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# ADVANCING SUSTAINABLE DEVELOPMENT GOALS (SDGS) THROUGH BLOCKCHAIN-ENHANCED HALAL SUPPLY CHAINS IN INDONESIA AND MALAYSIA

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## Abstract

Integrating blockchain technology in the halal supply chain presents a transformative approach to enhancing transparency, efficiency, and compliance with halal certification standards. This study conducts a comparative policy analysis between Indonesia and Malaysia, examining the regulatory frameworks, technological readiness, and strategic adoption models influencing blockchain implementation. Using a mixed-method approach, we employ SOAR (Strengths, Opportunities, Aspirations, Results) analysis to identify key drivers and potential growth areas and QSPM (Quantitative Strategic Planning Matrix) to evaluate strategic alternatives for blockchain adoption. Our findings highlight that Indonesia focuses on strengthening halal certification transparency, whereas Malaysia has progressed further in integrating blockchain within logistics and international halal trade. While both countries recognize blockchain's potential in achieving SDG 9 (Industry, Innovation, and Infrastructure), SDG 10 (Reduced Inequality), and SDG 12 (Responsible Consumption and Production), challenges remain in technological accessibility, regulatory standardization, and industry-wide adoption. The study recommends a hybrid approach, combining national blockchain adoption to enhance certification integrity with regional collaboration to standardize halal blockchain frameworks globally. This research contributes to the ongoing discourse on blockchain's role in sustainable supply chain management and provides actionable insights for policymakers, industry leaders, and halal certification bodies.

**Keywords:** Blockchain, Halal Supply Chain, SOAR Analysis, QSPM, Sustainable Development Goals (SDGs)

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## INTRODUCTION

Blockchain technology in the halal industry has been highlighted as a potential solution to improve transparency, efficiency, and compliance in the halal supply chain, especially in countries with large Muslim populations, such as Indonesia and Malaysia. Blockchain can improve supply chain resilience by reducing risk and increasing stakeholder trust (Kamble et al., 2020; H. Min, 2019; Modgil et al., 2022; Pattanayak et al., 2024; Sharma et al., 2022). In Malaysia, the integration of this technology has improved the reliability of information available to consumers, while in Indonesia, this technology has the potential to strengthen the halal certification system (Ismail et al., 2021; Perdana & Prasetyo, 2024; Susanty et al., 2024).

Blockchain technology in the halal industry is a significant solution to increase transparency and efficiency, especially in countries with Muslim-majority populations, such as Indonesia and Malaysia. The technology has the potential to strengthen consumer trust and support sustainable economic growth and the achievement of the Sustainable Development Goals (SDGs)(Ageron et al., 2020; Kamble et al., 2020; Modgil et al., 2022). In Indonesia, blockchain applications have been primarily focused on improving the halal certification system in response to the need for greater transparency in the halal product certification process. Meanwhile, Malaysia has adopted blockchain more broadly in various aspects of the halal supply chain, including logistics and exports, to strengthen its position as a global halal market leader (Schmidt & Wagner, 2019).

Given this vast potential, other studies have suggested the need for a deeper understanding of the benefits, challenges, and future research opportunities associated with blockchain in operations and supply chain management (Schmidt & Wagner, 2019). Therefore, it is essential for policymakers and industry leaders in Indonesia and Malaysia to strategically consider the integration of blockchain technology to maximize the economic and social benefits associated with the SDGs (Asnawi et al., 2023; Chandan et al., 2023; Wong et al., 2022). The literature further explains blockchain's support for SDGs, such as sustainable industry and infrastructure (SDG 9), responsible production and consumption (SDG 12), and reduced inequality (SDG 10). This technology offers opportunities to address the halal industry's critical challenges, such as product compliance and verification.(Sheel & Nath, 2019). Treiblmaier's research also suggests that blockchain can facilitate better coordination and operational efficiency across the value chain, which can significantly support the achievement of sustainability initiatives (Rejeb et al., 2021).

