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# READINESS, RESOURCES, AND CAPABILITIES FOR BLOCKCHAIN ADOPTION IN MALAYSIAN HALAL MEAT SUPPLY CHAINS: A SYSTEMATIC REVIEW

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**Abstract:**

The halal meat industry in Malaysia continues to face challenges in maintaining transparency and trust across its supply chains. Blockchain technology has been proposed as a potential way to address these challenges by improving traceability and information sharing. This systematic review examines the available evidence on the readiness, resources, and capabilities of Malaysian halal meat processors to adopt blockchain technology, with particular attention to awareness, organizational and environmental factors, barriers, and enabling conditions. A comprehensive literature search was conducted in accordance with the PRISMA guidelines. Studies examining blockchain adoption readiness in halal food supply chains involving meat processors or related entities were screened, and relevant information on study characteristics and key findings was extracted. The findings indicate that awareness and knowledge of blockchain remain relatively limited among processors. Organizational factors, particularly top management support and external support, appear to play an important role in shaping adoption intentions. Financial constraints, inadequate infrastructure, and limited technical expertise are among the most frequently reported barriers, while supply chain integration and regulatory alignment may facilitate adoption. Overall, the available evidence points to substantial gaps in the organizational, technological, resource, and human capabilities needed to support blockchain adoption in Malaysian halal meat-processing and related supply-chain contexts. Successful adoption is therefore likely to depend not only on

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technological investment but also on organizational support and targeted capacity building. Policy initiatives should focus on strengthening foundational readiness through training, financial support, and capability development before large-scale implementation is pursued. Future research should further examine these interventions through longitudinal and action-oriented studies.

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**Keyword:**

Blockchain, Halal, Policy, Supply Chain

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## Introduction

The global halal food industry represents a rapidly expanding economic sector, with an estimated market value exceeding USD 2 trillion annually and a consumer base that continues to grow across both Muslim-majority and non-Muslim countries (Azam & Abdullah, 2020). Within this vast ecosystem, the halal meat sector occupies a particularly critical position due to the stringent religious requirements governing animal slaughter, processing, handling, and distribution (Ellahi et al., 2025). For Muslim consumers, the assurance that meat products comply with Islamic law throughout the entire supply chain is not merely a matter of preference but a fundamental religious obligation. However, the complexity of modern meat supply chains, which often involve multiple intermediaries, cross-border transactions, and opaque documentation practices, has created persistent vulnerabilities in maintaining halal integrity (Zailani et al., 2010). Incidents of halal fraud, mislabeling, and contamination have eroded consumer trust and prompted regulatory bodies to seek more robust verification and assurance mechanisms (Dashti et al., 2024).

Malaysia has established itself as a global leader in halal certification and governance, with the Department of Islamic Development Malaysia (JAKIM) serving as the primary authority for halal assurance (Noordin et al., 2009). The country's halal meat processing industry, which supplies both domestic consumers and international markets, operates under a comprehensive regulatory framework that mandates strict adherence to halal standards from farm to fork. Despite these efforts, the industry still faces significant challenges in ensuring end-to-end transparency and traceability (Othman et al., 2009). Traditional paper-based certification systems, manual record-keeping practices, and fragmented information flows between supply chain actors create opportunities for documentation errors, fraudulent claims, and unintentional contamination. These systemic weaknesses are particularly pronounced in the meat processing sector, where products pass through multiple stages including slaughtering, deboning,

processing, packaging, storage, and distribution, each of which presents potential points of halal integrity compromise (Ellahi et al., 2025).

Blockchain technology has emerged as a promising solution to address these transparency and traceability challenges in food supply chains (Barge et al., 2022). By providing a decentralized, immutable, and transparent ledger for recording transactions and product movements, blockchain can enable real-time verification of halal compliance across the entire supply chain (Tan et al., 2022). The technology's inherent characteristics immutability, consensus mechanisms, and smart contract functionality offer the potential to create tamper-proof records of halal certification, track product provenance from source to consumer, and automate compliance verification processes (Agung et al., 2022). Several pilot projects and conceptual frameworks have demonstrated the technical feasibility of blockchain-based halal supply chain systems in various contexts (Zaman et al., 2026). However, the successful adoption of any technological innovation depends not only on its technical capabilities but also on the readiness, resources, and capabilities of the organizations that must implement and operate it (Nair et al., 2019).

This brings us to a critical research gap that motivates the present systematic review. While substantial literature exists on the technical design of blockchain systems for halal supply chains and on general barriers to technology adoption in food processing industries, synthesized evidence specifically addressing the readiness of Malaysian halal meat processors to adopt blockchain technology remains scarce (Masudin et al., 2026). Existing work tends to focus on consumer perspectives, large-scale food manufacturers, or theoretical adoption models without empirical grounding in the specific context of halal meat processing in Malaysia (Ulaga, 2003). Furthermore, the unique characteristics of halal meat processors, including their religious obligations, regulatory dependencies, operational scales, and supply chain structures, may create distinct adoption dynamics that are not adequately captured by generic technology adoption frameworks (Qader et al., 2023). Understanding these specific readiness factors, resource constraints, and capability requirements is essential for developing effective strategies to facilitate blockchain adoption in this sector.

This research is significant because it can inform both academic understanding and practical decision-making. From an academic perspective, this systematic review synthesizes fragmented evidence across multiple disciplines, including information systems, supply chain management, halal studies, and organizational behavior, to provide a comprehensive picture of the current state of knowledge regarding blockchain adoption readiness in the halal meat processing context (Hidayah et al., 2024). The review identifies patterns, contradictions, and gaps in the existing literature that can guide future research directions. From a practical standpoint, the findings offer valuable insights for policymakers, industry associations, and technology providers who are working to promote blockchain adoption in the Malaysian halal meat sector (Hawkins, 1999). By clarifying the specific readiness dimensions that require attention, whether they be awareness building, financial support, technical training, or regulatory alignment, this review can help prioritize interventions and allocate resources more effectively.

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This systematic review aims to synthesize the available evidence on the readiness, resources, capabilities, barriers, and enabling conditions associated with blockchain adoption in Malaysian halal meat supply chains.

The review addresses three research questions:

- RQ1. What organizational, technological, resource, and capability factors influence blockchain adoption readiness in Malaysian halal meat supply chains?
- RQ2. What barriers and enabling factors affecting blockchain adoption are reported in the existing literature?
- RQ3. What institutional, regulatory, and strategic conditions shape blockchain adoption readiness in Malaysian halal meat supply chains?

## Methodology

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). The methodology was designed to ensure transparency, reproducibility, and rigor in the identification, selection, and synthesis of relevant studies. The review protocol was developed a priori and guided by the SPICE framework (Setting, Perspective, Intervention, Comparison, Evaluation) to formulate the research question and structure the search strategy.

### *Review Protocol*

The literature search covered six electronic databases and search engines; each selected for its relevance to the interdisciplinary nature of the research topic. Scopus was chosen as the primary database because it comprehensively covers peer-reviewed literature in the social sciences, business, and technology domains, including a substantial body of work on halal supply chain management and blockchain adoption. Web of Science was selected for its rigorous indexing of high-impact journals across multiple disciplines, ensuring access to foundational studies in technology adoption and organizational readiness. ScienceDirect was included for its extensive collection of full-text articles in computer science, engineering, and food science, which are directly relevant to blockchain applications in food processing. SpringerLink was chosen for its strong representation of research in information systems, supply chain management, and halal studies, particularly from European and Asian perspectives. IEEE Xplore was selected to capture technical and engineering-oriented studies on blockchain architecture and implementation, which often include discussions of organizational requirements and readiness factors. Finally, Google Scholar was used as a supplementary search engine to identify grey literature, industry reports, and conference proceedings that might not be indexed in the other databases, thereby broadening the scope of the review.

The search strategy combined keywords and Boolean operators to capture studies addressing the intersection of blockchain technology, halal meat processing, and organizational readiness in Malaysia. The core search string was constructed as follows: (“Blockchain Technology” OR “Distributed Ledger Technology” OR “Blockchain”) AND (“Halal Meat” OR “Halal Supply Chain” OR “Halal Food” OR “Halal Certification”) AND (“Readiness” OR “Capabilities” OR “Resources” OR “Adoption” OR “Barriers” OR “Enablers”) AND (“Malaysia” OR “Malaysian”). This string was adapted for each database to accommodate specific syntax

requirements. For example, in Scopus, the search was executed as: TITLE-ABS-KEY ((“Blockchain Technology” OR “Distributed Ledger Technology” OR “Blockchain”) AND (“Halal Meat” OR “Halal Supply Chain” OR “Halal Food” OR “Halal Certification”) AND (“Readiness” OR “Capabilities” OR “Resources” OR “Adoption” OR “Barriers” OR “Enablers”) AND (“Malaysia” OR “Malaysian”)). In Web of Science, the search used the Topic field with the same Boolean logic. For Google Scholar, the search string was simplified to (“Blockchain” AND “Halal” AND “Readiness” AND “Malaysia”) due to the platform’s character limitations and less precise search functionality. The search was conducted in November 2024 and was limited to studies published in English or Malay, with no restriction on publication year to capture the full evolution of the research field.

### *Thematic Dimensions for Analysis*

To structure the synthesis of findings from the included studies, we developed a thematic classification framework based on the research question and the SPICE framework. This framework organizes the extracted data into four distinct analytical dimensions that reflect the key aspects of blockchain adoption readiness among Malaysian halal meat processors. The first dimension, Adoption Drivers and Barriers, includes studies that identify and analyze factors that facilitate or impede the intention to adopt blockchain technology, including perceived benefits, organizational pressures, and external constraints. The second dimension, Technological and Operational Readiness, focuses on studies that assess meat processors' existing technological infrastructure, digital capabilities, and operational processes in relation to blockchain implementation requirements. The third dimension, Institutional and Strategic Perspectives, includes studies that examine the role of regulatory frameworks, industry standards, certification bodies, and strategic alignment in shaping adoption decisions and readiness levels. The fourth dimension, Others, serves as a residual category for studies that address readiness-related topics not fully captured by the first three dimensions, such as awareness and knowledge levels, training needs, or comparative analyses across different supply chain actors. This classification scheme was applied consistently during data extraction to ensure that all relevant findings were systematically categorized and could be synthesized across studies within each dimension.

