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TRANSFORMING ISLAMIC FINANCE: THE IMPACT OF BLOCKCHAIN AND SMART SUKUK

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ABSTRACT

This article presents a comprehensive investigation of tokenized Sukuk (Islamic bonds), demonstrating that blockchain technology and smart contracts have significantly positively impacted Islamic finance. Our findings discuss smart securities globally, key Sharia-related jurisprudential matters, international cases of blockchain-based or smart Sukuk implementations, examining how each case addresses critical issues in conventional Islamic financing and interview analysis. ***Background:*** *Exploration of the current role of blockchain implementation in Islamic finance.*
Objectives*: The primary objective of this article is to examine how the use of smart contracts, particularly smart Sukuk, has enhanced Islamic finance.* ***Methods/Approach****: This article employs a descriptive analytical method to discuss how smart contracts improve Islamic finance through the issuance of smart Sukuk. We utilized secondary data collected from existing literature on the evolving field of smart Sukuk, including scientific papers, professional reports, and company websites. Additionally, we conducted interviews with the CEOs of two firms, Blossom Finance and Finterra, which have integrated smart contracts into Islamic finance. Eventually qualitative analysis techniques employed by using Atlas.ti software and generate a word cloud to provide a concise overview of interviewees' primary concerns and interests.*
Results*: Our results are presented in four sections. First, we provide an overview of the implementation of smart securities worldwide. Next, we discuss key jurisprudential matters regarding the introduction of blockchain and smart contracts in Islamic fintech. Besides, we offer a comprehensive review of cases where blockchain and smart Sukuk have been implemented in Islamic finance, highlighting the problems addressed and the enhancements made in each case. Finally, we analyze the visual representation derived from interviews with ATLAS.ti software in the form of a word cloud.*
Conclusions*: This article investigates how international, real-world, and innovative examples of blockchain and smart contract implementations have improved and enhanced Islamic financing processes. Overall, the advantages of using blockchain and smart Sukuk in these examples include streamlining Islamic financing processes, facilitating social financing, reducing poverty, enhancing Sukuk issuance by the banking sector, and enabling pre-purchasing and easier trading of Sukuk in secondary markets. These promising examples illustrate the significant potential of this innovative approach, which can benefit researchers and practitioners in Islamic finance. Ultimately the interviews highlighted the critical role of blockchain reinforcing the findings from the case studies.*

Keywords: Blockchain, smart contract, smart Sukuk, Islamic finance.
JEL classification: G23; O32; O33.
Paper type: Case Study

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INTRODUCTION

This article aims to investigate how the implementation of smart contracts, particularly smart Sukuk, has enhanced Islamic finance. Smart Sukuk refers to tokenized Sukuk that are issued and managed through blockchain-based smart contracts (as opposed to the commonly misunderstood definition of cryptocurrency-

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or bitcoin-based Sukuk). These contracts feature fully automated payment flows, with contractual clauses automatically executed through software (Tan, 2018a; Tan, 2019; Busari and Aminu, 2022). This innovative approach in Islamic finance offers lower costs and faster processing speeds, presenting considerable potential for optimizing both corporate and public financing, thus warranting further exploration.

Islamic finance is one of the fastest-growing sectors in international finance. Estimates indicate an annual growth rate of 17% since 2009, with global assets valued at $1.9 trillion in 2015. This growth has attracted interest from predominantly Muslim countries, as well as nations like the UK, Luxembourg, Hong Kong, and South Africa (Asian Development Bank; The World Bank, 2015). Definitions of Islamic financing range from interest-free banking to financial activities compliant with Sharia law. We define it as "financial activities in accordance with Sharia laws," emphasizing two key aspects: "equitable distribution of risk or profit and loss" and "the encouragement of economic activities and social development through Zakat." Unlike conventional finance, which often involves speculative activities, Islamic finance focuses on financing really goods and services, thereby creating genuine value for economic growth (Kamdzhalov, 2020).

Blockchain, or Distributed Ledger Technology (DLT), has the potential to revolutionize conventional financial services, particularly through its ability to transmit, store, and immutably record information (Delle Foglie et al., 2021; Truby and Ismailov, 2022). This paper contributes to the existing body of research by presenting the most comprehensive list of empirical cases of smart Sukuk implementation and explaining how each case has specifically improved Islamic financial processes.

LITERATURE REVIEW

Numerous studies investigate how blockchain technology enhances Islamic finance. Malika (2021) emphasizes the importance of blockchain-based Sukuk in Islamic finance through various smart Sukuk cases. Sidik and Ahmad (2021) argue that Sukuk play a crucial role in Malaysia’s development, noting that blockchain can accelerate growth and mitigate losses and credit reduction. Their review of the literature on Malaysia’s use of blockchain in Sukuk issuance concludes that Distributed Ledger Technology (DLT) can address several issues, including high costs, time-consuming exchanges, complex issuance processes, ambiguous risks, and payment defaults.

As Sukuk have emerged as an innovative alternative to traditional securities in Islamic finance, Shaikh and Zaka (2018) present a model for issued smart Sukuk, detailing their characteristics and design. They highlight the growth limitations of Sukuk, which are tied to real assets and loans backed by them. Blockchain technology can help overcome these limitations by enhancing the credibility and market value of Sukuk through features such as improved credit tracking for financed assets and the use of smart contracts to bolster security and reduce transaction times.

