Blockchain Technology for Halal Supply Chain Management*

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Abstract

Blockchain technology (BT) is a distributed and decentralized database that store transaction information in a network. Due to providing better visibility and transparency, this technology has gained a considerable attention in the recent years. This research is carried out with the purpose of exploring the potential of blockchain technology to increase supply chain integrity in halal food industry. Therefore, a literature on BT and its adoption in the halal supply chain is given and a model is developed to identify the influence of BT on halal supply chain. Three features of smart contract including traceability, decentralized, and anonymity are added to the model as moderators to explore their influence on integrity of halal supply chain..

Keywords: Blockchain Technology; Halal Supply Chain; Supply Chain Integrity.

1. Introduction

Nowadays, due to the global safety crisis, the concerns of consumers about food safety, quality, origin, and authenticity is increased (Zailani et al, 2018), and lack of uniformity has caused issues in halal supply chain (Talib, Hamid, & Chin, 2016). The traditional supply chain is complex, and all of the information is outbreak and cannot be observed clearly. It is because everything is recorded on the paper, so there is a need to provide end to end visibility to deliver information quickly (Zailani et al, 2018). Another concern is ingredients and cleanliness of the food, and possibility of cross-contamination of halal food with any non-halal ingredients in the process of storage and distribution, which does not conform to the Islamic principle (Zailani et al, 2018). Currently, trust in the halal supply chain is solely according to presence of the halal logo or halal certification on the packages (Ali et al, 2017) as it allows the consumers to acknowledge that products are made based on the halal guideline and principles of Sharia law. Despite the existence of halal certificate, consumers are questioning the legality of the displayed certificates and halal logo (Azmi, et al, 2018). It is due to the fact that there have been several reports of displaying fake certificates or halal logo in Malaysia, which negatively impacted the

reputation of Halal industry, and it cast doubt and tarnished trust among halal consumers. Hence, it is vital to improve trust between all actors of halal food network in order to enhance the integrity status of the halal food supply chain (Zulfakar et al, 2014; Zailani,et al, 2018). Putting an effort to build a comprehensive and strict halal quality assurance system or a using a dedicated transportation to deliver the halal food products, can go on waste if other actors that directly deal with them in the supply chain do not trust the firm in providing halal products (Zulfakar et al, 2014).

Moreover, the inability to trace the supply chain is common for industries such as agri-food and creates challenges in the management of the Halal supply chain. Developing a traceability system, which is trusted and reliable, in the Halal food supply chain will potentially enhance the transparency and therefore improves the integrity of halal supply chain (Zulfakar et al, 2014). Some studies offered existing technology such as Radio Frequency Identification Device (RFID) (Accorsi et al, 2016; Dabbene et al, 2016; Farooq et al, 2016) to develop and improve halal traceability, however very few studies addressed blockchain–SCM integration, and there is a need to further study adopting blockchain technology in supply chain (Azmi et al, 2018; Tsang et al, 2019; Queiroz et al, 2019).

With the purpose of addressing this research gap, this research attempts to elaborate on the integrity of the halal supply chain using blockchain technology, to understand the integrity of the halal supply chain and related factors, as well as the importance of the blockchain on integrity of halal supply chain.

