

Strategy for Strengthening the Halal Ecosystem through Digitalization of the Sharia Supply Chain

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Abstract: The rapid growth of the global halal industry and advances in digital technology have created major opportunities to strengthen the halal ecosystem through the digitalization of the Sharia supply chain. Despite this potential, the halal industry continues to face several challenges, including lack of transparency, weak traceability systems, fake halal labels, inefficient logistics, and limited stakeholder integration. This research aims to analyze strategies for strengthening the halal ecosystem through digital transformation and to examine the impact of digitalization on halal integrity, operational efficiency, consumer trust, and ecosystem performance. This study employs a mixed-method approach by combining qualitative and quantitative methods. Qualitative data were collected through case studies, in-depth interviews, and document analysis involving halal industry actors, Micro, Small, and Medium Enterprises (MSMEs), halal certification institutions, logistics companies, and Islamic fintech providers. Quantitative data were obtained through questionnaires and analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS), regression analysis, and path analysis to evaluate relationships among digitalization, supply chain integration, halal assurance, consumer trust, and operational efficiency. The findings reveal that digitalization significantly improves transparency, traceability, halal assurance systems, and operational efficiency within Sharia supply chains. Technologies such as blockchain, Internet of Things (IoT), artificial intelligence (AI), and digital platforms strengthen halal integrity and increase consumer trust through transparent and verifiable halal information. The study also identifies institutional readiness, regulatory support, digital literacy, stakeholder collaboration, and Sharia governance as critical success factors for sustainable digital halal ecosystems. Therefore, integrating digital technology with Islamic business principles is essential to enhance the competitiveness and sustainability of the global halal industry.

Research Highlights:

- This research analyzes strategies for strengthening the halal ecosystem through the digitalization of the Sharia supply chain.
- The study examines the role of digital technologies such as blockchain, Internet of Things (IoT), artificial intelligence (AI), and digital platforms in improving halal supply chain management.
- The findings reveal that digitalization significantly enhances transparency, traceability, halal assurance, operational efficiency, and consumer trust.
- Institutional readiness, regulatory support, digital literacy, stakeholder collaboration, and Sharia governance are identified as critical success factors for sustainable digital halal ecosystems.
- The research emphasizes the importance of integrating digital transformation with Islamic business principles to improve the competitiveness and sustainability of the global halal industry.

Article history

Submitted 27-10-2025

Revised 25-11-2025

Accepted 27-12-2025

Keywords

Halal Ecosystem;
Sharia Supply Chain;
Digitalization;
Halal Integrity;
Consumer Trust.

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INTRODUCTION

The rapid development of the global halal industry has transformed halal products and services into one of the fastest-growing sectors in the world economy. The increasing Muslim population, rising awareness of halal lifestyles, and expanding international trade have significantly contributed to the growth of halal-based industries, including food and beverages, cosmetics, pharmaceuticals, fashion, tourism, and Islamic financial services. The halal industry is no longer viewed solely from a religious perspective, but also as a representation of product quality, safety, hygiene, ethical production, and sustainability. As a result, many countries, including non-Muslim majority countries, are actively developing halal markets to capture the growing global demand for halal products and services.

Indonesia possesses enormous potential in the development of the halal industry because it has the largest Muslim population in the world (Mujahidin, 2020). This demographic advantage creates substantial opportunities for Indonesia to become a global halal production and distribution center. The Indonesian government has demonstrated strong commitment to strengthening the halal ecosystem through various policies, including mandatory halal certification, the development of halal industrial zones, and the promotion of Islamic economic development. Alongside these developments, the growth of digital technology and internet penetration has accelerated changes in consumer behavior and business operations, encouraging the integration of digital systems into various economic sectors, including the halal industry.

The increasing awareness of Muslim consumers regarding halal products also becomes an important factor driving the growth of the halal market. Modern Muslim consumers are not only concerned with the halal status of final products but also pay attention to the entire production and distribution process. Consumers increasingly demand transparency, traceability, ethical sourcing, and assurance that products comply with Islamic principles throughout the supply chain (Ab Rashid & Bojei, 2020). This shift in consumer behavior encourages companies to improve the credibility and accountability of their halal assurance systems. Consequently, trust has become one of the most critical elements in maintaining the sustainability and competitiveness of halal businesses in the modern market.

However, despite the significant growth potential, the halal industry still faces various challenges, particularly in the management of halal supply chains. One of the major issues is the lack of transparency in supply chain activities, where consumers often have limited access to information regarding raw materials, processing methods, storage systems, and distribution mechanisms (Wognum et al., 2011). This condition creates uncertainty regarding the halal integrity of products. In addition, traceability problems remain a serious concern because many halal businesses still rely on conventional and fragmented monitoring systems that are unable to track products comprehensively from upstream suppliers to end consumers.

