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Blockchain Technology for Islamic Finance: Use-Cases and Threats

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Abstract

Blockchain as the type of a ledger in which value-exchange transactions (in the form of cryptocurrencies, tokens or information) are sequentially grouped into blocks. Each block contains a signature that is based on the exact content (string of data) of that block. Blockchain increases transparency in the banking industry by providing a clear and accessible record of transactions as it streamline and reduces the time and cost of the banking processes. It also helps financial institutions to comply with regulatory requirements, by providing a secure and verifiable record of customer identity information. Blockchain technology has the potential to make a significant impact on Islamic finance and will surely help the Islamic financial institutions (IFIs) to enhance and harness their potentials productively. This paper uses agency theory and adopted qualitative approach in analyzing the significant use-cases as well as challenges of innovative technology "Blockchain" in Islamic finance industry. The paper discussed the various interesting applications of blockchain in Islamic finance that can bring different benefits. The paper also shed light on the challenges facing Applying Blockchain for Islamic finance and lastly the paper suggest that IFIs should study how blockchain works and possible way of using it in Islamic finance.

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1. Introduction

The financial services (FS) industry is witnessing an increase in the number of advocates for the distributed ledger technology (DLT) adoption every day. And why not? After all, DLT – aka blockchain – has shown immense potential. For financial institutions (FIs), it promises huge savings in infrastructure, transaction, and administrative costs. It can disintermediate the transfer of financial assets digitally, reducing the role of central counterparties. It can also help improve the level of trust, accuracy, and resilience in the financial ecosystem. Infosys (2019) opined that according to a report by Santander in 2015, upon its industry-wide implementation, by 2022, blockchain can reduce banks' infrastructure costs that are attributable to securities trading, cross-border payments, and regulatory compliance by approximately US$20 billion per annum.

Today, central banks, commercial banks, stock exchanges, and many other FS players are keenly exploring blockchain's potential. According to the World Economic Forum report published in August 2016, over 24 countries are currently investing in blockchain. Over 90 corporations are part of .blockchain consortia and more than 2,500 blockchain patents have been filed over the past three years. Additionally, over 90 central banks across the world are engaged in blockchain discussions. Adding to it, over US$1.4 billion has been invested over the past three years through venture capital to explore blockchain usage in the FS industry, Infosys (2019).

Muneeza & Mustapha (2020) studied that blockchain is a technological revolution that will spark a new world order. It represents a decentralized system offering the possibility of settling transactions at a low cost with absolute transparency and security in an immutable distributed ledger. A distributed ledger constitutes a database recorded and put to the reach of several nodes in a decentralized structure where no entity has control over it, and therefore it cannot be modified or changed.

Islamic finance ecosystem could leverage from blockchain technology in order to improve business processes and streamline operations. The characteristics and conditions of blockchain are in alignment with the principles of Islamic Law as it creates the possibility of coordinating institutions' transactional activities within a strong mechanism of trust and transparency. Blockchain technology allows businesses to build decentralized models and opens new horizons for them to conduct transactions and make agreements.

The blockchain in Islamic finance and banking will surely help the Islamic banks, and financial institutes to succeed. It will help in sharp reduction in the element of gharar with contracting between unknown parties that meet on the internet, when Islamic contracts take the form of self-executing digital or smart contracts, with "electronically coded" terms of executions. The contractual terms will execute only if the pre-configured conditions are met. This will automate the entire contractual process for Islamic institutions without worry about the interest and other such issues Islamic banking system will be able to work more productively. Management of loans and other relatable services will become easy. In addition to reducing fraud and risk, it can bring down the

high costs associated with Islamic finance. The cost of processing Islamic financial products is higher than regular financial services products, so blockchain is a very effective tool to bring down the cost in the back-end processing systems of Islamic finance companies.

The Islamic financial products/ services will now be easy to verify, immutable and secure, mitigating gharar in the form of operational risks arising from settlement, as well counterparty risks. IFIs should embrace blockchain not just to gain a strong foothold in this technological revolution, but also to be able to fully comply with the Shari'ah in a transparent way. The Shari'ah laws can form the conditions of a blockchain. Honesty, transparency and trustworthiness are qualities that should make a financial transaction in the Islamic finance industry, and blockchain is inherently all of these in the era of faster globalization.

