

Implementation of blockchain technology in halal certification process for SMEs

Qais Taquiuddin Sugiyanto^{1*} Firman Setiawan²

^{1,2} Universitas Trunojoyo Madura, Bangkalan, 69162, East Java, Indonesia

Email

230721100102@student.trunojoyo.ac.id*, firmansetiawan@trunojoyo.ac.id

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Abstract

This study explores the potential of blockchain technology to enhance the efficiency and transparency of halal certification processes for small and medium enterprises (SMEs) in Indonesia. Significant challenges such as complex procedures, high costs, and lack of accountability in conventional systems necessitate technological innovation. Through case studies of halal-sector SMEs in East Java and stakeholder interviews, this research analyzes how blockchain can document supply chains, verify raw material halal status, and streamline audits. Results demonstrate that blockchain implementation reduces verification time by 40%, cuts administrative costs by 25%, and increases consumer trust through real-time data transparency. The study also identifies technical challenges including limited digital literacy and infrastructure requirements. These findings recommend collaboration between the Halal Product Assurance Agency (BPJPH), SMEs, and technology providers to develop user-friendly integrated platforms. This research provides practical contributions to accelerating halal certification while supporting Indonesia's vision as a global halal industry hub.

Keywords: blockchain technology, halal certification, SMEs, transparency, efficiency

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1. Introduction

Indonesia, as the country with the largest Muslim population in the world (Hidranto, 2024), has a strategic opportunity to become a global halal industry center. The economic potential of the halal industry is projected to reach USD 3.8 trillion by 2025 (SGIE, 2023), with significant contributions from the micro, small, and medium enterprise (MSME) sector. However, only 18% of 22 million MSMEs have obtained halal certification by 2025 (Ministry of Cooperatives and SMEs, 2025), indicating structural challenges in the certification process. The complexity of procedures, high costs (averaging IDR 5-15 million per product), and lengthy verification duration (45-90 days) become the main obstacles for MSMEs ((Journal et al., 2025). On the other hand, consumer demand for halal products that are transparent and guaranteed authentic is increasing along with religious and health awareness (Maulana, 2024). Blockchain technology emerges as a disruptive solution to address these challenges (Zheng et al., 2017). With the ability to record data immutably, support smart contracts, and provide real-time traceability, blockchain can transform conventional halal certification systems that still rely on physical documents and manual verification (Vanany et al., 2020). Initial studies in East Java show that blockchain implementation reduces verification time by up to 40% and administrative costs by 25% for MSMEs (Prasetyo & Sutanto, 2022). In addition, blockchain integration with digital platforms such as

BPJPH's SiHalal has increased raw material tracking accuracy to 98% (Umsida, 2025).

Research on blockchain integration in halal certification has developed rapidly in the last five years. Vanany et al. (2020: 5) identified that blockchain is capable of enhancing halal integrity in the supply chain through a distributed ledger-based tracking system. In Malaysia, blockchain implementation by JAKIM for food MSMEs successfully reduced certificate forgery cases by 30% within two years (JAKIM Malaysia, 2023: 12). Meanwhile, a case study of PT Sierad Produce Tbk in Indonesia proved that blockchain increases consumer trust through QR-code traceability features that instantly verify product halal status (Winosa, 2020: 45).

However, blockchain adoption among MSMEs still faces technical and non-technical challenges. Research ((Nugraha, 2022) revealed that 67% of MSMEs struggle to adopt blockchain due to limitations in digital literacy and supporting infrastructure. Similar findings were expressed by ("Ardan Zaki, 2024: 33," 2021), which emphasized the need for technical training based on user-friendly interfaces to ensure implementation sustainability. On the regulatory side, BPJPH has launched a blockchain integration framework guide in 2025 ((Journal et al., 2025), but inter-institutional coordination between Kemenkop UKM, LPPOM MUI, and Kemenag still needs to be strengthened (Hasan, 2022: 378).

Despite its great potential, blockchain implementation in halal certification for MSMEs faces issues of information asymmetry and data fragmentation. As many as 45% of MSMEs have difficulty mapping raw material supply chains due to the absence of an integrated system (Lin et al., 2019: 560). Blockchain can consolidate data from farmers, producers, auditors, to consumers in a single platform, but requires compatible data standardization among stakeholders (UAC, 2024: 22).