In their analysis of smart Murabahah Sukuk tokenization, Khan et al. (2022) demonstrate that while financing for small and medium-sized enterprises (SMEs) has often been hindered by the high cost of Sukuk issuance, blockchain can significantly lower these costs through Sukuk tokenization. They provide an algorithm for tokenizing Murabahah Sukuk on the Ethereum platform, along with the code for automating

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interest payments to investors. Their cost-benefit analysis reveals that the cost of issuing conventional Sukuk compared to tokenizing Sukuk on public Ethereum is 1.95 times higher, while the cost ratio for private Ethereum tokenization is 2.1 times higher. Consequently, Sukuk tokenization substantially reduces issuance costs. Additionally, tokenization enables fractional ownership, which can attract retail investors in SME financing by enhancing the tradability and liquidity of assets (Kumar et al., 2023).

Fintech innovations, particularly blockchain, can also be applied to crowdfunding. Mohsin and Muneeza (2019) note that integrating blockchain with crowdfunding enhances endowment collection, as smart contracts streamline and increase transparency in donation processes. Blockchain technology can be utilized across various domains, including security, transmission, and commercial exchange. In Malaysia, online endowment schemes based on a shared endowment model have successfully expanded financing opportunities.

Alshater et al. (2022) assert that employing Islamic social financial tools such as Zakat, Sadaqah, Waqf, micro-financing, and the Takaful model (or micro-insurance) promotes financial inclusion and reduces income inequality in Islamic countries. Furthermore, the implementation of Islamic fintech solutions, such as blockchain-based systems for Zakat and Gharz-al-hasaneh, enhances access to Islamic financial institutions and banking services. Improving the distribution of financial resources for small and underdeveloped businesses can significantly boost economic and social welfare, particularly for individuals with limited access to traditional banking services.

METHODOLOGY

This article employs a descriptive analytical method to examine how smart contracts enhance Islamic finance through the issuance of smart Sukuk. We conducted a comprehensive literature review of existing research in this emerging field, including scientific papers, professional reports, and relevant company websites. Consequently, this paper is classified as an analytical review article, following the framework of Petticrew and Roberts (2008).

To augment our literature review, we interviewed the CEOs of two companies—Blossom Finance and Finterra—that have successfully integrated smart contracts into Islamic finance. These interviews enriched our findings and provided triangulation. We employed qualitative analysis techniques, including thematic analysis of the interview transcripts. Additionally, a word cloud was generated using ATLAS.ti to visualize the frequency of terms mentioned, highlighting key themes and providing a concise overview of participants' primary concerns and interests.

The first interview was conducted with Mr. Matthew Joseph Martin, CEO of Blossom Finance, on June 27, 2019. This online session lasted approximately forty minutes and covered critical topics, including the role of blockchain in Islamic economics and banking, Blossom Finance's objectives for poverty alleviation, and the impact of microfinance measurement.

The second interview involved Mr. Hamid Rashid, CEO of Finterra, and Mr. Charan, the technical supervisor, on November 2, 2022. This online discussion addressed key differences between blockchain-based Sukuk (smart Sukuk) and traditional electronic Sukuk. Topics included identity verification for smart Sukuk

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traders, relevant regulatory considerations, the role of cryptocurrency in smart Sukuk exchanges, and mechanisms for transferring value.

Exhaustive review articles are essential in emerging scientific fields, as they can shape and update existing paradigms, particularly in the fintech sector (Suryono and Purwandari, 2020; Hasan et al., 2020).

RESULTS AND DISCUSSION

Our results are presented in four main sections. First, we provide an overview of the implementation of smart securities globally. Next, we discuss key jurisprudential issues surrounding the introduction of blockchain and smart contracts in Islamic fintech. Afterwards, we present a comprehensive review of cases where blockchain and smart Sukuk have been implemented in Islamic finance, highlighting the problems addressed and the enhancements achieved in each instance. Finally, we present an analysis of the visual representation derived from interviews conducted with two pioneers in the application of blockchain technology within smart sukuk and Islamic finance. This visual representation, in the form of a word cloud, highlights the most frequently mentioned themes and terms from the interviews, providing insight into the key concerns and interests of the participants. By analysing the word cloud alongside the interview content, we can more effectively illustrate how these industry leaders perceive the intersection of blockchain and Islamic finance.

-Smart Securities Around the World

Various organizations, including the World Bank and the Central Bank of China, have begun tokenizing securities, effectively converting traditional assets into digital formats (Khan et al., 2022). Digital securities can be issued more swiftly and efficiently compared to conventional ones, allowing issuers to create customized financial instruments tailored to investor demands (Javaid et al., 2022). The World Bank pioneered this initiative by issuing the 'i-Bond' in August 2018, the first securities utilizing blockchain technology, developed in collaboration with the Commonwealth Bank of Australia to facilitate digital documentation and transaction accounting. These two-year i-bonds, valued at $73 million, represent a new debt instrument. Given that the World Bank issues over $50 billion in securities annually to support sustainable development in emerging economies, there is significant potential for future issuances to leverage blockchain technology (Reuters, 2018).

