

Digital Transformation in Indonesian Halal Industrial Zones

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Abstract

Digital transformation has become a strategic imperative for enhancing the competitiveness of Indonesia's halal industrial zones in an increasingly dynamic and transparency-driven global market. This study investigates the application of digital technologies—namely Blockchain, the Internet of Things (IoT), and Artificial Intelligence (AI)—within halal industrial areas, while identifying key challenges, emerging opportunities, and strategic development pathways. Adopting a qualitative exploratory approach, the research involved semi-structured interviews with five key informants, including industrial zone managers, officials from the Halal Product Assurance Agency (BPJPH), and representatives of halal-oriented small and medium enterprises (SMEs). Additional data were collected through on-site participant observation and document analysis of relevant policies and technical reports. Thematic analysis was employed to examine the qualitative data, followed by interpretation through a SWOT framework, which was subsequently integrated into a TOWS matrix to formulate strategic recommendations. The findings highlight three primary challenges: digital inequality among industrial zones, resistance to technology adoption, and inadequate infrastructure. These issues underscore the urgent need for regulatory harmonization by the government, increased investment in infrastructure and digital literacy by industry stakeholders, and enhanced academic engagement in Shariah-compliant digitalization research. The study proposes several actionable recommendations, including the establishment of public-private partnerships (PPPs), the implementation of certified digital training programs for halal SMEs, the creation of halal technology incubators, and the development of national standards for halal-related digital technologies. Overall, this research contributes to the discourse on building a digitally integrated, transparent, and sustainable halal industrial ecosystem in Indonesia.

Keywords: Digitalization; Halal Industry; Modernization; Technology.

Abstrak

Transformasi digital menjadi kebutuhan strategis bagi penguatan daya saing kawasan industri halal Indonesia dalam menghadapi pasar global yang semakin dinamis dan menuntut transparansi. Penelitian ini bertujuan untuk menganalisis bagaimana teknologi digital seperti Blockchain, Internet of Things (IoT), dan Artificial Intelligence (AI) diterapkan dalam kawasan industri halal, serta mengidentifikasi tantangan, peluang, dan strategi pengembangan yang sesuai. Penelitian menggunakan pendekatan kualitatif eksploratif melalui wawancara semi-terstruktur terhadap lima informan kunci (pengelola kawasan, BPJPH, dan pelaku UKM halal), observasi partisipatif di lokasi, serta analisis dokumen kebijakan dan teknis. Analisis data dilakukan melalui teknik thematic analysis dan diperkuat dengan kerangka SWOT yang kemudian diintegrasikan dengan matriks TOWS untuk menghasilkan strategi operasional. Hasil penelitian menunjukkan tiga temuan utama, yaitu ketimpangan digital antar kawasan, resistensi terhadap adopsi teknologi digital, dan keterbatasan infrastruktur. Implikasi dari temuan ini mencakup perlunya harmonisasi regulasi dari pemerintah, peningkatan infrastruktur dan pelatihan oleh industri, serta kontribusi akademisi dalam riset lanjutan berbasis syariah. Rekomendasi aplikatif yang diajukan antara lain pembentukan public-private partnership (PPP), program pelatihan digital bersertifikat untuk UKM halal, inkubasi teknologi halal, dan penyusunan standar teknologi halal nasional. Penelitian ini memberikan kontribusi terhadap pengembangan ekosistem industri halal yang terintegrasi, transparan, dan berkelanjutan secara digital.

Kata kunci: Digitalisasi; Industri Halal; Modernisasi; Teknologi.

INTRODUCTION

In recent years, the international market has shown growing interest in halal products and services. This trend is driven by the expanding global Muslim population and a heightened awareness of the importance of consuming goods that adhere to halal principles. As the country with the world's largest Muslim population, Indonesia has prioritized the development of the halal sector as a key national strategy to stimulate economic growth and enhance its global competitiveness (Standard, 2020).

In parallel with these developments, halal industrial zones have emerged as key production hubs, ensuring the authenticity of halal products by overseeing the process from raw materials to finished goods. The digital era presents both significant opportunities and novel challenges for these zones. Digital technologies offer innovative solutions to enhance security, transparency, and efficiency throughout the halal production and distribution chain. Consequently, digital transformation has become an essential and non-negotiable step to sustain the growth of halal industries in an increasingly competitive global environment (BPJPH, 2024).

