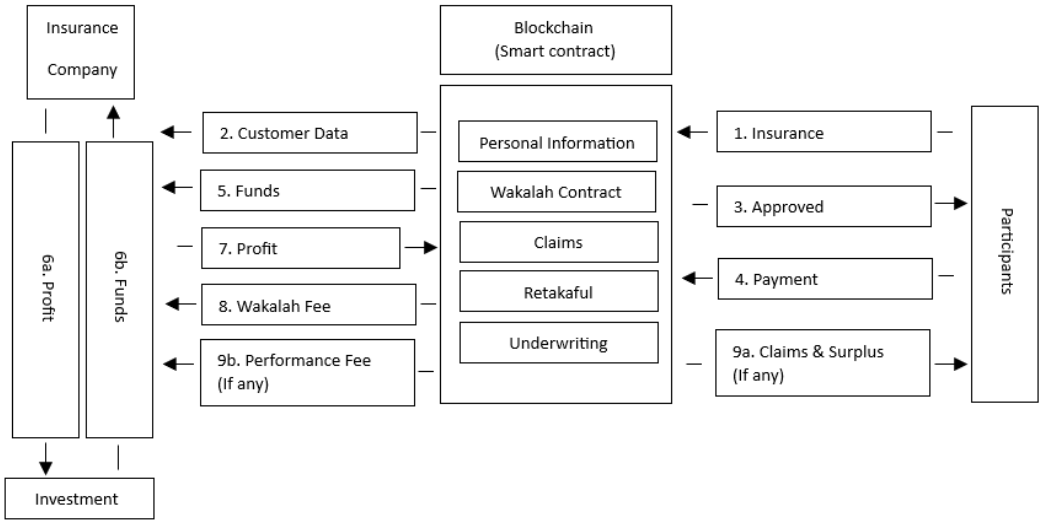



**Figure 1. Smart contract system in Sukuk**
**Source: www.asad-institute.co.id**

The Takaful blockchain system connects customers, Takaful companies, and related partners, such as healthcare providers. Prospective customers register through existing smart contracts (see Figure 2). The Takaful company collects prospective customer data, including medical records from healthcare providers. After underwriting, the system approves customer registration. The customer pays the premium through the blockchain and earns revenue from the wakalah fee. The company invests in collected funds to generate profits. Profits in general takaful are used to pay claims, whereas, in family takaful, investment profits are given directly to customers. Takaful operators may receive performance fees as an incentive. Claim payments can be made directly through blockchain.

The implementation of blockchain in social fund management aims to create a single data source that stakeholders can use as reference. Smart contracts make it easier for contributors such as Muzaki and Wakif to access and monitor the distribution of social funds. Public trust in Amil and Nazir has also increased. An obstacle to the management of Zakat and Waqf is the need for more transparency and accountability in financial reports. Philanthropic organizations that collect money from the public must have high accountability (Figure 3). 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 to receive notifications when donations reach their intended recipients (Dubey et al., 2020). Blockchain increases value and accelerates the receipt of zakat and waqf funds.

