# Intention to adopt a blockchain-based halal certification: Indonesia consumers and regulatory perspective

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## Abstract

**Purpose** – Halal certification is an acknowledgment of the halalness of a product or service issued by a halal regulator based on Islamic law. This study aims to investigate the intentions of consumers and regulators toward blockchain-based halal certification. Blockchain is useful for storing and verifying halal certificates, thereby increasing trust in products or services because the public cannot change or access data once it is stored.

**Design/methodology/approach** – This study uses a triangulation approach by distributing online questionnaires to consumers as a research instrument of a quantitative approach processed with smart partial least squares. Meanwhile, the qualitative approach is carried out through observation, in-depth interviews with the Ministry of Religion's Halal Product Assurance Organizing Agency (BPJPH) and Halal Examination Agency (LPH), and forum group discussions (FGDs) with several related parties.

**Findings** – The observation results show that most consumers expect the government to provide an easy-to-use application to check halal food products and restaurants. Consumers' intention to use this technology is influenced directly by attitudes and indirectly by their beliefs. Furthermore, the results of interviews and FGDs reported that LPH was not ready to apply blockchain technology, while BPJPH strongly supported adopting blockchain technology in the certification process.

**Practical implications** – This finding recommends that the Indonesian government apply blockchain technology to gain transparency and accountability regarding the halal product process.



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**Originality/value** – This study fills the research gap by observing three perspectives from different stakeholders and using a triangulation approach to analyze the need for adoption of blockchain-based halal certification of halal food products.

**Keywords** Blockchain, Food traceability, Halal certification, Halal supply chain, Intention to adopt blockchain

**Paper type** Research paper

## 1. Introduction

Indonesia is targeting becoming the world's largest producer and exporter of halal products to recover the national economy in 2024. Through the acceleration program, 10 million halal-certified products are expected to support this plan. Furthermore, the results of the Komite Nasional Ekonomi dan Keuangan Syariah (National Committee for Sharia Economics and Finance in Indonesia) survey at the end of 2021 show that halal attributes are very important for most Indonesian Muslim consumers, such as "no pork, no lard," nutritional content, authenticity and dietary requirements. To build this trust, transparency is highly important, as knowledge about halal food is limited to the slaughter of animals and the use of alcohol rather than covering the entire logistical process of obtaining the ingredients. Unfortunately, the current technology system for the certification process cannot fully accommodate transparency and traceability issues. The existing system has an abundance of limitations, including unattractive features, slow preaudit response times, repair times in document uploads, which often experience "errors," slow personnel response, and the absence of a "dialog box" to facilitate communication between the company and LPPOM MUI, as a halal examination agency (Phi Ro *et al.*, 2017).

Numerous academics highlight the great benefits of blockchain technology for the halal industry through intelligent contract mechanisms that can increase traceability (Bumblauskas *et al.*, 2020; Creydt and Fischer, 2019; Hackett, 2017; Tian, 2017) and integrity (Köhler and Pizzol, 2020). The Ministry of Religion's Halal Product Assurance Organizing Agency (hereinafter abbreviated as BPJPH) also explores using artificial intelligence (AI) and blockchain-based systems in halal certification services to improve service quality. BPJPH and the Halal Examination Agency (hereinafter abbreviated as LPH) are expected to benefit from smart contract authorization and verification criteria to ensure standards are practiced and followed in the supply chain. In addition, this technology reduces process reconciliation, error rates, risk, and administrative costs and allows consumers to share networks.

On the other hand, adopting blockchain to be applied in the halal product certification process may face many obstacles. This is because many standards, regulations, and requirements may increase complexity during certification. Waldo (2019) explains that technical factors such as scalability, energy consumption, and trust can hinder adopting this technology. In addition to the complexity of integration, large investments, and global regulations and standards, the addition of dedicated resources for development and governance can cause companies to delay it (Lin *et al.*, 2021; Chen *et al.*, 2021). For this reason, this study aims to examine the need for blockchain adoption in Indonesian halal certification from the perspective of consumers and regulators.

Previous research examined the benefits of using blockchain without observing the success stories of implementing this technology (Paliwal *et al.*, 2020). Moreover, their study only highlights blockchain for the theoretically halal food industry (Ali *et al.*, 2021). In addition, existing studies are limited to adopting blockchain technology in certain industries with case studies (Sidarto and Hamka, 2021; Sumarliah *et al.*, 2022; Vanany *et al.*, 2021). These issues are research gaps in testing blockchain-based halal certification. This study aims to fill this gap and recommend a complete blockchain model for halal certification in Indonesia.

