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Technology Adoption and Business Performance: Evidence from Halal MSMEs in Indonesia

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ABSTRACT

Digital transformation is essential for improving the competitiveness of halal MSMEs. This study aims to examine the effect of technology adoption (TA) and halal certification on business performance (BP) and to test whether halal certification moderates the relationship between TA and BP among halal micro, small, and medium enterprises (MSMEs) in Indonesia. This quantitative survey study employed purposive sampling and collected data from 110 halal MSMEs through a structured questionnaire. The data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with SmartPLS. The results show that TA has a positive and significant effect on BP ($b = 0.710$, $t = 13.168$, $p < 0.001$), halal certification also has a positive and significant effect on BP ($b = 0.196$, $t = 2.458$, $p = 0.014$), the model explains 65.3% of the variance in BP ($R^2 = 0.653$), and the moderating effect of halal certification is not significant ($b = 0.029$, $t = 0.886$, $p = 0.376$). The results indicate that halal certification and TA are crucial for improving BP. These findings imply that digital TA is the main driver of halal MSME performance, while halal certification functions as a complementary source of legitimacy and consumer trust.

Keywords: Business Performance; Digital Transformation; Halal Certification; Halal MSMEs; Indonesia; Technology Adoption

JEL Classification: L25; L26; M31; O33; Z12

INTRODUCTION

Micro, small, and medium enterprises (MSMEs) constitute the backbone of Indonesia's economy, contributing substantially to national gross domestic product and absorbing a large share of the workforce (Dasaraju & Tambunan, 2023; Kamar Dagang dan Industri [Kadin] Indonesia, 2025). Within this sector, halal MSMEs occupy a strategic position because Indonesia has the world's largest Muslim population and continues to strengthen its ambition to become a global hub for the halal economy (Kawsar, 2025; Syahr et al., 2025). The growing scale of Muslim consumer spending and the expansion of the digital Islamic economy present important opportunities for Indonesian halal MSMEs to enhance competitiveness, expand market access, and build consumer trust.

Despite these opportunities, many MSMEs still face constraints in adopting digital technology, including limited digital literacy, high adoption costs, managerial limitations, and resistance to organizational change (Rupeika-Apoga & Petrovska, 2022). For halal MSMEs, these barriers are more complex because technology adoption must not only support efficiency and marketing reach but also align with halal assurance, transparency, traceability, and consumer confidence across the halal value chain (Harsanto et al., 2024; Zailani et al., 2024). In this context, technology adoption and halal certification are both relevant mechanisms for strengthening business performance, although their roles may differ.

Prior studies generally show that adopting digital technology can improve innovation, operational efficiency, market reach, and firm performance (Badri & Amrina, 2023; Blichfeldt & Faullant, 2021; Huang et al., 2025; Usai et al., 2021). Other studies indicate that halal standards and halal certification can enhance legitimacy, consumer trust, market acceptance, and business outcomes (Giyanti et al., 2021; Nurjamjam, 2024; Salindal, 2018). However, these two research streams have often developed separately. Limited empirical evidence explains how technology adoption and halal certification jointly influence the business performance of halal MSMEs in Indonesia, particularly whether halal certification strengthens the effect of technology adoption on performance.

Therefore, this study aims to analyze the effect of technology adoption on the business performance of halal MSMEs, examine the direct effect of halal certification, and test the moderating role of halal certification in the relationship between technology adoption and business performance. The novelty of this study lies in integrating technology adoption and halal certification within a single empirical model in the Indonesian halal MSME context. The study is significant because it provides evidence for policymakers, halal authorities, and MSME stakeholders on whether digital capability and certification should be treated as interactive strategies or as complementary mechanisms for improving performance. The contribution of this study is both theoretical, by extending the digital adoption and halal business literatures, and practical, by offering guidance to strengthen halal MSME competitiveness in the digital economy.

LITERATURE REVIEW

Technology Adoption

Technology adoption refers to the extent to which firms recognize, accept, and integrate digital technologies into business processes. In MSMEs, adoption may involve digital marketing, e-commerce platforms, digital payment systems, customer relationship tools, and information systems that improve coordination and decision-making. The Diffusion of Innovations Theory explains that adoption is shaped by perceived relative advantage, compatibility with existing routines, complexity or ease of use, trialability, and

observability (Rogers, 2003). The Technology Acceptance Model also emphasizes perceived usefulness and perceived ease of use as important factors that influence acceptance of technology (Davis, 1989).

