

Perspectives of Stakeholders on the Application of Blockchain Technology in Halal Supply Chain in Malaysia

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Abstract: Blockchain (BC) technology has been introduced to the Halal food supply chain (HSC) in Malaysia in order to certify the Halal status of food products. This study uses a qualitative research approach to investigate the perspectives of stakeholders involved in HSC on the use of BC in the HSC in Malaysia, using semi-structured, one-to-one interviews. Five in-depth interviews revealed a range of interrelated themes, including the level of awareness of BC technology among participants, their vivid articulations of the perceived advantages and disadvantages of this transformative technology within the unique context of Halal supply chains in Malaysia and the challenges that exert their impact on Blockchain's course within this ecosystem, in addition to the perceived success factors, revealing that there is lack of awareness on Blockchain technology among stakeholders, excluding technology providers. Identified challenges span technological, legal, inter-organizational, security, safety, and financial domains. Conversely, success factors encompass heightened awareness, trust-building, financial backing, and regulatory alignment.

Keywords: Blockchain, halal certification, halal supply chain, challenges.

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1. INTRODUCTION

Halal Certification

The global Muslim population, estimated at over 1.9 billion people, is greatly influenced by the words Halal (Lawful) and Haram (Unlawful) in Islam (Bux *et al.*, 2022). Halal, meaning permissible, allowed, lawful, and legal, has expanded to include hygiene and safety (Elasrag, 2016). Halal food is distinguished by its nature, ingredients, and processing, making it acceptable by Islamic laws (Abdul *et al.*, 2009). The Halal industry, worth around 2.3 trillion USD, is a major player in international trade and extends beyond the food sector to include other sectors such as pharmaceuticals, cosmetics, health products, toiletries, medical devices, and service sectors (Elasrag, 2016; Muyassaroh *et al.*,

2021). Despite this, Halal food accounts for 61% of the Halal industry (Elasrag, 2016). In Malaysia, Muslims rely on Halal logos issued by JAKIM (the halal certification body in Malaysia) to ensure product or service compliance (Nasir *et al.*, 2011). However, it is still challenging to confirm the Halal status of food products due to the complexity of food industry, the use of multiple ingredients and processing techniques, which makes Halal certification crucial for both consumers and producers (Batu & Regenstein, 2014). Although Halal certifications are issued by several Islamic agencies worldwide, there is a lack of uniformity of Halal regulations in the market, and only 15% out of global Halal certification bodies are recognized by JAKIM (Bux *et al.*, 2022; Said *et al.*, 2014).

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Fraudulent Halal certification cases have been reported in Malaysia. For instance, Malaysia has been a site of several meat fraud scandals, including adulteration, mislabeling of meat products, and importing illegal meat from China, Ukraine, Brazil, and Argentina (Ariffin *et al.*, 2021). Therefore, Halal products must be maintained in a Halal supply chain due to issues such as discrepancies in Halal definition, misuse of Halal logos, and lack of enforcement by authorities (Sarah *et al.*, 2011). The Halal supply chain is defined as the movement of products or services from producers to consumers while adhering to Islamic laws and regulations, which includes the procurement and preparation of Halal ingredients, manufacturing, and market delivery (Sarah *et al.*, 2011), and should be practiced by all stakeholders, including manufacturers, suppliers, and consumers (Ab Talib *et al.*, 2015). Importantly, Halal supply chain verification covers five major areas: farming, slaughter, meat processing, packaging, labelling, storage, and distribution (Tan *et al.*, 2020). However, challenges such as traceability, transportation, storage, end-to-end chain integrity, and the lack of integration of information technology systems still exist (Tieman & Darun, 2017).