In contrast to the previous literature, this study explores it comprehensively in two ways. First, this study uses three perspectives from different stakeholders to analyze the need for halal-certified blockchain adoption for specific products. According to Alexopoulos *et al.* (2019) and Saxena *et al.* (2022), it is necessary to analyze blockchain technologies from various perspectives to better understand their potential, benefits, and the factors determining their adoption. Second, it uses quantitative methods supported by qualitative methods. The quantitative approach uses a questionnaire to study the feasibility of adopting a blockchain model. At the same time, the qualitative approach uses literature studies, unstructured, in-depth interviews, and forum group discussions (FGD) involving various stakeholders. In addition, existing studies are limited to a single-method approach (quantitative or qualitative) with case studies (Sidarto and Hamka, 2021; Sumarliah *et al.*, 2022; Vanany *et al.*, 2021) or highlighting blockchain for the halal food industry theoretically (Ali *et al.*, 2021). Mixed methods are superior to single methods because they provide a better understanding of the problem and produce complete evidence as the investigator increases depth and breadth. Moreover, this approach helps avoid overreliance on one approach and can capture "core views and experiences" (Jogulu and Pansiri, 2011) and subjective factors needed to explain complex social situations.

Using Indonesia as a unit of analysis for this research is interesting. It has enormous economic potential for producers and consumers of halal food due to its largest Muslim population in the world. However, this potential has not been widely observed by previous researchers. In addition, the implementation aspect is a challenge because a blockchain-based halal certificate management system for storing and verifying halal certificates is still in the early stages of the proposal. Official verification websites currently have a very low level of security due to opportunities for certificate duplication. Some information on the certificate copy could be changed, unauthorized halal logos, dishonest or hidden product information, or other noncompliance could occur. Other limitations include unattractive features, slow preaudit response times, repair times in document uploads, which often experience "errors," slow personnel responses, and the absence of a "dialog box" to facilitate communication between the company and the auditor (Phi Ro *et al.*, 2017).

## 2. Literature review

This section provides a brief overview of relevant concepts and factors influencing intentions to participate in the use of blockchain-based technologies. Theory of the planned behavior (TPB) model is applied as the conceptual framework of this research.

### *2.1 Halal-certified obligation rules and consumer protection*

The Indonesian Government, through the ministry of religion issued Law Number 33 of 2014 concerning Halal Product Guarantee, which requires industries (large and MSMEs) in Indonesia, which produce and trade food products, to have a halal certificate and a halal logo on the packaging. This regulation is expected to protect Muslim consumers because, according to previous regulations, registrations for halal certification of products by industries were only voluntary. The concern of large-scale industries for halal certification is also still limited. Meanwhile, small and medium-sized businesses (MSMEs) have not made halal certification a major thing, so some of their products only include the Household Industry Product label.

There are two mechanisms for halal certification of food and beverage products, namely, regular mechanisms and self-declaration mechanisms. Figure 1 describes the procedure for obtaining a halal certificate, which involves three institutions, namely, BPJPH, LPH and Indonesian Ulema Council (MUI). The applicant applies for halal certification through

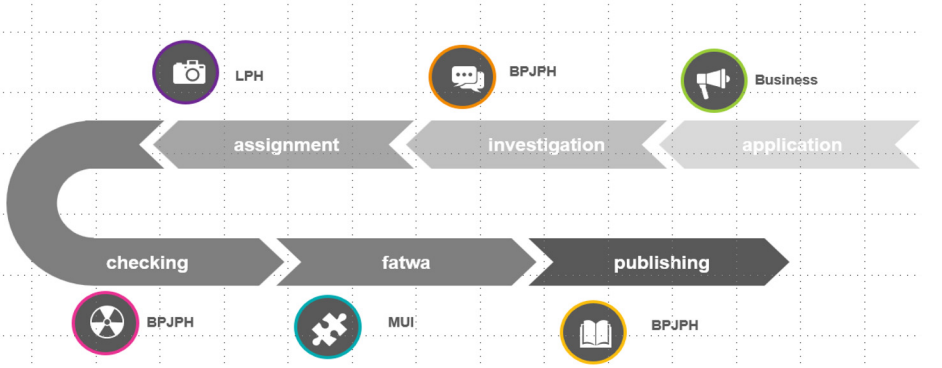



**Figure 1.**
Flow of halal certification

**Source:** www.halal.go.id

BPJPH, then BPJPH sets the LPH determined based on the application. Furthermore, LPH will conduct a halal examination of the product, the results of which will be the basis for determining the halalness of the product through the MUI halal fatwa hearing. Finally, the halal certificate can be issued by BPJPH.

Law Number 33 of 2014 concerning Halal Product Guarantee was further revised with the issuance of Law Number 11 of 2020 concerning job creation. Although this new law is still a matter of debate and polemics from various interests, it provides more opportunities for all MSMEs to apply for halal certification for free. This regulation also provides administrative sanctions if not fulfilled by industries. Thus, consumer protection is expected to be even better and there is no reason for MSMEs not to be halal certified for their processed products. The next step is the government's duty to provide facilities or services for the certification process that are easy and inexpensive to reach. One solution is to carry out halal certification of products massively and quickly. This will be easier by using advanced digital technologies such as AI and blockchain, so that bottlenecks do not occur.

