

RESEARCH ARTICLE

A COMPARATIVE ANALYSIS OF SMART CONTRACTS AND ISLAMIC CONTRACTS

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Abstract

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..... A smart contract is a computer protocol contract of which its' innovation rooted from the traditional contract. However, Shariacompliant transaction necessitates a contract to fulfils all pillars of Islamic contracts in order smart contract can be accepted as an innovation of Islamic contracts. Thus, this paper aims to make a comparison between Islamic contracts and smart contract on blockchain. This paper is a qualitative research by adopting content analysis method to analyze some related topics. The pillars of Islamic contract are compared with the smart contract to ensure whether the smart contract follows the guidelines of Islamic contract or vice versa. The analysis shows that smart contract does not entirely comply with the Islamic principles of a contract. Even though smart contract generally has three pillars of Islamic contract but in details, it does not comply with the Sharia principles. By comparing between the pillars of Islamic contract and smart contract on blockchain, it shows that smart contract on blockchain is not underline with the Islamic contract's pillars. Contracting parties participate in the smart contract does not recognize each other that can be lead to gharar. Meanwhile, every transaction in the smart contract allows prohibited subject matters such as illegal drugs, weapons where as it is not allowed in Islamic contract's transactions.

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Introduction:-

A smart contract is a disintermediation; thus, the primary purpose of a smart contract is to improve a contract condition by minimising every risk from an intermediary. Before the millennium, the significant application of smart contract did not attract the world because it lacked digital and programming technology (Tianyu Feng et al. 2019). Moreover, in the 1990s, people did not use technology as much as today of which technology has become a staple tool in people's daily life. Technology enables humans to work faster, improve work productivity and maximise efficiency.

In 2015, an operating system – Ethereum, reintroduced smart contract as an application on a blockchain platform. According to Buterin (2017), the smart contract application is like a vending machine. A buyer will receive an item from the machine according to the amount of money that he or she puts into it. It is also known as a straightforward application to make an offer and acceptance between contracting parties (Siti Rohaya et al. 2018). The existence of smart contract has automatically created an evolution of blockchain.

Corresponding Author:-Azlin Alisa Ahmad Address:- Research Centre for Sharia, Faculty of Islamic StudiesUniversity Kebangsaan Malaysia. Blockchain is a decentralised platform to eliminate third party (intermediary) involvement in every transaction. Blockchain emerged in 2008 alongside the successful cryptocurrency known as Bitcoin, introduced by an unidentified person or group known as Satoshi Nakamoto. Subsequently, the Bitcoin empire introduced its technological innovation known as 'blockchain 1.0'. Meanwhile, cryptocurrency is a protocol of peer-to-peer electronic cash system (Don Tapscott & Alex Tapscott 2016). This cryptocurrency is not under the control of any authority. As time progresses, blockchain has also evolved into 'blockchain 2.0'. This evolution took place after VitalikButerin proposed a project known as 'Ethereum's smart contract. Generally, Ethereum is an open-source operating system providing a smart contract application on a blockchain platform. Smart contract appears to be like an innovation of the traditional contract of which it is paperless, and users can write any transaction in the system source.

A blockchain platform helps smart contract to write any transaction in computer codes such as solidity and java (Hu et al. 2019). The purpose of translating the transactions into computer codes is to simplify and speed up data stored in a block before chaining it to another block (Harpreet, 2019). The smart contract digitalises a paper contract, which then converted into computer codes, and it works on a blockchain platform (Pratap 2018). Smart contract can record various transactions and store them in distributed network-based platform called Ethereum (Yoo 2017).

Various industry, especially finances, economy and banking, use contract-based transaction widely. A contract is an agreement between two parties to exchange a subject matter based on a purpose. The general purpose of a smart contract is to perform contract transaction using a computer protocol. Moreover, the goal of creating smart contract is to simplify every transaction within the traditional contract by eliminating the complicated elements, procedures and reducing cost (Naughter 2017). However, according to Amir (2018), it is doubtful that smart contract is capable of replacing the traditional contract. The blockchain system automatically verifies a smart contract transaction without any authorisation from the authority because due to blockchain's nature, it eliminates the interference from the authority. Blockchain is a decentralised system that aims to reduce human risk by eliminating intermediaries in the platform (Jha 2019). Therefore, the elimination of intermediaries automatically eliminates the authority to authorise the contract.