Halal Supply Chain

Although the Halal Certification matters in Malaysia are regulated by JAKIM, the information provided can be easily manipulated (Tan *et al.*, 2020). Companies need to monitor supply chains and product flow to achieve strategic goals, reduce costs, and develop customer trust (Älvebrink & Jansson, 2018). Therefore, Integrating Information Technology (ICT) in Halal food supply chains is a promising way to preserve the integrity of the Halal supply chains and confirm the Halal status of products. Barcodes were initially used as tracking systems, but faced limitations such as short-range readability and lack of automated tracking (Älvebrink & Jansson, 2018). RFID technology was introduced to address these issues and ensure Halal compliance in the food supply chain, but its adoption is constrained by high costs (Ab Talib *et al.*, 2015). The Internet of Things (IoT) can improve supply chain management by connecting physical objects and devices, allowing data to be automatically uploaded without human intervention (Chandra *et al.*, 2019). However, IoT faces challenges such as the heterogeneous nature of data centers, data mining tools, privacy concerns, security issues, and the need for third-party storage and hosting (Lee & Lee, 2015). A comprehensive review conducted by Rejeb (2021) concluded that integrating IoT in Halal supply chain in particular demonstrated several advantages, such as improved traceability, increased efficiency, improved livestock management, and improved authentication and certification methods (Rejeb *et al.*, 2021). However, challenges include technological limitations,

resistance of users, costs, and regulatory barriers. Technical limitations are mainly concerned with internet connectivity, which can hinder the flow of information and hinder consumers from determining the Halal status of products (Rahman *et al.*, 2016; Rejeb *et al.*, 2021). Human-related factors, such as lack of understanding and consumer acceptance of IoT technology, also contribute to the limited use of IoT in Halal food businesses (Jalil *et al.*, 2017).

Blockchain Technology

Blockchain (BC) technology, the 4th industrial revolution, is a decentralized database that ensures network security, transparency, and visibility (Dutta *et al.*, 2020). It has been used in various sectors, including Halal food, government election voting systems, healthcare, drug supply chains, and the food industry (Bumblauskas *et al.*, 2020; Hanifatunnisa & Rahardjo, 2018; Hastig & Sodhi, 2020; Jamil *et al.*, 2019; Zhang *et al.*, 2017). Commercial blockchain platforms like IBM Blockchain platform (Onik & Miraz, 2019), Haladinar (Haladinar.com), WhatsHalal (WhatsHalal.com), FoodChain (Food-chain.it), and Halal Digital Chain (Hew *et al.*, 2020), have been introduced globally.

BC technology offers advantages such as confidentiality, non-manipulation of information, traceability, and integrity (Pedro miguel Luorenc Costa, 2018; Shahapasand *et al.*, 2018; Tan *et al.*, 2020). BC technology is also user-friendly, cost-effective, time effective and can be automated for efficient use (Bux *et al.*, 2022). It is a decentralized, transparent, immutable, and open-source technology featuring anonymity, ownership, provenance, and contract automation (Dutta *et al.*, 2020). BC technology also promotes traceability by timestamped and signed digital transactions, increasing consumer trust in suppliers and suppliers (Shahapasand *et al.*, 2018), while blockchain technology offers numerous benefits, it also faces challenges such as its immaturity, potential for misuse, and potential for scalability issues (Dutta *et al.*, 2020). Despite these challenges, the adoption of blockchain technology in the Halal supply chain can significantly improve performance and competitiveness (Hendayani & Fernando, 2022).

Blockchain technology (BC) implementation faces several challenges, including technical scalability, environmental issues, and laws and regulations (Petersson & Baur, 2018; Wang *et al.*, 2018). Challenges in the Halal supply chain include the lack of a global Halal certification system, inaccurate data, poor regulation of raw materials, and ineffective traceability systems (Tan *et al.*, 2020). Technological challenges include compatibility, time, block size, distributed ledger systems, cybercrime, and newness (Hira *et al.*, 2022). Organizational

challenges include financial risk, lock-in effect, and parallel IT maintenance (Hira *et al.*, 2022). BC technology is disruptive and requires advanced collaboration, social readiness, and user readiness, therefore, resistance from users is another significant challenge (Hira *et al.*, 2022). In Indonesia, a case study was conducted to assess the challenges of a blockchain architecture for a chicken meat company, and the identified challenges include high costs, digitizing traditional processes, lack of technology knowledge, trust, and willingness to share data (Sugihartanto & Hakim, 2021). Other challenges in the implementation of BC technology in other sectors include scalability, integration, data privacy, security, latency, and standardization (Mahmood, 2020). In the telecommunication industry, challenges include integrating third-party operators' network stacks, capacity of BC mining hubs, hashing calculation, database latency, system transmission capacity, data transfer capacity, and the need for broadcast communications between stakeholders (Baligar *et al.*, 2019).