### *Inclusion and Exclusion Criteria*

Clear inclusion and exclusion criteria were established to ensure the relevance and consistency of the selected studies. Studies were considered eligible for inclusion if they focused on the adoption, readiness, resources, or capabilities related to blockchain technology within the halal food supply chain, specifically involving meat processors or similar food processing entities. The study had to be published in a peer-reviewed journal, a peer-reviewed conference proceeding, or as a formal industry or government report to ensure a minimum level of scholarly rigor. Only studies written in English or Malay were included, as these are the primary languages of academic discourse in Malaysia. Furthermore, the study had to present empirical data, whether qualitative, quantitative, or mixed-methods, or a systematic conceptual framework that directly addressed readiness, resources, or capabilities for technology adoption. Studies that were purely theoretical or opinion-based without empirical grounding were excluded.

Conversely, studies were excluded if they discussed blockchain technology in halal supply chains but did not address the processor-level readiness, resources, or capabilities, for example, by focusing only on consumer perception or logistics without processor involvement. Studies that were purely technical in nature, such as those proposing a new blockchain algorithm or system architecture without any analysis of organizational or operational readiness, were also excluded. Opinion pieces, editorials, and non-systematic literature reviews were not considered, as they lack the methodological rigor required for evidence synthesis. Studies for which the full text was not available after reasonable retrieval efforts, including attempts to contact authors and search institutional repositories, were excluded. Finally, studies that focused on halal certification or traceability in non-meat sectors, such as pharmaceuticals or cosmetics, were excluded unless they had a clear and direct application to meat processing that was explicitly discussed.

***Study Selection Process***

The study selection process followed the PRISMA guidelines and consisted of four stages: identification, screening, eligibility assessment, and inclusion. In the identification stage, database searches yielded 362 records. After removing 195 duplicate records, 167 unique records remained for screening. No records were removed for other reasons, such as retraction or inaccessibility at the identification stage. In the screening stage, two researchers independently reviewed the titles and abstracts of the 167 records against the inclusion and exclusion criteria. The researchers resolved disagreements through discussion and, when necessary, consultation with a third reviewer. This process excluded 115 records that clearly did not meet the eligibility criteria, leaving 52 reports for full-text retrieval. Of these, we could not retrieve 6 reports despite multiple attempts through institutional subscriptions, interlibrary loans, and direct contact with authors. The remaining 46 reports were assessed for eligibility through full-text reading. During this eligibility assessment, we excluded 37 reports for reasons including insufficient focus on processor-level readiness (n=18), lack of empirical data (n=9), focus on non-meat halal sectors (n=7), and non-peer-reviewed publication type (n=3). Ultimately, 9 studies met all inclusion criteria and were included in the final review.

The quality of the included studies was assessed using a customized appraisal tool developed for this review, which considered criteria such as clarity of research objectives, appropriateness of research design, rigor of data collection and analysis, relevance of findings to the research question, and transparency in reporting limitations. Each study was rated as high, moderate, or low quality based on these criteria. No studies were excluded based on quality assessment alone, as the goal was to synthesize the full range of available evidence; however, quality ratings were considered during the synthesis to contextualize the strength of findings. Figure 1 illustrates the study selection process and presents the PRISMA flowchart detailing the number of records at each stage.

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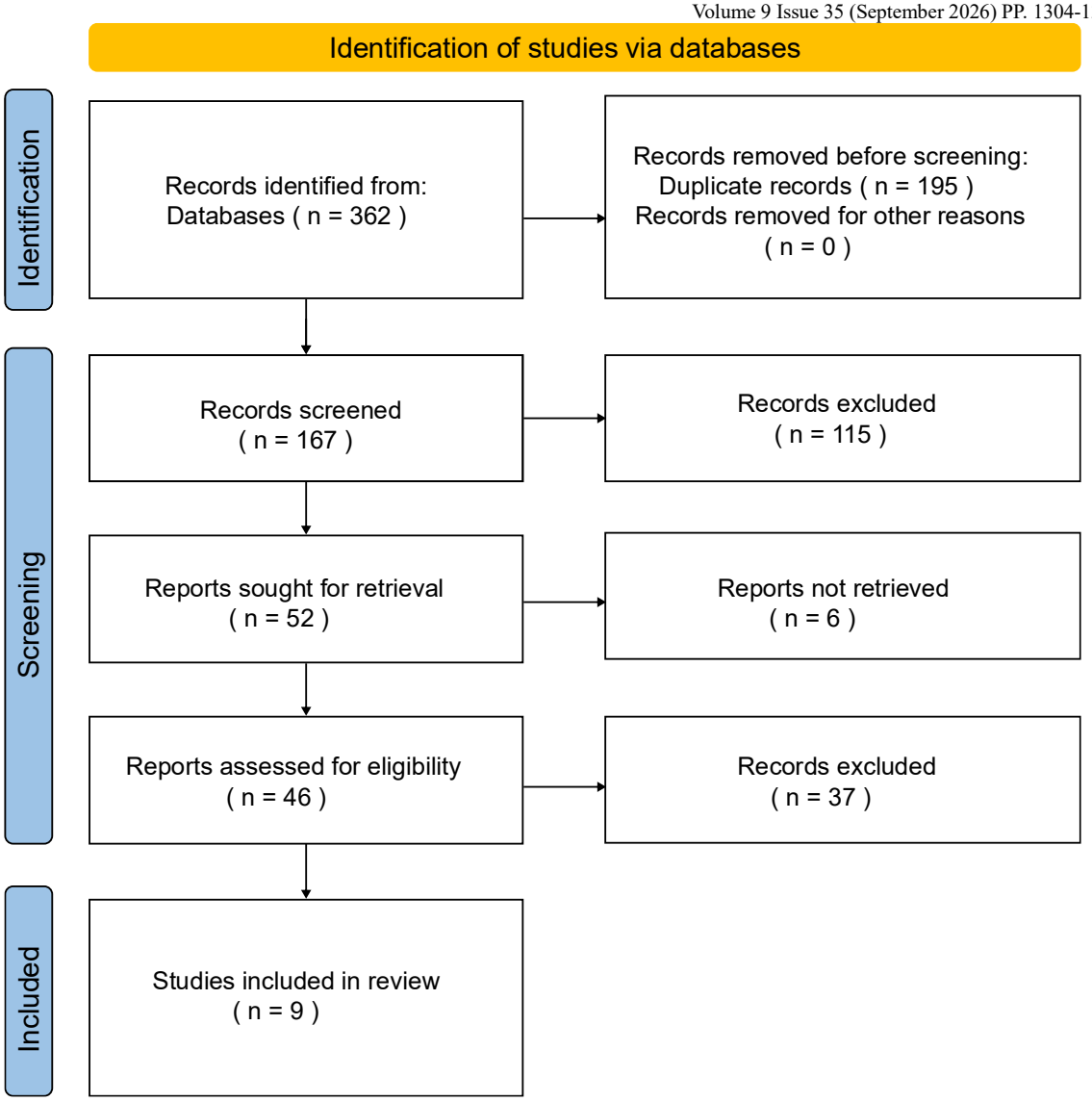



**Figure 1. PRISMA Flowchart Of The Study Selection Process**

Several limitations of the study selection process should be acknowledged. First, the search was limited to six databases and search engines, which may have omitted relevant studies indexed in other sources, such as regional databases or non-English language repositories. Second, excluding non-peer-reviewed grey literature, such as industry white papers and unpublished theses, may have introduced publication bias toward positive or statistically significant findings. Third, the focus on studies written in English or Malay may have excluded relevant research published in other languages, particularly Arabic or Indonesian, which are relevant to the halal industry context. Fourth, reliance on title and abstract screening may have inadvertently excluded studies whose relevance was not apparent from the abstracts alone. Finally, the small number of included studies (n=9) limits the generalizability of the synthesized findings and underscores the nascent state of research in this area.

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### *Quality Appraisal*

Because the included studies employed heterogeneous designs, the methodological quality of each study should be assessed using an appropriate appraisal approach and reported transparently. Quality considerations should inform interpretation of the evidence and should be distinguished from the substantive findings of individual studies.

*Data Synthesis*

Findings were synthesized thematically according to the research questions. Qualitative, quantitative, mixed-methods, structural modelling, and conceptual evidence were treated as distinct evidence types. Convergent findings were identified across studies, while differences in study design, population, context, and analytical approach were retained when interpreting the evidence.

## Results

### *Research Trends*

The distribution of the nine included studies across publication years reveals a clear and significant trend in the evolution of this research domain. As shown in Figure 2, the field was virtually dormant until 2020, with only one study in that year, followed by one study each in 2021 and 2022. This initial period of sparse activity suggests that the intersection of blockchain technology, halal meat processing, and organizational readiness was not yet a consolidated area of inquiry. However, scholarly output surged in 2024, when five of the nine included studies were published, representing over half of the corpus. This concentration of publications in a single year indicates a recent, rapid acceleration of academic interest in the topic, likely driven by a confluence of factors, including the maturation of blockchain technology, increased regulatory attention to halal supply chain integrity in Malaysia, and a growing recognition of the specific challenges faced by meat processors.

