Smart Contracts and the Possibility of Gharar

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Abstract

Deriving from the rapidly evolving blockchain technology, smart contracts—self-executing contracts with terms and conditions embedded in code—present both opportunities and challenges for the world of finance. While these digital contracts promise efficiency and transparency, the study of their compatibility with the Shariah perspective remains a significant and largely unexplored area. This research was done by understanding the foundations of Islamic Finance and fundamentals of Smart Contracts from articles and other references to explore the potential avenues and challenges of integrating smart contracts within Shariah-compliant financial practices and to ascertain whether the characteristics and mechanics of smart contracts can align with the ethical, transparent, and fair mandates of Islamic finance or if they introduce elements of Gharar (uncertainty/ambiguity), potentially violating these principles. This paper finds that there are 4 common factors between Islamic Finance and Smart Contracts while there are 5 areas where they might be discordant which then may introduce Gharar. This paper also simulates scenarios to analyze possible Gharar introductions and offers ways how to mitigate these.

Keywords

Islamic Finance, Smart Contracts, Blockchain Technology, Shariah Compliance, Fintech

Introduction

In recent years, the emergence of blockchain technology- a distributed software system -has transformed transaction processes with a decentralized approach where no trusted third party is required. The innovation helps complete business activities promptly and cost-effective. Furthermore, the immutability of blockchains assures distributed trust as the transactions stored in blockchains cannot be altered or tampered with, and the historical transactions are traceable and auditable (Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M., 2020).

Unlike other technologies that have given rise to the internet, including TCP/IP which came into being in 1972, blockchain technology has significant advantages for smart contracts, as highlighted by Williams (2017) (Williams, S., 2017). Some of the benefits of these include improved transparency, reduced transaction costs, faster settlement, user-controlled networks, and decentralisation. (Zain, N. R. B. M., Ali, E. R. A. E., Abideen, A., & Rahman, H. A., 2019)

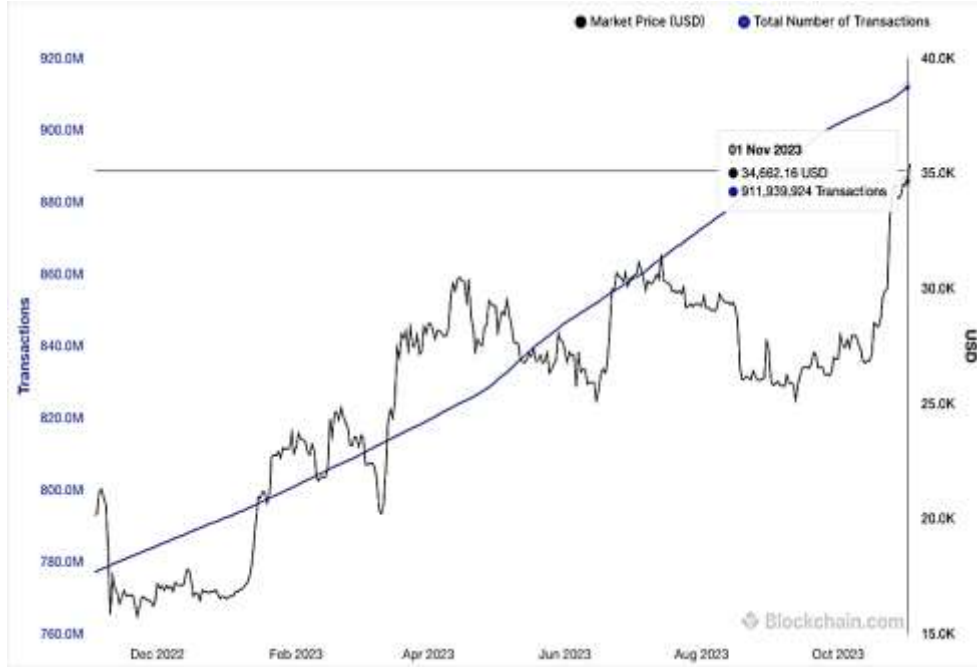*Figure 1 Number of Transactions from Blockchain on 03 November 2022* (Blockchain.com, 2023)

Figure 2 The number of transactions from Blockchain on 01 November 2023 (Blockchain.com, 2023)

Blockchain technology has manifested the deployments of smart contracts through Ethereum where over 44 million smart contracts have been implemented since its inception. Notably, about 70 percent of the live contracts are just variations of the 15 templates implying some degree of standardization (Young, 2022). Figure 1 and Figure 2, extracted from Blockchain.com, demonstrated the rapid increase in the execution of transactions in blockchain in the span of one year, implying that the trend will keep increasing in the future. Between November 2022 and November 2023, there was a 17 percent increase in the number of transactions, which is 134,757,041 more transactions than in November 2022.

