Journal of Artificial Intelligence and Engineering Applications

Website : https://ioinformatic.org/

June 2026. Vol. 5. No. 3; e-ISSN: 2808-4519

System Requirements Analysis for the Implementation of Digital Traceability in the Sme-Scale Eid Al-Fitr Cookie Industry

Cinta Desta Awandini[1]*, Fauzan Abdillah Shodiq[2], Lailatul Khusna[3], Fatkhur Rokhman[4]

[1,2,3,4]Faculty of Science and Technology, UIN KH. Abdurrahman Wahid Pekalongan
cinta.desta.awandini25005@mhs.uingusdur.ac.id[1], fauzan.abdillah.shodiq25009@mhs.uingusdur.ac.id[2], lailatul.khusna25018@mhs.uingusdur.ac.id[3], fatkhur.rokhman@uingusdur.ac.id[4]

Abstract

Small, and Medium Enterprises (UMKM) in the dry Eid cake production sector face primary challenges related to supply chain transparency and product quality assurance. The lack of organized record-keeping systems makes product traceability difficult to implement, especially when issues arise such as customer complaints or product recalls. This research aims to identify and analyze information system needs for implementing digital traceability in these SMEs. The approach used is qualitative, with system needs analysis techniques based on the early phases of SDLC (Software Development Life Cycle), including direct field observations, semi-structured interviews, and process document reviews. Findings show that the AS-IS condition in most SMEs is characterized by the absence of digital documentation, lack of product batch codes, and no backward tracing mechanisms. From these gaps, this research develops a TO-BE condition using affordable technologies such as Google Form, QR Code, and Google Sheets as the basis for a simple traceability system suitable for SMEs. Comparison between conditions before and after implementation indicates significant improvements in accountability, food safety, and consumer trust. This research is expected to provide practical benefits for SME actors while enriching food information system studies in Indonesia.

Keywords: *Digital Traceability, Food Safety, System Requirements Analysis, QR Code, Supply Chain*

1. Introduction

Eid al-Fitr, or the Lebaran holiday in Indonesia, is not only a religious celebration but also an economic phenomenon that generates billions of rupiah in revenue, particularly in the traditional snack industry, such as cookies. Every year, the surge in demand for Lebaran cookies drives thousands of small and medium-sized enterprises (SMEs) to ramp up production intensively during a limited timeframe. However, amid the hustle and bustle of the production season, there is a fundamental issue that is often overlooked: the lack of an adequate product tracking and recording system.

On a global scale, food traceability has become an essential standard governed by various international regulations, such as the EU General Food Law Regulation (EC) No. 178/2002 and the Codex Alimentarius standards. At the national level, the Indonesian Food and Drug Monitoring Agency (BPOM), through BPOM Regulation No. 22 of 2021 on Good Manufacturing Practices for Processed Foods (CPPOB), also mandates the implementation of a product traceability system, although its implementation among MSMEs remains very limited [2]. This gap between regulatory provisions and on-the-ground realities forms the primary basis for this study.

From an information technology perspective, rapid advancements in cloud-based digital solutions and mobile devices have opened up access for small businesses to adopt information systems that were previously only available to large corporations. Digital tracking concepts can now be implemented at low cost through the integration of Google Forms, cloud-based spreadsheets, and QR code generators that are available for free or at minimal cost [4]. However, technological readiness alone is not sufficient; an in-depth analysis of system requirements is necessary to ensure that the solution design is truly aligned with the capabilities and operational dynamics of SMEs.

Research gaps identified in the literature review indicate that most studies on food traceability focus primarily on large-scale industries or international supply chains, whereas research specifically addressing the system requirements for seasonal food MSMEs, particularly those producing Lebaran cookies, remains scarce. Existing studies are generally technical in nature (focusing on system architecture) without sufficiently exploring the needs analysis aspect from the perspective of field users with low digital literacy [1]. It is this gap that this study aims to address.

Therefore, the main objectives of this study are threefold: first, to map the current state of the production process at Lebaran cookie MSMEs; second, to identify and document the functional requirements of a digital tracking system; and third, to design the target state, accompanied by a comprehensive comparison of the situation before and after implementation. Overall, this study is expected to provide practical, actionable guidance for food MSMEs in Indonesia.

