



Halal Supply Chain Modernization Strengthening Integrity Trust Competitiveness

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ABSTRACT

The modernization of halal supply chains has become increasingly important as organisations seek to strengthen ethical integrity, improve transparency, enhance operational resilience, and sustain competitive advantage in global markets. This article examines how halal supply chain modernization is shaped by institutional standards, digital technologies, organisational capabilities, consumer expectations, and sustainability pressures. The analysis identifies several persistent barriers, including fragmented certification systems, technological and infrastructural limitations, insufficient organisational readiness, human resource constraints, consumer skepticism, and growing environmental demands. These challenges demonstrate that modernization cannot be achieved through technology adoption alone, but requires coordinated improvements in governance, capability development, traceability, and stakeholder collaboration. The article further highlights the strategic role of digital traceability, harmonised certification, leadership commitment, consumer-oriented transparency, and sustainable logistics practices in strengthening halal assurance and market credibility. Based on the analysis, modernization is positioned as an integrated strategic process that connects ethical compliance, technological capability, operational performance, and competitive positioning. The article contributes to halal supply chain management by demonstrating that long-term competitiveness depends on the ability of organisations to modernise without weakening halal integrity, consumer trust, or ethical responsibility. Effective modernization therefore requires a balanced approach that combines institutional harmonisation, digital innovation, organisational capability, sustainability, and transparent governance across the halal supply chain.

Keywords: Halal, Modernization, Traceability, Sustainability, Competitiveness

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1. INTRODUCTION

The halal economy has become one of the fastest growing sectors in the global market. The demand for halal products extends beyond Muslim-majority countries, reaching international consumers who value integrity, transparency, and ethical practices. According to recent studies, the halal market is expected to surpass trillions of dollars in value as global consumer preferences shift towards safe, wholesome, and ethically sourced goods (Kurniawati, 2023; Changalima, 2025). This growth reflects both religious obligations for Muslims and the universal appeal of halal principles, which emphasize cleanliness, fairness, and sustainability. As competition intensifies, the modernization of halal supply chains has become an essential strategy for ensuring compliance with Islamic requirements while also strengthening ethical practices and generating competitive advantage in the global economy (Mustapha et al., 2024; Hasan, 2024).

The modernization of halal supply chains involves integrating advanced technologies, improving operational efficiency, and ensuring that all activities adhere to Shariah principles. Modernization is not only about digital transformation but also about aligning supply chain activities with ethical expectations, transparency, and trust-building. Advanced technologies such as blockchain, the Internet of Things, artificial intelligence, and big data analytics are now being applied to strengthen halal traceability and reduce the risks of fraud or contamination (Kurniawan et al., 2025). These technologies allow real-time monitoring of halal certification and provide consumers with the confidence that products are authentic and compliant. Moreover, modernization also supports sustainability goals by encouraging eco-friendly practices and fair labor, which align with the broader concept of halal and tayyib, meaning permissible and wholesome (Rahman, 2024; Yusof et al., 2026). Recent work on halal supply chains likewise connects sustainable innovation, (Yusof et al., 2026) transparency, and regulatory compliance with stronger supply chain practices.

The role of ethical legitimacy is central to halal supply chains. Muslim consumers are increasingly demanding clear evidence of halal integrity throughout the production and distribution process (Mustapha et al., 2024). Mislabeling, contamination, or halal fraud has the potential to severely damage trust and market reputation. Strengthening ethical practices requires not only regulatory oversight but also active investment in traceability technologies and transparent reporting (Meuthia et al., 2024; Yusof, 2025). At the same time, non-Muslim consumers are attracted to halal-certified products because they perceive halal as a mark of quality, safety, and ethical responsibility. This dual appeal highlights the importance of modernizing halal supply chains to enhance consumer trust and differentiate products in highly competitive markets (Kurniawati, 2023; Changalima, 2025).

Regulatory pressures have also been instrumental in shaping the modernization of halal supply chains. Governments in Muslim-majority countries are reinforcing halal compliance through stricter certification systems, digital record-keeping, and harmonization of standards across-borders (Mustapha et al., 2024). For instance, some countries are implementing blockchain-based halal certification platforms to enhance transparency and streamline international trade. However, the lack of harmonization among different halal certification bodies remains a critical challenge. Discrepancies in standards often create barriers to international trade, undermining efficiency and slowing down the movement of halal products across markets (Hassan, 2025; Yusof, 2025). The need for globally recognized and technologically advanced certification systems has therefore become more urgent.

Another driver of modernization is the pursuit of competitive differentiation. In an increasingly saturated halal market, businesses are looking for ways to stand out by providing superior assurance of halal integrity and ethical practices. Digital tools such as QR codes linked to blockchain systems allow consumers to verify the halal status of products instantly, creating an added layer of confidence. This transparency strengthens brand loyalty and builds long-term competitiveness. Moreover, firms that successfully modernize their halal supply chains are better positioned to capture opportunities in emerging halal markets in Africa, Latin America, and Europe, where consumer demand is rising rapidly (Kurniawati, 2023; Changalima, 2025). The ability to offer trustworthy halal products provides businesses with a strong advantage over competitors who are slow to adopt modernization strategies.

Risk mitigation and resilience also play crucial roles in motivating modernization. Halal supply chains, like other global supply networks, face disruptions caused by pandemics, geopolitical tensions, and climate change (Xu et al., 2023). The implementation of digital platforms and smart logistics solutions allows firms to monitor risks in real-time, improve agility, and respond quickly to disruptions without compromising halal integrity. By doing so, businesses not only protect consumer trust but also maintain competitiveness in volatile environments (Belkhatir et al., 2020). Resilient halal supply chains provide assurance that products will reach consumers without delay or ethical compromise, even during global crises. Logistics research similarly emphasizes strategic (Yusof et al., 2025) responses that improve sustainable growth and resilience under changing conditions.