In reality, smart contract is a technological innovation, not an improvement of the conventional contract elements. Concerning contract, Islamic contract places a great emphasis on elements that observe Shariah principles. In this case, three pillars of Islamic contract are requisite and serve as the guidelines for any contract. Hence, it is critical to compare between smart contract and Islamic contract to determine whether smart contract aligns with each pillar of the Islamic contract. It is also to analyse the standard of smart contract, whether it is similar to the Islamic contract in terms of its compliance with the Sharia principles. This study hopes to maintain the purity of the Islamic Finance industry as well as to help Muslims eliminate their scepticism towards the use of smart contract.

Smart Contract and Blockchain

Nick Szabo (1996) introduced the first smart contract in his paperwork entitled 'Smart Contracts: Building Blocks for Digital Markets'. Szabo's readings of Ayn Rand and his knowledge about contract laws and computer technology inspired him to work on smart contract (Shrikar 2018). The purpose of smart contract is to make some adjustments in the traditional contract conditions such as payment terms, confidentiality, and even enforcement. Unfortunately, people at the time of its initial introduction did not recognise smart contract until 19 years later when Buterin introduced Ethereum in 2015. Buterin (2017) explains that smart contract is like a vending machine that dispenses a product of the exact values of the price paid. A buyer will receive the goods that he or she desires after inserting the right amount of money into the money slot. Therefore, there is a possibility that they will not receive their desired goods if they do not insert the right amount of money.

Every transaction and agreement created in a smart contract is automatically executed and run by an executable program (Raskin 2017). The smart contract used on a blockchain is a computer code containing a set of rules agreed by the contracting parties (Siti Rohaya et al. 2018). Two cryptographic computation experts, Haber and Stornetta (1992) created a computer code using the cryptographic hash function to secure data on a blockchain. The cryptographic hash function is capable of storing multiple data and converting them into a string of letters and numbers to secure against data tampering. The cryptographic hash function will digest every transaction into hash values before storing it into blocks. Hash function links each block with another block because any change in the transactions will entirely alter the original hash of every linked block.

According to Pratap (2018), a smart contract is a digital contract converted into computer codes and used on a blockchain. Any application that works on a blockchain is decentralised, including smart contract. Decentralised means there is no human interference in this system. For example, in a property purchase, a traditional contract necessitates the presence of a bank and a lawyer, but a smart contract removes them. A smart contract enables a more straightforward transaction (Williamson 2017). It removes third-party intervention. For example, A wants to deliver money to B, but A does not want to use C delivery service. A smart contract is the best way to remove the delivery service. Thus, A can use smart contract to deliver the money directly to B without using C delivery service.



To deliver money using a smart contract, A must correctly and accurately write the conditions in the smart contract. For example, A writes "B will receive money of RM300 on 24th April 2019". The smart contract will work according to the conditions written. Meanwhile, B will receive the money according to the conditions specified. The transaction in a smart contract typically involves cryptocurrency (Brunoni 2017). It is because the intention behind the innovation is to secure the system decentralised purpose. So, A need to have his or her crypto wallet to purchase cryptocurrency. In this situation, he or she must convert his or her actual money into cryptocurrency before attempting a transaction to deliver the money to B. This means, B will receive the money in terms of cryptocurrency.

Blockchain uses smart contract widely to ensure that it works automatically and transparently (Nitish et al. 2019). Even though a smart contract is a distributed ledger, users can monitor the movement to ensure there is no fraud in the contract. Other users can duplicate the data stored in a blockchain to ensure that every data becomes immutable (Francisco and Swanson 2018). Therefore, no one can change or delete the data without the owner's permissions. In the meantime, according to Venegas (2017), a smart contract can eliminate not only the involvement of third-party, but it can also reduce costs. Moreover, experts have programmed smart contract to protect privacy and maintain security under a decentralised system (Asharaf 2017).