In this context, the study employed qualitative approach in discussing Blockchain use-cases to Islamic financial industry, it is very incentive to find the horizons which can be opened within the framework of the applicability of Blockchain in Islamic finance to improve its efficiency. In this way, the paper is structured as follows: section one entails introduction, Section two includes a conceptual definition of Blockchain. Section three potential use-cases of blockchain in Islamic finance whereas section four discuses some of potential threats of using blockchain. Finally, section five serves as the conclusion.

2. Blockchain Technology

Blockchain is the most well-known and used distributed ledger technology. David et al. (2019) define Blockchain as the type of a ledger in which value-exchange transactions (in the form of cryptocurrencies, tokens or information) are sequentially grouped into blocks. Each block contains a signature that is based on the exact content (string of data) of that block. The next block contains this signature as well, and each block is chained to all previous blocks to each other up until the first block. Blocks are immutably recorded across a peer-to-peer network, using cryptographic trust and assurance mechanisms.

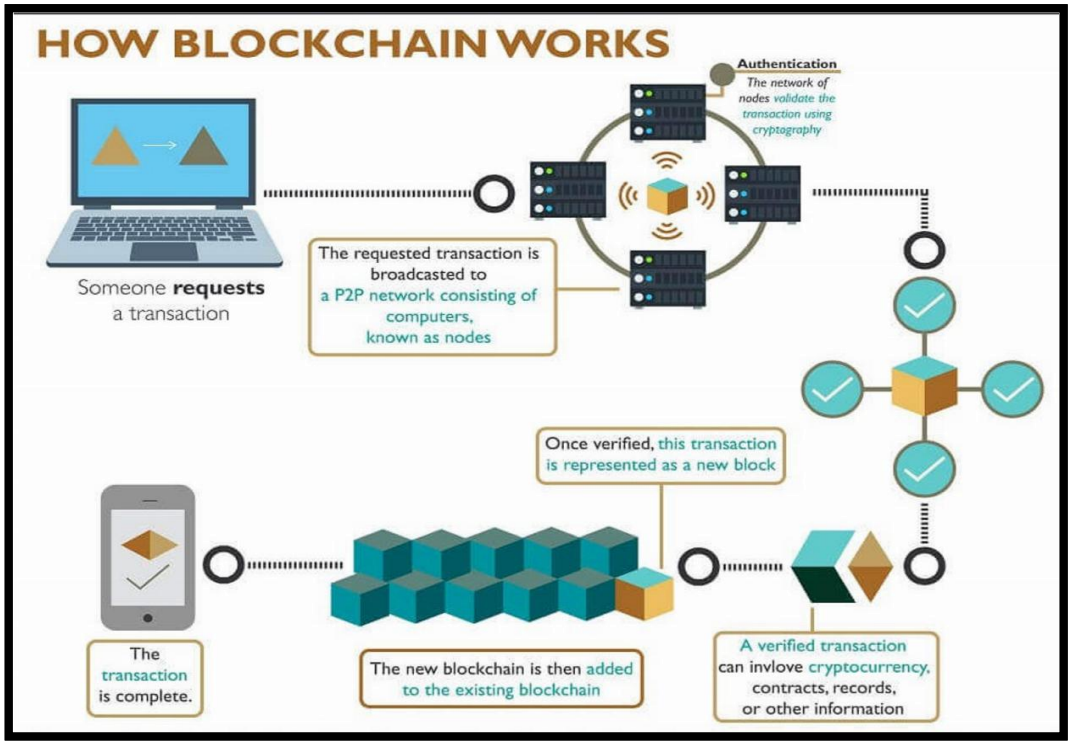
Distributed ledger technology (DLT) refers to the protocols and supporting infrastructure that allow computers in different locations to propose and validate transactions and update records in a synchronized way across a network, David et al. (2019).

Blockchain finds its origin in a paper published by an anonymous group of author(s) called Satoshi Nakamoto. In this paper, the idea of a Bitcoin was introduced as a purely peer-to-peer (P2P) electronic transaction network. This network allows for direct financial transactions instead of via a financial institution (Nakamoto, 2008). To simplify, blockchain technology allows two actors in the system (called nodes) to transact in a peer-to-peer (P2P) network and stores these transactions in a distributed way across the network (Back et al., 2014). It registers the owners of the assets that are transacted and the transaction itself.

A transaction is verified by the network by a 'consensus mechanism', which allows users in the P2P network to validate the transactions and update the registry in the entire network (Warburg, 2016). The

consensus mechanism is used to establish trust in the accuracy of the data in the system which is traditionally established by an intermediary or an administrator in a centralized system. A consensus mechanism is a process by which nodes in a distributed network agree on proposed transactions. This mechanism provides a way to record information in the ledger in a manner that ensures data integrity, immutability and consistency.

