Opportunities and Challenges Blockchain-based Smart Contracts in Indonesia

Joshua Alvaro Fitzhan[1], Jessica Cleine[2], Yohanes Farley Viriando[3], Gunawan Wang[4], Sfenrianto[5]

Information System Management Department, BINUS Graduate Program-Master of Information System, Bina Nusantara University, Jakarta, Indonesia, 11480. e-mail: [1]joshua.fitzhan@binus.ac.id, [2]jessica.cleine@binus.ac.id, [3]yohanes.viriando@binus.ac.id, [4]gwang@binus.edu, [5]sfenrianto@binus.edu

ABSTRACT

Information systems and technology has changed the world in every aspect. One of them is how a contract is made. Smart contract technology has offered a new, efficient, and secure way to automatically execute the terms of the agreement with no third-party to perform such contracts. The objective of this paper is to conduct a systematic overview of how the smart contract can bring opportunities and also challenges to Indonesia. We propose this paper due to the benefits Indonesian businesses will have by implementing smart contracts. Apart from the benefits, in Indonesia, there are still very few journals discussing smart contracts implementation. In this paper, there will be our findings of how smart contracts are utilized currently in industries, the challenges, and the current smart contract in Indonesia. The result will be used as guidance when considering, planning, and applicating smart contracts in Indonesia.

Key words : Blockchain, Indonesia, Smart Contracts

1. INTRODUCTION

Most people by now are familiar with Blockchain technology which took the world by storm when Bitcoin was introduced. Blockchain was originally designed for the use of Bitcoin or cryptocurrency which is a digital currency [1]. Thenceforth blockchain keeps evolving up to blockchain 3.0. The evolution of blockchain 2.0 supports the concept of smart contracts while blockchain 3.0 expands the concept from only financial action and transfer to supporting in varieties of industry [2].

Blockchain technology has come to Indonesia and attracted many users. Indonesian are actively involved in Blockchain 1.0 which is bitcoin or cryptocurrency transaction. The regulation supporting this was released in February 2019 by Commodity Futures Trading Regulatory Agency on Number 5 the Year 2019. Notwithstanding, smart contracts are not as popular as blockchain in Indonesia. The smart contracts concept is relatively new to Indonesian.

In Indonesia's society, people created contracts through intermediaries. They use third parties to store and send the goods at the right to the right person when requested. Other than that, they trust third parties e.g. notary publics to help

them create a legal agreement by overseeing the parties of contracts and authenticating it. People are still unaware of the use of smart contracts technology to facilitate this process. Therefore, we would like to discover the opportunities and challenges smart contracts has in Indonesia. Because of Indonesia's rapid growth, we would like to see how blockchain could increase Indonesia's growth by implementing it in many industries in Indonesia. We will explore the opportunities and challenges of smart contracts in Indonesia by using Systematic Literature Review.

2. BLOCKCHAIN 3.0 SMART CONTRACTS LITERATURE REVIEW

Blockchain is a concept where the data are not stored in one big storage system but are being shared through the devices or system that uses the blockchain-based system. Transaction through Bitcoin could happen without any help from any third party due to the usage of specialized storage design [3].

Blockchain technology itself already established since 2008 and implemented in 2009 [3]. As we stated before, the data in the system are stored in many devices or system that uses the blockchain, but not all the data are stored within them. In general, those stored data are called transactions. The transactions are executed in the public ledger and kept in blocks [4]. Those blocks are connected or chained together, that's why we called it blockchain. This chain of blocks grows as new blocks are supplemented to it continuously. To maintain user security and the consistency of the ledger, blockchain uses dissymmetrical cryptography and distributed unity algorithms [3]. The operation inside blockchain could be hardly decoupled from the blockchain system.

The concept of smart contracts is one of the more promising use cases that used blockchain technology [5]. A smart contract is a concept which moves the digital assets according to unpredictable pre-specified rules [6]. A smart contract is part of a blockchain transaction where they got deployed or executed on the blockchain system [7].

