Research Article

Digital Transformation of Mushroom MSMEs through a Cloud-Based Barcode Inventory Information System: An Implementation and Functional Evaluation

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Abstract

Effective inventory management remains a challenge for many micro, small, and medium enterprises (MSMEs), particularly when product identification and stock transactions are managed manually. This study aims to implement a cloud-based barcode inventory information system for a mushroom MSME and evaluate its functional performance. The system was developed as a web-based application integrating product master-data management, barcode generation and scanning, inventory transactions, stock monitoring, supplier and customer management, delivery documentation, reporting, and operator activity history. A scenario-based black-box testing approach was employed to evaluate the implemented system. The evaluation consisted of 16 predefined test cases covering general system functions, barcode operations, inventory transactions, and cloud-based data handling. Functional correctness was measured using the Functional Success Rate (FSR), calculated as the proportion of successfully completed test cases relative to the total number of test cases. The evaluation resulted in 14 successful test cases out of 16, corresponding to an FSR of 87.5%. The findings demonstrate that the implemented system successfully performed the specified inventory management functions and integrated barcode-based product identification with centralized cloud-based inventory data management. The study contributes an implementation-oriented approach for applying barcode and cloud technologies to inventory management in mushroom MSMEs. However, because systematic pre-implementation measurements were not collected, the study does not claim improvements in processing time, inventory accuracy, or transaction throughput. Future research should conduct longitudinal evaluations to quantify the operational impact of system adoption.

Keywords: Barcode Technology, Cloud Computing, Digital Transformation, Inventory Information System, Mushroom MSME

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1. Introduction

Micro, Small, and Medium Enterprises (MSMEs) play a strategic role in Indonesia's economic development by contributing significantly to employment creation, regional economic growth, and food security. Among agricultural MSMEs, mushroom cultivation businesses have experienced continuous growth due to increasing consumer demand and relatively low production costs. However, many mushroom enterprises continue to rely on conventional inventory management practices, where stock recording is performed manually using notebooks or spreadsheet applications. Such practices often result in inventory inaccuracies, delayed reporting, duplicated data entry, and difficulties in monitoring stock availability (Salih et al., 2023; Suparmanto et al., 2025).

Inventory management is one of the most critical operational functions within mushroom cultivation

because the business simultaneously manages various inventory categories, including raw materials, production supplies, packaging materials, harvested mushrooms, and finished products (Wei et al., 2023). Furthermore, harvested mushrooms are highly perishable commodities with relatively short storage periods. Consequently, inaccurate inventory information may lead to production delays, product spoilage, unnecessary purchasing activities, and financial losses (Refanto et al., 2024).

Digital transformation has become an important strategy for improving operational efficiency within MSMEs. Recent advances in cloud computing and automatic identification technologies provide affordable solutions that were previously available only to large enterprises (Mayo et al., 2018; Rao, 2025). Among these technologies, barcode systems offer a practical approach for improving inventory accuracy by minimizing manual data entry and enabling automatic identification during inventory transactions. Combined with cloud-based information systems, barcode technology enables real-time inventory monitoring, centralized data management, and faster reporting processes without requiring expensive infrastructure investments.

Several previous studies have developed inventory information systems for MSMEs (Abdila et al., 2024; Agboola et al., 2022; Chukwumuanya et al., 2024; Erameh & Odoh, 2021; Otobo & Alegbe, 2024; Pasaribu, 2021; Soegoto & Palalungan, 2020; Susanto et al., 2024; Yoraeni et al., 2025); however, many of these studies primarily focused on software development and functional implementation. Limited research has evaluated the operational impact of implementing barcode-based cloud inventory systems in agricultural MSMEs handling perishable products. Moreover, practical implementation evidence demonstrating improvements in business operations remains relatively scarce.

To address this research gap, this study implements a cloud-based inventory information system integrated with barcode technology in Kelompok Tani Jamur Sedyo Lestari, a mushroom cultivation MSME located in Yogyakarta, Indonesia. Unlike previous studies emphasizing application development, this research evaluates the implementation outcomes by examining improvements in inventory recording efficiency, stock monitoring, reporting processes, and operational performance after system deployment.

Therefore, this study aims to (1) implement a cloud-based barcode inventory information system tailored to the operational characteristics of mushroom MSMEs, (2) evaluate its effectiveness in improving inventory management activities, and (3) analyze the operational impacts of digital transformation on inventory management practices. The findings are expected to provide practical guidance for MSMEs seeking affordable digital solutions while contributing empirical evidence to the growing literature on digital transformation and inventory information systems for agricultural enterprises.

2. Literature Review

2.1. Digital Transformation in Agricultural MSMEs

Digital transformation refers to the integration of digital technologies into business processes to improve operational performance, productivity, and competitiveness (Hendrawan et al., 2024). In agricultural MSMEs, digital transformation has gradually shifted business operations from manual record-keeping toward integrated information systems capable of supporting production planning, inventory control, and business decision-making.