Within the framework of Islam, the principles of transparency and honesty in muamalah (transactions) are grounded in strong values. Allah SWT states in Surah Al-Muthaffifin (83): 1-3:

وَيْلٌ لِّلْمُطَفِّفِينَ ۝ الَّذِينَ إِذَا اكْتَالُوا عَلَى النَّاسِ يَسْتَوْفُونَ ۝ وَإِذَا كَالُوهُمْ أَو
وَّزَنُوهُمْ يُخْسِرُونَ

“Woe to those who cheat (in measures and weights), those who, when they receive a measure from others, demand the full amount, but when they give a measure or weight to others, they cheat.” (Quran 102:1-3)

This verse indirectly emphasizes the urgency of accountability and transparency in economic transactions, which essentially form the foundation of the traceability concept in contemporary food systems. Muslim SME operators should view the implementation of traceability systems not merely as a regulatory requirement, but as a means of putting into practice the values of honesty and responsibility mandated by their religion.

2. Literature Review

2.1. The Concept of Traceability in the Food Industry

Product traceability, as defined by the International Organization for Standardization (ISO 9001:2015), refers to the ability to track the history, use, or location of an entity through recorded identification. In the food sector, the International Food Standard (IFS) and BRC Global Standard define food traceability as the ability to link finished products to raw materials in both directions, from upstream to downstream and vice versa [11]. This capability serves as a critical foundation in food safety management systems, as it facilitates appropriate corrective actions in the event of contamination or quality deviations.

In recent developments, the concept of traceability is no longer limited to physical manual record-keeping but has evolved into a digital form that utilizes various technologies such as Radio Frequency Identification (RFID), barcodes, QR codes, the Internet of Things (IoT), and blockchain technology [5]. However, it should be noted that the implementation of cutting-edge technologies like blockchain requires significant infrastructure investment; therefore, for SMEs, simpler yet effective solutions tend to be more suitable and sustainable [19].

2.2. Food MSMEs and the Challenges of Digitization

SMEs are the backbone of Indonesia’s economy, with more than 65 million businesses contributing approximately 61% of the national Gross Domestic Product (GDP) [9]. Nevertheless, the rate of digital technology adoption among SMEs remains low; according to [12], only about 21% of SMEs have fully leveraged digital technology in their business operations. Key challenges include limited digital literacy, insufficient funding for technology procurement, and a lack of technical guidance from both the government and the private sector [16].

For MSMEs in the food sector in particular, the complexity of food safety regulations is placing an increasing burden on their operations. A study by [6] revealed that the majority of micro-scale food MSMEs have not yet mastered the concept of HACCP (Hazard Analysis and Critical Control Point), let alone more comprehensive tracking systems. This situation creates a high vulnerability to food safety risks, especially during periods of large-scale production such as the Eid al-Fitr holiday.

2.3. Digital Traceability: Affordable Technology-Based Solutions

Recent studies indicate that the implementation of digital tracking in SMEs can be achieved at low cost if designed with the right strategy. [4] introduced a QR code-based tracking model that was successfully implemented in food SMEs in China at very low cost. The model integrates three key elements: standardized data entry (via digital forms), the creation of a unique identifier for each production batch, and a traceability interface accessible to consumers via QR code scanning.

In Indonesia, a number of studies have begun to explore the potential of Google Workspace, particularly Google Forms and Google Sheets, as the foundation for an affordable yet reliable information system for SMEs. These platforms excel in terms of ease of use, do not rely on physical servers, are available at no cost, and can be accessed via mobile devices, features that are well-suited to the dynamic nature of SME operations.

2.4. System Requirements Analysis in the Context of the SDLC

The system requirements analysis phase plays a vital role in the Software Development Life Cycle (SDLC), as it serves as the foundation for the entire system’s development. [14] classify system requirements into two main groups: functional requirements, which describe the functions the system must fulfill, and non-functional requirements, which establish quality standards such as performance, security, and scalability.

For information systems in the SME sector, participatory requirements analysis methods that directly involve end-users have been shown to increase system acceptance [15]. Techniques such as process observation, semi-structured interviews, and low-fidelity prototyping are effective ways to capture the needs of SME groups who may be less familiar with technical terms related to information systems.

