

Halal Transportation Providers as Strategic Guardians of Compliance and Efficiency in Global Supply Chains

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ABSTRACT

Halal transportation has become a critical component of global supply chains as the halal market expands across food, pharmaceuticals, cosmetics, and other product categories. This article examines the strategic role of halal transportation providers in protecting halal integrity while maintaining operational efficiency across increasingly complex international supply chains. The analysis focuses on major challenges involving fragmented certification requirements, cross-contamination risks, technological adoption, regulatory inconsistencies, operational costs, and workforce capability. It further evaluates how transportation providers can strengthen compliance through product segregation, dedicated transportation resources, appropriate handling procedures, workforce development, and stronger coordination among supply chain stakeholders. Digital technologies, particularly blockchain, the Internet of Things, artificial intelligence, and real-time monitoring systems, are identified as important capabilities for improving traceability, transparency, environmental monitoring, route optimisation, and compliance control. The analysis indicates that effective halal transportation requires more than adherence to certification requirements because providers must simultaneously protect product integrity, manage operational costs, maintain service reliability, and respond to different regulatory environments across international markets. Greater certification harmonisation, technological integration, workforce development, and stakeholder collaboration are therefore essential for strengthening halal logistics performance. The article positions halal transportation providers as strategic guardians connecting religious compliance with logistics capability, demonstrating their important contribution to supply chain integrity, consumer confidence, operational efficiency, and the long-term competitiveness of global halal supply chains.

Keywords: Compliance, Transportation, Traceability, Integrity, Efficiency

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1. INTRODUCTION

The halal industry, once predominantly associated with food products, has evolved significantly over the past few decades, now spanning multiple sectors such as pharmaceuticals, cosmetics, and even logistics. This growth is primarily driven by the increasing global Muslim population, heightened awareness of ethical consumption, and a growing demand for halal-certified products across both Muslim-majority and non-Muslim-majority countries. Halal supply chain management is central to maintaining the integrity of halal products from production to consumption. One key component of this system, often overlooked, is the role of halal transportation providers. These providers ensure the compliance of halal products throughout their journey by adhering to Islamic law (Shariah). Effective halal transportation is essential to ensure that halal products are transported without contamination, maintaining their integrity and meeting religious requirements (Ali & Ahmed, 2021).

Halal supply chains require intricate systems of checks and balances at each stage of product movement. It is not merely about the product's source or production methods but also about the handling, storage, and transportation process. As supply chains globalize and expand, ensuring compliance throughout this journey becomes increasingly complex (Bakar & Yusoff, 2020). While much attention is given to production and storage, transportation plays an equally crucial role. It ensures that the integrity of halal products remains intact, from the manufacturing stage to retail or consumer delivery (Khan et al., 2020). Transportation providers must ensure that products are segregated properly to avoid contamination, that storage conditions are maintained during transportation, and that the physical handling of products aligns with Shariah principles (Zhang & Shabbir, 2019).

Halal certification systems have been implemented globally to ensure compliance with Islamic principles, particularly for food and beverages. These systems focus on the raw materials used, the manufacturing processes, and the final product (Musa et al., 2021). However, halal certification, in many cases, stops at the production level, leaving out the important transportation stage. The lack of halal guidelines in transportation often leads to contamination risks, especially when halal products are transported alongside non-halal goods. Even in regions where halal certification is widely regulated, many logistics companies lack the infrastructure and training required to handle halal goods properly, posing a risk to the integrity of the entire halal supply chain (Saleh & Darwis, 2020).

The transportation of halal goods requires specialized handling procedures. One of the main risks in the halal transportation process is cross-contamination. This is a particularly significant issue in the food sector, where even trace contamination by non-halal materials such as pork or alcohol can render the product non-compliant with Shariah law (Khalil & Aziz, 2020). Transportation vehicles must therefore be dedicated to halal goods, properly segregated, and cleaned regularly to avoid contamination (Lee et al., 2020). In addition to physical separation, halal logistics also require careful attention to temperature control, especially for perishable items like halal meat and dairy products. The halal transportation process must ensure that these products are kept under optimal conditions throughout the journey (Jabbar et al., 2020).

Another challenge in halal transportation arises from the lack of standardized halal certification processes across borders. In regions like Malaysia, Indonesia, and the Middle East, halal certification processes are relatively well-defined. However, in other parts of the world, particularly in Europe

and North America, halal logistics face fragmentation due to different certification systems and unclear regulations. This lack of uniformity complicates international trade and increases the risk of non-compliance when halal products are transported across borders (Sarwar et al., 2021). While global trade in halal products increases, so does the complexity of halal supply chain management, particularly in ensuring halal compliance in international logistics.

Global halal transportation providers also face increasing pressure to ensure their operations are more efficient and transparent. Technology plays a pivotal role in addressing these challenges by enabling real-time tracking, monitoring of environmental conditions, and ensuring regulatory compliance. The application of technologies like GPS tracking, blockchain, and automated temperature monitoring has revolutionized halal transportation management by increasing operational transparency and enabling better management of logistics (Sami et al., 2021). Real-time tracking systems allow halal products to be monitored throughout their journey, ensuring compliance with halal standards at every stage of the transportation process (Khan et al., 2020).

Blockchain technology, in particular, holds great promise in ensuring transparency within the halal supply chain. By providing an immutable record of transactions and movements, blockchain guarantees that each step of the supply chain is verifiable and compliant with halal principles (Moghaddam & Nof, 2022). This can include tracking the product's origin, certification, transportation conditions, and final destination. Such technologies increase consumer confidence in halal products, which is vital as the demand for halal goods continues to rise globally.

