



The application of blockchain for halal product assurance: A systematic review of the current developments and future directions

Norliza Katuk

School of Computing, Universiti Utara Malaysia, k.norliza@uum.edu.my

ABSTRACT

The demand for halal product assurance has increased recently at the global level due to the increase in users' awareness as well as the Muslim population. Consequently, the demand for halal certification service by the product manufacturers is also increased. However, the conventional halal certification model is unable to support the increasing demand for certification services in which it does not support the halal industry efficiently that makes the certification process costly. Technological support, particularly blockchain, can facilitate and simplify the halal certification process, which leads to an automated and more efficient process. Blockchain for halal product assurance is considered a new multidisciplinary field; hence, there is a need to gather and synthesize the current information about the field of study in a thorough and unbiased manner so that a more general conclusion can be drawn as well as providing preliminary information to encourage further research in the field. Therefore, a systematic review was conducted to identify, evaluate, and interpret research and developments relevant to the implementation of blockchain technology for halal product assurance. The result is expected to cultivate new studies that can improve the entire process for halal product assurance.

Key words: Block-chain, Decentralized networks, Distributed computer systems, Peer-to-peer networks

1. INTRODUCTION

Product assurance is a guarantee of food safety and quality that is given by authorized agencies through an investigation of how the product was produced [1]. It allows consumption of the products safely to support consumers' dietary needs or faith, such as products certified as organic, kosher, halal, and vegetarian. This study focuses on products certified as halal that are intended for Muslim consumption. Products that are halal fulfill Shariah law in which permitted ingredients were used, compliant to labor or environment law, clean production process, and safe for human consumption [2]. Consumers verify the authenticity of halal products by halal

logo printed on their cover [3] that confirms they have undergone product assurance process by the authorized halal certification agencies.

Halal certification on consumer products contributes to pleasant, security, safety, and certainty of product availability to Muslim consumers as well as increasing value for the business entities [4]. Recently, awareness of and demand for halal products increase as a result of emerging Muslim communities globally through migration and conversion activities [5-7]. For this reason, the demand for halal product assurance is also increasing globally [8]. Halal certification is a complex process where an internal audit of the manufacturing process has to be conducted to ensure that it complies the halal requirements [9]. Then, only the manufacturers can apply for halal certification from the authorized agencies. During the certification process, the authorized agencies perform an assessment of the whole manufacturing process, including the source of the raw materials for the products. The certification process is tedious and time-consuming that causes the conventional halal certification model unable to support the increasing demand for certification services [10]. Therefore, there is a need for an improvement in the certification process to make it more efficient and supporting the growing halal business industry effectively. Blockchain is one of the possible technology that could facilitate the entire halal certification process through automation and decentralized certification activities [11].

Blockchain was designed in 2008 and implemented a year later [12]. It has the potential to increase business opportunities and could have a significant impact on industries including financial systems and transportations due to its decentralized features that implemented on open protocol and standard [13]. Blockchain is not limited to cryptocurrency applications, but beyond that [14], where transactions are involved [15]. It also turns to be one of the most promising technologies for the next generation of systems that incorporates smart contracts, public services, internet of things (IoT) [16], reputation systems, and security services [12]. The technology is expected to affect the accounting practices, data storage and sharing methods, supply chain administration, and smart trading [17]. In the context of halal product assurance, blockchain is expected to facilitate the process of halal product certification, which

makes it more efficient to support the demand for halal product certification. The development in the area is just started and attracted attention from researchers and halal business players. This study intends to provide an

understanding of blockchain for halal product certification by reviewing the current developments and future directions of it.