Another important challenge is the circulation of fake halal labels and unauthorized certification practices that can damage consumer trust and harm the credibility of halal industries. The misuse of halal certification by irresponsible business actors creates doubts among consumers regarding the authenticity of halal claims. Furthermore, logistics inefficiencies also contribute to the weakening of halal integrity, particularly when halal and non-halal products are transported or stored together without proper segregation systems. Such conditions increase the risk of contamination and violate the principles of halal assurance required in Islamic business practices.

In facing these challenges, digital transformation emerges as an important strategic solution for strengthening the halal ecosystem. The advancement of Industry 4.0 technologies, such as blockchain, Internet of Things (IoT), artificial intelligence (AI), big data analytics, cloud computing, and digital platforms, offers innovative opportunities to improve supply chain efficiency, transparency, accountability, and traceability. Through digitalization, halal supply chains can be monitored in real time, allowing stakeholders to track the movement and status of products from production to consumption more effectively. Digital systems also enable more accurate halal verification processes, reduce the risk of fraud, and improve operational efficiency across the supply chain network.

The concept of digital economy development further strengthens the importance of digital transformation within the halal industry. Digital platforms, e-commerce, fintech services, and online marketplaces have expanded market access for halal businesses, especially Micro, Small, and Medium Enterprises (MSMEs) (Jumper et al., 2021). Digitalization not only facilitates business transactions but also strengthens collaboration among producers, suppliers, logistics providers, certification bodies, regulators, and consumers within the halal ecosystem. Therefore, integrating digital technology into Sharia-based supply chains becomes increasingly necessary to ensure halal integrity, operational efficiency, and sustainable business competitiveness.

The Sharia supply chain itself differs from conventional supply chains because it emphasizes compliance with Islamic principles throughout all business processes. A Sharia supply chain requires halal assurance, ethical sourcing, fairness, transparency, accountability, and the avoidance of prohibited elements such as *riba*, *gharar*, fraud, and contamination with non-halal materials. Therefore, maintaining halal integrity across the supply chain requires an integrated system capable of monitoring and controlling every stage of production, storage, transportation, and distribution. Digitalization can play a strategic role in supporting these objectives by providing transparent, automated, and verifiable systems that enhance halal assurance and consumer trust.

Research related to the strengthening of the halal ecosystem and the digitalization of Sharia supply chains has grown significantly over the last decade, particularly alongside the rapid development of Industry 4.0 technologies and the digital economy. Previous studies generally focus on halal supply chain management, blockchain implementation, digital traceability systems, halal assurance, consumer trust, and the integration of digital technologies into Islamic business ecosystems. One of the earlier studies discussing digital traceability in supply chains was conducted by Henry M. Kim and Marek Laskowski in 2016. Their research entitled "Towards an Ontology-Driven Blockchain Design for Supply Chain Provenance" explained the role of blockchain technology in improving supply chain provenance and traceability systems. The study emphasized that blockchain and Internet of Things (IoT) technologies can strengthen transparency and authenticity verification in supply chains through decentralized and immutable data systems. Although the study did not specifically focus on halal industries, it became one of the important foundations for the development of blockchain-based halal supply chain systems.

Research on blockchain adoption in supply chains was further developed by Nikhil Vadgama and Paolo Tasca in 2020 through their study "An Analysis of Blockchain Adoption in Supply Chains Between 2010 and 2020." The study analyzed the growth of blockchain implementation across global supply chain sectors and found that agriculture, logistics, and food industries were among the most active sectors in blockchain utilization. Their findings highlighted that blockchain significantly improves traceability, operational efficiency, and stakeholder trust in complex supply chains.

In the context of halal ecosystems, an important study was conducted by Andry Alamsyah, Naufal Hakim, and Ratih Hendayani in 2022 entitled "Blockchain-Based Traceability System to Support the Indonesian Halal Supply Chain Ecosystem." The research explained how blockchain technology can strengthen transparency, traceability, and halal assurance within Indonesian halal supply chains. The study emphasized that blockchain systems can reduce fraud, improve monitoring efficiency, and increase consumer trust in halal-certified products. The authors also highlighted the importance of collaboration between regulators, certification institutions, and industry actors in implementing blockchain-based halal ecosystems.

In the same year, research by Ming-Lang Tseng and colleagues discussed sustainable halal food supply chains through a comparative perspective between halal and non-halal systems. Their study found that halal supply chains place stronger emphasis on halal certification, Islamic values, halal trust, and food safety as critical sustainability indicators. The study also emphasized the growing importance of data-driven and technology-supported systems in achieving sustainable halal supply chain management.

Research regarding digital ecosystem management was also explored by Marin Jovanovic and colleagues in 2022 through the study "Managing a Blockchain-Based Platform Ecosystem for Industry-Wide Adoption: The Case of TradeLens." The study explained that blockchain-based platform ecosystems require interoperability, governance mechanisms, and institutional collaboration to achieve industry-wide adoption. Their findings are relevant to halal ecosystems because successful halal digitalization also depends on cooperation among regulators, logistics providers, businesses, and certification institutions.