In addition to technological advancements, the role of halal transportation providers must be understood within the broader context of halal supply chain management. Halal supply chains are not confined to food; they now include pharmaceuticals, cosmetics, and personal care products, each of which may have different transportation needs (Zhang & Shabbir, 2019). For instance, halal pharmaceuticals require specialized storage and handling to maintain their compliance with halal standards, while halal cosmetics must avoid contamination from non-halal substances like alcohol or pork-derived ingredients (Saleh & Darwis, 2020). As halal markets diversify, the logistics sector must adapt to handle a wider range of halal products, each with unique transportation needs.

Moreover, the halal logistics industry must also contend with operational challenges, such as rising costs and inefficiencies in managing logistics networks. Transportation providers face significant pressure to minimize costs while maintaining high compliance standards. The need for dedicated vehicles, specialized storage systems, and skilled personnel means that halal logistics services tend to be more expensive than traditional logistics services (Sami et al., 2021). These costs can be particularly burdensome for small and medium-sized enterprises (SMEs) operating in the halal market, which may not have the resources to invest in the necessary infrastructure and personnel training to ensure halal compliance (Musa et al., 2021).

The global nature of the halal market means that transportation providers must navigate different halal certification standards across regions and adapt their operations accordingly. This creates a significant barrier to efficiency in the halal supply chain. To address this issue, there needs to be greater collaboration between various stakeholders, including manufacturers, transportation providers, certification bodies, and regulators, to develop standardized systems and processes for

halal logistics. Through such collaboration, the industry can develop clear guidelines and best practices that ensure halal compliance in transportation while improving operational efficiency (Musa et al., 2021).

Consumer trust plays a pivotal role in the success of the halal market, and this trust is closely tied to the perceived reliability of the halal supply chain, particularly the transportation aspect. A breach in compliance at any point in the supply chain can damage consumer confidence, leading to a loss of market share. Therefore, it is critical for transportation providers to maintain rigorous halal standards throughout the entire transportation process to preserve the integrity of halal products (Khalil & Aziz, 2020). As the halal market expands, particularly in non-Muslim-majority countries, the demand for halal products will continue to grow, further highlighting the importance of maintaining compliance at every stage of the halal supply chain. Maritime logistics experience similarly shows that innovation and operational adaptation can strengthen performance in global shipping environments (Yusof, 2024).

In conclusion, halal transportation plays a crucial role in ensuring the compliance, efficiency, and reliability of halal supply chains. As the halal market continues to expand, the importance of halal transportation providers will grow, requiring them to address challenges related to cross-border certification discrepancies, cross-contamination risks, and operational inefficiencies. The integration of new technologies, better collaboration between stakeholders, and the development of standardized halal logistics systems can help address these challenges and ensure that halal products are transported in a manner that meets the highest halal standards. The continued evolution of halal transportation will be essential to maintaining the integrity of halal supply chains and supporting the long-term success of halal markets worldwide.

2. LITERATURE REVIEW

The halal industry has experienced significant growth in recent years, expanding across various sectors including food, pharmaceuticals, cosmetics, and logistics. The halal market's global growth has prompted the development of more complex and integrated halal supply chains, where the role of halal transportation providers is becoming increasingly important. The need to ensure that products maintain their halal integrity throughout the supply chain, particularly during transportation, is central to the success of the halal market. Halal transportation plays a crucial role in maintaining the compliance of halal products with Shariah (Islamic law), preventing contamination, and ensuring efficiency across the logistics process.

2.1 The Importance of Halal Supply Chain Management

Halal supply chain management (HSCM) encompasses the various processes involved in ensuring that products meet the strict guidelines of Shariah law, starting from sourcing raw materials to the final consumer product. In HSCM, transportation represents a critical phase, as it is the point at which halal products are vulnerable to contamination or mishandling. The halal supply chain is composed of several stages: production, processing, storage, transportation, and distribution. At each of these stages, products must adhere to halal standards. The transportation phase is often overlooked, but it is where much of the risk of contamination and non-compliance exists. According to McKinnon (2025), ensuring that products are transported according to Islamic principles is as important as ensuring halal compliance during production.

A key aspect of halal supply chains is the segregation of halal products from non-halal goods. This requirement is vital during transportation. Halal transportation providers must ensure that the vehicles used for transporting halal goods are properly dedicated to these products and are thoroughly cleaned before transporting halal goods. As noted by Ali and Ahmed (2021), the risk of contamination increases when halal products are transported alongside non-halal products. Therefore, dedicated vehicles for halal goods are a necessity in maintaining product integrity and ensuring that contamination does not occur during transit.

Additionally, halal products must often meet specific temperature and storage requirements. For instance, halal meat must be transported at specific temperatures to ensure it remains halal. Bakar and Yusof (2020) emphasize the importance of temperature-controlled transportation for halal meat, as maintaining proper storage conditions ensures that products are not spoiled and remain compliant with halal standards.

2.2 The Role of Transportation Providers in Halal Logistics

Transportation providers in halal supply chains have a complex and vital role to play in ensuring compliance with halal standards. These providers must adhere to the specific guidelines set out by halal certification bodies, ensuring that the transportation of products does not compromise their halal integrity. According to Dey et al. (2020), transportation providers must maintain clean and dedicated vehicles, properly manage handling practices, and ensure that products are properly segregated during transit.