Figure 1. How Blockchain promotes transactions



Source: Thottathil (2018)

2.1 Types of Blockchain

Since the Internet is comprised of a public version and several private variations, blockchains will also follow that path. Therefore, we will have public and private blockchains. Some will be natively bolted to a blockchain, whereas others might be a hybrid implementation that is part of an existing Web or private application. (Mougayar, 2016). Blockchains can be classified as public, private or hybrid variants, depending on their application:

2.1.1 Public blockchains (permission-less)

Public blockchains have no single owner; are visible by anyone; their consensus process is open to all to participate in; and they are full decentralized. Bitcoin is an example of a public blockchain.

Public blockchain is open source in which anyone can participate, without the need of permission. On such platform, anyone can download the code or software, and start running a full node on the local device, validating transactions in the network, thus participating in the consensus process. Elasrag (2019) opined that due to the public nature, anyone can see or audit transaction on the public block explorer; however, the parties of a transaction remain anonymous. There are few advantages of using public blockchain. It has a potential to disrupt current business

models through disintermediation. Moreover, there is no need to maintain servers or system admins by the central authority, this radically reduces the cost of creating and running decentralized applications (DApps). Some examples of public blockchain are Bitcoin, Ethereum, and Litecoin.(Abojeib & Habib, 2019)

2.1.2 Private Blockchain (also called permissioned)

Private blockchains use privileges to control who can read from and write to the blockchain. Consensus algorithms and mining usually aren't required as a single entity has ownership and controls block creation.

Private blockchain can be defined as a platform controlled by a single or centralized organization with restricted number of nodes within that organization. It is valuable for solving efficiency, security and fraud problems within traditional institutions, but the most important feature of decentralization is not available for private blockchain. It has same advantages as of the consortium blockchain, but it is different from it in the sense that it has more restriction and is not distributed.(Abojeib & Habib, 2019)

2.1.3 Hybrid Blockchain (Also known as consortium)

These blockchains are public only to a privileged group. The consensus process is controlled by known, privileged servers using a set of rules agreed to by all parties. Copies of the blockchain are only distributed among entitled participants; the network is therefore only partly decentralized, Elasrag (2019).

It is also called federated blockchain. It operates under the control of a specific group of organizations which are allowed to perform the role of full nodes. As opposed to public blockchain, the structure does not give access to all persons to participate in the process of verifying transactions. The consensus process is controlled by a preselected set of nodes in which the protocol defines the minimum number required to sign every block in order for the block to be valid. The right to read the blockchain can either be public or restricted to the participants only. This type of blockchain has some specific advantages. For example, it reduces transaction costs; avoids data redundancies; and replaces legacy systems. It is also helpful for simplifying document handling and getting rid of semi manual compliance mechanisms. The transaction processing in such blockchain is faster than a public blockchain, which means there is a potential for higher scalability. It also provides more privacy, but at the cost of lesser transparency. Consortium blockchain can be suitable for the traditional banking sector.(Abojeib & Habib, 2019)

2.2 Shari'ah Perspective

Sharia is flexible and open to any innovation likely to enable it to achieve its objectives (Maqasid al-Sharia) since it follows a fundamental rule in the organization of transactions which stipulates that anything is allowed as long as there is not a text which prohibits it (Alam et al., 2019). The correct Islamic transaction dealing must be based on honesty, truthfulness, and clarification of conditions in a way that removes confusion and matches reality within harmony with the Islamic jurisprudence perspective (International Islamic Fiqh Academy, 1995). Therefore any technology capable of giving

advantages to stimulate such values will be welcome.

When we talk about the blockchain, we can easily conclude that they are placed relatively within this framework since it meets the Sharia values in the transparency that it establishes as well as it helps to avoid practices that distort morality such as maysir (gambling), dharar (harms), tadlis (cheating) and gharar (uncertainty) thanks to the distributed ledger technology (Peredaryenko, 2019). In addition to that, the transactions are secure and riskfree since the terms are in the form of algorithmic codes. Thus, not only will parties' interests be protected, but it will also lead to an environment of trust and sincerity, which are the primary purposes of Sharia (Alam et al., 2019).