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This comprehensive review highlights blockchain's critical role in increasing transparency and efficiency in the halal supply chain while contributing to sustainable economic development in significant ways that align with the United Nations SDGs. Further elaboration on blockchain's potential reveals its ability to revolutionize the halal certification process. By automating and securing the certification workflow, blockchain technology significantly reduces the potential for human error and fraud, ensuring that all certified products truly meet halal standards. These advancements directly contribute to SDG 12 by promoting responsible consumption. Consumers gain access to verified information about the origin and handling of their food, empowering them to make more informed purchasing decisions (Hughes et al., 2019). Additionally, because blockchain technology provides a leaner and more transparent supply chain, it can reduce waste and use resources more efficiently, contributing to sustainable consumption practices.

Additionally, blockchain's impact on SDG 10 is particularly significant in the context of global trade. By democratizing market access, blockchain technology can help small and medium-sized enterprises (SMEs) in developing countries such as Indonesia and Malaysia compete more equally with large corporations. This engagement can increase economic opportunities and reduce disparities within and between countries (Galvez et al., 2018). The transparency provided by blockchain also means that unethical practices can be identified and addressed more efficiently, which promotes fairer trading conditions and can help lift underprivileged sectors of the economy, which is in line with the broader goals of SDG 10 (Ab Talib & Zulfakar, 2024; Modgil et al., 2022).

This study focuses on the impact of blockchain technology on the three Sustainable Development Goals (SDGs), namely Industry, Innovation, and Infrastructure (SDG 9), Responsible Consumption and Production (SDG 12), and Reducing Inequalities (SDG 10) in the context of the halal industry(Azalie, 2023). Blockchain technology, known for increasing transparency and efficiency, holds significant potential in modernizing the halal supply chain, supporting sustainability initiatives, and ensuring compliance with halal standards(Kamble et al., 2020; Modgil et al., 2022). Other research shows that blockchain can optimize supply chains by reducing inefficiencies, preventing product counterfeiting, and strengthening consumer trust, directly supporting SDG 12 by promoting more responsible consumption (Modgil et al., 2022).

Furthermore, blockchain helps reduce inequality by providing fairer and more transparent market access for small and medium producers, especially in

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developing countries like Indonesia and Malaysia, thereby contributing to SDG 10 (Schneider et al., 2020). Furthermore, identifying blockchain applications in the supply chain can reduce operational costs and provide significant competitive advantages for all stakeholders, mainly SMEs often hampered by cost and technological access barriers (Nurul Falach et al., 2024; Wamba & Queiroz, 2020). In the context of SDG 9, blockchain not only supports innovation through the development of new digital infrastructure but also helps build resilient industries through increased collaboration between sectors (ROTUNA et al., 2019; Wong et al., 2022). Implementing blockchain in national infrastructure can also help these countries leverage digital technology to accelerate industrial development, which is in line with SDG 9 targets (Parmentola et al., 2022).

To understand and develop optimal strategies for implementing blockchain technology in the halal supply chain, the SOAR (Strengths, Opportunities, Aspirations, Results) analysis approach (Rahman et al., 2021; Suryadi, 2021), QSPM (Quantitative Strategic Planning Matrix) can also be a strategic tool (Indriarti & Rachmawati Chaidir, 2021). SOAR helps identify internal strengths and external opportunities that can be leveraged to achieve desired goals in a blockchain-based halal supply chain ecosystem. Emphasizing aspirations and expected outcomes can help stakeholders design innovative strategies focusing on competitive advantage and long-term sustainability (Chiu, 2019).

Meanwhile, QSPM provides a quantitative framework for evaluating various possible strategic alternatives so that strategic decisions can be made based on each key factor's relative weight and attractiveness. In the context of blockchain in the halal supply chain, QSPM can be used to compare various implementation options for this technology in Indonesia and Malaysia, considering factors such as regulation, technology readiness, and adoption by industry players and consumers (Dzakwan & Budiman, 2020). This approach aligns with previous research showing that quantitative and strengths-based strategic planning can accelerate innovation adoption in the halal industry (Ab Talib & Zulfakar, 2024; Ageron et al., 2020). Therefore, this study's application of SOAR and QSPM provides a more comprehensive perspective on evaluating how blockchain technology can be optimally utilized to support the achievement of Sustainable Development Goals (SDGs) and increase efficiency, transparency, and reliability in the halal supply chain.

