Application of Blockchain Technology in Smart Contracts: A Systematic Literature Review

Zaleha Fauziah[1],Haznah Latifah[2], Xavier Omar [3],Alfiah Khoirunisa[4] ,Shofiyul Millah[5]
Manipal International University[1], Manipal International University[2],Informatics Academy[3]
,University of Raharja[45]
e-mail: zaleha fauziah@yahoo.com, hazna latifah@yahoo.com, omar xavier 44@yahoo.com
,alfiah@raharja.info, shofiyul@raharja.info

Abstract

Associated with the current development of the emergence of many technologies that have increased in the world, especially in industry, one of which is the blockchain which is a new technology that is undergoing drastic density, this technology has data that is difficult to manipulate so that the blockchain has data security very trusted, and every record of all the contents of the transaction data can be known from one server to another server so that both parties know each other what the activities are carried out. The recording of transactions in this blockchain technology is connected in one block that is secured directly by a computer network, the blockchain itself has several applications such as Cryptocurrency or can also be called digital currencies, and Smart Contracts. This Smart Contracts is an application owned by blockchain technology that carries out an agreement or digital agreement in the computer program code that is entrusted by both parties stored in the blockchain database, so that it cannot be changed by anyone or the help of other parties, then no longer needed entities that can be trusted in using Smart Contracts. These Smart Contracts help to process the exchange of money, shares and property. Currently there are many industries that use Smart Contracts, such as the business industry that records financial services, the health industry which records data on patient health history, even the insurance and government industries also use Smart Contracts, therefore the existence of Smart Contracts is useful to avoid an intermediary service so that a transaction process will be transparent. So it can be concluded from this study that smart contract is a form of legal contract and can be applied in Indonesia with the existence of regulations regarding contracts, especially electronic contracts. Then, the application of the principle of proportionality and the principle of good faith can realize smart contracts that are fair and beneficial to the parties.

Keywords*: Blockchain, Smart Contracts, Industry*

1. Introduction

Smart Contract is an application carried out by blockchain technology where between the two parties have an agreement that has been digitally agreed upon, but previously called a written contract that is making an agreement in written form, but in this way makes an ineffective agreement because it can make a mistake one party has fraud so it is less safe to do and easily damaged and lost. Now increasingly the times, almost all industrial activities using Smart Contract. The smart contract is another mention of Smart Contracts which was first discovered by Nick Szabo which aims to allow lawyers or lawyers to enter into a specific contract between parties, this discovery took place in 1994. While the blockchain was discovered in 2008 by Satoshi Nakamoto which was used for manufacturing digital currency or Bitcoin which is a means of exchanging information with a decentralized system that is even transparent so that it can easily connect all parties without having to go through intermediaries [1]. This blockchain system must involve all consumers and without an entity, so that every data on the blockchain is stored permanently, which is secured by a cryptographic system that is a system that aims to store the confidentiality of data, but the blockchain cannot store large amounts of data [2]. These Smart Contracts have the role of entering into an agreement with the transaction. Are stored in a blockchain network so that Smart Contracts itself has security in storing data. Basically, this blockchain technology has been used on the Ethereum system, which is a computer programming system whose use is very broad and suitable for use by Smart Contracts, but the blockchain cannot store large amounts of data, therefore developers need to make a Dapps in making Smart Contracts, this blockchain system must involve all parties and there is no prioritized entity, so that every data on the blockchain is stored permanently secured by a cryptographic system that is a system that aims to store the confidentiality of data so that the data stored will not be lost or engineered by any party [3]. Therefore, by implementing the Smart Contracts system on this blockchain can be used to find out ownership of something, so that other parties cannot track or manipulate data, another advantage of implementing Smart Contracts is flexibility, namely the ability to work effectively, there is no cost to pay intermediaries third parties namely lawyers and notaries, so that it will save time and no longer need to have to wait a long time to get the document agreement that was agreed between the two parties