2.3 Within Islamic Finance

The application of blockchain in Islamic finance is still in its early stages. However, it promises to be applied in a very broad field in Islamic banking, takaful, Sukuk market, microfinance, and crowdfunding. Islamic finance is struggling to operationally impose its values in a traditional financial ecosystem that is not the most favorable on the regulatory side to achieve its purposes. These new features will facilitate this, especially when we know that blockchain and smart contracts operate in a decentralized system, thus offering independence to IFIs from the pressures of the regulation dominance of traditional finance.

Over time, it is expected that Blockchain will be dominant technologies in the banking and financial sector, this is why even if it currently seems an optional choice for IFIs to take them into the application, they will face a huge lack of competitiveness compared to conventional financial institutions if they do not apply them in the future (Baniamer & Tahsin, 2019). The framework even touches the macroeconomic aspect because the context does not only present a simple integration of technology in Islamic finance but touches a whole new structure of a new Islamic digital economy which going to be a channel for economic prosperity such as growth, job creation and solving the problems that Islamic countries are facing (Peredaryenko, 2019).

Several traditional and Islamic financial institutions have started introducing blockchain into their organizational systems, as in Malaysia, where nine banks have integrated blockchain technology into their trade financing application (Hilal & Jamaludin, 2019). Blockchain have broad opportunities to be applied in all Islamic finance contracts, whether investment or financing contracts based on profit and loss sharing such as musharaka (partnership) and mudaraba (equity-based).

3.0 Potential Use-cases of Blockchain on Islamic Finance

3.1 Ensuring a halal investment

Through blockchain technology, investment funds in Islamic financial institutions (IFIs) will be accurately tracked to know where and for what purposes have been used. This verification can be done by encrypting and including halal certification in the blockchain in PDF form. As a result, it cannot be manipulated or modified as the transparency of blockchain technology ensures (Peredaryenko, 2019). It is thus

always checked whether the investment is sharia-compliant or not.

3.2 Contract Binding

It is well known that Islamic contracts are of two types: binding contracts and not binding contracts. A binding contract is a contract in which neither party can terminate the contract without the consent of both parties, while either party can terminate a not binding contract. Technically speaking, smart contracts can be used to function as escrow account. Thus, in a sale contract, a smart contract will not release the funds to the seller only if the buyer transfers the agreed amount to this account and take ownership of the asset, for example (Hilal & Jamaludin, 2019). Both conditions for binding of Islamic finance contract can be implemented in a smart contract and assisted by an escrow account. For instance the automatic implementation of the mudaraba contract will not begin unless the mudarib has handed over his fund to the IFI and this last start investing, and there is no review in this case because the contract became binding. Thereby, the smart contract guarantees and organizes binding mudaraba issues with full transparency.

3.3 Automate Audit and Assurance

Despite these complexities, blockchain technology offers an opportunity to streamline financial reporting and audit processes. Today, account reconciliations, trial balances, journal entries, sub-ledger extracts, and supporting spreadsheet files are provided to a charted professional accountant (CPA) auditor in a variety of electronic and manual formats. Each audit begins with different information and schedules that require a CPA auditor to invest significant time when planning an audit. In a blockchain world, the CPA auditor could have near real-time data access via read-only nodes on blockchains. This may allow an auditor to obtain information required for the audit in a consistent, recurring format, Deloitte (2017).

Blockchain is a promising technology for the accounting profession. A self-auditing and immutable record can mean massive changes for not just how much time and effort is required to verify the financials of a company, but significant reductions in the difficulty and complexity of audits (Right networks, 2017).

As more and more entities and processes migrate to blockchain solutions, accessing information in the blockchain will likely become more efficient. For example, if a significant class of transactions for an industry is recorded in a blockchain, it might be possible for a CPA auditor to develop software to continuously audit organizations using the blockchain. This could eliminate many of the manual data extraction and audit preparation activities that are labour intensive and time consuming for an entity's management and staff. Speeding up audit preparation activities could help reduce the lag between the transaction and verification dates — one of the major criticisms of financial reporting. Reducing lag time could offer the opportunity to increase the efficiency and effectiveness of financial reporting and auditing by enabling management and auditors to focus on riskier and more complex transactions while conducting routine auditing in near real time, Deloitte (2017).

3.4 Improve security and Transparency

Blockchain reduces the risk of fraud and errors by providing a secure and

immutable record of transactions, it also reduces data breach risk and secure sensitive data. Blockchain increases transparency in the banking industry by providing a clear and accessible record of transactions as it streamline and reduces the time and cost of the banking processes.