Recent studies show that the adoption of digital technology can strengthen firm performance by improving efficiency, accelerating innovation, expanding market access, and enhancing responsiveness to customer needs (Blichfeldt & Faullant, 2021; Chatterjee et al., 2021; Huang et al., 2025; Usai et al., 2021). In the MSME context, digital marketing and market orientation have been found to contribute positively to MSME performance (Rifani et al., 2025), while broader digital transformation can mediate the use of resources toward sustainable competitive advantage (Firdaussiah et al., 2026). For halal MSMEs, technology adoption is especially important because digital tools can support product promotion, consumer engagement, online transactions, and documentation of halal-related information.

Halal Certification

Halal certification is an institutional assurance that products, processes, and business practices comply with Islamic requirements. Certification functions as a credibility signal that reduces information asymmetry between producers and consumers, especially in markets where buyers cannot directly observe production processes or ingredient compliance. Signaling Theory posits that credible external certification can strengthen market trust by signaling quality, compliance, and accountability (Spence, 1973). In halal business, certification also reflects legitimacy by indicating that firms meet religious, ethical, and regulatory expectations.

Empirical studies show that halal certification and halal assurance practices can improve market access, innovation, brand credibility, and performance outcomes (Giyanti et al., 2021; Salindal, 2018; Talib et al., 2017). More recent evidence indicates that halal certification and halal quality assurance practices contribute to competitive advantage among MSMEs, although their financial impact may depend on how firms use certification in marketing, branding, and operational improvement (Fitri et al., 2023; Nurjamjam, 2024). For Indonesian halal MSMEs, certification is not only a legal or administrative requirement but also a strategic resource for building consumer trust in increasingly digital markets.

Business Performance

Business performance describes the extent to which a firm achieves desired financial and non-financial outcomes. In MSMEs, performance is commonly reflected in sales growth, market expansion, customer satisfaction, operational efficiency, innovation capability, and competitiveness. The Resource-Based View explains that firms can achieve superior performance when they possess valuable, rare, inimitable, and organized resources (Barney, 1991). Digital capability and halal legitimacy can therefore be viewed as strategic resources when they help MSMEs differentiate their products, improve internal processes, and respond to market expectations.

Studies on MSMEs show that business performance is influenced by digital marketing, entrepreneurial leadership, market orientation, financial capability, and institutional support (Bangguiyac & Castaneda, 2025; Rifani et al., 2025). In halal industries, performance is also shaped by the ability to balance market competitiveness with religious compliance, consumer assurance, and supply chain integrity. Therefore, business performance in halal MSMEs should be understood not only as a financial outcome but also as the result of effective use of technology, market legitimacy, and trust-based value creation.

Supporting Theories

This study is supported by the Diffusion of Innovations Theory, the Technology Acceptance Model, Signaling Theory, and the Resource-Based View. The Diffusion of Innovations Theory and Technology Acceptance Model explain why MSMEs adopt digital technology based on perceived benefits, compatibility, usefulness, and ease of use (Davis, 1989; Rogers, 2003). Signaling Theory explains how halal certification communicates credibility and reduces consumer uncertainty (Spence, 1973). The Resource-Based View explains how technological capability and halal legitimacy may become organizational resources that improve business performance (Barney, 1991). These theories provide a coherent foundation for examining the direct effects of technology adoption and halal certification, as well as the moderating role of certification.

Hypotheses Development

Technology Adoption and Business Performance

Technology adoption enables MSMEs to improve operational efficiency, reduce transaction costs, expand market reach, and respond more quickly to customer needs. Digital tools also help MSMEs improve promotion, distribution, customer communication, and data-based decision-making. Prior research demonstrates that the adoption of digital technology is positively associated with innovation and firm performance (Blichfeldt & Faullant, 2021; Huang et al., 2025; Usai et al., 2021). In the halal MSME context, the use of digital technology can expand market access while helping businesses communicate the halal value to consumers. Therefore, this study proposes the following hypothesis.

H1: Technology adoption positively affects the business performance of halal MSMEs.

Halal Certification and Business Performance

Halal certification can improve business performance by strengthening legitimacy, consumer trust, and access to halal-oriented markets. Certification provides assurance that products and processes comply with halal requirements, thereby reducing uncertainty and increasing purchase confidence. Prior studies show that halal certification and halal standards contribute to market performance, innovation, and competitive advantage (Giyanti et al., 2021; Nurjamjam, 2024; Salindal, 2018; Talib et al., 2017). Accordingly, halal certification is expected to improve the business performance of halal MSMEs.