Back in 1997, Nick Szabo introduced the smart contract which he explained as "A set of promises, including protocols within which the parties perform on the other promises." [8] These protocols that he mentions are usually implemented by programs on a computer network or any other form of digital electronics. Consequently, these contracts are 'smarter' than their ancestor which is a paper-based contract. The main aim

of implementing a smart contract is to execute an agreement once the specified conditions are met automatically [9]. With the help of smart contract, intermediary commission fees, third-party dependency, and the need for mutual interaction directly of the counter-parties could be avoided when a transaction happened between untrusted parties [5].

Each transaction in the blockchain that uses smart contract required some main components, which are a set of executable functions and state variables [10]. After the contract parties have negotiated and agreed, the contract will be turned into codes and put into the blockchain [11]. Each time a valid transaction recorded on the blockchain, the state of the blockchain is updated [12], based on all of the transaction recorded in the blockchain, smart contract could automatically trigger a transaction under some condition. After the contract has been recorded into the blockchain and initially programmed by some instruction, it cannot be changed and operated [13].

In general, there are three main advantages to using smart contract [13]. First, *increased efficiency* as a result of the network's users validating transactions, cutting the intermediary. Smart contract provides high speed of execution with automation and high accuracy by eliminating manual errors. The second advantage is *reduced transaction and legal costs*. Miners openly verified and added the blocks of transactions on to the chain which can cut fees that usually occur in traditional services. The potential cost savings also come from reduced infrastructure, operational and commercial expenses. Other advantages that smart contract could give are *greater transparency* and *anonymity* as it has decentralization data through distributed ledgers. Transactions utilizing cryptocurrencies and encryption avoid the chance of data being unlawfully accessed. Besides, backups and duplicates of data are available in the blockchain. Thus, safety is certain with smart contracts.

Nevertheless, legal issues, along with practical concerns to functionality, and security and workforce impact could rise by practicing smart contract despite having so much to offer [13]. The pace of socio-economical changes related to such new technology could not be supported by the law as the law is not adaptable [14]. Additionally, there is also a trust issue with the online personality in blockchain, as stated by many researchers that have studied the fact that the online reputation of a person cannot determine the real personality or status in real life [15].

3. RESEARCH METHODOLOGY

To identify the opportunities and challenges of using smart contracts concepts in Indonesia's various industry we use a Systematic Literature Review, the methods are:

1. Creating a systematic searching method: by defining the keyword from the topic that is going to be reviewed and store them in a document for documentation. Each time the keyword has been searched, then the keyword will be marked so that it will not be searched anymore. This will minimize the un-necessary search.

2. Source collection method: by Literature Study. This Study was done by searching journal to gain information and theories from the internet related to Smart Contracts in Indonesia and Indonesia's regulation.

The following are the keywords used in this systematic literature review: Blockchain smart contracts, Smart contracts, Smart contracts technology, Smart contracts Indonesia, Smart contacts use case, Smart contracts case study, Smart contracts real estate, Smart contracts government, Smart contracts health care, Smart contracts insurance, Smart contracts banking, Smart contracts retail, Smart contracts IoT, Smart contracts internet of thing, Smart contracts application, Smart contracts challenges.

The keywords were chosen with the aim to find the use case and application of smart all over the world. After searching through the generic keyword, we tried using keywords that are more specific such as real estate, government and more.

We are using the following search engine to search keywords that we mention earlier: Google Scholar and IEEE. The search engine we're using in this research is used because of the easiness to find literature studies, the reliableness sources, and the effectiveness of the engine.