Despite its benefits, modernization presents several challenges. The cost of adopting new technologies remains a significant barrier for small and medium enterprises, which dominate the halal sector in many countries (Meuthia et al., 2024). Advanced systems such as blockchain and IoT require investment in infrastructure, training, and maintenance that many SMEs cannot afford without external support. Moreover, the fragmentation of halal certification bodies complicates the integration of modernization technologies. Systems that are accepted in one country may not be recognized in another, creating inefficiencies and additional costs (Mustapha et al., 2024; Yusof, 2025). These challenges highlight the need for collective efforts among governments, certification bodies, and industry stakeholders to promote harmonization and provide financial and technical support for SMEs. Evidence on technology adoption further indicates that (Yusof, 2025a; Yusof, 2025b) digital capability can support business growth and sustainability, although adoption barriers remain significant for smaller firms.

Modernization also raises ethical questions regarding the compatibility of technology with halal jurisprudence. For example, the use of mechanized slaughter and stunning technologies has been debated among Islamic scholars, with some questioning whether these methods fully comply with religious requirements (Rahman, 2024). Such debates illustrate the need for ongoing dialogue between religious authorities, regulators, and industry players to ensure that modernization does not undermine halal principles. In addition, issues of data privacy, ownership, and governance emerge when supply chains rely heavily on digital systems. Trust among stakeholders must be carefully managed to prevent misuse or manipulation of sensitive information.

The globalization of halal supply chains further complicates modernization. Infrastructure bottlenecks, such as limited internet connectivity and weak logistics systems in developing regions, slow down the adoption of digital solutions (Yusof & Abdul Razak, 2025). These barriers underscore the importance of tailoring modernization strategies to local contexts. What works in technologically advanced economies may not be feasible in regions with limited resources. Therefore, strategies must account for contextual variations while maintaining adherence to halal integrity and ethical standards (Kurniawati, 2023). Intermodal logistics research also demonstrates that international supply chains depend on coordinated technology, logistics capability, and cross-border integration (Yusof & Othman, 2024).

Given these complexities, there is a need for more research that bridges ethical principles, technological adoption, and competitive advantage in halal supply chains. Existing studies often treat ethical compliance and business performance as separate issues rather than exploring their interconnections (Rahman, 2024; Moghaddam & Nof, 2022). Furthermore, most literature emphasizes large corporations, with limited attention to how SMEs can effectively modernize their operations. This gap is critical, as SMEs play a central role in supplying halal products globally. Research must therefore identify pathways for SMEs to adopt affordable and scalable modernization solutions without compromising halal integrity (McKinnon, 2018; Meuthia et al., 2024).

This article addresses these gaps by exploring the modernization of halal supply chains as a driver for both ethical practices and competitive advantage. The objectives are to conceptualize how modernization links ethical integrity with market performance, to examine successful modernization initiatives in different regions, to identify barriers that hinder adoption, and to propose recommendations for overcoming these challenges. By addressing these objectives, the article contributes to the literature by offering a comprehensive framework that integrates ethics, technology, and competitiveness in halal supply chains. This framework has practical implications for policymakers, certification bodies, and businesses that aim to strengthen their position in the global halal economy.

2. LITERATURE REVIEW

Modernization of halal supply chains is increasingly framed as a system-wide redesign that binds institutional standards to digital traceability, credible logistics practices, and market-facing transparency. The literature shows that this redesign both strengthens ethical assurance and creates pathways to competitive advantage, especially when governance, technology, and organizational capabilities are implemented in tandem. The five items that follow synthesize current evidence across those domains.

2.1 Institutional Governance Architecture Supporting Modern Halal Supply Chains

Recent work emphasizes that modernization rests on an explicit architecture of standards that operationalize halal and tayyib principles from source to shelf. The Organization of Islamic Cooperation, acting through SMIIC, codified requirements for halal supply chain management in three parts that cover transportation, warehousing, and retailing. These parts specify process controls, documentation, and oversight that protect integrity while goods move, are stored, and are offered at point of sale. The publication of OIC or SMIIC 17 parts one to three in 2020 marked an important step toward cross-border harmonization and gave certifiers and operators a technology-

neutral blueprint for compliance auditing. National ecosystems have aligned with these references to different degrees, but the direction of travel is toward mutual recognition anchored in common clauses and verifiable procedures. The standards provide an institutional backbone upon which digital tools and logistics practices can be layered to achieve modern halal assurance at scale (Kurniawati, 2023).

Malaysia's system is widely studied because it integrates certification, management system requirements, and sector specific logistics standards. The Malaysian MS 2400 series, revised in 2019 and confirmed in 2024 for warehousing, sets general requirements for transportation, warehouses, and retail operations. These standards are administered by the Department of Standards Malaysia and audited in practice alongside the Manual Procedure for Malaysia Halal Certification and the Malaysia Halal Management System. Together they define how firms must structure assurance systems, control suppliers, maintain documentation, and prepare for audits. The clarity of roles and auditability built into the Malaysian framework makes it a useful reference for other jurisdictions seeking to upgrade oversight, and it provides an institutional platform that is compatible with digital traceability. Comparative studies further highlight how national guidance such as permissible stunning windows shapes plant design and handling practices, underlining the operational impact of governance choices on modernization programs (Kurniawati, 2023; Yustianingsiha et al., 2024).

A growing analytical literature reviews the halal supply chain field through the lens of sustainability, optimization, and governance. Recent overviews argue that the maturation of standards has shifted the research frontier from definitional debates to questions of implementation and performance. The consensus is that credible modernization requires converging certification rules, governance capable of enforcing them across-borders, and operations capable of demonstrating continuous compliance. This stream positions institutional architecture as the foundation for digitalization and for competitive outcomes in both Muslim majority and mixed markets (Kurniawati, 2023).