Figure 3 presented the number of Ethereum daily transactions chart, where the highest number of transactions in one day in Ethereum is close to 2 million transactions. Whereas from 2022 until present, the average number, as can be observed from the graph, can be estimated between 1 million to 1.25 million transactions daily in Ethereum. Meanwhile, when studying from Figure 4 and Figure 5, the total number of verified contracts daily peaked at more than 2000 contracts of all-time while in 2023, it averaging at about 500 to 1000 number of verified contracts daily. This further solidify the fact that the usage of using smart contracts in Ethereum increasing through time and rapidly.
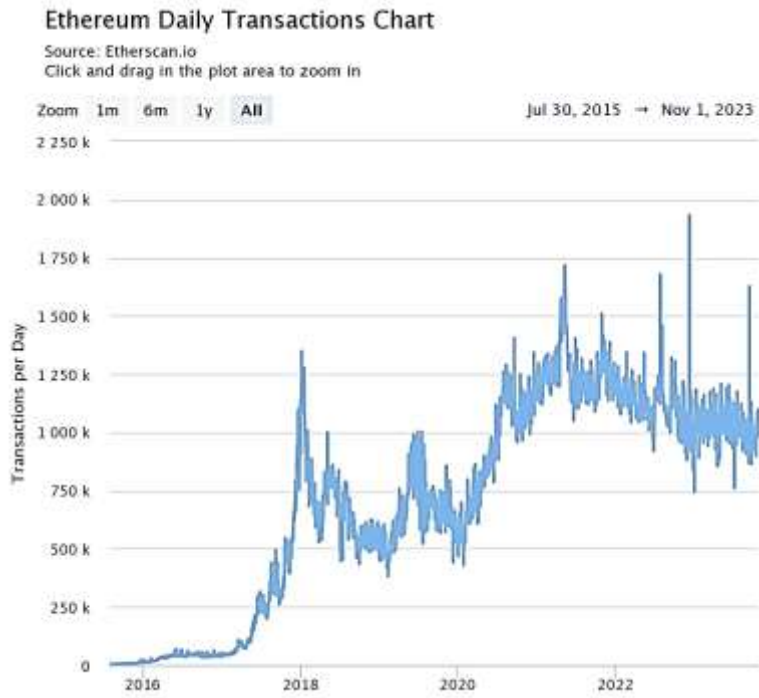
Ethereum Daily Transactions Chart

Source: Etherscan.io
Click and drag in the plot area to zoom in

Zoom 1m 6m 1y **All**   Jul 30, 2015 → Nov 1, 2023

Figure 3 Ethereum Daily Transactions Chart, all-time view. (Etherscan.io, 2023)

Ethereum Daily Verified Contracts Chart

Source: Etherscan.io
Click and drag in the plot area to zoom in

Zoom 1m 6m **1y** All   Nov 1, 2022 → Nov 1, 2023

Figure 4 Ethereum Daily Verified Contracts Chart, all-time view. (Etherscan.io, 2023).
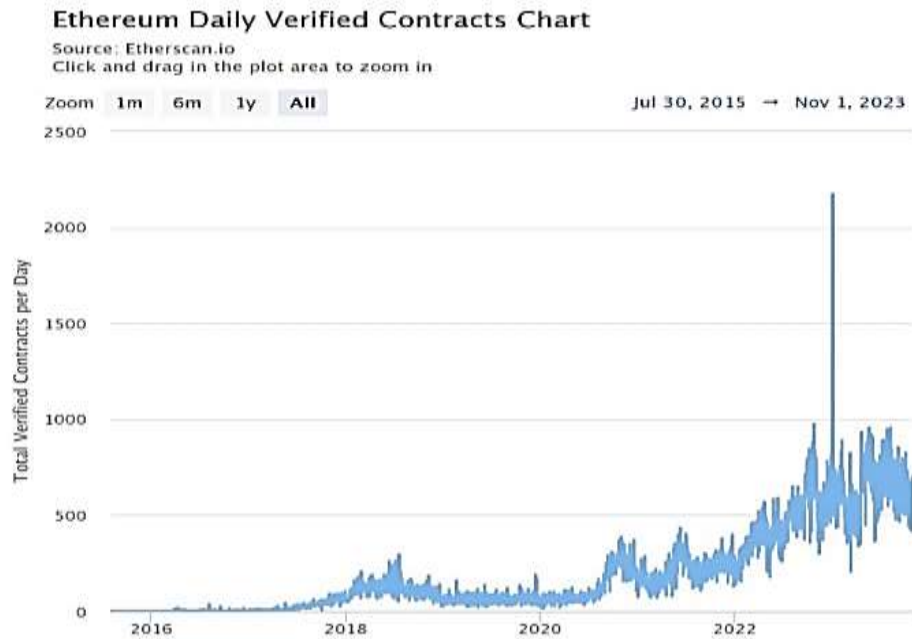
Figure 5 Ethereum Daily Verified Contracts Chart, 1 Year view. (Etherscan.io, 2023)**.**

In light of the patterns above and the expected increase in trends for this technology and the growth of global Islamic Fintech, its intersection with Islamic finance becomes more relevant. The global Islamic fintech (GIFT) report for 2022 projects that by 2026, this market (Islamic Fintech) will have experienced an average annual growth rate of 18%, resulting in a transaction volume of $179 billion, which is a substantial growth from $79 billion (Shafaki, The Global Islamic Fintech (GIFT) Report 2022, 2022). Additionally, Islamic Finance assets have reached an estimated value of US$3.6 trillion in 2022, which is expected to expand as it is anticipated to rise to US$4.9 trillion by 2025 (Shafaki, State of the Global Islamic Economy Report 2022, 2022).