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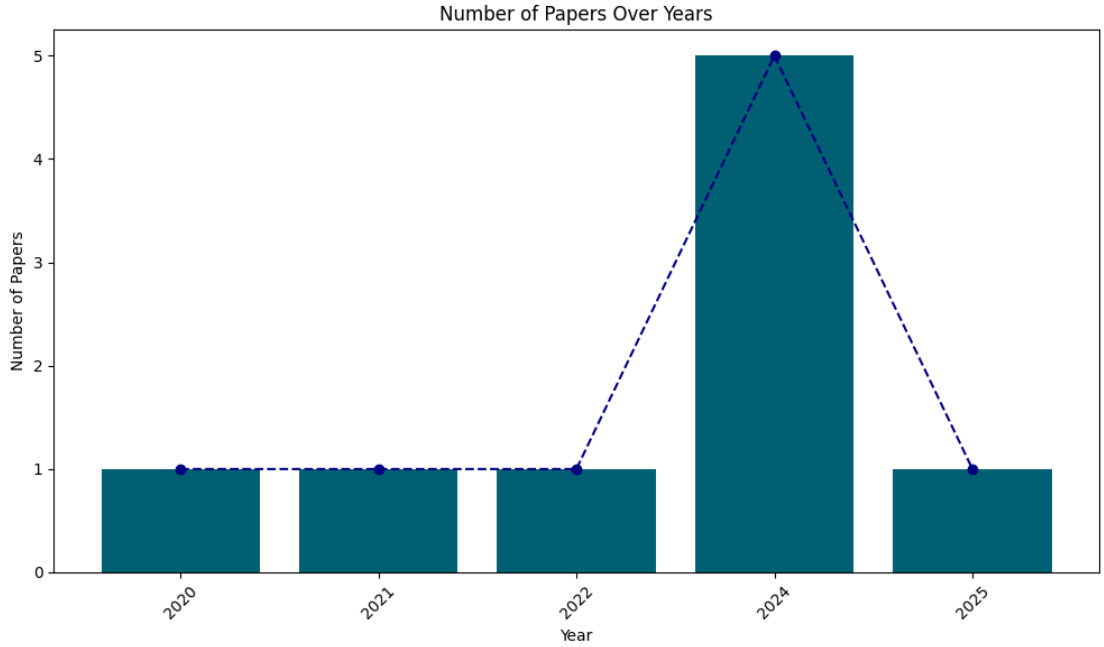



**Figure 2. Research Trends in The Domain of Readiness, Resources, And Capabilities of Malaysian Halal Meat Processors to Adopt Blockchain Technology**

This temporal pattern is not merely a descriptive observation but carries substantive implications for the interpretation of the review's findings. The fact that the majority of the evidence base was generated in 2024 suggests that the research is still in its formative stages, with many studies likely representing initial exploratory efforts rather than mature, cumulative investigations. Consequently, the findings synthesized in this review should be viewed as preliminary and indicative of emerging themes rather than as a definitive or settled body of knowledge. The single study published in 2025 further reinforces this notion of a nascent but growing field, as it indicates that the momentum from 2024 has continued into the current year. The long gap between 2022 and 2024, with no studies identified in 2023, is particularly noteworthy. This hiatus may reflect a period of theoretical consolidation or methodological refinement among researchers, or it could be an artifact of the publication lag inherent in academic journals, where studies conducted in 2023 may have only appeared in print in 2024. Regardless of the cause, this pattern underscores the need for continued and sustained research efforts to build a more robust and temporally diverse evidence base.

### *Overview of Included Studies*

Table 1 presents the main characteristics of the included studies. The extracted information included study identification, study design, population / sample, technology focus, key factors investigated, main outcomes / findings and theoretical framework, where applicable.

The included studies varied in terms of their research designs, theoretical frameworks, and key factors investigated. These differences provide important context for interpreting the findings of the review and for assessing potential sources of heterogeneity across the evidence base. Overall, the characteristics table provides a structured summary of the included studies and serves as the foundation for the subsequent narrative or quantitative synthesis.

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**Table 1. Characteristics of Included Studies**

| Study Id | Study Design | Population / Sample | Technology Focus | Key Factors Investigated | Main Outcomes / Findings | Theoretical Framework |
|---|---|---|---|---|---|---|
| (Ali et al., 2021) | Case study | Small and medium enterprises in halal food supply chain | Blockchain | Challenges in blockchain implementation, supply chain integration, food regulations | A practical framework comprising five key challenges for blockchain implementation in halal food supply chain; halal food supply chain can gain a congruent and fresh perspective in inducing or superseding blockchain technology; supply chain integration and food regulations are key enablers for blockchain success | |
| (Ali et al., 2023) | Survey using questionnaires | 500 halal-certified SMEs in Malaysia, with 175 respondents | Blockchain technology | Top management support, trialability, external support, competitive pressure, relative advantage, compatibility, complexity, uncertainty and security, observability, organizational readiness, government regulations, supply chain integration (as moderator) | Top management support, trialability, external support, and competitive pressure are critical factors influencing HFSMEs' intention to adopt blockchain technology. Relative advantages, compatibility, complexity, uncertainty and security, observability, organizational readiness, and government regulations do not affect | Technology, Organisation, Environment (TOE) framework and Diffusion of Innovation (DOI) theory |

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| Study Id | Study Design | Population / Sample | Technology Focus | Key Factors Investigated | Main Outcomes / Findings | Theoretical Framework |
|---|---|---|---|---|---|---|
| | | | | | intention. Supply chain integration moderates the diffusion of blockchain technology. | |
| (Elfarnawani & Kartiwi, 2024) | Qualitative research approach using semi-structured, one-to-one interviews | Stakeholders involved in Halal supply chain in Malaysia; five in-depth interviews conducted | Blockchain technology in Halal supply chain | Level of awareness, perceived advantages and disadvantages, challenges (technological, legal, inter-organizational, security, safety, financial), and perceived success factors (heightened awareness, trust-building, financial backing, regulatory alignment) | Lack of awareness on Blockchain technology among stakeholders excluding technology providers; identified challenges span technological, legal, inter-organizational, security, safety, and financial domains; success factors encompass heightened awareness, trust-building, financial backing, and regulatory alignment | |
| (Hamdi et al., 2025) | convergent mixed-methods design | | blockchain technology | transparency, compliance, traceability, HACCP integration, SNI 99001: 2016 compliance, blockchain implementation | transparency and compliance were prioritized over traditional traceability metrics; significant gaps were identified in blockchain implementation (100% noncompliance), HACCP integration (42% noncompliance), and SNI | resource orchestration and institutional theory |

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| Study Id | Study Design | Population / Sample | Technology Focus | Key Factors Investigated | Main Outcomes / Findings | Theoretical Framework |
|---|---|---|---|---|---|---|
| | | | | | 99001: 2016 (38% noncompliance), primarily due to cost and infrastructure barriers | |
| (Hew et al., 2020) | Phone interviews using a sample drawn from Halal Malaysia Official Portal with simple random sampling technique; analyzed using partial least squares structural equation modelling | 143 Malaysian Halal food and beverage manufacturers, key managerial personnel with experience and knowledge on the Halal supply chain | Blockchain-based Halal traceability system | Halal orientation strategy, institutional pressures, technological characteristics of the system, perceived desirability | Manufacturers with a comprehensive Halal orientation strategy are more perceptive to institutional pressures; in response to pressures, they evaluate technological characteristics and develop perceived desirability; favorable perceived desirability leads to intention to participate. The model explains 73.19% of variance in intention to participate. | Halal orientation strategy, institutional theory, diffusion of innovation theory |
| (Rosli et al., 2024) | Exploratory study using surveys and interviews | Ten respondents from industry professionals directly engaged in the adoption of blockchain in the halal food sector | Blockchain adoption in the halal food industry | Data integration, stakeholder management, data availability, team competency, data unavailability, unstable adoption | Risk priority numbers (RPN) for team competency (336), data unavailability (256), and unstable adoption (245) were identified as the most significant challenges to blockchain adoption | Technology-Organization-Environment (TOE) theory and Failure Mode Effect Analysis (FMEA) framework |
| (Susanty et al., 2024) | Interpretative structural modeling | Six experts for validation questionnaire, | Blockchain-based halal | Barriers preventing adoption of | Out of 15 identified barriers, ten | |

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| Study Id | Study Design | Population / Sample | Technology Focus | Key Factors Investigated | Main Outcomes / Findings | Theoretical Framework |
|---|---|---|---|---|---|---|
| | (ISM) approach and content validation method | six experts for ISM questionnaire | traceability system | blockchain-based halal traceability systems in chicken meat-based food supply chain | are relevant; limited knowledge or ability of supply chain actors to operate the systems is the most fundamental barrier located in the root layer of the ISM model | |
| (Tan et al., 2020) | Conceptual framework development based on real-life Blockchain implementation in three distinct Halal supply chains | Three distinct Halal supply chains and three Blockchain software providers | Blockchain with smart contract | Current traceability challenges for the food supply chain in Malaysia to comply with Halal requirements | A novel traceability framework built on Blockchain that integrates both Halal processes and technologies to improve traceability of Halal food supply chain from farm to fork | Institutional theory and agency theory |
| (Zailani et al., 2024) | Exploratory study using in-depth interviews | Leaders and high-ranked officials from both public and private sectors in Malaysia and Indonesia | Blockchain-based halal traceability system | Internal factors (strengths and weaknesses) and external factors (opportunities and threats) related to adoption | Adoption of the blockchain-based halal traceability system is not a simple task; enterprises should evaluate all opportunities and threats before making strategic decisions; respondents agreed the system could foster development of halal food supply chain; six research propositions for future research were offered | Resource-based view (RBV) theory |

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### *Adoption Drivers and Barriers*

The adoption of blockchain technology among Malaysian halal meat processors is shaped by a complex interplay of driving forces and inhibiting factors that span technological, organizational, environmental, and institutional domains. The included studies consistently identify a range of barriers that impede adoption, alongside a set of enablers that facilitate it, with the relative importance of these factors varying across different stakeholder groups and organizational contexts. Understanding this duality is essential for developing targeted interventions that address the specific constraints faced by meat processors while capitalizing on the factors that can accelerate adoption.

The barriers to blockchain adoption in the halal meat processing sector are multifaceted and deeply interconnected. Technological challenges are among the most frequently cited obstacles, particularly those related to data integration, data availability, and system interoperability. One study (Rosli et al., 2024) employed the Technology-Organization-Environment (TOE) framework combined with Failure Mode Effect Analysis (FMEA) to identify and prioritize these challenges, finding that data integration, stakeholder management, and data availability emerged as the primary technological barriers. The risk priority numbers (RPNs) for team competency (336), data unavailability (256), and unstable adoption (245) indicated that these factors posed the greatest failure risks for blockchain implementation in the halal food industry. These findings suggest that the technical infrastructure required for blockchain, such as reliable data sources, standardized data formats, and skilled personnel, is often lacking in the current operational environment of meat processors.

Organizational barriers are equally critical and perhaps more fundamental than technological ones. Several studies point to limited knowledge and ability among supply chain actors as a root cause of adoption resistance. In a study focusing on chicken meat-based food supply chains (Susanty et al., 2024), the interpretative structural modelling (ISM) approach revealed that limited knowledge or ability of supply chain actors to operate blockchain-based systems was the most fundamental barrier, located at the root layer of the hierarchical model. This finding implies that without addressing the knowledge and skills gap, other barriers such as cost concerns or infrastructure limitations cannot be effectively resolved. Another study (Elfarnawani & Kartiwi, 2024) confirmed this through qualitative interviews with stakeholders, which revealed a general lack of awareness about blockchain technology among all participants except technology providers. The study further identified that challenges span technological, legal, inter-organizational, security, safety, and financial domains, suggesting that the knowledge deficit is not limited to technical aspects but extends to understanding the broader implications and requirements of blockchain adoption.