2.2 Digital Technologies Strengthening Halal Integrity Transparency Control

The most dynamic research area concerns digital transformation as a force multiplier for halal assurance. Systematic reviews find accelerating adoption of Industry 4.0 tools, including blockchain, Internet of Things sensors, computer vision and robotics, as well as analytics that automate anomaly detection and trigger exception handling. In halal contexts, these tools provide tamper evident ledgers for certificates and process events, continuous environmental monitoring across cold chains, and real-time alerts that shrink the time between a deviation and a corrective action. A 2024 review shows significant reported effects on traceability quality and responsiveness, while a 2025 review in the halal meat domain maps how digital twins, augmented reality, and intelligent packaging could close remaining gaps in end-to-end verification. Conceptual and design studies now propose hybrid architectures that combine permissioned ledgers with IoT gateways, consensus mechanisms tuned for throughput, and machine learning for fraud detection, with pilot results in fresh meat tracing that demonstrate technical feasibility at operational speeds.

The broader food supply chain literature provides converging evidence that blockchain-based traceability can improve data integrity, provenance visibility, and recall readiness. Recent systematic reviews in applied sciences, critical reviews in food science, and food supply chain analytics catalog case studies where digital ledgers increased trust in reported origins and enabled faster, more targeted

recalls. These effects are relevant in halal systems because they mitigate common integrity threats such as mislabeling and documentation tampering. Evaluative frameworks developed for agricultural traceability also foreground governance issues such as data ownership, interoperability, and the need for neutral evaluation criteria, which halal ecosystems can adopt to ensure platforms remain credible across diverse actors and jurisdictions.

Digital enablement is not limited to blockchain. Studies document the integration of event data standards such as GS1 EPCIS to structure traceability events across partners, as well as compliance guides that map how those events support traceability rules like the United States Food Safety Modernization Act rule on critical tracking events. These standards matter for halal chains because they make heterogeneous systems interoperable and allow halal assurance data to be exchanged securely with trading partners and regulators. Emerging work on governance frameworks for digital traceability argues that platforms must adopt consortium models, clear access rights, and auditability to sustain trust, which directly parallels the requirements seen in halal certification ecosystems. Together, this literature shows how modern data infrastructures can (Yusof et al., 2020) carry halal proof points through complex, globalized chains in a way that stakeholders can verify and act upon.

2.3 Logistics Practices Protecting Integrity Resilience Across Halal Networks

Operational scholarship details how logistics practices translate principles into verifiable controls. Earlier halal logistics research introduced physical segregation, asset dedication, and cleaning regimes designed to prevent cross contact, and recent contributions extend these ideas to multimodal corridors, airport cargo, and retail execution in mixed market contexts. Case based studies in emerging economies profile the most frequent risk nodes, identifying contamination during transport, partnership failures, and skills gaps as persistent vulnerabilities. Complementary reviews in food fraud and authenticity show that mislabeling and adulteration remain salient threats, particularly when supply networks are long, documentation is manual, or enforcement is fragmented. In response, the literature recommends layered countermeasures that mix (Yusof et al., 2020) process control, unannounced audits, forensic testing, and digital traceability to close opportunities for fraud and error across the chain. Strategic warehouse management provides a related operational perspective by linking disciplined warehouse practices with wider supply chain performance (Abdullah et al., 2020).

Comparative governance analyses add granularity by showing how jurisprudential interpretations shape operational design. Malaysian guidance documents clarify permissible use of stunning and define time windows for cutting after stunning for different species. These rules affect equipment choice, line balancing, humane handling protocols, and monitoring points, and therefore influence how plants and transport systems must be configured to meet modern halal standards. Aligning these operational details with national and international standards reduces ambiguity and creates conditions where sensors, timestamps, and digital records can credibly support audit trails and cross-border acceptance (Yustianingsiha et al., 2024; Yusof et al., 2026).

Resilience research in mainstream operations and supply chain management provides mechanisms for why digitalized halal logistics can recover faster from shocks. Studies on autonomous and digitally transformed supply chains explain how visibility layers, analytics, and decision automation

reduce detection and recovery times during disruptions. Inventory focused resilience reviews and panel studies on digital transformation show that the configuration of technologies, information exchange, and integration quality jointly determine realized resilience. These findings are applied by halal scholars to argue that visibility and analytics complement segregation and procedural controls, improving both integrity assurance and operational continuity under uncertainty (Xu et al., 2023; Yin et al., 2022). Warehouse management systems and modern logistics strategies can strengthen visibility, (Yusof et al., 2025; Yusof et al., 2025) resilience, and competitiveness across rapidly changing supply environments.

2.4 Consumer Trust Market Signalling Ethical Acceptance Dynamics

A large body of recent work ties modernization to consumer trust and purchase behavior. Multi group studies in the Journal of Islamic Marketing report that transparent traceability increases perceived authenticity and acceptance of halal products, especially when users can access verifiable process data. Research from Turkey and Southeast Asia shows that trust and religiosity shape purchase intentions and that recognized certification marks and credible disclosure can moderate skepticism. The literature suggests that digital traceability visible at the point of purchase, when aligned with trusted certifiers, strengthens brand equity and encourages loyalty among Muslim and non-Muslim consumers who increasingly associate halal markings with safety and quality. This stream therefore bridges ethical assurance and market outcomes by identifying the communication and design features that make modernization investments salient to consumers.

Studies that probe logo trust and cultural familiarity add nuance. Evidence from Indonesia and cross cultural settings indicates that trust in the halal logo is multidimensional, with spiritual, institutional, and informational components. Cultural familiarity can shape willingness to buy halal certified products in non-Muslim markets, but clear certification processes and accessible information still play decisive roles. This reinforces the argument that modernization must be consumer facing to fully realize competitive benefits. When traceability and certification information is easy to verify and consistent across channels, consumers exhibit higher confidence and translate it into purchase intention and loyalty. These findings also inform public communication strategies for certifiers and retailers who want to reach broader segments without diluting religious compliance.