4. RESULTS

By using the keywords that we have defined earlier through the search engine, we study the journal related to it and produce these results in Table 1

Table 1: Related Journals of Each Industry

No	Industry	Application	Year
1	Health care and Insurance	Medical record storage system [16]	2016
2		Insurance administration system [17]	2017
3		Automated micro payment [18]	2016
4		Automated remote patient monitoring [19]	2016
5		Smart healthcare provider system [20]	2020
6		Healthcare Data Management [21][22]	2017, 2018
7	Government	Identification document	2019

No		Title	Year
		electrification [23]	
8		E-Voting [24]	2017
9		Intellectual property [25]	2019
10	Banking	Mortgage services [25]	2016
11		Know your customer [26]	2017
12	Retail	Supply chain [27]	2017
13		Logistic [28]	2018
14	Internet of Things	Access control [29]	2018
15	Real Estate	Rent and terminate contract process [10]	2018
16		Rental payment process [10]	2018

There are some challenges in smart contract utilization as seen in Table 2.

Table 2: Challenges in Smart Contract Utilization

No	Title	Key Points	Year
1	Smart Contract Development: Challenges and Opportunities	This research exposed the challenges faced by developers of smart contracts. The study revealed 5 major challenges. First, the code uses for the smart contract cannot be guaranteed in the security sector. Second, the existing tools for development are still in its infancy. Third, there are still some limitations in the programming languages' capability, as well as the virtual machines. Fourth, the running environment is still constrained which causes the performance problems hard to handle. Fifth, online resources such as advanced or updated documents and support from the community to help the developers are still limited.	2019
2	An Overview on Smart Contracts: Challenges, Advances, and Platforms	In this paper, the researcher presents the smart contract's challenges, advances, and platforms. The challenge mentioned in the research is most of smart contracts are unreadable as a result of smart contracts being written in various programming languages which form of codes change over time.	2019
3	The Legal Framework and Challenges of Smart Contract Applications	The paper is focused on analyzing the potential challenges from the legal perspective. Eventually, the smart contracts will be self-regulated because the code itself will become the law. So, algorithms on smart contract codes must be precise to avoid abuses and defections.	2017
4	Life Cycle of Smart Contracts in Blockchain Ecosystems	Each smart contract's life cycle and the risk and limitations are briefly explained. The life cycles are to create, freeze, execute, finalize. The drawbacks of smart contracts are the parties still need to agree on the contracts on phase create. The programming language and machine needed are very powerful and can be a challenge.	2017
5	Is a 'smart contract' really a smart idea? Insights from a legal perspective	In this paper, the discussions are about the opportunities, law compatibilities, and issues of smart contract. The conclusion that there are still some uncertainties in complying with regulations which the researchers think they must do as they give an example of an advanced self-driving car still requires to obey the rules.	2017

Whilst the applications above are the usage and challenges of smart contract in many industries worldwide, there are some papers we found that are aimed for Indonesia's environment in Table 3.

Table 3: Smart Contract in Indonesia's Environment

No	Title	Key Points	Year
1	Designing Smart Contract for Electronic Document Taxation	In the corresponding paper, the system could transform the way stamp duty is managed and paid by the use of smart contract in Indonesia.	2019
2	Smart Contract in Islamic Trade Finance	They focused on the discussion of the possibility of implementing smart contracts in Islamic trade finance. It is as a result of the ethics and the environment that are different in the countries that are predominantly Muslim like Saudi Arabia, Qatar, Oman, Indonesia, and Malaysia. Bank Negara Malaysia's deputy governor said that they have been implementing blockchain applications to use for trade finance with the other nine banks and will embrace the emerging new technologies and keep advancing to not missed the trend.	2019
3	Digital Art Registry for Ownership and Saleability for AR-Based Digital Art Through Blockchain-based Smart Contract	In this research, the researcher attempts to implement smart contracts in the domain of augmented reality-based artworks by developing a proof-of-concept of such a system using the platform called Ethereum.	2019
4	Legality of Application of Smart Contracts in Agricultural Insurance in Indonesia	This research aims to investigate the usage of unregulated smart contract in Indonesia for agricultural insurance.	2019

5. OPPORTUNITIES AND CHALLENGES

Based on the systematic literature we have done, these are the main industry that could maximize the benefits of smart contracts in Indonesia:

1. Health Care and Insurance

By using blockchain, the hospital industry can store a medical record into the blockchain and also access other records that has been recorded by the other hospital [16]. Smart contract also features multi-signature approvals, but only legitimate devices or users can access or affix the record [17]. A researcher could also access some particular personal health data from the smart contract and also could automatically transfer micropayments to the patients that have participated in the researcher's research [18].