According to Kufner (2018), contracting parties in a smart contract are autonomous. They remain anonymous by introducing themselves using only surname. They also use the system to put together an agreement without the need for face to face interaction. According to the Islamic contract, one of its pillars is contracting parties. The pillar indicates that one of the conditions to become contracting parties is to comply with the Sharia principles. Hence, the contracting parties in a smart contract require further examination to verify its status, whether it complies with the pillars of Islamic contract or otherwise.

According to Kasireddy (2018), a trust-less transactional system such as blockchain uses smart contract, which is a permission-less and trust-less system that runs publicly to manage conditional transaction between two parties only. Nick Szabo founded smart contract in 1994, which he designed it to satisfy common contractual conditions (Szabo 1994). Smart contract digitalises contractual clause into computer codes with the purpose to summarise any transaction written in a smart contract. Ethereum commonly uses solidity in its smart contract. Solidity is one of the most straightforward language codes that users can understand. It helps the programme to work smoother and faster before being recorded into a block. After being recorded into a block, the block will chain itself with another block using hash cryptography, which is a code of numbers to ensure the block is immutable and more secure. Every block has different numbers of hash cryptography and users recognise hash cryptography as a serial barcode for each block. In this case, a smart contract uses a blockchain platform to lock any data recorded in the system by formulating the procedure.

In 2013, Ulbricht introduced a buy and sell transaction using a blockchain platform known as Silk Road. The purpose of this introduction is to hide trading activities from the authority. Silk Road allows unrestricted business transactions that include an array of dealings such as drugs, illegal weapons, fake identities and many more. Another platform that offers smart contract transactions is Dapp.com that also deals with various subject matters. The shortcoming of these websites is that their dealings involved elements prohibited in the Sharia principles, which one of them is gambling. These websites support a gambling-based game such as POWH3D. According to Harpreet

(2018), such support attracts people to use a blockchain platform. Besides gambling, these websites also support other subject matters that Shariah principles prohibit. This article will analyse the types of subject matter traded on a blockchain through the use of a case study on Silk Road and Dapp.com.

Users use an autonomous distributed ledger to keep a smart contract. The smart contract contains all information about asset ownership and the parties involved in a transaction. However, no authority or law is regulating or monitoring the smart contract. This situation may lead to an unpredictable problem in the transmission of customers personal data without their consent (Dell' Erba 2018). In this case, the absence of law enforcement and authority monitoring are the reasons for injustice and a lack of trust in a smart contract.

Furthermore, these aspects may also do not comply with the Sharia principles. Sharia-compliant agreement enforces trust and maintains justice in every contract. Thus, Islamic contract is a contractual agreement in the form of trust between contractual parties that is executable as long as it does not involve illegal or unlawful matters.

Theoritical Framework

The theory applied in this research is the three pillars of Islamic contract. The purpose of this study is to investigate the application of the three pillars of Islamic contract in a smart contract. The figure below illustrates the theoretical framework.





Illustrated by the researchers

The Definition of Islamic Contract

According to the Islamic perspective, a contract is an agreement of offer and acceptance between contracting parties that centres on Sharia-compliant terms and conditions (Rahmani 2008). In the agreement, there is an existence of an exchangeable object or subject between the parties. In modern law, contract in Arabic is known as 'aqd. It means promise or tying (الرَيْط). 'Aqdis also a combination of offer and acceptance (Lahsasna 2012). According to al-Zuhayli (1995), Islamic scholars commonly use 'aqdas a specific term of a contract to express an offer and acceptance. Before one accepts to take part in the offer and acceptance, the 'aqd must observe the Sharia guidelines. According to Shahrul Azman (2016), bilateral parties' agreement is the basis of an Islamic contract. Suhendi (2008) also states that the Islamic contract is an agreement between one party to accept an offer from another party. Meanwhile, Siti Salwani (2010) states that every element of a contract is an agreement according to legal perspective. Thus, a contract refers to an obligation, rights and responsibility for the involved persons to bear.