Technologies such as Blockchain, the Internet of Things (IoT), and Artificial Intelligence (AI) have opened new avenues for the halal sector to implement advanced supply chain management, product traceability, and enhanced quality assurance. Blockchain enables the verification of each stage in the supply chain, ensuring end-to-end transparency. This allows consumers and stakeholders to easily access and verify a product's halal status. Simultaneously, IoT facilitates real-time monitoring of production and storage conditions, thereby ensuring strict compliance with halal standards.

Amid the ongoing digital transformation, halal industrial zones in Indonesia and other countries face significant challenges in integrating digital technologies into traditional production systems. Furthermore, there is a pressing need for regulations and standards that not only accommodate these technological advancements but also ensure that the workforce within the sector possesses the necessary skills to adapt to an increasingly digital environment (Lee, 2015).

This article aims to examine the application of digital transformation in the halal industry, identify its associated challenges and opportunities, and provide strategic recommendations to support the sector's development in the digital era. Through this analysis, it is expected that stakeholders within the halal industry will recognize the urgency of adapting to technological advancements and harness the substantial potential offered by digital innovation.

Several studies have demonstrated the positive impact of adopting digital technologies in halal industrial zones. For instance, a halal industrial zone in Malaysia has implemented Blockchain technology to enhance supply chain transparency. Research by Abdullah et al. (2019) indicates that this technological integration significantly increased consumer trust and reinforced the global competitiveness of Malaysian halal products (Abdullah, 2019).

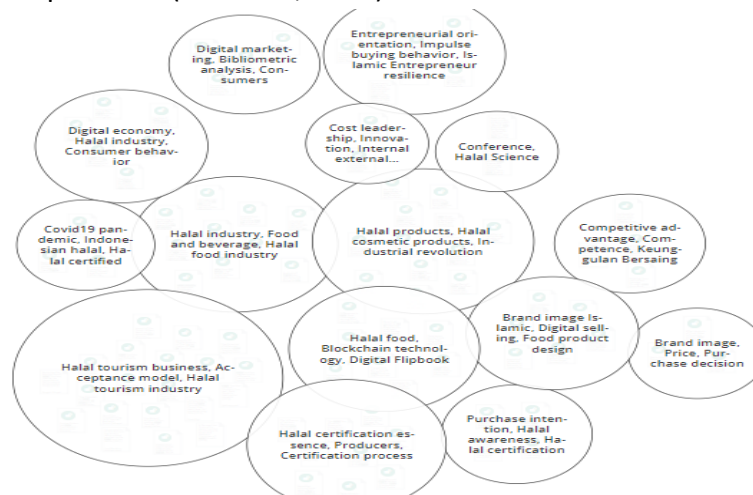


Figure 1. Research Gap in Halal Industry Digitalization

Source: <https://openknowledgemaps.org/map/11bd90ba3ada313725d699a6d0478274>

Recent literature indicates that digital transformation in halal industrial zones holds significant potential to enhance efficiency, transparency, and the global competitiveness of halal products. However, challenges such as inadequate technological infrastructure, regulatory gaps, and resistance to change must be addressed to fully realize these benefits. Collaborative efforts among government, industry, and academia are essential for overcoming these barriers. Such synergy will enable halal industrial zones to effectively leverage digital technologies, fostering greater sustainability and driving robust economic growth.

Indonesia's halal market has exhibited strong growth trends, both in terms of trade value and long-term projections. Between January and October 2024, the total

value of Indonesia's halal product trade reached USD 53.73 billion, with exports contributing USD 41.4 billion. The food and beverage sector emerged as the leading contributor, accounting for 81.16% of total halal exports (Antara, 2024). On the domestic front, the halal market is projected to expand from USD 279.26 billion in 2023 to USD 807.86 billion by 2031, reflecting a compound annual growth rate (CAGR) of 14.2% (DBMS, 2024). Overall, Indonesia's national halal economy is estimated to hold a potential value of IDR 20,000 trillion, encompassing sectors such as food, fashion, pharmaceuticals, tourism, and Islamic finance. These figures underscore the halal industry's role not only as a substantial market opportunity but also as a critical driver of Indonesia's economic development (Bisnis Indonesia, 2024).