Other than that, while maintaining a secure record of who has initiated medical monitoring activities, smart contract could also be used to do an automated remote patient monitoring by sending notifications to the related patients and medical professionals. [19].

Smart contracts could also allow the hospital to simplify the identification and acceptance of emergency patients that arrive without identity documents. Therefore, if the patient is in an emergency and s/he forgot to bring their identity document, the hospital is able to handle the patient and ease the administration process.

Not only smart contract is useful from the medical record and treatment standpoint, it could also handle some processes that usually found in the insurance industry such as calculate payouts, perform error checking, routing, and approve some workflows based on the claim that the client's made and the underlying policies. With smart contract handling the process mentioned before, the insurance company that uses it could remove the human factor from those processes and as a result, could enhance the transparency for the consumers and also cut the overall cost for administration work for the insurers [25].

With a population of around 260 million individuals [30], Indonesia is among the most populated countries in the world. Furthermore, 10.5 million of them are in the capital, Jakarta [31]. Each time they need to have a check-up to a doctor or need some consultation to a new hospital or clinic, they would need to fill their medical records. With that many populations in Jakarta, they would also need to have as may medical records they could have. This process could become easily resolve by implementing smart contracts.

2. Government

The government could also maximize blockchain technology where citizen identity is stored inside the blockchain. With it, a citizen may not always bring their identification documents such as identity cards, passport, driving license, and another identity documents each time they got out. When the citizen needed to use their identity data for some legal reason, they could just open it by system inside the blockchain.

The example of this implementation is a framework that uses a public Etherium smart contract that offers identity management called uPort [23]. uPort is a system for identity management where if the user loses his/her device, the system could protect its user's privacy and also recover the user's account. The functions maybe different but the concepts are the same where identity management is the pressure point.

The other application of smart contracts that the government of Indonesia could use is e-Voting. Due to Indonesia's current political state, if smart contract-based voting is successfully implemented, it will assure a lot of people about the results due to smart contracts being transparent. Even though the implementation of the presidential election cannot be immediate, it could start by a smaller scale election like the election of district chief or chairman of the neighborhood.

3. Banking

The usage that smart contract brings to the banking industry is to enforce rules and policies. It helps the embedded of policies such as Anti Money Laundering (AML) and Your Customer (KYC). It also facilitated automatic currency exchange in international transactions due to it being built on top of hyper ledger fabric [32].

Another advantage of smart contract in the banking industry is through the process redesign, automation, shared access to electronic versions of physical legal documents between trusted parties, and access to an external source of information, therefore the application of smart contract could diminish the cost and time for mortgage service [25].

The utilization of smart contract in the banking industry is not just from or for a specific country. The application above would surely fit in any country because it will improve every aspect of customer-centric banking.

4. Retail

In the retail industry, we would like to highlight the utilization of smart contract for the supply chain, as the smart contract provides some key properties needed in the supply chain and logistics being optimization, security, transparency, and visibility of various operations for the goods transportation [33]. The use of smart contract will also allow constant, real-time access to shared and reliable data that have more efficiency than the conventional supply chain. Blockchain also reducing the risk of wastage and spoilage, so the quality in production can be raised.

Right now, Indonesia is trying to be an independent country by not relying on other countries so much. By improving the supply chain, Indonesia products are most likely had better quality and confidence which will boost the interest of the investors and the usage internally.

5. Internet of Things

Internet of things (IoT) in real life stored and constantly shared a large amount of data. IoT integrates objects and the internet to provide a variety of services that can support many sectors and applications such as supply chain management, access control, e-health systems, inventory control systems, retailers, libraries, and industrial Internet by implicitly automating the business transactions and making good use of the integrated data [34] [35]. By adopting smart contracts into IoT, it could enhance trust in that large amount of data transaction that happens through the IoT devices. It will get rid of the chance intruder gaining illegal access from the system to the provided system by simply deploying existing IoT devices updates.