### *2.2 Blockchain and halal traceability*

Previous studies have explained the benefits of blockchain for stakeholders about halal supply chain management, including food traceability, which is safe for consumers or users (Bumblauskas *et al.*, 2020; Hackett, 2017), and food integrity both at the physical layer and digital, thereby reducing the risk of food fraud in the supply chain (Köhler and Pizzol, 2020; Rejeb *et al.*, 2020). Other studies prove that blockchain improves food safety and provides information to consumers regarding the nutrition of all edible foods through the digitalization of information (Creydt and Fischer, 2019; Hackett, 2017; Tian, 2017).

Many studies have examined the intention to use and adopt new technologies, but this study focuses on the perceptions and features of the technology. Consumer intentions regarding safe food choices and the spread of contaminated food influence the use and adoption of blockchain food traceability systems (Lin *et al.*, 2021). Blockchain capabilities regarding food traceability increase consumer trust and motivation to buy trustworthy products (Xiaorong *et al.*, 2015). In addition, several high-tech features of effective innovation implementation and best diffusion are important: trialability, the relative advantage of observability, complexity and compatibility (Lai *et al.*, 2016). Meanwhile, Alsaad *et al.* (2017) observed three factors influencing the decision to accept a new

technology: compatibility, complexity and relative advantage. However, implementing a new halal system, e.g. halal logistics, may incur additional costs, but because of the benefits to be gained, it ultimately leads to acceptance (Ab Talib *et al.*, 2016). Moreover, adopting halal logistics depends on whether the new system is compatible with the current system (Haleem and Khan, 2017). Compatibility, complexity and relative advantages are accepted primarily as important high-tech features to determine the assimilation and adoption of information technology and systems among firms (Lai *et al.*, 2016).

Despite some limitations, such as the lack of a reliable and universally accepted standards framework or certification authority, the application of blockchain technology has emerged as an attractive instrument to increase the trust and traceability of halal food. Bux *et al.* (2022) emphasize increasing blockchain-based halal certification to promote fair trade, ethical business, green animal breeding, environmental economy and sustainable development. They highlighted the obstacles and opportunities toward increasing halal food in the global market, focusing on the stage of the food supply chain. In contrast to previous research, this study further investigates consumer, BPJPH and LPH perceptions of halal certification, focusing on the role of customers as carriers of transparency, equity and trust within company boundaries.

### *2.3 Theory of planned behavior model and intention to use*

The TPB model proposed by Ajzen (1991) is a theory that explains the intention to perform various types of behavior that can be predicted from attitudes toward behavior, subjective norms and perceived behavioral control. Those intentions and perceptions of behavioral control are responsible for considerable differences in actual behavior. TPB has proven successful in predicting consumer intentions to choose safe food (Dean *et al.*, 2008; Yin *et al.*, 2018) and predicting the factors influencing the intention to use information systems (Lin *et al.*, 2021). Davis *et al.* (1989) define intention to use new technology as the extent to which a user intends to use or continue to use the technology. This intention occurs after consumers evaluate the new technology positively (Byun and Jang, 2018). TPB explains that attitude and trust will result in the formation of behavioral intentions, facilitating the will to take action. Hypotheses were developed based on these three perceptions to test the relationship between attributes.

Lin *et al.* (2021) stated that an optimistic attitude toward the blockchain system could significantly affect consumer confidence. Belief in food safety traceability refers to belief in safe food (Lassoued and Hobbs, 2015). On the other hand, incidents of unsafe food can only increase and decrease levels of trust (Bitzios *et al.*, 2017). Consumers will ensure a halal logo for every food and beverage product purchased. In addition, they ensure that a trusted institution issues the official halal logo.

A study by Chen (2017) proved the effect of attitude on intention to use. Furthermore, attitude relates to positive or negative behavior evaluation (Ajzen, 1991). In addition, attitude is an emotional reaction when users use innovative technology, expressing an individual's desire to continue using new technology (Peng and Yan, 2022).

Thus, this study argues that attitude is a key factor determining technology use or application through stakeholder trust. Based on this argument, the first hypothesis is formulated as follows:

*H1a.* Attitude directly affects trust in blockchain halal traceability.

*H1b.* Attitude indirectly affects intention to use blockchain halal traceability through trust.

DeLone and McLean (2003) confirmed that the quality of information is an important factor that determines consumer intentions to use certain technologies. System quality measures the level of user perception, pleasure in using, adaptability, and response time that users value. Information system quality affects user trust in wireless technology (Vance *et al.*, 2008) and blockchain technology (Lin *et al.*, 2021). Duan *et al.* (2020), Rejeb *et al.* (2020) and Zhang *et al.* (2019) proved that this technology prevents economic, reputational, and social losses.