2.5. Theoretical Framework: Technology Acceptance Model (TAM)

To evaluate the potential acceptance of digital tracking systems among SME operators, this study adopts the Technology Acceptance Model (TAM) introduced by Davis (1989) and widely validated in SME settings [17]. TAM states that technology acceptance is determined by two key elements: Perceived Usefulness (PU), the user's view of the technology's usefulness, and Perceived Ease of Use (PEOU), the user's view of how easy it is to use. In the design of a tracking system for SMEs, these two aspects must be prioritized so that the system not only functions technically but is also accepted and utilized sustainably by business owners.

2.6. Relevant Regulations and Standards

From a regulatory perspective, the implementation of tracking systems in Indonesia is supported by a number of laws and regulations. Law No. 18 of 2012 on Food requires that all food produced and distributed in Indonesia meet safety, quality, and nutritional standards. More specifically, Government Regulation No. 86 of 2019 on Food Safety sets out registration requirements and production standards, which ultimately necessitate an adequate documentation system [13]. At the technical level, SNI 7661:2011 on Dry Cookies establishes standard parameters as a benchmark for cookie product quality, while the global standard ISO 22000:2018 on Food Safety Management Systems offers a framework that can be adapted for SMEs [8].

3. Research Method

3.1. Research Approach and Design

This study employs a qualitative-descriptive approach based on the interpretive paradigm, which is considered the most appropriate for exploring and mapping the diverse operational conditions of MSMEs, which are influenced by specific contexts. The design used is a multiple case study according to [18] framework, with the unit of analysis being Lebaran cookie-producing MSMEs operating in the Greater Jakarta area and its surroundings.

3.2. Data Collection Techniques

Primary data collection was conducted using three complementary methods: first, participatory observation of the cookie-making process at six selected SMEs, which took place over a four-week period leading up to Eid al-Fitr; second, semi-structured interviews with 18 informants, including business owners, head chefs, and sales staff; and third, a review of documents such as production records, proof of purchase for raw materials, and existing product labels. The interview instrument was designed following a system requirements analysis framework based on the IEEE 830-1998 standard on Recommended Practices for Software Requirements Specifications.

3.3. Data Analysis

The data obtained was analyzed using an inductive thematic analysis technique adapted from [3], combined with business process modeling using Business Process Model and Notation (BPMN) to depict the AS-IS and TO-BE process flows. The identified system requirements were then prioritized using the MoSCoW method (Must have, Should have, Could have, Won't have), which is commonly used in requirements engineering [7]. The validity of the analysis results was verified through member checking involving four key informants.

3.4. Analytical Framework

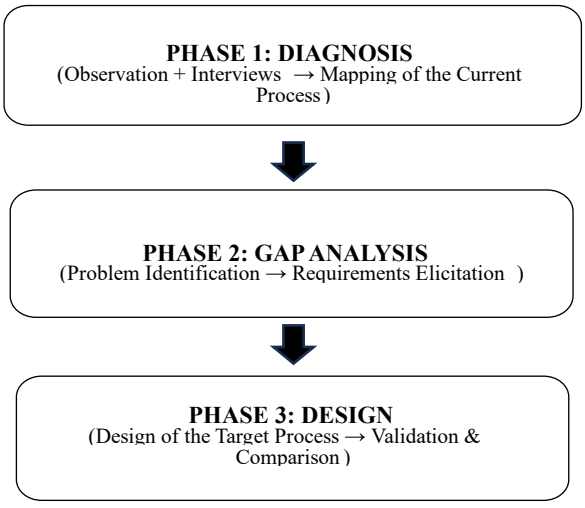
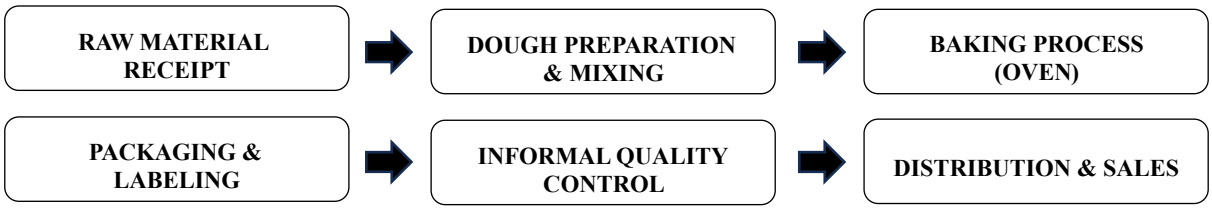