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## RESEARCH METHOD

This research uses a qualitative-quantitative approach with a mixed-methods method (Creswell & Creswell, 2017), which includes exploratory, descriptive analysis and a quantitative approach based on the Quantitative Strategic Planning Matrix (QSPM) (Siroj & Lukmandono, 2021). This study focuses on implementing blockchain in the halal supply chain in Indonesia and Malaysia through SOAR (Strengths, Opportunities, Aspirations, Results) analysis to identify internal strengths and external opportunities that can support the sustainability of the halal industry (Rahman et al., 2021). Primary data was collected through in-depth interviews and surveys with key stakeholders, including halal certification bodies, government regulators such as LPPOM MUI and JAKIM, and blockchain-based halal industry players in both countries. Secondary data was obtained from reputable journals, academic books, and official sources such as government websites, regulatory reports, and halal industry policies in Indonesia and Malaysia (INSIGHT: Buletin Ekonomi Syariah, 2020; KNEKS, 2022).

The analysis was carried out in stages, starting with identifying strategic factors using SOAR (Danandjaja, 2014), which is then integrated into QSPM to evaluate the relative attractiveness of various strategic alternatives in blockchain implementation. This approach allows this study to develop a data-based strategy map to support strategic decision-making for stakeholders (Hasibuan & Amela, 2019). This study refers to previous literature that discusses blockchain in the halal supply chain (Ab Talib & Zulfakar, 2024; Ageron et al., 2020; Creswell & Creswell, 2017), and SOAR and QSPM-based strategic planning methodology. The research results are expected to provide empirical and practical contributions to developing blockchain implementation policies and strategies in Indonesia and Malaysia's halal supply chain ecosystem.

## RESULTS AND DISCUSSION

Applying blockchain in the halal supply chain in Indonesia and Malaysia has great potential to increase transparency, efficiency, and global consumer trust (Ab Talib & Zulfakar, 2024; Asnawi et al., 2023; Zulfakar et al., 2012). Based on the SOAR (Strengths, Opportunities, Aspirations, Results) analysis, several key factors have been identified that support the Sustainable Development Goals (SDGs). In terms of strengths, strict halal regulations in both countries provide a strong legal basis for implementing blockchain as a halal verification tool.

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Support from halal certification bodies such as LPPOM MUI (Indonesia) and JAKIM (Malaysia) is the main factor driving the adoption of this technology (Al-Jarf, 2023). In addition, advances in digital infrastructure and the adoption of halal e-commerce are accelerating blockchain integration into the halal system (Chandan et al., 2023; Tiwari & Pal, 2022). In terms of opportunities, the growth of the global halal market, estimated to reach USD 2.8 trillion in 2024, and government support for the technology-based halal industry are big opportunities for blockchain implementation (Azalie, 2023; Perdana & Prasetyo, 2024).

The primary aspiration in implementing this blockchain is to make Indonesia and Malaysia the center of the global halal industry with a sustainable, transparent, and digital-based ecosystem (Galvez et al., 2018)Implementing this technology will make the halal certification system more efficient, supporting SDG 9 (Industry, Innovation, and Infrastructure) by building halal digital infrastructure and SDG 12 (Responsible Consumption and Production) by ensuring halal products are certified and safe (Parmentola et al., 2022). The expected results (Results) of this blockchain implementation include increasing the efficiency of halal certification, reducing operational costs, increasing the competitiveness of halal MSMEs, and supporting SDG 10 (Reducing Economic Inequality) by providing more inclusive market access for small and medium enterprises. With the SOAR approach, the blockchain implementation strategy can focus on achieving the halal industry's sustainability that benefits not only producers but also global consumers.

**SOAR Analysis**

The SOAR analysis is a strategic framework that helps identify key strengths, opportunities, aspirations, and expected results of blockchain implementation in the halal supply chain. This approach emphasizes leveraging existing strengths and opportunities to drive innovation and sustainability. By focusing on aspirations and results, SOAR analysis provides a proactive perspective that aligns with achieving the Sustainable Development Goals (SDGs). The following table outlines the SOAR analysis and its relation to SDGs.

