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Enhancing Supply Chain Efficiency Through WMS Implementation In Warehouse Management

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Abstract

Research aim : *This study aims to analyze the existing warehouse management conditions at Istika Grosir Kediri, identify the main problems affecting inventory accuracy and picking speed, design and implement a simple and adaptive Warehouse Management System (WMS) based on Excel and barcode technology suitable for micro-scale retail operations, and evaluate the impact of WMS implementation on inventory accuracy, picking speed, and overall supply chain efficiency.*

Design/Methode/Approach *: This research employs a mixed-methods case study with a before–after (pre-post) design conducted over a two-month period at the warehouse of Istika Grosir Kediri. Quantitative data were collected through direct observation, time studies, inventory audits, and performance measurements (inventory accuracy, picking time, error rates, delivery delays, and customer satisfaction). Qualitative data were obtained via in-depth interviews with warehouse staff and management. Data were analyzed descriptively and statistically using paired-sample t-tests to measure the significance of improvements after WMS implementation.*

Research Finding : *This study shows that implementing a simple, low-cost WMS can effectively improve warehouse efficiency and contribute to improved supply chain performance, particularly in micro-retail environments. The implementation of this system has successfully improved the accuracy of completeness, accelerated the picking process, and substantially reduced operational errors and delivery delays. Furthermore, these operational improvements have also positively impacted customer satisfaction.*

Theoretical contribution/Originality : *This research contributes to warehouse management and supply chain literature by demonstrating that a low-cost, Excel-and-barcode-based WMS can deliver significant performance improvements in micro-scale retail enterprises — a context often overlooked in previous studies that primarily focus on large companies with complex ERP systems. The findings reinforce the Technology Acceptance Model (TAM) in resource-constrained SME*

settings and provide empirical evidence of lean warehousing principles successfully applied through simple digital tools.

Practitionel/Policy implication : *The study provides practical guidance for micro and small retail businesses in Indonesia and other emerging markets to adopt affordable WMS solutions without large capital investment. It emphasizes the importance of location coding, barcode integration, real-time recording, and SOP standardization in improving operational efficiency, reducing errors, and enhancing customer service. The results can also serve as a reference for policymakers and industry associations to develop digital transformation programs supporting SMEs in the retail and distribution sector.*

Research limitation *: This study has several limitations. First, the implementation period was relatively short (only two months), so it cannot fully demonstrate the long-term sustainability of the WMS performance. Second, the research used a single-case study approach, which limits the generalizability of the findings to other companies or broader contexts. Third, the developed WMS is still a basic version and does not yet include advanced features such as automatic integration with sales systems (POS) or predictive analytics*

Keywords : *Warehouse Management System (WMS), supply chain efficiency, inventory accuracy, picking time, micro-enterprise, Excel-based WMS, retail logistics, Indonesia*

1. Introduction

In an era of increasingly intense business competition, companies are required to enhance operational performance, particularly supply chain efficiency (1). One critical component of the supply chain is the warehouse function, which serves as the central hub for the storage, control, and distribution of goods. Suboptimal warehouse performance often triggers various operational problems, such as mismatches between physical stock and system data, delays in order fulfillment, and increased operational costs, which ultimately result in decreased levels of customer satisfaction (2), (3). Various methods for improving supply chain efficiency have been extensively studied, with particular emphasis on warehouse management efficiency (4), (5), (6). Many micro-scale retail companies continue to face inefficiencies in warehouse management. These problems typically stem from reliance on manual systems, lack of standardized procedures, and limited adoption of information technology. Istika Grosir Kediri, a distributor and retail company, encounters significant challenges in effective warehouse management due to its continued use of manual recording systems and non-integrated Excel applications. A Warehouse Management System (WMS) is a technology-based system that integrates all warehouse activities from receiving, putaway, and picking to shipping (7). WMS encompasses every activity within a company's warehouse, including stock verification, goods inflow and outflow, thereby providing essential information to support primary goods distribution and sales data for consumers (8).

Previous studies have shown that WMS implementation positively impacts warehouse operational efficiency, delivering significant performance improvements, especially in time efficiency (9), (10). WMS enhances inventory accuracy, optimizes warehouse space utilization, increases workforce productivity, and provides real-time stock visibility to support faster decision-making (3), (11). Previous research findings also highlight the importance of infrastructure and technology support in warehouse management operations to improve operational efficiency (12). However, most existing research focuses on large enterprises with substantial technology investments, rendering the findings less applicable to Istika Grosir Kediri. Furthermore, there remains a research gap regarding WMS implementation for micro and retail businesses with limited resources. Previous research has tended to focus on complex, high-tech WMS systems, resulting in limited research on the effectiveness of simple, adaptive, and low-cost WMS approaches (4), (11). However, the primary need for micro-enterprises is not system complexity, but rather increased inventory accuracy, operational speed, and ease of implementation. Therefore, this research is crucial to bridge this gap by examining a simple WMS implementation that can still significantly impact warehouse management efficiency and supply chain performance.