Transportation providers must also ensure that the products are delivered in a timely manner to minimize delays that might affect product quality. According to Sarwar et al. (2021), the integrity of halal products is not only determined by the absence of contamination but also by the timely delivery of products. Delays, especially in the case of perishable halal goods such as meat and dairy, could render the product non-compliant with halal standards, leading to economic and reputational damage for the company involved.

While the role of transportation providers is significant in halal supply chains, the lack of standardized halal regulations across different countries poses a challenge. McKinnon (2025) notes that the absence of consistent halal certification guidelines across borders leads to inefficiencies and complications for transportation providers, especially in cross-border trade. In countries where halal regulations are underdeveloped or inconsistent, halal transportation providers may struggle to comply with varying requirements.

2.3 Technological Innovations in Halal Transportation

Advancements in technology have the potential to revolutionize halal transportation and address some of the challenges associated with ensuring halal compliance. According to Moghaddam and Nof (2022), blockchain technology is one of the most promising innovations in halal logistics. Blockchain enables full traceability of products throughout the supply chain. This technology provides an immutable record of each step in the supply chain, from production to transportation, ensuring that halal products are compliant at every stage. By providing transparency, blockchain technology helps strengthen consumer trust in the halal certification process.

Similarly, the Internet of Things (IoT) plays a significant role in enhancing halal transportation. IoT devices can monitor critical transportation conditions such as temperature, humidity, and exposure to light. Khalil and Aziz (2020) highlight that these devices allow transportation providers to track the environment in which halal goods are transported, ensuring that conditions remain optimal for the preservation of the halal status of the product. Real-time data from IoT devices helps transportation providers respond quickly to any potential issues, such as temperature fluctuations, that may affect product quality.

Moreover, AI-powered technologies for route optimization and predictive analytics can improve the efficiency of halal transportation systems. Sami et al. (2021) suggest that AI systems can optimize delivery routes based on factors such as traffic patterns, weather conditions, and the time required for transportation, thus reducing delays and minimizing transportation costs. These innovations not only improve the efficiency of halal logistics but also ensure that products are delivered in compliance with halal standards.

2.4 Challenges in Halal Transportation

Despite the technological advancements in halal transportation, several challenges remain. One of the key challenges is the lack of uniform halal certification standards across different regions. While countries like Malaysia and Indonesia have well-established halal certification systems, other countries lack consistency in their halal certification processes. This inconsistency can create confusion for transportation providers operating in multiple regions and lead to inefficiencies in ensuring halal compliance (Jabbar et al., 2020). According to Lee et al. (2020), the absence of a globally recognized halal certification standard complicates cross-border halal transportation, making it difficult for transportation providers to maintain consistency in their operations.

Another challenge is the risk of contamination. Halal transportation providers must take extensive measures to prevent contamination during transit, especially when transporting perishable goods like halal meat. As noted by Khan et al. (2020), even small amounts of non-halal products coming into contact with halal goods can render the entire shipment non-compliant with halal standards. Therefore, halal transportation providers must implement rigorous cleaning procedures, utilize dedicated vehicles, and ensure that halal and non-halal goods are kept separate throughout the transportation process.

Operational costs also pose a significant challenge in halal transportation. The need for dedicated vehicles, specialized storage, and temperature control can increase the cost of transportation compared to conventional logistics services. According to Saleh and Darwis (2020), these additional costs can create financial barriers for small and medium-sized enterprises (SMEs) seeking to enter the halal logistics market. The higher operational costs may also affect the pricing of halal products, making them less competitive in a market where price sensitivity is crucial.

2.5 Opportunities for Improvement

Despite the challenges faced by halal transportation providers, several opportunities exist for improving the halal logistics system. One potential area of improvement is the establishment of standardized halal certification processes. According to Moghaddam and Nof (2022), the creation of an internationally recognized halal certification framework would simplify the certification

process for halal goods, particularly in cross-border trade. A standardized system would ensure consistency and improve the efficiency of halal transportation systems globally, allowing transportation providers to operate more effectively across different regions.

Collaboration between stakeholders in the halal supply chain can also lead to improvements in halal transportation. Dey et al. (2020) suggest that partnerships between manufacturers, certification bodies, logistics providers, and technology companies can help develop best practices and improve the overall efficiency of halal logistics systems. Such collaboration can help address the challenges faced by halal transportation providers, such as cross-contamination and regulatory inconsistencies, and improve the overall compliance of the halal supply chain.

Additionally, continued investment in technology, particularly in blockchain and IoT, will help drive improvements in halal transportation. By enhancing transparency and traceability, these technologies can ensure that halal products are transported in compliance with Shariah law, even across international borders. Moreover, the use of AI in route optimization and predictive analytics will improve the efficiency and reliability of halal transportation systems, allowing providers to reduce costs and enhance service delivery (Sami et al., 2021).

3. STRUCTURAL CHALLENGES SHAPING HALAL TRANSPORTATION PERFORMANCE

The halal supply chain is growing in complexity as the global demand for halal products continues to rise. However, despite significant advancements in the logistics and transportation sectors, halal transportation providers continue to face numerous challenges that affect the efficiency and compliance of the halal supply chain. These issues impact both the operational efficiency of transportation providers and the integrity of halal products. In this section, we explore the various issues faced by halal transportation providers, discussing challenges in certification, contamination risks, technological adoption, regulatory inconsistencies, and financial barriers. These issues, if not adequately addressed, can undermine the reliability and success of halal supply chains globally.

