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# The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

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**Abstract.** This study aims to identify the main determinants influencing MSMEs in applying for halal certification through digital media, using a combination of the DeLone & McLean and UTAUT models, with a comparison between male and female MSME owners. The PLS-SEM Multi-Group Analysis (MGA) approach was employed as the evaluation method in this quantitative study, using SmartPLS 3.0. A total of 300 respondents met the required criteria. The findings show that service quality is not a major determinant for the male group. On the other hand, for the female group, system quality does not significantly influence intention to apply halal certificate. Several other constructs, such as performance expectancy, effort expectancy, social influence, and information quality, show similar results across both groups, while facilitating condition does not have a significant impact on either male or female groups. These findings provide practical implications, particularly for policymakers. The government should improve performance, ease of use and information clarity for MSMEs. For male MSMEs, focus on system quality and customer support, while for female MSMEs, extension officer assistance would be more effective in encouraging halal certificate applications.

***Abstrak.*** *Penelitian ini bertujuan untuk mengidentifikasi determinan utama yang memengaruhi UMKM dalam mengajukan sertifikasi halal melalui media digital, dengan menggunakan kombinasi model DeLone & McLean dan UTAUT, serta perbandingan antara pemilik UMKM pria dan wanita. Pendekatan* PLS-SEM Multi-Group Analysis (MGA) *digunakan sebagai metode evaluasi dalam penelitian kuantitatif ini, dengan menggunakan SmartPLS 3.0. Sebanyak 300 responden memenuhi kriteria yang ditetapkan. Hasil penelitian menunjukkan bahwa kualitas servis bukanlah determinan utama untuk kelompok pria. Di sisi lain, untuk kelompok wanita, kualitas sistem tidak berpengaruh signifikan terhadap minat untuk mengajukan sertifikat halal. Beberapa konstruk lain, seperti ekspektasi performa, ekspektasi usaha, pengaruh sosial, dan kualitas informasi, menunjukkan hasil yang serupa di kedua kelompok, sementara kondisi yang difasilitasi tidak memberikan dampak signifikan pada kelompok pria maupun wanita. Temuan ini memberikan implikasi praktis, khususnya bagi pembuat kebijakan. Pemerintah perlu meningkatkan kinerja, kemudahan penggunaan dan kejelasan informasi bagi UMKM. Untuk UMKM pria, fokus pada kualitas sistem dan dukungan pelanggan, sedangkan untuk*

*UMKM wanita, bantuan dari petugas penyuluh akan lebih efektif dalam mendorong pengajuan sertifikasi halal.*

## INTRODUCTION

Every year, an increasing number of consumers demand halal products and services. DinarStandard, (2025) supports this by stating that 2 billion Muslims spent a total of USD 2.43 trillion in six key halal industries. By 2028, experts project that this amount will rise to USD 3.36 trillion. To meet the growing demand for halal products and services, halal management must be carried out more professionally. This can be achieved by implementing specific measuring standards to ensure that products remain halal certified (HC) and meet high-quality standards (Chavez and Vicente, 2025). As a result, several countries have established regulatory bodies to oversee the sale of halal products and services within their territories (Wibowo et al., 2024). For example, Badruldin et al. (2012), mention that Malaysia's Department of Islamic Development's (JAKIM) "Halal Hub Division" is responsible for product testing and research. Similarly, Alrobaish et al. (2021) highlight that the Saudi Halal Center (SHC), a division of the Saudi Food and Drug Authority (SFDA), is tasked with overseeing and distributing halal certification across Saudi Arabia.

The Indonesian government is rapidly expanding the scope of halal certification to include various market products through the Halal Product Assurance Agency (BPJPH) (Fathoni et al., 2025). Tania et al., 2022) note that, to maintain the credibility and high quality of halal labels, external auditors such as the Indonesian Ulema Council (MUI) Fatwa Commission and Assessment Institute for Foods, Drugs and Cosmetics of the Indonesian Ulema Council (LPPOM) are involved in this process. All parties involved view this policy as a win-win situation. Consumers are reassured that the products they purchase adhere to Islamic teachings, giving them peace of mind (Zulfa et al., 2023). On the other hand, producers can improve the quality of their products, add value, and increase customer satisfaction (Othman and Md Nawi, 2025). However, despite these efforts, many business owners, especially in Micro, Small, and Medium Enterprises (MSMEs), face significant challenges. They struggle to apply for certification due to a lack of understanding of the process and requirements, legal infrastructure issues, and the availability and cost of halal raw materials (Ridlwan et al. 2025; Sari et al., 2025; Widigdo and Triyanto 2024). Furthermore, socialization programs and guidance for MSMEs remain limited, particularly for those less skilled in information technology (Prabowo et al., 2015).

Despite these challenges, halal certification accounts for less than one percent of Indonesia's MSMEs. MSMEs play a vital role in Indonesia's economy (Susilowati et al., 2023a; Susilowati et al., 2023b). As of March 2021, the Ministry of Cooperatives and SMEs reported that the number of MSMEs in Indonesia had reached 64.2 million, contributing 61.07% (IDR 8,573.89 trillion) to the gross domestic products (GDP) (Kemenkopumkm RI, 2024). MSMEs account for 99.99% of Indonesia's total business players and also contribute to job creation. One initiative to digitalize the halal certification application process to make it more transparent, quicker, and cost-effective is the use of digital media. Since the digitization process began, a larger number of MSMEs have applied for halal certification using the self-declaration system (Musataklima, 2021).

One of the major challenges is the gender perception gap. Research by Lutfi et al. (2023) indicates that there is a noticeable difference in how people in developing countries, such as Indonesia, perceive their religious duties. This perspective, however, is still debated among scholars. In the study by Ridlwan et al. (2025) on gender differences in zakat compliance among Muslim entrepreneurs, the female dataset reveals that religiosity and perceived behavioral control directly affect zakat compliance, while the male dataset shows different results. On the other hand, research on halal cosmetics purchase intent by Ngah et al. (2021), found that males are more influenced by perceived behavioral control than females. Al Boinin (2023) and

Timur (2022) also points out that MSMEs face challenges due to the gender gap in digital literacy, especially for female entrepreneurs. The online certification application process is confusing for many business owners, which is one of the reasons these barriers make it harder to use technology. Both male and female entrepreneurs are hesitant to use technology due to insufficient motivation, expertise, and concerns about data security, exacerbating the problem (Martiana et al., 2018). However, all business owners, regardless of gender, are required to apply for halal certification.