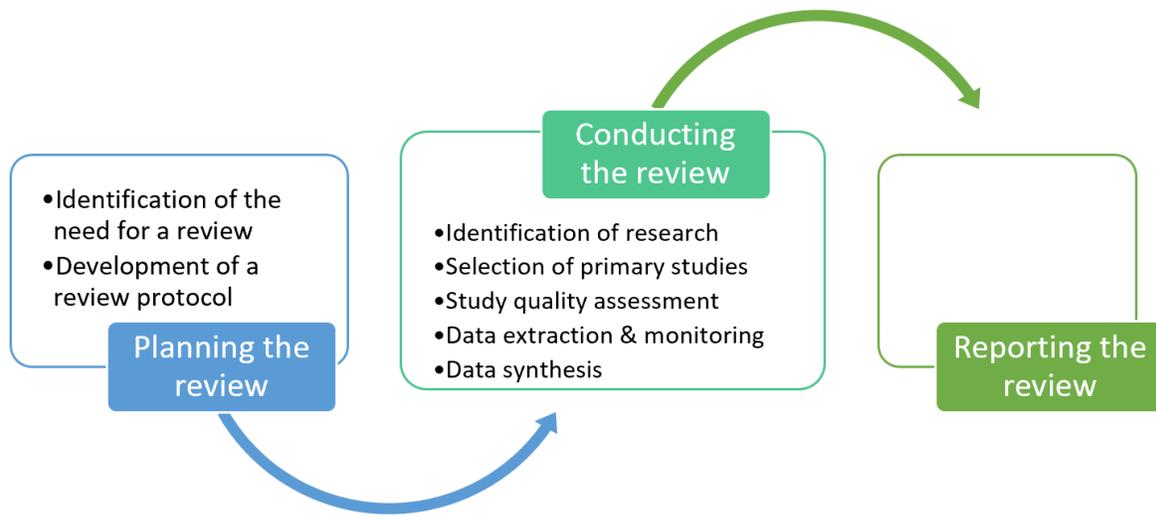


Figure 1: The generic process for conducting a systematic review [18]

2. METHODOLOGY

A systematic review was conducted to identify, evaluate, and interpret research and developments relevant to the implementation of blockchain technology for halal product assurance. The review followed the methodology for conducting a systematic review proposed by Kitchenham [18]. The methodology has three stages of processes, namely (1) planning the review, (2) conducting the review, and (3) reporting the review. The following subsections elaborate each of the processes.

2.1 Planning the Review

A. Identification of the need for review

Identification of the need for review is driven by the increasing demand for halal consumer products globally. Halal product assurance is the endorsement of the halal status of a product by an authorized organization in which the product receives a halal certificate that confirms it is compliant to Syariah law [19]. Obtaining a halal certification is a complex process where product manufacturers must perform an internal audit of the manufacturing process to comply with the requirements before applying for the certification from the authorized organization [9]. Currently, the certification process is conducted through a manual process where the manufacturers apply for halal certification, then the authorized organization conducts a visit, observes the entire process of the product manufacturing, writes a report, and awards the certificate to the product. However, the conventional halal certification model is unable to support the increasing demand for certification services due to its decentralized form of certification. As a result, this model is

unable to support the halal industry efficiently that makes the certification process costly. A question of whether the current halal certification model is sustainable or a better alternative is needed rises [10]. With the rapid development in information and communication technology, the issue in the current halal certification model can be resolved by adapting technological support, which can automate and simplify the halal certification process. One of the possible technology is blockchain that could facilitate the entire halal certification, which leads to an automated and more efficient than the manual process [11].

The implementation of blockchain technology for halal product assurance is considered a new multidisciplinary field. More studies from different fields of study are needed to guarantee a successful implementation of the technology. Hence, there is a need to gather and synthesize the current information about the field of study in a thorough and unbiased manner so that a more general conclusion can be drawn as well as providing preliminary information to encourage further research in the field. Therefore, the review presented in this paper aims in (1) providing a background of blockchain technology to allow researchers from different fields of study to appropriately position their new research activities, (2) summarizing the existing research and developments concerning the implementation of blockchain technology for halal product assurance, and (3) identifying gaps in current research that can lead to suggest areas for further investigation.

B. Development of a review protocol

The review protocol for this study is developed based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [20-23]. There are four main processes of PRISMA that include identifying records from various sources (identification), screening for duplicate records (screening), assessing the records for relevancy (eligibility) and analyzing the records qualitatively and quantitatively (included). Figure 2 shows the flow of the PRISMA process.

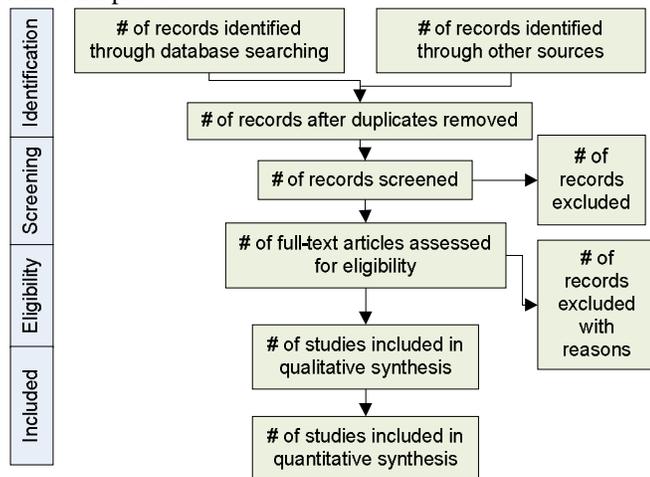


Figure 2: The PRISMA process [20-23]

In this stage, the research questions for the review study are constructed. Four research questions (RQ) were identified as below.