2. Research Method

Basically the Systematic Literature Review Method is useful for identifying, assessing, and collecting all available research, but this research method only focuses on the research into the application of the blockchain on smart contracts, so the authors will follow the guidelines of Barbara Kitchenham with her 2007 paper. entitled "Guidelines in performing Systematic Literature Reviews in Software Engineering", these guidelines were made to make it easier to find relevant and subjective study references. Following below are the guidelines to be discussed:

2.1 Research Questions

This research question only focuses on the challenges of the blockchain in using Smart Contract, now there are 3 questions as follows:

RQ1 - 'RQ1: What are the challenges faced by Smart Contract users in terms of transaction agreements?', RQ2 - 'How does the use of Smart Contracts work ?, and RQ3 -' What are the challenges faced by the industrial sector in carrying out Smart contracts ?. To answer all these questions, exploration of the literature in research is needed.

2.2 Search Strategy

In this study using keywords to find a reference of scientific work related to research made by the author, the search process is found on Google Scholar with the keywords "Blockchain", "Smart Contracts", and "Industry". In every scientific work made there is the name of the author and the year of publication there is even a scientific work published from year to year, so researchers can find references from the scientific work.

2.3 Literature Review

As an emerging technology, blockchain has always been the center of public attention, especially students in making references to scientific papers or papers. Therefore, based on research into the application of blockchain technology in the smart contract, there is now a core theory of previous research so that it can be a comparison between existing research.

a. Blockchain

Blockchain is a technology where the network is stored in many servers, the blockchain has the formulation of a decentralized digital transaction record and has reliable security without the intervention of others [4]. Even this blockchain technology can save time and money in the transaction process and blockchain which has decentralized characteristics, namely a system that gives everything to all blockchain users and the absence is prioritized, because they all have the same rights.
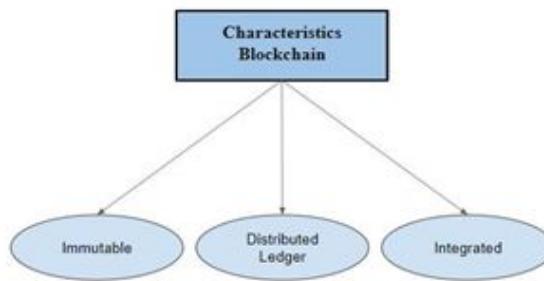

Figure 1. Characteristics of a blockchain

b. Ethereum

Ethereum is a platform that has a programming language and has a public network that is spread on the blockchain [11]. Ethereum was first discovered by a 22-year-old man named Vitalik Buterin in 2014, but previously he was a former developer of Bitcoin which lasted for 2 years, which began in 2011 until 2013. This platform is only focused on the blockchain. In running a decentralized one, an example application running Ethereum is an electronic money transfer tool in the form of tokens and ether.

c. Smart Contract

Smart Contract is run by the ethereum platform based on blockchain technology, Smart Contract has a digital contract performance in the language of computer network programming code, the use of blockchain in this Smart Contracts in order to avoid losing a contract data and accelerate the contract process [5]. Transactions used in Smart Contracts are in the form of Ether which is a digital currency, the EVM (Ethereum Virtual Machine) bytecode language is the language written on Smart Contracts, but the developer to make Smart Contracts does not use the EVM bytecode language but the solidity programming language is similar to the language Javascript. Now there are 2 types of Smart Contracts, namely [6]

1. Deterministic Smart Contracts namely all information related to the blockchain so that they can be operated, for example in this Deterministic Smart Contracts, one of which is the use of crypto tokens and share ownership.
2. Non-Deterministic Smart Contracts namely by requiring information that is external to the blockchain. This external factor means that there is interference from other parties, because the computer itself cannot handle it. For example information that comes from elections.

3. Findings
3.1 Problem

This section is to answer research questions by discussing the challenges faced by government agencies, company managers, and health workers in the use of Smart Contracts. Therefore, this section will analyze the challenges identified in this study.

