Penerbit Akademia Baru

Journal of Advanced Research Design

Journal homepage:
https://akademiabaru.com/submit/index.php/ard
ISSN: 2289-7984

The Integration of Blockchain Technology in Halal Supply Chain Management HSCM): Enhancing Transparency in Islamic Business Practices

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ARTICLE INFO

Article history:
Received 5 February 2025
Received in revised form 21 July 2025
Accepted 10 September 2025
Available online 25 September 2025

Keywords:
Integration, Blockchain Technology, Halal Supply Chain Management, Transparency, & Islamic Business Practices

ABSTRACT

In the contemporary global halal industry, ensuring transparency, accountability, traceability, and trustworthiness across the supply chain is of paramount importance. However, the industry continues to face challenges related to fraud, mislabeling, and lack of real-time verification. This study explores the integration of blockchain technology into halal supply chain management as a strategic approach to strengthen Islamic business ethics and operational integrity. Blockchain, with its immutable ledger and decentralized system, offers a reliable platform for recording and verifying every transaction and process within the halal supply chain from sourcing raw materials to final consumer delivery. The research adopts a qualitative approach through case studies and expert interviews within halal certification bodies, logistics providers, and halal food manufacturers. It investigates the extent to which blockchain can address key challenges such as fraudulent halal claims, non-compliance risks, and lack of real-time traceability. Findings suggest that blockchain integration not only enhances the efficiency and reliability of halal certification processes but also aligns closely with the principles of amanah (trust), taqwa (good deed), and mas'uliyyah (accountability) in Islamic business conduct. This paper contributes to the growing body of knowledge on Islamic business practices by highlighting how the implementation of blockchain technology can significantly enhance transparency, reduce fraud, and streamline processes within halal supply chains. It offers practical recommendations for halal industry stakeholders, policymakers, and tech developers to leverage this innovation in upholding Shariah-compliant standards while fostering ethical practices and supporting the growth and sustainability of the halal economy.

1. Introduction

The global halal industry, which encompasses food, pharmaceuticals, personal cares, hospitality products and services, cosmetics, Islamic finance and takaful, and logistics, is experiencing rapid growth. With an estimated market value exceeding USD 2.3 trillion, consumer demand for halal-compliant products has surged, not only in Muslim-majority countries but also in global markets

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where Muslim populations are expanding [1]. As this market evolves, so too do the challenges in ensuring compliance with Islamic law (Shariah) throughout increasingly complex supply chains.
Transparency, accountability, and trustworthiness are not merely operational expectations in the halal industry, they are fundamental to Islamic ethical conduct. The Qur'an commands believers to uphold trust and justice in all transactions:

إِنَّ ٱللَّهَ يَأۡمُرُكُمۡ أَن تُؤَدُّواْ ٱلۡأَمَٰنَٰتِ إِلَىٰٓ أَهۡلِهَا وَإِذَا حَكَمۡتُم بَيۡنَ ٱلنَّاسِ أَن تَحۡكُمُواْ بِٱلۡعَدۡلِۚ إِنَّ ٱللَّهَ نِعِمَّا يَعِظُكُم بِهِۦٓۗ إِنَّ ٱللَّهَ كَانَ سَمِيعَۢا بَصِيرٗا ٥٨

"Indeed, Allah commands you to return trusts to their rightful owners;[1] and when you judge between people, judge with fairness. What a noble commandment from Allah to you! Surely Allah is All-Hearing, All-Seeing." (Surah An-Nisa, 4:58)

Similarly, the Prophet Muhammad (peace be upon him) emphasized integrity in trade: *"The honest and trustworthy merchant will be with the Prophets, the truthful, and the martyrs."* (Hadith from Imam Tirmidhi, 1209).

However, current halal supply chains face persistent problems, including fraudulent halal claims, inadequate documentation, and delays in real-time verification of compliance. These issues threaten consumer trust and expose businesses to regulatory and reputational risks.
In this context, blockchain technology presents a novel and potentially transformative solution. By leveraging a decentralized, tamper-proof ledger system, blockchain can provide transparent, traceable, and immutable records of every process in the supply chain. This study investigates the integration of blockchain into Halal Supply Chain Management (HSCM) and evaluates its effectiveness in addressing key industry challenges while reinforcing Islamic ethical principles.

