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LEVERAGING BLOCKCHAIN-BASED SMART CONTRACT IN ISLAMIC FINANCIAL INSTITUTIONS: ISSUE AND RELEVANT SOLUTION

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ABSTRACT

A blockchain-based smart contract is a computer script, stored in the blockchain network and enforced automatically based on predetermined terms, decentralised verification as well as fully accessible real-time records to all blockchain users. Smart contract innovation, with a high level of transparency and a lower risk of operational errors, offers a novel approach for more effectively implementing Shariah contracts in Islamic financial institutions. However, the immutable smart contract principle, which disallows the amendment or deletion of the code deployed in the blockchain, appears incompatible with the *iḥsān* criterion implemented in Islamic financial institutions' product offerings that allow operations and terms adjustment under certain conditions, including payment rescheduling and contract restructuring facilities in financing products. This study aims to look into the concept of blockchain-based smart contracts, as well as issue related to immutable smart contract and viable solutions that align with Shariah and Islamic banking operations. The study utilised the library research to achieve the objective by referring to related literature. The qualitative data were then descriptively analysed using the conceptual content analysis method. The study's results found that, in order to comply with the characteristics of *iḥsān* to implement Shariah contracts using blockchain-based smart contract technology, the programmer should first write flexible code rather than fixed code, and the upgradable proxy contract should be well applied in the creation of the smart contract code.

Keywords: Distributed Ledger, *Iḥsān*, Industrial Revolution 4.0, Islamic Financial Institutions, Shariah Compliance

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INTRODUCTION

Blockchain-based smart contract technology is one of the fourth industrial revolution's outcomes, and is being regarded as a disruptor of financial industry operations. (DIEDC, 2018). Unlike traditional contract operations, this technology aims to execute contracts automatically with minimal human intervention and relying on a central authority to validate and record transaction data.

Blockchain-based smart contract have the potential of being used to operate Shariah contracts for Islamic financial institutions. It is, however, has several operational issues, including the fact that the code representing the term of the contract cannot be modified or terminated once it has been deployed into the blockchain network. This is in opposition to the operation of product offers in Islamic financial institutions, that offer variety of facilities that allow contract terms and applications to be amended based on the contract participants' consent.

This study aims to identify the potential of blockchain-based smart contract technology for the operation of Islamic financial institutions, the characteristics of the immutable code of smart contract technology and its issues on the Islamic financial institutions' product offerings as well as identifying the solutions that meet the value of *iḥsān* in the operation of Islamic financial institutions. A qualitative approach by referring to related documents and literature was implemented to collect data. While the descriptive content analysis method is used to analyse the qualitative data.

The paper is organised into six sections. Following the introduction, the second section is on understanding blockchain-based smart contract. The third section elaborates the potential of blockchain-based smart contract to Islamic financial institutions' operations. The fourth section explains the Shariah concern on immutable smart contract to the Islamic Financial institutions' operations, whereas the fifth section offers some relevant initiatives to achieve *iḥsān* using blockchain-based smart contracts in Islamic financial institutions' operations. Lastly, the seventh section draws the research conclusion.

UNDERSTANDING BLOCKCHAIN-BASED SMART CONTRACT

Smart contract technology is understood in a variety of ways. According to Nick Szabo (1997), smart contract is a computer code script that implements the conditions of the contract. A smart contract, according to Farrukh Habib (2019), is a contract based on a computer algorithm that automatically enforces the contract when the terms and conditions are met. Siti Rohaya et al. (2018) define a smart contract as a computer code that runs in a blockchain network. It comprises a set of rules that bind the parties involved in a smart contract transaction. While according to Nicola and Tiziana (2018), a smart contract is a fully automated contract if all of its computer-coded terms are met and verified by a consensus protocol to create a chain.

Two ideas may be extracted from the researchers' definition. The first is a smart contract, which is a script of code written by a programmer to represent a contract's terms. A computer script may well be understood of as a code arrangement in the form of "if-then" statements that enables the code to be executed when conditions are satisfied (Son Nguyen et al., 2020). For instance, when a predetermined date is reached, a smart contract distributes profits to all investors. The second is the blockchain, which serves as a platform for smart contract code execution.

The frequent interchangeability of the phrases 'blockchain' and 'smart contract' in technological debates demonstrates how closely connected the concepts of 'blockchain' with 'smart contract'. This is often because blockchain is the most viable platform to enforce smart contract code (Christian & Joshua, 2019). Besides enabling cryptocurrency transactions, blockchain 2.0's features have brought the smart contract idea, which was first proposed by Nick Szabo in the 1970s, back into the spotlight (Farhana & Faridah, 2019).

