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Leveraging Blockchain Technology for Ensuring the Integrity of Halal Supply Chains: A Systematic Review

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Introduction (1/2)

- **Halal Market Growth:** The halal industry spans seven key sectors, with Muslim consumer expenditure reaching two trillion U.S. dollars in 2021, projected to grow to 2.8 trillion by 2025 (Alamsyah et al., 2022; Statista, 2024).

- **Certification and Integrity:** Halal certification bodies ensure compliance with halal guidelines, but supply chains face challenges such as maintaining halal integrity, transparency, and trust (Ab Talib et al., 2015; Hew et al., 2020; Novianti et al., 2020).

- **Blockchain Potential:** Blockchain technology can enhance transparency, traceability, and integrity in halal supply chains, addressing issues like product integrity and information system integration (Alamsyah et al., 2022; Tan et al., 2022).

- **Research Gaps:** Existing research on blockchain in halal supply chains is fragmented and mostly theoretical, highlighting the need for empirical studies and a comprehensive theoretical framework (Ali et al., 2021; Sultana et al., 2022; Bux et al., 2022).

Introduction (2/2)

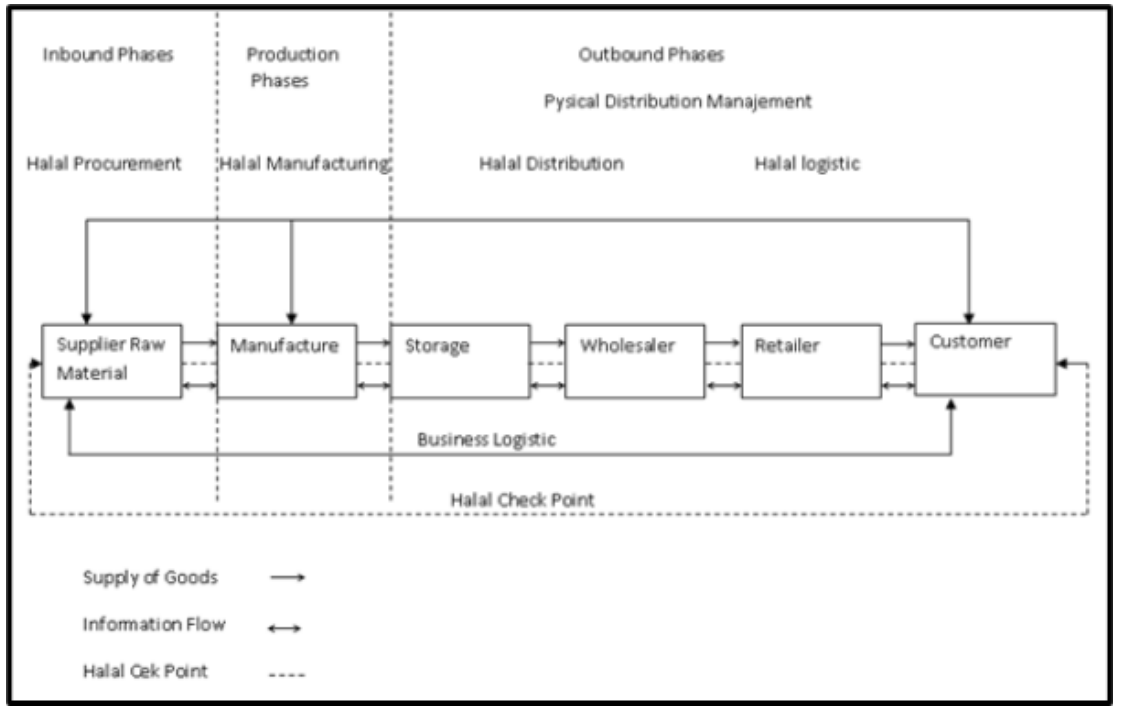
- **Paper's type:** Systematic Literature Review
- **Methodology:** Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) Statement
- **Research question**: *"Can blockchain technology enhance the reliability, traceability and sustainability of Halal foods?"*
- **Structure of the presentation**
  1. Theoretical background
  2. Methodology
  3. Analysis
  4. Conclusion

Theoretical background (1/2)

- **Halal supply chains (HSCs)** integrate Islamic principles across manufacturing, sourcing, distribution, and logistics, broken down into inbound (procurement), production (manufacturing), and outbound (distribution/logistics) phases (Sulaiman et al., 2018; Novianti et al., 2020).

- **Challenges in HSCs:** Key issues include traceability, compliance with Shariah, lack of standardized certification, cross-contamination, counterfeiting, and logistical challenges (Surjandari et al., 2021; Tieman et al., 2019; Ali et al., 2017; Tan et al., 2017).

- **Track and Trace Limitations:** Current methods like RFID, barcodes, and GPS lack real-time visibility and transparency, necessitating unified, blockchain-enabled solutions (Tan et al., 2022).