With the integration of smart contracts and IoT in Indonesia, Indonesia will grow faster due to its assurance of smart contracts concept by controlling the IoT devices. Transactions will be secured and faster. Businesses in Indonesia will grow to the maximum potential with IoT and smart contracts combination.

6. Real Estate

By utilizing smart contract in the real estate industry, the landlord or real estate owner and tenants can create a transaction to create smart contracts, call contract functions, and transfer value to the counterpart. Process of smart contract in the real estate started by rent contract signature, rental payment, and termination rent contract.

The following processes describe the smart contract functionality by Karamitos [10]:

- Create: The landlord will start by initiating the contract as he/she will set up the rental terms and details, and the state in the system will set to "Created".
- Start: After the initialization of the contract, the tenant signs the contract. Once the contract signed, the system will set the contract to "Started" and the possibility of overwriting the current tenant will be eliminated.
- Rent Collection: Smart contract will give the landlord the rent that has been collected from the tenant.
- Terminate: In the Terminate state, the landlord terminates the contract between the related side and all of the balance that has been deposited is sent back to the tenant after verifying the status of the property.

This application on the real estate industry will also affect Indonesia's growth due to the amount of real estate that is still not clear the status of legality. This state will create doubt for the buyer which sometimes are an investor from inside Indonesia or other countries. By using smart contracts, every real estate would have been recorded and could be traced to its sources and history.

Challenges:

Based on the systematic literature we have done, these are the main challenges to implement smart contracts in Indonesia:

1. Trust Issues

As blockchain is designed to be a public ledger, the data stored can be accessible to everyone in the world. In other words, we can view others' contracts stored in the blockchain. This can lead to trust issues in Indonesia as Indonesian tends to be very skeptical to new technology. Research of Microsoft and International Data Corporation (IDC) stated that 46% of Indonesian citizen doesn't trust digital service [36]. According to the research, the factors they are concerned with are 87% security, 86% privacy, 85% ethics, 82% compliance, and 82% reliability. Smart contracts surely fulfill the ethics and reliability. As smart contracts support democratic principles and private interests [37]. Ethics is not a problem. Nonetheless, the privacy, security, and compliance factors can be barriers in smart contracts application. The privacy factor shows that Indonesian worries about their data being exposed in the digital service. The security also There needs to be an extra challenge to convince Indonesian and a process for accustomation.

2. Legality Concern
As the legal regulations of smart contracts in Indonesia are still weak, the compliance factor can be a shortfall. The good news is the Indonesia government has established a regulation for a crypto asset. Regulation of Commodity Futures Trading Regulatory Agency Number 5 the Year 2019 was released in February 2019. However, it hasn't specified smart contracts issue.

3. Implementation Effort
To implement smart contracts, it will require complex codes. Hence developers with high programming skills are needed. In Indonesia programmers are still few and hard to found [38]–[41]. The alternatives are to outsource or to use platforms i.e. Ethereum to establish smart contracts. Such platforms will simplify the creation of smart contracts without requiring knowledge of blockchain or smart contracts.

4. Blockchain's high maintenance.
The characteristics of smart contracts such as integrity and immutability of data require an active mining pool [8]. To be active mining, blockchain will need the miners to join in the process which will put an end to the fraud of block. On account of miners' investment of their energies and resources, like computational power, Indonesian needs to contribute and incentivize the miners. This is necessary to avoid a slow transaction speed of blockchain or high approval time. This challenge is not only aimed at implementation in Indonesia, but it is a worldwide challenge that needs to be faced by everyone.

5. Inflexibility in smart contracts adjustment
After the smart contract is made, it cannot be changed. Considering Indonesia's culture that is fond of negotiation in settling or resolving a problem, this can be a challenge.

Indonesian will be forced to accept the contracts' agreements. Also, Indonesian might be reluctant to try using smart contracts.