2. Previous Work

Halal supply chain consists of a network of supply in which the products are given special attention to assure halal integrity. Considering the increasing demand for halal products throughout the world, both from Muslim and non-Muslim individuals, it is crucial to assure the quality of the product through an integrated supply chain (Rasi, et al, 2017). Integrity means honesty and demonstrates constant observation and strong ethical principles and values. It is essential to maintain the integrity of the halal supply chain, all aspects of halal food integrity must be cautious about the protection, and each actor involved in the supply chain must perform all necessary steps to escape any cross-contamination that cause product to become non-halal (Zulfakar, Anuar, & Talib, 2014). Moreover, food safety is part of halal integrity, and process of traceability that grant track relevant information from product source to point of sale. In this way, the entity can track and trace the food, such as ingredients of the food and expiry date, manufacturing date, packaging at all stages of the whole process of production, and record the process along the way, including when, where, and how (Kadir et al., 2016). To achieve an improved traceability, it is required to transfer the conventional supply chain and make it digitalized, which can be done by using blockchain technology in the halal supply chain management (SCM) system. It is recommended to use blockchain in halal supply chain due to following reasons: Firstly, using blockchain technology helps to solve traceability issues, because in blockchain technology all information is digitalized and every entity can have instant access to records about the food and products. Using smart contract between buyers and suppliers improve trust since data is immutable, as well as speed since third parties are eliminated. Secondly, blockchain technology avoid delays and therefore lengthen shelf live (Ibm, 2019). To elaborate blockchain technology on supply chain that related to halal, food integrity, supply chain integration, Islamic practices and firms' performance are reviewed. Literature of the relevant theories and discussion of supply chain management and halal studies form the foundation of conceptual framework.

In Islam, Muslims are banned from eating non-halal foods in daily living. The foods that are halal, namely as halal food, must be consumed by Muslims. To supply chain food industry, it has real example, food global safety alert. In 2018 December, in the US, E. coli infections linked to romaine lettuce, so United states was alert to people against to eat romaine lettuce because it has symptoms of Shiga toxin-producing, so everyone is infected with E. coli (STEC), but diarrhea and vomiting often happen, which can cause fever on some people. Most people got well in 5 to 7 days. Some infections are mild, while others are severe and even life-threating (Cdc.gov.2019). This issue causes millions of people who have eaten the popular lettuce, but investigators do not know precisely where, when or how the contamination happened. This is not only once a time that happened. So many real examples still exist. Therefore, in this example talking about the problems of supply

chain flow, which is in the traditional way of processes, has decreased the efficiency of the market. If the concept of blockchain is applied to this processes, the technology can be traced through the food supply chain, if this technology applied to romaine lettuce from the beginning, such as source details, lot numbers, manufacturer, and processing data, expiration dates, storage temperatures, and shipping and shipping details from source to destination are digitally linked to actual food (Rooyen, 2017). The records during each transaction are verified by companies' in-network (farms, transport companies, packaging companies, warehouses, and stores) and a consensus is formed (Rooyen, 2017). After verifying each block (record of each transaction), it is added to a chain of transactions, which is immutable throughout the process. Ultimately, all-veggie items received in the store is validate and truthful, and this digital record can reveal food safety issues between farm and retailers (Rooyen, 2017). As well as, in individual stores that digital capture can help to market stores to well manage shelf-life products (Rooyen, 2017; Zailani et al, 2018). As refer to the Supply chain and trade finance, the Blockchain request to make all stakeholders in the supply chain to send, receive and track an electronic bill of lading, with upload and send related trade documents such as orders, invoices, and transporting orders (Zailani et al, 2018). The claim is linked to a delivered systematization network that can safety record and prove the ownership and authority of documents. Therefore, in the process of sending and sharing of verification information, the verified gross mass (VGM) information of freight containers is shared using blockchain technology. Knowledge of the VGM of the container is important to ensure the proper storage of the vessel to resist maritime and port accidents. VGM data is stored on a public blockchain, which is granted perpetual record insights from port officials, shipping firms, consigners and hosts of cargo. Also, this record will replace tedious logs, spreadsheets, third party's data and private databases. (Rooyen, 2017). In supply chain management (SCM), international clients may need to authenticate the original documents through the notary function of the blockchain and optimize the best creation, justification, and protection. When changing of ownership during a shipment called merchant, retrospective to the source of all elements in the checklist material. Monitor and automatic control of the use of third-party logistic services, transportation, and freight forwarders through irrevocable and unchanged smart contract execution. When the returned products are repaired or renovated, process management will be performed to ensure that repairs follow strict protocols, and refurbished, the products again refer the formats and standards that can be efficiently resolved by a Blockchain's notarization. Those products that are moved during the return logistics process may also be subject to warranty terms that require changing ownership. Also, failed items can be traced back to the source of defects identified to perform a root-cause analysis (Panigrahi et al, 2018).