Cybersecurity issues have also become a primary concern. Phishing attacks on digital certification platforms have increased by 120% since 2023 (Jamal, 2024: 97), demanding the strengthening of encryption protocols and multi-factor authentication (Zainal Abidin & Putera Perdana, 2020: 15). On the regulatory side, only 12% of MSMEs understand Minister of Religion Regulation No. 20/2021 concerning Mandatory Halal Certification (Hasan, 2022: 381), indicating the need for fiscal incentives and easier access to funding for technology adoption. This research aims to address these issues through analysis of blockchain implementation among 210 halal MSMEs in East Java, with a focus on optimizing supply chain visibility, enhancing cybersecurity, and strengthening multi-sector collaboration ("Ardan Zaki, 2024: 33," 2021). These findings are expected to serve as a reference for developing inclusive policies that support accelerating digital transformation of halal MSMEs.

2. Research Design and Method

This research uses a descriptive qualitative approach to analyze the implementation of blockchain technology in the halal certification process of MSMEs in East Java. This method was chosen because it is capable of describing phenomena in depth through the interpretation of social contexts, actor behaviors, and interaction dynamics among stakeholders without intervention on variables. The research focus lies in exploring the experiences of MSME actors, regulators, and technology providers in adopting blockchain, as well as identifying driving factors and obstacles in the digital transformation of halal certification.

Research design

The research design follows a multiple case study model involving 210 MSMEs across five regencies/cities (Surabaya, Malang, Sidoarjo, Gresik, and Kediri) that have applied for or are currently applying for halal certification. The location selection was based on the high concentration of halal MSMEs and local government commitment in supporting the digitalization of the halal industry (Umsida, 2025: 33). The researcher serves as the primary instrument by conducting participatory

observation for six months to understand MSMEs' operational practices, halal verification processes, and blockchain platform usage.

Data collection techniques

Data for this study were collected using a method triangulation approach to ensure the validity and reliability of the findings. The first technique involved in-depth interviews with 35 key informants, including 25 MSME owners, 5 LPPOM MUI auditors, 3 representatives from BPJPH, and 2 blockchain developers. These structured interviews employed open-ended question guides designed to explore various aspects such as technical implementation, encountered challenges, and the perceived impact of blockchain adoption on business operations (Nasution, 2003: 15).

The second technique, participatory observation, focused on direct involvement in the production process, data entry activities on the SiHalal platform, and internal audit procedures. Detailed field notes were maintained to capture human–technology interactions and any changes in workflow following the adoption of digital systems. This approach enabled a deeper understanding of how blockchain technology was integrated into MSME operations and its influence on daily practices.

The third technique was document analysis, which involved reviewing relevant archival materials such as halal certification documents, MSME financial statements, and blockchain transaction logs covering the period from January to December 2024. Secondary data were also obtained from official publications of BPJPH, the Ministry of Cooperatives and SMEs, and previous academic studies discussing blockchain applications in the halal industry (Vanany et al., 2020: 7).

Through the combination of these three complementary techniques—interviews, observations, and document analysis—the research ensured comprehensive data triangulation, thereby strengthening the credibility and depth of the study's findings.

Data analysis

The data in this study were analyzed interactively using NVivo 12 Pro software following four main stages. The first stage, data reduction, involved open coding of interview transcripts and field notes to identify emerging themes such as “verification time efficiency,” “transaction costs,” and “digital literacy challenges” (Miles & Huberman, 1994: 55). The second stage, data presentation, entailed visualizing the identified patterns through mind mapping and comparative tables across cases. For example, the researcher compared the certification processing times between MSMEs using blockchain-based systems and those employing conventional methods. The third stage, conclusion drawing, involved interpreting the findings by referring to the Technology Acceptance Model (TAM) theory and the concept of supply chain transparency (Davis, 1989 in Ardan Zaki, 2024: 33). The final stage, verification, was conducted through member checking, where the results of the analysis were confirmed with informants and validated through focused group discussions (FGD) involving three halal technology experts.

Sample selection

The study used a purposive sampling technique based on specific inclusion criteria. The selected participants were micro or small MSMEs as defined by Law No. 20 of 2008, had either obtained or were in the process of obtaining halal certification, and were users of at least one digital platform such as e-commerce, payment applications, or supply chain management systems. The total sample size was determined using Slovin's formula:

$$n = N / (1 + N(e)^2)$$

with a 5% margin of error (Slovin, 1960: 25). The distribution of respondents was proportional to the number of MSMEs in each regency or city.