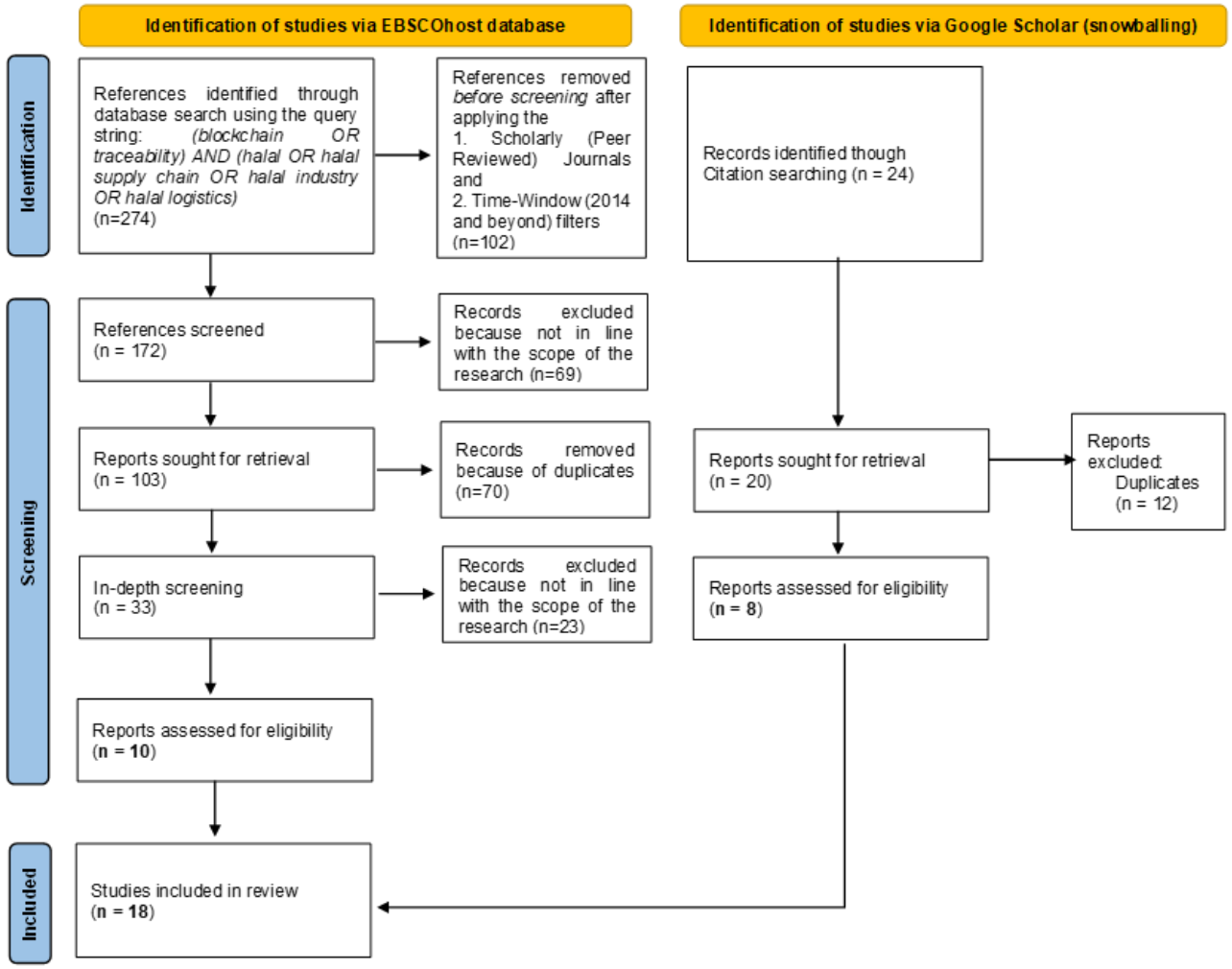


Theoretical background (2/2)

- **Definition of Blockchain:** A blockchain is a distributed database verified by a peer-to-peer network, providing an immutable record of transactions secured by public-key cryptography (Seebacher and Schüritz, 2017).
- **Blockchain Advantages:** Blockchain offers improved traceability, transparency, and data integrity, fostering trust and economic growth in the Islamic economy through secure, decentralized transactions (Abeyratne and Monfared, 2016; Ali et al., 2021; Chandra et al., 2019).
- **Blockchain Adoption:** Initially used in finance, blockchain is now applied in various sectors, including logistics and food, often requiring complementary technologies like IoT for enhanced transparency and traceability (Ziegler and Uli, 2021; Alamsyah et al., 2022).
- **Smart Contracts:** Integration of smart contracts with blockchain can automate quality control processes, reducing errors and enhancing supply chain efficiency (Vivaldini, 2021).
- **Enhancing HSCs with Blockchain:** Combining blockchain with halal certification can mitigate challenges such as contamination and disobedience, providing real-time data collection and secure access, ultimately enhancing transparency, traceability, and trust in halal supply chains (Ali et al., 2021; Tan et al., 2022; Novianti et al., 2020).