As adapted from Tianyu et al. (2019), Zibin et al. (2020), Farhana & Faridah, (2019), Figure 1 shows how a blockchain-based smart contract operates:

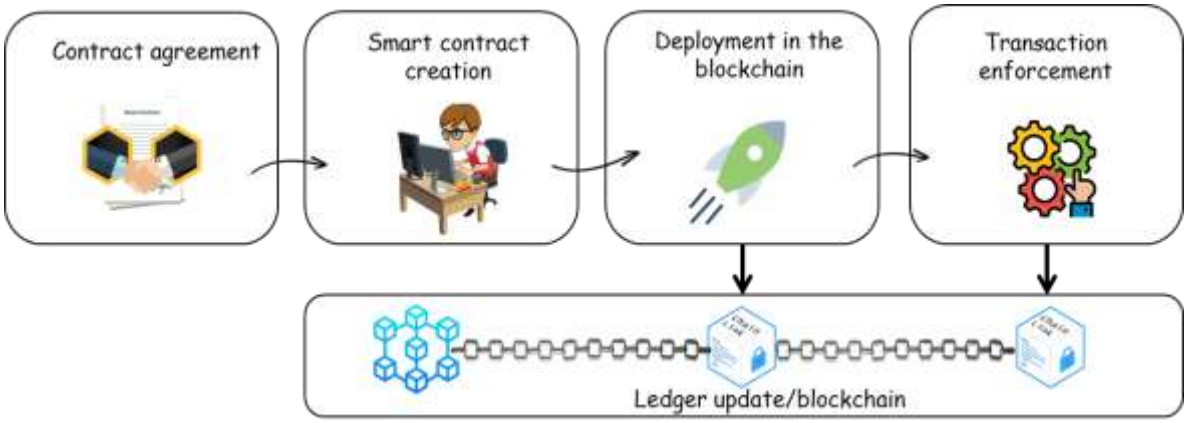

Figure 1: Blockchain-based Smart Contract Operational Cycle

1. Contract negotiation: Determining on a contract's conditions, such as the subject, pricing, tenure, and action in the event of a violation. The contracting parties will interact with one another to negotiate until the contract is achieved.
2. Smart contract creation: Upon the conclusion of an agreement, a computer programmer translates the contract terms into code language to create a smart contract.
3. Deployment in the blockchain: After developed, the smart contract will be deployed into the blockchain network. As a result, the smart contract code is become immutable. Every contract-related asset will also be distributed and frozen on the blockchain network.
4. Transaction enforcement: To execute transactions, the smart contract requires inputs that adhere to the contract terms. If any of the requirements are satisfied, the smart contract will execute the transaction automatically and the blockchain network community will validate the transaction input using a network-established consensus protocol (Peter Eze et al., 2017).
5. Smart contract completion: Every successfully enforced transaction is recorded on the blockchain network and distributed to all nodes or participants in the blockchain network. New blocks will be added to the ledgers of blockchain participants. As indicated in Figure 1, all transaction data will be recorded in the blockchain.

Three, at the very least, of the many operational characteristics of the blockchain-based smart contract are listed. Firstly, it is enforced automatically. The inputs and outputs set in the smart contract code are the only factors that determine how the smart contract will be executed once it has been created and deployed on the blockchain network. Hence, utilizing the smart contract technology in a transaction reduces the likelihood of operational errors. (Muhammad Faruq et al., 2020).

Next, decentralised validation. Every transaction conducted on the blockchain platform will be validated by the blockchain platform's participating nodes, which is known as the consensus protocol method. The consensus protocol varies depending on whether the blockchain is private or public. In principle, the consensus protocol aims to ensure that each transaction in the blockchain network is decentralised rather than centrally validated, and that transaction records are stored in the blockchain network (Shahbaz Alam & Hina Noor, 2020).

Lastly, distributed data record. Since transactions are carried out via the blockchain platform, validated transaction records will be distributed to each platform user. This means that all blockchain platform users will have identical data on their nodes. Using a blockchain platform to execute a transaction will increase the level of transparency with decentralized record verification and distributed record storage. This approach also improves transaction data security since the transaction data is not kept on a single computer server. According to technological players, there is very little chance for the blockchain to be exploited because doing so requires the consent of all participants in the blockchain who share the same data (Nur Husna Zakaria et al., 2018).