Based on the existing literature, previous studies have generally focused on blockchain implementation, halal traceability systems, digital assurance models, and technological integration within

halal supply chains. However, there is still limited research that comprehensively examines strategies for strengthening the halal ecosystem through the digitalization of Sharia supply chains, particularly within the Indonesian context. Most previous studies emphasize technological aspects without deeply integrating strategic, institutional, regulatory, and Sharia governance dimensions simultaneously. Therefore, this research seeks to fill the gap by analyzing how digitalization strategies can strengthen halal ecosystems holistically through the integration of technology, Islamic business principles, institutional collaboration, and sustainable Sharia supply chain management.

METHOD

This research employs a mixed-method methodology that combines qualitative and quantitative approaches to comprehensively analyze strategies for strengthening the halal ecosystem through the digitalization of the Sharia supply chain (Khastini, 2021). The use of a mixed-method approach is considered appropriate because the research topic involves both measurable operational factors and complex institutional, technological, and behavioral dynamics. By integrating qualitative and quantitative methods, this study is expected to provide deeper analytical insights as well as empirical evidence regarding the effectiveness of digital transformation in strengthening halal ecosystem performance.

The qualitative component of this research is intended to explore the implementation of digital technologies within Sharia supply chains and to understand the perceptions, experiences, and strategic responses of stakeholders involved in the halal ecosystem (Utomo et al., 2021). A case study approach is utilized to examine the real practices of halal-certified businesses, Islamic financial institutions, halal logistics providers, and digital platform operators in Indonesia. This approach enables the researcher to investigate how digitalization supports halal integrity, transparency, traceability, and operational efficiency within the halal value chain.

Qualitative data are collected through in-depth interviews and document analysis (Owen, 2013). Interviews are conducted with selected informants who possess direct involvement and expertise in halal supply chain activities. These informants include halal industry actors, Micro, Small, and Medium Enterprises (MSMEs), halal certification institutions, logistics companies, Islamic fintech providers, regulators, and digital platform developers. The interview process focuses on exploring issues related to digital adoption, halal assurance systems, technological challenges, institutional collaboration, consumer trust, and the integration of Sharia principles into digital business operations.

In addition to interviews, document analysis is used to strengthen and validate the findings (Owen, 2013). Various documents are examined, including government regulations, halal certification policies, institutional reports, digital platform documentation, journal articles, industry reports, and previous studies related to halal ecosystems and supply chain digitalization. The use of multiple data sources enhances the credibility and reliability of the research findings through data triangulation.

The qualitative data obtained from interviews and documents are analyzed using thematic analysis (Joffe, 2011). This analytical technique involves coding, categorizing, and identifying recurring themes and patterns relevant to the research objectives. Themes such as digital transparency, halal traceability, operational efficiency, institutional readiness, consumer trust, digital governance, and Sharia compliance are analyzed systematically to develop a comprehensive understanding of the strategic role of digitalization in strengthening the halal ecosystem.

The quantitative component of this research aims to empirically examine the relationships between digitalization and the performance of the halal ecosystem. Quantitative analysis is conducted to measure the influence of several independent variables on dependent variables associated with halal supply chain effectiveness and consumer trust. The independent variables in this study include the level of digitalization, supply chain integration, halal assurance systems, and operational efficiency. Meanwhile, the dependent variables include consumer trust, halal ecosystem performance, and business sustainability.

Quantitative data are collected through structured questionnaires distributed to halal business actors, MSMEs, logistics providers, Islamic financial institutions, and consumers who are actively involved in halal economic activities (Puspitaningrum et al., 2021). The questionnaire items are developed using Likert-scale measurements to assess respondents' perceptions regarding technology adoption, supply chain transparency, halal compliance, and organizational performance. The sampling technique employed in this study is purposive sampling, where respondents are selected based on specific criteria relevant to the research objectives.

The collected quantitative data are analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) (Yudatama et al., 2019). SEM-PLS is selected because it is capable of analyzing complex relationships among latent variables and can simultaneously evaluate measurement models and structural models. This method is particularly suitable for exploratory and predictive research involving multiple interconnected variables. In addition, SEM-PLS is effective for studies with relatively flexible sample size requirements and non-normal data distributions. To support the analysis, validity and reliability tests are conducted to ensure the consistency and accuracy of the measurement instruments.

Furthermore, regression analysis and path analysis are also employed to examine direct and indirect relationships among variables. Regression analysis is used to determine the magnitude of influence between digitalization variables and halal ecosystem performance, while path analysis helps identify mediating relationships among operational efficiency, halal assurance, consumer trust, and ecosystem sustainability. These statistical analyses provide empirical evidence regarding how digital transformation contributes to strengthening Sharia supply chain systems.

Overall, this methodology is designed to provide a holistic understanding of the research problem by integrating qualitative exploration and quantitative measurement. The qualitative approach provides deep insights into institutional dynamics, stakeholder perspectives, and implementation challenges, whereas the quantitative approach offers measurable evidence regarding the impact of digitalization on halal ecosystem performance. Through this comprehensive methodology, the research is expected to generate strategic recommendations for policymakers, halal industry practitioners, Islamic financial institutions, and digital platform providers in strengthening the halal ecosystem through the digitalization of Sharia supply chains.