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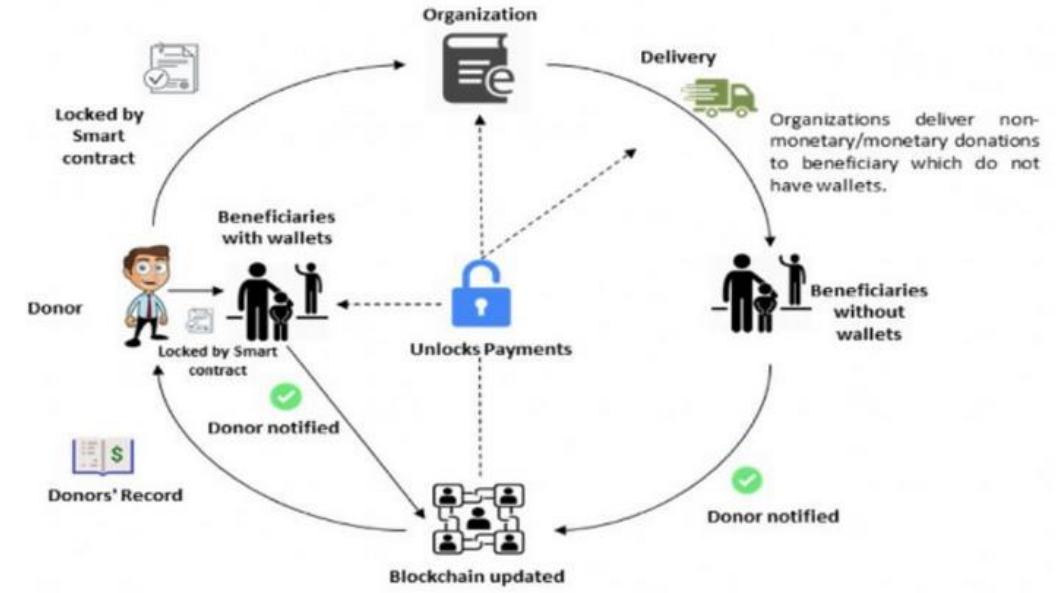


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## Challenges and Barriers to Implementation

Overcoming obstacles is necessary when implementing a blockchain-powered Islamic banking system (Elasrag, 2019). First, it requires sufficient technical infrastructure encompassing a dependable blockchain network, rapid transaction velocity, and certain system security. Thus, it is imperative to establish a robust technological framework and embrace blockchain technology that adheres to Islamic finance tenets. To address this issue, it is necessary to implement comprehensive educational and socialization initiatives regarding Islamic finance, as well as the advantages of incorporating blockchain technology in the field.

Enhancing comprehension and consciousness requires cooperation among scholars, professionals, and regulators. Current regulations pose a significant challenge for the complete deployment of blockchain-based Islamic financial systems. Regulators, legal experts, and Islamic finance practitioners must collaborate to create regulations suitable for implementing blockchain technology in Islamic finance (Alaeddin et al., 2021).

Trust and security also pose significant issues. To establish confidence in the implementation of blockchain-based Islamic financial systems, it is essential to have strong security measures, efficient auditing systems, and a commitment to adhere to Islamic financial principles in a fair and transparent manner (Chong, 2021). The adoption of a blockchain-powered Islamic

financial system can enhance adherence to the principles of equitable Islamic finance as well as efficiency and transparency.

**Case Study: Blockchain Implementation Project in Islamic Finance**

This section presents a case study demonstrating the application of blockchain technology in Islamic banking. The case study focuses on "Al Hilal Bank: Transforming Sukuk Transactions with Blockchain." This case study demonstrates the potential of blockchain technology in enhancing efficiency and transparency in the field of Islamic finance. Al Hilal Bank, a government-owned financial institution in the United Arab Emirates, achieved a significant milestone by becoming the world's first Islamic bank to use blockchain technology for Sukuk transactions. It utilized a digital ledger of transactions known as blockchain to sell and reimburse a piece of its $0.5 billion sukuk, which was issued two months earlier, in a secondary market transaction. Sukuk is set to mature in September 2023. Alex Coelho, the CEO of Al Hilal Bank, states that incorporating blockchain technology into the Sukuk offering will improve transaction security and guarantee adherence to Sharia law. In addition, the utilization of smart contracts in Sukuk offers several advantages including enhanced transaction security, significant adherence to Sharia principles, and the emergence of new prospects. Introducing groundbreaking sukuk will enhance transaction efficiency and decrease administrative expenses associated with the issuance and settlement processes.

For this case study, an Islamic bank collaborated with a blockchain technology company to create a platform that streamlined the Murabaha transaction process, making it more efficient and transparent. Using blockchain technology, each participant in a Murabaha transaction is equipped with a unique digital identity to ensure authenticity. The platform integrates measures for verifying transaction legitimacy, supported by automated smart contracts that execute transaction terms autonomously, thereby reducing human intervention. All Murabaha transactions are securely recorded on a distributed blockchain network, facilitating seamless monitoring and validation by stakeholders, such as customers, banks, and regulatory bodies. The platform provides robust auditing and tracking capabilities for every Murabaha transaction, thereby promoting transparency. Authorized parties can access and verify transaction details in the blockchain, thereby enhancing accountability and trust. By adopting blockchain technology, Al Hilal Bank has effectively enhanced the efficiency of the Murabaha transaction process, minimized administrative expenses, and reinforced transparency in Islamic financing.