3.1 Certification and Standardization Challenges

One of the most prominent challenges in halal transportation is the inconsistency in halal certification across different countries and regions. While countries like Malaysia, Indonesia, and Saudi Arabia have well-established halal certification systems, many other countries lack clear or universally accepted certification processes. According to Saleh and Darwis (2020), the lack of standardized halal certification frameworks creates difficulties for transportation providers who must navigate varying certification systems when transporting goods across borders.

McKinnon (2025) highlights that these discrepancies in certification standards lead to inefficiencies and increased operational costs for transportation providers. Cross-border transportation of halal goods requires strict adherence to local regulations, which may differ significantly from one country to another. For example, halal food products certified in one country may not meet the halal requirements of another, leading to delays or rejection at borders. As a result, transportation providers must spend considerable time and resources ensuring that products meet the halal certification requirements of every country involved in the transportation process.

The lack of a global standard for halal certification also limits the scope for streamlining halal logistics processes. According to Lee et al. (2020), the absence of a unified certification system makes it difficult to track halal goods accurately across international supply chains. This inconsistency in certification results in a lack of transparency, which is critical for maintaining consumer trust in halal products.

3.2 Cross-Contamination Risks

Another major issue in halal transportation is the risk of cross-contamination. Halal goods must be transported in conditions that prevent them from coming into contact with non-halal items, which could render them non-compliant with Shariah law. As Khan et al. (2020) point out, this is particularly challenging in the food industry, where halal and non-halal products are often transported together in the same vehicles, leading to contamination risks.

To mitigate this risk, halal transportation providers must use dedicated vehicles for halal products, ensuring that no non-halal goods are transported alongside them. Additionally, these vehicles must undergo regular cleaning and sanitization to prevent cross-contamination. However, even with these measures in place, human error and lapses in cleaning procedures can still result in contamination, which could lead to the entire shipment being rejected or recalled (Jabbar et al., 2020).

Bakar and Yusoff (2020) emphasize that contamination risks are particularly concerning when transporting perishable halal goods, such as meat and dairy, which require precise temperature control. If halal meat is stored or transported in a vehicle that has previously carried non-halal products, there is a significant risk that the meat could become contaminated with substances that violate halal principles, rendering the entire shipment non-compliant with Shariah law.

3.3 Technological Adoption and Integration

The integration of new technologies has the potential to address some of the issues in halal transportation, such as improving traceability, monitoring transportation conditions, and enhancing operational efficiency. However, the adoption of such technologies has been slow in many regions. According to Moghaddam and Nof (2022), transportation providers often face challenges in adopting advanced technologies due to high costs, limited technical expertise, and regulatory barriers.

One of the most promising technologies for improving halal transportation is blockchain, which offers an immutable and transparent record of every transaction in the supply chain. Blockchain can be used to track the movement of halal goods, ensuring that the products maintain their halal status at every stage of the transportation process. According to McKinnon (2018), the use of blockchain can help increase the transparency and accountability of halal transportation providers, improving consumer confidence in the halal certification system. Smart warehouse technologies can improve visibility while introducing maintenance and security requirements that must be actively managed (Yusof et al., 2025).

In addition to blockchain, the use of Internet of Things (IoT) devices to monitor transportation conditions is becoming increasingly common. IoT devices can track factors such as temperature, humidity, and exposure to contaminants, ensuring that halal goods are transported under the required conditions (Khalil & Aziz, 2020). However, despite the clear advantages of these technologies, many

transportation providers remain hesitant to adopt them due to the high initial costs and lack of technical knowledge (Sami et al., 2021).

The slow adoption of these technologies has hindered the efficiency and reliability of halal transportation systems, preventing them from fully capitalizing on the potential benefits that digitalization can bring to the halal supply chain.

3.4 Regulatory Inconsistencies Across Borders

Regulatory inconsistencies represent a significant challenge for halal transportation providers, particularly when transporting goods across borders. The halal industry is global, but there is no universally accepted set of regulations governing halal certification and logistics. This is particularly problematic for transportation providers who must navigate the regulatory systems of multiple countries. According to Jabbar et al. (2020), the lack of consistency in halal regulations across borders leads to delays, increased costs, and potential risks for non-compliance. Inconsistent halal certification requirements also complicate the traceability of halal products during transportation. While some countries require detailed documentation and certification at every stage of the supply chain, others have more relaxed requirements (Zhang & Shabbir, 2019). This inconsistency creates challenges for transportation providers, who must ensure that they comply with the specific halal regulations of each country involved in the transportation process. The absence of a standardized approach to halal logistics also complicates the ability to track products and verify their halal status, which could result in delays, disruptions, and non-compliance with local regulations.

3.5 Financial Barriers and Operational Costs

The high operational costs associated with halal transportation are another significant issue faced by providers. The need for dedicated vehicles, specialized storage systems, and adherence to halal certification standards increases the overall cost of transportation. According to Khalil and Aziz (2020), these costs can be particularly burdensome for small and medium-sized enterprises (SMEs) that are trying to enter the halal logistics market. The financial barriers to entry in halal transportation make it difficult for many companies to invest in the necessary infrastructure and technology to ensure compliance with halal standards.