Numerous banks and the International Monetary Fund (IMF) are also exploring ways to utilize blockchain to enhance the efficiency of international payments. Many blockchain platforms offer the capability for network segmentation and privatization, enabling specific digital signatures to access designated areas. Digital tokens can be created on blockchain to represent various assets, including currencies, cryptocurrencies, and shares, which can subsequently be exchanged through smart contracts (Ahluwalia et al., 2020).

One of the earliest applications of smart contracts in bond issuance occurred at Spain's Santander Bank. In its initial public offering, these bonds were restricted to the primary market (Santander, 2019). The bank successfully generated tokens worth $20 million using Ethereum technology to enhance liquidity. In France, Société Générale issued smart bonds on the Ethereum platform in 2019. Currently, only Switzerland and

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Luxembourg recognize contracts with digital signatures based on blockchain as legally binding (Busari and Aminu, 2022). Additionally, the SIX Group, operator of the Swiss Stock Exchange, utilized the R3 Corda blockchain platform to launch a securities token market in 2019. R3 is an industrial consortium comprising over 40 banks focused on researching and developing blockchain technology for financial applications and investing in early-stage initiatives in this domain (Attaran and Gunasekaran, 2019). Designed for highly regulated environments, R3 is also open-source and has expanded its activities beyond capital markets into areas such as insurance (Allison, 2019).

Since 2015, international institutions, including the UN and IMF, along with developed countries such as the United States, the United Kingdom, and Japan, have concentrated on developing blockchain sectors and their applications across various fields. In 2015, NASDAQ announced the launch of the first stock exchange utilizing blockchain technology through the Link platform (Guo and Liang, 2016). In 2017, a German automobile company issued one-year bonds worth €100 million as a pilot project, with several savings banks acting as lenders. All transactions—from creation and distribution to allocation, execution of contracts, and confirmation of interest repayments—were conducted digitally via blockchain (Busari and Aminu, 2022; Davradakis and Santos, 2019).

- *Jurisprudential Issues Related to Blockchain and Smart Contracts in Islamic Fintech*

This section explores differing opinions on the compatibility of emerging technologies with Sharia. In the realm of blockchain, many researchers argue that the use of cryptocurrencies is not compliant with Sharia due to their speculative and volatile nature (Kunhibava et al., 2021). Conversely, the use of smart contracts is generally viewed as permissible.

In Turkey, the Diyanet İşleri Başkanlığı (Ministry of Religious Affairs) issued a fatwa prohibiting Bitcoin exchanges, citing the absence of support from a central authority and the inherent ambiguities associated with such transactions (Kelso, 2017). Similarly, Magdy Ashour, a Republican mufti and Counsellor at Dar al-Iftaa in Egypt, has deemed Bitcoin to be an impermissible currency in Islam (Tawfeek, 2018). Additionally, twenty-one scholars from the Syrian Islamic Council and the Department of Dārul-Iftā' (Wifaqul Ulama) in the United Kingdom issued separate fatwas declaring cryptocurrency engagement to be religiously forbidden (ḥarām) due to its numerous risks and inherent volatility (Saleh, 2022a; Saleh, 2022b).

In Indonesia, the Majlis Ulama (Assembly of Religious Scholars) has emphasized the necessity of using fintech in accordance with approved Sharia contracts. Recent discussions regarding financial exchanges using blockchain suggest that such transactions may be permissible, provided they adhere to Sharia principles. Specifically, transactions conducted on the blockchain that do not involve usury, excessive uncertainty, or gambling are considered acceptable. The Shariah Advisory Council of the Securities Commission of Malaysia has stated that it is permissible to use digital currencies backed by gold, silver, and legal tender, provided that their use aligns with Sharia-compliant objectives. Ongoing research is examining the compatibility of various fintech innovations with Sharia (Busari and Aminu, 2022).

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However, the implementation of Islamic fintech faces legal and regulatory challenges, even in countries that are leaders in this sector, such as Malaysia and Indonesia. Muryanto (2022) investigates these challenges in Malaysia, Indonesia, and England, concluding that Islamic fintech necessitates the development of appropriate laws and policies, the establishment of Sharia supervisory boards, and adherence to Sharia governance standards.

Furthermore, Kunhibava et al. (2024a) highlight a regulatory deficiency regarding the legal framework necessary to support blockchain innovations in Islamic social finance, as well as a policy shortcoming in managing the Sharia and legal risks associated with transactions in this domain.

- *Global Cases of Implementing Smart Sukuk and Blockchain in Islamic Finance*

This section reviews real-world examples of blockchain implementation in Islamic finance globally, examining the key advantages brought by smart contracts and blockchain in the issuance and tokenization of Sukuk, cheque issuance, and other financial activities. These advancements have significantly enhanced Islamic finance, particularly in increasing financial inclusion.