## Comparative Analysis with Conventional Financial System

This section examines the disparities between blockchain-based financial systems in Islamic finance and traditional financial systems. This research aims to enhance the comprehension of the benefits and advantages of blockchain technology within the framework of Islamic banking with some criteria:

*Transparency and Auditability*

Traditional financial systems frequently suffer from a lack of openness. Accessing information and transaction details can be challenging for interested parties because of their complexity. Audit procedures can also be intricate and laborious. Every transaction recorded on the blockchain is indefinitely accessible to all authorized parties. This facilitates more efficient audits, openness, and enhanced confidence among the parties concerned (Dahdal et al., 2022).

*Data Security and Integrity*

Traditional banking systems are susceptible to security vulnerabilities and data tampering problems. Unscrupulous individuals can swiftly modify or tamper with data, leading to financial losses and skepticism. A blockchain-based financial system ensures robust security by cryptographically recording and linking every transaction in an unchangeable blockchain. Data manipulation becomes increasingly intricate as alterations to one block have a ripple effect on the entire chain.

*Efficiency and Cost*

Traditional financial systems, involving middlemen and lengthy processes, often lead to increased operational costs and slower transaction processing. A blockchain-based financial system has the potential to enhance the efficiency of the financial sector. Transactions can be executed directly between the parties involved, thereby removing superfluous middlemen. This results in a decrease in operational expenses and accelerates transaction processes (Azimov, 2021).

*Individual Empowerment*

Traditional financial systems often grant significant power to financial institutions and central authorities. People often rely on these organizations and their authority. Blockchain-based financial systems provide individuals with enhanced autonomy over assets and transactions. Users can immediately

retrieve their data and assets, thereby decreasing their reliance on institutions and authorities (Abojeib & Habib, 2021).

## Development Potential and Future of DeFi in Blockchain-Based Islamic Finance

The integration of blockchain technology in the Islamic finance sector is anticipated to revolutionize operations, offering significant potential for advancement and future prospects. The integration of blockchain technology in Islamic banking is anticipated to bring about favorable improvements in terms of accessibility, security, efficiency, and adherence to Sharia standards. This, in turn, propels the Islamic finance sector towards more innovation and inclusivity.

*Improved Accessibility and Speed*

Blockchain technology can enhance the availability of Islamic financial services to a wider range of people (Rabbani et al., 2020). By implementing this technology, users can conveniently avail themselves of Islamic financial services without being limited by geographical boundaries or administrative obstacles. Furthermore, blockchain transactions may be executed with greater speed and efficiency, thereby decreasing the processing time required for financial transactions.

*High Security and Trust.*

The blockchain technology in Islamic banking provides robust security and a high level of trust (Kamdzhalov, 2020). This system employs robust cryptographic techniques to safeguard data and transactions, thereby mitigating the potential for tampering and unauthorized data disclosure. Security and trust are crucial in Islamic finance to guarantee adherence to Shariah standards and to maintain integrity in transaction execution.

*Removal of Intermediaries*

Integrating blockchain technology into Islamic banking has the potential to remove superfluous intermediaries from the financial process (Antova & Tayachi, 2020). Smart contracts enable direct transactions between parties, thereby reducing expenses and reliance on conventional financial institutions. This enhances financial inclusion, particularly for individuals who lack access to traditional financial institutions.

*Traceability and Accountability.*

Blockchain technology facilitates transparent and unchangeable transactions (Khurshid 2020). It allows for tracking the source and path of an asset or fund in Islamic finance. The availability of publicly verified transaction records simplifies monitoring and auditing processes. Additionally, it helps ensure adherence to Sharia principles during financial transactions.