Sami et al. (2021) note that halal logistics providers often incur additional costs related to certification, employee training, and vehicle maintenance. These costs make halal transportation more expensive than conventional logistics services, potentially affecting the pricing of halal products and their competitiveness in the global market. For smaller businesses, these high costs may result in limited capacity to expand operations or offer competitive pricing on halal goods. Logistics innovation must therefore balance efficiency, resilience, and sustainable growth rather than treating technology as an isolated investment (Yusof, Abdul Razak, Syed A Rahman, et al., 2025). Additionally, the lack of standardization in halal certification processes across countries can further increase the cost of halal transportation. Transportation providers must often invest in additional resources to ensure compliance with multiple certification standards, leading to inefficiencies and higher operational costs (Saleh & Darwis, 2020).

3.6 Lack of Skilled Workforce

The halal logistics industry requires a skilled workforce capable of understanding and implementing the unique requirements of halal certification and transportation. However, there is a significant shortage of trained professionals in the halal transportation sector. According to Jabbar et al. (2020), many logistics companies lack employees who are knowledgeable about halal certification standards and how they apply to transportation.

The lack of skilled workers poses a risk to the integrity of the halal supply chain, as untrained employees may fail to implement proper procedures for handling and transporting halal goods. This shortage of skilled professionals can also hinder the adoption of new technologies, as employees may lack the necessary technical expertise to integrate and operate advanced systems like blockchain or IoT devices (Musa et al., 2021).

The shortage of skilled workers is particularly problematic in countries with growing halal markets but limited halal logistics training programs. Without adequate training and education, transportation providers will continue to struggle to meet the growing demands of the halal industry.

4. STRATEGIC INTEGRATION OF COMPLIANCE, TECHNOLOGY AND LOGISTICS CAPABILITY

The rapid growth of the halal market has necessitated a reevaluation of how halal supply chains, particularly in transportation, operate to meet both ethical and religious requirements. As global demand for halal products expands across various sectors, ensuring halal compliance during transportation has become a critical issue. This discussion synthesizes the key issues identified in the previous section, including challenges related to certification, contamination risks, technological adoption, regulatory inconsistencies, and financial barriers, while exploring opportunities to overcome these challenges. As the halal industry becomes more globalized, the need for standardized practices, technological integration, and more efficient halal logistics systems becomes ever more apparent.

4.1 Certification and Standardization in Halal Transportation

A core issue for halal transportation providers is the lack of standardized halal certification processes. The absence of uniformity across different countries and regions complicates the role of transportation providers, as they must comply with varying certification systems. As highlighted by Saleh and Darwis (2020), halal certification processes differ substantially across markets, which can delay shipments and cause inefficiencies. For example, halal certification in Malaysia is comprehensive and well-regulated, but the same standards may not be applicable in Europe, where halal certification systems are still developing (Jabbar et al., 2020). The inconsistency in certification makes it challenging for transportation providers to ensure uniform compliance with halal standards across borders.

This fragmentation in halal certification creates several complications for halal logistics providers. First, transportation providers must ensure that products certified in one region will be accepted in another, even if certification standards differ. As a result, transportation providers often face the burden of adapting to different regulatory environments, which requires significant time and effort.

McKinnon (2025) emphasizes that the absence of a global halal standard restricts the ability to streamline halal logistics processes. A globally recognized standard would make it easier for transportation providers to operate across multiple regions and ensure consistent halal compliance. One potential solution to this issue is the development of a unified global halal certification system.

According to Lee et al. (2020), the implementation of such a system could reduce operational inefficiencies, increase the reliability of halal transportation systems, and lower the risk of non-compliance. Additionally, establishing a global halal certification body could help facilitate the standardization of halal requirements, ensuring that halal products meet consistent standards regardless of where they are produced or transported. This approach would also make cross-border halal logistics more efficient, reducing the complexity and cost of compliance (Zhang & Shabbir, 2019).

4.2 Contamination Risks and the Need for Segregation

One of the most pressing issues in halal transportation is the risk of contamination, particularly in the food industry, where halal and non-halal products may be transported in the same vehicles. As discussed in the Issues section, contamination is a significant concern for halal transportation providers, as even a trace of non-halal substances, such as alcohol or pork, can render an entire shipment non-compliant with Shariah law (Khalil & Aziz, 2020). This risk is compounded by the increasing demand for halal products, leading to a growing volume of goods being transported internationally.

To mitigate the risk of contamination, halal transportation providers must ensure strict segregation between halal and non-halal products. As noted by Bakar and Yusof (2020), maintaining dedicated vehicles for halal products is one of the most effective ways to prevent contamination. This segregation ensures that halal products are not exposed to non-halal substances, which could compromise their integrity. However, the segregation of halal and non-halal products presents logistical challenges, particularly when transportation providers must manage diverse product categories across multiple regions.

The need for dedicated vehicles and facilities for halal products increases the operational costs of halal transportation providers. According to Jabbar et al. (2020), this is a significant financial burden, especially for small and medium-sized enterprises (SMEs) trying to enter the halal logistics market. Maintaining dedicated vehicles and implementing strict cleaning protocols requires investment in infrastructure and training, which can be prohibitively expensive for many companies. Furthermore, the increased risk of contamination can lead to product recalls, which further adds to the financial strain on halal transportation providers.

To address these challenges, transportation providers must invest in advanced cleaning technologies and adopt stringent protocols to ensure that their vehicles meet the necessary hygiene standards. Real-time monitoring systems, as suggested by Moghaddam and Nof (2022), could play a critical role in reducing contamination risks. These systems would allow transportation providers to track product conditions during transit, ensuring that halal products are transported in compliance with Shariah law and under optimal conditions. Additionally, the development of more efficient and cost-effective cleaning systems could help reduce operational costs while maintaining high standards of hygiene and segregation.