Sharma and Sharma (2019) found that consumers, especially Muslims, will search for, use, and rely on online information to help them make decisions. Quality information systems are designed to provide trust and stimulate consumer confidence to take advantage of technology. The official halal logo was also found without a registration number underneath. Meanwhile, consumers know the relationship between the halal logo and food and beverage product guarantees. In this case, consumers can track products through technology.

Trust is best understood as a relational attribute between interpersonal trust, institutional or systemic trust, and trust as a shared expectation (Becker and Bodó, 2021). Previous studies explained that trust is a person's willingness to rely on new technology or someone's will (Morgan and Hunt, 1994). Consumers want transparency and accountability in the supply chain using information technology to understand food and beverages' sources and production processes. Lack of reliable information about transactions in the market, such as dishonest and deceptive practices, can lead to failure to gain consumer trust (Lam *et al.*, 2020). Therefore, we suspect that system quality is a key factor determining technology use or application through stakeholder trust:

*H2a.* Information quality affects trust in blockchain halal traceability.

*H2b.* Information quality affects the intention to use blockchain halal traceability through trust.

Other studies found that trust is an important positive factor in acceptance and willingness to use mobile technologies such as mobile banking (Gao *et al.*, 2015; Liébana-Cabanillas *et al.*, 2016). Trust can significantly shape the psychological expectations of users to believe that blockchain halal traceability (BHT) can provide reliable services (Cho *et al.*, 2019). In this case, the higher the accumulation of trust in BHT, the higher the desire to continue using BHT. Trust in the traceability system of halal assurance will become very important and increase consumers' desire to use technology (Thorsøe and Kjeldsen, 2016):

*H3.* Trust affects the intention to use blockchain halal traceability.

## 3. Methodology

The proposed research population includes all target respondents (consumers, LPH and BPJPH). The research sample is a subset of the target population with characteristics appropriate for the planned study. Potential participants are then assessed based on the inclusion/exclusion criteria, and if they meet the requirements, they are recruited into the sample. This study examines the attributes using a random sample with a convenience sampling approach to obtain consumer data. Convenience sampling involves recruiting consumers primarily because their data is available, willing, easily accessible or contactable for the purpose of this study. This approach is also used because additional inputs were not required for the main research and all components of the population were eligible. Probability sampling was used as a parameter to keep this sampling bias under control. Meanwhile, data collection for halal regulators, such as LPH and BPJPH, uses purposive sampling. Purposive sampling is part of a nonrandom sampling technique that takes

samples with certain criteria or individual targets with characteristics appropriate to the research. This method is more effective with smaller sample sizes and lower margin of error (Turner, 2020). Referring to Figure 1, the LPH sample is based on halal audit companies that BPJPH has recognized. At the same time, BPJPH is the only halal regulator responsible for issuing halal certificates.

The triangulation approach is used as a qualitative data processing technique that combines various data sources, such as documents, archives, surveys, observation results, and FGD, or interviewing, with more than one subject considered to have a different point of view. These various views promote a breadth of knowledge to obtain reliable truth. In other words, this triangulation technique is used to check the validity of data by comparing the results of interviews with research objects so that accurate and precise conclusions can be drawn later. Qualitative data analysis procedures based on Krippendorff (2019, p. 86) are carried out through several stages, namely, determining the unit of analysis, coding, categorizing, describing and interpreting. Activities in data analysis also reduce data by summarizing, selecting key things, focusing on important things, and getting themes and patterns.

The questionnaire format aims to identify stakeholder needs to use and adopt blockchain-based halal certification. This study distributes structured questionnaires to 161 consumers and unstructured (in-depth interviews) to top leaders from LPH and BPJPH. This sample size is considered good because the recommended sample size for survey research ranges from 100 to 200 respondents (Memon *et al.*, 2020). The object of the structured questionnaire is equipped with five-point Likert scale questions, which vary from "strongly agree" to "strongly disagree." In the pretesting stage, according to the theme of this study and the postpandemic background, the relevant measurement items for most of the variables refer to the latest literature. Through face-to-face interviews, we contacted several representatives from academia and LPH. Furthermore, measurement items that are off target or easily misunderstood in the questionnaire are strengthened and corrected so that participants can fully understand the meaning of the items and improve the accuracy of the questionnaire.