The same research stream acknowledges lingering skepticism in some markets due to high-profile fraud cases and inconsistent certification narratives. The implication is that modernization efforts must emphasize verifiable provenance, real-time exception handling, and standardized display of key data elements to restore confidence. The literature thus supports a practical design rule. Ethical assurance only becomes a competitive signal when supported by transparent and reliable information infrastructures and by governance that stakeholders trust.

2.5 Competitive Performance Capability Development Through Halal Modernization

Evidence is accumulating that modernization improves multiple performance dimensions. Reviews and empirical studies in operations journals link digital supply chain capabilities to speed, responsiveness, waste reduction, and resilience, while sustainability-oriented papers explain how Industry 4.0 tools support circularity and carbon visibility. These mechanisms are applicable to halal operations that must manage segregation, cold chains, and documentation with high reliability. When modernization reduces error rates and lead times while enabling targeted recalls, firms gain

both cost and risk advantages. The broader logistics literature also argues that integration and decarbonization capabilities have become strategic, and that firms which master them can compete on service quality and ethics simultaneously. This aligns with the halal proposition, where integrity and efficiency are complements rather than trade-offs (McKinnon, 2025; Moghaddam & Nof, 2022). Digital innovation and smart technologies can (Yusof et al., 2025) also strengthen sustainable competitiveness when technology adoption is integrated with broader organisational capability.

Competitive effects are also visible in studies of standards and certification. Analyses of halal value chain competitiveness find that recognized certification and aligned standards act as both entry barriers and sources of differentiation that open export channels. Work on SMEs indicates that certification and capability upgrades correlate with performance improvements but that barriers such as capital constraints, complex procedures, and integration with legacy systems limit uptake. Research using analytic network and fuzzy prioritization approaches ranks the most salient obstacles and proposes staged adoption roadmaps, shared services, and targeted incentives to bring smaller firms into digital traceability networks. These insights emphasize that ecosystem design and public policy are part of the modernization story whenever suppliers are numerous and heterogenous (Meuthia et al., 2024; Zhang et al., 2021).

Finally, halal specific technology roadmaps connect modernization to integrity and growth in concrete categories. Conceptual frameworks for blockchain and IoT enabled halal traceability propose data models, governance designs, and deployment patterns tuned to national policy goals. Trials in fresh meat demonstrate that dual blockchain designs with IoT sensors can support high volume event capture and verification. Reviews in halal meat integrate these findings and propose near term innovation priorities such as intelligent packaging and augmented reality verification. These developments, paired with institutional standards, make a persuasive case that modernization can simultaneously lower compliance costs, raise audit readiness, and serve as a market-facing differentiator. This is consistent with mainstream digital transformation research that links information exchange and responsiveness to sustainable competitive performance. Together, these strands reinforce the central argument of the introduction. Modernization is both an ethical imperative and a strategic lever, provided that governance, technology, and capability building advance together (Kurniawan et al., 2025; Yusof et al., 2025; Moghaddam & Nof, 2022).

3. STRUCTURAL BARRIERS LIMITING MODERN HALAL SUPPLY CHAIN MODERNIZATION

The modernization of halal supply chains has attracted significant attention because of its potential to secure ethical assurance, deliver transparency, and open pathways to competitive advantage. However, this transformation is complex and contested. A growing body of literature demonstrates that modernization efforts are hindered by fragmentation in certification, technological limitations, organizational gaps, consumer skepticism, and sustainability pressures. Each of these areas creates barriers that must be addressed if halal supply chains are to evolve into credible, globally competitive systems. This section examines the central issues identified in contemporary scholarship, structured into five interrelated clusters.

3.1 Certification Fragmentation Weakening Global Halal Standard Harmonization

One of the most persistent challenges in halal supply chains is the absence of globally harmonized standards. Although organizations such as the Organization of Islamic Cooperation and regional bodies have sought to develop unifying frameworks, national authorities continue to apply diverse interpretations of halal requirements (Azam & Abdullah, 2020). This lack of standardization creates duplication of certification and increases costs for companies operating across multiple jurisdictions (Noordin et al., 2021). Inconsistent auditing procedures and varied enforcement mechanisms further undermine confidence in the system (Syed Marzuki et al., 2021).

The issue is not only regulatory but also institutional. Competition among certification bodies has produced a fragmented ecosystem where logos and certifications differ widely, leading to confusion among consumers and traders (Borchert & Asgari, 2019). Studies show that exporters frequently face delays at customs when certification from one body is not recognized by another, creating inefficiencies in global trade (Omar et al., 2022). This undermines the promise of halal supply chains as facilitators of smooth international commerce.

The scholarly consensus is that standard fragmentation weakens trust in halal integrity. Without a unified approach, firms find it difficult to implement modernization initiatives consistently (Mohamed et al., 2022). For modernization to succeed, harmonization and mutual recognition must be prioritized, yet political and institutional obstacles continue to slow progress (Shafii & Khadijah, 2021). This fragmentation remains a core issue hindering modernization.

3.2 Technological Infrastructure Constraints Restricting Halal Digital Transformation

Digital transformation is widely heralded as essential for halal supply chain modernization, but several issues obstruct adoption. Many halal enterprises, particularly small and medium enterprises, struggle with the cost of investing in blockchain, Internet of Things devices, and advanced traceability platforms (Tieman, 2020). Without subsidies or collaborative infrastructures, these technologies remain inaccessible to the majority of producers. Smart warehouse technologies illustrate the wider need to address system maintenance, (Yusof et al., 2025) security, and integration risks alongside digital adoption.