The implementation of digital technologies has become increasingly important for mushroom cultivation businesses because inventory includes perishable products requiring accurate monitoring. Real-time inventory information enables producers to reduce product losses, optimize purchasing decisions, and improve customer service. Cloud computing, barcode technology, mobile applications, and business information systems collectively provide opportunities for agricultural MSMEs to modernize their operational processes while maintaining affordable implementation costs.

2.2. Inventory Information System for MSMEs

An inventory information system is an integrated management system designed to manage inventory data efficiently throughout procurement, storage, production, and distribution activities (Hasanah et al., 2024). The primary objective of an inventory information system is to maintain accurate stock information, reduce inventory costs, and support timely decision-making. By providing real-time inventory

records, organizations can optimize stock levels, prevent stock shortages or overstocking, and improve overall operational performance. In MSMEs, inventory information systems have become increasingly important due to the growing complexity of business operations and the need for accurate inventory monitoring.

However, the implementation of an inventory information system for MSMEs is not simply a matter of digitizing existing records. The system must also provide an efficient mechanism for identifying the physical items involved in each transaction. If product identification remains entirely dependent on manual data entry, digitalization of the database does not necessarily eliminate the possibility of identification errors or inconsistent product selection. This issue creates an opportunity to integrate automated identification technology into inventory information systems.

2.3. Barcode Technology in Inventory Management

Barcode technology is one of the most widely adopted automatic identification technologies for inventory management. A barcode consists of machine-readable symbols representing product identification numbers that can be scanned using barcode readers. The implementation of barcode technology offers several operational advantages, including faster inventory transactions, reduced manual data entry, improved inventory accuracy, better product traceability, and lower probability of human error. Compared with manual inventory recording, barcode scanning simplifies product identification because users only need to scan the barcode label instead of entering product information manually. Barcode technology remains a practical solution for MSMEs because of its lower implementation cost and simpler infrastructure requirements.

For MSMEs, barcode-based identification can provide a relatively accessible technology for structuring inventory transactions. Nevertheless, barcode implementation alone does not constitute an integrated inventory information system. A barcode system needs to be connected to product master data and inventory transaction logic so that scanning an item produces a meaningful change in the corresponding inventory record. Consequently, the research interest is not limited to whether a barcode can be scanned, but whether barcode identification can be integrated into the complete inventory management workflow.

2.4. Cloud-Based Inventory Information Systems

Cloud computing enables organizations to access computing resources, applications, and databases through internet-based services without maintaining dedicated local servers. For MSMEs, cloud computing offers several advantages, including lower infrastructure costs, easier system maintenance, data accessibility, automatic backup, and scalability (Ragasari & Dewi, 2026). Cloud-based inventory systems allow business owners and employees to monitor inventory conditions in real time regardless of their physical location. This capability supports faster managerial decision-making while reducing the operational burden associated with maintaining conventional information technology infrastructure. The affordability and flexibility of cloud technology make it particularly suitable for agricultural MSMEs that require efficient information systems but have limited financial resources.

A cloud-based inventory system can be particularly useful when inventory information needs to be accessed from different devices or locations. Centralized data management can also support the integration of inventory transactions and reporting because the same data source is used for multiple system functions. However, cloud deployment introduces additional technical considerations. The application, database, and user interface need to operate as an integrated system, while transaction data must be stored consistently.

Therefore, implementation studies need to consider not only the availability of a cloud-hosted application but also the relationship between transaction processing and centralized data storage. The combination of cloud computing and barcode technology creates a two-level integration. Barcode technology connects the physical inventory item to a digital identifier, while cloud computing provides the centralized environment in which the resulting inventory information is stored and processed.

2.5. State of the Art

The existing literature indicates that inventory information systems, barcode technology, and cloud computing have each been applied to support inventory-related activities. Nevertheless, the degree of integration and evaluation varies among studies. For the present study, the state of the art is considered from four dimensions: inventory information system functionality, barcode-based identification, cloud-based deployment, and empirical technical evaluation. However, there remains a practical research gap concerning the implementation of an integrated system that combines barcode-based product identification, inventory transaction processing, centralized cloud data management, and explicit functional verification within a mushroom MSME context.

This study addresses the gap by implementing these components as a single operational workflow. Unlike a study that only demonstrates barcode generation or inventory database functionality, the proposed system connects product registration, barcode identification, inventory transactions, stock monitoring, and reporting. The system is subsequently evaluated using predefined functional test scenarios. The contribution is therefore positioned primarily as an implementation and technical evaluation contribution, rather than as a longitudinal assessment of business performance. This distinction is important because the present study does not include systematic pre-implementation measurements of transaction time, inventory accuracy, or transaction throughput.

3. Research Method

3.1. Research Design

This study employed an applied research approach to design, implement, and evaluate a cloud-based inventory information system integrated with barcode technology. The research was conducted at Kelompok Tani Jamur Sedyo Lestari, a mushroom-producing MSME located in Yogyakarta, Indonesia. The research focused on transforming the existing inventory management process into an integrated digital workflow covering product management, barcode identification, inventory transactions, stock monitoring, delivery documentation, and reporting. The research stages consisted of requirements identification, system development, cloud deployment, barcode integration, and technical evaluation. Figure 1 illustrates the overall research framework.

