

Unlocking Halal Food Performance: Exploring Technology Acceptance Model and Halal Traceability System Adoption in Malaysia's Food and Beverage SMEs

Haslinda Hadis¹, Azaze-Azizi Abdul Adis² and Masran Tamin^{3*}

¹ Faculty of Business, Economics, and Accountancy, Universiti Malaysia Sabah. (haslindahadis@gmail.com)

² Faculty of Business, Economics, and Accountancy, Universiti Malaysia Sabah. (azizi@ums.edu.my)

^{3*} Faculty of Business, Economics, and Accountancy, Universiti Malaysia Sabah. (masrantamin@ums.edu.my)

*Corresponding Author

Abstract:

The global halal food market has growing demands especially concerning transparency and compliance along halal food supply chains. Malaysia aims to position itself as a global Halal food hub, where the food and beverage (F&B) small and medium enterprises (SMEs) are critical in upholding halal credibility. However, due to resource constraints and a lack of technological readiness, these SMEs face challenges in adopting advanced technologies. This study examines the Halal traceability system adoption of Malaysian F&B SMEs through the lens of the Technology Acceptance Model (TAM). More specifically, it explores the relationships of perceived usefulness and perceived ease of use to the halal traceability systems adoption, as well as the effects of the of halal traceability systems adoption on the Halal food performance. A quantitative cross-sectional design was adopted, and data were collected from 189 SME stakeholders and analysed using SmartPLS. The findings showed that a lack of perceived ease of use in relation to the halal traceability system significantly inhibits its adoption, thereby enhancing the Halal food performance. In contrast, perceived usefulness was shown to have no significant impact on the Halal traceability systems adoption. The Halal traceability systems adoption does mediate the relationship between perceived ease of use of the constructs and Halal food performance. These findings contribute to the limited literature on the use of technology in the Halal sector and offer insights to policymakers and SMEs striving to improve Halal verification and digital shift.

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INTRODUCTION

The consistent rise in global Muslim population and the increasing appetite of the non-Muslim community for food that is both ethically and hygienically prepared is best demonstrated in the growing demand for halal food (Zailani et al., 2021). Where before the demand for halal food was justified on the basis of its religious character, a growing number of consumers have come to appreciate the food safety, quality, ethical animal treatment, and environmental sustainability that such food is associated with. Therefore, the expanding market for Halal food is a reflection of a growing global demand for food that is ethically prepared, hygienically produced, and associated with the religious and cultural requirements of the consumers. Consequently, countries that are able to successfully integrate Halal food into their economies will experience growing economic development and international trade.

In this regard, Malaysia has developed itself into an important global Halal hub, due to Malaysia's Halal certification, strong regulators, and government support for Halal industries. Other countries recognize

Malaysia's Halal ecosystem as credible and robust; as such, they frequently refer to it for Halal industry standards. The Malaysian Halal food and beverage (F&B) industry is becoming increasingly complex due to global sourcing, multi-tier suppliers, and complex distribution. Hence, maintaining Halal food integrity throughout the value chain has become a more critical issue (Rahman et al., 2022). This is particularly for small and medium-sized enterprises (SMEs) which are the main pillar of Malaysia's F&B industry and are essential in maintaining the distribution and production of halal food.

Moreover, most SMEs are unable to obtain financial resources, skilled personnel, effective technology, and digital infrastructure. These constraints create fragmented systems, manual and analog record-keeping, and a lack of cross-activity real-time visibility. These all contribute to a lack of visibility in supply chain activities. Consequently, there is a risk of insufficient, compromised, non-compliant, contaminated, and untraceable Halal products throughout the supply chain. These issues undermine the consumer confidence, competitive advantages, and the Halal integrity of SMEs. Additionally, the digital gaps between SMEs and larger corporations exacerbate these problems, as SMEs are perceived to be more digital solution lagged while larger corporations appear to be more digital. These lagged SMEs perceive the lack of sufficiently advanced digital systems to be a more complex issue, to cost more, and paradoxically, to be less effective in producing beneficial results.