RESULTS AND DISCUSSION

Effectiveness of digitalization

Digitalization has become one of the most important strategic approaches in improving the effectiveness of modern business operations, including within the halal industry and Sharia supply chain management (Industry, n.d.). The rapid advancement of digital technologies such as blockchain, Internet of Things (IoT), artificial intelligence (AI), cloud computing, big data analytics, and digital platforms has transformed the way organizations manage production, logistics, distribution, monitoring, and consumer engagement. In the context of the halal ecosystem, digitalization plays a significant role in strengthening transparency, operational efficiency, halal assurance, and consumer trust. Therefore, evaluating the effectiveness of digitalization is essential to determine whether technological integration truly contributes to improving the performance and sustainability of Sharia-based supply chains.

One of the primary indicators of the effectiveness of digitalization is the improvement of transparency within the halal supply chain (Abderahman et al., 2021). Traditional supply chain systems often rely on manual documentation and fragmented data management, making it difficult to monitor product movement and verify halal compliance throughout the production and distribution process. Through digital systems, information regarding raw materials, suppliers, processing methods, storage conditions, transportation, and certification status can be recorded and accessed in real time. Technologies such as blockchain provide decentralized and immutable records that increase accountability and reduce the risk of data manipulation or fraudulent halal claims. As a result, digitalization strengthens the integrity of halal products and allows consumers to verify halal information more easily and accurately.

Another important aspect of digitalization effectiveness is the enhancement of traceability systems. Traceability is highly crucial in halal supply chains because halal assurance requires continuous monitoring from upstream suppliers to end consumers. Digital technologies enable businesses to track products across every stage of the supply chain through QR codes, smart sensors, RFID systems, and IoT devices. These technologies facilitate rapid identification of potential contamination, logistics errors, or non-compliance with halal standards. Effective traceability systems not only improve operational control but also minimize risks associated with product recalls, supply chain disruptions, and halal violations. Consequently, businesses can maintain product quality and strengthen consumer confidence more effectively.

Digitalization also improves operational efficiency within halal supply chains (Ali et al., 2021). Conventional supply chain processes often involve excessive paperwork, manual verification, communication delays, and inefficient coordination among stakeholders. The integration of digital

platforms and automated systems significantly reduces administrative burdens, shortens processing time, and improves coordination among producers, suppliers, logistics providers, certification institutions, and regulators. For example, digital halal certification systems simplify registration, verification, and monitoring processes, thereby reducing bureaucracy and increasing service efficiency. Automated inventory management and logistics monitoring systems further optimize resource utilization and reduce operational costs.

The effectiveness of digitalization can also be observed in its contribution to strengthening halal assurance systems. Halal assurance requires strict compliance with Islamic principles throughout the entire supply chain, including sourcing, processing, packaging, transportation, and storage activities. Digital technologies help organizations monitor halal compliance continuously and systematically. Blockchain technology ensures that halal certification records remain transparent and tamper-proof, while AI-based systems can assist in detecting anomalies, identifying risks, and analyzing compliance data more efficiently. This digital integration enhances the reliability and credibility of halal assurance systems and reduces the possibility of fraud or human error.

In addition, digitalization significantly influences consumer trust, which is one of the most critical factors in the halal industry. Muslim consumers increasingly demand transparency and accountability regarding the halal status of products they consume (Sayogo, 2018). Through digital platforms, consumers can access detailed product information, verify halal certification authenticity, and track product origins in real time. This accessibility increases consumer confidence and strengthens brand reputation. Effective digital communication also allows businesses to engage directly with consumers, respond to concerns quickly, and provide educational information regarding halal standards and Sharia compliance.

Impact on halal integrity

Halal integrity is one of the most fundamental elements in the halal industry because it represents the consistency and reliability of halal compliance throughout the entire production, distribution, and consumption process. Halal integrity does not only refer to the halal status of the final product but also includes the assurance that all activities, materials, logistics systems, financial transactions, and business practices involved in the supply chain comply with Islamic principles. In the context of the modern halal industry, maintaining halal integrity has become increasingly challenging due to the complexity of global supply chains, cross-border trade, multiple suppliers, and the rapid movement of goods across various distribution channels. Therefore, the integration of digital technology into Sharia supply chains has emerged as an important strategy to strengthen halal integrity and ensure sustainable consumer trust.

One of the major impacts of digitalization on halal integrity is the improvement of transparency within supply chain operations. In conventional systems, halal monitoring often depends on manual documentation and fragmented reporting mechanisms, which create opportunities for human error, manipulation, and information gaps. Digital technologies such as blockchain, cloud computing, and integrated databases allow information regarding raw materials, suppliers, production processes, transportation, storage, and certification status to be recorded systematically and transparently. Blockchain technology, in particular, creates immutable and decentralized records that cannot easily be altered, thereby increasing accountability and reducing the risk of fraudulent halal claims. This transparency helps businesses and consumers verify halal compliance more effectively and strengthens the credibility of halal-certified products.