To support the expansion of the halal market, the Indonesian government has established Halal Industrial Zones (Kawasan Industri Halal, KIH) as part of a broader strategy to develop Sharia-compliant industrial infrastructure. A flagship initiative is the Modern Halal Valley in Cikande, Banten—the first and largest integrated halal industrial cluster in Indonesia—spanning 500 hectares. In East Java, the Safe n Lock Halal Industrial Park in Sidoarjo covers 148 hectares and is being developed in two phases. Meanwhile, the Bintan Inti Halal Hub in the Riau Islands specializes in halal food processing and related logistics services. Beyond these three core developments, future KIH projects are planned in Batam, Pulogadung (Jakarta), and Central Kalimantan. These initiatives underscore the government's commitment to building a standardized, efficient, and globally competitive halal industrial ecosystem to serve both domestic and international markets (Portal Informasi, 2021).

The quantitative growth and ongoing infrastructure development of Indonesia's halal industry underscore the urgency of positioning digital transformation as a national strategic agenda. The expanding halal market necessitates improved efficiency, transparency, and accountability—objectives that can be effectively pursued through the adoption of technologies such as Blockchain, the Internet of Things (IoT), and Artificial Intelligence (AI). Concurrently, the establishment of halal industrial zones demonstrates the government's commitment to developing a standardized and globally recognized halal production and distribution system. Within this context, research on the digitalization of halal industrial zones becomes both timely and strategically significant, particularly in evaluating the readiness of digital infrastructure, human resource competencies, and the effectiveness of existing policy frameworks. This study also contributes to formulating evidence-based recommendations to strengthen digital integration within the broader agenda of Indonesia's halal economic development (Kemenperin, 2021).

For instance, Halal Modern Valley (HMV), located in Cikande, Banten, is Indonesia's first and largest integrated halal industrial zone, spanning 500 hectares. Developed by PT Modern Industrial Estate with full support from the Ministry of Industry and the Halal Product Assurance Agency (BPJPH), HMV provides a comprehensive ecosystem for halal-oriented businesses. Its facilities include

industrial plots, logistics centers, halal certification laboratories, and residential-commercial complexes. In addition to its physical infrastructure, HMMV has begun implementing digital systems for logistics and halal product traceability to improve supply chain efficiency and transparency. The success of HMMV illustrates that integrating digital infrastructure into halal industrial management can accelerate the halal certification process and enhance the competitiveness of halal products in both domestic and international markets (Portal Informasi, 2021). Similarly, Malaysia has positioned itself as a pioneer in applying Blockchain technology to its halal supply chains, spearheaded by the Halal Development Corporation (HDC). Through the Halal Digital Chain system, every stage of production—from raw materials to distribution—is digitally recorded and rendered tamper-proof. Consumers and regulatory authorities can verify a product's halal status in real time using QR codes linked to a Blockchain-based platform. A study by Abdullah et al. (2019) found that the adoption of this technology has significantly increased consumer trust and bolstered the global competitiveness of Malaysian halal products. This case underscores the potential of advanced technologies such as Blockchain to provide innovative, transparent, and cross-border solutions for halal compliance (Abdullah et al., 2019).

Digital transformation is a critical prerequisite for Indonesia to achieve its ambition of becoming a global hub for the halal industry. As the country with the world's largest Muslim population, Indonesia possesses a substantial domestic market and considerable export potential. However, to meet the expectations of the global halal market—particularly regarding transparency, efficiency, and accountability in production—there is an urgent need to adopt digital technologies such as Blockchain, the Internet of Things (IoT), and Artificial Intelligence (AI). These technologies facilitate real-time halal traceability, expedite the certification process, and ensure consistent compliance across the supply chain. In this context, Indonesia's role should not be limited to that of a market participant, but rather evolve into a global leader and model for technology-driven halal industry governance. Without a cohesive and integrated digital transformation strategy, Indonesia risks falling behind countries such as Malaysia and the United Arab Emirates, which have already established advanced digital halal ecosystems.