Although, Blockchain may be the future currency, but for acceptance in Islamic finance, these must address volatility and fraud and align financial and shariah law. However, regulations should only increase, not eliminate, fintech's role. Blockchain adoption in Islamic finance is moving despite the challenges, offering efficient products and services to an underserved customer base. (Ledhem, Mohammed Ayoub & Mekidiche, Mohammed., 2020). Given this background and expectations, it is necessary to examine the feasibility and ramifications of adopting smart contracts in Islamic finance and how these tools will influence the evolution of Islamic finance. The purpose of this research paper is to explore Shariah view on smart contracts in Islamic finance, exploring the synergy and challenges between them, analyse possibilities of Gharar and mitigation steps to reduce or eliminate Gharar for the successful future of smart contracts in Islamic Finance.

Literature review

Smart Contracts

History and definitions of smart contracts

Smart contracts have been in existence since the 1990s when Nick Szabo proposed the concept of smart contracts. However, the idea was not implemented until the introduction of blockchain technology. These are smart contracts that automatically execute once the predefined conditions have been fulfilled. Transactions are kept, replicated, and updated among the distributed blockchains in smart contracts. Unlike traditional contracts, which require the presence of a third party who has to work in the center and the process takes long and involves costs. The combination of blockchain and smart contracts will pave the way to a "peer-to-peer market" (Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M., 2020).

Szabo's formulation in the 1990s regarded smart contracts as computerized transaction protocols which enforce contractual terms automatically upon certain conditions (Szabo, 1997). For example, one party could be subjected to contract penalties without a breach. Without blockchains, smart contracts would not be possible, as they are the base for these contracts. Logical connections are retained through features like if-else-if statements in executable computer programs created using the approved contractual clauses. Each contract statement is then recorded as a unique and immutable transaction within the blockchain (Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M., 2020).

Szabo (1997) predicts that smart contracts will transform installment loans and credit cards among financial services. In addition, he predicts their ability to change diverse industries like banking, insurance, energy, e-government, telecommunications, music and film, art, and education, and more (Szabo, 1997). Mohamed (2017) explains the complexity of smart contracts, which he defines as complex sets of software programs, that serve to automate performance and settlement of contracts. In effect, they are self-executing contracts, enforcing agreement terms when predetermined conditions are reached. If all the parties involved agree, then the smart contract cryptographically signs and deployed it on the distributed ledger for reliable and transparent execution (Mohamed, 2017).

Mechanics of smart contracts

Smart contracts are coded computer algorithms that automatically execute various stages during the transaction cycle until the end of the contract. Smart contracts have one main purpose, which is to have the record of every agreement and transaction be immutable, verifiable, and auditable. Smart contracts have been developed as complex software codes that automatically run and settle

their contractual obligations (Rahim, S. M., Mohamad, Z. Z., Bakar, J. A., Mohsin, F. H., & Isa, N. M., 2018).

Smart contract information is integrated as code in all computers within the network and constitutes part of the blockchain. This information is recorded, such as crucial events like expiry dates and strike prices triggered by the smart contract. The parties enter into an agreement on the terms and conditions within the contract, sign using a cryptographic signature, and deploy the smart contract into a distributed ledger. Afterward, it automatically executes specific actions once the predefined conditions of the contract have been fulfilled. The latter stages of the process are regulated, and this fact allows protection of the private position of the parties from the blockchain point of view (Rahim, S. M., Mohamad, Z. Z., Bakar, J. A., Mohsin, F. H., & Isa, N. M., 2018).

The life cycle of smart contracts encompasses four consecutive phases: the process entails the creation (which involves negotiations among several entities, design of the smart contract, implementation, and validation), deployment where contracts get stored in the blockchain and the digital assets of the involved parties get frozen, execution which entails the assessment of smart contract conditions or statements and automatic execution The different phases offer a clear understanding on how smart contracts are initiated, implemented, and at last finalized (Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M., 2020).
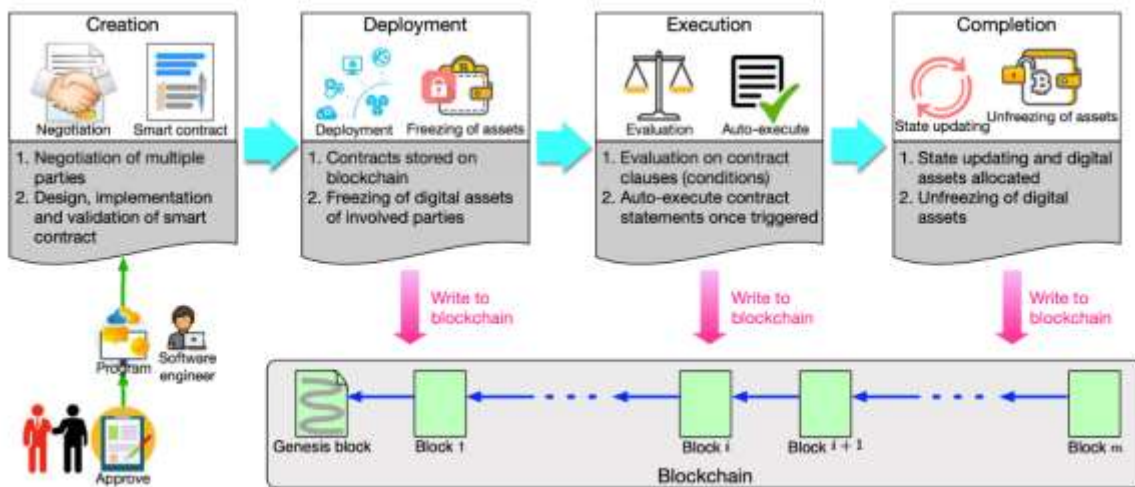