Financial constraints represent another major organizational barrier, particularly for small and medium enterprises (SMEs) that dominate the halal meat processing sector. The costs associated with blockchain implementation including hardware, software, integration, training, and ongoing maintenance can be prohibitive for processors with limited capital and tight profit margins. While one quantitative study (M. Ali et al., 2023) found that organizational readiness did not have a direct effect on adoption intention, this finding may reflect the specific measurement of readiness in that study rather than the absence of resource constraints. In contrast, the qualitative evidence consistently highlights financial limitations as a critical barrier. The study by (Elfarnawani & Kartiwi, 2024) explicitly identified financial challenges as one of the key domains of difficulty, while another (Rosli et al., 2024) ranked team

competency and data unavailability as high-risk factors, both of which have significant financial implications for training and infrastructure investment. The financial burden is particularly acute for smaller processors, who may lack the economies of scale to justify the substantial upfront investment required for blockchain systems.

Environmental and institutional barriers also play a significant role in shaping adoption decisions. Regulatory uncertainty and the lack of clear legal frameworks for blockchain-based traceability systems create hesitation among processors who are uncertain about compliance requirements and liability implications. The study by (Elfarnawani & Kartiwi, 2024) identified legal challenges as a distinct domain of difficulty, reflecting concerns about data privacy, smart contract enforceability, and cross-jurisdictional regulatory alignment. Similarly, inter-organizational challenges such as the need for coordination among multiple supply chain actors, each with different levels of technological readiness and willingness to participate create significant implementation hurdles. The study on chicken meat supply chains (Susanty et al., 2024) implicitly addressed this through its focus on supply chain actors' limited knowledge, which affects the entire chain's ability to adopt a unified system. Furthermore, the exploratory study involving Malaysia and Indonesia (Zailani et al., 2024) found that the adoption of blockchain-based halal traceability systems is not a simple task and requires enterprises to evaluate all opportunities and threats before making strategic decisions. This finding underscores the environmental complexity that processors must navigate, including varying levels of government support, industry readiness, and market pressures.

Despite these formidable barriers, the included studies also identify several key enablers that can facilitate blockchain adoption among halal meat processors. Top management support emerges as a consistently critical factor across multiple studies. The quantitative survey of halal food SMEs (M. Ali et al., 2023) found that top management support was one of the most significant factors influencing adoption intention, highlighting the importance of leadership commitment in driving organizational change. This finding is corroborated by the qualitative evidence from stakeholder interviews (Elfarnawani & Kartiwi, 2024), which identified financial backing a manifestation of top management support as a key success factor. The role of top management is particularly crucial in the context of SMEs, where owners or senior managers often have direct control over resource allocation and strategic direction. Without their active sponsorship, blockchain initiatives are unlikely to secure the necessary funding, personnel, and organizational priority required for successful implementation.

External support, including both technology providers and industry associations, is another important enabler. The same study (M. Ali et al., 2023) found that external support significantly influenced adoption intention, suggesting that processors rely on partners and consultants to bridge their internal knowledge and capability gaps. This finding aligns with the qualitative evidence from (Elfarnawani & Kartiwi, 2024), which identified trust-building and financial backing as success factors, both of which can be facilitated by external stakeholders who provide technical assistance, training, or co-investment opportunities. The role of supply chain integration as a moderating factor (M. Ali et al., 2023) further underscores the importance of external relationships; when supply chain actors are already integrated through existing information systems or collaborative practices, the adoption of blockchain becomes more feasible because the foundational infrastructure for data sharing and coordination is already in place.

Competitive pressure also serves as a significant driver of adoption. The study by (M. Ali et al., 2023) identified competitive pressure as a critical factor influencing intention, indicating that processors who perceive their competitors as adopting or planning to adopt blockchain are more likely to follow suit. This dynamic is consistent with institutional theory, which suggests that organizations adopt innovations to maintain legitimacy and competitive parity within their industry. The institutional pressures identified in another study (Hew et al., 2020) provide further support for this perspective, showing that manufacturers with a comprehensive halal orientation strategy are more perceptive to institutional pressures that demand participation in traceability systems. This finding suggests that the halal certification system itself, through its regulatory requirements and market expectations, can create coercive and normative pressures that drive blockchain adoption.

Trialability is the ability to experiment with blockchain on a limited basis before full-scale commitment is another factor that facilitates adoption. The study by (M. Ali et al., 2023) found that trialability significantly influenced adoption intention, implying that processors are more willing to adopt blockchain when they can test it in a low-risk environment. This finding has important implications for technology providers and policymakers, as it suggests that demonstration projects, pilot programs, and sandbox environments can be effective strategies for reducing perceived risk and building confidence among potential adopters. The case study research (Ali et al., 2021) also supports this notion by proposing a framework that includes five key challenges for blockchain implementation, which implicitly addresses the need for a phased approach that allows for learning and adaptation.

Regulatory alignment and trust-building are additional enablers that emerge from the qualitative evidence. The stakeholder interviews (Elfarnawani & Kartiwi, 2024) identified regulatory alignment as a key success factor, indicating that clear and supportive government policies can significantly reduce adoption barriers. When the regulatory framework is well-defined, consistent, and aligned with industry needs, processors face less uncertainty about compliance and liability, which in turn reduces their perceived risk. Trust-building among supply chain actors is equally important, as blockchain systems require a high degree of cooperation and data sharing among participants. Without mutual trust, actors may be reluctant to join the system or share sensitive information, undermining the very purpose of the technology. The study (Elfarnawani & Kartiwi, 2024) explicitly identified trust-building as a success factor, while the chicken meat supply chain study (Susanty et al., 2024) indirectly addressed this by highlighting the fundamental barrier of limited knowledge, which can be mitigated through trust-building activities such as training, transparency, and collaborative workshops.

The interplay between barriers and enablers is complex and context-dependent, as demonstrated by the varying findings across studies. For example, while one study (M. Ali et al., 2023) found that government regulations did not have a direct effect on adoption intention, another study (Elfarnawani & Kartiwi, 2024) and the case study research (M. H. Ali et al., 2021) identified regulatory alignment as a key success factor. These seemingly contradictory findings can be reconciled by considering the different measures and contexts used in each study. The quantitative study (M. Ali et al., 2023) measured government regulations as a discrete variable, which may not capture the nuanced ways in which regulatory support manifests such as through certification incentives, technical standards, or public-private partnerships. The qualitative evidence (Elfarnawani & Kartiwi, 2024) and case study (M. H. Ali et al., 2021) provide richer descriptions of how regulatory alignment operates in practice,

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suggesting that the absence of a direct statistical effect does not necessarily mean the factor is unimportant. Table 2 summarizes the key adoption drivers and barriers identified across the included studies.

**Table 2. Summary of Adoption Drivers and Barriers for Blockchain Technology Among Malaysian Halal Meat Processors**

| Study Id | Adoption Barriers | Key Enablers | Stakeholder Type | Methodology | Country (Region) |
|---|---|---|---|---|---|
| ( Ali et al., 2021) | | Supply chain integration and food regulations | Small and medium enterprises | Five in-depth halal food supply chain case studies | Malaysia |
| (Ali et al., 2023) | Relative advantage, compatibility, complexity, uncertainty and security, observability, organizational readiness, government regulations | Top management support, trialability, external support, competitive pressure, supply chain integration (moderator) | Halal food small and medium enterprises (HFSMEs) | Questionnaires covering 500 halal-certified SMEs, 175 respondents, tested DOI and TOE model | Malaysia |
| (Elfarnawani & Kartiwi, 2024) | Technological, legal, inter-organizational, security, safety, and financial domains | Heightened awareness, trust-building, financial backing, regulatory alignment | Stakeholders involved in Halal supply chain, including technology providers | Qualitative research approach using semi-structured, one-to-one interviews | Malaysia |
| (Hew et al., 2020) | | Comprehensive Halal orientation strategy, institutional pressures, perceived desirability of technological characteristics | Malaysian Halal food and beverage manufacturers | Simple random sampling, phone interviews, partial least squares structural equation modelling | Malaysia |
| (Rosli et al., 2024) | Data integration, stakeholder management, data availability, team competency, data unavailability, | | Industry professionals directly engaged in the adoption of blockchain | Surveys and interviews from ten respondents | |

| Study Id | Adoption Barriers | Key Enablers | Stakeholder Type | Methodology | Country (Region) |
|---|---|---|---|---|---|
| | unstable adoption | | | | |
| (Susanty et al., 2024) | Limited knowledge or ability of supply chain actors to operate the systems | | Chicken meat-based food supply chain actors | Content validation method, interpretative structural modeling (ISM) | |
| (Zailani et al., 2024) | | | Leaders and high-ranked officials from both public and private sectors | In-depth interviews | Malaysia and Indonesia |

The table reveals a clear pattern wherein barriers cluster around technological, knowledge, and financial domains, while enablers center on organizational support, external partnerships, and regulatory alignment. Notably, some studies focus exclusively on barriers (e.g., (Rosli et al., 2024) and (Susanty et al., 2024)), others on enablers (e.g., (M. H. Ali et al., 2021) and (Hew et al., 2020)), and only a few address both sides of the adoption equation (e.g., (M. Ali et al., 2023) and (Elfarnawani & Kartiwi, 2024)). This asymmetry in the literature suggests that the integrated understanding of drivers and barriers remains underdeveloped, as most studies adopt a single-sided perspective. The study by M. Ali et al. (2023) is particularly valuable because it examines both drivers and barriers within a unified theoretical framework, allowing a more nuanced analysis of their relative importance. The study found that top management support, trialability, external support, and competitive pressure were significant drivers, while traditional innovation attributes such as relative advantage, compatibility, and complexity did not significantly affect adoption intention. These findings challenge conventional assumptions about technology adoption and suggest that in the context of halal meat processing, the decision to adopt blockchain is driven more by organizational and environmental factors than by the technology's inherent characteristics.

The study by (Elfarnawani & Kartiwi, 2024) provides the most comprehensive qualitative account of both barriers and enablers, capturing the perspectives of multiple stakeholder groups including technology providers, industry representatives, and regulatory bodies. The study's findings that barriers span multiple domains technological, legal, inter-organizational, security, safety, and financial underscore the systemic nature of the adoption challenge. Similarly, the enablers identified heightened awareness, trust-building, financial backing, and regulatory alignment require coordinated action from multiple actors, including government, industry associations, technology vendors, and individual firms. This systemic perspective is reinforced by the case study research (M. H. Ali et al., 2021), which identified supply chain integration and food regulations as key enablers, both of which are system-level factors that cannot be addressed by individual processors acting alone.