H2: Halal certification positively affects the business performance of halal MSMEs.

Moderating Role of Halal Certification

Technology adoption may yield stronger performance outcomes when accompanied by credible halal certification, as certification can reinforce consumer trust in digitally marketed halal products. In online environments, consumers often rely on visible signals, such as halal logos, certification information, and traceability features, to assess product credibility. Halal certification may therefore strengthen the performance benefits of technology adoption by ensuring that digital promotion and transactions are supported by religious legitimacy and quality assurance. Based on this reasoning, the following hypothesis is proposed.

H3: Halal certification moderates the relationship between technology adoption and business performance.

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Conceptual Framework

The conceptual framework positions technology adoption and halal certification as direct predictors of business performance, and also tests halal certification as a moderating variable in the relationship between technology adoption and business performance. This framework reflects the assumption that digital capability improves operational and market outcomes, while halal certification provides legitimacy and trust. The interaction term examines whether certification strengthens or weakens the effect of technology adoption on performance.

Figure 1. Research Framework

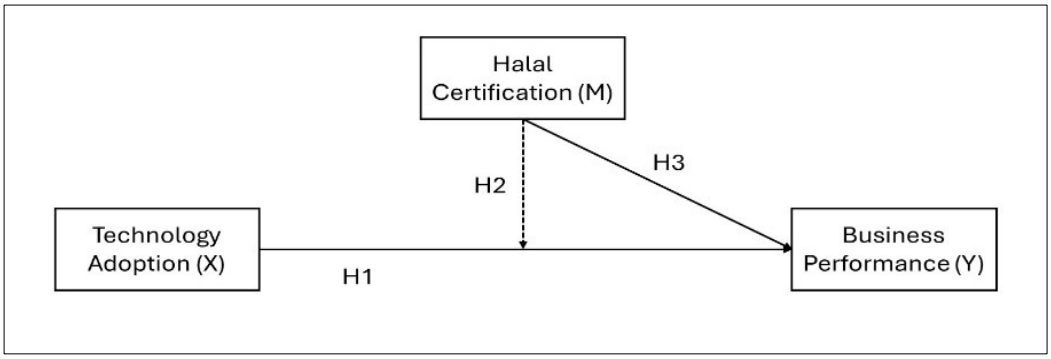

Figure 1 illustrates the proposed research framework. Technology adoption is expected to have a direct positive effect on business performance, halal certification is expected to have a direct positive effect, and the interaction between technology adoption and halal certification is tested to determine whether certification functions as a moderator. The framework integrates digital adoption and halal business legitimacy to explain performance outcomes among halal MSMEs in Indonesia.

RESEARCH METHOD

Research Design

This study applied a quantitative research design with a survey strategy to examine the effects of technology adoption and halal certification on the business performance of halal MSMEs in Indonesia. The quantitative approach was appropriate because the study tested causal relationships among latent constructs and examined a moderating effect using measurable indicators (Saunders et al., 2023).

Sample and Data Collection

The population consisted of halal MSMEs in Indonesia that had adopted digital technology and either had obtained halal certification or were in the process of obtaining it. A purposive sampling technique was used to ensure that respondents were relevant to the research objectives. Data were collected from 110 halal MSMEs through a structured questionnaire distributed online and offline. This sample size met the minimum requirement for Partial Least Squares Structural Equation Modeling (PLS-SEM), which is suitable for small-to-medium samples and complex models (Hair et al., 2019).

Measurement of Constructs

The measurement model was developed from established theories and validated constructs. Technology adoption was conceptualized as a multidimensional construct reflecting relative advantage, compatibility, perceived usefulness, and ease of use. Halal certification was operationalized as a construct encompassing halal assurance, credibility, and compliance, while business performance was measured using both

financial and non-financial indicators. All indicators were measured using a five-point Likert scale ranging from strongly disagree to strongly agree.

Reliability and Validity Assessment

Prior to hypothesis testing, the measurement model was evaluated using established reliability and validity criteria. Internal consistency reliability was assessed through Cronbach's alpha and composite reliability, with values above 0.70 considered acceptable. Convergent validity was evaluated through outer loadings and Average Variance Extracted (AVE), with acceptable thresholds of 0.50 or higher. Discriminant validity was assessed using the Fornell-Larcker criterion, where the square root of AVE for each construct should exceed its correlations with other constructs (Hair et al., 2021). The empirical values of these tests are reported in the Results section.