Figure 6 The life-cycle of smart contracts consisting of creation, deployment, execution and completion. (Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M., 2020)

Apart from how smart contracts work and their lifecycle process, Bartoletti and Pompianu (2017) have identified nine important design patterns necessary for the construction of solid and adaptable blockchain-based applications. Tokens represent fungible goods that are distributed to users by means of Token design pattern which helps in the management of digital assets. Another vital

pattern is authorization, which permits code execution dependent on the caller's address for secure access control within the contract. The Oracle design pattern makes it possible for smart contracts to fetch information from external sources that are beyond the blockchain, thus increasing the level of connectivity with the real world. Others include Randomness, a design pattern for generating unpredictable values, Poll, a design pattern for decentralized voting, Time-Constraint, a design pattern introducing temporal conditions and Termination, a pattern for handling the lifecycle conclusion, whether manually or automatically. Math design pattern embeds logical checks to protect vital operations, and Fork Check pattern enables contracts to detect whether they work on the main chain or a fork, making them more flexible (Bartoletti, M., & Pompianu, L., 2017). The wide range of design patterns allows developers to implement a variety of solutions and add different functionalities to the smart contracts according to the needs of the transactions.

Advantages of Smart Contract

Smart contracts have several advantages over conventional ones; hence the trust level in operation is higher. These contracts automate business processes both in the short and long terms, reducing costs in compliance, record keeping, and manual intervention which in turn minimizes risks, error rates, and reconciliation processes Its strength comes in its ability to create a shared infrastructure that frees capital and assists in compliance and regulatory reporting (Mohamed, 2017). Smart contracts have been suggested to cut costs by about 36% through process automation, reduction of HR costs, and streamlining distribution networks that rely less on intermediaries (Möhring, M., Keller, B., Schmidt, R., Rippin, A. L., Schulz, J., & Brückner, K.). Smart contracts may have potential benefits but implementation is constrained by such challenges as lack of maturity in technology, few ICT experts, compliance, and budget constraints (Möhring, M., Keller, B., Schmidt, R., Rippin, A. L., Schulz, J., & Brückner, K.).

On the durability note, once information is entered into blockchain, it cannot be retracted, which guarantees the endurance of smart contracts (Crosby, M., Pattanayak, P., Verma, S., and Kalyanaraman, V., 2016), (Möhring, M., Keller, B., Schmidt, R., Rippin, A. L., Schulz, J., & Brückner, K.). Smart contracts differ from traditional agreements in the sense that they reduce risks due to blockchain immutability, cut costs by eliminating intermediaries, and enhance efficiencies in business processes by removing their dependencies on third parties (Zheng, Z., Xie, S., Dai, H. N., Chen, W., Chen, X., Weng, J., & Imran, M., 2020). Benefits include enhancing transparency, facilitating business-to-business transactions, and diminishing the need for banks, lawyers, and middlemen (Rahim, S. M., Mohamad, Z. Z., Bakar, J. A., Mohsin, F. H., & Isa, N. M., 2018).

Significantly, the technology can transform the trade and banking sector with more reliable transactions that can be authenticated.

Smart contracts also bring a lot of potential benefits to Islamic banking. For example, it can reduce the cost of services by up to 95% and create an immutable record of ownership and assets (Oseni, U. A., & Ali, S. N. (Eds.)., 2019). Through the use of blockchain and smart contracts, Islamic banks can use smart finance agreements that automatically execute, maintain and enforce themselves, thereby reducing uncertainties in dispute resolution processes (Oseni, U. A., & Ali, S. N. (Eds.)., 2019).

Some of the challenges include risks for borrowers of losing funds such as the insolvency of the platform operator. The EBA points out that without proper regulatory authorizations, the platform risks missing out on money meant for the borrowers and that it needs to put in place proper measures to protect the money. Additionally, borrowers can lose money that they try to refund through the platform to lenders or investors who do not exist (EBA). As discussed by the World Bank in 2021: individual lenders or investors' assets are ring-fenced from the insolvency of a P2PL operator, but in the case of business failure of the latter, they are still exposed to the risk of financial losses (World Bank, 2021).

Islamic Finance

Principles of Islamic Finance

The Islamic economic model seeks to optimize financial processes. Several constraints are placed to enhance effectiveness and address inequalities (Semenova E.V, 2009). On this, first, is the prohibition of usury, any excess increase of capital in a loan is called Riba, it is more than traditional usury, it covers any interest (Paldi C., 2014). Secondly, risk-sharing in investment occurs because of the ban on interest. The capital owner and user share profit, loss, or risk. Thirdly, money is seen as "potential" capital and it becomes actual capital only when invested in a business. Fourth, speculative behavior is banned, not allowed for events based on random occurrences or speculations (gambling) (Tatiana, N., Igor, K., & Liliya, S., 2015). Fifth, it is vital to preserve the sanctity of contracts, which entails providing transparency and disclosing intentions. Finally, the investments must comply with Shariah principles, prohibiting pork, alcohol, arms, gambling, and traditional fixed-income financial products (Tatiana, N., Igor, K., & Liliya, S., 2015).