3. The Proposed Conceptual Framework

Based on the research results by Queiroz et al (2019), very few studies discussed about the influence of blockchain on supply chain management over the past decade. Therefore, it indicates the lack of researches focusing on blockchain and integrity in supply chain (Queiroz et al, 2019). Basically, Halal Supply Chain consists of four main activities which are explained in the following.

3.1 Halal procurement on using Block chain

To use Blockchain technology in the halal supply chain, halal procurement is going to record information about the item or products, certification of origin, and details of suppliers, resources and materials, such as, halal species, and any genetic crows' contaminations from Haram species by conventional breeding. Therefore, blockchain provides complete traceability and monitoring system, which are deal with between supplier and buyer under smart contract. Besides, halal suppliers should monitor the agricultural production system, such as appropriate use of land, water, and chemicals, and provide the halal food and fodder (Rasi et al, 2017).

3.2 Halal manufacturing on using Blockchain

Halal manufacturing is an entity that is also called the halal producer. In the halal manufacturing, the raw material and also added ingredients must be certified halal. Besides, it includes a well-organized packaging process, and transforming process (Mohammed et al, 2016). To ensure all ingredients are halal, and to improve integrity, the companies in supply chain use blockchain technology to share information of raw materials and organization of the products for the benefits of the

customers. Therefore, during this process, Blockchain will record this information, and share it with all of the entities from the supply chain (Rasi et al, 2017).

3.3 Halal distribution on using Blockchain

Halal distribution is an entity that provides halal packaging for the halal products or goods from the halal manufacturer which are finished products. Using Blockchain will help this entity confirm the safety of the product, expiry date, manufacturing date and ingredients or components of the Halal products. The distributor department deliver the products to the retailer that sells the Halal products or goods to the end-user customers (Rasi et al, 2017).

3.4 Halal logistic on using Blockchain

Halal logistic is considered as functions of logistics such as, transportation and packaging of products, warehouses to keep the halal products in storage, and documents of the bills, orders of financial transactions. Halal transportation has also benefited halal logistics activities (Tan et al., 2012). Logistic service provides information and communication technology, which is necessary to maintain the integrity of halal, and to enhancing the performance and efficiency of logistics and supply chain networks. Besides, the application of information technology components for halal transportation includes location tracking of the products or goods identification and data communication. (Ab-Talib, & Abdul-Hamid, 2014). Moreover, information technology controls logistic operation transparent and activities, which will improve the service and product level. Therefore, by using of blockchain technology all the information about transactions between supply chain entities will be recorded, which will also increase the efficiency of system.

Thiruchelvam et al (2018) studied the adoption of Blockchain Technology in the Coffee Supply Chain Trade. In this study the researchers investigated the effect of market access, premium pricing, traceability, transparency, and sustainability on blockhain efficiency and perceived usefulness. The results indicated that blockchain technology in the coffee supply chain helps coffee producers/farmers to gain better market access, sustainability, and traceability and therefore increase the fair trade and transparency in the supply chain. Francisco and Swanson (2018) proposed a framework for adopting technology of Blockchain for Supply Chain Transparency. The researcher concluded that using blockchain in supply chain contribute to companies' competitive advantages. Kamble et al (2018) revealed that supply chain practitioners believe that blockchain technology is beneficial for improving the supply chain effectiveness. Therefore, this study offers the following hypotheses:

Hypothesis 1. Adopting blockchain in halal supply chain positively impacts the integrity of the halal supply chain in the food industry.