Developments in technology may also offer means of addressing the challenges mentioned. Digital technologies, including distributed ledger technology, cloud computing, Internet of Things (IoT), and integrated traceability systems, are able to improve transparency, accountability, and information sharing in Halal supply chains (Kamarulzaman et al., 2021). For example, the use of blockchain can allow different supply-chain actors to 'record-capture' and share Halal-related information that they cannot alter and that is stored in a distributed manner. Real-time access to information, scalability, and cost-efficiency are characteristics of cloud computing, and thus cloud systems are likely to be more accessible for SMEs than traditional enterprise systems. Thus, Halal traceability systems can improve the monitoring of halal compliance, reduce asymmetry of information, improve operational efficiency, and build trust in halal-certified products among consumers.

Background of Study

In recent years, the global need for Halal-certified food has increased, influenced by a combination of ethical consumerism and demographic shifts. In 2021, Muslim consumers around the world spent around 1.27 trillion dollars on food, and this number is projected to rise to 1.67 trillion dollars by 2025 (State of the Global Islamic Economy Report, 2022). Malaysia, being one of the most prominent countries for Halal governance and certification, is able to meet this demand especially through the Food and Beverage (F&B) small and medium enterprises (SME) sector. In addition, more than 90% of F&B industry business establishments are SMEs (Department of Statistics Malaysia, 2022) and they are also the most important components of the supply chain for the delivery of Halal products. Even though regulatory bodies, such as JAKIM, offer support to such enterprises, they frequently encounter the absence of infrastructural developments and a lack of technological advancements, as well as employees (Talib et al, 2015). Also, inadequate supply chain documentation and fragmentation increase the risk of non-compliance to standards, while simultaneously eroding consumer confidence and Malaysia's international reputation in the halal industry (Salleh et al, 2020). Halal traceability systems are, therefore, important within the local halal industry. Using barcoding, RFID, and blockchain, systems provide a complete overview of Halal compliance, from raw materials to the end consumer. According to Kamarulzaman et al. (2021), these systems build trust, provide auditability, and meet international requirements for responsible supply chains.

In contrast, Halal traceability system adoption among Malaysian SMEs in the F&B sector is significantly lagging. Most of the SMEs are put off by the complexity, cost, and low level of digital literacy. Therefore, a better understanding of cognitive and behavioural factors contributing to this resistance is warranted. The TAM is useful to assess the extent to which perceived usefulness and perceived ease of use impact the intention to adopt Halal traceability systems and subsequently the Halal food performance. Moreover, Ab Talib et. al, (2021) state that the TAM is applicable in the logistics and agriculture sectors, the use of the model in the context of Halal traceability systems in SMEs is still novel. In addition, insufficient research has explored the direct effect of Halal traceability systems adoption on Halal food performance, such as regulatory compliance, efficiency, and customer satisfaction. Therefore, this research attempts to examine how the constructs of the Technology Acceptance Model shape the Halal traceability systems adoption and the extent to which such adoption enhances the performance of Halal food among Malaysian SMEs, The findings will be valuable to policymakers, Halal authorities, and private sector actors who are working towards digitally enhancing Malaysia's Halal ecosystem. This is another level 1 heading

LITERATURE REVIEW

The Halal Food Ecosystem in Malaysia

The Malaysian position in the Halal economy is supported by good regulatory frameworks, institutional oversight such as JAKIM and policy guidance (Ab. Talib, 2022). This institutional architecture reflects a state-driven governance model that integrates religious authority with economic strategy, positioning Malaysia as a global benchmark in halal standardisation. Thus, Malaysia has become a point of reference for Halal governance and certification. However, while regulatory robustness enhances credibility at the macro level, its effectiveness at the firm level, particularly among SMEs remains uneven and under-examined. The demand for Halal food remains high, especially with the Muslim population increasing and predicted to exceed 2.2 billion by 2030. Halal, in addition to being a religious requirement, is also gaining acceptance as being clean, ethical, and environmentally friendly (Azmi et al., 2023). This shift suggests that Halal consumption is no longer confined to faith-based observance but increasingly embedded within global ethical consumption trends. Nevertheless, the commercialisation of Halal raises critical concerns regarding authenticity, governance consistency, and the risk of symbolic compliance rather than substantive adherence.