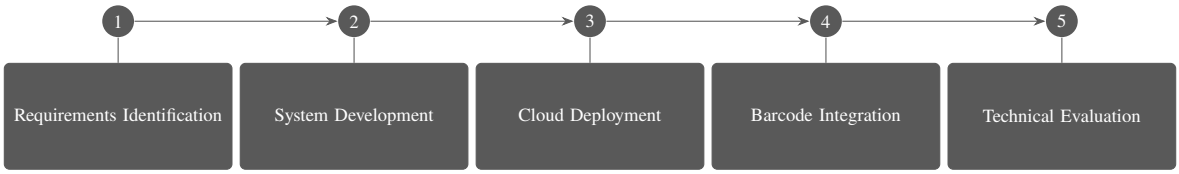


Figure 1. Research Framework

The evaluation was designed to assess whether the implemented system performed its intended inventory management functions correctly. Because baseline operational measurements were not systematically collected before implementation, the study did not perform a pre-post comparison of transaction time, inventory error reduction, or productivity. Instead, quantitative evaluation was conducted through predefined functional and technical test scenarios.

3.2. System Requirements and Functional Scope

System requirements were derived from the operational inventory activities of the partner MSME and were subsequently translated into functional modules. The implemented system supports the management of product master data, barcode identification, inventory transactions, stock monitoring, supplier and customer information, delivery documentation, and reporting. The principal functional scope includes user authentication and access, product and inventory master data management, barcode generation and printing, goods-in transactions, goods-out transactions, stock mutation recording, actual stock monitoring, supplier management, customer management, delivery note management, period-based reporting, and operator activity history.

3.3. System Development

The inventory information system was developed using the Rapid Application Development (RAD) methodology. RAD was selected because it emphasizes iterative development, rapid prototyping, and continuous user involvement, making it suitable for MSMEs where operational requirements may evolve during implementation. System development of RAD process consisted of four phases (Beynon-Davies et al., 1999; Martin, 1991):

1. Requirements Planning: Initial observations and interviews were conducted with the MSME owner and operational staff to identify inventory management problems. The analysis revealed several issues, including manual stock recording, duplicated inventory data, delayed report preparation, and difficulties in monitoring inventory levels.
2. User Design: Based on user requirements, system prototypes were designed collaboratively with end users. The system included modules for product management, barcode generation, purchasing, inventory transactions, stock adjustment, and reporting.
3. Construction: The web-based application was developed using modern web technologies connected to a cloud database. Barcode functionality was integrated to support automatic product identification through barcode labels and wireless barcode scanners.
4. Implementation: The completed system was deployed within the MSME environment. Users received training before the system was used in daily operational activities.

The system was designed as a web-based application so that inventory information could be accessed through standard web browsers. Product information and inventory transactions were maintained in a centralized database. Barcode functionality was incorporated into the product management process, allowing each registered inventory item to be associated with a unique product identifier represented by a machine-readable barcode. The development process emphasized the integration between product master data and inventory transactions. Consequently, barcode scanning did not merely identify products but also served as an input mechanism for inventory-related operations.

3.4. Cloud-Based System Architecture

The implemented system uses a layered cloud-based architecture consisting of the client layer, application layer, database layer, and barcode identification interface. At the client layer, users access the system through a web browser using a computer or other compatible device. The application layer processes authentication, product management, inventory transactions, reporting, and validation rules. The data layer provides centralized storage for product, inventory, transaction, supplier, customer, delivery, and activity-history data.

Barcode scanners function as the identification interface between physical inventory and the application. When a barcode is scanned, the resulting product identifier is submitted to the application and matched against the product master data stored in the database. This architecture allows inventory transactions to be recorded in a centralized database and subsequently reflected in inventory monitoring and reporting functions. The general data flow can be represented as Figure 2.

