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*ICIS2022Penang*
https://fim.uitm.edu.my/index.php/research/conference/342-icis-2022
**5th International Conference on Information Science**
Royale Chulan, Penang, Malaysia, 19-21 Sep 2022
Organised by Faculty of Information Management, UiTM, Malaysia

# Implementation of Smart Contract Technology in Financial Services Institutions

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**Abstract**
The popularity of blockchain-based applications has pushed the advancement of a smart contract as an essential part of the blockchain platform. Previous research has validated that smart contracts can facilitate many functions in financial services companies such as banking and insurance. A smart contract is useful to automate the execution of an agreement by initiating steps when a certain circumstance is fulfilled; thus, it can eliminate the role of any middlemen or waste time. This study explores the basic concepts of blockchain-based applications, smart contracts, advantages, challenges, and potential implementation in the financial services industry.

Keywords: Blockchain, smart contract, Ethereum, crypto


DOI: https://doi.org/10.21834/ebpj.v7iSI10.4129

## 1.0 Introduction

Blockchain technology has become one of the most discussed topics recently, along with the popularity of cryptocurrencies such as Bitcoin, Ethereum, and Dogecoin. Satoshi Nakamoto introduced Bitcoin in 2008, the first proposed cryptocurrency utilizing the Blockchain as a distributed infrastructural technology. Further, Ethereum, NXT, and Hyperledger Fabric emerged as blockchain-based systems used for cryptocurrency (Khan, 2021). A blockchain is a distributed software system allowing transactions to be processed without the necessity of a trusted third party. As a result, business activities can be completed inexpensively and quickly (Zheng et al., 2019). The technology is constructed in a way that data is stored in a series of 'blocks', and each block is connected to the previous one in the form of a successive 'chain'. The replication of these identical 'blocks' and 'chains' over a wide range of computer systems across the network forms the Blockchain. In case of any change to the chain, the sequence and time are recorded, and each participant is notified based on the rules of a particular Blockchain system (Bach, 2016)

Initially, the Blockchain framework was developed as an accounting method for the virtual Bitcoin currency (Eskandari et al., 2018). The technology utilizes Distributed Ledger Technology (DLT), which captures and tracks an item's history and present status. This item could be tangible, such as equipment or land, or intangible, such as contracts, plans, or schedules (Hassan, 2021). It records all the transactions that have ever occurred through the network. The most popular application of blockchain technology is the verification of transactions within cryptocurrency. It leads to the creation of fixed and permanent records in the network. The key characteristic of Blockchain is that the authenticity of the records can be verified by an entire community rather than a single centralized authority.

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DOI: https://doi.org/10.21834/ebpj.v7iSI10.4129

Blockchain technology has an inbuilt high level of robust security, shown by the public cryptocurrencies (Sombat, 2018). There are three types of Blockchain: public (or unauthorized), private (or permitted), and consortium (or allowed). Also, the main characteristics of the Blockchain are decentralized, consensus, provenance, immutability, and finality (Hassan, 2021).

Although Blockchain is most well-known for the coin's distributed transaction, the researchers have found other practical utilization of Blockchain for the financial and banking sector as well as government's public services, where the proper usage of blockchain technology can bring more productivity (Hassan, 2021). These are related to the main characteristics of the Blockchain, which are decentralized, consensus, provenance, immutable, and finality. The latest empirical research (Khadka, 2020) hypothesized that blockchain technology would lead to a big transformation in the financial industry. The technology seems promising to solve the inefficiency problems of financial institutions by removing third parties, increasing efficiency, and decreasing cost. He identified five promising areas where Blockchain will impact our cross-border payment, trade finance, knowing your customer (kyc), capital market, and regulation & compliance.

## 2.0 What is a Smart Contract?

The smart contract terminology was firstly coined by Nick Szabo in 1994, who defined it as "a computerized transaction protocol that executes the terms of a contract" (Li, 2020). Further, Szabo (1997) argued that utilizing protocols and user interfaces will facilitate all steps of the contracting process; thus, the smart contract is far more functional than the traditional contract. He added that smart contracts would facilitate many functions in financial services companies, typically for installments, loans, and credit cards. Besides, it has the potential to support many industries such as banking, insurance, energy, e-government, telecommunication, music and film industry, art, education, and many more. Later, Mik (2017) validated that smart contract is suitable for banks, lawyers, and courts.