In Malaysia's Halal food industry, SMEs stand out as they represent over 97% of this industry (SME Corp Malaysia, 2022). SMEs are also involved in the business of production, processing, and distribution at both the domestic and international levels. Despite their numerical dominance and operational significance, SMEs often lack the structural capacity to institutionalise advanced halal compliance mechanisms. On the contrary, Salleh and Hassan (2021) argue that SMEs face persistent challenges such as inadequate Halal training, digital resources, and certification gaps. The combination of deficient financial resources and a lack of knowledge over SMEs' ability to keep pace with the gaps in regulatory compliance also supports the claims of Talib et al (2015). This indicates a structural misalignment between regulatory expectations and SMEs' operational capabilities. As such, the more complex supply chains are, the more likely they are to source, process, transport, or store goods in ways that are not Halal compliant. Therefore, supply chain complexity amplifies compliance risks, particularly when monitoring mechanisms are fragmented or manually managed.

Considering increasingly global market competition, it must be stated that the still unparalleled economic value of Halal no longer stands for pure religious value. Rather, it emerges as a commercial necessity (Yusof et al., 2023). This transformation repositions Halal from a purely normative obligation to a

strategic competitive asset within international trade. Thus, since Halal is religiously and ethically a global norm, it is imperative for Malaysian SMEs to enhance the deployment of Halal traceability as a means to uphold the nation's Halal branding and sustain its competitive edge. Failure to institutionalise robust traceability mechanisms may undermine Malaysia's global Halal leadership and weaken stakeholder trust in its certification ecosystem.

The Critical Role of Halal Traceability Systems

The ability to preserve the systems of traceability within halal certification processes is crucial for the supervising and driving of the halal certification processes throughout the supply chain. Traceability serves not merely as a monitoring tool but as a governance instrument that ensures accountability, transparency, and integrity across multiple supply chain actors. Through the integration of cloud computing technology, blockchain, and RFID systems, halal traceability systems allow the supply chain to be monitored and managed in real-time, as well as in a fully transparent and detailed manner (Ab Talib et al., 2021; Kamarulzaman et al., 2021). These technologies reduce information asymmetry and enhance data reliability, which are critical in preventing contamination, fraud, and mislabeling within halal supply chains. With these technologies, systems to trace halal certifications can be operated for all stages of the supply chain. More importantly, the systems provide a means for upholding halal certification, as well as the National and International regulations pertaining to it. For SMEs, these systems of traceability provide a solution to the requirements of halal certification in Malaysia, while simultaneously building a trust relationship with their clients. However, the effectiveness of these systems depends on organisational readiness, technological competence, and strategic alignment within the firm.

Additionally, these systems create value for companies in both local and global markets by streamlining audits, inspections, and product recalls, as they quickly identify and resolve issues of non-compliance (Salleh and Hassan, 2021). This operational efficiency contributes not only to regulatory compliance but also to reputational capital and long-term financial sustainability. However, despite these benefits, the high costs of implementation, perceived complexity of the technology, and a lack of organisational and technological resources still slow SMEs' adoption of halal traceability systems (Salleh et al., 2020). These barriers suggest that technological solutions alone are insufficient without considering behavioural, organisational, and environmental determinants.

Consequently, to promote greater adoption in the future, it is of utmost importance to identify the perceptions of SMEs towards halal traceability systems. SMEs are more likely to integrate these systems into their business processes when they consider them to be of high operational value and easy to use. This perspective aligns with behavioural adoption theories that emphasise perceived usefulness and perceived ease of use as primary determinants of technology acceptance. The adoption of such systems reduces compliance uncertainty, improves managerial effectiveness, and increases visibility in the supply chain. Consequently, the Technology Acceptance Model is ideal for bridging this gap as it helps to explain the behavioural dimensions underpinning SMEs' of Halal traceability system adoption, whether it be from a position of willingness or reluctance. Nevertheless, relying solely on behavioural intention may overlook contextual factors such as regulatory pressure, competitive intensity, and organisational capability, thereby necessitating an integrated theoretical framework in this study.