Table 1 describes specific information related to the attributes used in this study, consisting of seven questions related to attitude (ATT1 and ATT2), information system quality (ISQ1 and ISQ2), trust (TRS1 and TRS2) and intention to use (INT1). This study uses the partial least squares (PLS) structural equation modeling (SEM) analysis method. Construct measurement is based on the results of previous studies (Table 3).

| Profile | Primary attributes | Sources | Measurement items |
|---|---|---|---|
| Religion, gender, married status, income, and job types | Attitude (ATT); information system quality (ISQ); Trust (TRS); intention (INT) | Ajzen (1991)<br>Lin *et al.* (2021)<br>DeLone and McLean (2003)<br>Spence (2018) | Buying products only with the halal logo? Halal logo from MUI? Halal logo without registration number? Halal certification guarantees halal products? Checking halal with the application? Need an easy-to-use app? |

**Notes:** This study limits the number to close to 150 due to limited research time, and responses from respondents tend to have the same answer. Moreover, most statisticians agree that the minimum sample size for obtaining meaningful results is 100
**Source:** Authors' calculations

**Table 1.**
Profile, attribute, and measurement items of consumers

PLS path modeling is a variance-based SEM technique widely applied in business and social sciences. Its ability to model composites and factors makes it a powerful statistical tool for research related to new technologies (blockchain) and information systems research (Henseler *et al.*, 2016). PLS requires the validity and reliability of the external and internal models to test the hypothesis. This study uses five Likert-type scales and as a condition of the PLS outer model, this study tests loading factor and average variance extracted (AVE) (to test convergent validity), internal composite reliability (to test reliability) and cross-loading tests to test discriminant validity. Based on the results presented in Table 3, this study has fulfilled the outer model requirements to test the validity and reliability of the results. PLS requires the standard loading factor to be greater than 0.5, while the internal consistency reliability (ICR) must exceed 0.6 (Hair *et al.*, 2011), so the AVE must be greater than 0.5 (Henseler *et al.*, 2016).

The interview and subsequent survey phases determine who to contact to participate, the ideal sample size of the study, the best way to categorize sample subsets and how to communicate with respondents for optimal results. Moreover, the questions are set to limit respondents' answers and use open-ended questions that allow the researchers to gain a complete perspective and produce more useful data (Lorimer *et al.*, 2017). The face-to-face interviews were conducted from May 20 to September 28 regarding the factors influencing stakeholders' willingness to use BHFT. The results of questionnaires, interviews and surveys were then discussed in FGDs to equate responses or perceptions from various interests to generate understanding and agreement regarding the topic being discussed. The FGD held in mid-November was attended by around 12 people representing consumers, LPH, BPJPH, academics and blockchain experts.

## 4. Results and discussion

### *4.1 Results*

General information related to consumer profiles includes religion, gender, marital status, salary and occupation. The survey results show that most respondents are Muslim (94%), female (58%), married (71%), working with a maximum salary of 12 million rupiahs (71%) and employees (37%).

Table 2 describes the attitude of respondents toward the halal logo, the assessment of the quality of the halal certificate information system, trust in the halal logo/certification and the intention to use digital technology to check the authenticity of halal certification. Most respondents stated "strongly agree" that the government should have an easy-to-use

**Table 2.** Summary of consumer needs in percentage (161 respondents)

| Code | Strongly disagree (%) | Disagree (%) | Neither agree (%) | Agree (%) | Strongly agree (%) | Average (%) |
|---|---|---|---|---|---|---|
| ATT1 | 1.24 | 1.86 | 8.07 | 24.84 | 63.98 | 4.484 |
| ATT2 | 1.86 | 6.21 | 11.18 | 27.33 | 53.42 | 4.242 |
| ISQ1 | 5.59 | 3.11 | 32.30 | 27.95 | 31.06 | 3.758 |
| ISQ2 | 0.00 | 0.62 | 4.35 | 20.50 | 74.53 | 4.689 |
| TRS1 | 4.97 | 3.73 | 12.42 | 18.63 | 60.25 | 4.255 |
| TRS2 | 4.97 | 9.94 | 26.09 | 23.60 | 35.40 | 3.745 |
| INT | 0.00 | 1.86 | 4.97 | 11.80 | 81.37 | 4.727 |
| | | | Average (Likert scale) | | | 4.272 |

**Notes:** ATT1 = attitude-1; ATT2 = attitude-2; ISQ-1 = information system quality1; ISQ-2 = information system quality-2; TRS1 = trust-1; TRS2 = trust-2; INT = intention
**Source:** Authors' calculations

application to check food products and halal restaurants (INT) (81.3%); halal logo/certification as a marker of halal food and beverage products (ISQ2) (74.6%); the food and beverage products they buy have a halal logo (ATT1) (64%); worried that there are still many nonoriginal halal certifications (60%) (TRS1); and will ensure buying products with official halal certification (ATT2) (53.4%). However, only a third of respondents (31%) stated that they strongly agreed if they found a halal logo without a registration number (ISQ1) and would check the product's halalness using an application (TRS2).

Furthermore, of all the questions asked of consumers, the halal logo/certification as a marker of halal food and beverage products (ISQ2) and the government's requirement to have an easy-to-use application to check halal food products and restaurants (INT) are the most important factors, with an average score of 4.7. Meanwhile, the least factor considered is checking product halalness using an application (TRS2) with an average value of 3.7. The results of this survey are reliable, with Cronbach's alpha and ICR values above 0.7. Finally, the reliability value of the indicator using the outer absolute standard loading is >0.7, as shown in Table 3.