LITERATURE REVIEW

Islamic Economic Theory in the Context of Digitalization

According to Islamic economic scholars, digital transformation in the halal industry can be viewed through the lenses of justice (*adl*), transparency (*shafafiyyah*), and sustainability (*istiqamah*). In the book *Future of Islamic Economics: An Islamic Perspective* (Chapra, 2001), Islamic economics emphasizes the importance of justice and social welfare in economic activities. The application of digital technology in the halal industry aligns with these principles, as technology can enhance operational efficiency and ensure that the products sold to consumers meet Islamic standards. Moreover, the concept of *Tawhid* (the oneness of God) in Islamic economics teaches

the integration of worldly and spiritual goals, including using technology to improve humanity and environmental sustainability. This is reflected in how digital technologies can help the halal industry optimize profits and ensure that the products comply with Islamic standards, benefit society, and support economic sustainability.

According to Rejeb et al. (2021), the integration of IoT into the halal food supply chain contributes in five major ways: real-time product tracking, supply chain efficiency, monitoring of farming and production processes, authentication of halal status, and oversight of the certification process. The study shows that by utilizing IoT, the halal industry can enhance logistics efficiency and ensure transparency in distribution. Meanwhile, AI plays a critical role in data-driven decision-making and forecasting demand within the halal market. This technology enables industry players to efficiently adjust production capacity and manage risk with greater accuracy. Nonetheless, challenges such as technical limitations, inadequate infrastructure, and low user adoption remain major obstacles to successful implementation.

Application of Digital Technologies in the Halal Industry

As discussed in this study, digital transformation in the halal sector involves using blockchain technology, IoT, and AI. Blockchain technology offers benefits in terms of transparency and traceability, allowing halal products to be tracked from raw materials to the final product delivered to consumers. As described by (Nakamoto, 2008), blockchain enables secure, tamper-proof, and openly distributed transactions, which are crucial in ensuring the integrity of halal products.

IoT technology can improve operational efficiency by enabling real-time monitoring and management of data in production and distribution processes. This aligns with the Jugaad Innovation theory presented by (Radjou et al., 2012), which emphasizes using technology to create more efficient and cost-effective solutions in operations, especially for small and medium-sized enterprises (SMEs).

On the other hand, the application of AI in the halal industry can potentially improve market demand forecasting, risk management, and product development. As outlined by Brynjolfsson (2014), AI allows for deeper data analysis and faster, more accurate decision-making at scale, which is vital for responding to rapidly changing market demands.

Through a systematic review, Sulaiman et al. (2023) identified that the application of digital technologies 4.0—particularly Blockchain, IoT, and AI—has proven to enhance company performance in terms of efficiency, compliance with halal standards, and product competitiveness. They emphasize that although the benefits of digitalization are clear, adoption among small and medium-sized halal enterprises (SMEs) remains limited due to resource constraints and a lack of awareness. Therefore, a more inclusive and comprehensive approach is required to ensure that digital transformation reaches all stakeholders within the halal ecosystem, not just large corporations.

Impact of Digitalization on Economic Growth and Empowering SMEs

One of the key aspects raised in this study is the impact of digital transformation on economic growth, particularly in empowering SMEs. According to Hassan et al. (2022), digitalization can empower SMEs in the halal industry by providing access to global markets, improving product quality, and increasing production efficiency. This also supports the theory of economic inclusion in Islamic economics, which aims to create opportunities for all sectors of society, including SMEs, to participate in the modern economy.

Digital transformation also opens up new job opportunities, which aligns with the principle of cooperation (*takaful*) in Islamic economics, encouraging collaboration between various parties to create social and economic benefits. Therefore, digital skills training for the local workforce is crucial to support the successful implementation of technology in the halal industry, as outlined in (Sachs, 2019) theory of human capital.

Challenges and Barriers to Implementing Digitalization

Despite the significant potential of digital transformation in the halal industry, several challenges must be addressed. One of these challenges is the substantial investment required in technological infrastructure and adopting suitable systems. As discussed by (Halim et al., 2017), the halal sector needs clear regulations and government support to ensure the success of digital transformation. Supportive regulations will provide a clearer framework for halal businesses to operate digitally and encourage more players in the industry to adopt digital technologies.

Additionally, resistance to change remains a major barrier. According to (Kotter, 1996), resistance to change is one of the key obstacles to implementing new technologies. This may occur due to concerns over altering established business processes or a lack of understanding of the benefits of these technologies. Therefore, the halal industry must engage in awareness campaigns and training programs to help workers and industry players understand and adopt digital technologies more easily.