It's Potential to Islamic Financial Institutions' Operation

Islamic financial institutions are intermediaries that offer financial products based on Shariah-compliant contracts. The execution of Islamic financial institutions' contracts has the potential to be implemented using blockchain-based smart contract technology. Researchers including Mohamed Cherif, Mustafa Omar, and Ruslan Sabirzyanov as well as Akram Laldin (2019), Az Azrinuddin (2018), Muhammad Faruq et al. (2020), Siti Rohaya et al. (2018), Auwal Adam (2018), and Dhiaeddine Rejeb (2021) have discussed the use of blockchain-based smart contract technology in Islamic financial institutions and various types of products (2021). According to their studies, each pillar of a Shariah contract must be realised and meticulously organised in the smart contract code in order to ensure the use of the smart contract technology in Shariah contract operations is Shariah-compliant.

In the future, blockchain-based smart contract technology may be a practical operational approach for Islamic financial institutions offering their services to tech-savvy clients who favor technological channels in daily operations, including financial activities (Richard et al., 2017). In delivering Islamic financial institution products, the integration of blockchain-based smart contract technology with other modern technologies such as artificial intelligence and big data can be an effective tool to compete with modern technology start-up companies that offer the same services as Islamic financial institutions (Eduardo et al., 2019).

The delivery of Islamic financial products via blockchain-based smart contract technology offers benefit from the viewpoint of Shariah compliance and Islamic *mu'āmalat* ethics. Operation error and Shariah non-compliant incidents caused by human intervention in operation can be reduced using smart contracts (Muhammad Faruq et al., 2020). This is due to the fact that a smart contract will only execute a transaction if the provided input meets with the set code (transaction terms) and generates the predetermined output. The smart contract interpreter, on the other hand, will reject invalid inputs (Son Nguyen et al., 2020).

Operating mistakes in Shariah contracts can be minimized by using blockchain-based smart contract. The offering *tawarruq*-based financing, for instance, involves a number of Shariah non-compliant events. Disbursement made before the commodity trading, errors in transaction sequence, the amount of purchase and sale of commodities with commodity sellers and buyers as well as wrong disbursement amount are a few of them (Muhammad Aiman & Najib, 2022; Amir Husin et al., 2019; Nasrun & Asmak, 2014). According to Mahbubi Ali and Rusni Hassan (2020), the error was caused by a human error.

Furthermore, the characteristics of distributed records in blockchain operations might enhance transaction transparency (Richard et al., 2017). The transaction record will be distributed to the blockchain users and cannot be amended once it has been validated by blockchain's data validation ecosystem. Smart contract code and transaction data are accessible to all blockchain communities through block explorers enabled by blockchain platform providers.

IMMUTABLE SMART CONTRACT AND ITS CONCERNS ON THE ISLAMIC FINANCIAL INSTITUTIONS OPERATIONS

What is Immutable Smart Contract?

In contrast to the traditional contract, which are enforced by documentation, smart contract technology is based on computer programmes or computer code. A contract that is carried out via a smart contract must be converted into a script of computer code to create a smart contract and subsequently be deployed in the blockchain network. Immutable is one of the value propositions offered in blockchain-based smart contract operations.

After the smart contract is deployed into the blockchain, which is the third process until the completion in Figure 1, immutable code takes effect. This means that data deployed and stored in the blockchain network, including smart contract codes and transaction records, cannot be modified or deleted unilaterally unless all blockchain network participants agree (Farrukh, 2019; Sirajulhaq & Marifatulhaq, 2019; Barlotelli & Livio, 2017).

Smart contracts are immutable because they are stored in the blockchain, which is a decentralised ledger system. This is to ensure the integrity of the contract operation via smart contract and to avoid any interference and fraud by ensuring that the contract terms (smart contract code) cannot be modified by any party (Romulo, 2019). Since the terms and conditions of the contract are recorded on a public ledger and can be accessed by anyone without depending on a central authority, the immutable characteristics of the smart contract on the blockchain enhance operation transparency and trust between contract parties (Aishath & Zakariya, 2019).