It also helps banks to comply with regulatory requirements, by providing a secure and verifiable record of customer identity information.

3.5 The more flexible Investment system

Technically speaking, smart contracts allow simultaneous transactions to be carried out (Prause, 2019). By adopting a system in which smart contract links each client, it is possible to operate in a flexible investment system where entry and exit operations in the investment pool are also carried out simultaneously, which is very attractive as a flexible investment mechanism for investors as it is less costly and less time-consuming.

3.6 Matching Financer to the financed

The smart contracts applied on blockchain platforms pave the way towards a decentralized financing system, where the one in need of financing can easily collect the required funds by only connecting to his blockchain account (on Ethereum for example) while establishing a set of demand and also showing his project proposal (Kasujja, 2018). This can also potentially be applied in matching the financer (*Rab'ul mal*) to the financee (*mudarib*) so that the customer does not have to go to the bank himself to put his money under mudaraba investment, as smart contracts allow a direct link between the two parties without mediation simply by entering in an account that the client has on a blockchain platform and communicates with the funder directly who offers the project that suits him.

3.7 Efficiency in transferring funds

Transferring funds is time-consuming for banks, especially in their third party relationships with suppliers, companies, and customers. Smart contracts contribute enormously to the acceleration of this operation while preserving transparency and accuracy given that algorithmic codes are immutable and distributed within the network. A smart contract will also contribute to the post-negotiation phase, where the verification of the transaction and the settlement will no longer be a manual operation (Lambert, 2019).

Blockchain facilitates faster and more secure cross-border payment. And it facilitates peer to peer transactions, which can help to reduce the need for intermediaries.

3.8 Improving KYC process

Know Your Customer (KYC) technique is a set of data relating to the customer's identity collected by the bank (and financial institutions) to offer services more effectively. It prevents impersonation, financial fraud, money laundering, and terrorism finance (Moiseev, 2019). The need for a KYC procedure arises mainly in the opening of bank accounts, the granting of loans or credit cards, and investments in mutual funds such as mudaraba. Any client who wants to join a Islamic equity-based investment pool needs to be identified by the bank through the KYC procedure.

How Blockchain and smart contracts can contribute to the development of KYC should be considered in this field. An example process should be : a certification node

(usually owned by the state or an authorized agent) is first integrated into the blockchain network. Once company A requests a certain number of documents on company B, it sends its request to this certification node. The latter thus ensure the verification of the validity of the documents after having taken consent for this from company B. All this process can be programmed in a smart contract, and the ultimate advantage in this context will be to reduce the time necessary for data collection and authenticity control (Moiseev, 2019). The same example can be seen in a bank and its customer.

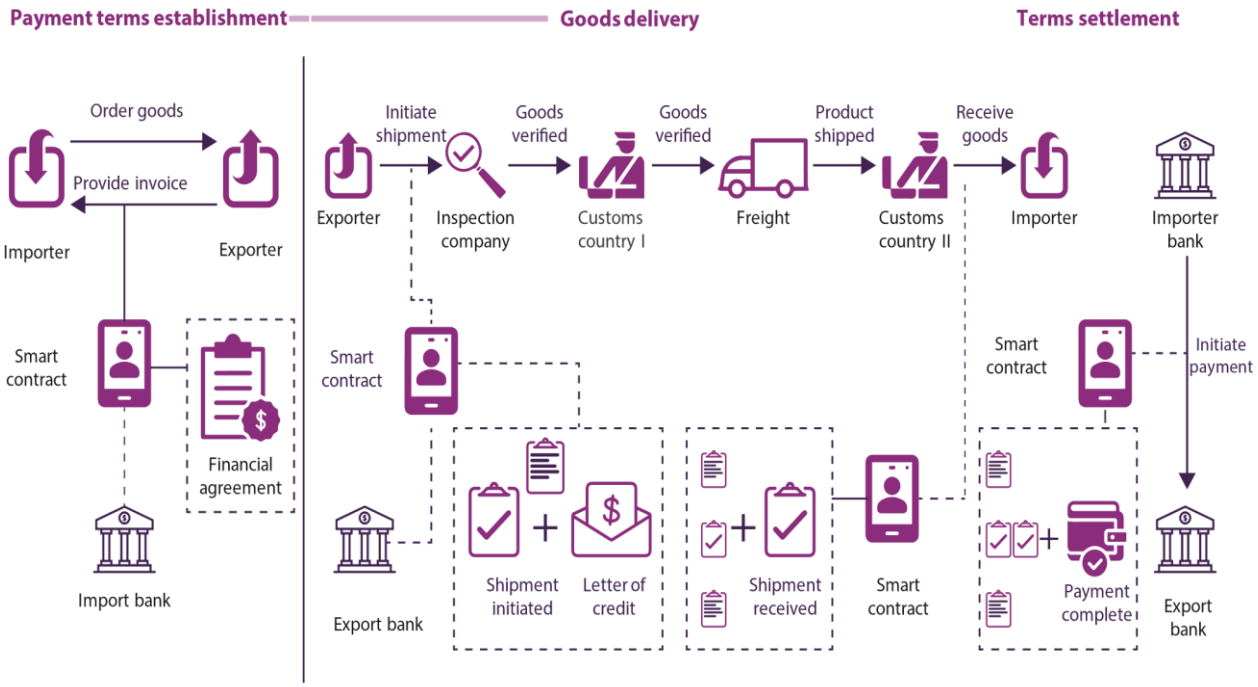
3.9 The more efficient Crowdfunding process