Several studies have examined the reasons why MSMEs seek halal certification. Ridlwan et al. (2025) conducted research to identify the motivations behind MSMEs applying for halal certification. To analyze the factors influencing MSMEs' intention to pursue halal certification, Sari et al. (2025) employed a domicile-based multi-group analysis. However, the researchers are unaware of any studies that have utilized a gender-based multi-group analysis method. Therefore, this study aims to address this gap by comparing MSMEs' intentions to apply for halal certification using gender-specific data sets.

## LITERATURE REVIEW

### The Development of Halal Certification Ownership in Indonesia

For Muslims to consume anything, it must adhere to the rules set by Islamic law, derived from the Quran and Sunnah (Karyani et al., 2024). Timur et al. (2023) state that halal certification (HC) ensures a product meets these sharia criteria by evaluating its ingredients, the manufacturing process, and its functionality to ensure compliance with Islamic regulations. Law No. 33 of 2014 on Halal Product Guarantee (Musataklima, 2021) lays the foundation for halal certification in Indonesia. This legislation governs the HC procedure in the country. The Halal Product Assurance Agency (BPJPH) is responsible for overseeing the certification process, under the Ministry of Religious Affairs of the Republic of Indonesia. The Halal Inspection Agency (LPH) and the Indonesian Ulema Council (MUI) work closely with BPJPH to determine whether a product is safe for consumption (Fathoni et al., 2025).

LPH inspects and tests products to ensure they are halal. Halal auditors visit factories to examine the ingredients and ensure they comply with sharia law. If the auditors are uncertain about the halal status of an ingredient, they may send it to a laboratory for testing to confirm its compliance. Once the inspection and testing are completed, the results are forwarded to BPJPH. These results are then submitted to MUI to obtain a fatwa determining whether the product is halal (Solehudin, 2024). MUI holds a Halal Fatwa Session after BPJPH submits the test results, where they decide the halal status of the product. A final decision is made within 30 business days. If the fatwa session concludes that the product does not meet the halal certification requirements, BPJPH will inform the business owner that the product has been rejected, providing the reasons for the rejection. If the product is confirmed to be halal, the halal certificate will be issued within seven business days after BPJPH receives the fatwa from MUI, allowing the product to be officially certified (Timur et al. 2025).

### Barriers and Challenges in Obtaining Halal Certification

Almunawar et al. (2025) state that halal certification (HC) benefits businesses both internally and externally. Products with HC undergo a series of tests covering every stage of the production and distribution processes, from obtaining raw ingredients to the final inspection. Usman et al. (2022) assert that this comprehensive approach enhances the overall quality of the product. According to Abdul Latiff et al. (2016) certified halal products capture a larger market share because they are easier to sell and are more trusted by consumers. Consumers tend to have a more favorable view of halal-certified products because the certification ensures that all production steps, from sourcing raw materials to packaging, comply with sharia law (Dashti et al., 2024). The HC provides assurance to buyers that the product meets the halal

criteria set by the certifying body and serves as proof that it adheres to Islamic principles (Ridlwan et al., 2025).

One of the major challenges to growing Indonesia's halal industry is the low number of business owners seeking HC. Vargas-Sánchez and Moral-Moral (2020) argue that the biggest issue is that businesses do not fully understand what HC is and how it can benefit them. Fathoni et al. (2025) explain that several factors hinder small and medium-sized enterprises (SMEs) in Indonesia from accessing HC. These factors include high costs, lack of education and socialization about halal standards, lengthy and complicated inspection and control processes, and unpredictable certification costs. These challenges make it difficult for companies, especially micro, small, and medium-sized enterprises (MSMEs), to utilize HC, which slows the overall growth of Indonesia's halal sector. As the halal industry evolves, these obstacles must be overcome to ensure that HC becomes more widely recognized, MSMEs can enter new markets, and halal-certified products can compete more effectively both domestically and internationally.

## Hypotheses Development

### *UTAUT model and intention to apply halal certificate*

The Unified Theory of Acceptance and Use of Technology (UTAUT), established by Venkatesh et al. (2003), is a model for understanding technology acceptance and use. It quantifies consumer behavior in business settings, primarily assessing users' intentions to use technology, which impacts the system as well (Ridlwan et al., 2025). UTAUT has been shown to predict technology acceptance 70% more accurately than previous models (Venkatesh et al., 2003) and is favored for its simplicity and robustness (Tarhini et al., 2016). It is particularly suitable for individual circumstances compared to other models.

The model consists of four variables: performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating condition (FC). PE measures the benefits users gain from technology (Venkatesh et al., 2003), while EE reflects how easily a consumer can use it (Venkatesh et al., 2003). SI refers to the influence of others on technology use (Venkatesh et al., 2003), and FC refers to support from facilitating factors like government. Users' understanding of technology benefits influences their behavior and desire to use it (Timur et al., 2024). PE has the strongest relationship with users' intention (INT) to simplify tasks (Jaenudin et al., 2025). EE indicates that technology provides user satisfaction through ease and practicality (Lutfi et al., 2023). SI, including social reviews and perceptions, also affects technology use. Motivation to use technology increases when users have support and when the technology aligns with prior experiences (Sari et al., 2025). The complexities of applying for a HC may reduce business actors' INT to proceed with the process, highlighting how UTAUT variables influence decision-making intentions. The hypotheses in this study are based on these factors:

- H1: PE has a significant impact on the INT to apply for HC through digital media.
- H2: EE has a significant impact on the INT to apply for HC through digital media.
- H3: SI has a significant impact on the INT to apply for HC through digital media.
- H4: FC has a significant impact on the INT to apply for HC through digital media.