Data Analysis

Structural Equation Modeling-Partial Least Squares (SEM-PLS) was applied using SmartPLS software to test the hypothesized relationships. PLS-SEM was selected because it is suitable for exploratory and prediction-oriented research, small-to-medium sample sizes, and models involving latent variables and moderation (Hair et al., 2019, 2021). The structural model was assessed using R2 values, path coefficients, t-statistics, p-values, effect sizes (f2), and model fit indicators.

RESULTS

Profile of Halal MSMEs

The respondents in this study comprised 110 halal MSMEs in Indonesia that had adopted digital technology in their business activities and had obtained halal certification or were in the process of obtaining it. The sample represented halal-oriented enterprises that use digital tools for marketing, communication, online transactions, or operational support. In terms of business profile, the respondents were mainly MSMEs operating in halal-related sectors, including food and beverages, fashion, cosmetics, services, and other consumer products. The businesses were located in Indonesian MSME markets where halal certification and digital adoption are increasingly relevant for strengthening competitiveness and consumer trust.

The profile indicates that the sample was appropriate for examining technology adoption, halal certification, and business performance because the respondents had direct experience with digital business practices and halal-related market requirements. This context supports the relevance of testing whether technology adoption and halal certification contribute to MSME performance and whether certification strengthens the technology-performance relationship.

Table 1. Profile of Halal MSMEs/Respondents

Demographic Category	Classification	Frequency (n)	Percentage (%)
Location	Samarinda	40	36.36
	Tenggarong	20	18.18
	Sangatta	15	13.64
	Balikpapan	10	9.09
	Bontang	15	13.64
	Paser	10	9.09
Business Age	0–5 years	15	13.64
	6–10 years	25	22.73
	11–15 years	20	18.18

	16–20 years	10	9.09
	21–25 years	20	18.18
	> 25 years	20	18.18
Halal Certification Status	Certified	60	54.55
	Certification in Process	50	45.45
Gender	Male	20	18.18
	Female	90	81.82
Position/Role	Owner	85	77.27
	Manager	15	13.64
	Others	10	9.09
Age	< 25 years	5	4.55
	26–30 years	15	13.64
	31–35 years	20	18.18
	36–40 years	25	22.73
	41–45 years	30	27.27
	46–50 years	10	9.09
	> 50 years	5	4.55
Education	Junior High School or Equivalent	10	9.09
	Senior High School/Vocational High School/Equivalent	40	36.36
	Diploma (D1–D3)	10	9.09
	Bachelor's Degree (D4/S1)	40	36.36
	Master's Degree (S2)	10	9.09
Annual Revenue	< IDR 50 Million per Year	60	54.55
	IDR 50–300 Million per Year	30	27.27
	IDR 300–500 Million per Year	10	9.09
	> IDR 500 Million per Year	10	9.09

In Table 1, a number of significant traits are revealed by the examined profile of MSMEs in the halal food industry. MSMEs are dispersed in Samarinda, Tenggarong, Sangatta, Balikpapan, Bontang, and Paser. The majority of businesses are between the ages of 0–5 and 6–10, suggesting that many new firms are participating. The status of halal certification varies as well; the majority are already certified, but some are still in the certification process.

In terms of gender, women made up the majority of responders. While some worked as marketing managers, the majority were business owners. The age range of the respondents varied, but the most prevalent age group was 41–45. The greatest level of education attained by the majority of respondents was either a Bachelor's Degree (D4/S1) or Senior High School/Vocational High School/Equivalent. The majority of MSMEs had a yearly turnover of less than IDR 50 million, indicating a comparatively small business scale. According to these statistics, women-managed small enterprises dominate Indonesia's halal culinary MSMEs, with an emphasis on boosting technology use and halal certification to improve competitiveness.

Measurement Model

The measurement model was assessed to ensure the reliability and validity of the constructs. Figure 2 illustrates the convergent validity results generated through the Partial Least Squares (PLS) approach. Table 2 presents the outer loading values for each indicator, Table 3 reports discriminant validity using the Fornell-Larcker criterion, and Table 4 summarizes reliability and convergent validity statistics.