The chicken meat supply chain study (Susanty et al., 2024) offers a unique contribution by using structural modeling to identify the hierarchical relationships among barriers. The finding

that limited knowledge or ability of supply chain actors to operate the systems is the most fundamental barrier has important practical implications: it suggests that capacity-building interventions—such as training programs, knowledge transfer initiatives, and awareness campaigns—should be prioritized over technological investments in the early stages of adoption. This is consistent with the findings of (Elfarnawani & Kartiwi, 2024), which identified lack of awareness as a pervasive issue, and the quantitative study (M. Ali et al., 2023), which found that external support (which often includes training and knowledge transfer) is a significant driver. The exploratory study involving Malaysia and Indonesia (Zailani et al., 2024) further reinforces this point by emphasizing that enterprises must evaluate all opportunities and threats before making strategic decisions, which requires a certain level of knowledge and analytical capability that many processors currently lack.

The study by (Hew et al., 2020) introduces a nuanced perspective by examining how halal orientation strategy shapes the adoption process. The study found that manufacturers with a comprehensive halal orientation strategy are more perceptive to institutional pressures that demand participation in traceability systems. This suggests that the adoption of blockchain is not solely a technological decision but is deeply embedded in the religious and ethical commitments of halal processors. Companies that already prioritize halal compliance as a core strategic objective are more likely to view blockchain as a tool for enhancing their halal assurance, rather than as an additional burden or cost. This finding has important implications for how blockchain adoption is framed: rather than being presented as a generic technology solution, it should be positioned as a means of strengthening halal integrity, which aligns with the fundamental values and strategic priorities of halal meat processors.

The study by (Rosli et al., 2024) is unique in its use of the FMEA framework to quantify the risk priority of different barriers. The identification of team competency (RPN = 336) as the highest risk factor underscores the critical importance of human capital in blockchain adoption. This finding is consistent with the root barrier identified by (Susanty et al., 2024) and the lack of awareness highlighted by (Elfarnawani & Kartiwi, 2024). The high RPN for data unavailability (256) and unstable adoption (245) further indicates that the technical and operational challenges are closely linked to human and organizational factors. Unstable adoption, for example, may reflect a lack of sustained organizational commitment or inadequate change management processes, both of which are ultimately human and managerial issues rather than purely technical ones.

***Technological and Operational Readiness: Assessing Infrastructure, Capabilities, and Process-Level Gaps***

The technological and operational readiness of Malaysian halal meat processors to adopt blockchain technology constitutes a critical dimension of the overall adoption landscape, as it directly addresses the practical requirements for implementation. This dimension encompasses the existing digital infrastructure, technical capabilities, data management practices, and operational processes that must be in place or at least developable to support a blockchain-based traceability system. The included studies reveal a consistent picture of significant gaps in this domain, with processors facing substantial challenges in terms of infrastructure, data readiness, and technical expertise. However, the evidence also points to specific areas where targeted interventions could build foundational capabilities that would enable eventual blockchain adoption.

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The most comprehensive assessment of technological and operational readiness comes from a convergent mixed-methods study that developed and validated the HABITS (Halal-Hygiene Assurance, Blockchain-Integrated Traceability System) model (Hamdi et al., 2025). This study employed a compliance gap analysis to evaluate the current state of infrastructure and processes relative to the requirements for blockchain implementation. The findings were stark: the study identified a 100% noncompliance rate for blockchain implementation, meaning that none of the assessed processors had the necessary technical infrastructure or operational procedures in place to support a blockchain system. This complete absence of readiness was attributed primarily to cost and infrastructure barriers, which encompasses both the financial resources required for hardware, software, and integration, as well as the physical and digital infrastructure necessary for data capture, storage, and transmission. The study further revealed significant gaps in related areas, including 42% noncompliance for HACCP integration and 38% noncompliance for SNI 99001:2016, both of which are foundational quality assurance systems that would need to be in place before blockchain could be effectively layered on top. These findings suggest that the readiness gap is not limited to blockchain itself but extends to the broader quality management and traceability infrastructure that blockchain is intended to enhance.

The operational process perspective is further illuminated by the case study research that proposed a sustainable blockchain framework for the halal food supply chain (M. H. Ali et al., 2021). Based on five in-depth case studies of halal food supply chains, this study identified five key challenges vital to small and medium enterprises in implementing blockchain in halal food supply chains. While the study does not explicitly list these challenges in the abstract, the framework it proposes is grounded in the practical realities of how halal food supply chains currently operate, including the specific processes involved in slaughtering, processing, packaging, and distribution. The study's emphasis on supply chain integration as a key enabler Ali et al. (2021) suggests that the current level of integration among supply chain actors, including meat processors, suppliers, distributors, and certifiers, is a critical determinant of technological readiness. In the absence of integrated information systems, standardized data formats, and collaborative data-sharing practices, the foundational infrastructure for blockchain is largely absent. The case study approach allows for a nuanced understanding of how these operational gaps manifest in different types of halal food supply chains, including variations in scale, product type, and market orientation.

The qualitative study involving stakeholder interviews (Elfarnawani & Kartiwi, 2024) adds depth to understanding technological readiness by identifying specific challenges across technological, inter-organizational, security, and safety domains. Technological challenges include concerns about blockchain compatibility with existing information systems, the reliability of data sources, and the technology's scalability to handle the volume of transactions in a typical meat processing operation. The inter-organizational challenges highlight the difficulty of coordinating blockchain adoption across multiple actors, each with different levels of technological sophistication and readiness. The security and safety challenges reflect legitimate concerns about data privacy, cybersecurity, and blockchain's potential to introduce new vulnerabilities, particularly if the underlying data entry points are not secure. The study's finding that there is a lack of awareness among stakeholders, excluding technology providers (Elfarnawani & Kartiwi, 2024), suggests that the readiness gap is not only technical but also cognitive: many processors do not yet understand what blockchain requires in terms of data, processes, and expertise, and therefore cannot accurately assess their own readiness.

The exploration study that employed the TOE framework and FMEA methodology (Rosli et al., 2024) offers a quantified perspective on the risk factors associated with technological readiness. The risk priority numbers (RPNs) calculated for team competency (336), data unavailability (256), and unstable adoption (245) are particularly instructive. The high RPN for team competency indicates that the lack of skilled personnel who can design, implement, and operate blockchain systems is the single most critical risk factor. This finding is consistent with the ISM study (Susanty et al., 2024), which identified limited knowledge or ability of supply chain actors to operate the systems as the most fundamental barrier. The high RPN for data unavailability reflects the reality that blockchain systems require reliable, accurate, and timely data inputs, yet many meat processors currently lack the data capture infrastructure, standardized data formats, and data management practices necessary to provide such inputs. The high RPN for unstable adoption suggests that even when initial implementation occurs, the lack of sustained organizational commitment, inadequate change management, or insufficient technical support can lead to system abandonment or underutilization.

The conceptual framework study that proposed a blockchain-based traceability system for halal food from farm to fork (Tan et al., 2020) provides a useful benchmark for assessing current readiness. The study, which drew inputs from three blockchain software providers and was grounded in real-life blockchain implementation in three distinct halal supply chains, identifies the current traceability challenges that must be overcome. These challenges include the fragmentation of information across multiple systems, the reliance on paper-based or manual documentation, the lack of standardized data formats across supply chain actors, and the difficulty of verifying the authenticity of halal certifications at each stage of the supply chain. The proposed framework integrates both halal processes and technologies, implying that current operational processes are not designed to seamlessly interface with blockchain systems. The study's grounding in institutional theory and agency theory (Tan et al., 2020) further suggests that the readiness gap is not merely technical but is also shaped by institutional structures and principal-agent relationships that affect how information is shared and verified across the supply chain.

The ISM study focusing on chicken meat-based food supply chains (Susanty et al., 2024) provides a hierarchical perspective on the barriers to technological readiness. The finding that limited knowledge or ability of supply chain actors to operate the systems is the most fundamental barrier, located at the root layer of the ISM model, has profound implications for understanding readiness. This finding suggests that before any technological infrastructure can be developed or deployed, the human capability gap must be addressed. The study validated 10 out of 15 identified barriers as relevant, indicating that the readiness challenge is multidimensional but that the knowledge and skills deficit is the most foundational. If this root barrier is not addressed, then other barriers such as infrastructure limitations, cost concerns, or data quality issues cannot be effectively resolved because the actors lack the capacity to identify, prioritize, and implement solutions.

The survey study of halal food SMEs (M. Ali et al., 2023) provides a quantitative perspective on organizational readiness, which is closely related to technological readiness. Interestingly, this study found that organizational readiness did not have a significant direct effect on adoption intention. This finding may appear contradictory to the qualitative evidence that emphasizes the importance of readiness, but it can be interpreted in several ways. First, the measurement of organizational readiness in this study may have focused on perceived readiness rather than actual readiness, and perceptions may be influenced by the same lack of awareness

that other studies have identified. Second, the finding may reflect that in the absence of other drivers such as top management support, external support, or competitive pressure even relatively high levels of readiness do not automatically translate into adoption intention. Third, the study's sample of 175 halal-certified SMEs may have been relatively homogeneous in terms of readiness levels, reducing the statistical power to detect a significant effect. The study did find that supply chain integration moderates the diffusion of blockchain technology, suggesting that the operational readiness of the entire supply chain, rather than individual processors, is a more critical factor.

The study that examined halal orientation strategy and institutional pressures (Hew et al., 2020) offers a complementary perspective on technological readiness by focusing on the perceptual and strategic factors that shape how processors evaluate technological characteristics. The study found that manufacturers with a comprehensive halal orientation strategy are more perceptive to institutional pressures and, in response to these pressures, evaluate technological characteristics and develop perceived desirability. This finding suggests that technological readiness is not solely a function of infrastructure and skills but is also shaped by the strategic orientation of the firm. Processors that already prioritize halal compliance as a core strategic objective may be more motivated to develop the technological capabilities needed for blockchain adoption, whereas those that view halal certification as a compliance requirement rather than a strategic asset may be less inclined to invest in readiness. The study's model explains 73.19% of the variance in intention to participate, indicating that strategic and perceptual factors are highly predictive of adoption behavior.