1. RQ1: What are the challenges faced by Smart contract users in terms of transaction agreements?
Smart contract users will make approval rules in digital form, these rules are determined in the computer network code that will be executed by all networks. This code will be stored in the blockchain so that only people on the network can access it. The data in the Smart contract must be permanent so that no other party can change the data, and the data will be stored securely in the blockchain network.

2. RQ1: How does the use of Smart Contracts work?
There is an EVM (Ethereum Virtual Machine) that runs Smart Contracts, that all calls to the contract are transaction processes, then Ether will be needed for the contract method being executed, for the process of transferring from the account call address to the contract account address, the contract address located at This blockchain has a contract code that is useful for knowing all contract transaction incoming call activities that have parameter data that is used as an "input" that is used to activate all contract data arranged in the recommended format.

3 RQ1: What are the challenges made by the industrial sector in carrying out the Smart contract?
The unique property owned by blockchain can be used by various industrial sectors, basically this blockchain technology uses Distributed Ledger Technology (DLT) which is utilized for the development of the marketplace so that it is decentralized. Having great potential in changing the world for the better and blockchain brings new challenges in providing opportunities to improve the financial system, access to financial services provided by the blockchain can be expanded so that the transaction process is cheaper and faster. Blockchain has a limited network so that it has risk threats such as technology crimes committed by irresponsible cyber crime. Then Indonesia itself is threatened with financial stability because it has a centralized financial system while the blockchain is decentralized, this digital currency can threaten conventional currencies due to shrinking.

3.2 Research Implementation

After making a short list of studies, they will be included in the SLR (Literature Review Study). The main relevant studies especially those related to the research problem will be continued into the data extraction process.
1. According to Tiara Sabrina, Avon Budiyono, and Adityas Widjajanto in their research entitled "Analysis of Memory Resources for the Implementation of Ipfs (Interplanetary File

System) on Ethereum Smart Contracts". This research discusses the making of DApps (Decentralized Applications) which integrates data storage of Ipfs (interplanetary File System) in Ethereum Smart Contracts.

2. Ahmad Bahrudin conducted a research in the Journal of Industrial Service in 2019, entitled "Blockchain Applications and Smart Contracts to Support Sharia Crowdfunding Based Supply Chain Finance". The research improves the Supply chain Finance system in accordance with Islamic sharia by using Smart Contracts

3. The study entitled "Legality of the Application of Smart Contracts in Agricultural Insurance in Indonesia" conducted by Bima Danubrata Adhijoso on improving the welfare of farmers by conducting agricultural insurance in the form of Smart Contracts which aims to facilitate the compensation process.

4. Satria Damai Kurnia, Henry Novianus, and Andreas Handojo in 2019 with the research title "Implementation of Blockchain: Case Study of E-Voting", which designed an electronic voting system by applying a blockchain to the Smart Contract, this research aims to maintain the security of the results of polling. sound.
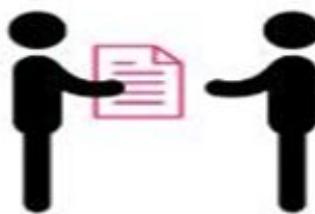
Figure 2. Smart Contract

In his blockchain research, he first met Bitcoin in 2008 by Satoshi Nakamoto. During this meeting, advances in technology were very rapid. There is 1 scientific work found in 2017 and 2018, then there is 1 scientific work found in 2018. In 2020 there was 1 scientific work covering security on the blockchain and there are 5 scientific works published in 2019 which cover the process use of Smart Contracts [7]

a. Application of Smart Contract

Implementation in Smart Contract requires an agreement that is not involved in a third party, all agreements that have been made together will be recorded in the blockchain network so that each user can know all the transactions made, in this agreement all parties must be able to carry out responsibility for agreements made and prohibited to be violated [8], if a violation occurs, the contract transaction will be canceled. But currently Smart Contract is not widely known by the wider community, because Smart Contract itself has a digital transaction process [9] , but the way the performance is performed by Smart Contract is uncertain in legal status so that it is still doubted by the public. In Smart Contract there is a blockchain network that is transparent where confidentiality will occur in an agreement made by all parties in the network [10].