- *Islamic Financial Inclusion Through Smart Sukuk: The Example of Blossom Finance*

Blossom Finance is the first private company to implement smart Sukuk using blockchain in Indonesia, having launched its initiative in 2017. The primary goal of this project is to enhance access to Islamic financial services through technology. By issuing blockchain-based Sukuk, Blossom has reduced costs to attract retail investors. The company first issued Mudarabah Sukuk, based on profit-and-loss sharing principles in microfinance, successfully raising $50,000 for the BMT Bina Ummah cooperative microfinance institution on a public blockchain.

Following this, Blossom transitioned to issuing Istisna Sukuk for micro-financing, exemplified by a $1 million issuance for construction projects, including a public hospital funded for social welfare purposes. The smart Sukuk platform facilitated small investments, enhancing transparency and transferability through a secondary market that also operates on the blockchain. Blossom utilized Ethereum smart contracts to improve efficiency and enable global Sukuk issuance.

Importantly, all processes related to Sukuk—including fundraising, issuance of ownership certificates to investors (using standard ERC20 tokens), fund transfers from overseas to Indonesia, currency conversion from foreign exchange to Rupiah, repayment management, and profit-sharing disbursements—are executed via Ethereum smart contracts (Whitehead, 2018). This automation has reduced international transfer costs for microfinance contributions by approximately 40%. As demonstrated by this project, microfinance institutions that lack access to conventional financial markets can leverage this technology to increase their financial resources (Babas, 2020; Martin, 2018; Goncalves, 2019).

According to Kunhibava et al. (2024b), the implementation of blockchain enhances transparency, efficiency, and accountability in financial accessibility. However, a suitable governance and legal framework must be gradually established to accommodate the unique aspects of blockchain technology, promoting greater access to finance and inclusivity.

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The functions of the Istisna smart Sukuk issued by Blossom are summarized in Figure 1 below. This Sukuk is designed as a sukuk al-Istisnaʿ wa al-Ijarah, or asset-based rental Sukuk. Despite the readiness of the technology, no funds have been mobilized for the Sukuk as of yet. Once completed, the hospital and its facilities will be leased, and profits generated will be shared with investors (Iman and Arifin, 2021).

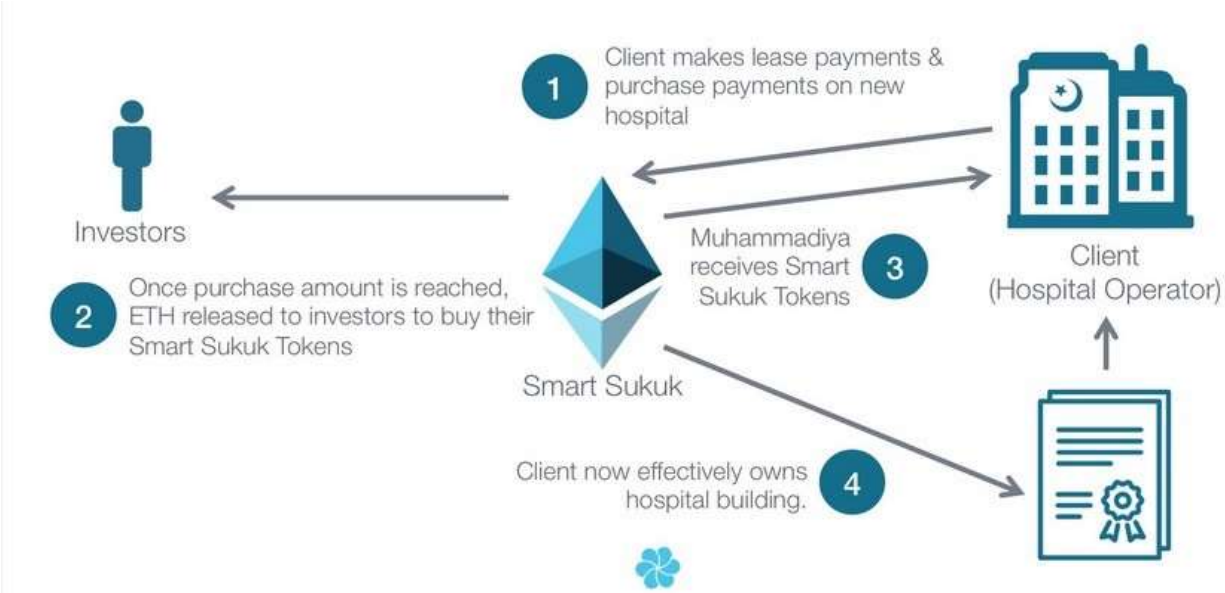

Figure 1. The function of Blossom's Istisna and Ijarah smart sukuk

Source: Blossom Finance, 2018

Blossom has also issued Mudarabah Sukuk with a profit-sharing structure, offering amounts ranging from $20,000 to $5 million, with a profit share of 60% for investors and 40% for suppliers. The company projects a 6% net annualized return for its six-month Sukuk (Whitehead, 2018). These innovative solutions significantly improve financial inclusion for individuals without bank accounts, a service that conventional financial institutions often fail to provide.