Because using the PLS data technique does not have to be a multivariate normal distribution, the outer model test with reflective indicators was evaluated with convergent validity. The ideal value of the absolute correlation between latent variables and indicators is >0.7. If all indicators are still included in the model, then each latent variable must be able to explain the variance of each indicator by at least 50 % (≥0.5). Furthermore, the validity test was assessed using the AVE value. The absolute value of the outer raw loadings is explained in Table 3, which presents the outer loadings of each latent variable, indicating the validity of the measurement of each indicator. The AVE values corresponding to the components attitude, trust, information system quality and intention are 0.871, 0.569, 0.532 and 1.000, respectively.

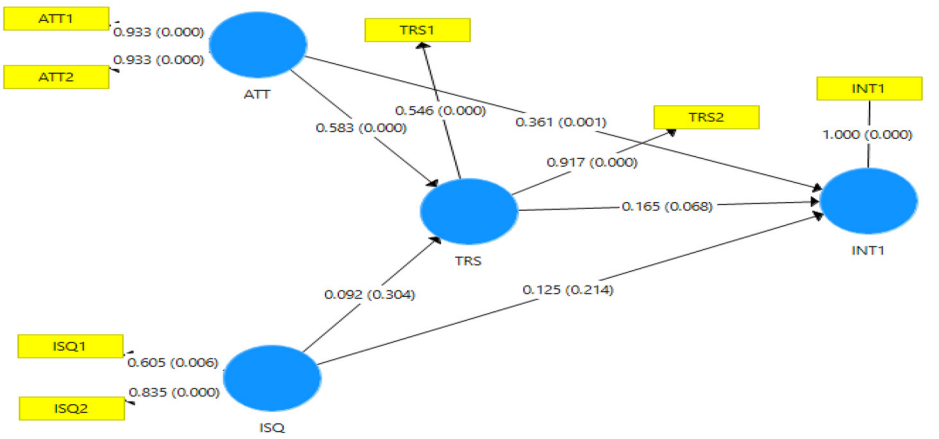
Furthermore, the test results of the structural model or the inner model as a model that links latent variables are described in Figure 2. The structural model was measured using the R-square value on the dependent construct, the *t*-test (significance of the structural path parameter coefficient) and the beta value for the path coefficient.

Figure 2 explains that the exogenous variables in this model are ATT and ISQ, while TRS and INT are endogenous variables. The TRS variable is a mediator variable that mediates the relationship between ATT and ISQ with INT. Moreover, Figure 2 explains the values of the three constructs of this research attribute. First, the attitude construct, measured by the ATT1 and ATT2 items, has a loading factor of 0.933 each. Second, the

| | Attitude (ATT) | Trust (TRS) | Information System Quality (ISQ) | Intention (INT) |
|---|---|---|---|---|
| Cronbach's alpha | 0.852 | 0.285 | 0.126 | 1.000 |
| Composite reliability | 0.931 | 0.713 | 0.689 | 1.000 |
| Average variance extracted (AVE) | 0.871 | 0.569 | 0.532 | 1.000 |
| ATT1 | 0.933*** | | | |
| ATT2 | 0.933*** | | | |
| TRS1 | | 0.546*** | | |
| TRS2 | | 0.917*** | | |
| ISQ1 | | | 0.605*** | |
| ISQ2 | | | 0.835*** | |
| INT1 | | | | 1.000*** |

**Notes:** ATT = attitude; ISQ = information system quality; TRS = trust; INT = intention
**Source:** Authors' calculations

**Table 3.** Construct value and outer loading of reflective construct




**Source:** Authors' calculations

**Figure 2.**
Outer weights/ loadings and *p*-values of structural model

constructs of information system quality, as measured by ISQ1 and ISQ2 items, yield a loading factor of 0.605 and 0.835, respectively. Third, the construct of trust (TRS) measured by TRS1 and TSR2 items are 0.546 and 0.361, respectively. All constructs have met the validity criteria indicated by the AVE value (Table 3).

The R-square value for the intention variable is 0.175 (17.5%), while the trust variable is 0.386 (38.6%). This shows that the ability of the exogenous variable attitude (ATT) and the quality of information systems (ISQ) to explain the endogenous variable trust (TRS) is categorized as "moderate." In contrast, the trust variable's (TSR) ability to explain intention is categorized as "weak."