- RQ1: How does a blockchain technology work in the context of halal product assurance?
- RQ2: What are the initiatives taken to implement blockchain for halal product assurance?
- RQ3: What is the state-of-the-art in research on the implementation of blockchain for halal product assurance?
- RQ4: What are the future directions of research in blockchain for halal product assurance?

Overview review [24] was applied for searching the answer for RQ1 in which it aims to provide a comprehensive summary of the blockchain technology for halal product assurance. The state-of-the-art review [24] was applied in RQ2 and RQ4 while the scoping review [24] and PRISMA process is applied in RQ3.

2.2 Conducting the Review

A. Identification of research

In this stage, the researcher searched documents reporting research and development in the implementation of blockchain for halal product assurance. The documents cover primary studies from journals, conference proceedings, theses, technical reports, and news from online newspapers. The search was conducted using Google Scholar, Scopus, and Ebscohost. The keywords used for the search was

“Blockchain” + (OR) “Halal”. In searching, the researcher avoided publication bias by searching grey literature using Google search engines for possible reports, news, and websites related to blockchain for halal product assurance. The results of the search were bibliographic information and full-text of the documents which have been stored in Endnote, a bibliography management tool.

B. Selection of primary studies

Selection of the primary studies was done by skimming and scanning the abstract to obtain a general overview of the study, which leads to the selection of relevant studies. Many primary studies were discussing the blockchain in the context of Shariah compliant of financial technology (FinTech) such as Bitcoin and other cryptosystems. This category of results we excluded from the study. The studies that include halal product assurance with technological perspective were included in the review.

C. Study quality assessment

The quality of studies reported in the retrieved documents was analyzed in terms of their research maturity stages. The documents were classified into three stages, namely (1) preliminary study, (2) on-going study, and (3) completed study. The preliminary studies reported a conceptual idea of the blockchain implementation for halal food assurance. On the other hand, the completed studies reported a study that has been evaluated empirically, while the on-going studies reported the framework of the study; however, they are not yet undergoing the evaluation process.

D. Data extraction and monitoring

In this stage, the researcher recorded the findings obtained from the primary studies related to the implementation of blockchain for halal product assurance. The data were extracted and recorded in a spreadsheet in which they cover the necessary bibliography information and additional remarks for the studies.

E. Data synthesis

In this stage, the researcher collated and summarized the findings of the included studies in both quantitative and qualitative manners, as reported in Section 3 of this paper.

2.3 Reporting the Review

The final stage of conducting the review study is writing the findings in the form of an article in the journal.

3. RESULTS AND FINDINGS

This section reported the findings of the review study based on the identified RQ.

3.1 RQ1: How does a blockchain technology work in the context of halal product assurance?

This section will first elaborate on the fundamental structure and components of blockchain technology in order to get a

better understanding of how the technology works. This understanding is important to put blockchain in the context of halal product assurance. Blockchain comprised of three main components (1) block – a container of data structure that contains headers and long list of transactions, (2) chain – a growing blocks linked using cryptography such as hash values, and (3) transaction – an operation that changes the block [25]. Figure 3 shows the building block of the blockchain.

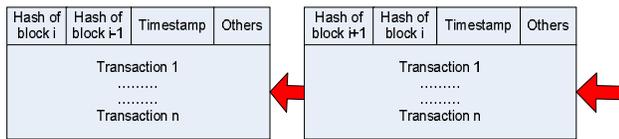


Figure 3: Blockchain data structure [25, 26]

Blockchain works on a distributed database environment which contains a growing list of transactions (data) that are validated by the participating nodes (entities) and recorded in a public ledger (database) [15]. Blockchain does not require a central third-party to verify the transactions that make the technology more transparent. In securing the blockchain, cryptographic methods such as hash, public/private key encryption, and digital signatures are employed apart of proof of work over communication on peer-to-peer networks [27]. Although the technology was initially developed to support cryptocurrency; the applications of blockchain go beyond the digital currency. Efanov and Roschin [28] described three generations of blockchain that shows the growing application of technology in various areas, as shown in Figure 4. Blockchain 1.0 was intended for the use of digital currency, particularly cryptocurrency, which was started around 2009. Then, Blockchain 2.0 emerged in 2015 to offer distributed ledgers and smart contract technology to foster a digital economy. Blockchain 3.0 arose in 2018 to support various daily life activities beyond the use of money to foster a digital society such as identity management, and scientific research cycle [29]. Blockchain 3.0 incorporate decentralized applications in which back-end code runs on a decentralized peer-to-peer network connecting users and providers directly [30]. A new emerging generation of Blockchain 4.0 incorporates artificial intelligence (AI) and the IoT to support industrial needs [30].