Table 1. SOAR Analysis Table and Its Relation to SDGs

| Category | Analysis | Relation to SDGs | References |
|---|---|---|---|
| **Strengths** | • Strict halal regulations in Indonesia and Malaysia.<br>• Support from halal certification bodies (LPPOM MUI, JAKIM). | **SDG 9 (Industry, Innovation, and Infrastructure)** Strengthening digital halal infrastructure to | Abd Rahman et al. (2023); Chandan et al. (2023) |

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| | | | |
|---|---|---|---|
| | • Growing digital infrastructure and adoption of halal e-commerce.<br>• Blockchain offers high transparency and security. | support a more efficient and innovative industry. | |
| **Opportunities** | • Growing global halal market.<br>• Government policy support from Indonesia and Malaysia.<br>• Advances in blockchain technology and smart contracts.<br>• Increasing consumer awareness of halal product authenticity. | **SDG 12 (Responsible Consumption and Production)** Promoting traceability and transparent halal certification, increasing consumer trust. | Azalie (2023); Perdana & Prasetyo (2024) |
| **Aspirations** | • Positioning Indonesia and Malaysia as global halal industry leaders using blockchain.<br>• Increasing consumer trust and competitiveness of the halal industry.<br>• Ensuring halal product verification is digital and real-time.- Establishing a sustainable halal ecosystem. | **SDG 12 (Responsible Consumption and Production)** Strengthening halal product traceability.**SDG 10 (Reduced Inequality)** – Providing market access for halal SMEs through digital systems. | Galvez et al. (2018); Parmentola et al. (2022) |
| **Results** | • Increased efficiency in halal certification.<br>• Reduced operational costs and risk of halal product fraud.<br>• Improved competitiveness of halal SMEs.<br>• Contribute to SDGs by adopting blockchain in the halal supply chain. | **SDG 9 (Industry, Innovation, and Infrastructure)** Developing digital halal infrastructure.**SDG 12 (Responsible Consumption and Production)** Reducing counterfeiting practices and increasing halal transparency.**SDG 10 (Reduced Inequality)** Expanding market opportunities for halal SMEs in developing countries. | Parmentola et al. (2022); Perdana & Prasetyo (2024) |

## QSPM Analysis

Following the SOAR analysis, a quantitative approach is necessary to determine the most effective strategy for blockchain implementation in the halal supply chain in Indonesia and Malaysia. One method used is the QSPM (Quantitative Strategic Planning Matrix), which enables strategic assessment

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based on key factors influencing the success of blockchain implementation. This method compares various strategic alternatives by considering each key factor's weight and relative attractiveness. The following table presents the QSPM analysis comparing National Blockchain Adoption and Regional Collaboration.

Table 2. QSPM Analysis Table for Blockchain Implementation in the Halal Supply Chain

| No. | Strategic Factor | Weight | Strategy Alternative 1: National Blockchain Adoption | Strategy Alternative 2: Regional Collaboration |
|---|---|---|---|---|
| 1. | Strict Halal Regulations | 0.20 | 4 (0.80) | 3 (0.60) |
| 2. | Support from Certification Bodies | 0.15 | 4 (0.60) | 3 (0.45) |
| 3. | Growing Digital Infrastructure | 0.10 | 3 (0.30) | 4 (0.40) |
| 4. | Expanding Global Halal Market | 0.20 | 3 (0.60) | 4 (0.80) |
| 5. | Advances in Smart Contracts | 0.10 | 3 (0.30) | 4 (0.40) |
| 6. | Consumer Awareness | 0.15 | 4 (0.60) | 3 (0.45) |
| 7. | Strengthening Halal SMEs | 0.10 | 3 (0.30) | 4 (0.40) |
| | **Total Score** | **1.00** | **3.50** | **3.50** |

The QSPM (Quantitative Strategic Planning Matrix) analysis results indicate that the two main strategies, National Blockchain Adoption and Regional Collaboration, have balanced scores (3.50). This suggests that both strategies hold equal potential in enhancing blockchain implementation in the halal supply chain in Indonesia and Malaysia. National Blockchain Adoption excels in regulatory compliance and certification support, while Regional Collaboration is superior in global market access and expanded digital infrastructure. Therefore, integrating both strategies may provide the optimal solution to strengthen Indonesia and Malaysia's position in the global halal industry.

The National Blockchain Adoption strategy effectively ensures regulatory compliance and maintains data integrity in the halal certification system. However, this strategy requires significant investment in domestic technology development and workforce capacity building to support the halal blockchain ecosystem. Conversely, the Regional Collaboration strategy facilitates cross-country standardization in the halal blockchain system, enhancing efficiency in halal trade between nations and strengthening Indonesia and Malaysia's role in the global halal supply chain. This strategy promotes broader integration with the global halal ecosystem, including Middle Eastern and European markets.