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Figure 2. Convergent Validity

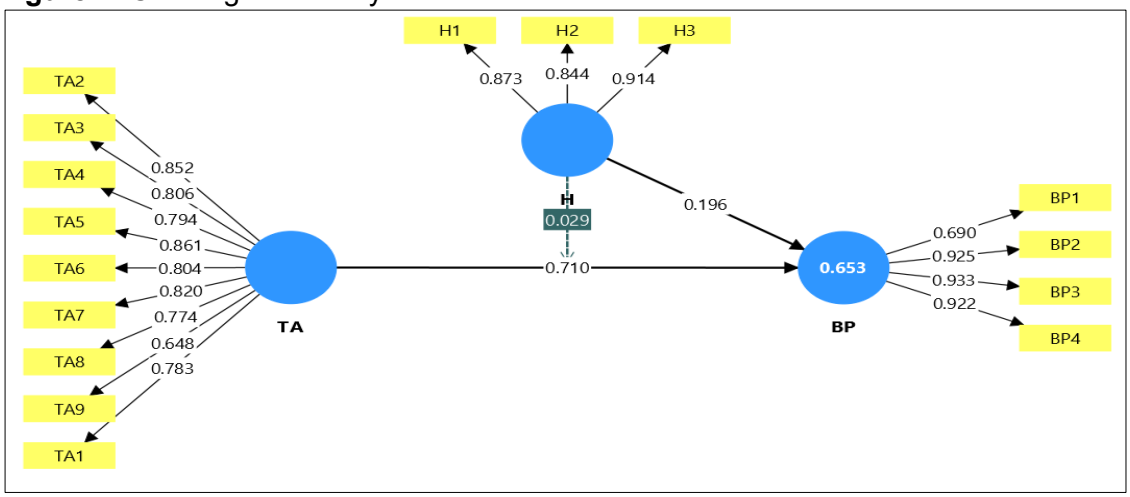

Figure 2 illustrates that the technology adoption (TA) construct is measured by nine indicators (TA1-TA9), with outer loadings ranging from 0.648 to 0.861. Table 2 shows that most TA indicators exceed the recommended threshold of 0.70, with TA9 having the lowest loading of 0.648 and TA1 having a loading of 0.783. TA9 can still be retained because the construct-level AVE exceeds 0.50, indicating adequate convergent validity.

The business performance (BP) construct is measured by four indicators (BP1-BP4), with loading values ranging from 0.690 to 0.933. These values indicate that the BP construct has adequate convergent validity. The R2 value of 0.653 indicates that 65.3% of the variance in BP is explained by technology adoption, halal certification, and the moderating construct, reflecting strong explanatory power in the structural model.

The structural path results indicate that the effect of technology adoption on business performance is strong and significant, while the moderating effect of halal certification is relatively small and not significant. Therefore, the model suggests that the influence of technology adoption on business performance is primarily direct rather than dependent on the interaction with halal certification.

Table 2. Outer Loadings

Indicator	BP	H	TA	H x TA
BP1	0.690			
BP2	0.925			
BP3	0.933			
BP4	0.922			
H1		0.873		
H2		0.844		
H3		0.914		
TA2			0.852	
TA3			0.806	
TA4			0.794	
TA5			0.861	
TA6			0.804	
TA7			0.820	
TA8			0.774	
TA9			0.648	

TA1			0.783	
H x TA				1.000

Table 2 shows that all outer loading values are above 0.50, indicating that all indicators meet the minimum requirement for convergent validity and are appropriate for measuring their respective constructs.

Table 3. Discriminant Validity

Construct	BP	H	TA
BP	0.873		
H	0.533	0.878	
TA	0.795	0.523	0.796

Table 3 shows that the square root of AVE for each construct is greater than its correlations with other constructs. This confirms that the constructs satisfy the Fornell-Larcker criterion and have adequate discriminant validity.

Table 4. Reliability Test

Construct	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
BP	0.892	0.916	0.927	0.763
H	0.852	0.867	0.910	0.771
TA	0.927	0.932	0.939	0.633

Table 4 shows that Cronbach's alpha and composite reliability values for all constructs exceed 0.70, while AVE values exceed 0.50. These results confirm that the measurement model is reliable and has adequate convergent validity.

Structural Model

The structural model yielded an R^2 value of 0.653 for business performance, indicating that technology adoption and halal certification jointly explained 65.3% of the variance in business performance. This demonstrates a substantial explanatory power of the model (Hair et al., 2021). Effect size (f^2) analysis revealed that technology adoption had a very large effect ($f^2 = 1.054$) on business performance, while halal certification showed a small effect ($f^2 = 0.050$). The moderating effect of halal certification was negligible ($f^2 = 0.004$).