The Islamic capital market is operated differently from conventional markets adhering to its legal norms and rules as dictated by the Quran. Shariah-compliant transactions have to match six rules, such as the principle banning interest, risk-sharing, and the prohibition of speculation (Lepeshkina

K.N.). The fundamental structure for an Islamic financial system is derived from Shariah, which derives in the Quran and the Sunnah (Iqbal, 1997). Prohibition of interest and encouragement for successful entrepreneurship is the basis of the Islamic financial system. Money is regarded as "potential" capital only counted when put towards productive activities. The system discourages hoarding and does not permit transactions that are uncertain, gambling, and risky. Contractual obligations and information disclosure as mandatory obligations to reduce the risks of asymmetric information and moral hazard. Business activities compliant with Shariah are the only ones acceptable for investment purposes, hence exclusion from alcohol, gaming, and casinos (Iqbal, 1997).

The prohibition of interest, risky asset sales, and gambling or speculation has a significant effect on Islamic accounting (Uddin, 2015). These principles form an Islamic economy by developing unique type of financial system.

Instruments/Products Definition and Framework

Islamic finance makes use of a variety of traditional contractual arrangements and instruments, which are divided into equity and debt modes and are designed to serve different financial needs as per Shariah principles (Ahmed, 2014). *Musharakah* and *Mudarabah* are the equity instruments that incorporate principles of partnership and silent partnership respectively, focusing on profit and loss sharing. *Murabahah*, *Bai-Muajjal, Salam, Istisna, Ijarah*, and other debt instruments help with cost-plus sales, deferred-payment sales, advance purchases, commissioned manufacturing, and operating leases (Ahmed, 2014). The underlying principles of risk-sharing, prohibiting interest and transparency are inherent in Islamic economic values (Ahmed, 2014).

Iqbal (1997) also stresses the commonness of many Islamic financial instruments as cost-plus sales, leasing, profit-sharing agreements, equity participation, and several contracts of sales among others. Kammer, et al. (2015) highlight the numerous uses of these tools in Islamic finance. Tatiana (2020) presents *Musharaka, Mudaraba, Ijara, and Murabaha* as active financial instruments (Kammer A., Norat M., Piñón M., Prasad A., Towe C., Zeidane Z, 2015). These instruments include long-term partnerships, short- and medium-term financing, focused on shared profits, transparent contractual obligations and compliance with Shariah principles (Tatiana, N., Igor, K., & Liliya, S., 2015). Essentially, Islamic finance utilizes various instruments to deal with particular financial situations while practicing ethical and Shariah-based principles.

Gharar Definitions, Types, and Parameters

The *Gharar* of Arab is related to cheating, uncertainties, and risk. Hanafi scholar says it is "what the result is unknown", on the other hand, Shafi'i scholar says it is "what the manner and the result is hidden (Uddin, 2015). This is an idea of uncertain object transaction details since insufficient knowledge is available. However, *Gharar* is subdivided into Gharar fahish (excess Gharar) and Gharar yasir (light *Gharar*); accepting the fact that all transaction contains some level of Gharar (Uddin, 2015).

Islam does not permit gambling which is also known as *Maysir*, particularly because it involves making a fortune on the risk that can harm other people (Uddin, 2015). *Gharar* is about the inherent uncertainties in commodities, prices, payment and delivery times, quantities, etc., while the former makes the contract itself illegal. However, the main principle of the *Gharar* ban is similar to gambling where a zero-sum game (Waemustafa, W., & Sukri, S. , 2015).

Five parameters make up the *Gharar* element of a derivative contract. These parameters include (Nordin, N., Aziz, S. A., Ahmad, A. A., & Daud, N., 2014):

1. Existence in Contract of Exchange: *Gharar* must be in the original contract and not other extra contracts.

2. Not in the Level of Need (Hajah): The contract should stop at the point of necessity.

3. Easily Avoidable: *Gharar* should be easily avoidable.

4. Abundance of *Gharar*: An excess of *Gharar* may invalidate the contract.

5. Not in the Subsequent (tabi'): The element of *Gharar* should not be there in the following contract.

6. If this is the case, the contract is considered void and this illustrates the sophisticated nature of Islamic finance. All agree that *Gharar* beyond limits makes voidable contracts, but it does not necessarily follow that *Gharar* light makes voidable contracts. Some scholars are having debate the particular contract that falls under the *Gharar mutawasit* category which should be provided with some elements that will enable the determination of whether the *Gharar* will affect the contract or not (Nordin, N., Aziz, S. A., Ahmad, A. A., & Daud, N., 2014). *Gharar* in forward contracts, for instance, does not automatically nullify the contract, under certain circumstances. Even though these contracts cannot be treated as voidable, they may be inspected in regard to other issues of Shariah, for instance, *Riba* (usury) or *Maysir* (Nordin, N., Aziz, S. A., Ahmad, A. A., & Daud, N., 2014).