Also, Savelyev (2017) proposed the key element between traditional and smart contracts; he defined smart contracts as "agreements existing in the form of software code implemented on the Blockchain platform ."Freund and Stanko (2018) define a smart contract as an executable code run on the Blockchain network to facilitate the execution and enforcement of the contract terms between the concerned untrusted parties. A smart contract could be considered a system that releases the digital asset to the parties involved once the contract's predetermined terms have been met. Additionally, a smart contract is a programming code stored on the Blockchain and automatically executes when predetermined and programmed terms and conditions are met (Sheikh, 2019; Gatteschi, 2018).

The general objectives of the smart contract are to satisfy common contractual conditions, minimize expectations, and the need for trusted intermediaries among contract makers (Bolhassan, 2021). A smart contract is useful to automate the implementation of an agreement so that all parties are guaranteed a timely conclusion without the need for any middlemen or wasted time. They can also automate a workflow by initiating the following step when certain circumstances are fulfilled (Luo, 2019). However, smart contracts require trust to be distributed across a community on a peer-to-peer network rather than centralized (England & Moreci, 2012). It means none can individually take action on behalf of the community (Lamb, 2018). At the same time, the terminology of "smart" in smart contracts refers to an artificial intelligence technology that replaces a human effort by making tasks easier to complete (Mason, 2017).

Traditional contract works straightforwardly to identify when an offer has been made and accepted by examining the words and conduct of the parties along with all relevant circumstances, whereas a smart contract can become a legal contract if certain conditions are met (Rahim, 2018). They also explained the working mechanism of the smart contract. Unlike a traditional contract, the terms and conditions of a contract are coded in a computer algorithm as a set of instructions that will be automatically executed in the next step until the entire transaction cycle completes. This mechanism allows an immutable, verifiable, and secure record of all contracts and transactions which are fully auditable. Bolhassan (2021) have compiled the differences between smart contracts and traditional contracts, as shown in table 1.

| Aspects | Smart Contract | Traditional Contract |
|---|---|---|
| **Signature** | Digital Signing | Wet Signature Mandatory |
| **Platform** | Peer-to-peer (P2P) Network, Distributed Ledger Technology (DLT) | Paper-based |
| **Storage** | Distributed Ledger | Physical Storage |
| **Network** | Distributed | Centralized |
| **Administration** | Self-executing | Executed and administered by human |

Table 1. Differences between smart contracts and traditional contract
*Source: Bolhassan (2021)*

Rahim (2018) describe how the smart contract works. A smart contract starts with defining specific conditions, such as the rights and obligations agreed upon by the smart contract parties. These events refer to the transaction initiated, and information received triggers the contract's execution. Subsequently, the terms of the contract dictate the movement of value based on conditions met. As for the settlement, there are two options available (i) on-chain assets (digital) and (ii) off-chain assets (physical). Typically, the smart contract chooses crypto-currency for digital assets on the chain (Bitcoin, Ethereum, Lite Coin). Thus, the payment transactions occur automatically. However, the smart contract requires stocks and fiat money for the physical assets. Beyond simple encryption and integrity

checks, this system will change specific accounts reflected on the ledger. The transactions simultaneously update the match off-chain settlement instructions. Figure 1 explains the process flow of a smart contract.


Figure 1. Process Flow of Smart Contract
*Source; Rahim (2018)*

According to Khan (2021), several platforms support high-level programming language to support smart contract development: (i) Bitcoin is a public blockchain platform that can be used to process cryptocurrency transactions, but with a very limited computing capability, (ii) Ethereum is the first blockchain platform for developing smart contracts. It supports advanced and customized smart contracts with the help of a Turing-complete virtual machine, called the Ethereum virtual machine (EVM); last but not least (iii) Hyperledger Fabric is a framework used by limited business-related organizations that can join in through a membership service provider, and its network is built up from the peers whose are owned and contributed by those organizations.

## 3.0 Smart Contract Advantages

As a part of Blockchain technology, the smart contract has inherited four major benefits of Blockchain. These include: near real-time settlement of records, and transactions and eliminating potential risk and conflicts; direct transactions where the technology is built on a digital signature where two untrusted parties can directly transact without the need for a trusted third party, such as a lawyer; distributed ledger which is a peer-to-peer distributed network that keeps track and record all the transactions retaining secure proof of all that has occurred (Swan, 2015). Percio (2018) added that Blockchain offers fraud-proof, which is verifiable, certain, and undeletable record proof of all the transactions that have ever been made.

Rahim (2018) suggested that the advantages of a smart contract over any other kind of agreement are efficiency and transparency. A smart contract works better if a rich data set can be derived from existing information. Terms and conditions of the smart contract need to be coded and will only be visible to the parties involved in the contract. Thus, it offers efficiency compared to the traditional contract model. In addition, smart contracts' transparency makes business-to-business (B2B) transactions simpler. Smart contract simplifies the process and minimizes the need for participation from banks, lawyers, and middlemen.