3.5 Traceability

Traceability is defined as the ability to track origin and history of a product (Sutawijaya & Awangsari, 2019). In Halal food industry, with the use of traceability the practitioners can trace the halal status of a product throughout blockchain network. In this way, all the information activities that the Halal food products have went through such as origin of the product, the time and date of transferring product, etc is stored. The primary characteristics of traceability systems are (Banerjee et al, 2015): (a) register the origin of units of ingredients, (b) storing detailed information about time and location units are transformed, and (c) a comprehensive system that shares and transfers relevant traceability information with the product to the subsequent stage.

The feature of traceability helps to monitor the halal control points to retrieve detailed information, and in case of suspension of any cross contamination with non-halal ingredients, appropriate measures should be taken to control and avoid any unwanted events (Zulfakar, Anuar, & Talib, 2014). According to the study by Rohmah el al (2019), cooperation between supply chain sectors is vital to achieve ethical halal traceability. Consumers must be able to access information about product halalness, food quality and food safety. The findings by Thiruchelvam et al (2018) points out the importance of traceability and indicated that it helps to increase transparency. Therefore, this study offers the following hypotheses:

Hypothesis 2: Traceability positively moderates the relationship between blockchain-based halal supply chain and integrity of halal supply chain

3.6 Decentralize

Yli-Huumo et al (2016) stated "the goal of Blockchain technology is to create a decentralized environment where no third party is in control of the transactions and data". Eliminating a central control increase speed, and remove delays as many-to-one traffic flows are avoided (Dorri et al., 2016). Similarly, the study by Khyzer et al (2018) revealed that decentralization has a positive mediating effect on supply chain practices. Therefore, this study offers the following hypotheses:

Hypothesis 3: Decentralization positively moderates the relationship between blockchain-based halal supply chain and integrity of halal supply chain

3.7 Anonymous

The blockchain network is characterized by the anonymity aspect. Anonymity in this sense implies that the respective identities of the users in the network are anonymous, and the transaction on the ledger are treated as eliminating from an anonymous entity. The aspect of anonymity is often propagated by the existence of no-trusting parties' interaction in a decentralized environment. Depending on the nature of the contract anonymity may be necessary while in others, the anonymity aspect may not be essential (Nzuva, 2019). Therefore, this study offers the following hypotheses:

Hypothesis 4: Anonymity positively moderates the relationship between blockchain-based halal supply chain and integrity of halal supply chain

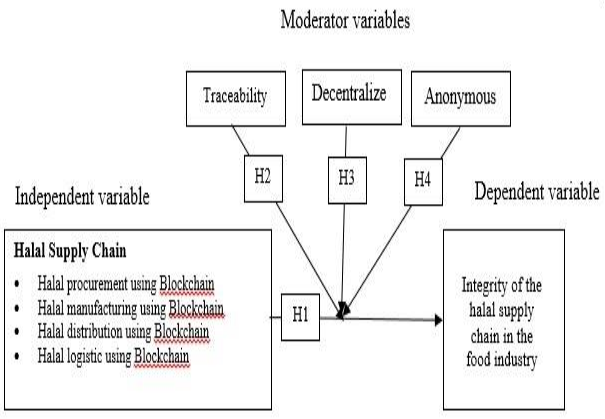

Fig.1: The Proposed Conceptual Framework

This proposed conceptual framework in fig.1 is the results of the comprehensive literature review, which includes blockchain in halal supply chain as independent variable (IV) (halal procurement, halal manufacturing, halal distribution, and halal logistic), and moderator variables of traceability, decentralization and anonymity as three moderators with the purpose of investigating the effect of variables on improving the integrity of the halal supply chain (DV).

4. Conclusion

This paper explained about blockchain, halal supply chain, and smart contract through a comprehensive literature review. The importance of blockchain in halal supply chain is discussed and the gap in the literature review is addressed. Considering the literature review, three feature of smart contract including traceability, decentralization and anonymity are studied to form the conceptual framework.

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Authors Introduction

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