Analysis

Potential alignments between Smart Contracts and Islamic Finance

Rejeb (2020), notes that blockchain technology establishes a transparent and reliable platform for data exchange and transactions that involves the use of a decentralized immutable network system. This makes all transactions visible and verified by every node in the network, helping to fight fraud and ensure protection against cyber-attacks. Openness is especially important for zakat institutes, eliminating the drawbacks and ensuring that donors can trace exactly how their funds are being used in order to promote trust and accountability in charitable donations (Peredaryenko, 2019). Also, blockchain has the ability to increase transparency in charity giving, directly connecting the contributions and project outcomes, says, Cole, Stevenson, and Aitken (2020).

However, Rejeb (2020) points out that although smart contracts have been seen as an innovation for Islamic finance products, Islamic scholars need to give firm fatwas on various technical aspects, especially smart contracts. They enable the implementation of the shariah compliance terms and the execution of the smart contracts in the Islamic banking. Rahim et al. (2018) point out that smart contracts will support various aspects in the Islamic finance industry like the Islamic capital markets, investment banking, Islamic banking, and the takaful industry for automating claims processing and the renewal of general takaful products (Rahim, S. M., Mohamad, Z. Z., Bakar, J. A., Mohsin, F. H., & Isa, N. M., 2018).

The use of blockchain technologies and smart contracts can increase credit processes, industry profitability, and reduce uncertainties such as *gharar*. IFIs should embrace FINTECH in their strategic risk management, putting trust in the value these technologies bring to the institution. These solutions ensure full transparency, smooth transactions, and tackle *gharar* from the Shariah perspective (Antova, I., & Tayachi, T., 2019).
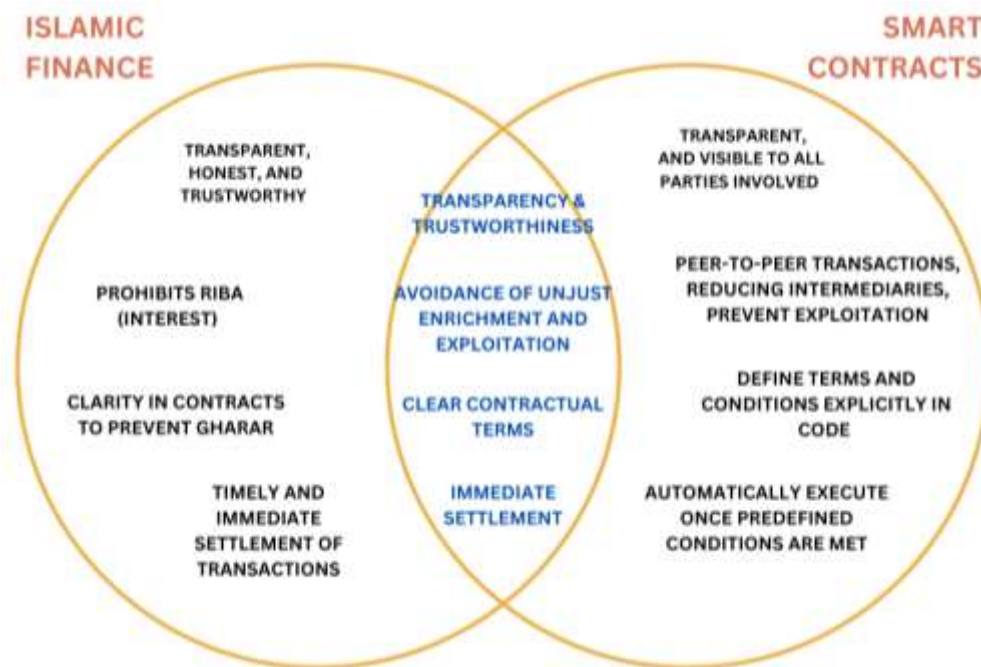
Figure 7 A Venn Diagram showing where the principles of Islamic Finance and characteristics of smart contracts aligned with each other (Author's own).

Potential Deviations between Smart Contracts and Islamic Finance

Individuals may be led into the pitfalls of greed and the pursuit of maximum profits while disregarding the circumstantial challenges of others through smart contracts without the necessary pure values. (Shaarani, A. Z. M., Muhammad, F., Noor, A. M., & Osman, M. F., 2023) Smart contracts have different regulatory challenges compared to Bitcoin, which largely exists in the field of private law. This calls for either extensive regulation of life events in line with existing contract law principles like force majeure, or the code should have limitation, which may make the code inadequate. This change in the approach to freedom of contract principle and representative assets concept is the effect of smart contracts evolution. This could also make consumer protection laws ineffective since most codified rules are more rigid than the legal framework. (Kerikmäe, T., & Rull, A. (Eds.), 2016).

Taking into account the characteristics of smart accounts as discussed in the literature review and posed onto Islamic Finance to see the deviations as summarized in Figure 8.
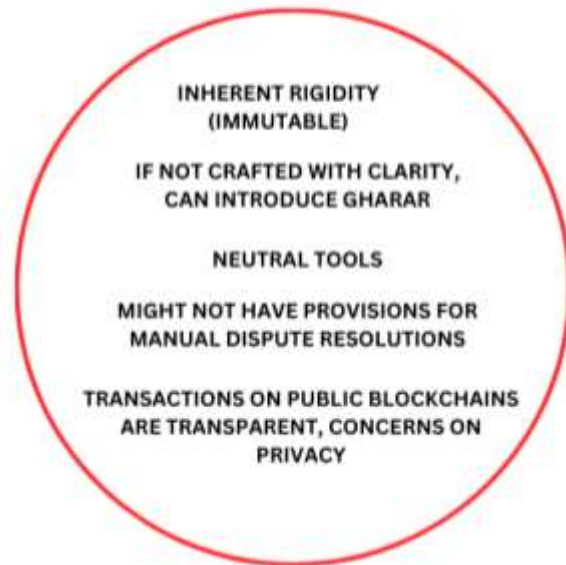
Figure 8 Deviations between Smart Contracts and Islamic Finance (Author's own).