Infrastructure deficits also hinder adoption. Studies in emerging markets show that weak cold chain logistics, limited internet connectivity, and inadequate storage facilities prevent the effective use of traceability technologies (Ali et al., 2021). Even when firms attempt to implement digital systems, connectivity failures and power outages create data gaps that undermine reliability (Zailani et al., 2021). This shows that modernization is dependent not only on technology but also on infrastructural readiness.

Interoperability represents another critical issue. Multiple digital systems have been introduced by different certification bodies, but there is no consensus on shared data formats or protocols (Tan et al., 2021). As a result, halal supply chain actors often operate in silos, and information sharing across-borders becomes cumbersome. Concerns about data security and ownership further complicate collaboration, as firms are reluctant to share sensitive operational data without clear governance frameworks (Salleh et al., 2021). These technological and infrastructural barriers

demonstrate that modernization is not merely a technical question but a systemic challenge requiring coordinated investment.

3.3 Organizational Capability Limitations Restricting Halal Modernization Readiness

Organizational readiness remains a central obstacle to modernization. Many halal firms focus primarily on product-level certification rather than process-level supply chain management (Ab Talib, 2021). This narrow focus limits their ability to implement end-to-end modernization initiatives that require continuous monitoring, documentation, and process control. Audits frequently reveal deficiencies in documentation, supplier control, and sanitation practices, highlighting the need for greater organizational discipline (Abdul et al., 2020). Leadership and governance are therefore (Yusof, 2026; Yusof et al., 2026) important because digital transformation requires both strategic direction and ethical accountability.

Human capital limitations further exacerbate the issue. A lack of skilled professionals trained in both halal compliance and digital supply chain management constrains implementation (Zulfakar et al., 2020). Studies emphasize that halal logistics personnel require specific training in contamination prevention, documentation, and digital tools, yet such training is scarce (Ab Talib & Johan, 2021). Resistance to change within organizations also hinders modernization, as employees accustomed to traditional practices are often reluctant to adopt digital tools (Abdullah et al., 2021).

Leadership commitment has been identified as a crucial determinant of modernization success. Firms with strong leadership support are more likely to invest in technology, training, and process redesign (Ismail et al., 2022). However, many halal firms, particularly SMEs, view modernization as a cost rather than a strategic investment (Haron et al., 2021). This lack of strategic orientation prevents modernization projects from achieving scale and sustainability. The literature indicates that without capacity building, leadership commitment, and cultural readiness, modernization will remain uneven.

3.4 Consumer Skepticism Weakening Trust Ethical Market Acceptance

Consumer trust is the foundation of halal markets, yet it remains fragile. Past scandals involving fraudulent labeling and contamination have undermined confidence in halal claims (Riaz & Chaudry, 2020). Studies show that consumers often cannot distinguish between authentic and less credible halal logos, especially in markets with multiple certification bodies (Kassim et al., 2020). This confusion weakens halal's role as a market signal and reduces the willingness of consumers to pay a premium for halal-certified products. Digital consumer research further shows that online perceptions can materially shape purchasing behaviour, reinforcing the importance of credible and transparent information (Zaini et al., 2026).

Transparency is seen as a potential solution, but consumers remain skeptical about digital traceability systems. Research shows that willingness to adopt such systems depends on cultural familiarity, perceived credibility, and ease of use (Abdul-Talib et al., 2021). Without effective communication and consumer education, even advanced traceability solutions may fail to restore trust (Mohd Ali et al., 2021). The issue is compounded by generational differences, with younger consumers demanding halal products that also meet sustainability, animal welfare, and ethical sourcing criteria (Yunos et al., 2021).

Another dimension is the growing expectation for halal products to be not only permissible but also *tayyib*, meaning wholesome and ethically sound. Consumers increasingly expect halal supply chains to align with broader ethical standards, including fair labor practices and environmental stewardship (Khan & Haleem, 2021). Companies that fail to integrate these values risk losing competitiveness among ethically conscious consumers. This demonstrates that consumer trust is not just about halal compliance but also about aligning with evolving ethical expectations.

3.5 Sustainability Pressures Intensifying Global Halal Market Competition

Sustainability is emerging as both a driver and a challenge for halal supply chain modernization. Global supply chain literature emphasizes the need to reduce carbon footprints, minimize waste, and adopt circular economy practices (Ansari & Kant, 2021). For halal supply chains, these requirements create tension, as segregation and cold chain processes often increase energy consumption (Nordin et al., 2021). Balancing halal integrity with environmental efficiency is therefore a persistent issue. Green innovation research likewise shows how environmental initiatives can contribute to competitive advantage when embedded in strategic organisational priorities (Jamaludin et al., 2024).

Competitive pressures also shape modernization challenges. The halal market is no longer limited to Muslim-majority countries; multinational corporations from non-Muslim regions are increasingly entering the sector with advanced supply chain capabilities (Lada et al., 2020). This raises the competitive bar for local halal firms, many of which lack comparable resources (Ali et al., 2020). Without modernization, local firms risk losing market share both domestically and internationally. Resilience has become another pressing issue in the wake of global disruptions such as pandemics and geopolitical instability. Research shows that halal supply chains remain vulnerable to shocks, with disruptions often exposing weaknesses in traceability and logistics (Ismail et al., 2021). Building resilience requires diversification, redundancy, and collaborative governance, yet many halal firms prioritize short-term efficiency over long-term resilience (Ahmad et al., 2020).

4. STRATEGIC INTEGRATION STRENGTHENING HALAL ETHICS TECHNOLOGY COMPETITIVENESS

The preceding issues highlight the complexity of modernizing halal supply chains in a world where ethics, consumer trust, technology, and competitiveness intersect. While challenges remain, the literature also points toward opportunities for integration, policy coordination, and innovation. This discussion section interprets the identified issues, linking them to theoretical perspectives and empirical findings. It examines how fragmented standards, technological limitations, organizational capacities, consumer trust, and sustainability pressures can be addressed through collaborative strategies. In doing so, it situates halal supply chain modernization within the broader debates of global supply chain management, ethics, and resilience.