Fig. 1: Research Framework for Digital Traceability of SMEs

4. Results and Discussion

4.1. Current Status of AS-IS: Mapping the Current Production Process

A close examination of six SMEs producing Eid cookies revealed production processes that tend to be similar, but all are characterized by the absence of a formal documentation system. Overall, the current production process flow can be described as shown in the following diagram:



Source: Field Observation Results, 2026

Fig. 2: AS-IS Production Process Flowchart for Eid Cookies SMEs (Chart 1 of 2)

Raw materials such as wheat flour, butter, powdered sugar, eggs, and various fillings (cheese, chocolate, nuts) are sourced from a variety of suppliers, ranging from traditional markets and distributors to supermarkets, without any official documentation regarding the source, brand, expiration date, or quality details. The acceptance of these ingredients relies entirely on the visual and olfactory assessment of the owner or head chef.

The dough is mixed according to recipes that are either memorized or jotted down on loose sheets of paper without any organized filing system. Differences in ingredient measurements often arise from batch to batch, whether due to intentional adjustments (seasonal factors) or unintentional variations (differences in ingredients or environmental conditions). There are currently no written standard operating procedures (SOPs) to serve as a consistent guide.

Baking is done in a standard oven, where temperature settings rely on the operator's judgment. There are significant fluctuations in temperature and baking time between batches, resulting in inconsistencies in the final product quality. Process parameters such as temperature, time, or batch number are not recorded for quality control purposes.

Packaging is done by hand using plastic containers, glass jars, or plastic bags, accompanied by basic labels listing the product name and business name, without batch numbers, production dates, or complete ingredient lists. Product distribution relies on personal networks, WhatsApp groups, and social media, without any organized order tracking.

4.2. Problem Identification and Gap Analysis

An analysis of the current state of affairs has revealed four critical issues. First, the lack of a validated unique product identifier makes it impossible to track products when customer complaints arise. In one documented case, a consumer found a foreign object in a cookie, but the manufacturer was unable to identify the specific batch involved, forcing them to recall the entire stock, a loss that could have been prevented with a simple batch-tracking system.

Second, the lack of documentation regarding the raw material supply chain poses food safety risks that are difficult to detect. When a supplier switches butter brands without notice, the change goes unrecorded and is only discovered after consumers complain about differences in the product's texture. This situation underscores the urgency of an organized supplier tracking system [1].

Third, the lack of an incident reporting mechanism leaves MSMEs without historical data needed to analyze problem patterns and implement long-term improvements. Fourth, these documentation limitations also hinder the halal certification process and BPOM registration, which require verified production records, thereby indirectly limiting MSMEs' access to formal markets [9]. **4.3. System Requirements Analysis**

4.3.1. Functional Requirements

Based on a gap analysis and interviews with MSME operators, the following is a list of functional requirements for a digital traceability system that were successfully identified and prioritized using the MoSCoW method:

Table 1: Functional Requirements Matrix for the Digital Traceability System for MSMEs Producing Eid Cookies

ID	Functional Requirement	Priority	Tools/Approach
FR-01	The system can record raw material data (name, supplier, date, quantity)	High	Google Forms + Sheets
FR-02	The system automatically generates a unique batch code	High	Script / Apps Script
FR-03	The system records production process data per batch	High	Google Forms
FR-04	The system generates and prints a QR Code per package	High	QR Generator API

FR-05	The system enables product tracking via QR scan	High	Web App / Landing Page
FR-06	The system records distribution and sales data	Medium	Google Sheets
FR-07	The system sends notifications in case of a product (recall)	Medium	Email/WhatsApp API
FR-08	Automated daily/weekly production summary reports	Medium	Google Data Studio
FR-09	Multi-user access with role-based permissions	Low	Google Workspace
FR-10	Automatic data backup to the cloud	Low	Google Drive

Source: Needs Analysis Results, 2026

4.3.2. Non-Functional Requirements

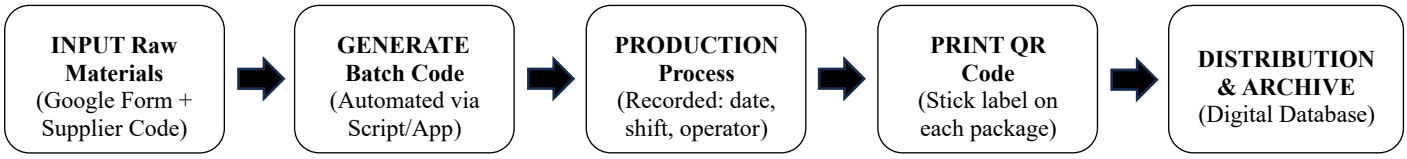
In addition to functional requirements, the analysis also identified a number of non-functional requirements that will affect the quality and sustainability of the system. Usability is a top priority: the system interface must be easy to use for users with basic digital skills, such as those who are proficient enough to use a smartphone for social media and instant messaging. As a benchmark, the time required to understand core features should not exceed 30 minutes for novice operators [17].