Possible Scenarios That May Introduces *Gharar* In Islamic Financial Instruments

To examine the possibilities of *Gharar* arising in smart contracts within the Islamic Finance landscape, it is worth studying how each Islamic Finance Instruments may contribute to this aspect depending on certain scenarios for each of the instruments. The table below demonstrates some of the possible scenarios in which *Gharar* may be introduced with some of the Islamic Finance Instruments, *namely Ijarah, Mudarabah, Murabahah, Musyarakah, Salam and Qard Hasan* taking into account the smart contracts mechanics.

Table 1 Possible scenarios for each instruments based on their definitions (Ahmed, 2014).

Instruments	Scenarios
Ijarah	In an Ijarah agreement, a smart contract may be realised to transfer the asset back to the owner once certain conditions are met in the agreement. However, the conditions written (coded) into the contract may be either too vague or not detailed. For example, the contract states the asset must be in good condition

	when transferred back. The lessee might interpret having a small defect might still be acceptable as "good condition" while the lessor might not.
Mudarabah	In a Mudarabah-based investment where the contract was written or coded to distribute returns based on the value of an asset at a predetermined time. For example, a $50,000 was invested in stocks. The stocks peaked for six months and crashed on valuation day, incurring lost. The sudden drop introduced unfair uncertainty.
Murabahah	A smart contract is drawn to determine the price for the *murabaha* transaction (cost-plus sale) based on the specific market index. Still, an unexpected error may make the contract acquire data from a wrong or irrelevant index available.
Musyarakah	The smart contract for a Musharakah, for example, allocates profit proportionally as external factors, such as the weather conditions for an agricultural project. Because of unusual changes in climate, or abnormal weather patterns, the venture incurs unforeseen costs. For example, person A is a farmer with limited funds and person B wants to be the financer in musyarakah with A but on the condition that it must not rain for 2 months.
Salam	The buyer agrees to a contract of Salam (forward contract) with a seller to buy specified goods in the future. The smart contract is programmed to pay for the purchase once the seller uploads a digital receipt. However, the uploaded receipt is a fake one or the goods depicted in it are of low quality, but still the smart contract has been executed and completed.
Qard Hasan	A Qard Hasan (benevolent loan) contract is agreed on with a fixed repayment plan. Nevertheless, unforeseeable misfortunes such as natural disasters or epidemics undermine the borrower's capacity to repay. Hence the borrower's inability to repay and unclear timelines introduces *gharar*.

Gharar Analysis

Table 2 Table showing the source of gharar from the scenarios in Table 1 (Author's own).

Instruments	Source	Gharar Introduction
Ijarah	Incomplete or Vague Conditions	Such vagueness of conditions may give rise to disputes once the assets have been transferred back.
Mudarabah	Fluctuating Asset Values	In such a case where the value of the asset fluctuates significantly in short term close to the distribution time, the parties may consider the distribution as arbitrary, creating an element of arbitrariness, or unfairness.
Murabahah	Automation Errors	The buyer can be paid a price that does not reflect the true cost or profit margin, making the transaction unreliable, or even noncompliant.
Musyarakah	Unpredictable External Factors	lack of provisions for such unpredictability in the smart contract may result into disputes or perceived unfairness in distribution, thus introducing Gharar to the agreement.
Salam	Lack of Human Oversight in Disputes	As the smart contract works automatically, it would release the payment once it receives the upload, without verifying the authenticity or quality of the goods, thus creating some uncertainty for the buyer.
Qard Hasan	Lack of Provisions for Force Majeure	In case the contract does not have coded provisions to cover such events, the borrower could be unduly penalised, since the contract is automatically executed, causing uncertainty and non-compliance.

By analyzing from the scenarios in Table 1, Table 2 illustrates the possible source of the *gharar* and *gharar* introduction from the provided scenarios. Each of the contracts may introduce elements of gharar when the contract is not crafted thoroughly and according to Shariah law. Although the gharar are identified, it is not enough to determine whether it is *gharar fahish or gharar yasir according* to the *gharar* parameters that were discussed earlier as the contents of the contract itself need to be available for analysis. However, based on these gharar analyses, it can be observed ways to tackle each type of contracts and implement necessary steps to reduce or eliminate *gharar* and ensures that the contracts are Shariah compliant.

Mitigation Steps to Prevent Gharar

From the discussion previously, it was clear that it is easy to introduce *Gharar* either intentionally or not, either from the result of human error or smart contracts mechanics' liabilities. For this reason, steps must be taken as preparation when implementing smart contracts to eliminate chances of *Gharar*, continuous monitoring and review during the transactions, and taking action afterward to make sure it aligns with Shariah Law in Islamic Finance in terms of prompt delivery and mediation or dispute resolution if discrepancies arise from the transactions.