In an era of increasingly fierce business competition, companies are required to improve operational performance, particularly in supply chain efficiency (1). One key component of the supply chain is the warehouse, which serves as the center for storing, controlling, and distributing goods. Suboptimal warehouse performance often triggers various operational problems, such as mismatches between physical inventory and system data, delays in order fulfillment, and increased operational costs, ultimately resulting in decreased customer satisfaction (2), (3). Therefore, optimizing warehouse management is a strategic aspect in improving overall supply chain efficiency. Various approaches have been developed to improve supply chain efficiency, with a particular emphasis on improving warehouse management systems and processes (4), (5), (6). However, micro-scale retail companies still face various challenges in warehouse management. These problems are generally caused by reliance on manual systems, a lack of standardized operational procedures, and low utilization of information technology. Istika Grosir Kediri, as a distributor and retail company, faces similar challenges in managing its warehouse activities effectively. The use of manual recording systems and unintegrated Excel applications results in poor data visibility and the potential for operational errors. In this context, a Warehouse Management System (WMS) exists as a technology-based solution capable of integrating all warehouse activities, from receiving, putaway, picking, to shipping (7). WMS enables more accurate, structured, and real-time inventory management, thus supporting smooth distribution of goods and providing relevant information for decision-making (8).

Several previous studies have shown that WMS implementation can significantly improve warehouse operational efficiency, particularly in terms of reducing processing time and increasing productivity (9), (10). Furthermore, WMS also contributes to improved

inventory accuracy, optimized space utilization, and real-time inventory visibility, supporting faster and more accurate decision-making (3), (11). However, most of this research focuses on large companies with significant resources and technology investment, so the results are not fully relevant to micro-scale companies like Istika Grosir Kediri. Furthermore, there is a research gap regarding WMS implementation in the context of micro and retail businesses with limited resources. Previous studies have tended to focus on complex, high-tech WMS systems, resulting in limited research on the effectiveness of simple, adaptive, and low-cost WMSs (4), (11). However, the primary need for micro-enterprises is not system complexity, but rather increased inventory accuracy, operational speed, and ease of implementation and use. Therefore, this research is crucial to bridge this gap by examining the implementation of a simple WMS that can still significantly impact warehouse management efficiency and supply chain performance.

Based on this background, the objectives of this study are: (1) to analyze the current state of warehouse management at Istika Grosir Kediri; (2) to identify key issues affecting stock accuracy and picking speed; (3) to examine the implementation of a simple and adaptive WMS; and (4) to analyze the effect of WMS implementation on improving inventory accuracy, picking speed, and overall supply chain efficiency. This research is expected to provide both theoretical and practical contributions. Theoretically, this research contributes to the development of operational management and supply chain management, particularly in the context of implementing a simple WMS in micro-enterprises and retail businesses. Practically, this research can serve as a reference for Istika Grosir Kediri in improving warehouse management efficiency through a more structured, accurate, and technology-based system. Furthermore, the findings of this study can serve as a reference for other retailers and SMEs in optimizing their warehousing systems, as well as providing a basis for managerial decisions related to technology investment, standardization of operational procedures, and improvement of warehouse performance as part of a broader supply chain efficiency strategy.

1.1. Statement of Problem

Suboptimal warehouse management remains a critical barrier to achieving supply chain efficiency, particularly in micro-scale retail enterprises. Istika Grosir Kediri, as a distributor and retailer, continues to experience persistent operational challenges, including discrepancies between physical stock and recorded data, prolonged picking times, and limited system integration due to reliance on manual recording and non-integrated spreadsheet-based tools. These conditions not only reduce operational efficiency but also increase the risk of errors, delay order fulfillment, and ultimately undermine customer satisfaction. While Warehouse Management Systems (WMS) have been widely recognized as effective tools for improving inventory accuracy and warehouse performance, existing implementations predominantly target large-scale enterprises with substantial technological and financial

resources. Consequently, there remains a significant gap in the adoption and empirical validation of WMS solutions that are simple, cost-effective, and adaptable to the constraints of micro and retail businesses. Therefore, the central problem addressed in this study is how to design and implement a simple and adaptive Warehouse Management System (WMS) that aligns with the operational characteristics of Istika Grosir Kediri, in order to enhance inventory accuracy, improve picking efficiency, and support overall supply chain performance.