The Deloitte (2023) report highlights that digital transformation is not merely about investing in technology, but also about an organization's ability to align strategy with execution. Based on a study of over 4,600 organizations, it was found that the right combination of actions in digital transformation can generate up to USD 1.25 trillion in added value, while misaligned strategies can lead to substantial losses. In the context of developing countries such as Indonesia, key challenges include infrastructure readiness, underdeveloped regulatory frameworks, and a digital skills gap. Therefore, digital transformation in Indonesia's halal industry must be systematically designed, supported by inclusive policy frameworks, and strengthened through multisectoral collaboration.

The adoption of digital technologies in the halal industry is not solely aimed at achieving operational efficiency, but also aligns closely with fundamental values in

Islamic economics. The principle of *adl* (justice) is reflected in the use of Artificial Intelligence (AI), which supports equitable planning of production and distribution, thus preventing supply chain imbalances and ensuring fair access to halal products. Meanwhile, *shafafiyyah* (transparency) is practically embodied through the implementation of Blockchain and the Internet of Things (IoT), which enable real-time, tamper-proof product tracking, allowing consumers to access trustworthy and transparent halal information. These technologies build trust and uphold the integrity of the halal supply chain. The principle of *istiqamah* (consistency and sustainability) is upheld through the digitization of environmentally responsible processes, reduction of waste, and assurance of halal quality from upstream to downstream. Therefore, digital transformation in the halal industry represents not only a technical innovation but also a concrete manifestation of *maqashid al-shariah* values in modern economic governance.

RESEARCH METHOD

This study employed a qualitative exploratory approach to investigate the implementation of digital transformation within Indonesia's halal industrial zones. The exploratory nature of the research allowed the researchers to gain an in-depth understanding of contextual challenges, stakeholder experiences, and systemic dynamics that influence digital adoption. Data were collected using three primary techniques. First, semi-structured interviews were conducted with five purposely selected informants: two managers of halal industrial zones, one official from the Halal Product Assurance Agency (BPJPH), and two SME practitioners engaged in halal product development. These participants were selected for their direct involvement in digitalization initiatives and practical knowledge of the industry. Second, participant observation was carried out at a selected halal industrial zone to examine the real-time application of digital technologies such as Blockchain, Internet of Things (IoT), and Artificial Intelligence (AI) in daily operational processes. Third, document analysis was performed by reviewing relevant regulatory frameworks, technical guidelines, and industry reports to support the triangulation of findings. The collected data were analyzed using thematic analysis, involving transcription, coding of key themes, categorization, and interpretative synthesis. This was complemented by a SWOT analysis to assess internal and external factors—specifically strengths, weaknesses, opportunities, and threats—surrounding the digital transformation efforts. Through this integrative method, the study provides a comprehensive understanding of the current landscape of digitalization in halal industrial zones and offers evidence-based insights to guide future strategies and policy-making.

RESULTS AND DISCUSSION

The research found that the halal industry in Indonesia, despite facing challenges in adopting digital technologies, shows great potential to enhance its

global competitiveness by applying technologies such as Blockchain, IoT, and AI. In this context, Blockchain can ensure transparency in halal goods' production and distribution processes, while IoT and AI provide ease in monitoring product quality and responding quickly and accurately to market demands.

Furthermore, the study also identified significant opportunities in creating new employment opportunities in small and medium-sized enterprises (SMEs) within the halal industry ecosystem. This shows that technology adoption focuses on increasing efficiency and empowering the local economy, especially in areas with substantial halal business potential. However, the biggest challenges identified were the lack of adequate digital infrastructure and resistance from some stakeholders who are reluctant to make digital changes due to regulatory uncertainties and the inability to adapt to new technologies.

One of the main debates in academic literature is about the benefits of digital technology's efficiency and transparency compared to originality and traditional beliefs in the halal industry. The supporters of digital transformation argue that technology such as Blockchain and the Internet of Things (IoT) can increase consumers' trust by providing unchanged notes of the halal product origins and processes. Nevertheless, the critics have concerns about over-dependency on technology that may destroy the beliefs toward traditional mechanisms and manual skills that have long been the foundation of halal certification.