- *Development Through Innovation: The Example of Wethaq*

A consortium of companies, including Wethaq Securities Ltd (Wethaq ADGM) registered in Abu Dhabi, EMRGO (DIFC) Ltd. in Dubai, Wethaq Capital Platform JSC (Wethaq KSA) in Saudi Arabia, and EMRGO Solutions Ltd. in the UK, launched the Wethaq platform in 2018. This fintech start-up aims to utilize smart contracts within Islamic capital markets, operating on the R3-Corda consortium, an open-source distributed ledger platform. In 2019, Wethaq obtained an Innovation Test License (ITL) from the Dubai Financial Services Authority, enabling the introduction of a new smart lease Sukuk that leverages smart contracts and distributed ledger technology (DLT), which is utilized by over 40 major banks worldwide to facilitate complex financial transactions with limited access to transactional data.

This multinational, automated Sukuk platform operates on a permissioned distributed ledger, benefiting from the advantages and transparency of the Corda environment, a licensed private blockchain platform developed by R3. Wethaq collaborates with the Shariyah Review Bureau (SRB) to ensure that all digital Sukuk

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rental activities comply with Sharia law, while also automating the execution of mandates. This collaboration enhances transparency in Sharia-compliant accounting processes for scholars and stakeholders. The platform features an omni-channel capability, allowing for the secure exchange, storage, and sale of Sukuk units, enabling investors to access real-time reporting and a comprehensive view of the underlying assets of the Sukuk (Zawya, 2019; R3 Publication, 2019).

Wethaq's platform facilitates various functions, including payment registration, accounting, asset transfer, publication, allocation, and management. Automation is achieved through the implementation of specific smart clauses, while the digitalization and standardization of Sukuk are supported by the ERC-20 basic protocol on Ethereum (Delle Foglie et al., 2021). The primary objectives of the Wethaq platform in applying DLT to the Sukuk market are as follows:

1. **Central Securities Depository and Registry Office**: Functions as a distributed ledger for securities.
2. **Integration with Settlement Infrastructures**: Facilitates internal interactions with other settlement systems and payment gateways.
3. **Regulatory Compliance**: Operates within existing regulatory frameworks.
4. **Communication among Stakeholders**: Enhances communication among market participants, service providers, and governance stakeholders.

In summary, the value created by the Wethaq platform stems from its innovative approach, which simplifies processes, reduces the need for intermediaries, and automates the execution of contractual obligations through smart clauses on a distributed ledger (Malika, 2021; R3 Publication, 2019).

- *Solving Key Sharia Compliance Issues: The Example of Smart Murabahah Sukuk*

The tokenization of Sukuk via Ethereum blockchain has been instrumental in addressing various inefficiencies associated with Sukuk issuance, including low processing speeds, high costs, Sharia compliance challenges, and the absence of necessary standards. By leveraging fintech, Islamic financial institutions have developed new business models and sales channels. Blockchain technology and smart contracts can facilitate standardization in Sukuk issuance, enabling issuers to compete on a global scale and reversing traditional financial flows in debt issuance. In 2019, Murabaha and Lease Sukuk constituted the largest market shares, with Murabaha accounting for 31% and rental Sukuk for 20% of the global Sukuk market.

In conventional Sukuk issuance, investors either directly or indirectly acquire the underlying assets or their ownership benefits. This raises Sharia compliance concerns, as the sale of debt is considered impermissible, leading to doubts about the religious legitimacy of purchasing ownership benefits. However, in the case of Murabahah smart Sukuk, investors hold ownership of a portion of the tokenized asset. This is feasible because, in asset-based Sukuk, the founder retains legal ownership of the asset, allowing the tokenization of the base assets to assign partial ownership to token holders or investors.

The algorithm for Murabahah Sukuk tokenization on Ethereum operates as follows: each investor must use their Ethereum address to purchase Sukuk and invest. The founder and the Special Purpose Vehicle (SPV) enter into the Murabahah contract outside the smart contract framework. Due to legal constraints, notary

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services cannot be performed online, which excludes the purchase and sale of Sukuk assets from the smart contract. Nevertheless, the SPV is required to provide information related to the underlying Sukuk asset for investors to view within the smart contract. The smart contract collects periodic payments from the obligor, disburses costs to the SPV, and pays periodic profits to the investors (Delle Foglie et al., 2021). This innovation effectively addresses the Sharia permissibility issue, a crucial factor in sustaining the relative success of Murabaha Sukuk.

- *Social Finance Through Blockchain: The Example of Finterra*

Following the initiatives of Blossom's micro-Sukuk in Indonesia and Wethaq's Sukuk in Abu Dhabi, Finterra, a Malaysian company with branches in Singapore, Hong Kong, the United Arab Emirates, and India, is preparing to implement its own smart Sukuk. This Sukuk will be marketed as "Islamic Redeemable Preference Shares" (IRPS) to avoid misinterpretation by legislators.

Currently, the absence of a recognized international legal framework for the issuance of smart Sukuk poses challenges for cross-border investments. To address this issue, Finterra (2021) advocates for the establishment of a committee tasked with creating standardized rules for monitoring and applying smart contracts in Islamic finance, particularly concerning smart Sukuk. This committee would collaborate with international Islamic organizations such as the Accounting and Auditing Organization of Islamic Financial Institutions (AAOIFI), the General Council of Islamic Banks and Financial Institutions (CIBAFI), and the International Islamic Fiqh Academy (IIFA), among others (Busari and Aminu, 2022).