6. SUMMARY

With the growth of blockchain technology, we began to see other expansion of blockchain. One of the more favored concepts is a concept called smart contracts. Due to smart contract being a new concept, many people haven't grasped the true potential that smart contract could bring to the table. Out of that reason, this paper presents an overview of smart contracts opportunities and challenges. Even though many countries have begun researching this topic, but there are still only a few of them directed to Indonesia's environment. Based on it, we decided to explore the opportunities smart contract have on Indonesia's vast industries.

We began researching the topic by creating the keywords and explored them. We mainly focused on the implementation and design of smart contract in many industries in the whole world and summarized them. We also search for the environment in Indonesia such as politics, culture, legality, and other aspects that may impact or challenge the implementation of smart contract in Indonesia. Afterward, we simulate the knowledge we have gathered to illustrate the opportunities and challenges of smart contract in Indonesia.

We divided the opportunities into various industries: health care and insurance, government, banking, retail, and internet of things. Those are the main industries that we think the best fit to implement in Indonesia due to the needs and compatibility of the industry. Even though smart contract is a cutting-edge technology that seems like what everybody needs, there are still some challenges that need to be considered like trust issues, legality concern, implementation effort, blockchain's high maintenance, inflexibility in smart contracts adjustment. It was due to the condition of Indonesia economically, politically, and its adoption rate to technology.

Even though there are some tough challenges, smart contract is a concept of technology that cannot be ignored. Companies or organizations could easily gain a competitive advantage if they successfully implement a smart contract in their business process. Smart contract maximizes the use of distributed ledgers to increase the quality and transparency of the system that implemented it.

REFERENCES

[1]   A. Sukhadeve, "**Why Is Blockchain Gaining So Much Popularity?**," *Datafloq*, 2017. [Online]. Available: https://datafloq.com/read/why-is-blockchain-gaining-so-much-popularity/3631. [Accessed: 18-Jan-2020].

[2]   S. Terzi, K. Votis, D. Tzovaras, I. Stamelos, and K. Cooper, "**Blockchain 3 . 0 Smart Contracts in E-Government 3.0 Applications**," *arXiv Prepr.*

arXiv1910.06092, 2019.

[3] S. Nakamoto, "**Bitcoin: A peer-to-peer electronic cash system**," 2019.

[4] H. Andre, A. K. Dewi, F. Pangemanan, and G. Wang, "**Designing blockchain to minimize fraud in state-owned national insurance company (Bpjs kesehatan)**," *Int. J. Emerg. Trends Eng. Res.*, vol. 7, no. 12, pp. 794–797, 2019. https://doi.org/10.30534/ijeter/2019/117122019

[5] D. Macrinici, C. Cartofeanu, and S. Gao, "**Smart contract applications within blockchain technology: A systematic mapping study**," *Telemat. Informatics*, vol. 35, no. 8, pp. 2337–2354, 2018. https://doi.org/10.1016/j.tele.2018.10.004

[6] V. Buterin, "**A next-generation smart contract and decentralized application platform**," *Etherum*, no. January, pp. 1–36, 2014.

[7] M. Alharby, A. Aldweesh, and A. Van Moorsel, "**Blockchain-based Smart Contracts: A Systematic Mapping Study of Academic Research (2018)**," *Int. Conf. Cloud Comput. Big Data Blockchain, ICCBB 2018*, pp. 1–6, 2018.

[8] C. Sillaber and B. Waltl, "**Life Cycle of Smart Contracts in Blockchain Ecosystems**," *Datenschutz und Datensicherheit - DuD*, vol. 41, no. 8, pp. 497–500, 2017. https://doi.org/10.1007/s11623-017-0819-7

[9] M. Alharby and A. van Moorsel, "**Blockchain Based Smart Contracts : A Systematic Mapping Study**," pp. 125–140, 2017.

[10] I. Karamitsos, M. Papadaki, and N. B. Al Barghuthi, "**Design of the Blockchain Smart Contract: A Use Case for Real Estate**," *J. Inf. Secur.*, vol. 09, no. 03, pp. 177–190, 2018.