2. RESEARCH METHODOLOGY

This study uses a qualitative research approach to investigate the use of Blockchain (BC) technology in the Halal Supply Chain in Malaysia. Non-numerical data were collected through semi-structured, one-to-one interviews, with the researcher acting as the instrument of data collection. The expert sampling technique was used to gather information based on four criteria: direct association with HSC, limited scope to Malaysian stakeholders, minimum five years of Halal industry expertise, and availability.

Data were then analyzed using thematic data analysis method, where the crucial details were extracted and organized into themes and subthemes.

3. Ethical Considerations

The interviewees will consent to audio recording and transcription, with personal information kept confidential.

4. RESULTS AND DISCUSSIONS

Five in-depth interviews were carried out with stakeholders with multiple roles, perspectives, experience levels, and HSC related fields. The study analyzes qualitative data on Blockchain technology's awareness, perceived advantages and disadvantages, and challenges in Halal supply chains implementation in Malaysia.

The results include a range of interrelated themes, from the awareness level of BC technology among participants, to their vivid articulations of the perceived advantages and disadvantages of this transformative technology within the unique context of Halal supply chains in Malaysia. We also probe into an analysis of the challenges that exert their impact on Blockchain's course within this ecosystem, revealing a maze of obstacles and opportunities that await. Complementing this examination is a co-occurrence analysis, unscrambling nuanced associations among themes, and accentuating the interplay between awareness, advantages, disadvantages, and challenges. Amidst this elaborated narrative, it also unveils the most significant challenges that must be prevailed to embrace BC's full potential within the HSC in Malaysia. The thematic model is presented in Figure1.

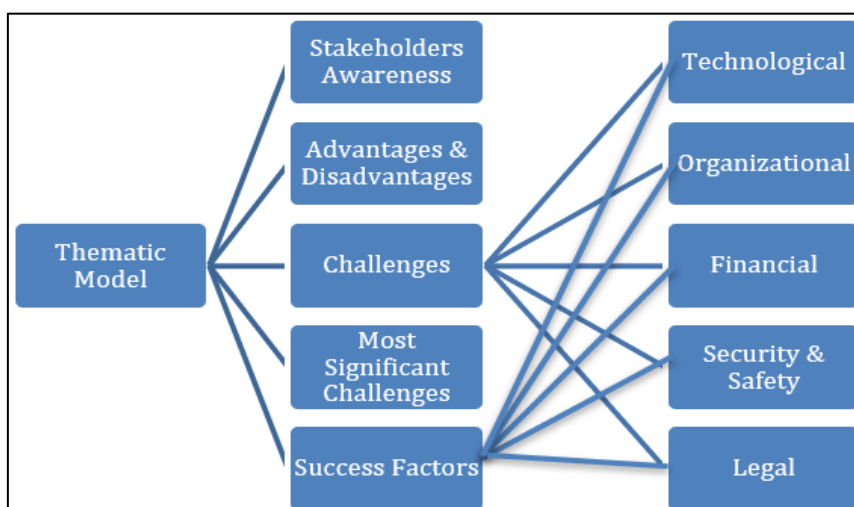


Figure 1: Thematic model

4.1. Level of awareness of BC among participants

The study explores the level of awareness of BC technology among the participants in the

interviews, aiming to gauge readiness and illuminate the path towards successful implementation within Malaysia's Halal ecosystem. Interviews with JAKIM

..... revealed the government's stance on implementing BC technology in the HSC, highlighting the scarcity of specialized expertise in blockchain implementation. MIMOS, a blockchain-based mobile application for COVID-19 vaccination, has extensive experience in BC implementation and is currently in the phase of requirements analysis. Small Medium Enterprises (SMEs) have a high understanding of BC technology, with a focus on cryptocurrency. An IT company manager has limited engagement with BC technology, with a recent focus on Musang King. Halal Development Corporations (HDC) have a broad understanding of BC technology but lack a dedicated, specialized team with in-depth blockchain expertise.