4.3 Technological Integration and Adoption in Halal Transportation

The integration of advanced technologies into halal transportation systems offers significant opportunities for improving efficiency and compliance. As noted by Moghaddam and Nof (2022), the adoption of digital technologies, such as blockchain, IoT, and AI, has the potential to transform halal logistics by providing greater transparency, traceability, and efficiency in operations. For example, blockchain technology can be used to create an immutable and transparent record of each transaction, ensuring that halal products are tracked and monitored at every stage of their journey (Sami et al., 2021). This transparency enhances consumer trust and allows for greater accountability in the halal supply chain.

Similarly, IoT devices can be used to monitor environmental conditions during transportation, such as temperature, humidity, and exposure to contaminants. As highlighted by Khalil and Aziz (2020), real-time monitoring systems provide valuable data that can be used to ensure that halal products are transported under the required conditions. These systems also enable transportation providers to respond quickly to any issues that may arise during transit, such as temperature fluctuations, ensuring that the halal integrity of the product is maintained.

However, the adoption of these technologies has been slow in many regions, primarily due to the high costs and lack of technical expertise. According to McKinnon (2018), the initial investment required to implement these technologies can be a significant barrier for small and medium-sized halal logistics providers. Furthermore, the lack of trained personnel capable of operating and managing these systems further delays the integration of technology into halal transportation. To overcome these challenges, halal transportation providers must invest in employee training and education, ensuring that their workforce is equipped with the necessary skills to operate and manage advanced technologies. Artificial intelligence, automation, and smart inventory systems illustrate how digital technologies can improve operational control and decision quality across logistics environments (Yusof, Ahmad Zaini, et al., 2025).

4.4 Regulatory Inconsistencies and Cross-Border Challenges

Regulatory inconsistencies across different countries represent a major challenge for halal transportation providers. As noted by Saleh and Darwis (2020), the halal certification standards in one country may differ significantly from those in another, creating uncertainty and inefficiency in the halal logistics process. For example, a halal product certified in one country may not meet the certification standards of another, which could result in delays or even rejection at borders. This inconsistency in halal certification regulations complicates the movement of goods across borders, making it difficult for transportation providers to ensure that their operations remain compliant with the varying halal requirements of different countries.

According to McKinnon (2025), regulatory inconsistencies also make it difficult for halal transportation providers to track and monitor halal products during international transit. While some countries require detailed documentation and certification at every stage of the supply chain, others have more relaxed requirements. This lack of consistency in regulatory frameworks not only complicates halal logistics but also creates inefficiencies and increases the cost of transportation. To address this issue, greater international cooperation is needed to establish a unified halal certification framework that can be adopted globally.

The development of a universal halal certification standard would streamline cross-border halal logistics, reducing the complexity and cost of compliance. According to Lee et al. (2020), such a system would allow transportation providers to operate more efficiently across multiple regions, ensuring that halal products are transported in compliance with the same set of standards. A global halal certification framework would also improve traceability, allowing consumers and regulators to verify the halal status of products at every stage of the supply chain.

4.5 Financial Barriers and Operational Costs

The high operational costs associated with halal transportation are another significant challenge. As noted by Khalil and Aziz (2020), the need for dedicated vehicles, specialized storage systems, and compliance with halal certification standards increases the overall cost of transportation. For many small and medium-sized enterprises (SMEs), these costs can be prohibitive, limiting their ability to enter the halal logistics market. This financial barrier makes it difficult for many companies to invest in the necessary infrastructure, technology, and training to maintain halal compliance.

Moreover, the lack of economies of scale in the halal logistics sector further drives up costs. While larger companies with extensive operations can absorb the additional costs of halal transportation, SMEs may struggle to remain competitive. According to Dey et al. (2020), SMEs often face difficulties in scaling their operations to meet the growing demand for halal products, as the costs associated with maintaining halal compliance are disproportionately high for smaller businesses.

To address these financial challenges, there is a need for greater industry collaboration and the development of cost-sharing mechanisms. As suggested by McKinnon (2025), stakeholders in the halal logistics sector, including manufacturers, certification bodies, and transportation providers, must work together to reduce the costs associated with halal compliance. Additionally, governments could provide financial incentives or subsidies to help SMEs invest in halal logistics infrastructure and technology, enabling them to compete in the growing halal market.

5. PATHWAYS TO RESILIENT AND GLOBALLY INTEGRATED HALAL TRANSPORTATION

The halal logistics sector faces a myriad of challenges, as outlined in the discussion section, including certification inconsistencies, contamination risks, financial barriers, and technological adoption. As the halal market continues to expand, especially in non-Muslim-majority regions, there is an urgent need for effective solutions to address these challenges. This section aims to provide suggestions for improving halal transportation systems, enhancing efficiency, and ensuring compliance with halal standards. These suggestions will focus on the development of standardized systems, the adoption of advanced technologies, the need for greater industry collaboration, and addressing the financial and regulatory barriers that currently hinder the growth of halal transportation.

5.1 Development of a Global Standard for Halal Certification

One of the most pressing issues faced by halal transportation providers is the inconsistency of halal certification standards across different regions. As highlighted by McKinnon (2025), this lack of uniformity creates inefficiencies in the global halal supply chain. Halal certification standards vary

significantly between countries, which complicates cross-border transportation and increases the risk of non-compliance. In some regions, halal certification is highly regulated, while in others, it is underdeveloped or inconsistent. This regulatory fragmentation leads to confusion among halal transportation providers and increases the complexity of international trade in halal products (Saleh & Darwis, 2020).