In terms of availability, the system must be accessible at any time and from anywhere, given that MSME production activities often take place outside of regular business hours, including at night or on weekends. Cloud-based platforms like Google Workspace naturally meet these requirements. Regarding data security, the system must include access control settings that distinguish the roles of data entry personnel, supervisors, and business owners to prevent unauthorized data changes [15].

Scalability is also a key consideration: the system must be able to handle a tenfold increase in data volume during the Eid al-Fitr peak season without any significant drop in performance. Finally, the system's operating costs must not exceed Rp 500,000 per month in the initial phase; this limit is based on the average financial conditions of the MSMEs studied.

4.4. TO-BE Design: Digital Traceability System Architecture

Based on a comprehensive identification of system requirements, this study designs a TO-BE state that leverages an affordable yet functional technology ecosystem. The TO-BE system architecture consists of four interconnected layers:



Source: Research Proposal, 2026

Fig. 3: TO-BE Process Flow: Digital Traceability System for MSMEs Producing Eid Cookies

The first layer is the Data Input Layer, which uses Google Forms as a standardized data input interface. Three main forms have been designed: the Raw Material Receipt Form (to record the material name, supplier, receipt date, quantity, and visual condition), the Production Process Form (to record the batch code, production date, operator, process parameters, and quantity of finished products), and the Distribution Form (to record the buyer's name, quantity, date, and distribution channel). All of this data is automatically stored in Google Sheets, which serves as a centralized database [4].

The second layer is the Batch Identification Layer. Each production batch is assigned a unique batch code generated automatically via Google Apps Script in the format [Product Code]-[Year]-[Month]-[Sequence Number], for example, CKS-2025-03-047. This code serves as the primary key linking all data from upstream (raw materials) to downstream (distribution). This approach to issuing batch codes aligns with GS1 standards, a global system for product identification [5].

The third layer is the Product Identification Layer, which generates a unique QR code for each production batch using Google Apps Script integrated with the QR Code API. These QR codes are printed on adhesive labels and affixed to each package. When consumers scan the QR code using their smartphone camera, they are directed to a simple web page displaying information such as the product name, production date, batch number, general ingredients, and the manufacturer's contact information.

The fourth layer is the Analytics & Reporting Layer, which uses Google Data Studio (Looker Studio) to visualize production data through easy-to-understand dashboards. These dashboards display key indicators, such as the number of production batches per period, production volume by product variant, a summary of raw material suppliers, and distribution records. These reports support SME owners in making data-driven business decisions, a capability they previously lacked entirely [19].

4.5. Comparative Analysis of AS-IS vs. TO-BE

Table 2: Comprehensive Comparison of the AS-IS vs. TO-BE Conditions of the SME Traceability System

Aspect	AS-IS Condition (Before)	TO-BE Condition (After)
Raw Material Recording	Manual/verbal, undocumented	Digital via Google Forms, automatically saved
Product Identification	No batch codes, generic labels	Unique batch codes + QR Code on each package

Traceability	Cannot be traced if there is an issue	Can be traced from the QR code throughout the entire production chain
Quality Control	Based on instinct/experience	Standardized, with digital checkpoints per batch
Incident Response	Slow, unclear source of the problem	Fast: identify batch → recall specific product
Implementation Cost	Low (no system)	Low to medium (based on free/low-cost tools)
Consumer Trust	Depends on personal reputation	Increased: transparency via QR scan

Source: Comparative Analysis Results, 2026

Table 2 in the comparative analysis clearly demonstrates the added value of implementing a digital traceability system. The most fundamental change is evident in the area of traceability: moving from a situation with no traceability mechanism at all to a system that allows the complete history of each product to be tracked simply by scanning a QR code in a matter of seconds. This is not merely a technological advancement, but a paradigm shift in the management of MSME production.