Technology Acceptance Model (TAM) and Theoretical Constructs

The Technology Acceptance Model developed by Davis in 1989, outlines the way an individual's perception of the new technology impacts acceptance of it. He focuses on two elements:

- i. Perceived Usefulness: In the case of adoption of Halal traceability systems in SMEs, perceived usefulness is primary for influencing the user's intention and action. This is based on the idea that people are encouraged to use the system to increase their overall performance at work (Amin et al, 2021). In the case of Halal SMEs, the use of a Halal traceability system should be perceived as operationally effective and beyond that, in terms of guaranteeing Halal integrity, compliance with regulations, and consumer confidence.

In the context of Malaysian Halal food SMEs, halal traceability systems can strengthen certification management, improve supply chain transparency, ensure regulatory compliance, and enhance consumer trust. When SMEs perceive that such systems contribute to operational effectiveness and market credibility, they are more inclined to adopt them. TAM consistently demonstrates that perceived usefulness is the strongest predictor of adoption behaviour.

H1: Perceived usefulness positively influences Halal traceability system adoption among Malaysian food SMEs.

- ii. Perceived ease of use: This focuses on the extent to which a user thinks a certain type of technology is simple and easy to use (Salleh et al., 2020). In the Halal sector, where many of the SMEs operate under serious resource constraints and lack digital literacy, the ease of use of a system can be a deciding factor in system adoption. More recent studies have reported that SMEs are most likely to adopt a system due to its simplicity and low level of required technology (Yusof et al., 2023; Azmi et al., 2023). Entrepreneurs' conviction that low system training expenses are required and that the system can be operated by untrained, non-specialised, and non-advanced staff, increases acceptance significantly. Moreover, in the case of technologies that add step-by-step verification and do not disturb business processes, they are seen as relieving rather than disruptive (Rahman et al., 2023). Therefore, if the technology is viewed as having utility, it will not only be a factor in the willingness to continue use, but it will also be a significant factor in the use of the Halal traceability system in SMEs.

For Halal food SMEs, systems that integrate smoothly into existing workflows and do not require advanced technical expertise are more likely to be adopted. When entrepreneurs perceive halal traceability systems as easy to implement and operate, their likelihood of adoption increases.

H2: Perceived ease of use positively influences Halal traceability system adoption among Malaysian food SMEs.

Halal Traceability System Adoption and Halal Food Performance

While TAM explains technology adoption, it does not fully address performance outcomes. Drawing from the Resource-Based View (RBV) proposed by Jay Barney (1991), organisational capabilities that are valuable, rare, and difficult to imitate can create sustained competitive advantage. Halal traceability systems may function as strategic technological capabilities by enhancing transparency, reducing compliance risk, improving brand reputation, and increasing customer confidence. These capabilities may translate into improved financial and non-financial performance indicators such as market access, customer retention, and operational efficiency.

H3: Halal traceability system adoption positively influences halal food performance among Malaysian food SMEs.

Mediating Role of Halal Traceability System Adoption

TAM suggests that perceptions (perceived usefulness and perceived ease of use) influence behavioural intention, which subsequently affects actual usage behaviour (Davis, 1989). Extending this logic to the organisational level, perceived usefulness and ease of use may not directly enhance performance unless they translate into actual adoption of the system. Thus, Halal traceability system adoption serves as an intervening mechanism linking technological perceptions to firm performance outcomes.

H4a: Halal traceability system adoption mediates the relationship between perceived usefulness and Halal food performance.

H4b: Halal traceability system adoption mediates the relationship between perceived ease of use and Halal food performance.