The Pillars Of Islamic Contract

According to al-Jaziri (2012), the pillars of Islamic contract from the Hanafi's views is offer and acceptance (expression). Meanwhile, the Maliki, Hanbali and Shafie's view agrees that there are three pillars of Islamic contract based on the Sharia perspective (Zaharuddin 2010). The three pillars of Islamic contract are: expression, contracting parties and subject matter.

Expression of Offer and Acceptance (Sighah)

In Arabic, *Sighah* means pronunciation or expression. An expression is the first pillar in initiating the application of contract in financial transactions (Lahsasna 2012). It is an expression of one's intention to make an offer and acceptance. This pillar must be in a complete expression and understood by all contracting parties to avoid

uncertainty and coercion between them. There are several ways to express *sighah* in the matter involving contracting parties' abilities (Billah 2006). The Quran (2:185) has already stated the diversity of *sighah*, which is as follows:

"Allah intends for you ease and does not intend for you hardship and [wants] for you to complete the period and to glorify Allah for that [to] which He has guided you; perhaps you will be grateful."

The contracting parties use an expression to express their intentions through two means, which are speaking or doing and submitting (al-Jaziri 2012).

a) The Verbal and Written Method

The contracting parties must verbalise the words clearly for clarity of meaning that both parties can understand very well (Billah 2006). A verbal contract is a standard method used by contracting parties and regarded as '*urf* in some places. For example, the expressions for the acceptance of sale and purchase are "I bought this book for RM10" and "I sold this book for RM10". This verbal method is also a popular alternative among people with illiteracy issues and visual impairment that hinder their ability to officiate their contract. If the contracting parties communicate in different languages, they must hire a translator to translate the expressions in the language they understand (Mohd Ali 1999).

It is also common that the contracting parties who perform verbal 'aqd are present at the same time and place to exchange goods at mutual will. For instance, in a barter system, the contracting parties pronounce the sale and purchase contract to mutually exchange the goods between them, which the bidder says, "I sell" and the recipient replies "I buy" after the item is sold. al-Jaziri (2012) says that the expression is considered valid if qabul establishes before *ijab*. For example, the recipient says, "give me this item at this price". The Hanafi's view accepts this situation because the contract is valid as it contains meaning in its possession.

The written form is also meant to express *Sighah*. In the event where distance separates the contracting parties from each other, they can use the written method (Ash-Shiddieqy 1974). This method can serve as proof of offer and acceptance between the contracting parties in the future. It is also permanent and explicit as the contracting parties specify the terms in writing. Moreover, the inclusion of the names of the contracting parties and their signatures ensure the validity of the contract. The Hanafi and Maliki's view argues that the justification for this method is "writing is like speech" (Ash-Shiddieqy 1974; al-Zuhayli 1995). The contract will legally bind if the parties have set Shariah-compliant terms. Plus, the contracting parties must write the words and state the details explicitly to ensure no element of fraud or defamation. The parties involved in the contract need to enter into the contract and to sign it to maintain their business. If there is a discrepancy in the contract or one of the parties does not sign it, or in case of fraud, then the contract is invalid (al-Zuhayli 1995).

The Silence Method

Nowadays, the silence method has become a norm of the public practices widely and extensively. A buyer pays the seller for the item he or she bought at a price shown on the label and the seller accepts the payment of the price without communicating the exchange via written, verbal or act. According to the Hanafi and Hanbali's view, this method is valid as the people have become aware and accepted it as customary practice (al-Zuhayli 1995). Meanwhile, the Maliki's view states that this is a valid method as it is a voluntary agreement between the contracting parties. However, the Shafie's view disagrees with these views stating that this method is invalid. The Shafie's view argues that the nature of the actions does not have a strong argument to show that it is a valid contract. Also, the evidence of willingness between the parties is hidden. However, the Shafie's view agrees that the contract will be valid if the contracting parties verbalise the expression. Nevertheless, some of the Shafie scholars agree that this method is valid as there is no obligation on the condition that the contract should be made with only words.