DeFi offers several benefits in Islamic finance, such as increased transparency in transactions, reduced reliance on conventional financial institutions through decentralization, and improved operational efficiency through automated transaction procedures. To effectively incorporate DeFi into Islamic banking, it is essential to merge Sharia principles with the blockchain technology. This entails the creation of smart agreements that adhere to Islamic law, guaranteeing openness in all transactions, and maintaining a system that upholds Islamic financial principles, such as the prohibition of usury and speculative trades. Nevertheless, several vulnerabilities must be resolved, including the legal ambiguity surrounding DeFi regulation in Islamic banking and the security threats posed by cyber-attacks and technological flaws in DeFi systems. To overcome these shortcomings, it is necessary to implement risk-reduction methods. These encompass the establishment of explicit laws that adhere to Islamic financial principles, frequent security audits, the adoption of strong security measures, and the provision of education and training to DeFi users about effective cyber security procedures. By thoroughly understanding the benefits and challenges of DeFi in Islamic finance and implementing appropriate risk-mitigation measures, the use of blockchain technology to build a decentralized Islamic financial system is expected to maximize benefits while managing risk effectively.

## CONCLUSION

The adoption of blockchain technology in Islamic finance carries substantial ramifications amid the disruption of the Islamic market in the era of digital technology. Blockchain technology has the potential to mitigate risks, such as corruption, money laundering, and illicit activities within the Islamic financial system by ensuring transparent and irreversible transaction records, thereby reducing the potential for data manipulation and enhancing the integrity of Islamic banking. Furthermore, it ensures equitable access for everyone to participate in the financial ecosystem, thereby promoting integration of previously excluded populations. This system also upholds the

ideals of Islamic finance that advocate fairness. It enhances the level of openness and accountability in Islamic financial transactions, facilitating more efficient supervision and simplifying auditing processes. By maintaining immutable transaction records, adherence to Sharia norms is strengthened, bolstering confidence in the Islamic financial ecosystem.

However, there are challenges in implementing blockchain technology in the context of Islamic banking. Regulatory ambiguity is a potential obstacle in the broad implementation of blockchain technology in the Islamic financial sector. Furthermore, security threats, such as cyber-attacks and technological weaknesses in blockchain systems, are an additional set of obstacles. Hence, regulators, financial institutions, and other relevant parties must collaborate closely, establish suitable legislation, and enhance blockchain network security. Collaboration among the Islamic banking sector, academia, and the blockchain community is crucial for conducting research, creating, and experimenting with creative ideas in blockchain-based Islamic finance. Furthermore, it is crucial to enhance awareness of the capabilities, benefits, challenges, and risks of blockchain technology in Islamic finance through educational initiatives and training programs for professionals, scholars, and the public. We recommend these topics for further investigation into the adoption of blockchain technology 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*. 1114-1128 https://api.semanticscholar.org/CorpusID:159680571

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

Ayub, M., Hassan, M. K., & Saba, I. (2023). Revisiting the paradigm of Sharīʿah governance of Islamic financial institutions. *Journal of Islamic Accounting and Business Research*. Vol. ahead-of-print No. ahead-of-print https://doi.org/10.1108/JIABR-04-2022-0110

Azimov, D. (2021). Analysis of the international experience of implementing blockchain technology. Access to science, business, innovation in digital economy, ACCESS Press, 2(2): 138-149. https://doi.org/10.46656/access.2021.2.2(2)

Bakar, R. A, 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

Bakar, A. Y. S., Nafees, S. M., Dorloh, S., & Aji, R. H. (2023). The concept of sukuk and its applications in contemporary Islamic financial system. *Law and Humanities Quarterly Reviews*. 39-54 https://doi.org/10.31014/aior.1996.02.03.70

Bakti, F. P., Achmad, & Rifai, A. (2022). Analysis of the characteristics of financial risk in contract with the principle of profit-sharing in sharia banking. *Awang Long Law Review*, 5(1), 19-28. https://doi.org/10.56301/awl.v5i1.530

Batorshyna, A., Tokar, V., Kolinets, L., Sybyrka, L., & Almarashdi, O. (2021). The interplay between the global Islamic finance and economic growth of Muslim countries. *Financial and Credit Activity: Problems of Theory and Practice*. https://doi.org/10.18371/fcaptp.v3i38.237452