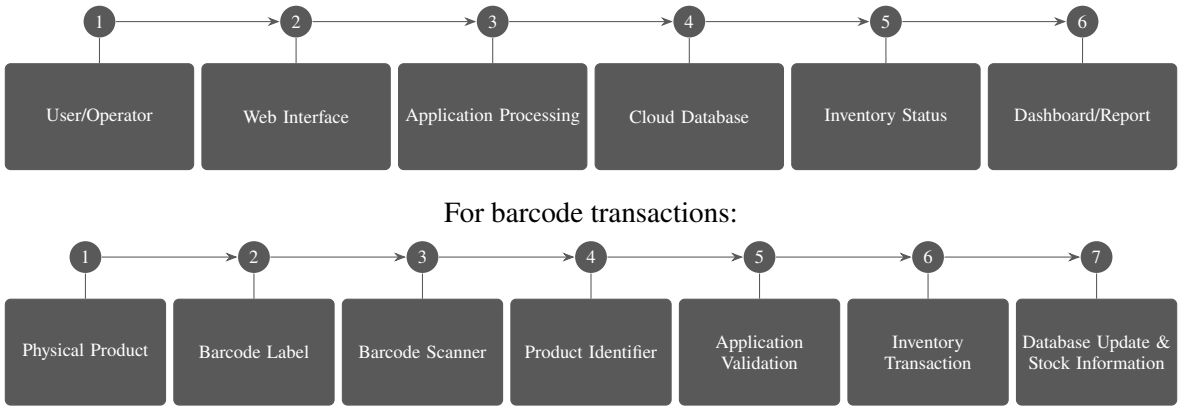


Figure 2. Cloud-Based System Architecture

3.5. Barcode-Based Inventory Workflow

The barcode-based workflow begins with product registration. The operator enters the required product information and generates a barcode associated with the registered product. The barcode can subsequently be printed and attached to the corresponding inventory item. During inventory operations, the operator scans the barcode. The system retrieves the corresponding product record and uses the identified product as the basis for the inventory transaction. For a goods-in transaction, the scanned product is associated with an incoming quantity and the corresponding inventory balance is increased.

For a goods-out transaction, the system records the outgoing quantity and reduces the inventory balance accordingly. The same product identification mechanism supports inventory monitoring and transaction traceability through the recorded inventory and operator activity history.

3.6. Test Procedure and Observations

The implemented system was evaluated using scenario-based functional testing. Test scenarios were derived from the functional scope of the system and focused on whether each operation produced the expected result. The system evaluation was conducted by the researchers through scenario-based functional testing after the system had been implemented. No separate user-participant study was conducted in this evaluation because the primary objective was to verify the technical and functional operation of the developed inventory information system. A total of 16 test observations were conducted across the main functional areas of the system.

The observations were organized into four categories: (1) general system functions, (2) barcode operations, (3) inventory transactions, and (4) cloud-based data handling. Each test observation consisted of a predefined input or operational condition and an expected system response. The researchers executed the test scenario and recorded the observed result. A test observation was classified as successful when the actual system response corresponded to the expected result.

The testing covered both normal and exception conditions. Normal conditions included valid login, product registration, barcode generation, barcode scanning, stock-in, stock-out, stock mutation, and report generation. Exception conditions included invalid or unregistered barcode input and inventory transactions requiring system validation. Because systematic baseline observations were not collected before implementation, the study did not perform a before-and-after comparison of transaction processing time, inventory accuracy, error reduction, or transaction throughput. Therefore, the quantitative evaluation was limited to the successful execution of predefined functional and technical test scenarios.

3.7. Evaluation Method

The primary evaluation metric was the Functional Success Rate (FSR). FSR measures the proportion of test observations that were successfully completed according to their predefined expected results. The FSR was calculated using the following equation:

$$\text{FSR} = \frac{N_s}{N_t} \times 100\% \tag{1}$$

where N_s is the number of successful test observations and N_t is the total number of test observations.

The FSR was calculated for the overall system and, where appropriate, for each evaluation area. This approach provides a simple quantitative indicator of functional correctness while avoiding unsupported claims regarding operational improvements that were not measured before system implementation. The test observations were grouped into four evaluation areas, as shown in Table 1.

4. Result and Discussion

4.1. System Implementation

The cloud-based barcode inventory information system was implemented to support the inventory management activities of the mushroom MSME. The system integrates product management, barcode processing, inventory transactions, stock monitoring, supplier and customer management, delivery documentation, reporting, and operator activity history within a single web-based platform. The implementa-

Table 1. Test Procedure and Observations

Evaluation Area	Main Test Focus
General system functions	Authentication, product management, reporting, and activity history
Barcode operations	Barcode generation, printing, scanning, and invalid barcode handling
Inventory transactions	Stock-in, stock-out, stock mutation, and stock monitoring
Cloud-based data handling	Storage and retrieval of supplier and customer data, and delivery documentation

tion establishes an integrated relationship between physical inventory and digital inventory records. Each registered product is associated with a unique product identifier that can be represented by a barcode. The barcode provides an alternative input mechanism for inventory transactions, allowing the operator to identify products through scanning rather than relying solely on manual product selection.

The implemented system consists of several interconnected functional areas. The product management module is used to maintain product information, while barcode functions support barcode generation and printing. Inventory transaction functions support incoming and outgoing stock as well as stock mutation. Additional functions provide information related to suppliers, customers, delivery documents, inventory reports, and operator activities. The centralized structure allows inventory-related information to be maintained within the same application environment. Consequently, product identification, inventory transactions, stock monitoring, and reporting are connected through the same data structure. The main interface of the system is shown in Figure 3.