Another debate concerns infrastructure and human resources readiness to adopt digital technology in the halal industrial zone. Some scholars believe industrial zones lack sufficient technological infrastructure, especially in developing countries. They also highlight the lack of technical skills among the local workforce, which can significantly hinder the adoption of digital technology. On the contrary, the optimists believe that investment in training and infrastructure development can overcome the challenges. There are also skeptical perspectives on the rapid adoption of digital technology in the halal industrial zone. Some economists, particularly from developing countries, argue that digital transformation may worsen the digital divide, especially for small businesses that lack the resources or infrastructure to invest in high-end technology. Also, they warn about the potential for excessive regulations that could slow down technology adoption. Some people in the halal industry believe that overly strict regulations on implementing technology could become barriers rather than solutions, ultimately stifling innovation and growth in the sector.

Regulation and data security issues have also become the center of debate. Scholars who support digital transformation emphasize the importance of clear and strong regulations to ensure the safety and ethical use of Blockchain and AI. However, there is uncertainty that excessive regulation can hinder innovation and technology adaptation. In addition, some parties are also concerned that new technology can increase the violation of data and consumers' privacy.

According to the data in this study, digital technology employment in halal industrial zones can enhance operational efficiency and transparency. For example,

Blockchain technology enables real-time product tracking from its origin to the consumers, ensuring the halal status of a product remains halal along the supply chain. IoT can help supervise storage conditions and distribution and confirm strict compliance with the halal standard.

This study also reveals that a lack of technological infrastructure and technical skills are the main obstacles to the digital transformation of the halal industrial zone. Many industrial zones struggle to equip basic infrastructure, such as reliable internet connectivity and hardware, to apply digital technology. Besides, this study clarifies data security and privacy concerns when using digital technology. Even though Blockchain offers high security, there is always a risk in organizing and storing sensitive data. This research also shows the necessity of a strong regulation framework to protect consumers' data and ensure technology's ethical use. Moreover, this study also reveals that digital transformation can positively impact the local economy and community empowerment. With proper training, the local workforce can unlock new skills needed in a highly digital industry, open better job opportunities, and help reduce economic disparities.

Recommendations from this study include: Investment in infrastructure (government and private investment to support digital transformation in the halal industrial zone); Training and Education (local workforce training program and technical skill education on digital technology); Supporting Regulations (clear and comprehensive regulation to regulate the use of digital technology, including protection to the consumers' data privacy and security; International collaboration) strengthen international collaboration to share knowledge and best practice of the application of digital technology in halal industry.

Nevertheless, research findings show that digital transformation in halal industrial zones offers significant advantages, such as improving efficiency, transparency, and positive impacts on the local economy. However, challenges such as a lack of infrastructure, technical skills, and data security problems need to be fixed to maximize the advantages of this transformation. With a holistic and collaborative approach, halal industrial zones can integrate digital technology to achieve better sustainability and stronger economic growth.

Table 1. The Strengths of Digital Transformation in Halal Industrial Zones

Strengths:	
1	Vast Domestic Market: The significant Muslim population in Indonesia provides a huge domestic market for halal products. Digital transformation can enhance production efficiency and product quality, meeting the growing number of consumers' demands.
2	Government's Support of Regulation Framework: The Indonesian government supports the halal industry through regulation and initiation, such as the Agency for Halal Products (BPJPH). This kind of support

	facilitates digital technology adoption by creating an encouraging regulation environment.
3	Increasing Transparency and Traceability: Digital technology like Blockchain provides a strong system to trace down and verify halal products throughout the supply chain. This can increase transparency, develop consumers' trust, and ensure compliance with halal standards.
4	Increasing Operational Efficiency: Technology like the Internet of Things (IoT) can optimize production processes and distribution by providing real-time and automated data. This can improve operational efficiency, reduce waste, and lower production costs.
5	Opportunity for Innovation and Competitive Edge: Adopting digital transformation opens up product development innovation and supply chain management opportunities. With advanced technology, the Indonesian halal industrial zone can have a competitive edge in local and international markets.

Table 2. The Weaknesses of Digital Transformation in Halal Industrial Zones**Weaknesses:**

1	Infrastructure Limitations: Many areas in Indonesia, especially rural and remote areas, lack adequate technological infrastructure, such as high-speed internet and hardware, such as modems, which can hinder the application of digital technology.
2	Skill Disparity and Training Needs: The lack of technical skills needed to manage and use digital technology effectively. These kinds of disparities need huge investments in skill training and workforce development.
3	High Initial Costs: Adopting and integrating digital technology, including purchasing equipment, software, and infrastructure provision, can be very high. The financial burden might be a huge challenge for the middle and lower industries.
4	Resistance to Changes: There might be rejections from traditional stakeholders who are used to conventional methods and practices. This resistance can slow down the adoption of digital technology and interfere with the whole transformation process.