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*, 50–61. https://doi.org/10.13135/2421-2172/3176

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

Budiyanti, N., Kosasih, A., & Az-Zahra, S. A. (2021). Sharia Investment in Islamic Economic Principles. *FITRAH: Jurnal Kajian Ilmu-ilmu Keislaman*, 7(1), 119-132. doi:https://doi.org/10.24952/fitrah.v7i1.3679

Cao, S., William Cong, L., & Yang, B. (2019). Financial reporting and blockchains: Audit pricing, misstatements, and regulation. *Regulation of Financial Institutions ,7.* http://dx.doi.org/10.2139/ssrn.3248002

Chohan, U. W. (2021). Decentralized Finance (DeFi): An emergent alternative financial architecture. *Econometric Modeling: International Financial Markets - Foreign Exchange EJournal*. http://dx.doi.org/10.2139/ssrn.3791921

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*, 33(2),175–192. https://doi.org/10.54648/eulr2022005

Dawood, H. M., Zadjali, D. F. Al, Rawahi, M. Al, Karim, D. S., & Hazik, D. M. (2022). Business trends & challenges in Islamic FinTech: A systematic literature review. *F1000Research*, *11*, 329. https://doi.org/10.12688/f1000research.109400.1

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/

Farikhin, A., & Mulyasari, H. (2022). Gharar, Fraud and Dispute in Islamic Business Transaction an Islamic Law Perspectives. *International Economic and Finance Review, 1*(2), 40–53. https://doi.org/10.56897/iefr.v1i2.18

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

Hari, G. S. (2023). Data extraction from Decentralized Finance (DeFi). *International Journal of Scientific and Research Publications*, 13(9), http://dx.doi.org/10.29322/IJSRP.13.09.2023.p14106

Hassan, A., AlMaghaireh, A. I., & Islam, M. S. (2022). Islamic financial markets and institutions. *Islamic Financial Markets and Institutions*. https://doi.org/10.4324/9780429321207

Hassan, M. K., Aliyu, S., Huda, M., & Rashid, M. (2019). A survey on Islamic Finance and accounting standards. *Borsa Istanbul Review*, 19(1). https://doi.org/10.1016/j.bir.2019.07.006

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

Inzirillo, H., & de Quenetain, S. (2022). Managing risk in DeFi Portfolios. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.4228899

Ishak, M. A. F., Ramli, J., & Ahmad, H. H. (2023). Maneuvering the application of Musharakah Contract on venture capital. *International Journal of Academic Research in Business and Social Sciences*. http://dx.doi.org/10.6007/IJARBSS/v13-i10/18912

Jiang, E., Qin, B., Wang, Q., Wang, Z., Wu, Q., Weng, J., Li, X., Wang, C., Ding, Y., & Zhang, Y. (2023). Decentralized Finance (DeFi): A survey. *IACR Cryptol. EPrint Arch.*, *2023*, 1210. https://doi.org/10.48550/arXiv.2308.05282

Kamdzhalov, 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

Krytsula, A. A. (2022). Legal regulation of smart contracts. *Rossijskoe Pravosudie*. https://doi.org/10.1055/s-0037-1616066

Kuznetsova, A., & Tenberga, I. (2022). Purchase and sale and prohibition of uncertainty (gharar) in the Islamic tradition. *Pravovedenie*. https://doi.org/10.21638/spbu25.2022.203

Kwon, S. (2023). Regulation of DeFi Lending. *Science and Technology Law Review*. https://doi.org/10.52214/stlr.v24i2.11629

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

Majumdar, S., & Gochhait, S. (2022). Risks and solutions in Islamic decentralised finance. *2022 International Conference on Sustainable Islamic Business and Finance (SIBF)*, 159–163. https://doi.org/10.1109/SIBF56821.2022.9939821

Mitrev, D. (2023). Ecological impact on digitalization in insurance and insurance intermediation. *10th SWS International Scientific Conferences on SOCIAL SCIENCES - ISCSS Proceedings 2023*. https://doi.org/10.35603/sws.iscss.2023/s13.55