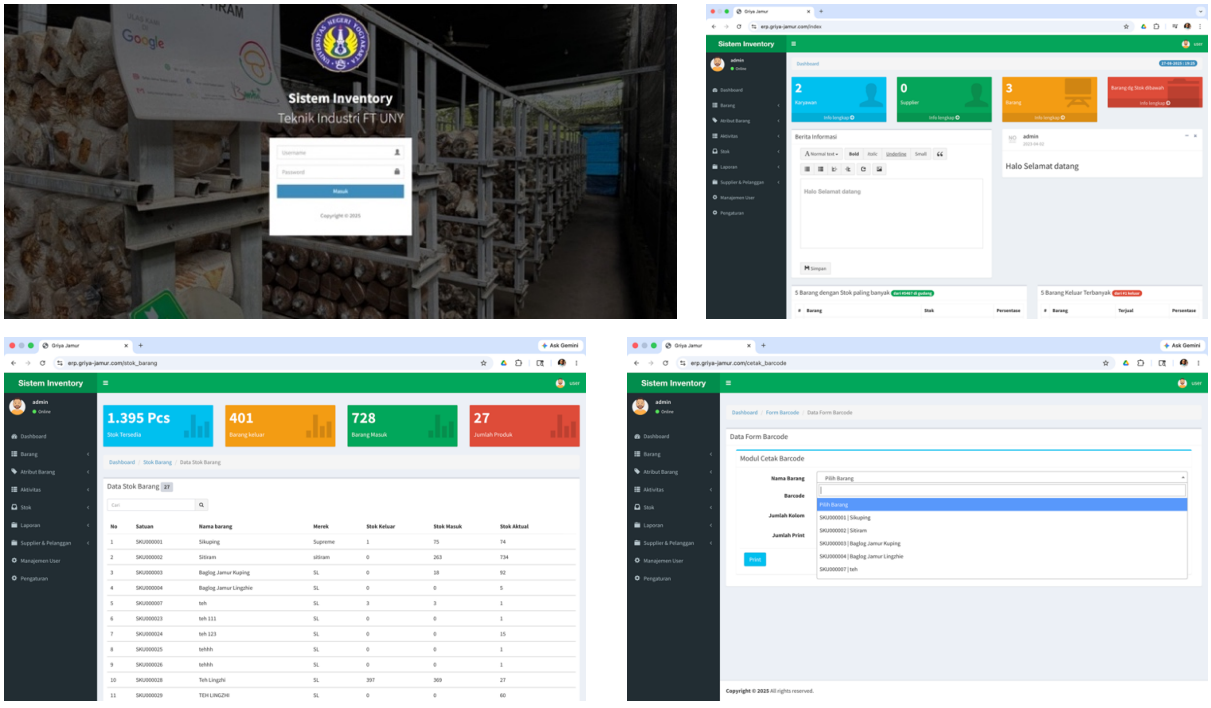


Figure 3. Main Interface of the Inventory Information System

4.2. Barcode-Based Inventory Implementation

Barcode functionality was implemented as an identification mechanism within the inventory workflow. The process starts with product registration, in which the product information is stored in the system and associated with a unique product identifier. The corresponding barcode can then be generated and printed for physical labeling. During an inventory transaction, the operator scans the barcode attached

to the relevant inventory item. The scanner transfers the barcode value to the application, which uses the captured identifier to retrieve the corresponding product record.

The identified product is subsequently used in the inventory transaction. For incoming inventory, the quantity is added to the relevant stock record, whereas an outgoing transaction reduces the corresponding stock quantity. Stock mutation can also be recorded when inventory is transferred or adjusted. The implemented workflow can be represented as Figure 4. This workflow provides a direct connection between the physical inventory item and its digital record. The integration is particularly relevant for MSMEs because it allows barcode technology to be incorporated into routine inventory activities without requiring a complex identification infrastructure.

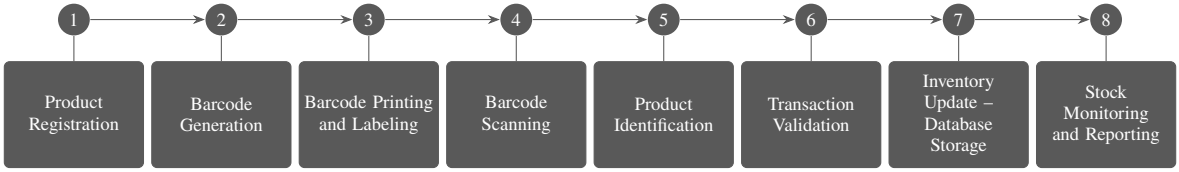


Figure 4. Barcode-Based Inventory Workflow

4.3. Functional Testing Results

The implemented system was evaluated using scenario-based black-box functional testing. The testing focused on observable system behavior rather than source-code inspection. Sixteen test cases were defined based on the principal functions and operational workflow of the implemented system. The test cases covered authentication, product management, barcode processing, inventory transactions, supporting master data, delivery documentation, reporting, and activity traceability, as shown in Table 2.