An important benefit that is often overlooked but has a tangible empirical impact is increased consumer trust. A study by [19] revealed that consumers who can access production information via QR codes have a 34% higher level of trust and a 28% greater likelihood of repurchasing compared to those without access to such information. These findings are highly relevant for small and medium-sized enterprises (SMEs) producing Eid cookies that aim to strengthen customer loyalty amid increasingly fierce market competition.

From a risk management perspective, the ability to accurately identify and isolate problematic batches can substantially reduce financial losses. Without a traceability system, the product recall process requires SMEs to recall all available stock, a measure that is not only economically burdensome but also damages their reputation. Thanks to batch tracking, recalls can be targeted specifically at only the problematic batches [11].

4.6. Implementation Challenges and Mitigation Strategies

Although the developed system utilizes relatively accessible technology, its implementation still faces several obstacles. The first major obstacle is resistance to change from MSME actors who have long been accustomed to conventional business methods. Interview results indicate that 11 out of 18 informants were initially skeptical about the usefulness of the digital system, citing concerns that digital recordkeeping could potentially slow down production.

To address this resistance, the recommended strategy is phased implementation: starting with the most basic elements that deliver tangible and immediate benefits, such as digital forms for receiving raw materials, before moving on to more complex features like QR code generation. This strategy aligns with change management principles that emphasize the role of quick wins in driving adoption [10].

The second challenge stems from limited digital infrastructure, particularly among SMEs in areas with unstable internet connections. The solution is to create data entry forms that can operate offline and synchronize information once a connection is restored, a capability supported by Google Forms on mobile devices. The third challenge concerns long-term system maintenance after the mentoring period ends. Therefore, in-depth training for at least two “system administrators” at each SME is an essential step to reduce reliance on external assistance [16].

4.7. Cost-Benefit Analysis

One of the most common practical concerns raised by MSME operators relates to costs. The estimated costs for implementing a digital traceability system in this study can be summarized as follows: purchase of smartphones (if not already available): IDR 1,500,0002,000,000 (one-time payment); printing QR Code stickers per batch: IDR 500-1,000 per sheet; internet subscription: IDR 50,000-150,000 per month; Google Workspace (optional, for additional features): IDR 0–150,000 per month; and initial training: IDR 0 if conducted independently.

With these relatively low costs, MSMEs can reap benefits such as savings from avoiding losses due to product recalls (estimated at Rp 2,000,000 to Rp 10,000,000 per incident), expanded access to formal markets that require proof of production documentation (such as premium e-commerce platforms and supermarkets), and easier acquisition of MUI halal certification and BPOM P-IRT registration, all of which open opportunities to larger market segments [9]. A cost-benefit analysis confirms that the return on investment (ROI) from a digital traceability system can be achieved in just one to two production cycles.

5. Conclusions and Recommendations

5.1. Conclusions

This study yields three key contributions. First, an in-depth mapping of the current state of small and medium-sized enterprises (SMEs) producing Eid cookies reveals a systematic pattern of missing production documentation, which collectively creates food safety gaps and substantial business vulnerabilities. This lack of record-keeping is not merely negligence but a consequence of an SME ecosystem that still lacks sufficient systemic support and capabilities.

Second, the requirements analysis yielded a list of 10 functional requirements and five non-functional requirements, which were prioritized using the MoSCoW method. Overall, these requirements can be met by the cost-effective Google Workspace ecosystem, thereby significantly reducing the financial barriers that often hinder the digital transformation of SMEs.

Third, the TO-BE design demonstrates that an effective digital traceability system, including standardized data entry, automatic batch coding, and QR code tracking, can be implemented at an affordable cost in the context of SMEs. A comparative analysis of the AS-IS and TO-BE scenarios reveals qualitative improvements across seven key dimensions, with traceability and food safety emerging as the most essential benefits.

More broadly, this study reinforces the understanding that the digitalization of food-sector MSMEs is not merely a matter of technology, but rather a shift in mindset from instinct-driven production to data-driven production. This shift is, in essence, an absolute prerequisite for enhancing the competitiveness and sustainability of Indonesia's food MSMEs in an increasingly demanding market.

5.2. Recommendations

Based on the research findings, there are several recommendations worth considering. For MSME operators, it is recommended to start by implementing digital raw material tracking as an initial step, before moving on to more complex features. A phased approach, starting small, implemented consistently, and developed gradually, has proven to be more successful than making sweeping changes all at once.