During the preparation phase, it is essential to train and educate relevant parties who play an integral part in the genesis of the contract, notably the code writer to ensure that they are well-trained in Shariah principles, enabling them to recognize and prevent *Gharar* when drafting and executing the contracts. Jointly, it is advised to engage Shariah experts familiar with Islamic finance during this stage to ensure its compliance.

Regarding the contract itself, it must have clear contractual terms and be drafted with clarity, defining every term, condition, and obligation including provisions for force majeure to prevent any ambiguity. Detailed specifications need to be provided in contracts involving goods or services. For example, a sales contract should include clear descriptions, quality, quantity, and delivery terms if any.

Additionally, it is imperative to ensure that the pricing mechanisms are transparent and to avoid contracts where the pricing is determined by uncertain future events. Similarly, it is critical to avoid complex financial derivatives that bet on future prices or events as they are rife with *Gharar*. In other words, to avoid future-based sales, which is to refrain from selling something that is not yet possessed as this is a common source of *Gharar*. For instance, selling crops that have not yet been harvested. On the other hand, it is also advised to base transactions on tangible assets or clear benefits and to generally avoid speculative transactions, this is because transactions that are based on speculation or betting on future events introduce *Gharar*.

For contracts of a longer duration, it is crucial to stipulate clear exit clauses that clearly define the conditions under which the involved parties can exit the contract safely to avoid disputes and uncertainties along the line. Above all, it is recommended to adopt standardized contracts, which have been reviewed, implemented all the mentioned precautions and vetted for *Gharar*, especially for routine and repetitive transactions. According to Hoffman et al., there are four categories of standards that can be distinguished to help standardized smart contracts: semantic standards, measurement and testing standards, interface standards and compatibility standards and quality standards and variety-reducing standards (Hofmann, F., Wurster, S., Ron, E., & Böhmecke-Schwafert, M.).

During the on-going transactions, it is a best practice to continuously review and monitor the contracts, especially for long-term contracts, to ensure they remain free of *Gharar* as the conditions of the contracts change. To regularly do security audits, for example, using Security to effectively prove the correctness of the smart contracts and to discover critical violations (Tsankov, P., Dan, A., Drachsler-Cohen, D., Gervais, A., Buenzli, F., & Vechev, M., 2018).

After successful transactions, it is encouraged to have immediate delivery of goods or, at the least, immediate possession, reducing uncertainty related to future delivery. However, if any ambiguity or discrepancies do arise, a clear mediation or dispute resolution mechanism by Shariah law must be in place to help clarify terms and reduce *Gharar*.
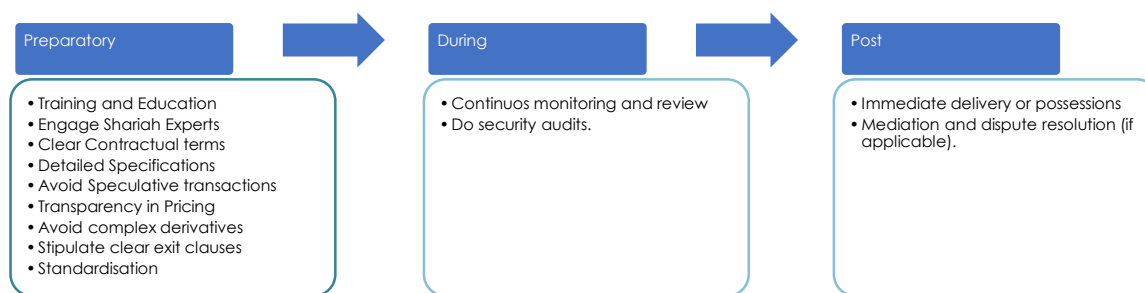

Figure 9 Stages for Mitigating the Chances of Gharar in Smart Contracts (Author's own).

Conclusion

In conclusion, the introduction of smart contracts into traditional contractual processes in Islamic finance raises both expectations and challenges. First, the intrinsic characteristics in smart contracts such as immutability, automatic operation, and transparency in blockchain technology go in tandem with the central pillars of clarity, fairness, and timely fulfillment in Islamic finance. In other words, these attributes provide a digital representation of the inviolability of contracts, enhancing their legitimacy and dependability via technological advancement.

However, the complex and moral aspects of Islamic financial transactions that adhere to Shariah laws should have been taken into account when adopting smart contracts. Issues such as the inflexibility of automatic procedures, potential coding errors, or Islamic jurisprudence-compatible dispute resolution procedures should be thoroughly taken into consideration. Care should be taken to reduce or eliminate the introduction of *gharar*, or excessive uncertainty, into smart contracts. This should be done within the limits established by Shariah experts. A harmonious balance is needed in integrating this technology such as the exactness of modern smart contracts with the morally sensitive Islamic Finance traditions. This intersection becomes necessary as smart

contracts should ensure the integrity of the contracts within the framework of Islamic finance. Collaboration among Shariah scholars, legal professionals, and technologists is therefore crucial.

Further research efforts, particularly empirical investigations, are necessary to gain further insights into the synergy between Islamic finance and smart contracts as well as the reduction or elimination of *gharar* in smart contracts. This exploration will contribute to the standardisation and enhancement of smart contracts within the industry, fostering the growth of the Islamic finance sector which is imperative to prevent being stagnated in the swiftly evolving landscape of financial technology.

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