Finterra is notable for being the first fintech company globally to engage in Islamic social financing—encompassing endowments, charity, and Zakat—through blockchain technology. Its flagship product, the "Waqf Chain," facilitates Waqf management via blockchain, enabling efficient administration of endowments as well as the development of charitable initiatives and Zakat distribution (Finterra website, 2021).

Figure 2 illustrates the streamlined process of its Sukuk chain, highlighting the various participants, including investors, legislators, Islamic insurance providers, and financial resource managers, who interact through blockchain platforms via smart contracts (Maghdeed, 2019). As depicted in the figure, a fund manager seeking financing introduces a digital asset onto the blockchain. However, investing in these digital assets through Sukuk necessitates specific regulatory adjustments that the authorities must implement. Additionally, insurance coverage is required to mitigate potential risks while ensuring compliance with Islamic principles, which is provided through Takaful. Ultimately, investments in digital assets are facilitated through the exchange of digital currency from digital wallets and digital Sukuk, leveraging blockchain technology to enable investors to participate in these digital assets.

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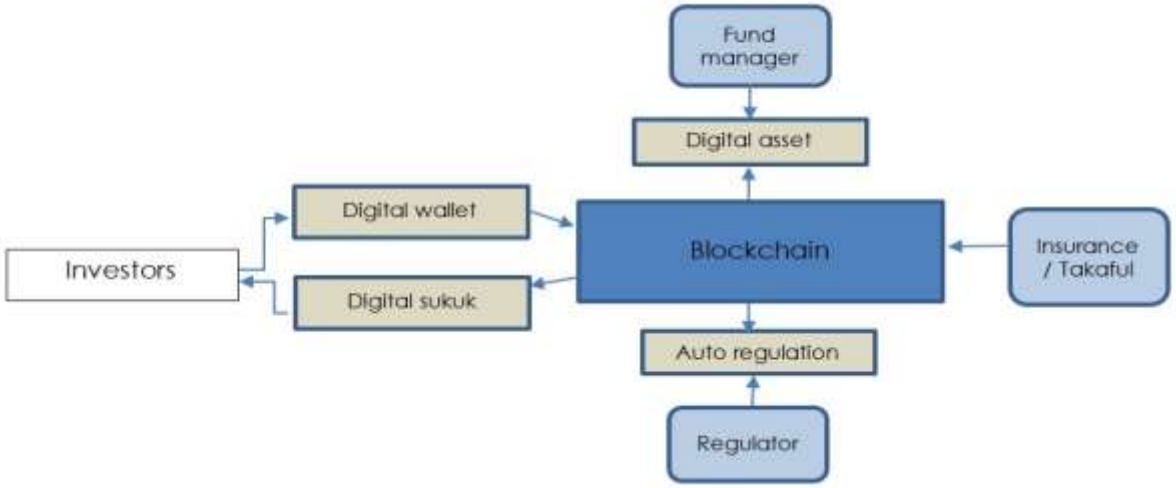

Figure 2. Finterra's simple Sukuk-Chain flow

Source: Maghdeed, 2019

-Increased Access to Investors and Markets in Islamic Banking

Al-Hilal was the first bank to issue smart Sukuk through blockchain technology in Abu Dhabi, launching a Sukuk worth $1 million in November 2018. Additionally, the bank offered a portion of a five-year Sukuk valued at $500 million to the private sector via blockchain, with a maturity date set for 2023 to facilitate secondary market transactions. This initiative resulted from a collaboration between Al Hilal Bank, Jibrel Network (a fintech company headquartered in Switzerland with branches in the UAE), and the support of fintech platforms within the Abu Dhabi Global Markets Center (ADGM), which aims to enhance the innovation environment in Abu Dhabi and the broader region (Al Hilal Bank website, 2018).

To bolster the cooperative (Islamic) banking sector's share to 15% of the overall banking sector by 2025, the Turkish government has adopted a policy to design smart Sukuk in collaboration with banks, which are currently in the preparatory stages for implementation. These Sukuk, structured on blockchain technology, will be announced to investors through a Special Purpose Vehicle (SPV) via a dedicated platform. To facilitate the acceptance of smart Sukuk, individuals will be able to submit requests through mobile or internet banking systems.

In addition, Emirates Islamic Bank launched the first blockchain-powered cheque to combat fraud in the region. In Saudi Arabia, banks such as Bank AlJazira are implementing blockchain solutions for identity management and security. Furthermore, Al Rajhi Bank (ARB) completed the first cross-border money transfer using Ripple Blockchain Technology, significantly reducing delivery times and enhancing accuracy (Tan, 2018b; Zawya, 2017).

Hamza (2020) reviews the issuance and structure of smart Sukuk by Turkish Islamic banks, concluding that the banking sector's involvement enables greater participation from both retail and corporate investors in Sukuk issuances. This is facilitated by features such as faster processing capabilities, increased transparency, immutability, lower transaction costs, effective auditing and reconciliation systems, and streamlined

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operational processes (e.g., reduced documentation and signature requirements). These improvements are poised to foster the development of the Sukuk market within the banking sector.