Methodology

- **Approach:** Systematic literature review (SLR) following the guidelines outlined in the PRISMA Statement (Moher et al., 2009).
- **Database:** Business Source Premier database (via EBSCOhost)
- **Query string:** (blockchain OR traceability) AND (halal OR halal supply chain OR halal industry OR halal logistics) -> eight permutations -> 274 results.
- **Filters:** i. Scholarly (Peer Reviewed) Journals, and ii. Time-window (2014 onward) -> 172 results.
- **Screening phase:** abstracts have been assessed for substantive relevance -> 103 results
- **Snowballing:** Google Scholar and citation searching yielded an additional 20 references.
- **Eligibility phase:** duplicates removed and thorough assessment of the remaining papers to confirm their suitability for inclusion in our systematic literature review.
- Ultimately, **18 papers** were selected for consideration and review.
- The references have been then coded using Citavi 6.0 for thematic patterns identification.



Results: the references analyzed

Author(s)	Title	Research type	Topic
Asnan *et al.*, 2024	Mapping the Future of Halal Supply Chain Management: A Biblioshiny R Application	Bibliometric Analysis	This research aims to analyze halal supply chain management publications and visualize the emergent trend for future publication.
Hendayani and Fernando, 2023	Adoption of blockchain technology to improve Halal supply chain performance and competitiveness	Quantitative	This study aims to investigate the relationship between blockchain technology adoption and firm competitiveness through Halal supply chain performance as a mediating variable.
Purusottoma *et al.*, 2023	Exploring the potential of blockchain adoption for promoting value innovation: a case of the halal industry	Empirical	The study developed a typology model that describes the blockchain adoption for value innovation in the halal industry in Indonesia.
Alamsyah *et al.*, 2022	Blockchain-Based Traceability System to Support the Indonesian Halal Supply Chain Ecosystem	Theoretical	The authors propose a blockchain-based halal traceability system model specific for the halal meat supply chain.
Bux *et al.*, 2022	Halal Food Sustainability between Certification and Blockchain: A Review	Literature review	This literature review investigates halal food sustainability, examining the barriers and opportunities offered by the certification and blockchain tools.
Sumarliah *et al.*, 2022	Blockchain-empowered halal fashion traceability system in Indonesia	Quantitative	The research examines the participation intent in blockchain-empowered Halal fashion traceability (BHFT) system.
Tan *et al.*, 2022	Applying Blockchain for Halal food traceability	Theoretical	The authors propose a traceability framework built on Blockchain derived from real-life blockchain implementation in three distinct halal supply chains.
Ali *et al.*, 2021	A sustainable Blockchain framework for the halal food supply chain: Lessons from Malaysia	Theoretical	The authors propose a novel sustainable blockchain framework for the halal food supply chain that can be used to enhance the supply chain integrity.
Surjandari *et al.*, 2021	Designing a Permissioned Blockchain Network for the Halal Industry using Hyperledger Fabric with multiple channels and the raft consensus mechanism	Experimental/ Simulation	The study uses a Blockchain Network with three channels and uses raft consensus algorithm to test their capabilities.
Hew *et al.*, 2020	The blockchain-based Halal traceability systems: a hype or reality?	Quantitative	The study proposes an integrated model aimed at explaining the variance in intention to participate in a blockchain-based Halal traceability system.
Novianti et al., 2020	Designing a Transparent Distributed Systems for Halal Supply Chains Using Blockchain Technology	Theoretical	The paper proposes a distributed system for tracing halal food along its supply chains using blockchain technology.
Vanany *et al.*, 2020	Indonesian halal food integrity: Blockchain platform	Theoretical	Conceptual framework using a specific blockchain architecture, namely Hyperledger fabric, to investigate Indonesian halal food integrity.
Zainal Abidin and Putera Perdana, 2020	A Proposed Conceptual Framework for Blockchain Technology in Halal Food Product Verification	Theoretical	The study presents a framework for blockchain technology for Halal product verification for manufactured food products.
Chandra *et al.*, 2019	Blockchain Redefining: The Halal Food Sector	Experimental	The authors provide a demonstration on how the blockchain technology would shape the halal food supply chain through the hyperledger fabric composer architecture.
Rohmah *et al.*, 2019	Traceability and Tracking Systems of Halal Food Using Blockchain Technology to Improve Food Industry Competitiveness	Theoretical	Conceptual framework of halal food traceability and tracking system using blockchain technology and its impact on food industry competitiveness.
Tieman *et al.*, 2019	Utilizing Blockchain Technology to Enhance Halal Integrity: The Perspectives of Halal Certification Bodies	Theoretical	The paper offers the specific perspective of halal certification toward blockchain technology to improve halal integrity.
Rejeb, 2018	Halal meat supply chain traceability based on HACCP, blockchain and internet of things	Theoretical	The paper suggests a halal meat supply chain traceability system based on HACCP, blockchain and Internet of Things.
Tieman and Ridzuan, 2017	Leveraging blockchain technology for halal supply chains	Theoretical/ Exploratory	The authors provide an overview about the impact of blockchain on halal supply chains providing the basic design principles of blockchain-based HSCs.