Considering the gaps and newly arising problems, this study is driven by the following aims:

- To examine the relationship between perceived usefulness and Halal traceability systems adoption among Malaysian food SMEs.
- To examine the relationship between perceived ease of use and Halal traceability systems adoption among Malaysian food SMEs.
- To examine the relationship between the Halal traceability systems adoption and Halal food performance.
- To explore whether the Halal traceability systems adoption mediates the relationship between perceived usefulness, perceived ease of use, and Halal food performance.

This study applies the Technology Acceptance Model to the intersection of Halal and culturally integrated religious domains and furthers the understanding of the cognitive barriers that shape not only the adoption of innovation but also affect the performance outcomes, providing both theoretical and practical insights to the stakeholders of the Halal industry.

METHODOLOGY

This study used a quantitative research methodology and a cross-sectional survey design to examine relationships among the key variables based on the Technology Acceptance Model. More particularly, the research model consists of two independent variables (perceived usefulness and perceived ease of use), one mediation variable (Halal traceability systems adoption), and one dependent variable (Halal food performance). Using a cross-sectional design, this study is able to examine the behavioral and perceptual phenomena of respondents since data is gathered from them at one specific point in time (Creswell & Creswell, 2018).

This study targets a number of small and medium-sized enterprises in the food and beverage industry in Malaysia. Moreover, the chosen respondents were from the managerial and senior management tiers concerning

marketing, branding, or compliance, and who also have knowledge of the company's Halal way of doing business and its corresponding technological implementation. These leaders are best suited for the organisational readiness and the Technology Acceptance Model concerning the adoption of traceability systems. Additionally, the study employed stratified random sampling. This method, which involved the official Halal certified lists of F&B SMEs from SME Corp Malaysia and Majlis Amanah Rakyat (MARA), allowed the division of the population into different strata. The study also aimed to provide a balanced perspective concerning the various divisions of F&B SMEs so the respondents could minimise the gaps in experience to the Halal traceability systems. Furthermore, to ensure the sample provided sufficient statistical power and validity, the sample size was calculated using G*Power 3.1 software. Hence, the study model which had four latent variables needed no less than 180 responses.

The collection of 189 valid responses confirmed that data collection needs were met while also providing data sufficient for SEM-based multivariate analysis. The data collection tool consisted of a self-administered structured questionnaire in English and Malay. Considering this research is at a preliminary stage, this approach is justified, especially with a collection of small to moderate samples. Furthermore, in relation to older data sets with numerous underlying factors and variables interrelating to create varying relationships and influence outcomes (Hair et al., 2017), this approach is most adequate. The study obtained informed consent from all respondent's, ensured participation was voluntary, and maintained anonymity by not collecting personal or company identifiers. All responses were stored securely and reported in aggregate to protect confidentiality.

RESULTS

The demographic profile of the respondents, presented in Table 1, outlines an extensive coverage of Malaysian food and beverage SMEs. It shows that small-sized enterprises make up the largest percentage at 49% followed by micro-enterprises at 38%. A notable proportion of respondents have been operational for less than three years (37%), highlighting that the sector, though young, is brimming with activity. Moreover, a good number of these SMEs predominantly cater to the local market (75%) compared to those with international markets. Respondents are geographically located in the pertinent states of Malaysia, with Sabah (22%), Sarawak (19.5%), Selangor (19.5%), Johor (19.5%), and Pahang (19.5%) noted as the dominant states.

The Halal traceability systems adoption is generally perceived favourably, and this information is relayed in Table 2. The SMEs do appreciate the advantages of implementing halal traceability systems as the mean score for perceived usefulness stands at 4.13. However, perceived ease of use received a mean score of 3.81 indicating that while implementation is considered manageable, some scepticism may be present regarding ease of incorporation. The intention to adopt the Halal traceability system scored an average of 3.83 which demonstrated moderate to high willingness among SMEs to accept this technology. Most significantly, Halal food performance regarding the perceived impact of adopting the Halal traceability systems on food quality and safety scored an aggregate of 3.91 indicating optimism about the expectation concerning performance improvement.