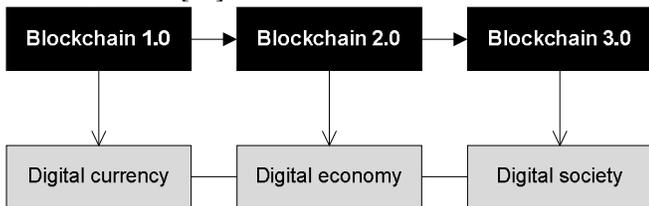


Figure 4: Generations of blockchain [28]

After understanding the necessary components of blockchain technology, the question of how it can be used for halal product assurance rises. Analysis of the literature suggested that the implementation of blockchain on halal product assurance adapt the use of the technology in supply chain management. Blockchain is a technology that provides

storage of all information related to food products and makes the information visible and transparent for all members throughout the supply chain [31, 32]. Global Blockchain Halal Industry Forum 2019¹ differentiated halal supply chain with and without blockchain as illustrated in Figure 5. In halal supply chain with blockchain, all entities in the supply chain system including customers, suppliers, logistics providers, manufacturers, distributors, and retailers store their transactions on a shared ledger, and a smart contract controls them. For halal product certification, halal certification bodies (HCB) have access to the shared ledger and the smart contract for product certification. On the other hand, in the supply chain system without halal blockchain, all entities in the system have separate in house ledger to record their transactions. For halal product certification, the HCB needs to confirm the halal condition of all entities in the system individually in which it involved a complicated process.

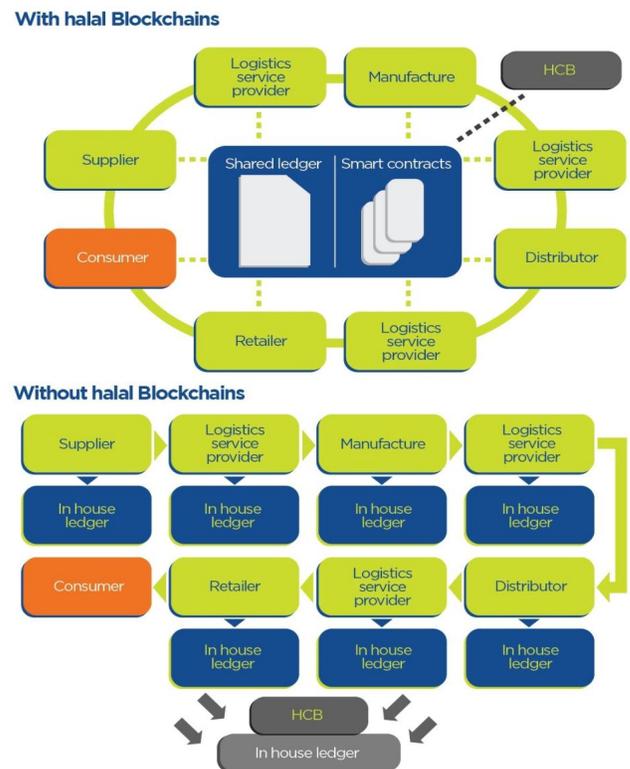


Figure 5: Supply chain with halal blockchain²

Chandra, et al. [33] also proposing the use of blockchain in halal food product supply chain. The entities involved in the supply chain includes the regulatory bodies, raw material suppliers, producers, distributors, wholesalers, retailers, and end customers, as shown in Figure 6. The blockchain system started with regulatory bodies approve new transactions from raw material providers, producers, and distributors only once their quality assurance has been validated. The transactions are recorded in the blockchain and controlled by IoT and smart contract.