Another important impact of digitalization is the enhancement of traceability systems, which are critical for maintaining halal integrity. Traceability refers to the ability to track the movement and condition of products throughout the entire supply chain (Jansen-Vullers et al., 2003). In halal industries, traceability is essential because contamination with non-halal materials can occur at any stage, including sourcing, processing, packaging, transportation, or storage. Through technologies such as Internet of Things (IoT), RFID systems, QR codes, and smart sensors, businesses can monitor products in real time and detect potential violations of halal standards immediately. This capability enables faster corrective actions and minimizes the risk of distributing non-compliant products to consumers. As a result, digital traceability systems significantly strengthen the protection of halal integrity across the halal value chain.

Digitalization also contributes to reducing the risk of fake halal labels and unauthorized certification practices (Rejeb, 2018). The misuse of halal logos and false certification claims has become a serious issue in many markets, damaging consumer trust and weakening the reputation of halal industries. By implementing digital verification systems, consumers and regulators can authenticate halal certificates directly through digital platforms, QR codes, or blockchain-based databases. This process increases the

reliability of halal certification systems and prevents the circulation of counterfeit halal products. Consequently, digitalization enhances consumer confidence and supports stronger governance within the halal ecosystem.

Furthermore, digital technology improves monitoring and control mechanisms in halal logistics management. One of the key challenges in maintaining halal integrity is ensuring the separation between halal and non-halal products during transportation and storage. Inadequate segregation systems can lead to contamination and violation of Sharia principles. Through digital logistics systems and IoT-enabled monitoring devices, logistics providers can track storage conditions, transportation routes, handling procedures, and environmental factors in real time. Automated alerts and monitoring systems help ensure that halal logistics requirements are consistently maintained. This strengthens the integrity of halal products throughout the distribution process and reduces operational risks associated with contamination.

The effectiveness of digitalization is also reflected in the expansion of market access and business competitiveness. Digital economy platforms such as e-commerce marketplaces, digital payment systems, and online marketing channels allow halal businesses, particularly Micro, Small, and Medium Enterprises (MSMEs), to reach broader domestic and international markets (Lukonga, 2020). Digitalization lowers entry barriers for smaller businesses and enables them to participate more actively in the global halal economy. Furthermore, digital systems facilitate cross-border trade by improving data standardization, certification verification, and logistics coordination among countries.

Despite its numerous advantages, the effectiveness of digitalization also depends on several supporting factors. Technological infrastructure, digital literacy, regulatory support, cybersecurity systems, and institutional collaboration greatly influence the success of digital transformation within halal ecosystems. In many developing countries, including Indonesia, limited technological readiness, inadequate digital infrastructure, and low levels of digital literacy among MSMEs remain significant challenges. Additionally, the implementation of advanced technologies such as blockchain and AI often requires high investment costs and specialized expertise. Without adequate institutional support and strategic planning, digitalization initiatives may not achieve optimal results.

Another important issue affecting digitalization effectiveness is the integration between technology and Sharia principles. Digital systems used in halal supply chains must not only improve efficiency but also maintain compliance with Islamic ethical values such as transparency, fairness, accountability, trustworthiness, and the avoidance of prohibited elements such as fraud and uncertainty. Therefore, digital transformation within the halal industry should be accompanied by strong governance systems, standardized halal regulations, and continuous monitoring to ensure that technological innovation aligns with Sharia objectives.

Overall, digitalization has demonstrated considerable effectiveness in strengthening halal supply chain management and enhancing the sustainability of the halal ecosystem. The integration of digital technologies improves transparency, traceability, operational efficiency, halal assurance, consumer trust, and market competitiveness. However, the effectiveness of digitalization depends not only on technological adoption but also on the readiness of institutions, human resources, regulatory frameworks, and governance systems. Therefore, successful digital transformation within the halal ecosystem requires comprehensive collaboration among government institutions, businesses, halal certification bodies, technology providers, and consumers to ensure that digital innovation contributes positively to sustainable and Sharia-compliant economic development.

Influence on consumer trust

One of the main ways digitalization influences consumer trust is through increased transparency (Riedl, 2021). In traditional supply chain systems, consumers often have limited access to information regarding the origin of raw materials, production methods, storage conditions, transportation systems, and certification processes. This lack of transparency can create uncertainty and skepticism regarding the authenticity of halal claims. Through digital technologies such as blockchain, QR-code systems, cloud databases, and mobile applications, consumers can access detailed and real-time information about halal products. They are able to verify certification status, track product origins, and monitor supply chain activities more easily. The availability of transparent and verifiable information reduces information asymmetry between producers and consumers, thereby increasing consumer confidence in halal products.