## 4.0 Smart Contract Challenges

The study by Muayad and Abumandil, (2022) has identified several challenges that must be solved before implementing the blockchain-based smart contract use cases. The challenges are, firstly, the obstacles related to the system's scalability. The cost-benefit analysis of the different options and the scalability of such financial and banking systems may be limited by the computer capability vs. the volume of banking transactions (Xia, 2017). Secondly, the development, implementation, and operating expenses of blockchain-based financial and banking systems must be carefully considered as they involve relatively high investment. It is critical to determine the total cost of such a system and the resources needed to implement them (Zyzkind, 2015).

Thirdly, there are challenges related to the standard protocol for implementing smart contracts within the industry. There is a serious concern related to consumers' data security and privacy. The main challenges of blockchain-based financial and banking systems are still the same. Solid security measures require an approved person and the individual to be able to access the data and the data storage; therefore, the data sharing process must be done safely. Fourthly, there is a challenge regarding the lack of data sharing willingness. Understandably, some finance companies and banks are reluctant to perform data sharing. One of the possible reasons for this is that they may wish to maintain expense data on hand; thus they still can charge fees to their customers. Hence, to ensure the success of smart contract implementation, trust must be built between multiple entities, such that each company agrees to exchange data for the benefit of everyone in systems of finance and banking (Muayad & Abumandil, 2022).

In addition, Bader (2019) argued that the challenges of smart contract implementations are related to data reliability, cost efficiency, and customer privacy. Data reliability for smart contract-based optimization requires the smart contract to provide equally reliable data for an accurate decision-making process. The extremely volatile and high prices of cryptocurrencies have made the cost-efficient blockchain-based process more difficult than ever. It is mainly caused by transaction fees, which are paid per byte of transaction size, as well as the increase in gas costs. Since it is based on Ethereum, thus the users must pay for its operation with so-called gas, a subdivision of Ether, which is added complexity to the interaction with the smart contract. Lastly, the issue of customer privacy has become the main challenge of smart contract-based implementation. Leaked sensitive customer data such as event locations can occur due to sensor-recorded events data utilization.

## 5.0 Smart Contract in Financial Industry

There are many possibilities for smart contract utilization in the financial service industry. A smart contract is a mechanized exchange consensus on the terms of an agreement. The general purpose of the smart contract is to ensure both parties establish a good level of trust related to smooth execution of payment terms, confidentiality, and enforcement to avoid accidental and malicious exceptions. Also, related monetary objectives include bringing down misrepresentation misfortune, mediations and authorization costs, and other transaction costs (Thenmozhi, 2021).

Study by Miro (2016) identified several use cases of smart contracts for the financial services sector. The following table explains these use cases.

Table 2. Use cases of smart contract utilization in the financial services sector
*Source: Miro (2016)*

| | |
|---|---|
| **Loans** | **A credit agreement can be treated with a smart contract. In that sense, both parts have the information with the collateral. If the borrower fails to pay the installment, the contract is executed, and the keys for accessing the house deeds are revoked.** |
| **Inheritances** | The digital assets are stored in the Blockchain network, and once the smart contract is executed by the trigger condition (i.e., someone dies), the contract will automatically go into effect, and the assets will be surrendered to the beneficiary. It will minimize the potential of disputes in the division of inheritances process. |
| **Escrow Account** | The contract is settled as an escrow account where the buyer and the payer have a digital agreement related to the purchase of an asset. Then, the buyer executes a transaction for the amount of money for the product purchased. The money will be blocked and safely stored by a third party (Smart contract). Once the product is sent and well received by the buyer, the money becomes unblocked and is automatically transferred to the seller's account. |
| **Cryptocurrency wallet controls** | Digital wallets are currently controlled by predetermined contracts that include several rules and controls such as daily limits, exchange currency rates, and fees. These rules could be automated and controlled by rules given through smart contracts. |
| **Capital Markets** | There are various transactions in the capital market, such as buying/selling stocks, dividends, settling bonds, and many others, that can be automated with a smart contract. |

## 6.0 The Potential Smart Contract Implementation in Insurance Industry

The researchers agreed that smart contracts could potentially disrupt the insurance industry. Insurance is an agreement of two parties in which an individual or institution receives compensation from an insurance provider in the event of a loss, represented by a policy (Hassan, 2021). Although the insurance business is sometimes perceived as a matured business, the claim settlement process from the customers is not a hassle-free procedure. There are many situations when an insurer refuses to pay the insured money, which causes lawsuit action from its customer. Also, there are false claims that are troubling the insurance companies. Many situations are caused by a lack of transparency and a conventional contract loophole. These problems can be solved by properly implementing smart contracts by improving the need for trust and providing legal clarity between insurers and insurers (Hassan, 2021).