¹ <http://www.globalblockchainedhalalindustryforum.com>

² <http://www.globalblockchainedhalalindustryforum.com>

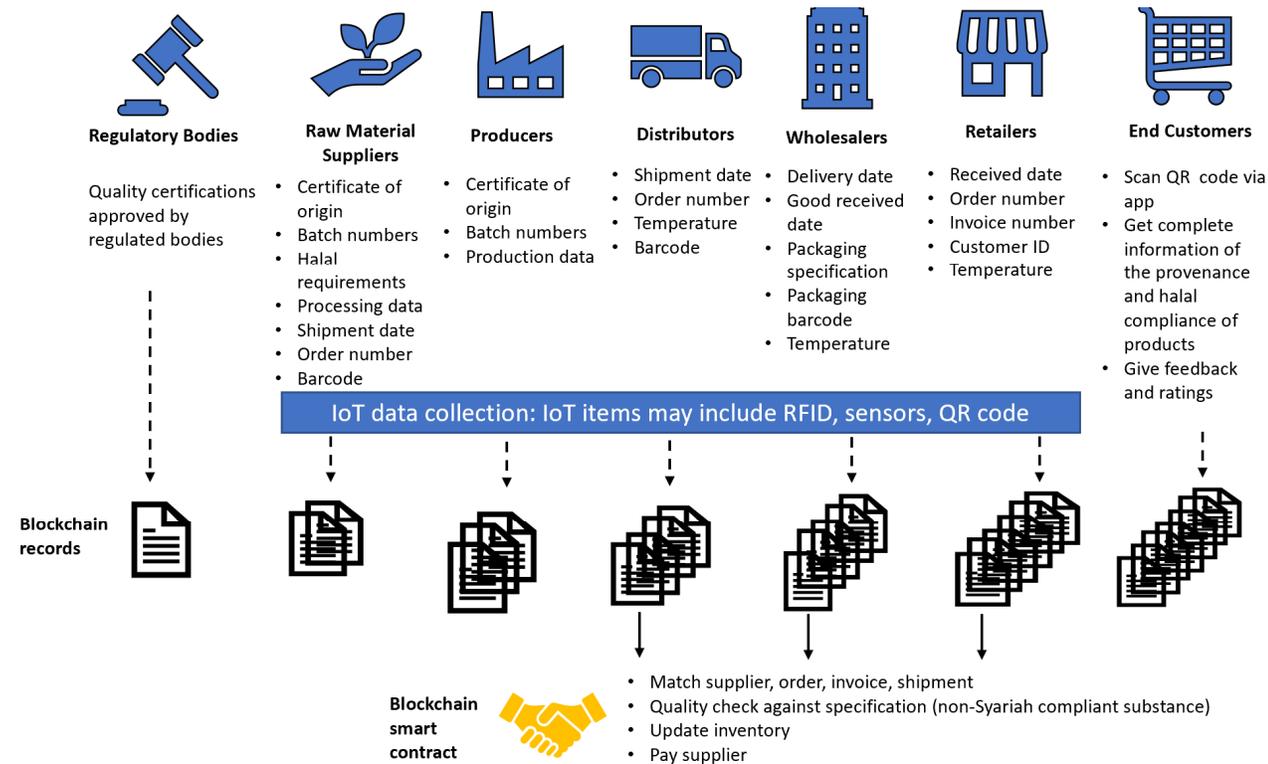


Figure 6: Blockchain implementation for halal supply chain [33]

Table 1: Initiatives to implement blockchain for halal product assurance

Event	Year	Organizer	Objective
³ Global Blockchain Halal Industry Forum 2019	2019	Penang International Halal Hub	The forum provides a platform for the halal industry stakeholders in understanding the impacts of blockchain on their business operations and strategies.
⁴ Unblock Meet up - (1) Blockchain for Food Traceability in the Halal Food Industry (2) Ever Wonder How Blockchain Can Enhance Traceability in Halal Food?	2019	Asia Blockchain Review	A platform that connects all entities interested in the blockchain through a range of group discussions, technical workshops, conferences, and consulting programs.
⁵ World Halal Conference 2019	2019	Halal Industry Development Corporation (HDC)	A platform for halal industry leaders to explore and deliberate on challenges relating to the development of the halal economy.

3.2 RQ2: What are the initiatives taken to implement blockchain for halal product assurance?

This RQ intends to analyze the efforts that have been taken globally to implement blockchain for halal product assurance. A search on Google search engine using the keyword “blockchain OR halal” returned approximately 566K results. Then, the results were filtered by removing documents that are related to cryptocurrency, and documents relevant to end-consumer products were selected. The types of the document include news and websites reporting on blockchain

for product assurance. The search results divided the initiatives into three categories: (1) seminars/forums, (2) digital solutions, and (3) partnership. Initiatives towards implementing blockchain for halal product assurance were just started around 2018.