The exploratory study involving Malaysia and Indonesia (Zailani et al., 2024) provides a regional perspective on technological readiness by comparing internal factors (strengths and weaknesses) and external factors (opportunities and threats) across two countries. The study's finding that the adoption of a blockchain-based halal traceability system is not a simple task and that enterprises should evaluate all opportunities and threats before making strategic decisions suggests that technological readiness is context-dependent and varies across countries, industries, and firm types. The study offers six research propositions for future research, which collectively point to the need for a more nuanced understanding of how readiness develops over time and how it is influenced by both firm-level capabilities and environmental conditions.

Table 3 provides a comprehensive summary of the technological and operational readiness assessments across the included studies, highlighting the specific gaps, challenges, and requirements identified in each study.

**Table 3. Summary of Technological and Operational Readiness Assessments Across Included Studies**

| Study Id | Readiness Dimension | Key Findings On Readiness | Identified Gaps | Methodology |
|---|---|---|---|---|
| (Ali et al., 2021) | Operational processes and supply chain integration | Halal food supply chain can gain a congruent perspective for blockchain implementation; supply chain | Lack of integrated information systems and standardized data formats across supply chain actors | Five in-depth case studies |

| Study Id | Readiness Dimension | Key Findings On Readiness | Identified Gaps | Methodology |
|---|---|---|---|---|
| | | integration is a key enabler | | |
| (Elfarnawani & Kartiwi, 2024) | Technological, inter-organizational, security, and safety domains | Stakeholders lack awareness of blockchain technology; challenges span multiple domains | Compatibility with existing systems, data reliability, scalability, security, and safety | Semi-structured interviews with five stakeholders |
| (Hamdi et al., 2025) | Infrastructure, HACCP, SNI 99001:2016, blockchain implementation | 100% noncompliance in blockchain implementation; 42% noncompliance in HACCP; 38% noncompliance in SNI 99001:2016 | Cost and infrastructure barriers; complete absence of blockchain-ready infrastructure | Convergent mixed-methods, AHP, compliance gap analysis |
| (Rosli et al., 2024) | Team competency, data availability, adoption stability | RPN = 336 for team competency, 256 for data unavailability, 245 for unstable adoption | Lack of skilled personnel, inadequate data capture and management, unstable implementation | Surveys and interviews, TOE and FMEA |
| (Susanty et al., 2024) | Knowledge and ability of supply chain actors | Limited knowledge or ability to operate the systems is the most fundamental barrier | Human capability gap at the root of the barrier hierarchy | Content validation, ISM |
| (Tan et al., 2020) | Traceability systems and processes | Fragmented information, paper-based documentation, lack of standardized data formats | Integration of Halal processes and technologies from farm to fork | Conceptual framework based on real-life implementation and software provider inputs |
| (Zailani et al., 2024) | Internal capabilities and external environment | Adoption is not a simple task; enterprises must evaluate opportunities and threats | Context-dependent gaps; need for strategic assessment of readiness | In-depth interviews, RBV theory |

The table reveals a consistent pattern across studies: Malaysian halal meat processors' technological and operational readiness is currently very low, with significant gaps in infrastructure, data management, technical expertise, and process integration. The HABITS study (Hamdi et al., 2025) provides the most alarming quantitative assessment, showing a complete absence of blockchain-ready infrastructure. The ISM study (Susanty et al., 2024) identifies the root cause as the limited knowledge and ability of supply chain actors, suggesting that the readiness gap is fundamentally a human capital issue. The FMEA study (Rosli et al., 2024) quantifies the risk associated with this gap, with team competency receiving the highest RPN. The stakeholder interview study (Elfarnawani & Kartiwi, 2024) confirms that awareness is low across all stakeholder groups except technology providers. The case study research (M. H. Ali et al., 2021) and the conceptual framework study (Tan et al., 2020) emphasize the

importance of supply chain integration and standardized processes, both of which are currently lacking. The cross-country study (Zailani et al., 2024) adds a layer of complexity by showing that readiness varies across contexts and requires a strategic assessment of both internal and external factors.

Hew et al. (2020) offer a more optimistic perspective, showing that halal orientation strategy can shape perceptions of technological characteristics and build perceived desirability. This suggests that while current readiness is low, processors can build readiness if strategic alignment with halal objectives motivates them. The study's high explanatory power (73.19% of variance in intention) indicates that perceptual and strategic factors are powerful levers for influencing adoption behavior, even without full technological readiness. This finding implies that readiness interventions should not focus solely on infrastructure and skills but should also address the strategic framing of blockchain as a tool for enhancing halal integrity, which resonates with the core values and strategic priorities of halal meat processors.

The survey study of halal food SMEs (M. Ali et al., 2023) offers a nuanced perspective: while organizational readiness did not directly affect adoption intention, trialability and external support were significant drivers. This suggests that processors may be willing to adopt blockchain even without full readiness, provided they can test the technology in a low-risk environment and receive support from external partners. This finding has important implications for adoption strategy design: rather than requiring processors to achieve full readiness before adoption, stakeholders can facilitate a phased approach that allows learning, experimentation, and capability building during implementation. The study's finding that supply chain integration moderates the diffusion of blockchain technology further underscores the importance of addressing readiness at the supply chain level rather than at the individual firm level.

The conceptual framework study (Tan et al., 2020) offers a practical roadmap for building readiness by proposing a traceability framework that integrates both halal processes and technologies. The framework's grounding in real-life blockchain implementation across three distinct halal supply chains suggests that the proposed approach is feasible and has been tested in practice. The study's use of inputs from three blockchain software providers further ensures that the framework is grounded in technical realities rather than theoretical aspirations. The framework's emphasis on integrating Halal processes (e.g., slaughtering procedures, certification verification, handling requirements) with blockchain technologies (e.g., smart contracts, immutable ledgers, consensus mechanisms) provides a concrete blueprint for what readiness should look like. However, the study's identification of current traceability challenges also reminds us that the gap between current reality and the proposed framework is substantial and will require significant effort to bridge.

The study of chicken meat supply chains (Susanty et al., 2024) provides a particularly useful framework for prioritizing readiness-building efforts. By identifying limited knowledge or ability as the root barrier, the study suggests that capacity-building interventions should be the first priority. This finding is consistent with the FMEA study (Rosli et al., 2024), which identified team competency as the highest risk factor, and the stakeholder interview study (Elfarnawani & Kartiwi, 2024), which identified lack of awareness as a pervasive issue. The ISM methodology allows identification of dependent relationships among barriers, so interventions can target the most fundamental causes rather than symptoms. For example, addressing infrastructure limitations (a surface-level barrier) without addressing the knowledge

and skills deficit (a root-level barrier) would likely be ineffective because, even if infrastructure were provided, actors would not know how to use it effectively. This hierarchical perspective is valuable for designing a phased readiness-building strategy that begins with awareness and training, then moves to infrastructure development, and finally to system implementation and scaling.

The cross-country study involving Malaysia and Indonesia (Zailani et al., 2024) adds a comparative dimension that helps explain readiness in the Malaysian context. The study's finding that adoption is not a simple task and requires evaluation of opportunities and threats suggests that readiness is not a binary state but a continuum that varies across firms and contexts. The study's use of the resource-based view (RBV) theory provides a theoretical lens for understanding readiness as a function of the firm's internal resources and capabilities. This perspective shifts the focus from external factors (e.g., technology availability, regulatory support) to internal factors (e.g., knowledge, skills, infrastructure, financial resources) that are under the firm's control. The study's six research propositions provide a valuable agenda for future research on how readiness develops and how it can be built through strategic resource allocation and capability development.

**Institutional and Strategic Perspectives**

The institutional and strategic dimensions of blockchain adoption among Malaysian halal meat processors are examined through institutional theory, strategic orientation, and resource-based perspectives. The included studies consistently show that adoption decisions are not made in a vacuum but are shaped by formal and informal institutional pressures, strategic alignment with organizational goals, and the technology's perceived legitimacy within the halal ecosystem. Understanding these institutional and strategic factors is essential for explaining why some processors are more inclined to adopt blockchain than others, even when facing similar technological and operational challenges.

Institutional theory most directly influences blockchain adoption in three studies that explicitly incorporate this framework. One study (Tan et al., 2020) grounds its proposed traceability framework in both institutional theory and agency theory, arguing that current traceability challenges in the Malaysian food supply chain are fundamentally institutional. The study positions blockchain adoption as a response to institutional pressures that demand greater transparency and compliance with halal requirements. By drawing on real-life blockchain implementation in three distinct halal supply chains, the study demonstrates that institutional pressures, including coercive pressures from regulatory bodies, normative pressures from industry associations and certification bodies, and mimetic pressures from competitors, create a compelling environment for adoption. The proposed framework integrates halal processes and technologies, suggesting that successful adoption requires not only technical implementation but also institutional alignment with the existing halal certification and governance structures.

Another study (Hew et al., 2020) provides a more nuanced understanding of how institutional pressures operate in the halal food manufacturing context. Through a survey of 143 Malaysian halal food and beverage manufacturers, the study found that manufacturers with a comprehensive halal orientation strategy are more perceptive to institutional pressures that demand participation in a blockchain-based traceability system. This finding matters because it shows that the relationship between institutional pressures and adoption is not uniform across

firms but is moderated by the firm's strategic orientation. Manufacturers that have already embedded halal compliance as a core strategic priority are more likely to view institutional pressures as legitimate and relevant and are therefore more likely to respond by evaluating and adopting blockchain technology. The study's model explains 73.19% of the variance in intention to participate, indicating that the institutional and strategic factors captured in the model strongly predict adoption behavior.

A third study (Hamdi et al., 2025) applies institutional theory alongside resource orchestration theory to develop and validate the HABITS model for broiler supply chains. The study's findings reveal that transparency and compliance were prioritized over traditional traceability metrics, suggesting that institutional pressures for legitimacy and compliance are driving the adoption of blockchain-based traceability systems. The study's identification of significant gaps in blockchain implementation (100% noncompliance), HACCP integration (42% noncompliance), and SNI 99001:2016 (38% noncompliance) underscores the tension between institutional pressures for adoption and the practical constraints of cost and infrastructure. The HABITS model extends resource orchestration theory to religious-cultural contexts, showing that effective adoption requires not only aligning resources and capabilities but also strategically orchestrating them to achieve institutional legitimacy and operational performance simultaneously.