2. Literature Review

2.1 Halal Supply Chain Management (HSCM) and Islamic Ethics - Halal, meaning "permissible" in Arabic, refers to practices that comply with Islamic law. The halal supply chain ensures that halal integrity is preserved from farm to fork, or source to consumption [2]. Core ethical concepts underpinning Islamic business practices include *amanah* (trust), *taqwa* (piety), *mas'uliyyah* (accountability), and *adl* (justice). Any breach of these values, such as mislabeling or cross-contamination, undermines the ethical foundation of halal commerce [3]. According to Yusuf al-Qaradawi (1960), "halal" in Islam refers to anything that is permissible, allowed, and lawful, while "haram" is that which is forbidden based on evidence in the Quran and Sunnah. Yusuf al-Qaradawi emphasizes that the right to determine what is halal and haram belongs to Allah alone, and humans should not arbitrarily declare things permissible or prohibited without proper Islamic knowledge [4]. This highlights the need for religious adherence and scholarly input in designing and managing halal supply chains. As the halal industry continues to grow fuelled by rising global Muslim populations and increasing demand for ethically sourced products the integrity of HSCM becomes not only a religious concern but also a commercial imperative.

Equally important is the prohibition of deceit, ambiguity, and unlawful gain in commerce. The Qur'an strongly warns against engaging in unethical financial practices:

ٱلَّذِينَ يَأۡكُلُونَ ٱلرِّبَوٰاْ لَا يَقُومُونَ إِلَّا كَمَا يَقُومُ ٱلَّذِي يَتَخَبَّطُهُ ٱلشَّيۡطَٰنُ مِنَ ٱلۡمَسِّۚ ذَٰلِكَ بِأَنَّهُمۡ قَالُوٓاْ إِنَّمَا ٱلۡبَيۡعُ مِثۡلُ ٱلرِّبَوٰاْۗ وَأَحَلَّ ٱللَّهُ ٱلۡبَيۡعَ وَحَرَّمَ ٱلرِّبَوٰاْۚ فَمَن جَآءَهُۥ مَوۡعِظَةٞ مِّن رَّبِّهِۦ فَٱنتَهَىٰ فَلَهُۥ مَا سَلَفَ وَأَمۡرُهُۥٓ إِلَى ٱللَّهِۖ وَمَنۡ عَادَ فَأُوْلَٰٓئِكَ أَصۡحَٰبُ ٱلنَّارِۖ هُمۡ فِيهَا خَٰلِدُونَ ٢٧٥

"Those who consume interest will stand ˹on Judgment Day˺ like those driven to madness by Satan's touch. That is because they say, "Trade is no different than interest." But Allah has permitted trading and forbidden interest. Whoever refrains—after having received warning from their Lord—may keep their previous gains, and their case is left to Allah. As for those who persist, it is they who will be the residents of the Fire. They will be there forever." (Surah Al-Baqarah, 2:275)

This verse not only affirms the permissibility of ethical trade but also draws a firm distinction between just commerce and exploitative transactions, highlighting the divine preference for moral, transparent, and lawful economic activity.

2.2 Challenges in Current Halal Supply Chains - Despite expanding regulatory frameworks and the increasing global demand for halal-certified products, current halal supply chains face significant challenges. One of the most pressing concerns is the risk of halal fraud, which includes false certification, unauthorized use of halal labels, and non-compliant handling or processing methods [5]. These risks are amplified in cross-border trade, where supply chains often span multiple jurisdictions with varying standards and certification bodies.

The lack of harmonization among halal certification authorities leads to inconsistencies in defining and verifying halal compliance. This creates confusion among producers and consumers alike. Additionally, much of the documentation required for certification, inspection, and tracking remains paper-based or is managed within siloed digital systems. This fragmentation limits traceability slows down verification processes and introduces vulnerabilities to fraud and error. Another key issue is the information asymmetry between producers, certifiers, retailers, and end consumers. Consumers lack access to real-time, verifiable data regarding the halal status of the products they purchase. This lack of transparency not only affects consumer trust but also limits their ability to make informed purchasing decisions.