Table 3. Opportunities for Digital Transformation in Halal Industrial Zones**Opportunities:**

1	International Market Expansion: Digital technology can increase the quality, traceability, and compliance of halal products, thus becoming more competitive in the global market. This way allows Indonesian halal products to set foot and thrive in the global market.
2	Improving Consumers' Engagement: Digital tools like e-commerce and social media can enhance direct consumer engagement. This allows for

	better marketing, customer feedback collection, and personalized service, increasing sales and brand loyalty.
3	Better Regulation Compliance: Digital solutions can simplify compliance with halal certification regulations. Blockchain technology can provide clear and unchangeable halal compliance that simplifies audit and inspection.
4	Economic Growth and Job Creation: Investment in digital technology can drive economic growth by modernizing halal industry. It also creates new job opportunities in technological management, data analysis, and global marketing, contributing to local economic growth.
5	Innovation in Product and Process Development: Digital transformation drives innovation in product development and manufacturing processes. Advanced technologies like Artificial intelligence (AI) and IoT can lead to new product offers and more efficient manufacturing processes.

Table 4. Threats of Digital Transformation in Halal Industrial Zones**Threats:**

1	Data Security Risks: The increase in the use of digital technology has created concern about cyber security and data privacy. The vulnerability of digital systems can cause data violation, sensitive information stealing, and loss of consumers' trust.
2	Regulation Uncertainty: The ever-changing environment in which regulation prevails for digital technology and halal certification can become challenging. The unclear and inconsistent regulations can cause compliance problems that affect the application and operation of digital systems.
3	Out-Dated Technology: Fast technological advancement means the adopted system and solution can easily be outdated. This leads to updating and investing in the latest technology and maintaining a competitive edge.
4	Resistance to Changes: There are possibilities of resistance from traditional stakeholders and workers who are used to conventional practices. This resistance can slow the adoption of the latest technology and hinder the overall digital transformation initiatives.
5	Infrastructure Disparity: Uneven availability of technological infrastructure in less developed areas causes disparity. Industrial zones in less developed areas may struggle with internet connectivity and outdated hardware, limiting the benefits of digital transformation.

The SWOT analysis provides a structured insight into the main factors that influence digital transformation in the halal industrial zone, and highlights the strengths, weaknesses, opportunities, and threats so that stakeholders can consider them for effective implementation and strategic planning.

Table 5. Internal Factor Evaluation (IFE)

Key Internal Factors	Weight	Rating	Weighted Score
Strengths			
1. Huge Domestic Market	0.25	4	1.00
2. Government's Support and Regulatory Framework	0.20	4	0.80
3. Increased Transparency and Traceability	0.15	3	0.45
4. Increased Operational Efficiency	0.15	3	0.45
5. Opportunities for Innovation and Competitive Advantage	0.10	4	0.40
Weaknesses			
1. Infrastructure Limitations	0.10	2	0.20
2. Skill Gaps and Training Needs	0.05	2	0.10
3. High Initial Costs	0.05	2	0.10
4. Resistance to Change	0.05	2	0.10
Total	1.00		3.60

Table 6. External Factor Evaluation (EFE)

Key External Factors	Weight	Rating	Weighted Score
Opportunities			
1. International Expansion	0.25	4	1.00
2. Increasing Consumers' Engagement	0.20	3	0.60
3. Better Regulatory Compliance	0.15	3	0.45
4. Economic Growth and Job Creation	0.15	3	0.45
5. Innovation in Product and Process Development	0.10	3	0.30
Threats			
1. Data Security Threats	0.05	3	0.15
2. Uncertain Regulation	0.05	2	0.10
3. Outdated Technology	0.05	2	0.10
4. Resistance upon Changes	0.05	2	0.10
5. Infrastructure Disparity	0.05	2	0.10
Total	1.00		3.35

Based on the IFE analysis, the total score of 3.60 shows that the halal industry in Indonesia has internal and significant strengths that can be optimized for further development. Meanwhile, from the EFE analysis, the total score of 3.35 shows that many external opportunities can be applied to the halal industry in Indonesia, even though several threats that need to be fixed also exist.