Table 2. Functional Test Cases

Test ID	Evaluation Area	Test Scenario	Expected Result	Result
T01	General system functions	Login using valid credentials	Dashboard is displayed	Pass
T02	General system functions	Add a new product	Product record is stored	Pass
T03	General system functions	Edit product information	Updated product information is stored	Pass
T04	Barcode operations	Generate product barcode	Barcode is generated	Pass
T05	Barcode operations	Print barcode label	Barcode label is produced	Pass
T06	Barcode operations	Scan registered barcode	Corresponding product is identified	Fail
T07	Barcode operations	Scan unregistered barcode	Invalid product is rejected or identified as invalid	Pass
T08	Inventory transactions	Record goods-in transaction	Stock quantity increases correctly	Pass
T09	Inventory transactions	Record goods-out transaction	Stock quantity decreases correctly	Pass
T10	Inventory transactions	Record stock mutation	Inventory movement is recorded	Pass
T11	Inventory transactions	View actual stock	Current stock information is displayed	Pass
T12	Cloud-based data handling	Manage supplier information	Supplier information is stored/retrieved	Pass
T13	Cloud-based data handling	Manage customer information	Customer information is stored/retrieved	Pass
T14	Cloud-based data handling	Create delivery note	Delivery document is generated	Fail
T15	General system functions	Generate inventory report	Requested report is displayed	Pass
T16	General system functions	View operator activity history	Activity history is displayed	Pass

For the 16 predefined test cases, the resulting FSR is:

$$\text{FSR} = \frac{14}{16} \times 100\% = 87.5\%$$

Thus, the system achieved an 87.5% functional success rate across the 16 predefined test cases. The results indicate that the implemented system was able to execute the specified functional operations according to the predefined expected outcomes.

Two test cases initially produced unsuccessful results during functional testing: **T06 (Scan Registered Barcode) and T14 (Create Delivery Note)**. For T06, the barcode scanner did not immediately identify the registered barcode as expected. Further examination indicated that the device settings were not yet properly configured for the application environment, and the operator was still becoming familiar with the scanner's operation. Thus, the initial failure was associated with device configuration and operational familiarity rather than the absence of barcode functionality in the system. After the appropriate device settings were adjusted and the scanning procedure was better understood, the barcode scanning function could be used according to the intended workflow.

For T14, the initial test was unsuccessful because the operator selected the wrong button during the delivery note creation process. The failure was therefore related to an operational input error rather than a system processing error. This finding indicates that correct system operation depends not only on functional availability but also on appropriate user interaction with the interface. The occurrence of this error provides useful evidence for identifying areas where interface guidance or operator familiarization may be improved. These two initial unsuccessful observations were retained in the evaluation results rather than being excluded from the analysis.

Accordingly, 14 of the 16 predefined test cases were initially completed successfully, resulting in an FSR of 87.5%. The two unsuccessful cases also provided practical information for identifying configuration and operational issues that need to be addressed during system adoption. The successful execution covered not only basic product management but also the barcode-based inventory workflow and supporting inventory management functions. The result should be interpreted as evidence of functional correctness under the tested scenarios. It does not, however, demonstrate that the system reduced inventory processing time, reduced operational errors, or increased transaction throughput because these indicators were not measured using a pre-implementation baseline.

4.4. Functional Results by Evaluation Area

To provide a more detailed interpretation, the 16 test cases can be grouped into four evaluation areas: general system functions, barcode operations, inventory transactions, and cloud-based data handling, as shown in Table 3.

Table 3. Functional Testing by Evaluation Area

Evaluation Area	Test IDs	Test Cases	Successful	FSR
General system functions	T01–T03, T15, T16	5	5	100%
Barcode operations	T04–T07	4	3	75%
Inventory transactions	T08–T11	4	4	100%
Cloud-based data handling	T12–T14	3	2	66.7%
Total	T01–T16	**16**	**14**	**87.5%**

The general system functions included authentication, product management, reporting, and activity history. All corresponding scenarios were successfully executed under the defined test conditions. The barcode evaluation focused on barcode generation, barcode printing, and barcode scanning, including validation of an unregistered barcode. The results indicate that the barcode mechanism was functionally integrated with the inventory application. The inventory transaction tests covered stock-in, stock-out, stock mutation, and stock monitoring. Successful execution of these scenarios indicates that the system was able to process the principal inventory movements and display the resulting stock information. The

cloud-based data handling tests verified that supplier and customer data could be stored and retrieved and that delivery documents could be generated through the implemented system, apart from the initial T14 failure discussed above. These tests provide functional evidence of the integration between the application and its centralized data environment.

4.5. Barcode and Inventory Transaction Verification

The barcode tests demonstrated the role of barcode identification as an input mechanism for inventory management. A successful barcode transaction requires several sequential operations: barcode capture, product identification, transaction processing, and inventory update. The test of a registered barcode verified that the scanner input could be associated with an existing product record. Conversely, the unregistered barcode scenario was included to verify that the system did not automatically treat an unknown product identifier as a valid inventory item.

The inventory transaction tests further verified the relationship between product identification and stock records. For goods-in transactions, the expected behavior was an increase in inventory quantity. For goods-out transactions, the expected behavior was a corresponding decrease. Stock mutation was tested to verify that inventory movement could be recorded independently of ordinary incoming and outgoing transactions. These tests demonstrate that barcode integration was implemented as part of the inventory transaction workflow rather than merely as a product-labeling feature.