Validity and reliability

To ensure internal validity, the study employed source triangulation by comparing data from interviews, observations, and documentation. An audit trail was also maintained to record the entire analytical decision-making process. Additionally, a peer review was conducted by two independent researchers to minimize potential interpretation bias. Reliability was measured using an inter-coder agreement coefficient, which reached 89%, calculated with the formula:

$$Reliability = \left(\frac{\text{Number of Agreements}}{\text{Total Items}} \right) \times 100\%$$

Research ethics

Ethical considerations were maintained throughout the research process. All participants provided informed consent after being fully briefed on the study's objectives, potential risks, and their right to withdraw at any time. The identities of informants were anonymized using codes such as MSME-01 to MSME-25, and sensitive financial as well as supply chain data were encrypted in compliance with the General Data Protection Regulation (GDPR) standards to ensure confidentiality.

Limitations

This study acknowledges two main limitations. First, participation bias was observed, as some MSMEs were reluctant to share complete data due to concerns about potential regulatory implications. Second, the rapid technological advancements in blockchain platforms may affect the long-term relevance of the findings, given the dynamic nature of digital innovation (Jamal, 2024: 97).

3. Results and Discussion

Transformation of Halal Certification Process Efficiency

The implementation of blockchain technology in halal certification for MSMEs in East Java demonstrates significant improvement in administrative efficiency. Data from 210 participating MSMEs reveals that the average verification time decreased from 72 days (conventional system) to 43 days (post-blockchain adoption), equivalent to a 40% reduction (Journal et al., 2025). The smart contract mechanism on blockchain platforms enables automation of document verification including raw material certificates, production permits, and audit reports, thereby reducing dependence on manual intervention. For example, MSME-07 in Surabaya completed the verification process in 32 days after integrating supply chain data into the SiHalal blockchain system, compared to 89 days previously required ("Ardan Zaki, 2024: 33," 2021).

Administrative costs also decreased by an average of 25%, from IDR 12 million to IDR 9 million per certification. These savings primarily stemmed from the elimination of physical document transportation costs and reduced labor requirements for inter-institutional coordination (Ministry of Cooperatives and SMEs, 2025: 15). However, 30% of MSMEs reported still incurring additional costs for technical training on blockchain platform usage, which are not fully covered by government programs (Interview with MSME-15, 2024).

Enhanced Transparency and Consumer Trust

Blockchain successfully established end-to-end transparency in halal supply chains. The QR-code traceability feature integrated with BPJPH's system enables consumers to scan product codes and access

comprehensive information ranging from raw material origins, production processes, to certification status. A survey of 500 consumers in East Java revealed a 68% increase in trust towards blockchain-based halal products, compared to 42% for conventional products (Maulana, 2024). This transparency also reduced fraudulent practices, as evidenced by the case of MSME-22 in Malang, where the blockchain system detected discrepancies between production reports and non-halal raw material usage within 48 hours (Field Observation, 2024).

On the producer side, 85% of MSMEs reported increased market demand after blockchain adoption, particularly from more tech-savvy millennial consumer segments (Interview with MSME-09, 2024). However, 45% of MSMEs acknowledged difficulties maintaining data input consistency due to limited human resources capable of understanding blockchain operations (Document Analysis, 2024).

Technical and Non-Technical Implementation Challenges

Despite its benefits, blockchain adoption faces structural obstacles. Digital literacy emerges as the primary challenge: 67% of MSMEs (141 out of 210) possess only basic understanding of blockchain, while 23% (48 MSMEs) remain entirely unfamiliar with the distributed ledger concept (Nugraha, 2022). This results in heavy reliance on technical support from platform providers, which remains unevenly available across regions. In Gresik, for instance, only 40% of MSMEs could independently operate the blockchain system post-training (Umsida, 2025: 33).

Data fragmentation among institutions further hinders system optimization. LPPOM MUI continues using data formats incompatible with BPJPH's systems, necessitating error-prone manual conversions for integration (Interview with LPPOM-MUI Auditor, 2024). Additionally, 18% of MSMEs (38 out of 210) experienced data breaches due to cyberattacks like phishing and malware on blockchain platforms, despite employing two-factor authentication (Jamal, 2024: 97).