From these values, the conclusion can be drawn that digital transformation in the halal industrial zone in Indonesia is in Quadrant 1 (Strengths and Opportunities), which is the most profitable position. In Quadrant 1 (SO), an organization or a project has a huge and vast internal strength. Thus, the strategy that must be implemented should be aggressive by utilizing internal strengths to maximize external strengths.

This strategy includes expansion and development through improving operations and entering new markets, product and service innovation to develop new halal products that meet the customer's needs, and strategic partnerships with other organizations to strengthen the market position, thus enhancing brands' reputations as leaders in the halal industry. Using this analysis, organizations can formulate effective strategies to leverage their strengths and seize opportunities in digital transformation in the halal industrial zones.

The SWOT analysis applied in this study is grounded in the strategic management framework proposed by David (2011), which integrates both internal and external environmental assessments to support strategic decision-making. The analysis evaluates key internal factors—strengths and weaknesses—through an Internal Factor Evaluation (IFE) matrix, and external factors—opportunities and threats—through an External Factor Evaluation (EFE) matrix. Each factor is weighted and rated to produce a composite score that reflects the organization's strategic position. The total score of the IFE matrix in this study is 3.60, indicating that Indonesia's halal industrial zones possess strong internal capabilities such as government support, market size, and digital innovation potential. Meanwhile, the EFE matrix yields a score of 3.35, suggesting that the external environment offers considerable opportunities for digital transformation, though challenges such as regulatory uncertainty and infrastructure gaps remain.

Based on these scores, the industry is positioned in Quadrant I (Strengths–Opportunities/SO) of the TOWS matrix, which supports the development of aggressive growth strategies. To translate the SWOT findings into actionable strategies, the following TOWS-based strategic directions are proposed:

Table 7. TOWS-Based Strategic Directions

SO (Strength–Opportunity) Strategy	:	Leverage strong internal capabilities to pursue global expansion and foster digital innovation in product and process development.
WO (Weakness–Opportunity) Strategy	:	Address internal limitations—such as skills gaps and infrastructure deficits—through targeted digital literacy training, workforce development, and public–private investment in technology infrastructure
ST (Strength–Threat) Strategy	:	Utilize regulatory support and institutional strength to mitigate cybersecurity risks and enforce robust data protection systems across halal digital platforms

WT (Weakness–Threat) Strategy	: Reduce resistance to change and technological disparity through community-based digital awareness programs, stakeholder engagement, and incubation of small-scale halal tech enterprises
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This integration of SWOT and TOWS not only enhances the analytical depth but also provides stakeholders with a roadmap for strengthening digital resilience and competitiveness in Indonesia’s halal industrial zones.

CONCLUSION

This article explores the strategic alignment of digital transformation within halal industrial zones as a means to enhance competitiveness, efficiency, and transparency in the global halal market. The research employs a combination of literature review, in-depth interviews, participant observation, and document analysis to examine the role of digital technologies in this context. The findings highlight several key advantages of digital transformation. Notably, the adoption of advanced technologies such as Blockchain and the Internet of Things (IoT) has led to improved operational efficiency by enabling real-time tracking and more effective supply chain management. Furthermore, digital technologies enhance accountability and transparency, thereby strengthening consumer trust in halal-certified products.

Based on the analysis, Indonesia’s halal industry is positioned in Quadrant I (Strengths and Opportunities) of the SWOT matrix, indicating a strategic focus on leveraging internal strengths to capitalize on external opportunities. Nonetheless, the study also identifies several critical challenges and threats. Among them are limited technological infrastructure and inadequate internet connectivity, particularly in less developed regions. A shortage of technical skills required for effective implementation of digital technologies also poses a significant barrier, underscoring the need for targeted training and capacity-building programs. Moreover, data security and privacy concerns must be addressed through stringent regulations and the establishment of a robust data protection framework. To overcome these challenges, the halal industry should pursue an expansion strategy that emphasizes product and service innovation, the formation of strategic partnerships, and the enhancement of brand positioning. These measures will enable the industry to effectively harness its strengths, seize emerging opportunities, and mitigate the risks identified through the SWOT analysis.

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