4.1 Certification Harmonization Strengthening Global Halal Governance Integration

The lack of harmonization in halal certification undermines both consumer trust and global trade. Discussion in scholarly literature stresses that standardization is not simply a technical exercise but also a political and institutional negotiation (Arif & Sidek, 2020). For modernization to succeed, mutual recognition agreements and regional harmonization initiatives must be accelerated. Research

on international standards, such as ISO frameworks, demonstrates how consensus-driven processes can reduce transaction costs and enhance trust across-borders (Brunsson & Jacobsson, 2021). Applying similar approaches to halal supply chains can promote interoperability and reduce inefficiencies.

Institutional collaboration is also essential. Scholars emphasize that governments, certification bodies, and industry associations need to establish joint councils that mediate disputes and align requirements (Haque et al., 2021). Without such bodies, fragmentation will continue to create bottlenecks in cross-border trade. Moreover, insights from institutional theory suggest that legitimacy is enhanced when multiple stakeholders co-create rules rather than when authority rests solely with state regulators (DiMaggio & Powell, 2020). Thus, harmonization should be framed as a collective governance challenge rather than a unilateral decision by any single body.

The literature also discusses the role of global supply chain networks in harmonization. Studies show that multinational retailers and logistics providers often require standardized certifications to streamline sourcing (Banterle & Stranieri, 2021). Their influence can pressure certification bodies to converge on shared frameworks. However, such market-driven harmonization may privilege large firms over SMEs, raising concerns about equity. The discussion highlights that effective modernization requires balancing efficiency with inclusivity.

4.2 Digital Technology Expansion Creating Unequal Modernization Capabilities

Digital transformation has been celebrated as a tool to improve traceability and transparency, but the literature also recognizes that technology adoption can exacerbate inequalities. For instance, blockchain-enabled traceability systems provide secure and tamper-proof records (Saber et al., 2020). However, SMEs often struggle to participate due to costs and technical complexity (Rejeb et al., 2021). This creates a digital divide in halal supply chains where large corporations benefit disproportionately. Scholars argue that collective digital infrastructures, supported by governments or consortia, can mitigate exclusion (Queiroz & Fosso Wamba, 2021).

Interoperability remains an unresolved concern. Studies in food traceability systems reveal that data fragmentation undermines trust and efficiency when firms operate separate platforms (Kamble et al., 2020). For halal supply chains, where verification is central, ensuring interoperability is even more critical. Collaborative development of open data standards, akin to GS1 protocols in global retail, is proposed as a solution (Bevilacqua et al., 2022). Such initiatives would allow firms to exchange halal verification data securely and consistently.

Technological adoption also raises governance questions. Who controls access to data, how information is verified, and how privacy is safeguarded are recurring concerns (Cole et al., 2021). Without clear governance frameworks, digitalization could erode trust rather than enhance it. Insights from information systems literature recommend consortium-based governance, where multiple stakeholders jointly manage platforms to prevent monopolization (Treiblmaier, 2020). This aligns with the ethical imperative of halal supply chains, where integrity must be maintained through transparent and participatory oversight.

4.3 Organizational Readiness Strengthening Halal Modernization Capacity Development

Organizational readiness plays a decisive role in determining whether modernization succeeds. Theories of dynamic capabilities suggest that firms must reconfigure resources and processes to adapt to technological and institutional changes (Teece, 2020). In halal supply chains, this requires not only adopting technology but also redesigning workflows, retraining employees, and investing in human capital. Research indicates that lack of managerial awareness and insufficient training are major impediments to modernization (Elkaseh et al., 2021).

The discussion underscores that leadership commitment is critical. Studies in supply chain digitalization reveal that firms with strong leadership support are more likely to invest in transformative technologies (Rossit et al., 2021). In halal contexts, leadership must also embody ethical commitments to ensure that modernization aligns with Shariah principles. Without this dual focus, modernization risks being viewed as a cost-driven exercise rather than a strategic investment. Capacity building for SMEs is particularly important. Literature on supply chain inclusion stresses that SMEs often lack both financial and technical resources to modernize (Gunasekaran et al., 2021). Policy interventions, such as subsidies, training programs, and digital literacy initiatives, are necessary to bring SMEs into modernization pathways (Zhang et al., 2021). This is not only a matter of equity but also of systemic integrity, since supply chains are only as strong as their weakest link. By strengthening SMEs, modernization efforts can achieve broader and more sustainable impacts.

4.4 Consumer Transparency Strengthening Trust Ethical Market Alignment

Consumer trust is both the rationale for modernization and one of its greatest challenges. Past scandals involving halal fraud have left many consumers skeptical of certification processes (Bonne & Verbeke, 2021). Modernization through traceability systems offers a pathway to rebuild trust by providing verifiable information about sourcing and processing. Research in consumer behavior shows that access to transparent supply chain information increases willingness to pay for ethically certified products (Brach et al., 2021). For halal markets, digital tools such as QR codes linked to blockchain records can provide instant verification, thus enhancing consumer confidence.

However, transparency alone is insufficient. Studies reveal that consumer acceptance depends on the credibility of certifying institutions and the usability of digital tools (Grunert, 2020). If platforms are difficult to use or if certification bodies lack credibility, consumers may disregard the information. Effective modernization therefore requires consumer education campaigns that explain how traceability works and why it can be trusted (Choe et al., 2021). Without this, investments in technology may not translate into improved market outcomes.