b. Smart Contract Threats

Blockchain has a limited network so that it has risk threats such as technology crimes committed by irresponsible cyber crime [11] . In Smart Contracts, an agreement must be made [12], however, if there is a disagreement, there will be a conflict that can cause blockchain performance that does not run smoothly as in general [13]. If an

agreement has been reached then all parties must have the responsibility to carry out [14]

4 . Conclusion

After conducting research in applying the blockchain to smart contracts [15], where each transaction process involves all parties and there are no intermediaries [16], therefore the authors can draw conclusions drawn from the use of smart contracts [17]. Blockchain technology has a smart contract application that has limited storage capacity so it needs to be improved [18]. On smart contracts owned by blockchain can produce accurate contract data so that no one party can manipulate the contract data [19]. Smart contract this has a decentralized network so that security is guaranteed, a contract transaction process that involves all parties [21]. Using smart contracts can make it easier to track the transaction process on a contract [22]. The application of smart contracts used in voting [23], will be protected so that there is no manipulation of data by all parties because they have been controlled together and as well as significant cost and time savings in the process [24].

References

[1]   J. Oh and I. Song, "A case study on business model innovations using Blockchain: focusing on financial institutions," Asia Pacific Journal of Innovation and Entrepreneurship, vol.
11, no. 3, pp. 335–344, 2017, doi: 10.1108/apjie-12-2017-038.

[2]   R. P. George, B. L. Peterson, O. Yaros, D. L. Beam, J. M. Dibbell, and R. C. Moore, "Blockchain for business," Journal of Investment Compliance, vol. 20, no. 1, pp. 17–21, 2019, doi: 10.1108/joic-01-2019-0001.

[3]   D. R. E. and G. Paul, "Smart contracts: will Fintech be the catalyst for the next global financial crisis?," Journal of Financial Regulation and Compliance, vol. ahead-of-p, no. ahead-of-print. Jan. 01, 2019, doi: 10.1108/JFRC-09-2018-0122.

[4]   T. Feng, X. Yu, Y. Chai, and Y. Liu, "Smart contract model for complex reality transaction," International Journal of Crowd Science, vol. 3, no. 2, pp. 184–197, 2019, doi: 10.1108/ijcs-03-2019-0010.

[5]   B. Willi and M. A. I., "From digital currencies to digital finance: the case for a smart financial contract standard," The Journal of Risk Finance, vol. 19, no. 1, pp. 76–92, Jan. 2018, doi: 10.1108/JRF-02-2017-0025.

[6]   R. M. Garcia-Teruel, "Legal challenges and opportunities of blockchain technology in the real estate sector," Journal of Property, Planning and Environmental Law, 2020, doi: 10.1108/JPPEL-07-2019-0039.

[7]   S. Hemang, "Security tokens: architecture, smart contract applications and illustrations using SAFE," Managerial Finance, vol. ahead-of-p, no. ahead-of-print. Jan. 01, 2019, doi: 10.1108/MF-09-2018-0467.

[8]   C. S. Ernest, C. Yi-Chian, and W. Tzu-Ching, "Exploring blockchain technology in international trade: Business process re-engineering for letter of credit," Industrial Management & Data Systems, vol. 119, no. 8, pp. 1712–1733, Jan. 2019, doi: 10.1108/IMDS-12-2018-0568.

[9]   B. Richard, "Blockchain and insurance: a review for operations and regulation," Journal of Financial Regulation and Compliance, vol. 28, no. 2, pp. 215–234, Jan. 2019, doi: 10.1108/JFRC-09-2018-0127.

[10]   S. Mahdi, B. Sylvia, and W. Kelly, "Incorporating Blockchain technology in construction management," Strategic Direction, vol. 35, no. 10, pp. 1–3, Jan. 2019, doi: 10.1108/SD-03-2019-0062.