4.6. Cloud-Based Data Handling and Traceability

The cloud-based implementation provides centralized storage for inventory-related information. Functional verification focused on whether transactions processed through the application resulted in the corresponding inventory information being available through the system. The verification of data handling consisted of checking the relationship between the submitted transaction and the resulting inventory state. A transaction was considered correctly handled when it was accepted by the application, stored in the data environment, and reflected in the relevant inventory information.

The operator activity history provides an additional traceability mechanism. Inventory-related activities can be associated with the corresponding operator record, providing a historical record of system activities. This combination of centralized data storage and activity history is relevant to inventory management because it provides a structured mechanism for tracking inventory-related operations rather than relying exclusively on manually maintained records.

4.7. Discussion

The results demonstrate the technical feasibility of implementing a cloud-based barcode inventory information system for mushroom MSMEs. The system integrates barcode-based product identification with inventory transactions, stock monitoring, reporting, and activity traceability. The most important finding is the successful integration of barcode identification into the inventory workflow. Barcode scanning is not implemented as an isolated function but is connected to product records and subsequent inventory transactions. This integration establishes a digital link between physical inventory and the corresponding database record.

The functional testing resulted in an 87.5% success rate (14 of 16 predefined test cases). The test coverage includes general system operations, barcode functions, inventory transactions, and cloud-based data handling. This provides quantitative evidence that the implemented system performed the specified functions under the tested conditions. The failed cases represent the initial test results. The barcode issue was subsequently addressed through device configuration and operational familiarization, while the delivery-note issue was attributed to incorrect button selection.

The findings also demonstrate the importance of evaluating inventory systems at multiple functional levels. Testing only the user interface or barcode scanning would not be sufficient to verify an inventory information system because the captured product identifier must subsequently be processed as an inventory transaction and reflected in the stored inventory data. The present testing therefore considers the complete functional chain from product identification to inventory information update. From an MSME perspective, the implementation demonstrates that cloud-based inventory management and

barcode identification can be combined within a relatively straightforward web-based system.

The architecture provides centralized inventory information while barcode scanning provides a structured mechanism for identifying inventory items. Nevertheless, the current evaluation has an important limitation. The study did not collect structured baseline measurements before implementation. Consequently, the 87.5% functional success rate should not be interpreted as an 87.5% improvement in business performance. In particular, the study cannot establish quantitative reductions in inventory processing time, data-entry errors, inventory discrepancies, or increases in transaction throughput.

This limitation also defines an opportunity for future research. A longitudinal evaluation could compare operational indicators before and after system adoption, including average transaction processing time, inventory accuracy, stock discrepancy frequency, reporting time, and transaction throughput. Such measurements would complement the functional evaluation presented in this study and provide stronger evidence regarding the operational impact of digital inventory transformation.

Overall, the present results establish that the implemented system successfully provides the specified inventory functions and integrates barcode-based identification with centralized cloud-based inventory management. The findings provide a technical foundation for subsequent evaluation of usability, user experience, and long-term operational performance.

5. Conclusion

This study implemented a cloud-based barcode inventory information system to support inventory management activities in a mushroom MSME. The implemented system integrates product master-data management, barcode generation and scanning, inventory transactions, stock monitoring, supporting master data, delivery documentation, reporting, and operator activity history within a centralized web-based environment.

The technical implementation establishes an integrated workflow connecting physical inventory identification through barcode scanning with digital inventory records and subsequent stock transactions. This integration enables barcode identification to function as part of the inventory transaction process rather than merely as a product-labeling mechanism. The functional evaluation was conducted using scenario-based black-box testing involving 16 predefined test cases. The test scenarios covered general system functions, barcode operations, inventory transactions, and cloud-based data handling. Fourteen of the 16 test cases were successfully completed, resulting in a Functional Success Rate (FSR) of 87.5%. The result indicates that the implemented system successfully performed the specified functions under the tested conditions.

The main contribution of this study is the implementation and technical verification of an integrated cloud-based barcode inventory information system adapted to the operational context of a mushroom MSME. The findings demonstrate the technical feasibility of combining barcode-based product identification with centralized inventory data management in an MSME environment. Nevertheless, the study has an important limitation. Systematic baseline data were not collected before implementation; therefore, the study cannot quantitatively determine improvements in transaction processing time, inventory accuracy, error reduction, transaction throughput, or operational cost. The 87.5% functional success rate should consequently be interpreted as evidence of functional correctness under the defined test scenarios rather than as evidence of business performance improvement.

Future research should extend the evaluation through longitudinal measurements conducted before and after system adoption. Relevant indicators may include inventory accuracy, transaction processing time, stock discrepancy frequency, reporting time, transaction throughput, and operational cost. In addition, usability and user experience evaluations can provide complementary evidence regarding user acceptance and interaction quality. Overall, the study demonstrates that a cloud-based barcode approach can be implemented as an integrated inventory information system for mushroom MSMEs and provides a technical foundation for subsequent evaluation of usability and long-term operational impact.