1.2. Research Objectives

This study aims to examine and evaluate the optimization of warehouse management through the implementation of a Warehouse Management System (WMS) in supporting supply chain efficiency at Istika Grosir Kediri. Specifically, the objectives of this study are:

1. To assess the existing warehouse management conditions at Istika Grosir Kediri by establishing baseline performance metrics, particularly inventory accuracy and average picking time during the initial observation period.
2. To identify and quantify key operational issues in warehouse management, including stock discrepancies, picking errors, and process inefficiencies, based on observational and operational data collected over the study period.
3. To design and implement a simple, cost-effective WMS based on Excel and barcode technology that is aligned with the operational characteristics and resource constraints of Istika Grosir Kediri within a two-month implementation period.
4. To evaluate the impact of WMS implementation on inventory accuracy, with a targeted improvement to at least 95–98% compared to baseline conditions.
5. To analyze improvements in picking efficiency by comparing average picking times before and after WMS implementation, with a minimum targeted reduction of 30%.
6. To examine the overall impact of WMS implementation on supply chain efficiency, as reflected in key performance indicators such as order fulfillment lead time and delivery error rates.

2. Method

This study employs a mixed-methods approach, integrating quantitative and qualitative techniques within a case study design focused on the warehouse operations of Istika Grosir Kediri. The use of a mixed-methods approach is justified by the need to obtain a comprehensive understanding of the research problem. The quantitative component enables objective measurement of improvements in key warehouse performance indicators—namely inventory accuracy, picking speed, and overall supply chain efficiency—while the qualitative component provides deeper insights into operational conditions, underlying problems, and user experiences during the implementation of the Warehouse Management System (WMS). This integration allows for methodological triangulation, thereby enhancing the validity and robustness of the findings.

The selection of a case study design is appropriate given the context-specific nature of warehouse management practices and the study's focus on a single organization with unique operational characteristics. A case study approach allows for an in-depth exploration of real-world processes, particularly in environments with limited technological adoption, such as micro-scale retail businesses. Furthermore, it facilitates the examination of how a simple and adaptive WMS can be implemented and evaluated within actual operational constraints, which may not be captured through large-scale or purely quantitative studies.

A before–after analysis design is adopted to systematically compare warehouse performance prior to and following the implementation of a simple WMS based on Excel and barcode technology over a two-month period. This design enables the study to capture measurable performance improvements attributable to the intervention.

Data collection is conducted through multiple techniques to ensure robustness and triangulation. These include direct observation of warehouse activities, in-depth interviews with the warehouse manager and operational staff, and documentation analysis of inventory records and process-time data. In addition, a time study is carried out to measure changes in picking speed before and after implementation.

The study defines WMS implementation as the independent variable, while inventory accuracy, picking speed, and supply chain efficiency serve as the dependent variables. Inventory accuracy is measured by comparing physical stock with recorded data, picking speed is assessed through average processing time per order, and supply chain efficiency is evaluated using indicators such as order fulfillment lead time and delivery error rates.

Data analysis is performed in two stages. First, descriptive analysis is used to present baseline conditions and post-implementation performance. Second, quantitative analysis is conducted using inventory accuracy calculations, average picking time comparisons, and paired-sample t-tests to examine the statistical significance of differences before and after WMS implementation. The qualitative data are analyzed thematically to provide contextual insights and to complement the quantitative findings, thereby offering a more comprehensive evaluation of the effectiveness of WMS in optimizing warehouse management performance.

3. Results and Discussion

3.1 Existing Warehouse Management Conditions (Baseline)

Initial observations indicate that warehouse management practices at Istika Grosir Kediri were conducted entirely through manual and non-integrated processes, with no formal information system in place. The absence of *location coding* resulted in inconsistent and unstructured product placement, making item retrieval highly dependent on staff familiarity rather than standardized procedures. Inventory records were maintained using a combination of manual ledgers and WhatsApp-based notes, leading to data duplication, inconsistency, and the lack of real-time visibility. Furthermore, the picking process relied heavily on the tacit knowledge and memory of warehouse personnel, which increased variability in performance and reduced operational reliability.

These limitations translated into significant inefficiencies in warehouse operations. Empirical measurements revealed a 25.2% discrepancy between physical inventory and recorded data, indicating low inventory accuracy and weak control over stock movements. The average picking time was 48 minutes per order, reflecting inefficient search and retrieval processes. In addition, the delivery error rate reached 13.7%, primarily due to *mis-picks* and incorrect shipments, which in turn contributed to a 22% late-delivery rate. These operational shortcomings had direct implications for service quality, as reflected in a customer satisfaction score of only 3.1 out of 5, suggesting that the existing system failed to meet customer expectations.

Findings from in-depth interviews with the owner and warehouse staff further revealed that these issues stemmed from several underlying factors: redundant and unsynchronized recording practices across multiple media, limited real-time visibility of inventory data, and the absence of clearly defined standard operating procedures (SOPs). Collectively, these findings demonstrate that the observed inefficiencies were not solely technical in nature but also systemic and process-related, highlighting the need for an integrated and structured solution. Consequently, the implementation of a *Warehouse Management System* (WMS) becomes a critical intervention to enhance inventory accuracy, streamline operations, and improve overall supply chain performance.