The Gestures Method

Besides verbal and written form, gestures and acts can also convey the expression of offer and acceptance. In a transaction, after the completion of an offer and acceptance, an act of offer and acceptance is manifested via the exchange of goods at mutual will between the contracting parties (Siti Salwani 2010). People who have speech problems such as stuttering and those who are unlettered can apply the gesture method. Gestures refer to the movement of the hands, body, lips and anything that can substitute the utterance of offer and acceptance (Lahsasna 2012). The Maliki's view states that the practice of gestures is legal by those who can speak to interact with those who are unable to utter any words in any contract.

Contracting Parties

The contracting parties mean persons who perform a contract with one or more people (al-Jaziri 2012). In Islam, one of the requirements for contracting parties to be involved in a contract is that they must comply with Sharia-compliant requirements (Lahsasna 2012; Shahrul Azman 2016). Sharia-compliant requirements are a legal requirement that contracting parties must fulfil whether they are independent or bound under authorities.

Void Conditions to Participate as Contracting Parties

The contracting parties must comply with the Sharia requirements to ensure that the executed contract is valid. However, several Islamic law principles specify strict conditions on some of the requirements to participate in a contract. The strict conditions are to maintain the purity and security of a contract as well as the contracting parties. The general prohibitions in contractual agreements are as follows.

- 1. An underage person, a child
- 2. An insane person
- 3. An extravagant person
- 4. A mentally impaired person
- 5. A person who is suffering a fatal disease or terminally ill
- 6. A bankrupt person
- 7. A person who is alcoholically intoxicated

Subject Matter

The purpose of any contract is to make an exchange of any object or subject between two parties. The object or subject must have value and benefit to both parties. The contracting parties need to explicitly explain the specifications of such subject matter and then agreed at their own will without any coercion. According to the Shafie's view (al-Zuhayli 1995), executing a forcible contract is divided into two parts.

- a) One party is forced to sell goods or receive the money paid or the like to the other party. This activity is not a sale contract; thus, it immediately terminates the contract. This situation imposes cruelty on one side even though it benefits the other.
- b) One party is forced to sell his or her property as a means to pay a debt to a particular party. This situation is considered legitimate as it does not endanger any contracting party.

This division of forcible conditions helps contracting parties avoid invalidity of a contract or any damage during the transaction of a contract. Moreover, these conditions are also to secure the welfare of the contracting parties. Researchers have also found several conditions contracting parties need to observe regarding a subject matter of a contract (al-Jaziri 2012). They are:

- a) The subject matter of a contractmust be free from impurities. However, the Hanafi's view argues that an impure subject matter that still possesses some beneficial purposes is valid as long as it is not food. For example, the use of goats' excrement as fertilisers, the use of methane gas that originates from livestock's decayed organic waste, and others alike. However, the Qur'an prohibits sources from swine and alcohol. In addition, unidentified carcasses are also invalid according to subject matter.
- b) The subject mattershould have usufruct for the contracting parties according to the Sharia principles.
- c) The subject matter must belong to the seller. It is invalid to sell a subject matter without knowing the owner to avoid uncertainty *(gharar)*. The *gharar* ownership includes the selling of birds in the sky, the selling of unborn calves and the selling of fish in the oceans.
- d) The subject matter has a physical form that is transferable or beneficial. Hairdressing or massaging service is legitimate as such subject matter provides service desired by the clients.

The subject matter offered by the contracting parties in a contract may not be in the form of physical goods only. The contracting parties can also offer any service that the benefit is exchangeable. However, regardless of physical or abstract subject matter, the contracting parties need to know what kind of goods or service they want to exchange in the contract and done so based on mutual agreement.

The analysis shows that there are three elements in an Islamic contract, which are expression, contracting parties dan subject matter. The study provides a detailed explanation of the elements to avoid them being mistaken for reference. The following is the summary of the discussion.