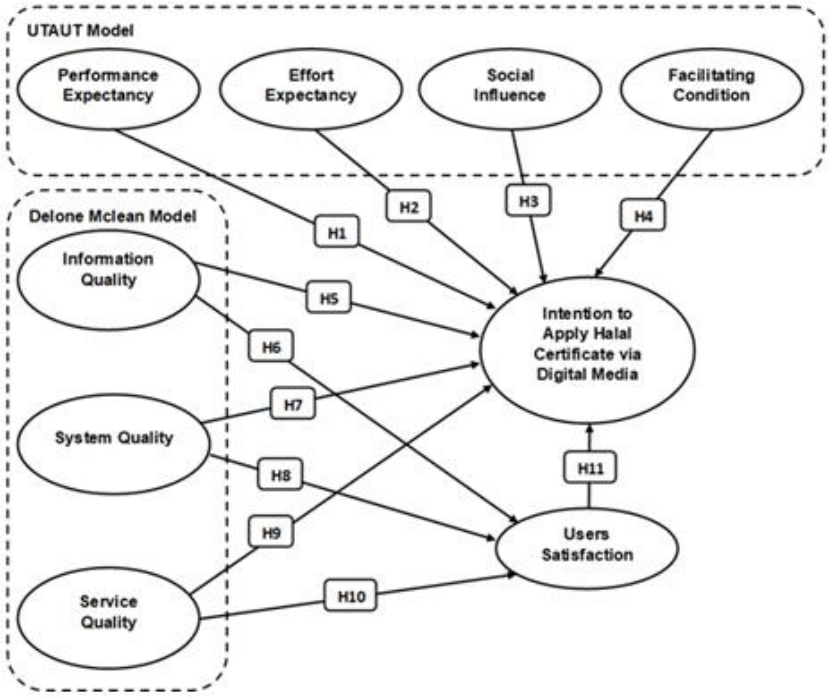
### *DeLone McLean informationsuccess model and intention to apply halal certificate*

The DeLone and McLean information success model (D&M ISS) is used to measure the effectiveness of an information system by combining factors such as information quality, system quality, system usage, user satisfaction, individual impact, and organizational impact. Nearly a decade later, it was updated to include service quality factors. Introduced by DeLone and McLean (1992), the model identifies the key factors influencing the effectiveness of an information system, proposing causal interdependencies between these factors. The model's flexibility is one of its strengths, as it can be applied at various levels of analysis depending on the research objectives (DeLone and McLean, 1992).

DeLone and McLean (1992) proposed three main variables to assess user satisfaction with an information technology system: information quality (IQ), system quality (SYQ), and service quality (SEQ). IQ is defined as the subjective measure of the information system's quality from the user's perspective (Al-Hattami et al., 2024), evaluated using six indicators: completeness, precision, reliability, currency, and format of output (DeLone and McLean, 1992). SYQ refers to the system's performance, assessing how well the hardware, software, policies, and procedures meet users' informational needs (DeLone and McLean, 1992). SYQ is also measured subjectively, using six indicators: system flexibility, system integration, response time, error recovery, convenience of access, and language. SEQ compares customer expectations with their perceptions of the services they actually receive (DeLone and McLean, 1992).

In the context of using technology to apply for HC, the DeLone McLean Success model can determine user satisfaction (US) for MSMEs, which influences individual impact and, in turn, leads to the intention (INT) to apply for HC. Higher IQ, SYQ, and SEQ are associated with greater user satisfaction, increased system usage, and positive individual and organizational impacts (Ridlwan et al., 2025). In particular, the halal industry, through government regulation, is working on integrating technology and information systems to enhance the effectiveness and efficiency of HC services (Chetioui et al., 2023). Previous studies have shown that technology use positively impacts the performance and satisfaction of business actors in the halal industry (Ridlwan et al., 2025; Sari et al., 2025). However, it remains unclear whether technology usage can also encourage business actors to apply for HC, warranting further investigation. Based on this, the researchers formulated the following hypothesis:

- H5: IQ has a significant impact on the INT to apply for HC through digital media.
- H6: IQ significant effect on the US.
- H7: SYQ has a significant impact on the INT to apply for HC through digital media.
- H8: SYQ significant effect on the US.
- H9: SEQ has a significant impact on the INT to apply for HC through digital media.
- H10: SEQ significant effect on the US.
- H11: US has a significant impact on the INT to apply for HC through digital media.




Source: Authors, 2025.

Figure 1 Model hypotheses in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

## METHOD

### Research Design

This study compares the behavioral intentions of MSMEs in urban and rural areas regarding halal certificate applications using the DeLone Mclean and UTAUT models. Variable items are measured on a 7-point Likert scale, ranging from strongly disagree to strongly agree. The questionnaire is divided into two sections: the first section gathers demographic information (gender, age, education, business field, and annual revenue), while the second part includes questions related to the study's variables. Respondents must meet specific criteria: they are Indonesian citizens aged 17-70, MSME business owners (as per Law No. 20/2008), have businesses without a halal certificate, and are familiar with the halal certification process.

Table 1 Construct, indicator and references in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Constructs | Indicators | References |
|---|---|---|
| Performance Expectancy (PE) | 5 | Ridlwan et al. (2025), Sari et al. (2025), Timur et al. (2025), Mutmainah et al. (2024) |
| Effort Expectancy (EE) | 3 | Ridlwan et al. (2025), Sari et al. (2025), Timur et al. (2025), Mutmainah et al. (2024) |
| Social Influence (SI) | 3 | Ridlwan et al. (2025), Sari et al. (2025), Timur et al. (2025), Mutmainah et al. (2024) |
| Facilitating Condition (FC) | 3 | Ridlwan et al. (2025), Sari et al. (2025), Timur et al. (2025), Mutmainah et al. (2024) |
| Information Quality (IQ) | 4 | Chetioui et al. (2023), Ridlwan et al. (2025), Al-Hattami et al. (2024) |
| System Quality (SYQ) | 3 | Chetioui et al. (2023), Ridlwan et al. (2025), Al-Hattami et al. (2024) |
| Service Quality (SEQ) | 5 | Chetioui et al. (2023), Ridlwan et al. (2025), Al-Hattami et al. (2024) |
| Users Satisfaction (US) | 5 | Chetioui et al. (2023), Ridlwan et al. (2025), Al-Hattami et al. (2024) |
| Intention to Apply Halal Certificate (INT) | 6 | DeLone and McLean (2004), Pham and Dau, (2022), Al-Hattami et al. (2024), Kamboj et al. (2022) |

Source: Authors, 2025 (processed data).

A pre-quotient process was conducted to select respondents who met the criteria for this study, with those not meeting the requirements being excluded. The measurement items were adapted from previous research and modified to fit the context and resarch model (see Table 1)

### Data Collection

Non-probability sampling was used to select participants who met specific criteria (Timur et al., 2024). Data was collected through online surveys distributed via social media platforms. The survey was conducted over four months, from January to March 2023, resulting in 517 responses. After filtering out ineligible samples, 460 valid responses were retained for further analysis. According to Hair et al. (2018), the minimum sample size for Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis should range between 100 and 200, depending on the model's complexity.