Table 1: Profile of respondent

Demographic profiles	Categories	Frequency	Percentage (%)
Company size	Micro	72	38
	Small	92	49
	Medium	25	13
Years of operation	Less than 3 years	70	37
	6 years above	62	33
	11 years	57	30
Market level	International	47	25
	Domestic	142	75
State	Selangor	37	19.5
	Sabah	41	22
	Sarawak	37	19.5
	Johor	37	19.5
	Pahang	37	19.5

Table 2: Descriptive Statistic

Variables	Mean	Standard Deviation
Perceived Usefulness	4.13	0.51
Perceived Ease of Use	3.81	0.64
Halal Traceability System Adoption	3.83	0.51
Halal Food Performance	3.91	0.66

Table 3 validates the reliability and the construct measurements with all items loading greater than 0.5, AVE values greater than 0.5, and composite reliability greater than 0.7. These indicators support the adequacy of the measurement model and confirm that the constructs measure the correct variables. In this study, all variables have higher factor loadings which indicates these dynamic variables are strongly representable by latent constructs; AVE values suggest that constructs explain more than half the variance of their indicators, implying convergent validity. Furthermore, composite reliability values above the accepted value of 0.7 indicate that the measurement items explain some degree of overlap among individual items, thus confirming internal consistency. Hence, these results thoroughly validate the measurement model and strengthen the effectiveness of the structural analysis and the results of the model.

Table 3: Result of Measurement

Construct	Items	Loading	AVE	CR
Perceived Usefulness	PU1: Using a Halal traceability system improves company performance	0.770	0.538	0.890
	PU2: Using a Halal traceability system increases company productivity	0.753		
	PU3: We found that a Halal traceability system is useful to our company	0.694		
	PU4: Using a Halal traceability system improves employee performance	0.778		
	PU5: Using a Halal traceability system would allow the company to trace products along the food supply chain more quickly	0.639		
	PU6: Using a Halal traceability system would enhance effectiveness in tracing product material	0.656		
	PU7: The adoption of a Halal traceability system will provide timely information required for decision-making	0.709		
	PU8: Halal traceability system is compatible with our organisation's current values and goals	0.846		
Perceived Ease of Use	PEU1: Implementation process of the Halal traceability system is understandable	0.843	0.567	0.913
	PEU2: It is easy to integrate a Halal traceability system with the existing system	0.819		
	PEU3: We found that it is easy to learn about the Halal traceability system	0.568		
	PEU4: Management using a Halal traceability system would be clearer	0.773		
	PEU5: Management using a Halal traceability system would be more understandable	0.606		
	PEU6: The skills required to use a Halal traceability system are simple for our employees	0.777		
	PEU7: Halal traceability system allows our firm to trace products along the food supply chain easily	0.829		
	PEU8: Overall, the Halal traceability system is easy to use	0.760		
Halal Traceability System Adoption	AD1: Our company has a high intention to adopt Halal traceability system in our company	0.811	0.564	0.807
	AD2: Our company intends to learn about using a Halal traceability system	0.698		
	AD3: Our company intends to adopt a Halal traceability system as the profit gains by the company are expected to be increased	0.698		
	AD4: Our company take initiative to adopt a Halal traceability system in the company	0.773		
	AD5: Our company would use a Halal traceability system rather than the old method to trace the products	0.769		
Halal Food Performance	PER1: Adopting Halal traceability system will increase my company's profitability of the company	0.793	0.518	0.781
	PER2: Adopting Halal traceability system will increase my company's return on assets (total assets)	0.780		
	PER3: Adopting Halal traceability system will increase my company's sales margin	0.554		
	PER4: Adopting Halal traceability system will increase my company's cash flow, including investment	0.728		
	PER5: Adopting Halal traceability system will increase my company's return on sales (total sales)	0.720		

Note: PU indicated Perceived Usefulness; PEU indicated Perceived Ease of Use; AD indicated Halal Traceability System Adoption; PER indicated Halal Food Performance; AVE indicated Average Variance Extracted; CR indicated Composite Reliability.