Digital traceability systems also significantly influence consumer trust. Traceability refers to the ability to monitor and track products from the sourcing of raw materials to final consumption. In halal

industries, traceability is particularly important because consumers are highly concerned about contamination risks, improper handling, and the mixing of halal and non-halal products during production or logistics processes. Technologies such as blockchain, Internet of Things (IoT), RFID systems, and smart sensors enable real-time product tracking and monitoring throughout the supply chain. These systems allow consumers to obtain accurate information regarding product movement, storage conditions, and halal compliance at every stage. As a result, consumers feel more secure and assured about the integrity of the products they purchase.

Another important influence of digitalization on consumer trust is the prevention of fraudulent halal practices. The circulation of fake halal labels, unauthorized certifications, and misleading product information has become a major issue in many halal markets (Voak, 2021). Such practices damage consumer confidence and weaken the credibility of halal industries. Digital verification systems provide more secure and reliable mechanisms for authenticating halal certificates and product claims. For example, blockchain-based certification systems create immutable records that cannot easily be manipulated, while QR-code verification allows consumers to confirm product authenticity instantly using smartphones. These technologies help reduce the risk of fraud and increase public trust in halal certification institutions and halal business operators.

Digitalization also improves communication and interaction between businesses and consumers, which further strengthens trust relationships. Through digital platforms, social media, mobile applications, and e-commerce systems, businesses can provide educational information regarding halal standards, certification processes, product ingredients, and Sharia compliance practices. Consumers can also communicate directly with businesses, ask questions, submit complaints, and receive immediate responses. Effective digital communication creates greater openness, responsiveness, and customer engagement, all of which contribute positively to building long-term consumer trust.

Furthermore, operational efficiency achieved through digitalization indirectly influences consumer trust. Efficient supply chain systems reduce delays, minimize errors, improve product quality control, and enhance service reliability. Automated inventory management, smart logistics systems, and digital monitoring technologies help businesses maintain consistent product quality and halal compliance (Tan & Husny, 2020). Consumers are more likely to trust businesses that demonstrate professionalism, reliability, and consistency in delivering halal products and services. Therefore, digitalization strengthens not only technical aspects of halal assurance but also the overall consumer experience.

The influence of digitalization on consumer trust is also closely related to the implementation of Islamic ethical principles within business operations. Sharia-based supply chains emphasize values such as honesty, transparency, fairness, accountability, and trustworthiness (*amanah*). Digital technologies support these principles by providing accurate information, reducing opportunities for manipulation, and improving accountability among stakeholders. Consumers tend to trust businesses that consistently demonstrate ethical behavior and commitment to Islamic values through transparent and accountable digital systems.

In addition, the rise of the digital economy and e-commerce has expanded access to halal products across domestic and international markets. Online marketplaces and digital platforms allow consumers to compare products, review certifications, read customer feedback, and access halal information more conveniently. Positive digital experiences and reliable online verification systems enhance consumer satisfaction and strengthen trust in halal brands. This is particularly important for younger generations of Muslim consumers who are highly connected to digital technology and increasingly rely on online information when making purchasing decisions.

However, despite the positive influence of digitalization on consumer trust, several challenges still remain. Cybersecurity risks, data privacy concerns, technological complexity, and low digital literacy can reduce consumer confidence if not managed properly (Burkell et al., 2015). Consumers may become skeptical if digital systems are vulnerable to hacking, misinformation, or technical failures. In addition, some businesses may adopt digital technologies superficially without genuinely improving halal compliance and ethical practices. Therefore, digitalization must be supported by strong governance systems, effective regulations, standardized certification procedures, and continuous supervision to ensure that technology is used responsibly and consistently with Sharia principles.

Institutional Readiness

Institutional readiness is a crucial factor in determining the success of strengthening the halal ecosystem through the digitalization of the Sharia supply chain. Institutional readiness refers to the ability of organizations, regulatory bodies, certification institutions, businesses, and supporting stakeholders to adapt to technological transformation, implement digital systems effectively, and maintain compliance with Sharia principles. In the context of halal ecosystems, institutional readiness encompasses technological capability, organizational commitment, regulatory support, human resource competence, digital infrastructure, governance systems, and inter-institutional collaboration. Without adequate readiness, the implementation of digitalization in halal supply chains may face operational inefficiencies, weak coordination, and limited effectiveness in maintaining halal integrity.

One of the main dimensions of institutional readiness is technological readiness (Webster & Gardner, 2019). Institutions involved in halal supply chains must possess adequate technological infrastructure to support digital operations, including internet connectivity, cloud systems, integrated databases, cybersecurity mechanisms, and digital monitoring tools. The adoption of technologies such as blockchain, Internet of Things (IoT), artificial intelligence (AI), and digital certification systems requires institutions to develop reliable digital platforms capable of supporting real-time data processing and information sharing. Organizations that lack technological infrastructure may encounter difficulties in integrating digital systems into their operational activities, which can weaken supply chain transparency and traceability.