### Method of Analysis

This study employs PLS-SEM, processed using Smart-PLS 3.0 software. The use of PLS-SEM is justified by the complexity of the research model and the non-normal distribution of the data (Hair et al., 2018). The model incorporates both reflective and formative paths and includes moderating constructs. The reliability and validity of the construct model were assessed in two components: the inner model, which evaluates the reliability and validity of the data, and the outer model, which estimates the structural modeling (Hair et al., 2018).

Construct reliability is determined by composite reliability and Cronbach's alpha values, with composite reliability values exceeding 0.70 and Cronbach's alpha above 0.60 indicating data reliability. Construct validity is assessed using the Average Variance Extracted (AVE), which should exceed 0.50 (Hair et al., 2018). The structural model incorporates both direct and moderation effects, with the interaction effect evaluated using a two-stage approach as recommended by Hair et al. (2018). The R2 values for the structural model were 0.25, 0.50, and 0.75, indicating varying levels of predictive accuracy. Hypotheses were tested using a critical t-value of 1.98 at the 5% significance level, with a p-value threshold of 0.05. A hypothesis is accepted if the p-value is less than 0.05 and the t-value exceeds the critical value of 1.98.

## RESULTS AND DISCUSSION

### Respondent Demography

The first demographic information on the respondents that can be gleaned from the 300 respondents' responses to the survey is their gender. 128 male respondents, or 53% of all respondents, participated in this survey. In comparison, 122 responses or 47% of the total were female. Also, 138 respondents, or 58% of all respondents, were aged 17 to 30 years, making up the majority of the respondents in this study. 170 respondents, or 71% of all respondents, were bachelor's degree holders, the highest level of education. Meanwhile, the majority of respondents live in East Java province with a total of 112 respondents or 47% of the total respondents. The majority of the respondents are MSMEs that have businesses in the culinary sector, as many as 95 people or 32%. Of the 240 MSME respondents who participated in this study, 212 people or 88% of them have a gross revenue of IDR 0-300,000,000 per year. The overall interpretation of the respondent demographic results is summarized in the Table 2.

Table 2 Respondent demographic profile in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Demography | Frequency | Percentage (%) |
|---|---|---|
| *Gender* | | |
| Male | 150 | 50 |
| Female | 150 | 50 |
| *Age* | | |
| 17-30 years old | 168 | 56 |
| 31-40 years old | 87 | 29 |
| 41-50 years old | 36 | 12 |
| 51-60 years old | 6 | 2 |
| >60 years old | 3 | 1 |
| *Educational Background* | | |
| Senior High School | 56 | 18.7 |
| Diploma/Bachelor | 207 | 69 |
| Master | 27 | 9 |
| Doctoral | 10 | 3.3 |

Table 2 Respondent demographic profile in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis (continued)

| Demography | Frequency | Percentage (%) |
|---|---|---|
| *Provinces* | | |
| DKI Jakarta | 22 | 7.3 |
| Banten | 4 | 1.3 |
| West Java | 58 | 19.3 |
| Central Java | 60 | 20 |
| DIY Yogyakarta | 18 | 6 |
| East Java | 120 | 40 |
| Others | 18 | 6 |
| *Bussiness Sector* | | |
| Agriculture/Livestock | 55 | 18.3 |
| Trading | 35 | 11.7 |
| Culinary | 115 | 38.3 |
| Fashion | 30 | 10 |
| Automotive | 20 | 6.7 |
| Services | 70 | 23.3 |
| Others | 30 | 10 |
| *Gross Revenue Per Year* | | |
| IDR 0-300,000,000 | 257 | 85.7 |
| IDR 300,000,001-2,500,000,000 | 40 | 13.3 |
| >IDR 2,500,000,001 | 3 | 1 |

Source: Research finding by authors, 2025 (processed data).

## Measurement Model Assestment (Outer Model)

The second step was the measurement model. This stage was divided into three stages: first, the results showed that the outer model measurement scale has a significan contribution to each construct (Hair et al., 2018), while the majority of the internal weights on the indicators studied showed all loading factors >0.70 (0.770–0.930) (See Table 3).

Table 3 Construct validity and reliability in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Constructs | Item | Factor Loading |
|---|---|---|
| PE (Cronbach Alpha = 0.923; Composite Reliability = 0.900; Average Variance Extracted = 0.898) | | |
| PE1 | I discovered that technology can facilitate the application process for HC. | 0.822 |
| PE2 | Utilizing technology helps expedite the application process for HC. | 0.821 |
| PE3 | Utilizing technology facilitates my application for a HC efficiently. | 0.790 |
| PE4 | Utilizing technology to obtain a HC can enhance my productivity. | 0.910 |
| PE5 | Utilizing technology to obtain a HC can enhance the efficiency of my time management. | 0.893 |
| EE (Cronbach Alpha = 0.855; Composite Reliability = 0.861; Average Variance Extracted = 0.711) | | |
| EE1 | Acquiring proficiency in utilizing technology for the application of HC is straightforward. | 0.811 |

Table 3 Construct validity and reliability in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis (continued)

| Constructs | Item | Factor Loading |
|---|---|---|
| EE2 | My engagement with technology for obtaining a HC is comprehensible. I find technology user-friendly for the application process of a halal certificate. | 0.870 |
| EE3 | Acquiring proficiency in utilizing technology for the application of HC is straightforward. | 0.888 |
| SI (Cronbach Alpha = 0.874; Composite Reliability = 0.919 ; Average Variance Extracted = 0.800) | | |
| SI1 | Individuals I regard as significant believe I should utilize technology to obtain a HC. | 0.919 |
| SI2 | Individuals that influence me believe that I should utilize technology to obtain a HC. | 0.913 |
| SI3 | Individuals whose opinions I value prefer that I utilize technology to obtain a HC. | 0.811 |
| FC (Cronbach Alpha = 0.845; Composite Reliability = 0.929 ; Average Variance Extracted = 0.813) | | |
| FC1 | I possess the resources to utilize technology for obtaining a HC. | 0.857 |
| FC2 | I possess expertise in utilizing technology to obtain HC. | 0.911 |
| FC3 | I obtain guidance on the procedure for acquiring a HC via technology. | 0.903 |
| IQ (Cronbach Alpha = 0.794; Composite Reliability = 0.850 ; Average Variance Extracted = 0.783) | | |
| IQ1 | Technology can furnish me with precise information regarding the application for HC. | 0.770 |
| IQ2 | Technology can furnish me with timely information regarding the application process for HC. | 0.822 |
| IQ3 | Technology can furnish me with current and pertinent information regarding the application for HC. | 0.890 |
| SYQ (Cronbach Alpha = 0.847; Composite Reliability = 0.890 ; Average Variance Extracted = 0.777 | | |
| SYQ1 | I believe the process for obtaining a HC is efficient, reliable, and cost-effective. | 0.789 |
| SYQ2 | The technology facilitates my search for information regarding the application process for a HC. | 0.790 |
| SYQ3 | The solution can efficiently integrate data from multiple sources to enhance the utilization of HC. | 0.888 |
| SYQ4 | The technology utilized for obtaining HC is dependable. | 0.840 |
| SEQ (Cronbach Alpha = 0.876; Composite Reliability = 0.843 ; Average Variance Extracted = 0.710) | | |
| SEQ1 | The application process for a HC utilizes aesthetically pleasing technological materials. | 0.809 |
| SEQ2 | The application process for a HC utilizes a well-structured technological interface. | 0.777 |
| SEQ3 | The utilization of technology in obtaining a HC effectively addresses my request. | 0.899 |
| SEQ4 | The application of technology in obtaining a HC lacks personalized attention for me. | 0.870 |
| SEQ5 | The utilization of technology in obtaining a HC affords me expedited service. | 0.800 |