4.2. Perceived advantages and disadvantages

The Halal Development Corporation (HDC) and Malaysian Department of Islamic Development (JAKIM) have praised BC technology for its potential advantages, such as secure, efficient, and timely information sharing. The implementation of BC technology can lead to a unified database, enhancing

operational efficiency and fostering trust among consumers regarding Halal products. Private technology firms also praised BC's transparency, provenance, and tamper-proof functionality. However, the HDC has identified concerns about vulnerabilities, software bugs, hacking susceptibility, and potential data loss due to compromised encryption keys. These drawbacks highlight the need for robust security measures and meticulous maintenance within the BC technology ecosystem.

4.3. Challenges that Influence the Implementation of Blockchain for Halal Supply Chain in Malaysia:

The integration of BC technology into Malaysia's Halal Food Supply Chain (HSC) faces numerous challenges, including navigating complex regulatory landscapes and technical hurdles. These challenges highlight the dynamic ecosystem where BC technology is being used to enhance trust and traceability in the Halal industry. The challenges are presented in Figure 2.

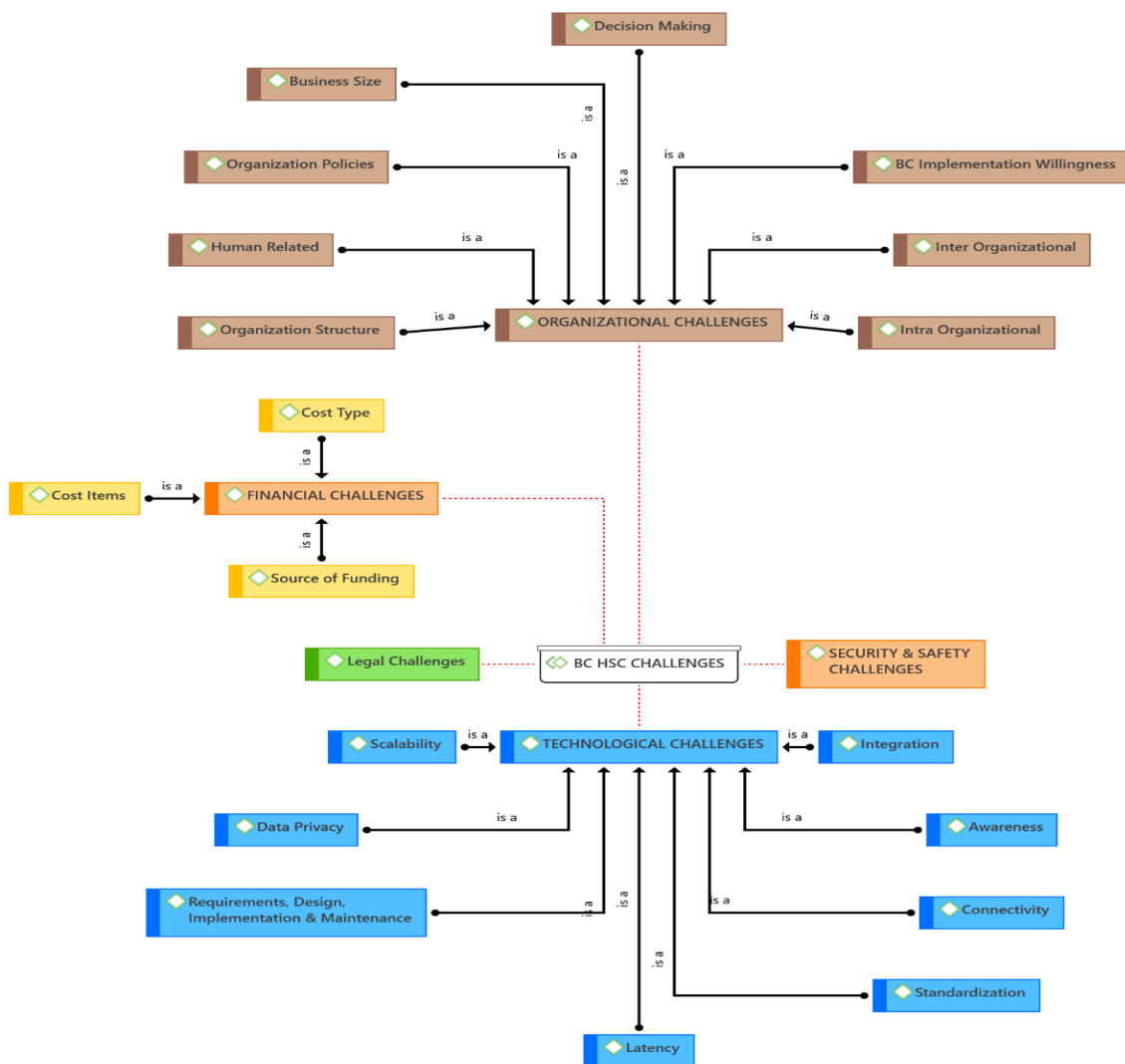


Figure 2: The challenges of blockchain implementation

4.3.1 Technological Challenges:

BC technology, the core of Industrial Revolution 4.0, faces several implementation challenges in Malaysia. These include awareness, connectivity, data privacy, and integration. Awareness is crucial for successful implementation, as it influences the acceptance and cooperation of all stakeholders involved in the supply chain. Stakeholders must be well-informed about the technology's capabilities, such as sharing information while safeguarding sensitive data and ensuring data privacy. Connectivity affects implementation significantly, especially in rural areas where limited internet access hinders automation efforts. Data privacy is another challenge, as end users may realize that products are imported from overseas, leading to resistance due to competition concerns or attempts to conceal fraudulent activities.

Integration with BC is also a challenge, as many stakeholders lack the readiness for integration with BC. Standardization can alleviate these integration complexities, but robust connectivity is essential for successful integration. The complexity of Halal certification, involving multiple authorities, amplifies the challenge of integrating multiple stakeholders into a unified system.

4.3.2 Financial Challenges