Shariah Concern on Immutable Smart Contract

Munzir Qahf, Muhammad Sharīf, and Quṭub Muṣṭafā Sānū (2019) view the jurisprudence method "the original rule of something related to *mu'āmalat* is permissibility" as the premise for its application in order to carry out transactions utilising the blockchain-based smart contract technology. According to the method, Hussam al-Din (2009) claims that as long as *mu'āmalat* activities do not violate Sharia law, there are no restrictions to its advancement. According to Mohamad Akram and Hafas Furqani (2019), this approach offers flexibility for introducing innovative transactional mechanisms and Islamic business, especially the use of smart contract technology. Sumaia Ali (2022) believes of using the smart contract to perform out contracts can achieve *maqāṣid al-Sharī'ah* in regards to preserving property for smart contract code is only enforceable on valid predetermined inputs and outputs as well as transparent blockchain ecosystem verification and recording methods. This demonstrates that the fairness in Islamic *mu'āmalat* may be preserved through the use of the smart contract in executing contracts.

Even when not specified in the contract, from the perspective of Islamic muamalat, providing such amenities is a type of *iḥsān* as Islam encourages and demonstrates the value of empathy and consideration in performing Islamic *mu'āmalat* (Abdul Muneem et al., 2020). Alongwith facilitating customers, these facilities also benefit Islamic financial institutions by

reducing the insolvent financing list and sustaining its performance (Aznan Hasan et al., 2018). This option also allows banks to continue financing the customer without resorting to legal action, saving costs on legal expenses and other recovery procedures including imposing the liquidation of the customer's assets (Siti Mazlita, 2014).

In regards to smart contract operations, the facilities described require smart contract code modification after deployment in the blockchain network to allow the enforcement of terms that are not part of the code. This goes against the idea of immutability that blockchain-based smart contracts provide. Moreover, Ahmad Zakirullah opines that the immutable aspects illustrate that smart contract operations do not align to the *tasammuh* and *iḥsān* principles in Islamic *mu'āmalat* and reducing the element of empathy as compared to traditional contracts that can be amended since they are formed on documents and physical enforcement (Ahmad Zakirullah, 2020).

THE RELEVANT INITIATIVE TO ACHIEVE *IHSAN* IN USING BLOCKCHAIN-BASED SMART CONTRACT

In principle, when a contract agreement is achieved, it binds the participants to fulfil their obligations and refrain from performing acts that might violate the contract terms ('Abd A-Sattar, 2016). Unless the contract participants agree to an *iqālah*, the binding terms could be modified. In this way, the smart contract satisfies the contract execution criteria by assuring that transactions are enforced in accordance with the code established based on the contract's terms and will not process inputs and generate indeterminate outputs.

A smart contract puts the specified instructions into execution. Nonetheless, there are facilities that might result in adjustments to the contract's terms in the way that Islamic financial institutions operate. For that reason, it is necessary to determine if each contract clause is fixed or flexible. A fixed smart contract code can be created for transaction operations involving fixed and unchangeable terms.

For flexible term clauses that may be altered in the future, the creation of organised and planned flexible code with a variety of alternative code implementations is adapted. Ideal flexibility entails that the implementation of the code can be channelled to the other predetermined implementation. If developers have a clearer understanding of the potential forthcoming operations' adjustments, they may create flexible smart contract code. This makes the code flexible with several alternative code implementations able to be carried out.

In general, Islamic financial institutions have sufficient data to determine which contract terms are likely to be amended in the future. In this regard, Islamic financial institutions can compile a number of alternatives that fulfil banking risk and customer needs and embed them into the smart contract code as part of sound credit management. With flexible alternative codes readily available, the smart contract code can communicate with their implementation according to the input given to the smart contract. The bank, for instance, includes several payment amount alternatives in the smart contract code to meet the customer's obligations to the bank under the financing product. If the customer requests for refinancing due to being unable to pay the agreed-upon monthly financing amount, the other repayment amount option specified in the code may be taken into consideration.

For the unexpected events require a term to be amended in banking product offering, such as contract restructuring that need the execution of a new contract and the termination of an old contract, the upgradable proxy contract may be applied in the code creation. The term 'upgradable proxy contract' refers to the migratable smart contract code from old to a new one by deploying new code in the blockchain without modifying or delete the old code (Lovodica Marchesi et al., 2020; Massimo & Livio, 2017).

A smart contract code arrangement approach called an upgradeable proxy contract was created by blockchain industry players. It allows the smart contract owner to stop the smart contract code from implementing the existing code set, deploy new code, and command the smart contract to implement the new code set. Due to the immutability of the blockchain-based smart contract, the old code is still in the blockchain. By enabling the ability to upgrade the smart contract code that has been distributed in the blockchain, this invention of an upgradable proxy contract can solve the arisen issue (Tianyu Feng et al., 2019).