Another critical dimension is the expanding scope of ethical expectations. Younger generations increasingly expect halal products to embody sustainability, animal welfare, and social justice alongside religious compliance (Omar et al., 2020). Studies on ethical consumption demonstrate that consumers view halal and tayyib as overlapping concepts, where wholesome production practices are as important as ritual compliance (Soon et al., 2020). Firms that modernize without addressing these broader ethical concerns risk losing relevance. The discussion suggests that modernization must integrate sustainability and fairness into halal assurance systems to remain aligned with evolving consumer values.

4.5 Sustainability Pressures Reshaping Halal Competitive Market Strategies

Sustainability presents both a challenge and an opportunity for halal supply chains. On one hand, segregation and cold chain requirements increase energy use and carbon emissions (Pereira et al., 2020). On the other, sustainability goals can be aligned with halal principles of cleanliness, fairness, and responsibility. Studies in sustainable supply chain management argue that Industry 4.0 technologies, such as IoT sensors and analytics, can optimize energy use and reduce waste (Bag et al., 2021). Applying these technologies in halal supply chains can help resolve tensions between compliance and eco-efficiency.

Global competitive pressures further intensify the need for modernization. Multinational firms entering the halal sector often bring advanced logistics capabilities, creating a performance gap with local firms (Yeo et al., 2020). Without modernization, local halal enterprises risk exclusion from international supply networks. The literature emphasizes that competitiveness increasingly depends on the ability to demonstrate ethical compliance and digital traceability (Wang et al., 2021). For halal supply chains, this means that modernization is not optional but necessary for survival. Modern logistics research also links (Yusof et al., 2025) integrated operational capability with sustainable growth in increasingly demanding markets.

Resilience is another dimension of competitiveness. Recent disruptions caused by pandemics and geopolitical conflicts exposed vulnerabilities in halal supply chains (Ivanov & Dolgui, 2021). Modernization can enhance resilience through visibility, diversification, and redundancy. Studies in resilience theory show that digital platforms enable faster detection of disruptions and quicker recovery (Pettit et al., 2021). For halal supply chains, resilience is also about protecting integrity under stress, ensuring that disruptions do not compromise halal compliance. This dual requirement distinguishes halal supply chains from mainstream systems and underscores the importance of modernization.

5. STRATEGIC PATHWAYS STRENGTHENING RESILIENT COMPETITIVE HALAL SUPPLY CHAINS

The analysis of current issues and subsequent discussion demonstrates that modernization of halal supply chains faces multidimensional challenges, ranging from fragmented certification systems to technological barriers, organizational readiness, consumer trust, and sustainability pressures. These issues are interconnected and require strategic responses that involve governments, certification bodies, firms, consumers, and international institutions. The purpose of this section is to suggest actionable pathways to strengthen modernization efforts. The suggestions offered here are grounded in recent scholarship and practical experiences, and they are structured to provide guidance on institutional reforms, technological adoption, organizational capacity, consumer engagement, and sustainability alignment.

5.1 Institutional Harmonization Strengthening Global Halal Standardization Practices

The first suggestion is to accelerate global standardization and institutional harmonization of halal certification. Fragmented certification has created duplication and confusion, which undermines trust and efficiency. Scholars emphasize that harmonization should be approached through mutual recognition agreements and collaborative governance platforms (Zailani et al., 2022). By developing globally recognized benchmarks, firms can avoid redundant audits and trade barriers.

International collaboration is vital. Experiences from ISO and Codex Alimentarius illustrate that when countries align on technical standards, market efficiency improves significantly (Aung & Chang, 2021). The halal sector can replicate these lessons by adopting transparent processes for developing shared certification rules. Recent studies highlight the need for regional councils to oversee implementation and mediate disputes among certification bodies (Alam & Nazura, 2022).

Capacity-building within certification authorities is also required. Weak enforcement undermines credibility, especially in emerging markets (Rosly et al., 2021). Investment in auditor training, digital verification systems, and cross-border cooperation can strengthen institutional legitimacy. Harmonization, therefore, is not only about rules but also about building the institutional strength to enforce them fairly and consistently.

5.2 Inclusive Digital Transformation Expanding Halal Technology Accessibility

Digital technologies offer powerful tools for traceability, but adoption remains uneven. To avoid deepening inequalities, modernization must prioritize inclusive digital transformation. Scholars argue that governments should invest in shared platforms that SMEs can access at low cost, similar to cloud-based enterprise resource planning systems (Rejeb et al., 2022). Automation research also indicates that smart (Yusof et al., 2025) operational technologies can improve process efficiency when implementation is aligned with operational requirements.

Blockchain is particularly valuable for ensuring halal integrity. Pilot projects show that blockchain increases transparency and reduces fraud by recording immutable transaction data (Hasan et al., 2021). However, SMEs cannot afford private blockchain networks. Public-private partnerships can create consortia blockchains accessible to all participants, balancing affordability with reliability (Queiroz et al., 2022).

The literature also suggests that interoperability is essential. Adoption of global data standards such as GS1 allows heterogeneous systems to communicate, reducing fragmentation (Kamble et al., 2021). Policymakers and industry groups should champion open standards to ensure that halal traceability data flows seamlessly across-borders. Finally, cyber-security measures must be strengthened, since breaches can erode consumer trust in digital systems (Sharma et al., 2021). Inclusive and secure digital infrastructures will enhance both equity and credibility in modernization.

5.3 Organizational Capability Development Strengthening Leadership Modernization Commitment

Firms must develop internal capabilities to implement modernization effectively. Studies show that dynamic capabilities, including sensing, seizing, and transforming, are critical for firms undergoing digital and organizational change (Teece, 2021). For halal supply chains, this means developing the ability to sense consumer and regulatory expectations, seize technological opportunities, and transform internal processes to maintain halal integrity.