Table 3 Construct validity and reliability in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis (continued)

| Constructs | Item | Factor Loading |
|---|---|---|
| US (Cronbach Alpha = 0.932; Composite Reliability = 0.960 ; Average Variance Extracted = 0.892 | | |
| US1 | I am satisfied with the performance of the technology I use in applying for a HC. | 0.846 |
| US2 | I am pleased with the process of obtaining for a HC through technology. | 0.815 |
| US3 | I am content with the functionalities offered by the system I utilize for obtaining a HC. | 0.920 |
| US4 | I am pleased with the overall experience of obtaining for a HC via the technology. | 0.931 |
| US5 | I am pleased with the innovations provided by the technologies I utilize for obtaining a HC. | 0.920 |
| INT (Cronbach Alpha = 0.820; Composite Reliability = 0.911 ; Average Variance Extracted = 0.750 | | |
| INT1 | I plan to persist in organizing all actions pertaining to HC through the use of technology. | 0.820 |
| INT2 | I shall consistently endeavor to manage all actions pertaining to HC in my life through the use of technology. | 0.780 |
| INT3 | I intend to manage HC through technology in the future. | 0.862 |
| INT4 | Utilizing technology to apply for a HC will be my primary preference. | 0.877 |
| INT5 | Technology prompts me to contemplate obtaining a HC | 0.898 |
| INT6 | The utilization of technology motivates me to pursue a HC | 0.799 |

Source: Research finding by authors, 2025 (processed data).

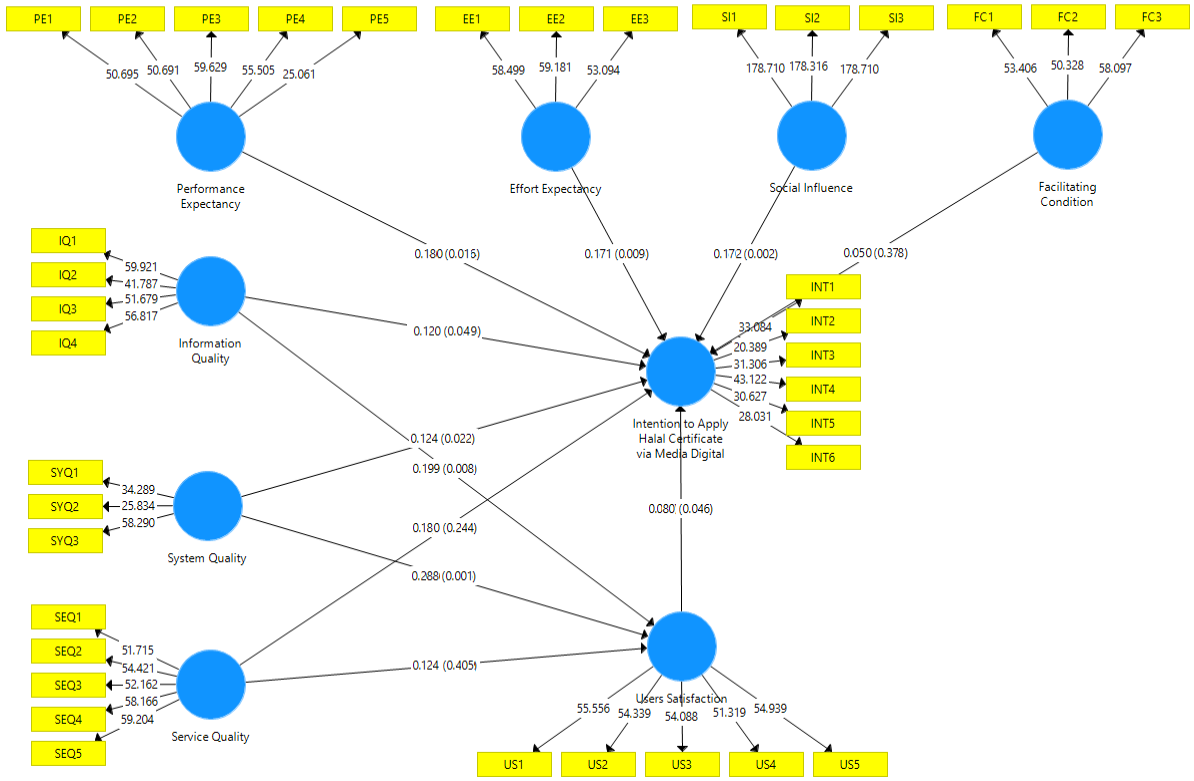
Second, convergent and discriminant validity were applied in the setting of average variance extracted (AVE) and heterotrait–monotrait (HTMT) ratios. The results provided information that the overall value corresponds to the threshold, namely, AVE>0.50 and HTMT<0.90 (Hair et al., 2018). Thus, all reflective constructs avoid the risk of validity. Third, we tested the reliability of the research construct using Cronbach's alpha (α) and composite reliability (CR). The values of α (0.794–0.932) and CR (0.843–0.960) showed good internal consistency, according to the threshold of a and CR>0.70 (Hair et al., 2018). Further explanation can be seen in Table 3 and Table 4.