A potential solution to this issue is the development of a unified global halal certification system. According to Lee et al. (2020), the establishment of a universally recognized halal certification framework would streamline the certification process, reducing operational costs and improving the efficiency of halal transportation systems. Such a framework would ensure that halal products are consistently certified and compliant with the same set of standards, regardless of the country of origin or destination.

A global halal certification system would also improve traceability, making it easier for transportation providers to track halal goods across international supply chains. This transparency is crucial for maintaining consumer trust in halal products and ensuring that the halal integrity of the goods is preserved throughout the transportation process (Jabbar et al., 2020). Furthermore, a unified certification system would facilitate smoother cross-border trade, reducing delays and increasing the speed of product delivery.

5.2 Adoption of Advanced Technologies for Efficiency and Compliance

Technological innovations offer significant opportunities to improve the efficiency and compliance of halal transportation systems. As noted by Moghaddam and Nof (2022), blockchain technology is one of the most promising tools for enhancing transparency and traceability in the halal logistics sector. By utilizing blockchain, transportation providers can create an immutable and transparent record of each transaction in the supply chain. This allows for better tracking of halal products and ensures that they are compliant with halal standards at every stage of their journey.

Blockchain can also help mitigate the risk of fraud, as it provides a secure and verifiable way to confirm the halal status of a product. According to McKinnon (2025), integrating blockchain into halal transportation would increase consumer confidence in halal products, as it provides an indisputable record of their compliance. Additionally, blockchain can enhance supply chain efficiency by reducing paperwork and the need for manual verification, streamlining the halal certification process.

Another technological solution that can improve halal transportation is the use of Internet of Things (IoT) devices. IoT devices can monitor key environmental factors such as temperature, humidity, and exposure to contaminants during the transportation of halal products. As noted by Khalil and Aziz (2020), these devices provide real-time data that can be used to ensure that halal products are transported under the required conditions. This technology is particularly important for perishable halal goods such as meat and dairy, which require strict temperature control to maintain their halal status.

The integration of AI and machine learning can also enhance operational efficiency in halal transportation. AI-powered algorithms can optimize delivery routes, predict potential delays, and

streamline scheduling to ensure that halal products are delivered on time and in compliance with halal standards (Sami et al., 2021). Additionally, predictive analytics can be used to identify potential risks and issues in the transportation process before they occur, enabling transportation providers to take proactive measures to prevent disruptions. Smart automation and process optimization can improve picking and packing efficiency, providing a useful operational parallel for technology-enabled halal logistics (Yusof, Fauzi, Mat Yusop, et al., 2025).

Despite the clear advantages of these technologies, the adoption of advanced systems in halal transportation has been slow due to the high initial costs and lack of technical expertise. To address this, transportation providers should collaborate with technology companies to develop cost-effective solutions tailored to the needs of the halal logistics sector. Additionally, governments and industry bodies can play a role by offering incentives and subsidies to encourage the adoption of new technologies in halal transportation.

5.3 Increased Collaboration Between Stakeholders

Collaboration between various stakeholders in the halal supply chain is essential for addressing the challenges faced by halal transportation providers. As highlighted by Dey et al. (2020), greater collaboration can lead to the development of best practices, improved efficiency, and a more cohesive approach to halal logistics. Manufacturers, certification bodies, logistics providers, and technology companies must work together to create standardized systems, share knowledge, and improve the overall compliance of halal transportation.

One key area of collaboration is the sharing of information and data across the halal supply chain. By developing a centralized platform for tracking and monitoring halal products, all stakeholders can access real-time data on the status of shipments, ensuring that products are transported in compliance with halal standards. This level of transparency will help reduce the risk of contamination, fraud, and errors, ultimately improving the efficiency of the halal supply chain. Ethical accountability and transparent governance are also important when logistics actors must demonstrate compliance to multiple stakeholders (Yusof, Abdul Razak, Misnan, et al., 2026). Consumer perceptions in digital markets also show the strategic importance of credible information and trust signals in shaping purchasing behaviour (Zaini et al., 2026).

According to McKinnon (2018), the collaboration between halal certification bodies and logistics providers is particularly important. Certification bodies must provide clear guidelines for halal transportation and support logistics providers in implementing these guidelines. In turn, transportation providers can offer feedback on the challenges they face in ensuring halal compliance during transit, helping certification bodies refine their standards and make them more practical for real-world applications.

Furthermore, partnerships between halal transportation providers and technology companies can facilitate the adoption of advanced systems such as blockchain and IoT, improving both compliance and operational efficiency. By working together, stakeholders can overcome the barriers to technology adoption and create scalable solutions that benefit the entire halal logistics ecosystem.

5.4 Financial Support and Incentives for Halal Transportation Providers

The high costs associated with halal transportation are a significant barrier for many small and medium-sized enterprises (SMEs) looking to enter the halal logistics market. As noted by Khalil and Aziz (2020), the need for dedicated vehicles, specialized storage, and regular cleaning protocols increases the overall operational costs for halal transportation providers. SMEs often lack the resources to invest in these infrastructure requirements, which can prevent them from competing effectively in the halal market.