Table 4 Panel A reports the results of hypothesis testing, which shows that attitude had a significant direct effect on intention ($\beta$ = 0.361, <0.05) and trust (ß = 0.583, <0.05). Information system quality had a direct and insignificant effect on intention ($\beta$ = 0.125, >0.05) and trust (ß = 0.092, >0.05), whereas Panel B explains the indirect relationship that

| | Coefficient (ß) | Sample mean (M) | Standard deviation (STDEV) | *p*-values | *t*-statistics | Adjusted R2 |
|---|---|---|---|---|---|---|
| *Panel A: Direct effect* | | | | | | |
| Attitude → intention | 0.361*** | 0.351 | 0.108 | 0.001 | 3.328 | 0.627 |
| Attitude → trust | 0.583*** | 0.581 | 0.060 | 0.000 | 9.744 | 0.691 |
| Information system quality → intention | 0.125 | 0.130 | 0.097 | 0.201 | 1.281 | 0.326 |
| Information system quality → trust | 0.092 | 0.106 | 0.087 | 0.287 | 1.067 | 0.277 |
| Trust → intention | 0.165* | 0.163 | 0.091 | 0.070 | 1.817 | 0.342 |
| *Panel B: Indirect effect* | | | | | | |
| Attitude → intention | 0.096* | 0.095 | 0.055 | 0.079 | 1.759 | 0.208 |
| Information system quality → intention | 0.015 | 0.017 | 0.019 | 0.447 | 0.760 | 0.072 |

**Source:** Authors' calculations

**Table 4.**
Hypothesis Test-Path coefficient

attitude and information system quality had an indirect and insignificant effect on the intention at $\alpha > 0.05$. Thus, *H1a* is supported, while *H1b*, *H2a*, *H2b* and *H3* are not supported.

### *4.2 Discussion and implications*

Based on the data reported in the questionnaire results section, it appears that most consumers strongly agree that the halal logo/certificate is a marker of halal food and beverage products (ISQ2), the food and beverage products they buy have a halal logo (ATT1), ensure that they will buy products with official halal certification (ATT2). The purpose of including the halal certificate logo is to determine food and beverage products circulating in the community, provide protection and legal certainty for the rights of Muslim consumers to nonhalal products and prevent Muslim consumers from consuming nonhalal products. For this reason, business actors in trading a product should apply for a halal certificate through BPJPH to obtain it and then put their halal logo on their products.

The public or consumers often doubt the halal status of food, beverages, medicine, and cosmetic products that do not have an official halal certificate label. Cases like this are called fake halal labels, which can be found on products bearing the halal logo, but the product contains elements or ingredients prohibited by Islamic law. Fake halal labels can also occur because halal labels have expired, were not renewed by business actors, or an authorized institution did not issue halal labels. The main causal factors for fake halal labels are weak law enforcement and inadequate socialization by the government. Therefore, when respondents were asked whether they were worried about counterfeit halal labels, they strongly agreed that nongenuine halal certificates were still commonly found on products labeled halal (TRS1). Factually, the halal logo is usually printed on the package, both inside the package (inner packaging) and outside the package (outer packaging), such as cardboard boxes/cardboard. The halal logo is indeed a guarantee for consumers that a product with a halal logo printed on the packaging means the food product is legally halal.

Finally, consumers strongly agreed that the government needs an easy-to-use application to check the halalness of food products and restaurants (INT1). The results of this survey show that consumers are very concerned about the traceability of halal certification. However, only a third of the respondents would check the halalness of a product using an application (TRS2). With the existence of blockchain technology, Indonesian people, especially Muslims, are expected to be able to check products that have received an official halal certificate to ensure product halalness.

In general, there are a number of ways that the public can check the halalness of an Indonesian product, for example, by downloading the halal MUI application through the Google Play Store or App Store or the official website of MUI at https://halalmui.org and https://info.halal.go.id/cari/. The results of interviews and surveys show several problems with using the website and the application interface. After using the application, a consumer stated:

> The system currently used by BPJPH does not use a user-friendly interface, bugs are still found in the three systems (BPJPH, LPH, MUI). A flaw in the app that can cause the app not to work as it should.

However, previous studies show inconsistent results regarding users' desire to use a user-friendly technology system. Sawrikar and Mote's (2022) study, for example, cannot prove that there is a relationship between perceived ease of use and intentions to use technology. However, on average, the observations from this study show that consumers are very

concerned (4.3 out of 5) with the traceability of halal certification, so the government must meet this need.

The linear regression modeling partially supports *H1a* but does not support *H1b*, *H2a*, *H2b* and *H3*. Greater perceived benefits related to attitudes are associated with greater consumer confidence in blockchain technology and intentions to use blockchain technology (*H1a*). This is in line with Lin *et al.* (2021) and Peng and Yan (2022), who state that an optimistic attitude will increase trust and desire to use new technology. When users experience the benefits of using an application (e.g. traceability), they tend to have a positive attitude toward using the application. The higher the attitude, the higher the behavioral intention to use a blockchain-based application to trace halal food and drink.

Conversely, the quality of information systems does not have a significant relationship with consumer trust and intention to use blockchain technology (*H2a*). The users will trust the technology when they have high confidence in the security and privacy provided by blockchain-based technology. Bhattacherjee and Barfar (2011) and Susanto *et al.* (2016) emphasized perceived security and privacy as *post ante* expectations, motivating users to use intention continuously.