2.3 Blockchain Technology and Supply Chain Transparency - Blockchain technology has emerged as a transformative tool with the potential to revolutionize supply chain management. By offering a decentralized and immutable ledger, blockchain enables multiple parties to record, access, and verify transaction data in real time. Each transaction recorded on a blockchain is time-stamped, tamper-proof, and transparent to all authorized participants, making the technology highly suitable for sectors where traceability and trust are essential [6].

In food supply chains, blockchain has been successfully applied to improve food safety traceability, monitor pharmaceutical supply chains, and ensure ethical sourcing in fair trade networks. When applied to halal supply chains, blockchain can:

i. Enhance traceability from source to consumer;
ii. Enable real-time verification of halal certificates and compliance data;
iii. Reduce reliance on intermediaries by utilizing smart contracts that automate compliance checks and trigger alerts upon detecting non-compliance;
iv. Improve auditability for certification bodies and regulatory authorities [7].

By integrating blockchain into HSCM, stakeholders can address current challenges such as fraud, inefficiency, and lack of consumer trust. The decentralized nature of the technology also aligns with Islamic ethical principles of justice, transparency, and accountability, making it not only a practical innovation but also a spiritually congruent one.

3. Methodology

This research adopts a qualitative exploratory approach, suitable for investigating emerging technologies within complex sociocultural and regulatory environments. Data were collected through i) Case Studies: Three halal-certified firms—one logistics provider, one food manufacturer, and one halal certification authority—were selected. ii) Expert Interviews: Semi-structured interviews were conducted with eight key informants, including supply chain managers, Shariah advisors, and blockchain developers. Interviews were transcribed and analysed using thematic coding, focusing on perceived benefits, implementation challenges, and alignment with Islamic ethical values.

4. Findings and Discussion

This section presents the key findings from case studies and expert interviews, highlighting how blockchain technology can enhance halal supply chain management (HSCM). The results are organized around four core themes that emerged from thematic analysis: enhancing traceability and verification, reducing fraud and mislabeling, alignment with Islamic ethical principles, and challenges in implementation, as in **Figure 1**. These findings illustrate not only the technical advantages of blockchain but also its potential to reinforce Shariah-compliant practices and ethical business conduct in line with Islamic values. Direct quotations from participants are used to support and contextualize the insights, offering practical perspectives from supply chain managers, Shariah advisors, and blockchain developers actively engaged in halal industry innovation.

4.1 Enhancing Traceability and Verification Participants noted that blockchain enables real-time tracking of product origins and compliance status. Consumers can scan QR codes to access this data instantly. A central theme emerging from both interviews and case study data is the transformative role of blockchain in enhancing product traceability. Participants emphasized that blockchain enables end-to-end visibility of halal product flows, from raw material sourcing to final consumption. Each transaction recorded on the blockchain ledger is time-stamped, immutable, and accessible to all authorized stakeholders. A supply chain manager from a halal-certified logistics firm noted:

"*Blockchain allows us to verify the halal status of a product at each checkpoint—storage, handling, transportation. This level of traceability was previously not achievable*."

Consumers benefit from scannable QR codes, enabling instant access to product histories, halal certification data, and compliance status. This capability aligns with growing consumer demand for transparency, trust, and ethical assurance in halal consumption.

4.2 Reducing Fraud and Mislabelling Blockchain's immutability prevents falsification of halal certificates. Smart contracts automate compliance checks. Interviewees from the halal certification authority and blockchain developers highlighted that one of the most significant advantages of blockchain is its immutability, which reduces the risk of data tampering, counterfeit halal labels, and unauthorized product substitution. A blockchain engineer explained:

"*Once the halal certificate is recorded on-chain, it cannot be modified or deleted without consensus. This effectively prevents backdoor manipulation or fraudulent labeling*."

In addition, smart contracts can automate halal compliance protocols. For example, contracts can be programmed to flag or reject products that lack required documentation, thus enforcing real-time compliance and removing reliance on manual verification.

This has implications for cross-border halal trade, where diverse certification bodies and standards often lead to inconsistency and fraud risk. Blockchain could serve as a neutral verification layer, trusted by regulators and consumers alike.