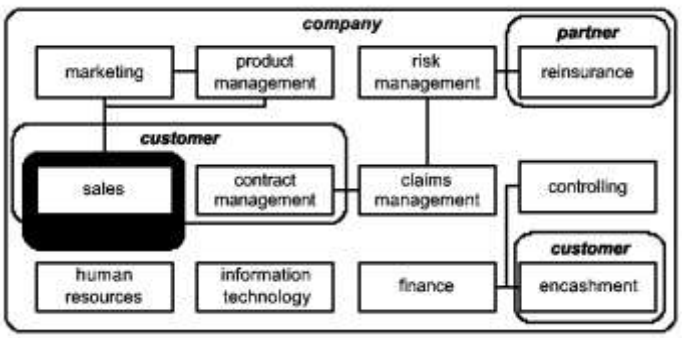


Figure 2 illustrates the core processes in an insurance company.
*Source: (Alexsieva, 2019).*

The main objective of smart contract utilization in the insurance business is to make the sale and purchase of insurance more efficient to reduce the cost, provide greater transparency for the claim process, and democratize access to reinsurance (Aleksieva, 2019). The

traditional insurance ecosystem relies on complex contracts between the insurer and the customer and strict decision processes. This complexity is required as insurers and customers have inherently opposing interests and can act maliciously (Bader, 2018). Figure 2 shows the core processes of insurance that the smart contract can support.

Furthermore, if a customer proposes a claim to the insurance, there are labor-intensive processes needed to perform the process. The insurer needs to validate that the claim meets the policy's preconditions, which requires experienced consulting surveyors and intensive paperwork, which makes up around 25% of the insurer's costs (McKinsey, 2014). Hence it is sensible to explore the possibility of blockchain-based technology, especially smart contract utilization, to reduce the operation cost (Bader, 2018).

## 7.0 Pre-implementation Requirement

Several requirements are needed before implementing a smart contract: interoperability; data protection; consistency, integrity, and immutability of data; efficacy of cost and resources; and simplicity (Muayad & Abumandil, 2022). Interoperability means an established global standard for the interchange of necessary data. Data protection and network security are essential for financial and banking systems to protect consumers' sensitive data. Thus, data privacy and security issues become a top priority to be considered before implementing blockchain-based use cases such as a smart contracts.

Data silos and inconsistencies are major issues in the financial and banking system, resulting in faults and increased expenses. Therefore, it is compulsory to ensure data integration and quality before implementing smart contract technology. Also, important factors such as costs, calculations, time, and physical resources must be considered before starting the smart contract implementation. Finally, a smart contract is a relatively new technology that is complicated for many parties and therefore needs some time before they become familiar with and willing to adopt the new technology. Hence, the prerequisites for implementing the smart contract are that the transactions' procedures are as simple as possible and shall avoid excessive complications.

## 8.0 Future Research

The digital smart contract is highly possible to replace traditional forms of paper contracts in the future. It is mainly caused by smart contracts' characteristics, which help improve a more credible transaction without jeopardizing the authenticity and credibility of the contract. Thus, digital smart contracts have the potential to revolutionize the trade and banking industry (Rahim, 2018). Previous researchers agreed that smart contract technology is an emerging new technology and therefore needs to be tested its capabilities to answer the business challenges in financial service organizations (Khadka, 2020). Moreover, the smart contract is a new technology that changes rapidly, and other proposed solutions must be considered.

The author finds it fascinating to investigate the possibility of implementing smart contract technology in the financial services sector using primary data from decision-makers. The preliminary research questions are (i) the understanding level of smart contract technology among financial services executives; (ii) the possibility of implementing smart contracts in the financial service industry (iii); what smart contract use cases are suitable for financial services companies (iv) factor influencing the adoption of smart contract implementation in the financial services sector. The next step is that the author will write a state-of-the-art article followed by a systematic literature review to gain further understanding of the latest research trends in this field.

## 9.0 Conclusion

In conclusion there is a good future for the utilization of blockchain-based smart contract technology for financial industry. However, the implementation needs to consider both advantages and drawbacks of smart contract technology. Proper implementation of smart contract in banking, finance, and insurance can disrupt existing process by increase data security, fasten the process, and significant cost reduction. Although smart contract is acknowledged as a promising future technology, but still there are limited research available in this field, thus many opportunities available for future researches.

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