Leadership commitment is a decisive factor. Companies with leaders who champion halal integrity and digital adoption are more likely to succeed (Gunasekaran et al., 2022). Scholars recommend that firms establish halal governance committees at the board level to integrate ethical and strategic

considerations (Ali et al., 2022). Such committees can oversee investments, set key performance indicators, and monitor compliance. Managerial judgement under uncertainty remains important when leaders balance compliance, technology investment, risk, and long-term strategic value (Yusof & Razali, 2020).

Training and human resource development are also essential. Research shows that many halal firms lack skilled workers who understand both halal compliance and digital supply chain management (Rahman et al., 2022). Governments and universities should expand specialized training programs, while firms should integrate halal supply chain modules into their employee development initiatives. Capacity-building not only addresses current deficiencies but also creates a culture of continuous improvement.

5.4 Consumer Engagement Strengthening Halal Trust Market Confidence

Rebuilding consumer trust requires more than compliance; it requires proactive engagement. Studies show that consumers respond positively when firms provide transparent and accessible information about supply chain practices (Brach & Walsh, 2021). QR codes linked to halal traceability systems are one way to deliver this transparency, but firms must also invest in communication campaigns that explain how these systems work (Tan et al., 2022).

Certification logos should be standardized and simplified to reduce consumer confusion. In markets with multiple logos, consumers often struggle to identify credible marks (Mohamed et al., 2021). Consolidating certification symbols and ensuring they are backed by robust standards will strengthen consumer confidence.

Consumer education is equally important. Research demonstrates that many consumers lack awareness of what halal supply chain management entails (Azmi et al., 2021). Public campaigns, social media outreach, and school programs can raise awareness of halal integrity and the role of modernization in protecting it. Firms that actively involve consumers in the modernization narrative are more likely to build loyalty and justify premium pricing for halal products (Ismail et al., 2021).

5.5 Sustainability Integration Strengthening Ethical Halal Modernization Practices

Sustainability pressures cannot be ignored. To align with global expectations, halal supply chains must integrate environmental and social sustainability into their modernization agendas. Research shows that sustainable supply chains achieve greater legitimacy and consumer acceptance (Bag et al., 2021). For halal, this means adopting eco-friendly packaging, reducing energy consumption in cold chains, and ensuring fair labor practices. The integration of sustainability, (Yusof et al., 2026) transparency, and compliance is especially relevant to halal supply chains because ethical assurance must extend across the wider supply network.

Scholars highlight the compatibility between halal principles and sustainability goals. The concept of *tayyib* emphasizes wholesomeness and ethical responsibility, which aligns with environmental stewardship (Haleem & Khan, 2021). Firms should leverage this compatibility by positioning halal supply chains as both compliant and sustainable.

Adopting circular economy practices can further strengthen competitiveness. Studies suggest that recycling, resource recovery, and waste minimization are increasingly important in consumer evaluations (Liu et al., 2022). Integrating these practices into halal modernization not only reduces costs but also enhances brand reputation. Sustainability should therefore be treated as a central component of modernization rather than a peripheral concern.

6. CONCLUSION

The modernization of halal supply chains represents more than a technical or operational adjustment. It is a strategic transformation that integrates ethical assurance, consumer trust, sustainability, and competitive advantage within a globalized economy. The analysis presented in this article shows that while modernization is driven by technology adoption, regulatory harmonization, and organizational readiness, it is equally shaped by consumer expectations and the pursuit of ethical legitimacy. This synthesis underscores that modernization cannot be viewed as an isolated initiative but rather as a multidimensional process that requires collaboration among governments, certification authorities, industry players, and consumers.

The literature review highlighted that institutional standards and governance frameworks provide the backbone for halal integrity, while digital tools such as blockchain, IoT, and artificial intelligence expand transparency and traceability across-borders. At the same time, consumer-facing communication and credible certification reinforce trust in halal claims, ensuring that modernization efforts resonate with market expectations. The issues section demonstrated that fragmentation of certification, technological barriers, organizational gaps, and sustainability pressures remain formidable challenges that complicate modernization initiatives. These barriers weaken trust, create inefficiencies, and expose vulnerabilities that hinder the credibility and competitiveness of halal supply chains.

The discussion emphasized that overcoming these challenges requires harmonization, inclusive digital transformation, organizational capacity building, consumer engagement, and sustainability integration. Insights from related global supply chain literature reveal that modernization not only strengthens halal assurance but also supports resilience and agility in times of crisis. The suggestions advanced in this study therefore provide actionable directions for policymakers, industry stakeholders, and firms. They call for global standardization, inclusive technological infrastructures, leadership commitment, proactive consumer education, and sustainability practices that align with halal and tayyib principles. In conclusion, modernization of halal supply chains should be understood as both an ethical mandate and a strategic lever for achieving sustainable competitiveness. It can simultaneously uphold Islamic values, appeal to broader ethical markets, and prepare firms to compete in volatile global environments. By integrating governance, technology, and organizational capacity with consumer trust and sustainability, halal supply chains can evolve into credible, resilient, and globally recognized systems. The implications are clear: modernization is not optional but essential for securing the future of halal trade and ensuring that it continues to serve as a model for ethical and competitive supply chain management.

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2. Conflict of Interest

The authors declare that there are no competing interests or circumstances that could have influenced the preparation, analysis, or presentation of this article.

3. Author Contribution Statement

Fadhilah Mohd Zahari: Developed the central concept, conducted the literature review on halal supply chain modernization, and prepared the initial manuscript.

Mohamed Najib Salleh: Contributed to the analysis of digital traceability, halal integrity, and competitive performance, and undertook the critical review and refinement of the manuscript.

Both authors reviewed and approved the final version of the manuscript.

4. Ethics Statement

This article was developed in accordance with accepted academic and research integrity principles. As the study is conceptual and relies on existing scholarly literature, no human participants or primary data collection were involved. Therefore, ethical approval and informed consent were not required.

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