The following is an illustration of an upgradable proxy contract in the operation of a blockchain-based smart contract:

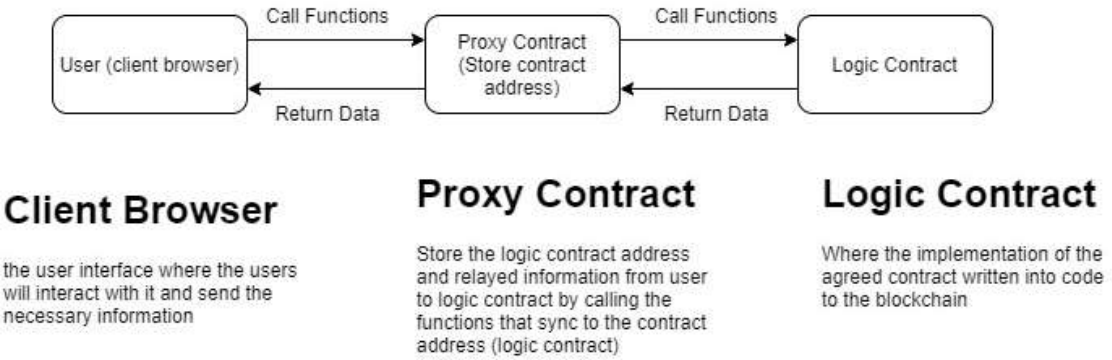

Figure 2: Illustration of Upgradable Proxy Contract

According to Gaving Zheng et al. (2021), the proxy contract links the smart contract user interface to the logical contract/implementation contract. The logical contract/implementation contract will be stored in the proxy contract. The owner of the smart contract can create new code and deploy it on the blockchain network at any moment. The contract owner then can direct the user to the logical contract implementation that has the correct or desired logic. The data from the previous contracts, however, is still recorded in the blockchain (Maximilian & Uwe, 2018).

Upgradable proxy contract is used in the smart contract creation when users of blockchain-based smart contract encounter the risk of operations changing. If Islamic financial institutions use the blockchain-based smart contract in their product offerings, upgradable proxy contract is suitable alternative to be used in code formation to deal with situations that require operational changes due to changes in contract terms, such as contract restructuring (Qi Yang et al., 2019).

Upgradeable smart contracts, created using proxy patterns, enable developers to modify contract functionality after deployment without harming the contract's security. Likewise, it could preserve the contract's legitimacy by keeping the previous code (contract terms) intact and stored in the blockchain (Lovodica Marchesi et al., 2020). The proxy pattern is continuously being improved by tech players nowadays (Van Cuaong et al., 2021). Proxy patterns in smart contract coding will allow the facilities offered in the product offering to be executed without interfering with the contract's purposes.

Upgradeable smart contracts, created using proxy patterns, enable developers to modify contract functionality after deployment without harming the contract's security. Likewise, it could preserve the contract's legitimacy by keeping the previous code (contract terms) intact and stored in the blockchain.

Smart contracts' flexible code and upgradable proxy contract can be used to meet the operational needs of product offerings in Islamic financial institutions. Aside from the benefits

of automatic transactions based on smart contract codes, decentralised verification, and distributed records that can be accessed in real time by all contract participants, which certainly fulfils the *maqāṣid* in property protection, the values of *iḥsān* recommended in Islamic *muʿāmalat* ethics can also be well preserved.

CONCLUSION

The blockchain-based smart contract is a new operating mechanism that can reduce operational errors in Islamic financial institutions that involve physical operations, increase transparency while ensure that Islamic financial institutions' operations are in line with modern technological developments. To integrate the blockchain-based smart contract into financial institutions', particularly Islamic financial institutions' product offerings, issues such as the immutable smart contract's unmodifiable code must be well managed to ensure that its use does not contradict the needs of customers and financial institutions, including the facilities that are typically available in financial institutions', especially facilities in Islamic financial institutions' product offerings that are align with *iḥsān* in Islamic muamalat. The flexible writing of term clauses in smart contract code and the usage of the upgradable proxy contract in the code creation is an approach that may be considered to cope with the issue. In conclusion, in addition to the benefits that the blockchain-based smart contract provide to Islamic financial institutions, the proposed initiative in the formation of a smart contract code can manage the aforementioned issue while also maintaining and preserving the application of *iḥsān* in Islamic financial institutions' product offerings.

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