The financial challenges in implementing traceability solutions for high-cost and essential products were explored. The sensitivity of consumers to high price can lead to resistance to new features, such as RFID tags or IoT applications. Initial costs can also be used as justifications for price hikes. Large corporations and SMEs face hurdles in investing in new technologies, which must align with *Shariah* compliance principles, undergo rigorous audits, maintain transparency, and ensure timely communication with investors.

4.3.3 Legal Challenges

Malaysia has significant regulatory gaps in implementing BC for HSC traceability, with no specific legislation or regulations. Questions remain regarding the constitution of a steering committee, data privacy laws, scope of information sharing, consumer protection regulations, inclusion within the Halal Manual, and audit mechanisms. However,

the absence of legal restrictions suggests an open environment for implementation efforts.

4.3.4 Organizational Challenges

The successful implementation of BC-HSC technology in the HSC is influenced by several internal and external challenges. These include generating willingness among stakeholders, which is crucial for both government and industry sectors, and addressing business size disparities between large enterprises and SMEs. Human-related challenges include a shortage of specialized talent and skilled manpower, as well as resistance and acceptance in the face of unknowns and additional workloads. Inter-organizational challenges include information sharing, defining roles, and addressing stakeholder engagement. The organizational structure also plays a significant role, with large-scale enterprises requiring a specialized team to address BC-HSC. These challenges highlight the importance of collaboration and harmonization among stakeholders for successful implementation. Incorporating a dedicated team to address BC-HSC can lead to significant transformation in organizational structure.

4.3.5. Security and Safety Challenges

Blockchain technology's nascent nature raises security concerns, while innovative solutions to combat fraud and corruption may expose authorities to genuine safety concerns, as seen in the 2013 murder of Malaysian Customs Deputy Director.

Co-occurrence Analysis

The Sankey diagram (Figure 3) shows the correlation between financial challenges and awareness in implementing BC for HSC in Malaysia. The Code Co-Occurrence Analysis reveals a strong correlation between financial challenges and inter-organization challenges like willingness, human-related, and policies. Awareness is a significant challenge, while cost-related challenges are linked to human-related and organizational policies. The matrix of coded data and numeric values (Table 1) reveals the complexity of inter-organizational dynamics in relation to awareness. Addressing human factors is crucial for successful implementation.