To support SMEs, governments and industry bodies should provide financial incentives and subsidies to help them invest in the necessary infrastructure and technology to maintain halal compliance. As suggested by Jabbar et al. (2020), these financial incentives could take the form of tax breaks, low-interest loans, or grants to support the development of halal logistics infrastructure. This support would help reduce the financial burden on SMEs and enable them to enter the halal logistics market with a more competitive edge.

Moreover, larger companies that already operate in the halal logistics market could play a role in supporting SMEs by offering mentorship and sharing resources. According to Dey et al. (2020), larger companies can assist smaller businesses by providing training, sharing best practices, and collaborating on research and development efforts. This kind of mentorship would help SMEs build capacity and scale their operations, allowing them to meet the growing demand for halal transportation services. Digital leadership is particularly relevant for smaller firms that need to translate technology investment into sustainable performance (Yusof, 2026).

5.5 Regulatory Streamlining and Cross-Border Collaboration

To facilitate smoother cross-border trade in halal products, there needs to be greater collaboration between governments and regulatory bodies across regions. As highlighted in the Issues section, regulatory inconsistencies between countries create significant challenges for halal transportation providers. Different countries have different halal certification standards, which complicates the transportation of halal products across borders and increases the cost of compliance.

According to Saleh and Darwis (2020), one of the key steps in overcoming this challenge is the establishment of bilateral agreements between countries to recognize each other's halal certification systems. This recognition would simplify the movement of halal goods across borders and reduce the regulatory burden on transportation providers. McKinnon (2025) suggests that governments should work together to harmonize halal certification standards, creating a more streamlined process for halal transportation providers.

Additionally, the development of regional halal logistics hubs could improve cross-border transportation efficiency. By establishing regional hubs where halal certification is universally recognized, transportation providers can more easily move goods across borders within a specific region. This would reduce delays and improve the overall efficiency of halal logistics, helping transportation providers meet the growing demand for halal products (Zhang & Shabbir, 2019).

5.6 Training and Education for the Halal Logistics Workforce

The shortage of skilled workers in the halal logistics sector remains a major issue. As noted by Jabbar et al. (2020), many transportation providers lack employees who are properly trained in halal certification standards and halal transportation requirements. This lack of skilled labor increases the risk of non-compliance and inefficiency in halal transportation systems.

To address this issue, it is essential to invest in education and training programs for the halal logistics workforce. According to McKinnon (2018), training programs should focus on the specific requirements of halal certification, as well as the use of advanced technologies like blockchain, IoT, and AI in halal transportation. These programs should be offered by industry bodies, certification agencies, and academic institutions to ensure that transportation providers have access to the resources they need to build a skilled workforce.

Furthermore, as new technologies continue to emerge in the logistics industry, continuous education and upskilling will be necessary to keep pace with these changes. Transportation providers should offer ongoing training to their employees to ensure they are equipped with the latest knowledge and skills to manage halal logistics systems effectively.

6. CONCLUSION

The halal transportation sector is a critical component of halal supply chains, ensuring that halal products are delivered in compliance with Shariah law. As the global demand for halal products continues to grow, the challenges faced by halal transportation providers have become more complex. Issues such as certification inconsistencies, contamination risks, technological adoption, regulatory discrepancies, and financial barriers all impact the efficiency and compliance of halal transportation systems. Despite these challenges, there are significant opportunities for improvement that could enhance the efficiency, transparency, and overall effectiveness of halal logistics.

The development of standardized halal certification systems across global markets would address the inconsistencies that currently plague the halal logistics industry. By adopting a unified approach to halal certification, the regulatory complexity of transporting halal goods across borders would be minimized, reducing inefficiencies and fostering greater cross-border trade. Furthermore, advancements in technology, such as blockchain and IoT, hold immense potential for improving transparency and traceability in halal transportation, thereby enhancing consumer confidence in the integrity of halal products. The integration of these technologies would streamline processes and provide real-time monitoring, reducing the risks of contamination and ensuring that halal products are transported under optimal conditions.

Collaboration between stakeholders, including manufacturers, halal certification bodies, technology providers, and transportation companies, is essential for driving improvements in halal transportation. By sharing knowledge and best practices, these stakeholders can collectively address the industry's challenges and work toward creating a more cohesive and efficient halal logistics system. Additionally, financial incentives and support for small and medium-sized enterprises (SMEs) entering the halal logistics market would help overcome the financial barriers that currently limit access to halal transportation infrastructure and technology.

In conclusion, the halal transportation sector is integral to the success of halal supply chains and the continued growth of the halal market. While challenges remain, the opportunities for improvement are vast. By standardizing halal certification, adopting advanced technologies, fostering collaboration, and providing financial support, the halal transportation industry can overcome existing barriers and continue to meet the growing demand for halal products globally. The future of halal logistics lies in the seamless integration of these improvements, ensuring that halal products are transported efficiently, securely, and in full compliance with Shariah law.

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2. Conflict of Interest

The authors declare that there are no financial, professional, personal, or other competing interests that could have influenced the preparation or publication of this article.

3. Author Contribution Statement

Muhamad Ali Imran Kamarudin: Conceptualization, literature review, critical analysis, manuscript preparation, and development of the main arguments.

Mohamed Suhaimi Yusof: Literature synthesis, critical analysis, development of strategic insights, manuscript review, and editing.

Both authors have read and approved the final version of the manuscript.

4. Ethics Statement

This study was conducted in accordance with applicable ethical principles and research standards. As this is a conceptual study based on published literature, no human participants or primary data collection were involved. Therefore, ethical approval and informed consent were not applicable. All sources were appropriately acknowledged in accordance with academic research standards.

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