Crowdfunding, a method of raising funds through online platforms, is among the fields where smart contracts can be applied. Crowdfunding was also approved and adapted for application within the framework of Islamic finance principles under a new analog concept known as Islamic crowdfunding. It thus relies on partnership contracts of Islamic finance such as musharaka and mudaraba to finance projects, start-ups, small and medium enterprises, or capital increase (Kamdzhalov, 2020).

3.10 Trade-Finance

Traditional trade finance is associated with many issues such as loaded paper, increased errors, and slow method of processing transactions between counterparties. Blockchain has a lot to offer to the world of trade finance, ranging from removing papers, automating processes and payments, reducing fraud, and cutting costs to tracking and tracing shipments and allowing all participants to access the same information (The Banker, 2018; Monrat et al., 2019). Many companies and banks formed consortia with a commitment to finding solutions for improved trade finance. For example, IBM and the bank-led consortium R3 developed a blockchain project. This project involved 12 international banks, including BBVA, Mizuho, and U.S. Bank, and aimed at digitizing paper letters of credit (Macknight, 2018). Blockchain streamline trade finance processes by enabling the digitization of documents and automating many manual processes.

Figure 2: How Blockchain is streamlining Trade Finance



Illustrative trade finance process flow under blockchain setup

Source: Infosys (2019)

3.11 Mitigate investment risks

The IFIs tends to participate in the investment pool with the funds of its depositors, which exposes it to a risk familiar in all banking systems that of the loss of these funds and the lack of liquidity, especially in the case of risky investments that can upset the stability of the financial sector. Indeed we talk about counterparty risk in the bank balance sheet, which can be mitigated through sufficient monitoring of the funds available and how they are used as well as making the share of profits or losses clear and all this is thanks to the transparency provided by smart contracts within distributed ledger technology (Kasujja, 2018).

3.12 Financial Inclusion Improvement

It is possible and potentially promising to deploy smart contracts in Islamic microfinance activities in to automate the chain of intermediation or facilitate disintermediation and transformation into other intermediaries. Thanks to this automation, the resource planning tools of companies can be integrated into a blockchain which allows supporting young companies and start-ups with transparency and visibility on the operational side as well as in the advice in terms of their commercial operations (Kasujja, 2018). Investment contracts used in Islamic microfinance can greatly benefit from these advantages and contribute to a digitalized and more efficient financial inclusion system.

3.13 Financial Clearance and Settlements

Companies and institutions can use blockchain to record, validate, and process financial settlements without the need for a clearinghouse. Blockchain can facilitate clearing procedures that include adjusting financial obligations to authorize payments (Al-Jaroodi & Mohamed, 2019). Blockchain can enable the direct settlement of transactions and maintain track of those transactions more effectively than current systems such as SWIFT (How Blockchain Could Disrupt Banking, 2018).

The Royal Bank of Canada, one of the first adopters of this application, started to use blockchain-based Hyperledger for its US–Canada interbank settlements (Suberg, 2017).