Seminars/forums were conducted to provide understanding to halal industry players on the potential of blockchain for transforming the halal certification process into a more efficient model that supports the increasing demand for halal product assurance. Table 1 listed these seminars/forums that include Global Blockchain Halal Industry Forum 2019,

³ <http://www.globalblockchainhalalindustryforum.com/>

⁴ <https://www.asiablockchainreview.com>

⁵ <http://whc.hdcglobal.com/2019/>

Unblock Meet up by Asia Blockchain Review and World Halal Conference 2019. The purpose of these initiatives is to provide a platform for halal industry players to understand the technology better as well as to discuss the impact of the technology on the industries.

Apart from the seminars/forums, there is also an initiative to provide understanding to the general audience on blockchain for halal product assurance. As concluded in RQ1, blockchain implementation for halal product assurance adapts the halal blockchain for supply chain management. A portal named “Halal Supply Chain Management⁶” is available online to provide the understanding and as well as to increase public awareness on the implementation of the technology. Another portal named SalaamGateway.com⁷ provides news and information on the efforts taken to implement blockchain for halal product assurance.

Technology service providers have also started to offer digital solutions for the implementation of halal product assurance using blockchain. A search on news and websites using Google search engine found that a few technology service providers have started in proving the infrastructure for implementing the blockchain for halal product assurance as listed in Table 2. The technology service providers establish their company in countries like United Arab Emirates (UAE), Malaysia, Singapore, United Kingdom (UK), Kingdom of Bahrain, India and South Africa where Muslim populations are high either in the country itself or other surrounding countries. Those digital solutions are known as HalalChain, HADIC, WhatsHalal, HALAL TRAIL, OneAgrix Market Place, LuxTag, and PO Certify.

Table 2: Digital solutions of blockchain for halal product assurance

Country base	Digital Solutions
UAE	HalalChain ⁸
Malaysia	HADIC ⁹
Singapore	WhatsHalal ¹⁰
UK, Kingdom of Bahrain, India	HALAL TRAIL ¹¹
Singapore	OneAgrix Market Place ¹²
Malaysia	LuxTag ¹³
South Africa	PO Certify ¹⁴

⁶ <http://www.halalsupplychainmanagement.com/halal-scm.html>

⁷ <https://www.salaamgateway.com>

⁸ <https://www.foodnavigator-asia.com/Article/2018/05/17/First-of-its-kind-blockchain-technology-to-trace-Halal-food-launched-in-Dubai>

⁹ <https://www.theborneopost.com/2019/04/08/blockchain-powered-hadic-to-empower-halal-industry/>

¹⁰ <https://www.techinasia.com/halal-food-blockchain-startup-whatshalal>

¹¹ <https://cointelegraph.com/press-releases/halal-food-companies-are-going-to-blockchain>

¹² <https://halalfocus.net/trace-labs-launches-oneagrinx-blockchain-project-to-track-halal-products/>

¹³ <https://www.luxtag.io/2019/04/16/how-can-the-halal-industry-benefit-from-the-luxtags-solution/>

¹⁴ <https://www.halalincorp.co.uk/pocertify-halal-certification-on-blockchain/>

Strategic partnerships have also been established between halal business entities and digital solution providers to start implementing blockchain for halal product assurance. The initiatives are to ensure that halal process of processed food or meat comply with the Shariah law so that the products that consumers purchased from the supermarket are guaranteed for their halal status. It is also to support the halal business entities in ensuring their internal process complies to the standard and quality set by halal certification bodies that make the product certification more efficient and faster than the conventional certification model. The strategic partnerships have been established as early as May 2018 and keep increasing in 2019. The information of the strategic partnership is listed in Table 3. Halal business entities based in the UK, UAE, Hongkong, Malaysia, and Slovenia had started to collaborate towards providing certified halal products through the use of blockchain. The information listed in Table 3 is up to the time this study was reported (i.e., August 2019). It is expected that more strategic partnerships will be established towards the end of 2019 and the beginning of 2020. In 2020, it is also anticipated that blockchain for halal product assurance will be fully implemented and customers will be able to experience the impact by the next three years.