Table 5. R Square

Construct	R-square	R-square Adjusted
BP	0.653	0.643

Table 5 shows that the R-square value of BP is 0.653, while the adjusted R-square is 0.643. This means that technology adoption, halal certification, and the moderation term explain 65.3% of the variance in business performance, indicating strong explanatory power.

Table 6. Effect Size

Variables	f^2 on Business Performance (BP)	Interpretation
Halal Certification (H)	0.050	Small Effect
Technology Adoption (TA)	1.054	Very Large Effect
H x TA (Moderation)	0.004	No Effect / Negligible

Table 6 presents the effect size (f2) values, which indicate the relative contribution of each predictor to BP. TA has a very large effect on BP (f2 = 1.054), showing that digital

technology is the dominant driver of performance improvement among halal MSMEs. This suggests that effective adoption of digital tools can substantially improve efficiency, innovation, market reach, and competitiveness.

Halal Certification (H) has a small effect on BP (f2 = 0.050), indicating that certification contributes positively but less strongly than technology adoption. This finding suggests that certification enhances trust and legitimacy but may require integration with marketing, innovation, and digital practices to produce stronger performance outcomes.

The interaction term H x TA has a negligible effect on BP (f2 = 0.004). This indicates that halal certification does not meaningfully strengthen or weaken the effect of technology adoption on business performance. Therefore, the two factors appear to operate mainly as complementary mechanisms rather than as mutually reinforcing factors

The results of the effect size (f^2) analysis demonstrate the relative contribution of each variable to BP within the structural model. According to Cohen's (1988) guidelines, the H variable shows an effect size of 0.050, which is categorized as a small effect. This indicates that while Halal Certification contributes positively to improving Business Performance, its influence is relatively limited compared to other predictors in the model. In practical terms, Halal Certification may enhance consumer trust and brand credibility, but by itself, it does not strongly determine overall business performance.

In contrast, TA exhibits an effect size of 1.054, which is considered a very large effect. This suggests that TA plays a dominant role in influencing Business Performance. The adoption of technology likely enhances operational efficiency, innovation capacity, and competitiveness, which together lead to substantial improvements in business outcomes. The magnitude of this effect underscores that technology is a critical driver of firm performance, possibly outweighing other organizational or environmental factors.

Finally, the interaction term H × TA (Moderation) shows an effect size of 0.004, indicating no or a negligible effect. This means that the moderating influence of Halal Certification on the relationship between Technology Adoption and Business Performance is minimal. In other words, the positive impact of technology adoption on performance does not significantly depend on whether a firm holds a Halal Certification. This finding implies that while both factors are important, their effects on Business Performance operate largely independently rather than synergistically.

Hypothesis Testing

The results of hypothesis testing are presented in Table 7. Technology adoption had a significant and positive effect on business performance ($\beta = 0.710$, $p < 0.001$), supporting H1. Halal certification also demonstrated a significant but relatively smaller positive effect on business performance ($\beta = 0.196$, $p = 0.014$), supporting H2. However, the moderating effect of halal certification on the relationship between technology adoption and business performance was not significant ($\beta = 0.029$, $p = 0.376$), leading to the rejection of H3. The findings of this study offer important theoretical and practical contributions to the literature on halal MSMEs, particularly regarding the roles of technology adoption and halal certification in shaping business performance.

Table 7. Hypothesis Testing Results (Path Coefficients and Significance)

Relationship		Path coefficient / Original sample	t-statistics	p-value	Significance
H1	Technology Adoption (TA) -> Business Performance (BP)	0.710	13.168	0.000	Significant
H2	Halal Certification (H) -> Business Performance (BP)	0.196	2.458	0.014	Significant
H3	Halal Certification x Technology Adoption (H x TA) -> Business Performance (BP)	0.029	0.886	0.376	Not significant

Table 7 shows that the relationship between TA and BP is the strongest and most significant relationship in the model. The path coefficient of 0.710 and p-value below 0.001 indicate that higher technology adoption leads to better business performance among halal MSMEs.

Table 7 also indicates that halal certification has a positive and significant effect on BP. The coefficient of 0.196 and p-value of 0.014 suggest that certification contributes to performance by strengthening trust, credibility, and market access, although the effect is smaller than that of technology adoption.

The moderation result in Table 7 shows that the interaction between halal certification and TA does not significantly affect BP. The coefficient of 0.029 and p-value of 0.376 indicate that certification does not significantly alter the strength of the technology adoption-performance relationship.