To assess discriminant validity, the Heterotrait-Monotrait (HTMT) ratio of correlations was utilized. According to Henseler et al. (2015), discriminant validity is established when HTMT values are below the threshold of 0.85 or 0.90. As shown in Table 4, all HTMT values ranged from 0.658 to 0.884. Since all values remained below the recommended 0.90 threshold, the results confirm that each latent construct in the model is empirically distinct, successfully establishing discriminant validity.

Table 4: Discriminant Validity (HTMT)

Construct	1	2	3	4
Adoption				
Perceived Ease of Use	0.742			
Perceived Usefulness	0.811	0.658		
Performance	0.884	0.713	0.789	

As shown in Table 5, the insights gained from the hypothesis testing are of particular interest concerning the interplay of the studied variables. Most importantly, useful perception does not significantly impact the SMEs' Halal traceability systems adoption ($t=0.809$, $p=0.419$), indicating that the recognised advantages are unlikely to motivate adoption by themselves. On the contrary, perceived ease of use has a significant positive effect on Halal traceability systems adoption ($t=2.793$, $p=0.005$), showing that SMEs' technology acceptance is highly influenced by usability factors. Additionally, Halal traceability systems adoption has a very strong and significant effect on Halal food performance ($t=7.385$, $p=0.000$), which suggests that SMEs' adoption to implement traceability systems enhance the perceived value concerning the quality, safety, and overall Halal food performance.

Table 5: The Result of Direct Effect

Hypothesis	Parth	t-value	p-value	Decision
H1	Perceived Usefulness → Halal Traceability System Adoption	0.809	0.419	Not Supported
H2	Perceived Ease of Use → Halal Traceability System Adoption	2.793	0.005	Supported
H3	Halal Traceability System Adoption → Halal Food Performance	7.385	0.000	Supported

In Table 6, the indirect effects were assessed to study the mediating role of Halal traceability system adoption. The outcomes suggest that perceived usefulness does not indirectly impact food performance through Halal traceability system adoption ($t = 0.805$, $p = 0.421$), reflecting its lack of impact on the mediated pathway effect within this framework. On the other hand, perceived ease of use does influence Halal food performance through Halal traceability system adoption ($t = 2.473$, $p = 0.013$), which demonstrates that perceived ease of use enhances Halal food performance indirectly through greater adoption in the intermediary role.

Table 6: Mediation Analysis

Hypothesis	Parth	t-value	p-value	Decision
H4a	Perceived Usefulness → Halal Traceability System Adoption → Halal Food Performance	0.805	0.421	Not Supported
H4b	Perceived Ease of Use → Halal Traceability System Adoption → Halal Food Performance	2.473	0.013	Supported

DISCUSSION

This study identified and analyzed the technological factors affecting the Malaysian SMEs' Halal traceability systems adoption and their implications on Halal food performance within the Malaysian SMEs' food and beverage sector. Using the Technology Acceptance Model, this study examined the relationships among perceived usefulness, and perceived ease of use, Halal traceability systems adoption, and the dependent variable, Halal food performance. The findings suggest that perceived ease of use plays a more influential role than perceived usefulness in shaping SMEs' adoption decisions. This indicates that, in resource-constrained SME environments, operational simplicity may outweigh strategic performance considerations when evaluating new technologies. Moreover, the results show that the Halal traceability systems adoption positively affected Halal food performance. This implies that actual system implementation rather than mere perception, functions as a capability that enhances organisational outcomes.

The findings indicate that for SMEs, the likely adoption of Halal traceability systems depends on the perceived ease of use of such systems. This aligns with the Technology Adoption Model claim that perceived ease of use increases technology acceptance (Davis, 1989). Besides confirming TAM, this finding suggests that SMEs prioritise feasibility and disruption minimisation over long-term strategic gains. In small firms where managerial capacity, digital literacy, and financial resources are limited, ease of use reduces perceived risk, training costs, and implementation uncertainty. Thus, usability may function as a threshold condition for adoption.