Monzur-E-Elahi, M., & Alam, M. M. (2022). *Application of Maqasid Al-Shariah and rules of shariah in managing wealth and financial transactions*. https://doi.org/10.31219/osf.io/ueavm

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

Muhammad, R., & Lanaula, R. (2019). Challenges of Islamic supervisory in the islamic financial technology industry. *Economica: Jurnal Ekonomi Islam*. https://doi.org/10.21580/economica.2019.10.2.3400

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

Muryanto, Y. T. (2022). The urgency of sharia compliance regulations for Islamic Fintechs: a comparative study of Indonesia, Malaysia and the United Kingdom. *Journal of Financial Crime*. https://doi.org/10.1108/jfc-05-2022-0099

Musjtari, D. N., & Kencana, S. W. (2020). *Legal relations and legal consequences of Wakālah contract implementation in Hajj Fund Deposit*. https://doi.org/10.26555/novelty.v11i2.a16979

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

Nikolić, L. (2023). Challenges of digitalization of financial transactions. *Zbornik Radova Pravnog Fakulteta Nis*. https://doi.org/10.5937/zrpfn1-44231

Osman, M., & Elamin, I. (2023). Advancing ethical and sustainable economy: Islamic finance solutions for environmental, social, & economic challenges in the digital age. *International Journal*, *10*(5), 408-429. https://doi.org/10.15379/ijmst.v10i5.2515

Otoritas Jasa Keuangan. (2022). Laporan perkembangan keuangan syariah 2022. *Lap Perkembangan Keuangan Syariah Indonesia*, 1–184. https://ojk.go.id/id/kanal/syariah/data-dan-statistik/laporan-perkembangan-keuangan-syariah-indonesia/Pages/Laporan-

Perkembangan-Keuangan-Syariah-Indonesia-2022.aspx

Popescu, A. D. (2022). Understanding FinTech and Decentralized Finance (DeFi) for financial inclusion. *FinTech Development for Financial Inclusiveness*. https://doi.org/10.4018/978-1-7998-8447-7.ch001

Qin, K., Zhou, L., Afonin, Y., Lazzaretti, L., & Gervais, A. (2021). CeFi vs. DeFi - Comparing Centralized to Decentralized Finance. *ArXiv*, *abs/2106.08157*. https://api.semanticscholar.org/CorpusID:235435858

Rabbani, M. R., Khan, S., & Thalassinos, E. I. (2020). FinTech, blockchain and Islamic finance: An extensive literature review. *International Journal of Economics and Business Administration*. https://doi.org/10.35808/ersj/1560

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

Salami, I. (2021). Challenges and approaches to regulating decentralized finance. *AJIL Unbound*, *115*, 425–429. https://doi.org/10.1017/aju.2021.66

Schueffel, P. E. (2021). DeFi: Decentralized Finance - An introduction and overview. *Journal of Innovation Management*. https://doi.org/10.24840/2183-0606_009.003_0001

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

Simanjuntak, D. A., Safitri, K., Rahayu, D. R., Nainggolan, N. S., & Amelia, R. (2023). Islamic law perspective on investment. *Cashflow : Current Advanced Research On Sharia Finance And Economic Worldwide*. https://doi.org/10.55047/cashflow.v2i3.644

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

Tariq, A., Haq, H. B., & Ali, S. T. (2019). Cerberus: A blockchain-based accreditation and degree verification system. *IEEE Transactions on Computational Social Systems*, *10*, 1503–1514. https://doi.org/10.1109/TCSS.2022.3188453

Wang, B., Dabbaghjamanesh, 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

Weingärtner, T., Fasser, F., da Costa, P. R. S., & Farkas, W. (2023). Deciphering DeFi: A comprehensive analysis and visualization of risks in decentralized finance. *Journal of Risk and Financial Management*. https://doi.org/10.3390/jrfm16100454

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

www.asad-institute.co.id. Accessed on 2024, avalaible https://asad-institute.co.id/learn/blockchain-untuk-keuangan-syariah

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