Table 3: Partnership towards the implementation of blockchain for halal product assurance

Country	Year	Halal business entities involved in the partnership
UK	May 2018	TE Food and Halal Trail ¹⁵
UAE	June 2018	Apla and Halal Guide ¹⁶
Hongkong	March 2019	Trace Lab and OneAgrix ¹⁷
Malaysia	April 2019	TE Food, Islah Venture, and Penang International Halal Hub (PIHH) ¹⁸
Slovenia	May 2019	Perutnina Ptuj Group and OneAgrix ¹⁹
Malaysia	June 2019	MIMOS Berhad and Oracle ²⁰
Malaysia	August 2019	Perbadanan Islam Johor Sdn Bhd (PIJ) and Dagang NeXchange Bhd (DNeX) ²¹

¹⁵ <https://www.reuters.com/brandfeatures/venture-capital/article?id=38153>

¹⁶ <https://meikogroup.com/public-relations/news/apla-unveils-halalguide-a-comprehensive-halal-platform-that-now-uses-blockchain-technology/>

¹⁷ https://www.salaamgateway.com/en/press-releases/trace_labs_and_oneagrinx_partner_to_enable_halal_traceability_on_the_blockchain-SALAA-M28032019020916/

¹⁸ <https://medium.com/te-food/the-first-halal-food-blockchain-hub-with-governmental-backing-will-run-on-te-foods-technology-c7b01cf0f9d5>

¹⁹ <https://www.poultryworld.net/Meat/Articles/2019/6/Halal-poultry-partners-adopt-proof-of-concept-blockchain-439305E/>

²⁰ <http://www.focusmalaysia.my/Snippets/mimos-oracle-to-leverage-blockchain-technology>

²¹ <https://www.nst.com.my/business/2019/08/512590/dnex-inks-mou-pij-holdings>

3.3 RQ3: What is the state-of-the-art in research on the implementation of blockchain for halal product assurance?

A search using Google Scholar, Scopus, and Ebscohost was conducted to answer RQ3. The search protocol adapts the PRISMA [20-23] using the keywords “blockchain AND halal” as of 31 August 2019. The search returned several documents; however, many were discarded as the documents were related to cryptocurrency and financial application of blockchain, which is not relevant to the scope of the review presented in this paper. Table 4 presents the summary of PRISMA protocol.

Table 4: Search results based on PRISMA Process

PRISMA Process	Google Scholar (Excluding patent and citation)	Scopus	EBSCOhost
Records identified through database searching	426	3	2
Records after duplicates removed	423	3	2
Records screened	423	3	2
Records excluded	417	1	0
Full-text articles assessed for eligibility	5	2	2
Full-text articles excluded, with reasons	0	0	0
Studies included in qualitative synthesis	5	2	2
Studies included in quantitative synthesis	5	2	2
SUB TOTAL	5	2	2
TOTAL		9	

The search for the documents from three leading scholarly databases returned nine documents relevant to the implementation of blockchain for halal product assurance. The title of the documents and the databases the documents were retrieved were recorded in Table 5. In the last column of Table 5, the types of research papers were stated. Three of the papers were classified as a review study, while three papers reported a qualitative study about blockchain implementation for halal product assurance. The study was conducted through interview and group discussions. A quantitative study through a survey was also reported in one of the studies in which it investigated characteristics of technology that facilitates quality assurance for halal product. From a technology viewpoint, a study was also conducted to evaluate an opensource blockchain digital solution that can be used for halal product assurance.

Analysis of the year of publication revealed that research in the area of blockchain for halal product assurance has been started since 2017. The area of study is growing at a slow pace in which only five papers reported the findings in academic databases. Up to August 2019, research in the area was still

growing at a very slow pace where only two papers reported their finding related to blockchain for halal product assurance. The results obtained from this review study raise a question on how to sustain the area of study related to blockchain for halal product assurance. Researchers and developers may conduct studies; however, they are not reported in the academic databases or do not receive coverage by the news, which makes resources in the area are limited.