[11] W. N. Hussein, L. M. Kamarudin, M. R. Hamzah, H. N. Hussain, and K. J. Jadaa, "**A New Era with Blockchain Technology in Saudi Arabia**," *Int. J. Emerg. Trends Eng. Res.*, vol. 7, no. 12, pp. 886–894, 2019. https://doi.org/10.30534/ijeter/2019/267122019

[12] J. Bonneau, A. Miller, J. Clark, A. Narayanan, J. A. Kroll, and E. W. Felten, "**SoK: Research perspectives and challenges for bitcoin and cryptocurrencies**," *Proc. - IEEE Symp. Secur. Priv.*, vol. 2015-July, pp. 104–121, 2015.

[13] M. Giancaspro, "**Is a 'smart contract' really a smart idea? Insights from a legal perspective**," *Comput. Law Secur. Rev.*, vol. 33, no. 6, pp. 825–835, 2017. https://doi.org/10.1016/j.clsr.2017.05.007

[14] M. Hulicki, "**The legal framework and challenges of smart contract applications**," 2017.

[15] A. Yasin and L. Liu, "**An Online Identity and Smart Contract Management System**," *Proc. - Int. Comput. Softw. Appl. Conf.*, vol. 2, pp. 192–198, 2016.

[16] A. Ekblaw, A. Azaria, J. D. Halamka, and A. Lippman, "**A Case Study for Blockchain in Healthcare:'MedRec' prototype for electronic health records and medical research data**," in *Proceedings of IEEE open & big data conference*, 2016, vol. 13, p. 13.

[17] R. Hans, H. Zuber, A. Rizk, and R. Steinmetz, "**Blockchain and smart contracts: Disruptive technologies for the insurance market**," *AMCIS 2017 - Am. Conf. Inf. Syst. A Tradit. Innov.*, vol. 2017-Augus, pp. 1–10, 2017.

[18] L. A. Linn and M. B. Koo, "**Blockchain For Health Data and Its Potential Use in Health IT and Health Care Related Research**," *ONC/NIST Use Blockchain Healthc. Res. Work.*, pp. 1–10, 2016.

[19] K. N. Griggs, O. Ossipova, C. P. Kohlios, A. N. Baccarini, E. A. Howson, and T. Hayajneh, "**Healthcare Blockchain System Using Smart Contracts for Secure Automated Remote Patient Monitoring**," *J. Med. Syst.*, vol. 42, no. 7, pp. 1–7, 2018. https://doi.org/10.1007/s10916-018-0982-x

[20] A. Khatoon, "**A Blockchain-Based Smart Contract System for Healthcare Management**," 2020. https://doi.org/10.3390/electronics9010094

[21] A. Al Omar, M. S. Rahman, A. Basu, and S. Kiyomoto, "**Medibchain: A blockchain based privacy preserving platform for healthcare data**," in *International conference on security, privacy and anonymity in computation, communication and storage*, 2017, pp. 534–543.

[22] A. Theodouli, S. Arakliotis, K. Moschou, K. Votis, and D. Tzovaras, "**On the Design of a Blockchain-Based System to Facilitate Healthcare Data Sharing**," *Proc. - 17th IEEE Int. Conf. Trust. Secur. Priv. Comput. Commun. 12th IEEE Int. Conf. Big Data Sci. Eng. Trust. 2018*, pp. 1374–1379, 2018.

[23] uPort, "**uPort - Tools for Decentralized Identity and Trusted Data**." [Online]. Available: https://www.uport.me.

[24] P. McCorry, S. F. Shahandashti, and F. Hao, "**A Smart Contract for Boardroom Voting**," *Financ. Cryptogr. Data Secur. FC 2017. Lect. Notes Comput. Sci.*, vol. 10322, pp. 357–375, 2017.

[25] B. Cant *et al.*, "**Smart contracts in financial services: getting from hype to reality**," *Capgemini Consult.*, pp. 1–24, 2016.