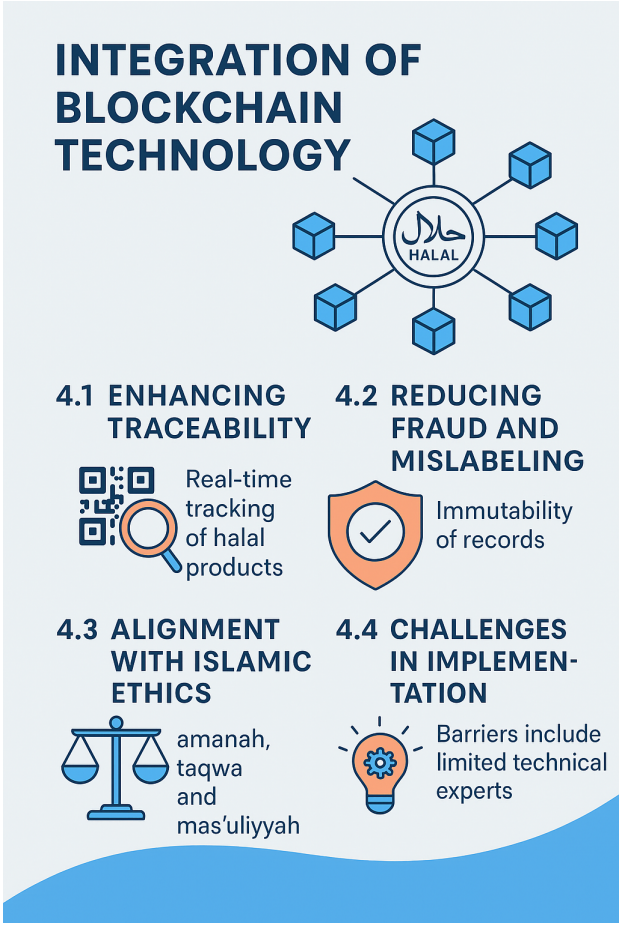

Fig. 1. Finding and discussion about Integration of Blockchain in Halal Supply Chain Management

4.3 Alignment with Islamic Ethical Principles Blockchain supports amanah, taqwa, and mas'uliyyah by providing verifiable and transparent records. Participants also noted that blockchain technology aligns well with Islamic ethical values, particularly amanah (trustworthiness), taqwa (God-consciousness), mas'uliyyah (accountability), and adl (justice). These values underpin not only halal practices but broader Islamic commercial ethics. A Shariah advisor from a certification body shared: "*The transparency and accountability provided by blockchain reflect the essence of amanah. If we can use technology to uphold these values, it becomes a tool that supports not contradicts Shariah*."

The decentralized, transparent, and verifiable nature of blockchain ensures that all stakeholders including producers, certifiers, distributors, and consumers can be held accountable. This shared

visibility fosters mutual trust and reduces dependency on a single controlling authority, which resonates with Islamic distributive justice.

4.4 Challenges in Implementation Barriers include limited technical expertise, lack of regulatory standards, and high initial costs. Despite its potential, the adoption of blockchain in halal supply chains faces substantial implementation barriers. These include:

i. Limited technical expertise among halal industry players, especially small and medium-sized enterprises (SMEs), who may lack the capacity to deploy and maintain blockchain systems;
ii. Regulatory uncertainty due to the absence of standardized protocols for halal blockchain integration;
iii. High initial costs for infrastructure development, integration with legacy systems, and stakeholder training;
iv. Resistance to change, particularly among traditional stakeholders who may view blockchain as disruptive or difficult to understand.

One participant noted: "*For blockchain to be mainstream in halal logistics, we need a national-level standard and support from JAKIM and industry players. Without that, adoption will remain fragmented*."

These challenges suggest that multi-stakeholder collaboration is essential bringing together regulators, certification bodies, tech developers, and scholars to create an enabling ecosystem for halal blockchain innovation.

5. Implications for Islamic Business and Halal Governance

Blockchain transforms governance and accountability in halal supply chains. It enables institutional trust, empowers consumers, and upholds Shariah compliance, echoing the Islamic principle of hisbah (market oversight with moral regulation).