Human resource readiness is another important aspect of institutional preparedness. The successful implementation of digital transformation depends heavily on the knowledge, technical skills, and digital literacy of employees and management. Many halal businesses, particularly Micro, Small, and Medium Enterprises (MSMEs), still face limitations in digital competence and technological understanding (Puspitaningrum et al., 2021). Employees may lack experience in operating digital platforms, analyzing data, or managing automated systems. Therefore, institutions must invest in education, training, and capacity-building programs to improve digital literacy and strengthen understanding of Sharia-compliant digital supply chain management. Human resource development is essential to ensure that digital technologies are utilized effectively and consistently with halal principles.

Organizational commitment and leadership readiness also play significant roles in supporting institutional transformation. Digitalization often requires substantial changes in organizational culture, operational procedures, and management systems. Leaders within halal institutions and businesses must demonstrate strong commitment to innovation, transparency, and continuous improvement. Effective leadership encourages organizational adaptation, supports employee readiness, and facilitates the integration of digital strategies into long-term business objectives. Institutions that resist technological change or lack strategic vision may experience difficulties in implementing digital transformation successfully.

Regulatory readiness is equally important in strengthening the halal ecosystem through digitalization. Governments and regulatory institutions must establish clear legal frameworks, digital standards, and governance systems to support halal digital transformation (Nawi, 2016). Regulations related to halal certification, digital verification, cybersecurity, data protection, and electronic transactions are necessary to ensure the reliability and legitimacy of digital halal systems. In many developing countries, including Indonesia, regulatory frameworks for blockchain-based halal certification, AI-supported verification systems, and cross-border halal data integration are still evolving. Weak or inconsistent regulations may create uncertainty for businesses and reduce the effectiveness of digital supply chain implementation.

Another essential aspect of institutional readiness is inter-institutional collaboration. The halal ecosystem involves multiple stakeholders, including producers, suppliers, logistics companies, certification institutions, Islamic financial institutions, regulators, digital platform providers, and consumers. Effective digitalization requires coordination and integration among these stakeholders to ensure smooth information exchange, standardized procedures, and synchronized monitoring systems. Institutions must be prepared to collaborate through shared digital platforms, interoperable databases, and integrated governance mechanisms (Ansell & Gash, 2018). Strong collaboration enhances operational efficiency, reduces duplication of processes, and strengthens overall halal assurance systems.

Institutional readiness also includes financial readiness and investment capability. The implementation of advanced digital technologies often requires substantial financial resources for infrastructure development, software acquisition, employee training, cybersecurity systems, and system

maintenance. Large corporations may possess greater financial capacity to adopt digital transformation, while MSMEs frequently encounter budget limitations that hinder technology adoption. Therefore, institutional readiness also depends on access to financing, government incentives, and support programs that encourage digital transformation within halal industries.

Cybersecurity readiness has become increasingly important as digital systems become more integrated into halal supply chains (Rejeb et al., 2019). Institutions managing digital halal data must ensure that information systems are protected from cyber threats, data breaches, hacking, and unauthorized access. Consumer trust and halal integrity can be severely damaged if digital systems are compromised. Therefore, institutions must establish strong cybersecurity policies, risk management procedures, and data protection mechanisms to ensure the reliability and security of digital operations.

In addition, institutional readiness must also be evaluated from the perspective of Sharia governance. Digital transformation within halal ecosystems should not focus solely on technological efficiency but must also maintain compliance with Islamic ethical principles. Institutions must ensure that digital systems support transparency, accountability, fairness, honesty, and halal assurance throughout the supply chain process. Sharia governance frameworks are necessary to supervise technological implementation and ensure that digital innovation aligns with Islamic business ethics and *maqāṣid al-sharī'ah* objectives.

Despite its importance, institutional readiness remains a major challenge in many halal industries. Limited digital infrastructure, low technological literacy, fragmented regulatory systems, weak coordination among stakeholders, and resistance to organizational change continue to hinder the effectiveness of digital transformation. Many MSMEs still rely on traditional operational methods and face difficulties adapting to digital systems due to financial and technical constraints (Kurniawati et al., 2021). Furthermore, disparities in technological capability among institutions may create unequal levels of participation within the halal ecosystem.

Consumer trust and public acceptance also strongly influence the success of digital halal ecosystems. Muslim consumers increasingly demand transparency, authenticity, and accountability regarding the halal status of products and services. Digital systems that provide accurate, accessible, and verifiable information regarding halal certification, product origins, supply chain activities, and compliance monitoring can significantly increase consumer confidence. Technologies such as QR-code verification systems, blockchain-based certification records, and mobile halal applications allow consumers to independently verify product authenticity and halal compliance. High levels of consumer trust encourage greater market participation and strengthen the competitiveness of halal businesses in domestic and global markets.

Another important success factor is the implementation of effective halal assurance and traceability systems. Halal integrity must be maintained consistently across all stages of production, processing, storage, transportation, and distribution. Digital traceability technologies enable businesses to track products in real time and identify potential contamination risks or non-compliance issues immediately. Automated monitoring systems reduce human error, improve accountability, and strengthen halal assurance mechanisms. Effective traceability systems not only enhance operational control but also protect the credibility and reputation of halal industries.