[11]   T. Hariguna, M. Yusup, and A. Priyadi, "The Transaction Optimization Of Color Print Sales Through E-Commerce Website Based On Yii Framework On Higher Education," Aptisi Transactions On Technopreneurship (ATT), vol. 1, no. 1, pp. 1–10, 2019.

[12]   S. Santoso, J. Kauf, and N. C. Aristo, "The Information System of Name Card Sales Based on Digital Marketing to Improve Creativepreneur on College E-Commerce Website," Aptisi Transactions On Technopreneurship (ATT), vol. 1, no. 1, pp. 64–72, 2019.

[13]   P. A. Sunarya, D. D. Bernard, and D. M. Damanik, "Viewboard Implementation Based on Javascript Charts as a Media for Submitting Sales Information on a Green E-Commerce Website Light Cafe," Aptisi Transactions On Technopreneurship (ATT), vol. 1, no. 1, pp. 11–19, 2019.

[14]   M. Zarlis, E. P. Harahap, and L. N. Husna, "Test Appraisal System Application Based on YII Framework as Media Input Student Value Final Project and Thesis Session at Higher Education," Aptisi Transactions On Technopreneurship (ATT), vol. 1, no. 1, pp. 73–81, 2019.

[15]   B. Sharmila, D. E. Kyle, and M. Markus, "Blockchain and records management: disruptive force or new approach?," Records Management Journal, vol. ahead-of-p, no. ahead-of-print. Jan. 01, 2020, doi: 10.1108/RMJ-08-2019-0040.

[16]   H. J. Mohammad, N. Yuka, and D. Krishnan, "Cryptocurrency, a successful application of blockchain technology," Managerial Finance, vol. ahead-of-p, no. ahead-of-print. Jan. 01, 2019, doi: 10.1108/MF-09-2018-0451.

[17]   B. Serhat, S. Ozcan, and S. Harun, "IdeaChain: a conceptual proposal for blockchain-based STI policy development," foresight, vol. 22, no. 2, pp. 189–204, Jan. 2020, doi: 10.1108/FS-07-2019-0067.

[18]   T. Gaki and G. Shang, "Understanding security in the government's use of blockchain technology with value focused thinking approach," Journal of Enterprise Information Management, vol. 33, no. 3, pp. 519–540, Jan. 2020, doi: 10.1108/JEIM-06-2018-0138. [19] H. K. Sundtoft and K. Aseem, "How the blockchain enables and constrains supply chain performance," International Journal of Physical Distribution & Logistics Management, vol. 49, no. 4, pp. 376–397, Jan. 2019, doi: 10.1108/IJPDLM-02-2019-0063.

[20]   O.-L. M. R., "Blockchains 2019 in e-HRM: Hit or Hype?," in HRM 4.0 For Human-Centered Organizations, vol. 23, Emerald Publishing Limited, 2019, pp. 117–139. [21] H. Keith, "Contracting out of a public library service: business to be, or not to be?," Library Management, vol. 24, no. 4/5, pp. 187–192, Jan. 2003, doi: 10.1108/01435120310475284.

[22]   T. Riccardo, T. Silvia, C. Mirella, and F. Emanuele, "The blockchain as a sustainable business model innovation," Management Decision, vol. ahead-of-p, no. ahead-of-print. Jan. 01, 2020, doi: 10.1108/MD-09-2019-1281.

[23]   J. Lin, Z. Shen, C. Miao, and S. Liu, "Using blockchain to build trusted LoRaWAN sharing server," International Journal of Crowd Science, vol. 1, no. 3, pp. 270–280, 2017, doi: 10.1108/ijcs-08-2017-0010.

[24]   S. Tsiulin, K. H. Reinau, O. P. Hilmola, N. Goryaev, and A. Karam, "Blockchain-based applications in shipping and port management: a literature review towards defining key conceptual frameworks," Review of International Business and Strategy, vol. 30, no. 2, pp. 201–224, 2020, doi: 10.1108/RIBS-04-2019-0051.