[26] J. Parra Moyano and O. Ross, "**KYC Optimization Using Distributed Ledger Technology**," *Bus. Inf. Syst. Eng.*, vol. 59, no. 6, pp. 411–423, 2017. https://doi.org/10.1007/s12599-017-0504-2

[27] K. Korpela, J. Hallikas, and T. Dahlberg, "**Digital supply chain transformation toward blockchain integration**," in *proceedings of the 50th Hawaii international conference on system sciences*, 2017.

[28] R. Casado-Vara, A. González-Briones, J. Prieto, and J. M. Corchado, "**Smart contract for monitoring**

and control of logistics activities: pharmaceutical utilities case study," in *The 13th International Conference on Soft Computing Models in Industrial and Environmental Applications*, 2018, pp. 509–517.

[29] Y. Zhang, S. Kasahara, Y. Shen, X. Jiang, and J. Wan, "**Smart contract-based access control for the internet of things**," *IEEE Internet Things J.*, vol. 6, no. 2, pp. 1594–1605, 2019.

[30] I. Investments, "**Population of Indonesia**," *Indonesia Investments*, 2017. [Online]. Available: https://www.indonesia-investments.com/culture/population/item67. [Accessed: 12-Jan-2020].

[31] D. H. Jayani, "**Jumlah Penduduk DKI Jakarta 2019 Mencapai 10,5 Juta Jiwa**," 2019. [Online]. Available: https://databoks.katadata.co.id/datapublish/2019/09/10/jumlah-penduduk-dki-jakarta-2019-mencapai-105-juta-jiwa.

[32] Stellar, "**Stellar - an open network for money**," *Stellar*. [Online]. Available: https://www.stellar.org. [Accessed: 10-Jan-2020].

[33] K. Sadouskaya, "A**doption of Blockchain Technology in Supply Chain and Logistics**," 2017.

[34] Z. Zheng *et al.*, "**An overview on smart contracts: Challenges, advances and platforms**," *Futur. Gener. Comput. Syst.*, vol. 105, pp. 475–491, 2020.

[35] W. N. Hussein, L. M. Kamarudin, M. R. Hamzah, H. N. Hussain, and K. J. Jadaa, "**A Methodology for Big Data Analytics and IoT-Oriented Transportation System for future implementation**," *Int. J. Emerg. Trends Eng. Res.*, vol. 7, no. 11, pp. 449–453, 2019. https://doi.org/10.30534/ijeter/2019/087112019

[36] D. H. Jayani, "**46% Konsumen Indonesia Tak Percaya Layanan Digital**," *Databoks*, 2019. [Online]. Available: https://databoks.katadata.co.id/datapublish/2019/06/27/46-konsumen-indonesia-tak-percaya-layanan-digital. [Accessed: 10-Jan-2020].

[37] Robert Herian, "**The challenge of smart contracts**," *The Open University Business School*. [Online]. Available: http://business-school.open.ac.uk/news/challenge-smart-contracts. [Accessed: 10-Jan-2020].

[38] I. Yunelia, "**Indonesia Masih Kekurangan Ahli Coding**," *medcom*, 2019. [Online]. Available: https://www.medcom.id/pendidikan/news-pendidikan/0Kv96W4k-indonesia-masih-kekurangan-ahli-coding.

[39] A. M. Damar, "**iCIO: Indonesia Kekurangan Ahli di Bidang Teknologi**," *Liputan6*, 2017. [Online]. Available: https://www.liputan6.com/tekno/read/2946218/icio-indonesia-kekurangan-ahli-di-bidang-teknologi.

[40] N. Azizah, "**Indonesia Masih Kekurangan Ahli Siber**," *Republika*, 2019. [Online]. Available: https://www.republika.co.id/berita/trendtek/internet/19/09/11/pxn56i463-indonesia-masih-kekurangan-ahli-siber.

[41] E. Sutriyanto, "**Indonesia Kekurangan Tenaga Ahli di Bidang Teknologi dan Engineering**," *Tribunnews*, 2018. .