Pillar	Description		
Expression	 The pronunciation or expression made to express the wish of acceptance. Valid pronunciation types: 1. Verbal form 2. Written form 3. Acts a) Acceptance via the silent method b) Gestures 		
Contracting Parties	 Involve two or more people. Consist of necessary qualifications and authority to execute a contract. Unauthorised contracting parties: An underage person, a child (not <i>mummayyiz</i>). An insane person (<i>majnun</i>) An extravagant person A mentally impaired person (<i>Al-ma'tuh</i>) A person who is suffering a fatal disease or terminally ill (<i>marad al-mawt</i>). A bankrupt person (<i>Iflas</i>) A person who is alcoholically intoxicated 		
Subject Matter	 Subject matter offered needs to have value and benefit(s). Requires approval and agreement from every party involved. Does not involve banned items according to the Sharia principles such as alcohol, swine and others that are non-Sharia-compliant. No coercion in the offer and acceptance of the subject matter. 		

Table I:- The Elements of Islamic Contract.

The Classification of Islamic Contract and Smart Contract

Islam beyond religion is a way of life. It has established rulings to govern the human's life affairs, including business conduct. Thus, Islam has laid out a set of principles that govern a contract with the purest intention to protect the wellbeing and maintain justice between parties in a contract. Presently, the advancement of technology has led to significant financial innovations, such as smart contract. Smart contract operates based on a technological platform, which generally has subsided the elements of contact according to the Islamic principles.

Moreover, the implementation of a smart contract within the Islamic digital financial community also does not consider the concept of Islamic contract. Nevertheless, a smart contract is still valid as an innovation within the Islamic contract so long there is no conflicting elements with the Sharia-compliant smart contract (Siti Rohaya et al. 2018). Below is the research analysis obtained about the application of smart contract in Islamic contract.

Pillar	Smart Contract	Islamic Contract	Analysis
Expression	Blockchain system confirms the transaction after one party receives an offer from the other party.	Must include the expression of offer and acceptance.	Smart contract's <i>sighah</i> is similar to the Islamic contract's because both contracts contain an offer and acceptance (the requirement of <i>'aqd</i> in Islamic contract) **Smart contract's expression is
Contracting Parties	 The parties are anonymous No condition for contracting parties 	 Know Your Customer (KYC) Specific conditions applied to participate as contracting parties 	Smart contract is different from an Islamic contract due to <i>gharar</i> element between the contracting parties (unknown to each other) **Smart contract's contracting parties is invalid within the Islamic

			contract
Subject Matter	No restriction on the subject matter. Any subject matter can participate. PoWH3D - Ponzi scheme	Any subject matter must have usufruct and comply with the Sharia principles (swine, alcohol, drugs	Smart contract does not comply with the Sharia requirement regarding permitted subject matter: gambling; riba; drugs – qiyas liquor
	services Fomo3D - Gambling game services Silk Road - Drugs, illegal weapons and fake identity cards	and others alike invalid).	**Smart contract subject matter is invalid in Islamic contract

From the analysis above, it is evident that two of three elements of smart contract contain non-Sharia-compliant elements such as gambling, uncertainty and intoxicants. These elements denote that a smart contract does not fulfil the Islamic contract requirements.

Conclusion:-

Based on the comparison between smart contract and Islamic contract, it is apparent that a smart contract contains several prohibited elements according to the Sharia principles. Therefore, there is a need for further studies regarding the use of a smart contract, especially among Muslims. Despite smart contract being a sophisticated innovation to facilitate faster and smoother business and financial transactions, it needs the authority's regulations and monitoring, mainly to ensure the security and wellbeing of Islamic financial activities. Presently, it is too soon to say that smart contract constitutes a financial innovation in Islamic Financial Technology and as a *maslahah* for the Muslims. Furthermore, a smart contract is different from the traditional Islamic contract that is precise and transparent, providing a sense of certainty; thus, it becomes the number one choice for secure transactions. Traditional Islamic contract thus far the best means in any financial transaction. Hence, the application of smart contract requires authority's improvisation, regulation and monitoring. The measures are to ensure any non-Sharia-compliant elements is removed and restricted within a smart contract transaction.