-Trading Opportunities of Smart Sukuk in the Secondary Market: The Example of HLC

Another notable example of smart Sukuk is the launch of the 'Halal Chain' (HLC) platform. Initially, the target customers for the HLC smart Sukuk platform included investment banks, rating agencies, legal professionals, financiers, and reputable investors. Key features of this platform include strict compliance with Sharia law, the transfer of stable cash flows to Sukuk holders, transparency in accounting based on relevant legal structures, low offering costs, and the introduction of new tokens with reduced risk.

Access to the HLC Smart Sukuk platform is granted through an initial payment for the duration that the Sukuk are available. This platform facilitates the pre-purchase, management, and secondary trading of Sukuk efficiently and securely. The HLC public chain is built on a new distributed ledger technology (Directed Acyclic Graph) that offers high operational capacity, ensuring security and decentralization. Examples of Sukuk issued on this platform include smart Sukuk for real estate rentals, hybrid smart Sukuk for airlines, and smart Sukuk for crowdfunding—all of which are backed by collateralized assets. The platform also provides opportunities to create asset-backed tokens (ABTs) as a new financial instrument (Malika, 2021).

The findings from our investigation into the cases of implementing smart Sukuk and blockchain are summarized in Table 1 below.

Table 1. How each case of smart Sukuk implementation enhanced Islamic finance

Company name	The way which helped Islamic Finance			
Blossom Finance „Micro-Sukuk“ in Indonesia	Improve financial inclusion for people without bank accounts or increase access to Islamic financial services through technology	Facilitating public financing or the use of crowd funding	Reduce poverty	Reduce transaction cost
Wethaq Sukuk in Abu Dhabi	Development of Islamic financing	Provides transparency in regard to sharia-compliant accounting processes	Automatic execution of contractual obligations, digitalization and standardization of Sukuk through the use of smart clauses	Improving innovation environment
Smart Murabahah Sukuk	Overcome the problems of Sukuk issuance such as low processing speed, high costs, sharia compliance	Create new business models and sale channels	solve the issue of standardization in Sukuk issuance	

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	problems and the lack of necessary standards.			
Finterra Smart Sukuk in Malaysia	Islamic social financing (such as endowment, charity and zakat) with blockchain technology.	Combination of charity and blockchain is considered as an innovation for economic sustainability by providing low-cost funds for solving the humanitarian funding gaps and developing Waqf assets.	Sukuk will be offered using blockchain platforms through a smart contract.	
Increased access to investors and markets in Islamic banking	To increase the activity of the cooperative (Islamic) banking sector to 15% of the banking sector by 2025 in Turkey, government has designed smart Sukuk that are issued with the help of banks.	To transact a secondary market deal and transform the Sukuk market, Al-Hilal bank issued smart Sukuk through blockchain in Abu Dhabi. To avoid fraud in the region Emirates Islamic bank launched the first blockchain powered cheques.	To manage identity and security, some banks like Bank AlJazira implement blockchain technology.	To Reduce delivery time and enhane accuracy, Al Rajhi Bank (ARB) made the first cross border money transfer on Ripple Blockchain Technology.
HLC Smart Sukuk platform	Transfer of stable cash flow to Sukuk owners, transparency and accounting based on relevant legal structures, low cost of offering and new tokens with low risk.	Safe and efficient management, secondary exchange and the possibility for pre-purchasing sukuk	Ensure security and decentralization by using new distributed ledger with high operational capacity.	High compliance with sharia laws
In conclusion	Accelerating and increasing the efficiency of finance and crowd funding	Electronic accounting through capabilities in recording and sorting information	Enhancing transparency and sharia compliance in Sukuk market and Standardizing Sukuk	Improving innovation environment

Source: Author's illustration

- *Interview analysis:*

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This study employed a qualitative approach, utilizing semi-structured interviews to gather insights on how blockchain and smart sukuk are transforming Islamic finance. Two interviews were conducted: the first with Mr. Matthew Joseph Martin, CEO of Blossom Finance, and the second with Mr. Hamid Rashid, CEO of Finterra, along with Mr. Charan, the technical supervisor.

To analyze the interview data, thematic analysis was employed to identify key themes and patterns. Additionally, a word cloud was generated using ATLAS.ti to visualize the most frequently mentioned terms during the interviews. This visual representation emphasized the predominant concerns and interests of the participants, providing a clear overview of the essential elements of their discussions.

The interview with Mr. Martin, conducted online in 2019, focused on the role of blockchain in Islamic economics and banking, poverty alleviation, and the impact of blockchain on microfinance measurement. The second interview, held online in 2022 with Mr. Rashid and Mr. Charan, explored critical differences between blockchain-based sukuk (smart sukuk) and traditional electronic sukuk. Key topics included the identity verification of smart sukuk traders, relevant regulatory considerations, the role of cryptocurrency in smart sukuk exchanges, and mechanisms for transferring value through blockchain without using cryptocurrency.