Table 4 Heterotrait-monotrait (HTMT) results in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| | EE | FC | INT | IQ | PE | SEQ | SI | SYQ | US |
|---|---|---|---|---|---|---|---|---|---|
| EE | | | | | | | | | |
| FC | 0.672 | | | | | | | | |
| INT | 0.650 | 0.572 | | | | | | | |
| IQ | 0.664 | 0.566 | 0.497 | | | | | | |
| PE | 0.611 | 0.468 | 0.439 | 0.497 | | | | | |
| SEQ | 0.567 | 0.411 | 0.458 | 0.456 | 0.418 | | | | |
| SI | 0.515 | 0.409 | 0.443 | 0.421 | 0.394 | 0.386 | | | |
| SYQ | 0.419 | 0.339 | 0.309 | 0.445 | 0.270 | 0.345 | 0.173 | | |
| US | 0.413 | 0.304 | 0.300 | 0.323 | 0.220 | 0.289 | 0.109 | 0.168 | |

Source: Research finding by authors, 2025 (processed data).

**Structural Model Assestment (Inner Model)**




Source: Research finding by authors, 2025 (processed data).

Figure 2 Bootstrapping result (male) in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

The bootstrapping test in PLS-SEM aims to measure the relationship between variables. The influence between variables can be seen from the P values. P values with a value< 0.05 can indicate that the variable significantly affects the independent variable. In contrast, if the P value> 0.05, the variable does not affect the dependent variable (Hair et al., 2018). The relationship between variables (positive or negative) can be seen from the original sample value. If the original sample value is positive, then the relationship between the measured variables can be said to be positive, and vice versa. Overall, the bootstrapping results showing the relationship between variables are shown in Table 5, Table 6, Figure 2, and Figure 3.

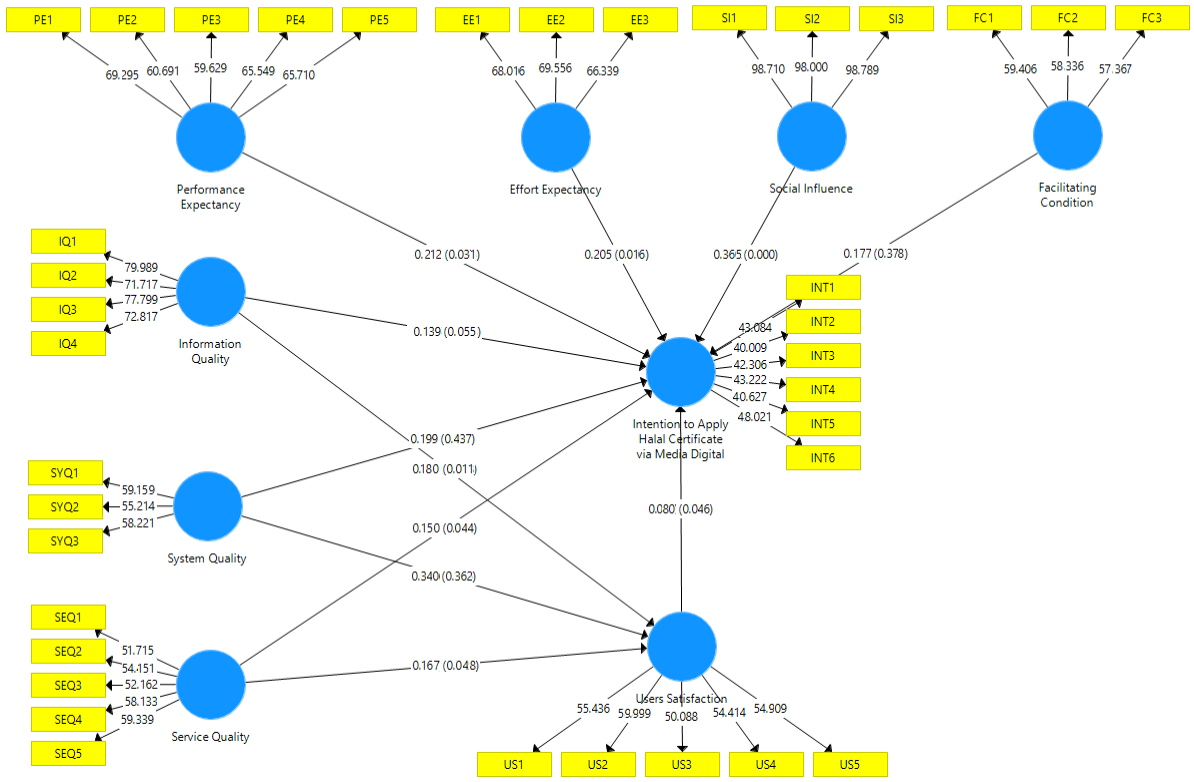
Table 5 Path coefficient and hypotheses testing (male) in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Path | Original Sample | Sample Mean | Standard Deviation | T-statistics | p-values | Results |
|---|---|---|---|---|---|---|
| PE → INT | 0.180 | 0.160 | 0.095 | 3.089 | 0.016 | Significant |
| EE → INT | 0.171 | 0.145 | 0.080 | 9.800 | 0.009 | Significant |
| SI → INT | 0.172 | 0.219 | 0.114 | 2.950 | 0.027 | Significant |
| FC → INT | 0.050 | 0.067 | 0.120 | 0.098 | 0.378 | Not Significant |
| IQ → INT | 0.120 | 0.116 | 0.078 | 2.100 | 0.049 | Significant |
| IQ → US | 0.199 | 0.098 | 0.113 | 9.212 | 0.008 | Significant |
| SYQ → INT | 0.124 | 0.140 | 0.173 | 2.755 | 0.022 | Significant |
| SYQ → US | 0.288 | 0.260 | 0.085 | 11.800 | 0.001 | Significant |
| SEQ → INT | 0.180 | 0.299 | 0.097 | 0.070 | 0.244 | Not Significant |

Table 5 Path coefficient and hypotheses testing (male) in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis (continued)

| Path | Original Sample | Sample Mean | Standard Deviation | T-statistics | p-values | Results |
|---|---|---|---|---|---|---|
| SEQ → US | 0.124 | 0.020 | 0.198 | 0.044 | 0.405 | Not Significant |
| US → INT | 0.080 | 0.245 | 0.200 | 2.150 | 0.046 | Significant |

Source: Research finding by authors, 2025 (processed data).




Source: Research finding by authors, 2025 (processed data).