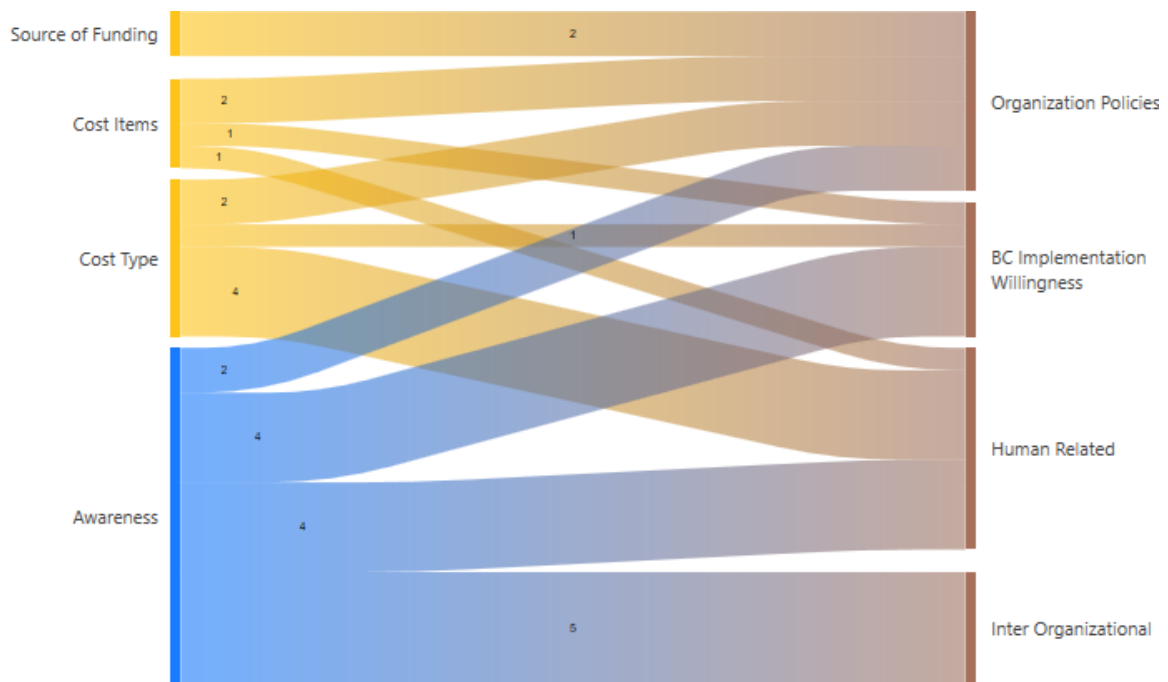


Figure 3. Financial Challenges and the Awareness with the Different Inter-Organization Challenges Co-Occurrence Analysis

Table 1: Organizational challenges Co-Occurrence Analysis

	BC Imple...	Business...	Human...	Inter Org...	Intra Org...	Organiza...
BC Implementatio...		1	2	16	2	14
Business Size	1		1			3
Human Related	2	1		3	3	8
Inter Organizational	16		3		1	16
Intra Organizational	2		3	1		3
Organization Policies	14	3	8	16	3	
Organization Struct...	1	1	3		1	5

4.4. Perceived Success Factors for a Successful Blockchain Implementation of Halal Supply Chain in Malaysia

The successful implementation of Blockchain Technology (BC) in the Halal Supply Chain (HSC) in Malaysia requires careful assessment of cost-effectiveness, stakeholder education, data security, privacy concerns, collaboration, scalability, and regulatory compliance. These factors ensure the successful integration of BC into the existing supply chain infrastructure, fostering consensus-building and cooperative governance, and ensuring regulatory compliance to maintain consumer trust and ensure transparency. By considering these factors, the HSC can achieve its full potential.

5. CONCLUSION

The Halal industry, with Halal food accounting for the majority of this industry, plays a

significant role in international trade. However, the Halal status of the products was jeopardized, nevertheless, by inconsistent Halal regulations and the presence of fraudulent certifications. To address these issues, integrating information technology, such as the blockchain technology into the Halal supply chain has been recommended. In this study, in-depth interviews were conducted with stakeholders involved in Halal supply chains in Malaysia to analyze qualitative data on the perspectives of stakeholders on the application of blockchain technology in halal supply chain in Malaysia. The results revealed a range of themes, including the level of awareness of BC technology, perceived advantages and disadvantages, and challenges hindering successful implementation. These challenges were not only the technical hurdles and integration, but also included regulatory landscapes, awareness, connectivity, data privacy, financial constraints, legal gaps, organizational

challenges, and security concerns. The study also emphasized the need for stakeholder collaboration and harmonization for successful implementation, as well as the importance of addressing human factors throughout the process and financial backing.

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