In contrast, the perceived usefulness of Halal traceability systems adoption was found to be non-significant. The non-significant role of perceived usefulness requires deeper theoretical reflection. Traditionally, TAM posits perceived usefulness as the strongest determinant of technology adoption. However, in the context of Malaysian Halal SMEs, traceability systems may be perceived primarily as compliance tools rather than strategic performance enhancers. When a technology is institutionalised or externally encouraged through regulatory structures, its usefulness may become taken-for-granted and thus lose explanatory power in predicting adoption. Additionally, SMEs may adopt a short-term survival orientation. While usefulness reflects anticipated future performance improvements, SMEs may prioritise immediate operational stability and cost control. Therefore, even if usefulness is recognised, it may not translate into adoption unless usability concerns are first resolved. This confirms some other studies which suggest that during the early stages of technology acceptance, it is ease of use that captures the most attention while usefulness is left unattended, especially in the case of resource-constrained SMEs (Ab Talib et al., 2021).

The study confirms that Halal traceability system adoption has a significant mediating effect on improving operational performance in halal food. SMEs that show a high willingness to adopt Halal traceability systems adoption. Rather than simply reflecting correlation, this finding suggests that adoption operates as an organisational capability that enhances transparency, strengthens compliance reliability, and builds consumer

trust, critical performance drivers in the Halal industry. This validates the expanding literature on the positive relationship between technology adoption and performance in food safety and quality assurance (Kamarulzaman et al., 2021). Importantly, the mediation result indicates that performance gains do not stem directly from perceptions (perceived usefulness or perceived ease of use), but from actual system implementation. This strengthens the theoretical argument that perceptions must translate into concrete organisational action before measurable performance outcomes can occur.

The stakeholders in the industry as well as in the government will need to take the results into consideration. First, the promotional activities aimed at encouraging the Halal traceability system to be adopted by SMEs need to demonstrate how easy the system is to integrate. Most SMEs are resource-constrained, and policies that provide funding for services, system design that is easy to use, and training will most likely reduce the barriers to acceptance. Rather than focusing solely on communicating long-term strategic benefits, policymakers and Halal authorities should reduce perceived complexity and implementation anxiety. Practical onboarding frameworks, technical assistance, and collaborative partnerships between technology providers and industry associations can help bridge digital capability gaps.

In addition, issuing bodies and Halal bodies, including JAKIM, need to improve the adoption of these systems by offering to subsidize, mitigate, and support technical certificates, and provide other forms of support. Such support would, at least in part, help SMEs to overcome their resource barriers, and will help to accelerate the digital transformation of Malaysia and increase the country's capacity to be a digital global Halal Hub. Further, fostering collaborations between tech companies and industry associations will help to address the suboptimal digital and pedagogical knowledge gaps.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The analysis has certain strengths and weaknesses, and in this study, it has some value. Cross-sectional design will make it difficult to make causal inferences, and even then, it is limited to a region/ sector, as it is a sample representative of SMEs in Malaysia. Subsequent longitudinal studies will be necessary to examine changing perceptions and the behaviours of adopters over time. Also, UTAUT is likely to provide better explanatory power regarding the social and organizational variables at play. Adding external factors such as the institutional environment, the level of technological infrastructure, the control complexity within the supply chain, and such can improve the overall model. Situating the stakeholders, namely the suppliers, the regulators, and the end consumers, will address the value of the model in describing the ecosystem of the Halal supply chain in Malaysia; and the within ecosystem Halal traceability system.

CONCLUSION

In conclusion, this study articulated the impacts of perceived ease of use on the Halal traceability systems adoption by Malaysian SMEs and its impact on Halal food performance. The need for the digital adoption within the halal food supply chain is focused on technology simplification and improving user experience. User experience and technology simplification should be prioritized if Malaysia wants to evolve to be a global Halal hub. Innovations within SMEs like the traceability systems will be important to ensure halal integrity, bolster trust of consumers, and secure the market position within the flexible and competitive global marketplace. Furthermore, the stakeholders can reinforce the trust and transparency of the Halal ecosystem by better aligning technology and methods for SMEs. The long-term impacts of Halal traceability systems adoption and the study of other behavioural and organizational factors affecting technology acceptance and food performance within various sectors of the Halal industry would allow for further development of these findings.

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