Figure 3 Bootstrapping result (female) in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

Table 6 Path coefficient and hypotheses testing (female) in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Path | Original Sample | Sample Mean | Standard Deviation | T-statistics | p-values | Results |
|---|---|---|---|---|---|---|
| PE → INT | 0.212 | 0.210 | 0.121 | 6.867 | 0.031 | Significant |
| EE → INT | 0.205 | 0.155 | 0.090 | 8.655 | 0.016 | Significant |
| SI → INT | 0.365 | 0.244 | 0.134 | 12.002 | 0.000 | Significant |
| FC → INT | 0.177 | 0.159 | 0.080 | 1.468 | 0.071 | Not Significant |
| IQ → INT | 0.139 | 0.123 | 0.099 | 4.604 | 0.055 | Significant |
| IQ → US | 0.180 | 0.148 | 0.165 | 9.952 | 0.011 | Significant |
| SYQ → INT | 0.199 | 0.056 | 0.050 | 0.059 | 0.437 | Not Significant |
| SYQ → US | 0.340 | 0.067 | 0.111 | 0.063 | 0.362 | Not Significant |
| SEQ → INT | 0.150 | 0.150 | 0.087 | 5.609 | 0.044 | Significant |
| SEQ → US | 0.167 | 0.144 | 0.067 | 5.272 | 0.048 | Significant |
| US → INT | 0.194 | 0.099 | 0.120 | 7.901 | 0.024 | Accepted |

Source: Research finding by authors, 2025 (processed data).

Cohen $f^2$ is used to identify the effect between variables in the model, which indicates a change in the value of $R^2$ when one of the exogenous constructs is removed from the model. Cohen's $f^2$ value of 0.02 (weak), 0.15 (moderate) and 0.35 (strong) can be a measure of predictor effects (Hair et al., 2018). Table 7 explains that the overall output $f^2$ is in the range 0.154 (moderate) to 0.237 (moderate). The Variance Inflation Factor (VIF) is used to assess the presence of collinearity (Hair et al., 2018). Statistics frequently encounters the phenomenon of multicollinearity. Multicollinearity refers to the situation where there is a strong correlation between two or more independent variables or exogenous constructs, resulting in a decrease in the predictive accuracy of the model (Sekaran and Bougie, 2016). The VIF number should be below 5, as a value beyond 5 suggests the existence of multicollinearity among conceptions (Hair et al., 2018). The presence of multicollinearity or substantial intercorrelation among independent variables in this PLS SEM tutorial is shown by the VIF Inner Model value in Table 7 below:

Table 7 The Variance Inflation Factor (VIF) and $f^2$ result in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Hypotheses | VIF | $f^2$ | Colienarity Result |
|---|---|---|---|
| PE → INT | 2.689 | 0.167 | No Multicolienarity |
| EE → INT | 1.803 | 0.180 | No Multicolienarity |
| SI → INT | 1.773 | 0.171 | No Multicolienarity |
| FC → INT | 2.901 | 0.170 | No Multicolienarity |
| IQ → INT | 1.674 | 0.172 | No Multicolienarity |
| IQ → US | 1.555 | 0.160 | No Multicolienarity |
| SYQ → INT | 1.394 | 0.209 | No Multicolienarity |
| SEQ → INT | 1.525 | 0.237 | No Multicolienarity |
| SYQ → US | 1.298 | 0.203 | No Multicolienarity |
| SEQ → US | 1.265 | 0.161 | No Multicolienarity |
| US → INT | 2.179 | 0.180 | No Multicolienarity |

Source: Research finding by authors, 2025 (processed data).

The coefficient of determination for the INT and US construct in Table 8 indicates a significantly high value ($R^2$ adjusted = 0.537 and 0.537). The PE, EE, SI, FC, IQ, SYQ, SEQ and US all account for 52 percent of the variation in INT. The $R^2$ values of 0.75, 0.50, and 0.25 are commonly regarded as cutoffs for strong, moderate, and weak explanatory power of endogenous constructs, as stated by Hair et al. (2018). In Table 8, all $R^2$ values are above 0.539, indicating that the data used in this study has moderate explanatory power. Nevertheless, the $R^2$ number solely measures the extent to which the sample data can explain the phenomenon under investigation, and it does not account for the projected performance beyond the sample (Hair et al., 2018). $Q^2$ values describe the small, medium, and large predictive relevance of the PLS path model. The $Q^2$ value is interpreted as having a small, medium or large influence based on whether the $Q^2$ value is greater than the value of 0, 0.25 or 0.50. In Table 8, we can see that the data used has a $Q^2$ value or above 0 with a range of numbers above 0.50. Therefore, it can be concluded that the data used has a large influence on the predictive relevance of the PLS path model (See Table 8).

Table 8 Coefficient determination and predictive relevance result in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Constructs | SSO | SSE | $Q^2$ (1-SSE/SSO) | $R^2$ | $R^2$ Adjusted |
|---|---|---|---|---|---|
| PE | 1,550.000 | 1,550.000 | | | |
| EE | 900.000 | 900.000 | | | |
| SV | 900.000 | 900.000 | | | |
| FC | 900.000 | 900.000 | | | |
| IQ | 900.000 | 900.000 | | | |
| SYQ | 1,300.000 | 1,300.000 | | | |

Table 8 Coefficient determination and predictive relevance result in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis (continued)

| Constructs | SSO | SSE | $Q^2$ (1-SSE/SSO) | $R^2$ | $R^2$ Adjusted |
|---|---|---|---|---|---|
| SEQ | 1,400.000 | 1,400.000 | | | |
| US | 1,500.000 | 1,406.700 | 0.580 | 0.540 | 0.537 |
| INT | 1,800.000 | 1,196.100 | 0.555 | 0.540 | 0.537 |

Source: Research finding by authors, 2025 (processed data).

Thus, this study use the PLSpredict methodology, specifically targeting the construct of INT and US (See Table 9). PLSpredict is useful in assessing out-of-sample models predictive power (Hair et al., 2018). If the $Q^2$ predictive value ≤ 0, then this value indicates that the model does not outperform the most naïve benchmark (Hair et al., 2018). The value of $Q^2$ can be used as a reference for the predictive relevance of the independent variable and the dependent variable (Hair et al., 2018). The $Q^2$ value of the variable is 0.011 to 0.354 (above 0). This indicates that the model has predictive accuracy. Additionally, the PLS-SEM model exhibits reduced values for the root mean squared error (RMSE) and mean absolute error (MAE) indicators compared to the naïve linear model. The model in this investigation exhibits a high degree of predictive efficacy.