4. Potential Threats of Blockchain in Islamic Finance

However, some challenges related to Blockchain need to be resolved for this product to be fully Sharia-compliant. Among these challenges, the inevitability of an offer and acceptance (sighah) that expresses the esoteric will of both parties, adapting of the contract session (majlis), the way the settlement is realized, warranty and liability for loss and defects, and finally the contract evidence, that is, how to prove a contract without a physical paper so as not to lead to disputes. There is also another challenge related to cryptocurrency and how it can be a Sharia-compliant means of payment under any conditions. The real challenge, going forward, will be the legality of smart contracts, and the global regulatory framework needed to establish true peer-to-peer lending across borders; just because it is legal in one country, does not make it so in the next.

4.1 Regulation

One of the primary issues with implementing blockchain in Islamic Finance is the lack of regulation and standards. According to a survey of blockchain-savvy executives conducted by Deloitte, regulatory issues were cited to be among major barriers to increased investment in blockchain technology.This technology supports many features, such as cryptographic signatures and smart contracts, but current regulations do not address them (Deloitte, 2018). Besides, a poll of senior professionals who attended the Ernst & Young Global Blockchain Summit in New York found out that regulatory complexity is significantly impacting widespread blockchain adoption (Ernst & Young, 2018).

Lin and Liao (2017) mentioned that, using Bitcoin as an example, the characteristics of this decentralized system will weaken the central bank's ability to control economic policy and the amount of money, making the government cautious of blockchain technologies. Therefore, authorities have to address this new issue and speed up the formulation of new policies to stop its likely impact on the market. As blockchain is still in its infancy, governments are continuously modifying regulations as it develops. For instance, in 2018, over 17 U.S. state legislatures considered and approved many bills relating to blockchain technology implementation. These bills address various areas, including "the recognition of cryptographic signatures, the definition and use of smart contracts, and the use of blockchains for maintaining business records" (Deloitte, 2018).

Table 1: Blockchain adoption – Technological risks and Challenges

#	Technological risks/	Elaboration

	Challenges	
1	Performance	• Even as their adoption requires high initial capital costs, many blockchain applications have demonstrated poor scalability, high transaction processing delays, and latency issues, especially where permissionless ledgers are involved • Owing to their very calculation-intensive cryptographic component, many DLs are significantly slower than the conventional databases • There is a risk that blockchain applications designed for sophisticated multi-jurisdictional use cases may not be scalable, optimally functional, secure, and cost-effective • Smart contracts are not fault-tolerant, and there are chances of coding issues. Reviews have found that large numbers of template contracts for Ethereum scripting system contain significant vulnerabilities. Digital currencies have also shown that they are not always crash prone. • In the blockchain setup, when major FIs act as full nodes, there is a risk that the DL size may become unmanageable. • As smart contracts are created by humans, these are prone to human error. Correcting errors in smart contracts is relatively difficult as these need to be specifically created for updates
2	Interoperability	• Interoperability is crucial to maximize the power of DLs. However, today, there is a lack of consensus on policy and data interoperability • Using different DLs requires data-sharing capabilities. However, currently, the data exchange protocols and formats are not mature enough. Rival blockchain technologies can undermine system interoperability • Owing to difficulty in transposing different consensus protocols, transaction reconciliation between different DLs may be challenging • There are challenges in using wallet software with separate DLs. Currently, most DLs have their own wallet software. Enabling common wallet for various DLs is difficult
3	Standardization	• There is a lack of industry alignment on certain key design points. For example, access requirements for completely open versus permissioned ledgers, interoperability between networks, improvement approaches, and governance processes • Common DL and network protocols and standards are lacking. Users currently have their own mix of technology and back-office system stacks. There is also a lack of standard DLT tools or interfaces. This creates scalability and integration challenges. • There is a lack of consensus on effective international standards and versions of blockchain. There is division between myriad approaches, namely, private blockchains (e.g., R3, DAH) and openended blockchains (e.g., Ethereum).

Source: Infosys (2019)

5.0 Conclusion

Our study aimed at analyzing the different contributions and challenges of Blockchain to Islamic finance industry, the study found that blockchain technology has significant potentials to streamline products and services of IFIs. We concluded that Islamic finance contracts (products and services) could largely be developed from the technical and operational sides and Sharia-compliance perspective. If blockchain is applied correctly in IFIs, equity-based contracts will present an efficient, secure, and innovative investment model and will be able

to overcome the downsides faced by the traditional system. We suggest that the IFIs should study how blockchain works and possible way of using it in Islamic finance, regulators and supervisory bodies should also develop standards for using this innovative technology in IFIs.

Conflict of Interest

We do not have any conflict of interest, beign it personal, financial or professional

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