Using ATLAS.ti, the transcripts of both interviews were analyzed, and the resulting word cloud visually summarized the most frequently mentioned terms. The word cloud highlighted key themes, with a significant focus on "blockchain" and "sukuk," indicating that these concepts were central to the interviewees' discussions. Other frequently mentioned terms included "technology," "financing," "smart," and "company," reflecting the participants' emphasis on the technological aspects and financial implications of smart sukuk.

- Blockchain: This term’s prominence underscores its perceived importance in enhancing the efficiency, transparency, and security of financial transactions within the Islamic finance framework. Both interviewees emphasized how blockchain technology can facilitate innovative solutions, particularly in the realm of smart sukuk.
- Sukuk: The repeated mention of this term reflects ongoing discussions about the evolution of sukuk products in light of new technologies. It serves as a focal point for exploring how traditional sukuk can be transformed into "smart sukuk" through the application of blockchain, which can improve transaction processes and broaden accessibility for investors.
- Technology: This term complements the focus on blockchain and sukuk, encompassing the broader technological innovations driving change in Islamic finance. The interviewees illustrated how advancements in technology are reshaping financial products and services, enabling new opportunities for growth and development.

Overall, the analysis reveals that both interviewees are deeply engaged with the transformative potential of blockchain in Islamic finance, particularly in enhancing the efficiency and transparency of sukuk issuance and management.

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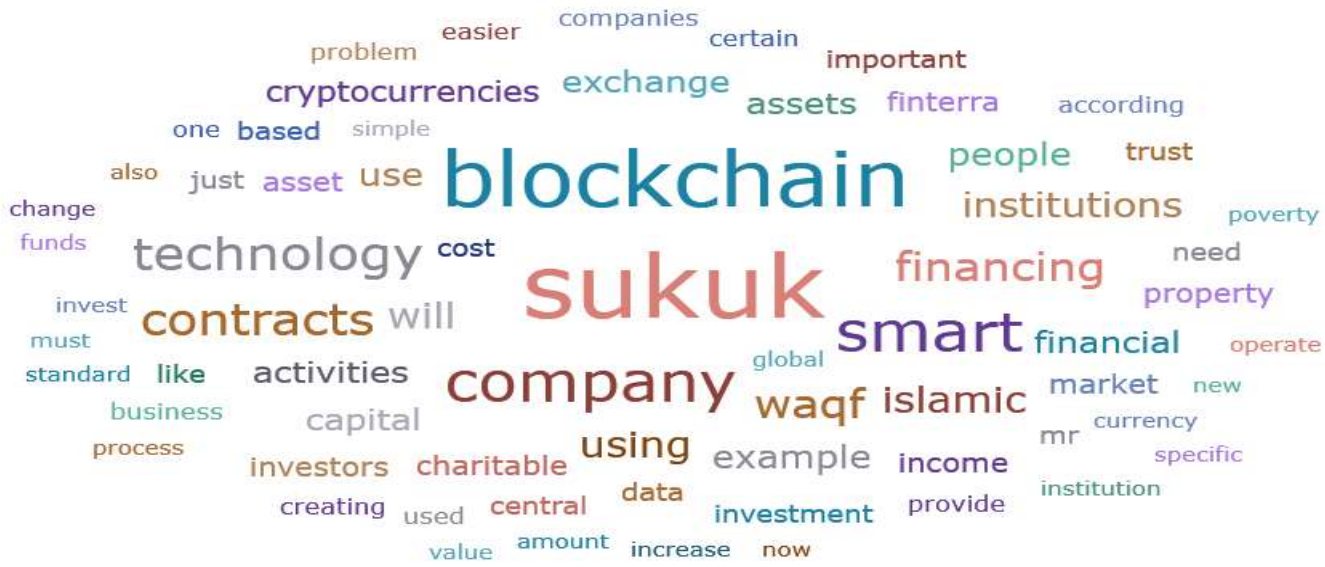

Figure 3. Word cloud generated from interviews

Source: Author's own creation using ATLAS.ti.

CONCLUSION

This paper explored how innovative, real-world applications of blockchain and smart contracts have significantly improved Islamic financing processes. The key advantages observed in the case studies of blockchain and smart Sukuk implementations include:

- Streamlining Islamic financing processes
- Facilitating social financing
- Reducing poverty levels
- Enhancing and developing Sukuk issuance through the banking sector
- Enabling pre-purchasing and easier trading of Sukuk in secondary markets

The interviews with Mr. Matthew Joseph Martin from Blossom Finance and Mr. Hamid Rashid from Finterra provided additional perspectives on the practical applications and challenges of implementing smart sukuk. Their insights highlighted the critical role of blockchain in improving transparency, efficiency, and accessibility in Islamic finance, reinforcing the findings from the case studies.

These promising examples highlight the vast potential of these innovative approaches, providing valuable insights for researchers and practitioners in the field of Islamic finance.

In future research, we recommend the further exploration of the quantitative relationship between Sukuk smartening, financing and capital formation and economic growth.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions:

Conceptualization, S.H.M. and A.T.; methodology, S.H.M.; validation, S.H.M, A.T.; formal analysis, S.H.M.; investigation, S.H.M.; resources, S.H.M.; writing—original draft preparation, S.H.M. and S.M.M; writing—review and editing, S.H.M. and S.M.M.; supervision, A.T.; project administration, A.T.

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