The strategic perspective is further developed in the exploratory study involving Malaysia and Indonesia (Zailani et al., 2024), which uses the resource-based view (RBV) theory to examine the internal and external factors that shape adoption decisions. Through in-depth interviews with leaders and high-ranking officials from both the public and private sectors, the study found that adopting a blockchain-based halal traceability system is not simple and requires enterprises to evaluate opportunities and threats before making strategic decisions. The study's findings suggest that the strategic decision to adopt blockchain is influenced by a complex interplay of internal strengths and weaknesses (e.g., technological capabilities, financial resources, organizational culture) and external opportunities and threats (e.g., regulatory support, market demand, competitive pressure). The study offers six research propositions for future research, including that firms with stronger internal resources and capabilities are more likely to successfully adopt blockchain and that strategic alignment between blockchain adoption and the firm's overall business strategy is a critical success factor.

The case study research (Ali et al., 2021) provides a practical perspective on the strategic considerations involved in blockchain adoption. By identifying five key challenges that are vital to small and medium enterprises in halal food supply chain blockchain implementation, the study highlights the strategic importance of supply chain integration and food regulations as key enablers. The study's framework suggests that successful adoption requires a strategic approach that considers the entire supply chain ecosystem, rather than focusing solely on the individual firm. This finding is consistent with the institutional perspective, which emphasizes that adoption decisions are shaped by the broader institutional environment, including the regulatory framework, industry standards, and supply chain relationships.

The survey study of halal food SMEs (Ali et al., 2023) provides quantitative evidence on the strategic factors that influence adoption intention. The study found that top management support, trialability, external support, and competitive pressure are critical factors influencing HFSMEs' intention to adopt blockchain technology. The finding that top management support is a significant driver underscores the importance of strategic leadership in driving

organizational change. The finding that competitive pressure is a significant driver suggests that firms' strategic decision to adopt blockchain is influenced by industry dynamics, where they may adopt the technology to maintain competitive parity or gain a competitive advantage. The study's finds that supply chain integration moderates the diffusion of blockchain technology and further emphasizes the strategic importance of inter-organizational relationships and coordination.

The study examining barriers in chicken meat supply chains (Susanty et al., 2024) offers a strategic perspective on the hierarchy of adoption barriers. The study's finding that limited knowledge or ability of supply chain actors to operate the systems is the most fundamental barrier that has important strategic implications. It suggests prioritizing strategic interventions to build human capital and organizational capabilities over technological investments, as the absence of such capabilities undermines the effectiveness of any technological solution. The study's use of interpretative structural modeling (ISM) allows for the identification of dependent relationships among barriers, enabling strategic prioritization of interventions.

The stakeholder interview study (Elfarnawani & Kartiwi, 2024) provides a comprehensive account of the strategic considerations that influence adoption decisions. The study's identification of success factors including heightened awareness, trust-building, financial backing, and regulatory alignment highlights the strategic importance of building a supportive ecosystem for adoption. The study finding that stakeholders, excluding technology providers, lack awareness suggests that strategic awareness-building initiatives are necessary to create the conditions for adoption. The study's identification of challenges spanning multiple domains technological, legal, inter-organizational, security, safety, and financial underscores the need for a comprehensive strategic approach that addresses all these dimensions simultaneously.

The FMEA study (Rosli et al., 2024) provides a strategic perspective on risk management in blockchain adoption. The study's identification of team competency, data unavailability, and unstable adoption as the highest-risk factors has important strategic implications. It suggests that strategic investments in human capital development, data management infrastructure, and change management processes are essential to mitigate adoption risks. The study's use of the TOE framework and FMEA methodology provide a structured approach for identifying and prioritizing strategic risks, enabling firms to allocate resources more effectively.

Table 4 provides a comprehensive summary of the institutional and strategic perspectives across the included studies, highlighting the key theoretical frameworks, institutional pressures, and strategic factors identified in each study.

**Table 4: Summary of Institutional and Strategic Perspectives on Blockchain Adoption Among Malaysian Halal Meat Processors**

| Study Id | Theoretical Framework | Institutional Pressures Considered | Key Barriers/ Challenges | Country (Region) | Methodology For Data Collection |
|---|---|---|---|---|---|
| (Ali et al., 2021) | | | | Malaysia | Five in-depth case studies |
| (M. Ali et al., 2023) | Technology, Organisation, Environment (TOE) | | | Malaysia | Questionnaires covering 500 halal-certified |

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| Study Id | Theoretical Framework | Institutional Pressures Considered | Key Barriers/ Challenges | Country (Region) | Methodology For Data Collection |
|---|---|---|---|---|---|
| | framework and Diffusion of Innovation (DOI) theory | | | | SMEs, 175 respondents |
| (Elfarnawani & Kartiwi, 2024) | | | Technological, legal, inter-organizational, security, safety, and financial domains | Malaysia | Semi-structured interviews with five stakeholders |
| (Hamdi et al., 2025) | Resource orchestration theory and institutional theory | Institutional theory | Cost and infrastructure barriers | | Convergent mixed-methods design, AHP, compliance gap analysis |
| (Hew et al., 2020) | Halal orientation strategy, institutional theory, and diffusion of innovation theory | Institutional theory | | Malaysia | Simple random sampling, phone interviews, partial least squares structural equation modelling |
| (Rosli et al., 2024) | Technology-Organization-Environment (TOE) theory and Failure Mode Effect Analysis (FMEA) | | Data integration, stakeholder management, data availability, team competency, data unavailability, unstable adoption | | Surveys and interviews from ten respondents |
| (Susanty et al., 2024) | | | Limited knowledge or ability of supply chain actors to operate the systems | | Content validation, interpretative structural modeling (ISM) |
| (Tan et al., 2020) | Institutional theory and agency theory | Institutional theory and agency theory | Current traceability challenges for the food supply chain in Malaysia to comply with Halal requirements | Malaysia | Real-life blockchain implementation in three distinct Halal supply chains; inputs from three Blockchain software providers |
| (Zailani et al., 2024) | Resource-based view (RBV) theory | | The adoption of the blockchain-based halal | Malaysia and Indonesia | In-depth interviews with leaders and |

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| Study Id | Theoretical Framework | Institutional Pressures Considered | Key Barriers/ Challenges | Country (Region) | Methodology For Data Collection |
|---|---|---|---|---|---|
| | | | traceability system is not a simple task; enterprises should evaluate all opportunities and threats before making strategic decisions | | high-ranked officials from both public and private sectors |

The table reveals a clear pattern in which studies that explicitly incorporate institutional theory tend to focus on the role of institutional pressures in driving adoption, while studies that adopt strategic perspectives emphasize the importance of internal resources, capabilities, and strategic alignment. The two studies that explicitly draw on institutional theory (Hamdi et al., 2025), (Hew et al., 2020), (Tan et al., 2020) collectively demonstrate that institutional pressures whether coercive, normative, or mimetic are a significant driver of adoption intention. However, these studies also show that the influence of institutional pressures is moderated by the firm's strategic orientation and internal capabilities. The study by (Hew et al., 2020) is particularly insightful in this regard, as it shows that a comprehensive halal orientation strategy amplifies the effect of institutional pressures, while the study by (Hamdi et al., 2025) shows that even when institutional pressures are present, the lack of infrastructure and financial resources can create significant compliance gaps.

The studies that adopt strategic perspectives, such as those using the resource-based view (Zailani et al., 2024) and the TOE framework (M. Ali et al., 2023), (Rosli et al., 2024), emphasize the importance of internal organizational factors in shaping adoption decisions. The RBV study (Zailani et al., 2024) highlights the need for firms to evaluate their internal strengths and weaknesses before making strategic decisions, while the TOE studies (M. Ali et al., 2023), (Rosli et al., 2024) identify specific organizational factors such as top management support, organizational readiness, and team competency that influence adoption intention. The ISM study (Susanty et al., 2024) provides a strategic framework for prioritizing interventions by identifying the most fundamental barriers to adoption.

The study by (Hamdi et al., 2025) is unique in its integration of resource orchestration theory with institutional theory, providing a comprehensive framework for understanding how firms can strategically align their resources and capabilities to respond to institutional pressures. The HABITS model developed in this study extends resource orchestration to religious-cultural contexts, demonstrating that effective adoption requires not only the alignment of resources and capabilities but also the strategic orchestration of these resources to achieve both institutional legitimacy and operational performance. The study's finding that transparency and compliance were prioritized over traditional traceability metrics suggests that the strategic objective of blockchain adoption is not merely operational efficiency but also institutional legitimacy, which is particularly important in the halal context where religious compliance is paramount.

The study by (Tan et al., 2020) provides a conceptual framework that integrates both halal processes and technologies, grounded in institutional theory and agency theory. The study's focus on the current traceability challenges in the Malaysian food supply chain highlights the institutional constraints that shape the adoption environment. The proposed framework, which draws on real-life blockchain implementation in three distinct halal supply chains, offers a practical roadmap for how firms can strategically respond to institutional pressures by adopting blockchain technology. The study's use of inputs from three blockchain software providers ensures that the framework is grounded in technical realities, while the theoretical grounding in institutional theory and agency theory provides a robust explanatory framework for understanding the strategic dynamics of adoption.

The study by (Hew et al., 2020) provides the most comprehensive empirical test of the relationship between institutional pressures and adoption intention. The study finds that a comprehensive halal orientation strategy moderates the effect of institutional pressures has important strategic implications. It suggests that firms that have already embedded halal compliance as a core strategic priority are more likely to perceive institutional pressures as legitimate and relevant and are therefore more likely to respond to them by evaluating and adopting blockchain technology. This finding implies that strategic interventions to build a halal orientation strategy can enhance the effectiveness of institutional pressures in driving adoption. The study's model explains 73.19% of the variance in intention to participate, indicating that the institutional and strategic factors captured in the model are highly predictive of adoption behavior.

The exploratory study involving Malaysia and Indonesia (Zailani et al., 2024) provides a comparative perspective on the strategic considerations that shape adoption decisions. The study finds that the adoption of a blockchain-based halal traceability system is not a simple task and requires enterprises to evaluate all opportunities and threats before making strategic decisions underscores the importance of a strategic approach to adoption. The six research propositions offered by the study provide a valuable agenda for future research, including propositions about the role of internal resources and capabilities, the importance of strategic alignment, and the need for a phased approach to adoption. The study's use of the resource-based view (RBV) theory provides a theoretical lens for understanding how firms can build the internal capabilities necessary for successful adoption.