Table 9 PLSpredict result in the research of The Impact of Technology on Halal Certification Intentions of MSMEs: A Gender-Based Analysis

| Construct | PLS | | | LM | | |
|---|---|---|---|---|---|---|
| | RMSE | MAE | $Q^2$ Predict | RMSE | MAE | $Q^2$ Predict |
| INT1 | 1.097 | 0.839 | 0.334 | 1.147 | 0.856 | 0.272 |
| INT2 | 1.179 | 0.925 | 0.327 | 1.218 | 0,927 | 0.283 |
| INT3 | 1.079 | 0.788 | 0.354 | 1.112 | 0.800 | 0.314 |
| INT4 | 1.148 | 0.872 | 0.345 | 1.161 | 0.899 | 0.331 |
| INT5 | 1.227 | 0.902 | 0.298 | 1.265 | 0.929 | 0.253 |
| INT6 | 1.129 | 0.832 | 0.294 | 1.121 | 0.811 | 0.304 |
| US1 | 1.392 | 1.080 | 0.011 | 1.219 | 0.903 | 0.242 |
| US2 | 1.321 | 1.035 | 0.063 | 1.163 | 0.842 | 0.273 |
| US3 | 1.236 | 0.983 | 0.075 | 0.991 | 0.737 | 0.405 |
| US4 | 1.272 | 0.989 | 0.030 | 0.974 | 0.730 | 0.432 |
| US5 | 1.285 | 1.019 | 0.025 | 1.004 | 0.763 | 0.405 |

Source: Research by authors, 2025 (processed data).

## Discussion

The results of this study aim to provide an in-depth analysis by comparing the factors influencing the intention to apply for halal certification between two different groups, namely male and female MSME entrepreneurs. The statistical tests reveal that in both groups, the variables of Performance Expectancy (PE), Effort Expectancy (EE), and Social Influence (SI) are the strongest predictors in influencing MSMEs' intentions to apply for halal certification. The significant effect of PE indicates that the use of technology in applying for halal certification offers practical benefits and enhances efficiency, as the process can be completed more quickly.

Khan et al. (2019) explained that one of the barriers for MSMEs in applying for halal certification in the past was the long process flow, numerous requirements, and the lack of information and knowledge possessed by MSMEs. With the current use of technology in applying for halal certification, MSMEs in this study feel that the use of technology improves performance, resulting in a greater intention to apply for a halal certificate. This is particularly helpful for MSMEs, especially for individuals with busy work schedules,

limiting their time to gather requirements, submit applications, and monitor the progress of their halal certificate applications. However, on the other hand, the operation of applications as tools for applying for halal certification often causes misunderstandings for MSMEs. Therefore, a simple and easy-to-understand interface is a key determinant for MSMEs' intention to apply for halal certification. Although the demographic profile of the respondents in this study is dominated by Generation Z, it is likely that as first-time users, they will find that ease of use and practicality will encourage them to use digital applications to apply for halal certification.

In addition to PE, the intention to apply for a halal certificate through technology is also influenced by considerations from the surrounding environment, including family, friends, relatives, and even religious leaders/ulamas who play a role in individual decision-making. The limited information and the deadline set by the Indonesian government for MSMEs to acquire halal certification urge them to seek information from trusted sources. While technology provides benefits and convenience, the lack of information is suspected to be one of the factors causing the slow growth in the number of halal certificate applications in Indonesia. As a new technology, many people still need to understand the benefits and usage of technology in applying for halal certification. In this regard, Social Influence (SI) enhances the intention (INT) by sending signals to consumers and strengthening positive perceptions and trust in the recommended options (Hooda et al., 2022).

Timur et al. (2023) stated that when someone does not have sufficient information, they will need more knowledge or information about the technological product and tend to rely on others' opinions. In this case, technology users tend to trust the opinions, personal experiences, and knowledge of those they consider trustworthy. Interestingly, in both data groups, it was found that Facilitating Conditions (FC) did not have a significant impact on INT. This suggests that the lack of facilities and resources available to MSMEs does not necessarily influence their INT. In line with the previous hypothesis, MSME entrepreneurs, both male and female, tend to seek help from trusted individuals, including receiving opinions or technical assistance in using technology when applying for a halal certificate.

An interesting finding emerged in the relationship between the Delone McLean model variables and User Satisfaction (US) and INT in applying for halal certification, where there were differences in the statistical test results between male and female respondents. Among the three Delone McLean model variables, only Service Quality (SEQ) had an impact on US and INT. In the female respondent group, System Quality (SYQ) did not have a significant effect on US and INT. This suggests that while system quality was expected to influence user satisfaction and the intention to apply for halal certification, it did not have a significant impact on the female group.

On the other hand, in the male respondent group, both SEQ and SYQ were found to have a stronger effect on US and INT. This could be due to differences in how men and women utilize technology, as well as their differing levels of comfort and familiarity with using technology for practical purposes such as applying for halal certification. It can be concluded that the influence of SEQ and SYQ on US and INT is more dominant for men than for women. This indicates that women may find it more difficult or less satisfied with the quality of the system, while men are more likely to perceive the benefits of the service quality and system provided in the halal certification application process.

## CONCLUSION

The results of this study reveal different insights between male and female data groups in making decisions to apply for a halal certificate using technology. The findings show that service quality (SEQ) is not a major determinant for the male group. On the other hand, for the female group, system quality (SYQ) does not

significantly influence intention to apply halal certificare (INT). Several other constructs, such as performance expectancy (PE), effort expectancy (EE), social influence (SI), and information quality (IQ), show similar results across both groups, while facilitating condition (FC) does not have a significant impact on either male or female groups. Therefore, the findings of this study offer several practical implications. First, in general, the government can focus its services on aspects of performance (speed, accuracy, and transparency), ease of use, and improving the quality and clarity of information provided to MSME entrepreneurs. Furthermore, for male MSMEs, the government should consider system quality, such as the quality of websites or digital platforms, as well as post-submission services like customer support. For female MSMEs, however, assistance from extension officers would be more effective in increasing their willingness to apply for a halal certificate using technology.

This study has several limitations. For instance, respondents aged 17-30 years, or Generation Z, dominate the sample, and most respondents live on the island of Java. Additionally, this study only considers established theories such as Delone Mclean Information Success Model (D&M ISS) and The Unified Theory of Acceptance and Use of Technology (UTAUT) models. Therefore, future research should employ a multi-group analysis approach based on other criteria. For example, future studies could compare data from educated and uneducated respondent groups. Moreover, future research could also conduct inter-generational analysis. This would mean comparing the use of technology for applying for halal certificates between Baby Boomers, Generation X, Generation Y, and Generation Z. The use of other established theories, such as the Diffusion of Innovation Theory (DIT), could also be considered.

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