References

Abdila, S. V., Rahadiyan, D., Galina, M., & Rachmat, R. S. (2024). Design and implementation of a web-based inventory management with offline capability: A case study at PT.XYZ. *IT for Society*, *9*(2), 39–46. https://doi.org/10.33021/itfs.v9i2.5918

Agboola, F. F., Malgwi, Y. M., Mahmud, M. A., & Oguntoye, J. P. (2022). Development of a web-based platform for automating an inventory management of a small and medium enterprise. *FUDMA Journal of Sciences*, *6*(5), 57–65. https://doi.org/10.33003/fjs-2022-0605-1064

Beynon-Davies, P., Carne, C., Mackay, H., & Tudhope, D. (1999). Rapid application development (RAD): An empirical review. *European Journal of Information Systems*, *8*(3), 211–223. https://doi.org/10.1057/palgrave.ejis.3000325

Chukwumuanya, O. E., Onwurah, U. O., & Ihueze, C. C. (2024). Development of a web-based inventory management system for small businesses. *International Journal of Industrial and Production Engineering*, *2*(2), 53–67. https://journals.unizik.edu.ng/ijipe/article/view/4096

Erameh, K. B., & Odoh, B. I. (2021). Design and implementation of a web-based inventory control system using a small medium enterprise (SME) as a case study. *NIPES – Journal of Science and Technology Research*, *3*(3), 211–219. https://doi.org/10.37933/nipes/3.3.2021.21

Hasanah, N., Saputra, D. I. S., & Hiiyatin, D. L. (2024). ERP-based management information system for MSMEs in Indonesia: A systematic literature review. *RIGGS: Journal of Artificial Intelligence and Digital Business*, *2*(2), 36–42. https://doi.org/10.31004/riggs.v2i2.224

Hendrawan, S. A., Afdhal Chatra, Nurul Iman, Soemarno Hidayatullah, & Degdo Suprayitno. (2024). Digital transformation in MSMEs: Challenges and opportunities in technology management. *Jurnal Informasi dan Teknologi*, *6*(2), 141–149. https://doi.org/10.60083/jidt.v6i2.551

Martin, J. (1991). *Rapid application development*. Macmillan Publishing Company.

Mayo, W., Ogbole, J. I., Okoruwa, P. O., & Oyewole, T. (2018). Developing a cloud-based inventory management model for data synchronization and operational efficiency in SMEs. *Iconic Research and Engineering Journals*, *1*(12). https://doi.org/10.64388/IREV1I12-1713059

Otobo, D. W., & Alegbe, T. (2024). Design of a web-based inventory management system for small and medium-sized production companies. *International Journal of Innovative Information Systems & Technology Research*, *12*(3), 111–124. https://doi.org/10.5281/zenodo.13860656

Pasaribu, J. S. (2021). Development of a web based inventory information system. *International Journal of Engineering, Science and Information Technology*, *1*(2), 24–31. https://doi.org/10.52088/ijesty.v1i2.51

Ragasari, D., & Dewi, A. R. (2026). The impact of cloud computing on supply chain management in small and medium enterprises (SMEs). *International Journal Multidisciplinary Science*, *5*(1), 68–78. https://doi.org/10.56127/ijml.v5i1.2556

Rao, A. M. (2025). Cloud-based solution for real-time inventory tracking and management. *International Journal of Information Technology and Computer Engineering*, *13*(1).

Refanto, M. B., Sardi, I. L., & Puspitasari, S. Y. (2024). Development of inventory management system for SME using DevOps software development process. *Jurnal Tekno Insentif*, *18*(2), 143–155. https://doi.org/10.36787/jti.v18i2.1737

Salih, H. S., Ghazi, M., & Aljanabi, M. (2023). Implementing an automated inventory management system for small and medium-sized enterprises. *Iraqi Journal for Computer Science and Mathematics*, *4*(2), 238–244. https://doi.org/10.52866/ijcsm.2023.02.02.021

Soegoto, E. S., & Palalungan, A. F. (2020). Web based online inventory information system. *IOP Conference Series: Materials Science and Engineering*, *879*(1), Article 012125. https://doi.org/10.1088/1757-899X/879/1/012125

Suparmanto, N., Nurdiyanto, H., & Kharismawati, A. (2025). Information systems and industrial resource planning. *Journal of Research in Social Science and Humaniora*, *5*(2). https://doi.org/10.47679/jrssh.v5i1.275

Susanto, D. A., Firmansyah, A., & Nawangsih, I. (2024). Implementation of a web-based raw material inventory information system using the prototype method: A case study at PT. XYD. *International*

Journal Software Engineering and Computer Science (IJSECS), *4*(2), 535–542. https://doi.org/10.35870/ijsecs.v4i2.2926

Wei, C. C., Ramiah, S. A., & Razali, N. F. (2023). Inventory management systems (IMS). *Journal of Applied Technology and Innovation*, *7*(3). https://doi.org/10.65136/jati.v7i1.129

Yoraeni, A., Margaret, A., Ifadah, M., & Mulyono, A. (2025). Implementation of a web-based inventory management information system. *Bit-Tech*, *8*(2), 2338–2347. https://doi.org/10.32877/bt.v8i2.3245