Although attitude is directly related to trust, it could not mediate the relationship between attitude and intention to use (*H1b*). Likewise, trust could not mediate the relationship between information system quality and intention to use (*H2b*). Trust is a person's willingness to rely on new technology. This study found no relationship between trust and intention to use (*H3*). This is in line with Waldo (2019), who states that technical factors such as scalability, energy consumption, and trust can be obstacles to adopting this technology. An information system that makes it possible to trace the halal status of a product related to halal food raw materials fails to make consumers believe and then does not generate an intention to use technology due to dishonest and deceptive practices (Lam *et al.*, 2020).

The next survey describes the perspective of halal regulators, namely, BPJPH and LPH, on blockchain-based halal certification. One of the leaders from BPJPH stated:

> BPJPH strongly agrees with having an identification number required for every food and beverage company; all product halal assurance standards are carried out in a transparent and accountable manner; and the need for a system that can be accessed by all stakeholders, as well as an integrated registrar registration and certification system.

However, BPJPH objected if every step of the 11 halal certification procedures was monitored with certainty. This last statement contradicts the wishes of the producers, who want the 11 procedures to be traceable, and BPJPH's commitment to transparency. This objection is because BPJPH is still preparing the technical regulations. In practice, developing technical rules is not easy. Halal certification is a standard that is applied to products in accordance with regulatory provisions and is not just an administrative formality that business actors must fulfill. This halal certificate process must involve a few parties to ensure product halalness.

Furthermore, the results of the FGD and in-depth interviews with several stakeholders obtained a perspective that the consumer has the consumer has the strongest desire or need to use or adopt blockchain for halal certification, followed by BPJPH. Meanwhile, LPH, although agreeing with the application of this technology, is still doubtful about using this technology in the near future due to unpreparedness in terms of facilities, inadequate resources, and insufficient literacy or education related to halal blockchain.

Following are some statements of "agreement" and "doubt" from LPH in general when asked semi-structured questions:

> We strongly agree that BPJPH should have a technology system that records the same certification process for all LPHs and data interconnected between LPHs to avoid duplicating the halal certification process and registering halal tests at other LPHs. However, we are unsure that our clients (industry) will use blockchain technology. In addition, we doubt whether the blockchain certification is compatible with our facilities and equipment.

The results of these interviews and FGDs imply that COVID-19 is an extreme example of an external nonsystemic risk that is difficult to avoid and still being felt while investing in a blockchain system requires spending resources that can hinder stakeholder participation. In the end, this research also has other implications for consumers (public), halal regulators or the government, and practitioners. First, suppose blockchain technology can be implemented in Indonesia initiated by the government. In that case, customers (the public) can access all information related to the halal process through the QR Code found on the company and products. It is important to obtain transparency and accountability regarding the halal process of the products they consume as needed. Consumers can also scan the product label for ingredients that violate Islamic law and send a list of ingredients to the server.

Second, in line with the agenda of the SDGs in 2030 and Bank Indonesia's (BI) commitment in 2022, BI, together with BPJPH and the Ministry of Finance, established a consortium to support facilities in the form of provision of funds, systems and infrastructure related to the blockchain-based halal certification project. This process is expected to further realize Indonesia as a world center for halal products and destinations in 2024 and spur the development of Indonesia's sharia economy and finance.

## 5. Conclusions

This study aims to explore the perspectives of consumer and halal regulators (BPJPH and LPH) on the intention to use blockchain platforms or blockchain-based halal certification in Indonesia. The triangulation approach involved a literature review; distribution of questionnaires, observations; focus group discussions; and in-depth interviews to obtain qualitative and quantitative data. Smart PLS was used to test the hypothesis of 160 consumer respondents. The study results show that the intention to use, from a consumer perspective, was only influenced by attitude. Meanwhile, information system quality and trust failed to explain the relationship between the two with the intention to use. Furthermore, the results of in-depth interviews and FGDs indicate that BPJPH's intention to use blockchain-based halal certification was higher than LPH. This was due to statements from LPH respondents regarding unpreparedness in terms of providing facilities, education, funding, and human resources.

This study has limitations that are expected to be elaborated on for further research. Surveys and interviews with other interested parties are still limited, which can hinder studies from deepening and understanding issues related to constraints in the certification system and process. The consumers surveyed in this study were also limited to the food products purchased. Future research needs to include other parties, such as producers, consumers of nonfood and beverage products, and the MUI. This approach is expected to reduce the problem of bias, increase the data's validity, deepen the analysis results, and produce more comprehensive study results. Finally, case studies on producers and LPH need to be considered for a more in-depth analysis of the problems encountered and the

possibility of calculating the benefits and costs of implementing blockchain-based halal certification.

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