The results of the hypothesis testing reveal the strength and significance of the relationships among the variables influencing BP. The relationship between halal certification and BP shows an Original Sample (O) value of 0.196, a T-statistic of 2.458, and a P-value of 0.014, indicating a significant positive effect. This suggests that Halal Certification contributes meaningfully to enhancing Business Performance. Firms holding Halal Certification may gain greater consumer trust, improved market access, and stronger brand credibility, collectively enhancing their overall performance. Although the effect size is moderate, it underscores the importance of certification as a value-adding factor in competitive markets, particularly in sectors that emphasize ethical and religious compliance.

The relationship between TA and BP demonstrates the strongest and most significant effect, with an O of 0.710, a T-statistic of 13.168, and a P-value of 0.000, which is highly significant. This indicates that technology adoption plays a dominant role in improving business performance. The strong positive coefficient implies that the more effectively organizations adopt and integrate technology, the greater their gains in efficiency, productivity, and innovation. This finding supports the argument that technology is a key driver of sustainable business success and competitiveness in the modern business environment.

On the other hand, the moderating effect of H × TA on BP shows an O value of 0.029, a T-statistic of 0.886, and a P-value of 0.376, indicating a non-significant effect. This suggests that halal certification does not significantly alter or strengthen the relationship between TA and BP. In practical terms, this means that while both halal certification and TA individually contribute to performance improvement, their combined or interactive influence does not produce an additional synergistic effect. Therefore, businesses can

pursue each factor independently to enhance performance rather than relying on their interaction to generate added benefits.

Table 8. Goodness of Fit

Construct	AVE	R^2
Business Performance (BP)	0.763	0.653
Halal Certification (H)	0.771	–
Technology Adoption (TA)	0.633	–
Average	0.722	0.653

GoF Calculation:

$$GoF = \sqrt{0.722 \times 0.653} = \sqrt{0.471} = 0.686$$

Table 8 shows that the average AVE is 0.722 and the R2 value for Business Performance is 0.653. The calculated Goodness of Fit (GoF) value is 0.686, which exceeds the minimum threshold for a large model fit category. This result indicates that the research model has strong overall explanatory capability.

Overall, the measurement and structural model results confirm that the empirical model is reliable, valid, and capable of explaining the business performance of halal MSMEs in Indonesia.

This means that the structural model built has a good ability to explain empirical data. This strengthens the overall validity of the model so that it can be relied upon to draw both theoretical and practical conclusions.

DISCUSSION

Technology Adoption and Business Performance

This study confirms that technology adoption exerts a very strong and positive effect on halal MSME performance (β = 0.710, p < 0.001; f2 = 1.054). Therefore, H1 is supported. This result aligns with prior studies emphasizing the transformative role of digital technologies in enhancing efficiency, reducing costs, expanding market reach, and improving competitiveness (Blichfeldt & Faullant, 2021; Huang et al., 2025; Rifani et al., 2025; Usai et al., 2021).

However, technology adoption does not always automatically translate into performance improvements. Some MSMEs face financial, human-resource, and managerial constraints that limit the effective use of digital tools (Iqbal et al., 2024; Rupeika-Apoga & Petrovska, 2022). The strong result in this study suggests that when halal MSMEs adopt technologies that align with their business needs, digital tools can become strategic resources for improving sales, customer interactions, operational efficiency, and market competitiveness. These contrasting findings suggest that while technology adoption is a critical driver of MSME performance, contextual barriers, such as financial constraints and managerial readiness, may condition its effectiveness.

Halal Certification and Business Performance

The results also reveal that halal certification contributes positively to business performance, although with a smaller effect size (β = 0.196, p = 0.014; f2 = 0.050). Therefore, H2 is supported. This finding is consistent with studies showing that halal certification improves consumer trust, market credibility, and competitive advantage (Giyanti et al., 2021; Nurjamjam, 2024; Salindal, 2018; Talib et al., 2017). These mixed findings suggest that while halal certification enhances legitimacy and consumer

confidence, its direct influence on business outcomes depends on how effectively MSMEs leverage certification within broader strategic initiatives such as innovation, branding, and digital marketing.

Moderating Role of Halal Certification

Contrary to theoretical expectations, this study finds no significant moderating effect of halal certification on the relationship between technology adoption and performance ($\beta = 0.029$, $p = 0.376$; $f2 = 0.004$). Therefore, H3 is not supported. This result indicates that halal certification and technology adoption function more as complementary mechanisms than as interactive mechanisms in improving halal MSME performance.