The pillars of Islamic contract are affected in the smart contract on blockchain. It seems that sharia auditor needs to monitor and supervise the application of smart contract to ensure it is be able to become the innovation of Islamic smart contract in future. Futhermore, further studies in this platform need to be performed before it is safe to use as a routine in the Islamic Finance industries. This study hopes that it would prompt further research to improvise smart contract, so it aligns with the principles of Islamic contract. Furthermore, it is also to help the Islamic Finance industry to level up with such technological innovation.

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References:-

- 1. Amir Azaaran. 2018. CDX Academy Blockchain Brand Innovation Summit NY: Lerner hall, Columbia University New York. 11 May 2018.
- 2. Ash-Shiddieqy, Hasbi. 1974. PengantarFiqhMuamalah. Jakarta: Bulan Bintang.
- 3. Asharaf, S & Adarsh. S. 2017. Decentralized Computing Using Blockchain Technologies and Smart Contracts: Emerging Research and Opportunities. ISBN: 9781522521938. Hershey: Information Science Reference IGI Global.
- 4. Brunoni. L. 2017. Smart Contract and Cybercrime: A Game Changer?. *Journal of Mathematical Structures and Modeling* 4(44): 136-140. DOI: 10.25513/2222-8772.2017.4.136-140 [5 Mac 2018].
- 5. Buterin, V. 2017. What are smart contracts & What is their Function? https://www.youtube.com/watch?v=r0S4qIMf4Pg [5 June 2018].
- 6. Dell'Erba, M. 2018. Demystifying Technology. Do Smart Contracts Require a New Legal Framework? Regulatory Fragmentation, Self-Regulation, Public Regulation. *Journal of Law & Public Affairs* August: 1-49.