The integration of Islamic ethical principles and Sharia governance is also fundamental to the success of digital halal ecosystems. Digital transformation within halal industries must align with Islamic values such as honesty, transparency, fairness, accountability, and trustworthiness (*amanah*). Institutions implementing digital systems should ensure that technological innovation supports halal integrity and avoids unethical practices such as fraud, manipulation, and information asymmetry. Strong Sharia governance frameworks help supervise technological implementation and ensure compliance with Islamic business ethics and *maqāṣid al-sharī'ah* objectives.

Financial readiness and investment capability also contribute significantly to ecosystem success. The development and maintenance of digital infrastructure often require substantial financial investment. Businesses must allocate resources for software development, cybersecurity systems, employee training, data integration, and technology maintenance. Access to Islamic financial services, fintech support, government subsidies, and investment incentives can help organizations, particularly MSMEs, adopt digital technologies more effectively. Sustainable financial support ensures the continuity and scalability of digital transformation initiatives within halal industries.

Cybersecurity and data protection are increasingly important success factors in digital halal ecosystems. Since digital platforms rely heavily on data sharing and online transactions, institutions must ensure that digital systems are secure from cyber threats, data breaches, and unauthorized access. Effective cybersecurity systems protect consumer information, certification records, and operational data while maintaining public trust in digital halal services. Weak cybersecurity systems may undermine confidence in digital platforms and negatively affect the credibility of halal businesses.

Finally, innovation and adaptability are essential for maintaining the long-term sustainability of digital halal ecosystems. Technological advancement and market dynamics continue to evolve rapidly, requiring organizations to continuously innovate and adapt to changing consumer demands and regulatory environments. Businesses that actively adopt new technologies, improve operational processes, and respond to market trends are more likely to remain competitive within the global halal economy. Continuous innovation also supports the development of smart halal ecosystems capable of integrating sustainability, efficiency, and Sharia compliance simultaneously.

CONCLUSION

The rapid growth of the halal industry and the advancement of digital technology have created significant opportunities for strengthening the halal ecosystem through the digitalization of the Sharia supply chain. This research demonstrates that digital transformation plays a strategic role in improving transparency, traceability, operational efficiency, halal assurance, and consumer trust within halal industries. Technologies such as blockchain, Internet of Things (IoT), artificial intelligence (AI), cloud computing, and digital platforms enable more effective monitoring and management of halal supply chain activities from raw material sourcing to final product distribution. Through digital integration, halal businesses are able to strengthen accountability, minimize the risk of fraud and contamination, and ensure that halal integrity is maintained consistently throughout the entire value chain. The findings of this research also indicate that digitalization significantly influences consumer trust by providing transparent, accessible, and verifiable information regarding halal certification and supply chain processes. Modern Muslim consumers increasingly demand authenticity, accountability, and ethical business practices, making digital transparency an essential factor in strengthening market confidence and business competitiveness. In addition, digital transformation contributes to operational efficiency by simplifying certification procedures, improving logistics management, reducing administrative burdens, and facilitating coordination among stakeholders within the halal ecosystem. However, the success of digital halal ecosystems depends not only on technological adoption but also on institutional readiness, regulatory support, human resource competence, financial capability, cybersecurity systems, and effective stakeholder collaboration. Many challenges remain, including limited digital infrastructure, low digital literacy among MSMEs, fragmented regulations, high implementation costs, and the need for standardized halal digital governance systems. Therefore, successful implementation of digital Sharia supply chains requires strong commitment and cooperation among governments, halal certification institutions, businesses, Islamic financial providers, technology developers, logistics companies, and consumers. Furthermore, this research highlights that the integration of digital technologies within halal ecosystems must remain aligned with Islamic ethical principles and Sharia governance. Digitalization should not solely focus on efficiency and technological innovation but must also support transparency, fairness, accountability, trustworthiness (*amanah*), and halal compliance throughout all business processes. The application of Sharia values within digital systems is essential to maintaining halal integrity and ensuring sustainable halal economic development. Overall, this research concludes that the digitalization of the Sharia supply chain has substantial potential to strengthen the halal ecosystem and enhance the global competitiveness of halal industries. By integrating technology, institutional collaboration, and Islamic business principles, digital halal ecosystems can support sustainable economic growth, improve consumer confidence, and position Indonesia as a leading global halal hub. Therefore, continuous innovation, supportive policies, institutional strengthening, and investment in digital capabilities are necessary to maximize the effectiveness and sustainability of digital halal ecosystem development in the future.

AUTHORS' DECLARATION

Authors' Contributions and Responsibilities

All authors contributed significantly to the completion of this research.

Competing Interests

The authors declare that there are no competing interests regarding the publication of this research. The research was conducted independently without any commercial, financial, or personal relationships that could influence the objectivity, interpretation, or findings of the study.

Acknowledgments

The authors would like to express their sincere gratitude to all parties who contributed to the completion of this research.

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