Although institutional theory suggests that legitimacy mechanisms can strengthen innovation outcomes, this study finds that certification does not automatically amplify the benefits of technology adoption. This divergence suggests that halal certification must be actively integrated into digital branding, traceability systems, and online market communication before it can create synergistic value. In this sense, certification should be treated as a complementary strategic asset rather than an automatic moderator of digital adoption outcomes (Iqbal et al., 2024; Tieman, 2020).

For policymakers, the implication is that digital capacity building, such as improving MSME digital literacy, reducing adoption costs, and integrating halal standards into digital marketplaces, should be prioritized. Halal certification remains important, but its strategic value lies in how it is embedded into digital practices, for instance, through blockchain-based halal traceability or e-commerce platforms that prominently display halal logos.

The findings of this study expand the conceptual understanding of technology in the context of halal MSMEs by positioning it not only as a performance-enhancing instrument but also as an ethical tool that supports Islamic values in business practice. Digital technology can strengthen transparency, consistency, and traceability in production and distribution activities, thereby reducing uncertainty and supporting halal integrity. This perspective complements the literature that views technology primarily through the lens of efficiency and competitive advantage by showing that, in the halal context, technology can also function as Sharia-enabling infrastructure (Harsanto et al., 2024; Tieman, 2020; Zailani et al., 2024).

CONCLUSION

This study examined the effects of technology adoption and halal certification on the business performance of halal MSMEs in Indonesia and evaluated whether halal certification moderates the relationship between technology adoption and performance. The results show that technology adoption has the strongest positive effect on business performance, while halal certification also has a positive but smaller effect. The moderating role of halal certification is not supported, indicating that certification does not significantly strengthen or weaken the influence of technology adoption on performance.

Theoretically, this study contributes to the literature by integrating digital technology adoption and halal certification within a single empirical model of halal MSME performance. The findings support the view that technology adoption is a strategic capability that directly improves business outcomes, while halal certification functions as a legitimacy and trust mechanism. The non-significant moderation result challenges the assumption that institutional legitimacy automatically amplifies innovation outcomes and

suggests that certification must be strategically integrated into digital practices to generate stronger value.

Practically, the findings suggest that halal MSME development should prioritize digital capacity building, including digital literacy, affordable technology access, online marketing skills, and the use of digital payment and e-commerce platforms. Halal certification remains important, but its value should be enhanced through integration with digital marketplaces, visible halal information, product traceability, and branding strategies. Policymakers, halal authorities, and MSME support institutions should therefore design programs that combine digital transformation with halal assurance to strengthen competitiveness in domestic and global halal markets.

In conclusion, the adoption of digital technology is the primary driver of halal MSME performance in the digital era, while halal certification serves as a complementary source of legitimacy and consumer trust. Future initiatives should not treat certification merely as an administrative requirement but should connect it with digital business practices that improve transparency, credibility, and market performance.

LIMITATION

This study has several limitations. First, the scope is limited to halal MSMEs in Indonesia, which may restrict the generalizability of the findings to halal MSMEs in other countries with different regulatory systems, consumer behavior, digital infrastructure, and halal market maturity. The Indonesian context is important because the country has a large halal market and an expanding MSME sector, but the findings should be interpreted within this specific institutional and cultural environment.

Second, the sample consisted of 110 halal MSMEs selected through purposive sampling. Although the sample size is suitable for PLS-SEM, future studies could use larger samples and more balanced representation across business sectors, regions, business ages, and certification statuses. A broader sample would allow for a more detailed comparison among certified and in-process firms, across different product categories, and among MSMEs at different stages of digital adoption.

Third, this study used a cross-sectional design, meaning data were collected at a single point in time. As a result, the analysis captures associations among technology adoption, halal certification, and business performance but cannot fully explain how these relationships develop over time. Future research could apply longitudinal designs to examine whether technology adoption and halal certification produce stronger cumulative effects as MSMEs gain more experience.

Fourth, halal certification was measured mainly as a structural attribute rather than as a dynamic strategic capability. This approach may underestimate the ways in which certification is actively used in branding, digital communication, supply chain traceability, and customer relationship management. Future studies should examine the quality of certification implementation, the visibility of halal information in digital channels, and the integration of halal assurance systems with digital business platforms.

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DECLARATION OF CONFLICTING INTERESTS

The authors declare that there is no conflict of interest related to the authorship, research process, data analysis, or publication of this article.

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