6. Recommendations

6.1 Develop International Standards: The halal industry spans multiple countries with different regulatory environments, interpretations of Shariah law, and certification standards. This fragmentation often results in inconsistent practices and mistrust among consumers and trading partners.To address this, international halal regulatory bodies, such as the Standards and Metrology Institute for Islamic Countries (SMIIC) or the Organization of Islamic Cooperation (OIC), should collaborate to develop uniform blockchain-enabled halal standards. These should include:

i. Standardized protocols for blockchain data inputs (e.g., slaughterhouse practices, logistics checkpoints).
ii. Clear technical and religious criteria for halal compliance verification.
iii. Cross-border recognition of blockchain-based halal certifications.

This will ensure interoperability, reduce redundancy, and increase mutual recognition of halal certifications across regions.

6.2 Invest in Education and Infrastructure: One of the major barriers to blockchain adoption in the halal sector is the lack of awareness and technical capacity among stakeholders, especially small and medium enterprises (SMEs). Governments, NGOs, and industry leaders should prioritize:

i. Training programs for halal supply chain participants (producers, certifiers, logistics providers) on blockchain literacy.
ii. Workshops and certifications on digital halal compliance and ethical technology usage.
iii. Investment in digital infrastructure, especially in developing countries, to ensure adequate internet connectivity, device availability, and blockchain integration capacity.

Bridging the digital divide will enable more inclusive and effective implementation of blockchain solutions.

6.3 Public-Private Partnerships: Blockchain implementation requires significant investment in technology, regulation, and system integration, which can be challenging for individual firms or public agencies alone. Governments should partner with private blockchain developers, halal certification bodies, and logistics firms to:

i. Develop pilot projects for halal product tracking.
ii. Offer subsidies or tax incentives for halal businesses implementing blockchain.
iii. Create shared platforms or blockchain consortia to reduce costs and promote trust.

Such partnerships can accelerate adoption, ensure regulatory alignment, and foster innovation while maintaining Shariah compliance and ethical oversight.

6.4 Integrate with Existing Platforms: Halal supply chains already use a variety of systems for certification, inventory management, and logistics. Replacing these systems outright may be costly and disruptive. Blockchain solutions should be designed to integrate seamlessly with existing halal management systems, such as:

i. Enterprise resource planning (ERP) software.
ii. RFID or QR code tracking systems.
iii. Existing halal certification databases.

Using APIs and modular designs, blockchain tools can enhance existing workflows instead of replacing them. This lowers adoption barriers and allows for gradual digital transformation.

7. Conclusion

The integration of blockchain technology into halal supply chain management represents a transformative step toward reinforcing the ethical, transparent, and accountable foundations of Islamic business practices. As the halal industry continues to expand globally, traditional systems have struggled to ensure real-time traceability, prevent fraudulent practices, and maintain consistent Shariah compliance across complex and often opaque supply chains. Blockchain, with its immutable ledger, decentralized structure, and ability to facilitate smart contracts, provides a viable and robust solution to these persistent challenges.

This study has demonstrated that blockchain not only improves operational efficiency and verification processes within halal supply chains but also aligns closely with fundamental Islamic ethical principles such as amanah (trustworthiness), taqwa (piety), and mas'uliyyah (accountability). Through qualitative analysis of case studies and expert insights, it is evident that blockchain can bridge the trust gap between producers, certifiers, and consumers while ensuring that halal integrity is upheld from source to consumption.

However, the adoption of blockchain technology is not without its challenges. Issues such as the lack of standardized frameworks, limited awareness, and infrastructure disparities must be addressed. Therefore, the successful implementation of blockchain in halal supply chains will depend on coordinated efforts among industry stakeholders, policymakers, and technology providers. By

developing international standards, investing in education and infrastructure, fostering public-private partnerships, and ensuring compatibility with existing systems, the halal industry can fully leverage blockchain's potential.

In conclusion, blockchain is more than a technological innovation—it is a strategic enabler of ethical compliance, consumer trust, and sustainability in the halal economy. Its adoption marks a significant advancement in aligning modern supply chain practices with the timeless values of Islamic business ethics.

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