For the government, particularly the Ministry of Cooperatives and Small and Medium Enterprises and the Indonesian Food and Drug Administration (BPOM), this study recommends the development of a digital traceability support program linked to halal certification and P-IRT initiatives. Facilitating certification tied to the use of digital traceability systems will serve as a strong driver for widespread adoption.

For future researchers, this study opens up opportunities for further research, such as the development and validation of technical system prototypes, the assessment of system acceptance levels following implementation, and the exploration of potential integration with blockchain technology to enhance data resilience in the future.

References

[1] R. Astuti, M. Marimin, and R. Poerwanto, "Analisis implementasi sistem keterlacakan produk hortikultura pada UMKM di Indonesia," *Jurnal Manajemen & Agribisnis*, vol. 19, no. 2, pp. 112–124, 2022.

[2] Badan Pengawas Obat dan Makanan Republik Indonesia, *Peraturan Badan Pengawas Obat dan Makanan Nomor 22 Tahun 2021 tentang Penerapan Sistem Jaminan Keamanan Pangan dan Mutu Pangan*. Jakarta, Indonesia: BPOM RI, 2021.

[3] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77–101, 2006.

[4] X. Duan, Y. Liu, and H. Zhang, "QR code-based food traceability system for small and medium-sized enterprises: A case study in China," *Food Control*, vol. 115, pp. 107294, 2020.

[5] J. F. Galvez, J. C. Mejuto, and J. Simal-Gandara, "Future challenges on the use of blockchain for food traceability analysis," *TrAC Trends in Analytical Chemistry*, vol. 107, pp. 222–232, 2020.

[6] T. Handayani, S. Kurnia, and F. Tjiptono, "Barriers to food safety management adoption among micro food businesses in developing economies," *British Food Journal*, vol. 125, no. 4, pp. 1432–1450, 2023.

[7] W. A. Khan, L. Liu, and M. Azhar, "Which requirements elicitation technique is most effective? A systematic literature review," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 12, pp. 138–155, 2021.

[8] International Organization for Standardization, *ISO 22000:2018 Food Safety Management Systems - Requirements for Any Organization in the Food Chain*. Geneva, Switzerland: ISO, 2018.

[9] Kementerian Koperasi dan UKM Republik Indonesia, *Laporan Tahunan Perkembangan UMKM Indonesia 2021-2022*. Jakarta, Indonesia: Kementerian Koperasi dan UKM RI, 2022.

[10] J. P. Kotter, *Leading Change*, 2nd ed. Boston, MA, USA: Harvard Business Review Press, 2020.

[11] L. Manning and J. M. Soon, "Food safety, food fraud, and food defense: A fast evolving literature," *Journal of Food Science*, vol. 81, no. 4, pp. R823–R834, 2016.

[12] McKinsey & Company, *Unlocking Growth Through Digitalization: A Study of Indonesian SMEs*. New York, NY, USA: McKinsey Global Institute, 2021.

[13] Sekretariat Kabinet Republik Indonesia, *Peraturan Pemerintah Republik Indonesia Nomor 86 Tahun 2019 tentang Keamanan Pangan*. Jakarta, Indonesia: Sekretariat Kabinet RI, 2019.

[14] R. S. Pressman and B. R. Maxim, *Software Engineering: A Practitioner's Approach*, 9th ed. New York, NY, USA: McGraw-Hill Education, 2020.

[15] I. Sommerville, *Software Engineering*, 10th ed. Hoboken, NJ: Pearson Education, 2021.

[16] T. T. H. Tambunan, "MSMEs in emerging economies: The key to achieving SDGs?," *Journal of Economic Integration*, vol. 36, no. 3, pp. 412–465, 2021.

[17] V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User acceptance of information technology: Toward a unified view," *MIS Quarterly*, vol. 27, no. 3, pp. 425–478, 2003.

[18] R. K. Yin, *Case Study Research and Applications: Design and Methods*, 6th ed. Thousand Oaks, CA, USA: Sage Publications, 2018.

[19] G. Zhao, S. Liu, C. Lopez, H. Lu, S. Elgueta, H. Chen, and B. M. Boshkoska, "Blockchain technology in agri-food value chain management: A synthesis of applications, challenges and future research directions," *Computers in Industry*, vol. 109, pp. 83–99, 2019.