Considering the implementation challenges and technological readiness, a hybrid approach combining both strategies may be the best option. Governments

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and the halal industry in Indonesia and Malaysia can initially adopt the national plan to solidify regulatory and technological foundations before expanding regional collaboration to enhance market access and global trust in blockchain-based halal products. Implementing blockchain in the halal supply chain can significantly improve transparency and efficiency in halal certification. Blockchain ensures that all records are automatically recorded and immutable, reducing the risk of halal certificate fraud.

However, the main challenges in blockchain implementation include high initial investment costs, the need for skilled blockchain professionals, and resistance from industry players still relying on conventional halal certification methods. In the long run, if blockchain implementation is systematically and gradually executed, Indonesia and Malaysia can pioneer the digital halal industry, making the halal ecosystem more integrated, efficient, and globally recognized. Government support, industry collaboration, and involvement of halal certification bodies are crucial in accelerating blockchain adoption in the supply chain. Adaptive regulations and strategic partnerships between countries will be key to successfully implementing this technology in the halal sector.

**Discussion**

Following the results of the SOAR analysis, it is essential to critically examine the implications and challenges of implementing blockchain in the halal supply chain. While blockchain offers significant advantages, such as enhanced transparency and efficiency, its practical application in Indonesia and Malaysia's halal industry raises several considerations. These include technological readiness, regulatory adaptation, cost-effectiveness, and industry-wide adoption. The discussion presented here is supported by various scholarly sources that provide insights into blockchain implementation in supply chain management and the halal industry.

Implementing blockchain in the halal supply chain requires a multidimensional evaluation integrating economic, technological, and socio-political perspectives. As suggested by Diffusion of Innovation Theory(Orr, 2003), the rate at which blockchain is adopted within the halal industry will depend on factors such as relative advantage, compatibility with existing practices, complexity, trialability, and observability. While blockchain presents significant efficiency advantages, the perception of complexity and cost remains a substantial barrier, particularly for small and medium enterprises (SMEs). The question is whether these businesses have the financial and human capital capacity to transition towards blockchain-based systems. Governments and

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industry leaders must work together to design training programs and policy incentives that facilitate smooth adoption.

Another critical theoretical perspective is the Institutional Theory.(Powell & DiMaggio, 2019), which emphasizes how regulatory and cultural frameworks shape organizational behavior. The halal supply chain operates under rigorous religious and legal requirements, meaning blockchain solutions must align with Islamic jurisprudence and global trade regulations. The fragmented nature of halal certification bodies across different countries challenges a unified blockchain solution. Without harmonized certification standards, blockchain implementation may lead to redundant or conflicting digital records that limit cross-border trade efficiency.

Transaction Cost Economics also provides an essential framework for analyzing the financial viability of blockchain adoption in the halal industry. Blockchain technology can reduce transaction costs by eliminating intermediaries, minimizing fraud, and increasing transparency. However, the initial capital expenditure required to develop and integrate blockchain solutions into existing supply chains is substantial. This creates a paradox: while blockchain can reduce long-term operational costs, the short-term financial burden may discourage adoption. To bridge this gap, strategic partnerships between governments, technology providers, and industry stakeholders are necessary to subsidize costs and mitigate financial risks.

Furthermore, Resource-Based View(Portugal Ferreira et al., 2016) Suggests that organizations with unique and valuable resources gain a competitive advantage. In this context, firms that successfully implement blockchain for halal certification could differentiate themselves as pioneers in the digital halal economy. However, the success of blockchain depends on access to specialized knowledge, expertise, and technical infrastructure. This raises the issue of inequality, where well-funded multinational corporations may monopolize blockchain adoption while SMEs struggle to compete.

The Social Exchange Theory(Yamao, 2024) Further, the importance of trust in technology adoption is highlighted. Blockchain's core feature—decentralized verification—enhances trust among supply chain participants by providing immutable transaction records. However, traditional halal industry stakeholders remain skeptical regarding the legitimacy and security of blockchain-based certification. Cultural resistance and lack of awareness may slow adoption rates. Blockchain education and awareness campaigns must be conducted within the halal industry to increase acceptance and trust.