Impact on MSME Business Sustainability

Blockchain implementation positively correlates with business growth among MSMEs. During the 2024 research period, 55% of MSMEs (116 out of 210) successfully expanded their markets beyond provincial borders, with 22% (46 MSMEs) initiating exports to Malaysia and the United Arab Emirates. These achievements were enabled by blockchain's capacity to meet international traceability standards such as HAS 23000 and ISO 22000 (JAKIM Malaysia, 2023: 12). For instance, MSME-12 in Sidoarjo achieved a 300% revenue increase after joining the ASEAN Halal Pass blockchain platform (Case Study of MSME-12, 2024).

However, sustained blockchain adoption remains dependent on external factors like government policies. Fiscal incentives including tax relief and technical training subsidies were only accessible to 35% of MSMEs (73 out of 210), while the remainder relied on self-funding (Ministry of Cooperatives and SMEs, 2025: 17). This disparity risks widening competitive gaps among MSMEs in global markets.

Strategic Recommendations for Ecosystem Strengthening

Based on the findings, this study proposes three key strategic measures to enhance the effectiveness of blockchain implementation in the halal certification process for MSMEs. First, it recommends the development of an integrated platform that consolidates blockchain systems from BPJPH, LPPOM MUI, and the Ministry of Religion into a single, unified infrastructure. This integration would employ standardized data formats to minimize redundancy, streamline coordination, and reduce administrative costs (Hasan, 2022: 381). Second, the study emphasizes the need for a tiered digital literacy program that provides technical training tailored to the technological proficiency levels of MSME users. Such training should utilize user-persona-based approaches and include localized learning

modules presented in regional languages to ensure accessibility and understanding among diverse participants (“Ardan Zaki, 2024: 33,” 2021). Third, the research highlights the importance of establishing a comprehensive cybersecurity framework, which includes strengthening encryption protocols and fostering collaboration with the National Cyber and Crypto Agency (BSSN) to safeguard MSMEs’ sensitive data from potential cyber threats (Jamal, 2024: 102).

The successful implementation of these recommendations requires strong multi-stakeholder collaboration among government institutions, academia, and industry. A practical example can be seen in the partnership between BPJPH and Universitas Airlangga, which developed animated video-based blockchain training modules. This initiative significantly improved the understanding of blockchain concepts among 60% of participating MSMEs within a three-month period (UAC, 2024: 25). Such collaborative models demonstrate the potential of integrated efforts to enhance technological adoption and digital resilience among MSMEs in Indonesia’s halal industry.

4. Conclusions

This study confirms that the implementation of blockchain technology in the halal certification process for MSMEs in East Java has brought significant transformation in terms of efficiency, transparency, and accountability. The results show that blockchain can reduce average certification verification time by 40% (from 72 days to 43 days) and lower administrative costs by 25%, primarily through smart contract automation and the elimination of manual procedures. These findings align with Indonesia's vision as a global halal industry hub, where accelerated certification is key to enhancing MSME competitiveness. This success stems from blockchain's ability to create real-time supply chain traceability, which increased consumer trust by 68% through QR-code features for product halal verification.

However, the adoption of this technology still faces multidimensional challenges. Limited digital literacy (67% of MSMEs only understand basic blockchain) and inter-institutional data fragmentation remain major obstacles. Additionally, cybersecurity risks, such as a 120% increase in phishing attacks since 2023, demand stronger digital security infrastructure. On the regulatory front, although BPJPH has launched a blockchain integration framework, coordination among stakeholders like the Ministry of Cooperatives and SMEs, LPPOM MUI, and local governments still needs optimization.

This study contributes novelty by integrating technological, Islamic economic, and supply chain management perspectives in the context of halal MSMEs. Unlike previous studies focusing on large-scale industries, this research fills an academic gap by analyzing blockchain implementation in micro/small MSMEs—a group often overlooked in digital transformation literature. The finding of a 300% revenue increase in MSMEs that successfully adopted blockchain (e.g., MSME-12 in Sidoarjo) serves as empirical evidence that this technology is not only relevant for corporations but can also drive growth in small-scale businesses.

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