The case study research (Ali et al., 2021) provides a practical perspective on the strategic considerations involved in blockchain adoption. The study's identification of five key challenges that are vital to small and medium enterprises in halal food supply chain blockchain implementation provides a useful framework for strategic planning. The study's emphasis on supply chain integration and food regulations as key enablers highlights the importance of strategic alignment with the broader supply chain ecosystem and regulatory environment. The study's framework suggests that successful adoption requires a strategic approach that considers the entire supply chain, rather than focusing solely on the individual firm.

The survey study of halal food SMEs (Ali et al., 2023) provides quantitative evidence on the strategic factors that influence adoption intention. The study finds that top management support, trialability, external support, and competitive pressure are critical factors influencing HFSMEs' intention to adopt blockchain technology and provide clear strategic priorities for firms and policymakers. The finding that top management support is a significant driver underscores the importance of strategic leadership in driving organizational change. The

finding that competitive pressure is a significant driver suggests that the strategic decision to adopt blockchain is influenced by industry competitive dynamics. The study finds that supply chain integration moderates the diffusion of blockchain technology and further emphasizes the strategic importance of inter-organizational relationships and coordination.

The study that examined barriers in chicken meat supply chains (Susanty et al., 2024) provides a strategic perspective on the hierarchy of barriers to adoption. The study finds that limited knowledge or ability of supply chain actors to operate the systems is the most fundamental barrier has important strategic implications for prioritizing interventions. The study's use of interpretative structural modeling (ISM) allows for the identification of dependent relationships among barriers, enabling strategic prioritization of capacity-building initiatives over technological investments.

The stakeholder interview study (Elfarnawani & Kartiwi, 2024) provides a comprehensive account of the strategic considerations that influence adoption decisions. The study's identification of success factors including heightened awareness, trust-building, financial backing, and regulatory alignment highlights the strategic importance of building a supportive ecosystem for adoption. The study finds that stakeholders, excluding technology providers, lack awareness suggests that strategic awareness-building initiatives are necessary to create the conditions for adoption. The study's identification of challenges spanning multiple domains underscores the need for a comprehensive strategic approach that addresses all these dimensions simultaneously.

The FMEA study (Rosli et al., 2024) provides a strategic perspective on risk management in blockchain adoption. The study's identification of team competency, data unavailability, and unstable adoption as the highest-risk factors has important strategic implications. The study's use of the TOE framework and FMEA methodology provide a structured approach for identifying and prioritizing strategic risks, enabling firms to allocate resources more effectively to mitigate the most critical risks.

**Discussion**

This systematic review indicates that Malaysian halal meat processors remain at an early stage of blockchain readiness. Across the nine included studies, the main barriers relate to limited knowledge, inadequate technological capability, weak organizational preparedness, resource constraints, and insufficient supply chain coordination. At the same time, the evidence suggests that capability development, institutional support, management commitment, and greater integration among supply chain actors can strengthen blockchain adoption.

Knowledge and awareness emerged as the most consistent foundational barriers. Several studies identified limited blockchain understanding and technical capability among halal supply chain actors (Elfarnawani & Kartiwi, 2024; Rosli et al., 2024; Susanty et al., 2024). Susanty et al. (2024), in particular, placed limited knowledge and ability at the root of the barrier hierarchy, suggesting that knowledge gaps may reinforce concerns about infrastructure, cost, and data management. This synthesis implies that financial or technological interventions alone are unlikely to produce sustainable adoption without corresponding investment in human capability. Awareness and training should therefore precede or accompany technological implementation.

The findings also highlight the importance of contextualizing blockchain within halal assurance rather than presenting it purely as a digital innovation. Hew et al. (2020) showed that halal orientation can strengthen the influence of institutional pressures on adoption intention. This suggests that processors may respond more positively when blockchain is associated with halal integrity, traceability, transparency, and regulatory compliance. From an SLR perspective, this finding extends conventional technology-adoption explanations by showing that religious and institutional requirements may shape how technological value is interpreted.

A second major theme concerns the relative importance of organizational and environmental conditions. Evidence from Ali et al. (2023) suggests that top management support, competitive pressure, external support, and trialability may be more influential than conventional technological attributes such as relative advantage, compatibility, and complexity. Rosli et al. (2024) identified similar concerns about organizational and technological preparedness. Collectively, these findings support the Technology-Organization-Environment perspective but indicate that the organizational and environmental dimensions may have greater explanatory importance within halal food supply chains. Blockchain adoption therefore depends not only on whether the technology is technically attractive, but also on whether organizations possess leadership commitment, resources, external assistance, and appropriate institutional conditions.

This organizational challenge is reinforced by the substantial gap between institutional expectations and actual operational capability. Hamdi et al. (2025) reported complete noncompliance with blockchain implementation within the context examined by the HABITS model, demonstrating that traceability expectations can exceed the capabilities currently available among supply chain actors. This finding suggests that mandatory implementation without capability building could produce compliance problems rather than meaningful digital transformation. A phased approach may therefore be more appropriate, beginning with digital infrastructure, workforce development, and process standardization before advancing toward full blockchain integration.

Supply chain coordination is another critical component of readiness. Blockchain creates value through distributed information sharing, meaning that individual firm readiness alone is insufficient. Ali et al. (2021) emphasized the importance of supply chain integration, while Ali et al. (2023) further demonstrated that integration shapes blockchain adoption dynamics. Readiness initiatives should consequently extend beyond individual processors to include suppliers, logistics providers, certifiers, regulators, and technology providers. Shared data standards, interoperable platforms, and collaborative governance are likely to be necessary for effective implementation across the halal meat supply chain.

The review also identified several inconsistencies that require contextual interpretation. Ali et al. (2023), for example, found no significant direct effect of government regulation on adoption intention, whereas Elfarnawani and Kartiwi (2024) identified regulatory alignment as an important implementation factor. Rather than representing a direct contradiction, these findings may reflect differences in research design and operationalization. Regulatory influence may operate indirectly through certification requirements, institutional support, technical standards, or stakeholder coordination rather than through a simple direct relationship with adoption intention. This illustrates the value of systematic synthesis in identifying relationships that may not be visible from individual studies.

Stakeholder heterogeneity further complicates adoption. Elfarnawani and Kartiwi (2024) found that technology providers demonstrated greater blockchain awareness than other stakeholders, while Ali et al. (2023) showed that adoption determinants may vary across organizational contexts. These findings suggest that a uniform adoption strategy would be inappropriate. Larger processors may require integration support and advanced technical solutions, whereas smaller firms may require foundational training, financial assistance, and access to shared technological infrastructure. Adoption models should therefore account for organizational size, technological maturity, and stakeholder roles.

Another important gap concerns the temporal development of readiness. The included evidence is predominantly cross-sectional and therefore offers limited insight into how readiness changes over time. Ali et al. (2023) highlight the importance of trialability, suggesting that organizational readiness may develop through experimentation and accumulated experience. Longitudinal research is needed to determine whether awareness, infrastructure, management commitment, and supply chain integration change in importance as firms progress from initial awareness to implementation and routinization.

Several limitations should be considered when interpreting the synthesis. First, the small number of included studies (n = 9) indicates that blockchain readiness within the halal meat sector remains an emerging research area. Five of the nine studies were published in 2024, further demonstrating the recent development of this literature. Second, potentially relevant evidence from non-English sources, regional databases, grey literature, industry reports, and unpublished research may not have been captured. Third, variation in study quality, research designs, theoretical frameworks, and measurement approaches limited direct comparison and prevented stronger conclusions regarding the relative importance of individual readiness factors.

Finally, the focus on Malaysian halal meat processors limits generalization to other countries and halal sectors with different regulatory, cultural, and technological environments.

Future studies should therefore move beyond cross-sectional descriptions toward longitudinal, comparative, and intervention-based research. Action research could examine whether training, mentoring, pilot implementation, or shared digital infrastructure effectively improves blockchain readiness. The moderating role of supply chain integration identified by Ali et al. (2023) also warrants further investigation across different organizational and national contexts. Comparative studies should examine whether readiness differs across halal meat, processed food, beverage, and pharmaceutical sectors and across countries with different halal governance systems.

Further research should also investigate the economic, religious, and technological dimensions of adoption. Hew et al. (2020) indicate that halal orientation may influence adoption responses, highlighting the need to examine how religious values and certification requirements interact with technological decision-making. Economic studies should evaluate implementation costs, expected benefits, and shared infrastructure models suitable for SMEs. Finally, emerging systems that combine blockchain with the Internet of Things, artificial intelligence, and RFID deserve further examination. The HABITS model proposed by Hamdi et al. (2025) provides an important foundation, but further empirical research is required to determine the technical feasibility, economic viability, and organizational requirements of integrated halal traceability systems.

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Overall, the synthesis shows that blockchain adoption in Malaysia's halal meat sector is primarily a readiness and capability challenge rather than a purely technological problem. Sustainable adoption requires a coordinated progression from awareness and skills development to organizational commitment, infrastructure investment, supply chain integration, and institutional support. Addressing these dimensions systematically may enable blockchain to develop from an emerging technological option into a practical mechanism for strengthening halal traceability, integrity, and trust.

## Conclusion

This systematic review assessed the current state of evidence on the readiness, resources, and capabilities of Malaysian halal meat processors to adopt blockchain technology. Our synthesis of nine included studies reveals a consistent and sobering picture: awareness and knowledge of blockchain among processors remain critically low, technological infrastructure is almost entirely absent, and organizational capabilities are underdeveloped across multiple dimensions. The evidence confirms that adoption is currently driven more by organizational and environmental factors, particularly top management support, external support, and competitive pressure, than by technology's inherent characteristics. Resource constraints, including financial limitations, infrastructure gaps, and a lack of technical expertise, were repeatedly identified as primary barriers, whereas supply chain integration and regulatory alignment emerged as key enablers. These findings collectively challenge the assumption that blockchain adoption can be achieved through technological solutions alone, instead underscoring the need for foundational capacity-building interventions.

The theoretical contribution of this review lies in synthesizing fragmented evidence across multiple disciplines, showing that existing technology adoption models may need adaptation for religiously regulated industries, where institutional pressures and strategic orientation play amplified roles. Practically, our findings suggest that policymakers should prioritize foundational readiness through targeted training programs, financial incentives, and phased implementation strategies before pursuing large-scale deployment. The HABITS study's finding of a complete absence of blockchain-ready infrastructure serves as a stark reminder that regulatory mandates without corresponding capability-building efforts are unlikely to succeed. Future research should therefore focus on longitudinal studies that track readiness development over time, action research that directly tests capacity-building interventions, and comparative studies across different halal food sectors and national contexts to identify context-specific adoption pathways.

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