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From a sustainability perspective, the Triple Bottom Line Theory(Metcalfe, 2006) Underscores how blockchain can contribute to social, economic, and environmental sustainability. Blockchain's ability to improve halal traceability supports consumer rights (social dimension), enhances trade efficiency (economic dimension), and reduces waste by optimizing resource allocation (environmental dimension). However, blockchain networks require significant computational power, raising concerns about energy consumption and environmental impact. To ensure sustainable blockchain adoption, the halal industry should explore integrating eco-friendly blockchain solutions, such as Proof-of-Stake (PoS) or hybrid consensus mechanisms.

**Implications and Future Considerations**

The successful implementation of blockchain in the halal supply chain requires a holistic strategy that incorporates regulatory compliance, financial feasibility, technological readiness, and cultural acceptance. Policymakers must prioritize establishing globally recognized blockchain-based halal certification frameworks. Additionally, financial institutions should offer low-interest loans or grants to SMEs willing to adopt blockchain technology, thereby reducing economic disparities within the halal industry.

Further research is needed to evaluate the long-term socio-economic impacts of blockchain adoption in the halal supply chain. Comparative studies between blockchain-enabled and traditional halal supply chains could provide empirical evidence on efficiency gains, cost savings, and market expansion. Moreover, interdisciplinary research integrating blockchain technology, Islamic finance, and supply chain management can yield innovative solutions that cater to the halal industry's unique needs. (Modgil et al., 2022).

Ultimately, blockchain has the potential to revolutionize the halal supply chain by enhancing transparency, efficiency, and trust. However, realizing its benefits requires addressing technological, regulatory, and socio-economic barriers through collaborative and evidence-based approaches. Theoretical insights from innovation diffusion, institutional frameworks, transaction cost economics, and sustainability studies provide valuable guidance in shaping the future of blockchain in the halal industry.

One of the significant concerns with blockchain implementation in the halal supply chain is technological readiness. While Indonesia and Malaysia have strong digital infrastructures, blockchain adoption at a large scale requires extensive investment in technical infrastructure, skilled labor, and interoperability among halal industry stakeholders.(Chang et al., 2019; Wamba &

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Queiroz, 2020). The question remains whether SMEs, which form the backbone of the halal economy, can afford and adapt to blockchain solutions.

Another critical aspect is regulatory adaptation. Although halal regulations in Indonesia and Malaysia are stringent, there must be a harmonized approach toward blockchain-based halal certification. Without a unified framework and international recognition, blockchain-based halal certification may struggle with acceptance in global markets, thus limiting its effectiveness (Ismail et al., 2021; Schmidt & Wagner, 2019).

Cost-effectiveness is also a key factor. While blockchain is often touted as a cost-saving technology due to its automation capabilities, its implementation requires significant initial investment. Companies in the halal supply chain, especially SMEs, may face financial constraints when integrating blockchain solutions (Kamble et al., 2020; S. Min et al., 2019). To mitigate this, governments and financial institutions should consider providing subsidies or economic incentives to encourage adoption.

Additionally, industry-wide adoption remains a challenge. While large corporations may readily integrate blockchain into their supply chains, smaller businesses may find it challenging due to a lack of technical knowledge and high implementation costs.(Hughes et al., 2019; Modgil et al., 2022). Collaborative efforts between the government, industry leaders, and tech developers are crucial to ensuring that blockchain solutions are accessible and beneficial to all players in the halal supply chain.

## CONCLUSION

This study highlights the potential of blockchain technology in enhancing transparency, efficiency, and trust within the halal supply chain in Indonesia and Malaysia, mainly through a more secure and verifiable halal certification system. SOAR and QSPM analyses indicate that strict regulations and support from halal certification bodies are key factors in blockchain adoption, contributing to SDG 9, SDG 12, and SDG 10. The implications include improved certification efficiency, reduced counterfeit halal products, and expanded market access for halal SMEs. From a policy perspective, accelerating regulations and developing a digital halal infrastructure are essential to enhancing the global competitiveness of the halal industry. Future research should further explore the effectiveness of blockchain in the global halal supply chain, its economic impact on SMEs, and a comprehensive analysis of security and cost efficiency to ensure optimal and sustainable implementation.

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