Table 5: List of research papers on blockchain for halal product assurance

Sources	Title	Year	Ref.	Types of research paper
Scopus/ Google Scholar	“Blockchain Redefining: The Halal Food Sector”	2019	[33]	Technical evaluation of blockchain digital solution
	“Utilizing blockchain technology to enhance halal integrity: The perspectives of halal certification bodies”	2019	[34]	Qualitative analysis of halal blockchain parameters for HCBs in certifying halal products
Ebscohost/ Google Scholar	“Creative Destruction of Halal Certification (Bodies) by Blockchain Technology?”	2019	[10]	Review
	“Leveraging Blockchain Technology for Halal Supply Chains”	2017	[35]	Review
Google Scholar	“Halal Supply Chain Certification: The Next Frontier in Halal Certification?”	2018	[11]	Review
	“Halal Meat Supply Chain Traceability Based on HACCP, Blockchain and Internet of Things”	2018	[31]	A conceptual framework for blockchain implementation in halal meat supply chain
	“Maintaining Halal Cold Chain Warehouse Temperature Stability Using IoT to Increase Halal Food Brand Equity”	2018	[36]	A qualitative study on how to maintain the stability of warehouse temperature using blockchain
	“Technology Requirement for Halal Quality Control”	2018	[37]	A quantitative study on characteristics of technology that facilitates quality assurance for halal product
	“The Implementation of Halal Supply Chain with Private Blockchain in Indonesia”	2018	[38]	A qualitative study of private blockchain implementation of Halal Supply Chain

3.4 RQ4: What are the future directions of research in blockchain for halal product assurance?

Blockchain implementation for halal product assurance is a multidisciplinary area in which it could contribute to business and social impact. Based on the findings derived from RQ3, there are many areas of research that can be explored to see the impacts of blockchain for halal product assurance, as well as to improve the implementation of the technology for the benefit of the society and business. This section answers RQ4 on the future directions of blockchain for halal product assurance that has been synthesized from the general studies in the supply chain; however, they are personalized to fit into the context of halal product assurance. The purpose of this RQ is to provide ideas on the opportunity of research works in the area to researchers who have expertise in the respective disciplines such as computer science, finance, economic, business, humanity, social science, and law; however, have not found the domain where the expertise could be applied. The research may cover the following topics:

1. The need for studying the current state of awareness and the effects of blockchain technology adoption to halal business entities. It is due to the infancy level of blockchain technology in which the effects are not known and investigated yet [39].
2. The need for converting blockchain ontology to programming code systematically by developing an application programming interface or conversion methods that are more efficient and block-chain compliant [40].
3. The need for developing a graphical user interface and advanced application programming interface to easily store and retrieve information in the chain [41].
4. The need for studying the trust level provided by the public ledger in relation to the number of monitoring events [42].
5. The need for studying the impact of the blockchain for halal product assurance among the Muslim community. The technology is considered disruptive, while its consequences of the adoption are not known [43].
6. The need for studying risk assessment and management in implementing blockchain for halal product assurance. The disruption and uncertainty of technology have risen the need for risk management [44].
7. The need for studying various technical methods for blockchain in halal supply chain such as coordination of distributed supply chain systems, coordination of material and flow of information, virtual enterprises, agile supply chain administration, flexible supply chain systems, performance evaluation of supply chain systems, resilient of a blockchain-based supply chain systems, real-time control systems and service-oriented supply chain systems [44].
8. The need for studying the impact of blockchain for halal assurance from the perspective of societies and industries of blockchain networks. The use of blockchain technology may contribute to structural changes in business models across industries, which may then lead to a significant change in socio-technological and economical at the global level [45].
9. The need for studying the mining techniques of blockchain data in halal product assurance. The blockchain mining processes require efficient mining techniques run on adequate computing resources [46].
10. The need for studying the appropriate methods to protect the privacy of the data and entities involved in the blockchain systems for halal product assurance; however, the transparency of the transactions are still provided. It is because transparency and privacy are always a tradeoff [47].

The above-suggested topics for future studies in the area of blockchain for halal product assurance are considered vital to ensure the sustainability of the technology and the research area. Therefore, funding agencies are welcomed to participate by providing research grants to support the works. Research institutes related to halal studies are also invited to look into the gaps in the area to keep maintaining the efforts towards an efficient halal product certification process.

4. CONCLUSION

This paper reported a review study on the implementation of blockchain technology for halal product assurance. Four research questions were answered in the study covering the fundamental architecture of blockchain for halal product certification as well as the available supports and solution towards a successful implementation of the technology. It also analyzed the state-of-the-art in research on the implementation of blockchain for halal product assurance. Finally, the review study also listed future directions for the implementation of blockchain for halal product assurance.

The findings of this study suggested that the studies in the area of blockchain for halal product assurance are still at its infancy stage. There is no evidence of implementation of the technology that enhances the conventional model of halal certification to support halal product assurance. The listed future directions illustrate many opportunities for exploring multidisciplinary aspects of the fields that may cover technology, process, and human.

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