Results: the overall view

- **Impact of Blockchain on Halal Supply Chain Management (HSCM)**: Blockchain is central to HSCM research, with four thematic quadrants: emerging/declining, basic, niche, and motor themes (Hasnan et al., 2024).

- **Benefits of Blockchain Adoption:** 1. Ensures product integrity, significant cost savings in certification (70-90%), 2. Streamlines complexity, 3. facilitates change management, and 4. promotes sustainable halal practices (Ali et al., 2021; Chandra et al., 2019; Tan et al., 2022; Hendayani and Fernando, 2023; Köhler and Pizzol, 2020).

- **General Challenges of Blockchain Adoption:** 1. Data privacy (GDPR), 2. interoperability/integration, 3. scalability, 4. cost/resource constraints, 5. regulatory compliance, and 6. education/awareness (Chandra et al., 2019; Tieman et al., 2019; Hew et al., 2020; Rahman et al., 2020; Majeed et al., 2021).

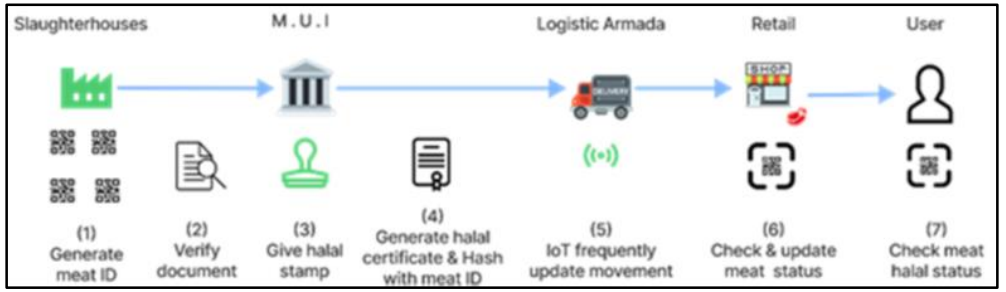
- **Specific Challenges for Halal Supply Chains:** 1. Absence of global halal certification, 2. inaccurate/inauthentic halal data, 3. inadequate raw material regulation, and 4. ineffective traceability systems like RFID or barcode (Ab Talib et al., 2015; Tan et al., 2022; Norman et al., 2009).

- **Types of Blockchain:** Four types based on permission levels (permissioned or permissionless) and accessibility (private or public). A private permissionless blockchain is suggested to enhance halal integrity (Ziegler and Uli, 2021; Tan et al., 2022).

Results: the case study in Indonesia

- **Status quo:** The current halal food system in Indonesia relies on halal certificates and labels overseen by LPPOM MUI, but lacks transparency for consumers, highlighting the need for improved traceability mechanisms (Zainal Abidin and Putera Perdana, 2020).

- **A blockchain-enhanced HSCM system**: A model for halal meat supply chain traceability includes reducing blockchain network participants, establishing a permissioned/private blockchain, and engaging halal bodies. Meat labeled with a unique ID is uploaded to the blockchain. The halal authority verifies and stamps the meat with halal certification. The blockchain is updated throughout distribution, and retailers and consumers can verify the halal status via QR codes (Surjandari et al., 2021).



- **Architecture:** The Avalanche platform is preferred for its rapid block creation and cost-effectiveness (Alamsyah et al., 2022).

- **Other framework/case studies**: Similar frameworks for halal food supply chains have been developed by other studies, underscoring the potential for blockchain to enhance transparency and trust (Novianti et al., 2020; Bux et al., 2022; Tan et al., 2022).

Conclusion

- The halal industry is a significant global market, projected to grow from US$2 trillion in 2021 to ***US$2.8 trillion by 2025***, but it faces challenges in maintaining halal integrity, transparency, and consumer trust.

- Blockchain technology is seen as a promising solution to ***enhance transparency, traceability, and integrity in halal supply chains***, though current academic literature on its implementation is sparse and lacks empirical research.

- The adoption of blockchain offers opportunities to ***improve trust and transparency in halal supply chains***, potentially revolutionizing product management and promoting sustainable growth in the Islamic economy, despite the need for further empirical studies.

- We must highlight that no concrete empirical implementations of Blockchain in the context of halal supply chains have been implemented.