- Francisco, K. & Swanson, D. 2018. The Supply Chain Has No Clothes: Technology Adoption of Blockchain for Supply Chain Transparency. *Journal of Logistics* 2(1): 1-13.Doi: 10.3390/logistics201002
- 8. Haber Stuart & Stornetta, W. Scott. 1990. How To Time Stamp a Digital Document. *Journal of Cryptology* 3(2): 99-111.
- 9. al-Jaziri, Syeikh Abdul Rahman. 2012. Siri Fiqh 4 Mazhab: JualBeli. Johor Bahru: Jahabersa.
- Jha, Prashant. 2019. What is the Difference between Smart Contracts & Traditional Contracts. https://www.btcwires.com/round-the-block/what-is-the-difference-between-smart-contracts-traditionalcontracts? [24 March 2018].
- Kasireddy, P. 2018. ELI5: What do you mean by "blockchains are trustless"?.https://medium.com/@preethikasireddy/eli5-what-do-we-mean-by-blockchains-are-trustlessaa420635d5f6 [25 March 2018].
- Kufner, R. 2018. Breaking Down the Smart Contract: Digging Deeper into the World of Autonomous Agreement. https://medium.com/nakamo-to/breaking-down-the-smart-contract-45b249b8bc71 [25 March 2018].
- 13. Lahsasna, A. 2012. *A Mini Guide to Islamic Contracts in Financial Services*. Kuala Lumpur: Centre For in Research and Training (CERT).
- 14. Mohd Ali Baharum. 1999. Undang-undangKontrakPerbandingan Islam &Inggeris. Kuala Lumpur: Percetakan Dewan Bahasa dan Pustaka.
- 15. MohdMa'sumBillah. 2006. Sharia Standard of Business Contract. Kuala Lumpur: Perpustakaan Negara Malaysia.
- 16. Naughter, T. 2017. Smart Contracts vs. Traditional Contracts. https://www.contractworks.com/blog/smartcontracts-vs.-traditional-contracts [1 April 2019]
- Nitish, A., Raghav, G., Manas, G., Sharannya, V. & Shekhar, V. 2019. Vulnerabilities on Hyperledger Fabric. *Journal of Pervasive and Mobile Computing* 59: 2-13. https://doi.org/10.1016/j.pmcj.2019.101050 [1 February 2019].
- Pratap, M. 2018. Everything You Need to Know About Smart Contracts: A Beginner's Guide. https://hackernoon.com/everything-you-need-to-know-about-smart-contracts-a-beginners-guide-c13cc138378a [25 March 2018].
- RahmaniRimonitaYulianti. 2008. Asas-asasPerjanjian (Akad) dalam Hukum Kontrak Syariah. JurnalEkonomi Islam Universitas Islam Indonesia 2(1): 91-107. http://www.pta-jambi.go.id/attachments/article/1449/Asas-Asas%20Perjanjian.pdf [1 July 2019]
- 20. Raskin, M. 2017. The Law and Legality of Smart Contracts. *Journal of Georgetown Law Technology Review* 1(2): 306-341.
- 21. Shahrul Azman Abd Razak. 2016. Combination of Contracts in Islamic Finance. Kuala Lumpur: Islamic Banking and Finance Institute Malaysia.
- 22. Shrikar. 2018. A brief history of smart contracts. https://blockmanity.com/blockchain/brief-history-smart-contracts/ [27 June 2018].
- 23. Harpreet Singh Maan. 2018. Skills Up Workshop : Introduction to Blockhain. Faculty of Science Tehnology& Computer Communication. University of Malaya, Kuala Lumpur, April 12.
- 24. Harpreet Singh Maan. 2019. Top 50 Blockchain Interview Questions And Answers 2019. https://101blockchains.com/blockchain-interview-questions/ [13 April 2019]
- Siti Rohaya Mat Rahim, ZamZuriyati Mohamad, Juliana Abu Bakar, Farhana Hanim Mohsin, &Norhayati Md Isa. 2018. Artificial Intelligence, Smart Contract and Islamic Finance. Canadian Center of Science and Education. Asian Social Science; Vol. 14, No. 2; 2018. Pp. 151
- 26. Siti Salwani Razali. 2010. Islamic Law of Contract. Singapore: Cengage Learning Asia Pte Ltd.
- 27. Suhendi, H. 2008. FiqhMuamalat : MembalasEkonomi Islam KedudukanHarta, Hak Milik, JualBeli, Bunga Bank dan Riba, Musyarakah, Ijarah, Mudayanah, Koperasi, Asuransi, Etika Bisnis dan lain-lain. Jakarta: Rajawali Pers.
- 28. Szabo, N. 1996. Smart Contracts: Building Blocks for Digital Markets. http://www.fon.hum.uva.nl/rob/Courses/InformationInSpeech/CDROM/Literature/LOTwinterschool2006/szabo .best.vwh.net/smart_contracts_2.html [10 April 2019].
- 29. Tapscott, A., & Tapscott, D. 2006. *Blockchain Revolution: How the Technology Behind Bitcoin is Changing Money, Business and the World*. United Kingdom: Portfolio Penguin.
- 30. Tianyu Feng, Xiao Yu, Yueting Chai and Yi Liu. 2019. Smart contract model for complex reality transaction. *International Journal of Crowd Science* 3: 184-197.

- 31. Venegas, P. 2017. Crypto Economy Complexity. *Journal of Economic Literature* G02. Costa Rica. SSRN: 3073413
- 32. Williamson, P. 2017. The first comprehensive guide to blockchain: Bitcoin, cryptocurrencies. P. Max Cafaro. Audiobook. ASIN: B077BJ8PNY
- Yoo, S. 2017. Blockchain Based Finnacial Case Analysis and its Implications. Hansei University. Republic of Korea. Asia Pacific Journal of Innovation and Entrepreneurship 11(3): 312- 321. https://doi.org/10.1108/APJIE-12-2017-036 [30 September 2018].
- 34. Zaharuddin Abd Rahman. 2010. *Contracts and the Products of Islamic Banking*. Kuala Lumpur: Centre for Research and Training (CERT).
- 35. al Zuhayli, Wahbah.1995. al-fiqh al-Islamiwaadillahtuhu, Md. Akhir Haji Yaacob et. al.(trans.), Vol. 4. Kuala Lumpur: Dewan Bahasa dan Pustaka.