3.2 Identification of Major Warehouse Problems

Based on a combination of direct observations and in-depth interviews, several critical issues were identified that hinder the effectiveness of warehouse operations at Istika Grosir Kediri. These problems are interconnected and collectively contribute to operational inefficiencies:

1. Inventory discrepancies, primarily caused by inconsistent and fragmented manual recording practices across multiple media, resulting in mismatches between physical stock and recorded data.
2. Picking errors, arising from the absence of systematic verification mechanisms, which increases the likelihood of *mis-picks* and incorrect order fulfillment.
3. Prolonged picking times, driven by the lack of a structured location system and inefficient retrieval paths, forcing employees to rely on trial-and-error search processes.
4. Lack of data integration, where inventory records are not synchronized with operational activities, limiting real-time visibility and decision-making accuracy.
5. Over-reliance on employees' tacit knowledge, making warehouse performance highly dependent on individual experience rather than standardized procedures, thereby reducing consistency and scalability.

These findings indicate that the underlying causes of warehouse inefficiency are not merely operational, but also systemic and structural in nature. The absence of an integrated information system, coupled with the lack of standardized operating procedures (SOPs), results in fragmented workflows, limited data transparency, and high variability in

operational performance. Consequently, these issues highlight the urgent need for a structured and technology-supported solution, such as a *Warehouse Management System* (WMS), to enhance process standardization, data integration, and overall warehouse efficiency.

3.3 Implementation of a Simple WMS

To address the identified operational inefficiencies, this study designed and implemented a simple and adaptive Warehouse Management System (WMS) tailored to the operational characteristics and resource constraints of Istika Grosir Kediri. The system was developed using a low-cost, Excel-based platform integrated with barcode technology, ensuring ease of adoption, scalability, and minimal investment requirements. The implementation was conducted over a two-month period and followed a structured, process-oriented approach.

The WMS was designed to integrate key warehouse processes into a unified workflow, including:

- Location Coding System: A structured alphanumeric coding scheme was introduced to standardize storage locations, enabling systematic product placement and faster retrieval.
- Barcode-Based Identification: Each product was assigned a barcode to facilitate accurate and efficient scanning during receiving, putaway, and picking processes.
- Centralized Inventory Database: A master database was developed in Excel to record real-time stock movements, ensuring data consistency and visibility.
- Digital Pick List and Transaction Logging: System-generated pick lists and transaction records were implemented to guide operations and minimize manual errors.
- Standard Operating Procedures (SOPs): Clear and standardized procedures were established for key activities (receiving, putaway, picking, and shipping) to ensure process consistency.

The implementation followed a phased approach:

- System Preparation: Development of the database structure, location mapping, and barcode assignment.
- Process Standardization: Formulation and dissemination of SOPs to ensure consistent operational practices.
- Training and Socialization: Training sessions were conducted for warehouse staff to enhance system usability and acceptance.
- Pilot Testing: Initial system trials were performed to identify and resolve technical and operational issues.
- Full Implementation: The WMS was fully deployed with real-time transaction recording and monitoring.

This phased implementation aligns with change management principles, ensuring a smooth transition from manual to system-based operations and minimizing resistance to change. Post-implementation observations indicate that the WMS significantly improved warehouse organization and operational clarity. The introduction of location coding reduced

ambiguity in product placement, while barcode scanning minimized manual input errors. Real-time data recording enhanced inventory visibility and enabled better coordination between operational activities. Additionally, the use of standardized procedures improved consistency in task execution and reduced dependence on individual experience.

3.4 Improved Inventory Accuracy

Table 1. Analysis of Effectiveness Indicators

Indicators	Before	After	Difference (d)	Improvement Level
Inventory Accuracy	74,8%	86,5%	↑15,6%	Moderate
Picking Time	48	31	↓35,4%	High
Delivery Error	13,7%	9,8%	↓28,5%	Moderate
Delivery Delays	22%	14%	↓81,8%	High
Customer Satisfaction	3,1	4,0	↑29,0%	High

Sumber : Data processed by the researcher (2026)

Based on table 1, inventory accuracy indicates improvements in stock control, although not yet optimal (not yet reaching ≥95%). This improvement indicates that recording is becoming more structured and input errors are decreasing. However, there are still accuracy gaps, possibly due to: inconsistent system use discipline and processes that are not yet fully real-time. Managerially, the WMS is starting to be effective, but is still in the transition stage (improvement stage), not yet fully optimized. Furthermore, picking efficiency was found to have increased significantly. This indicates a clearer search flow for goods and a drastic reduction in "searching" time. However, there is still room for improvement (modern benchmarks can be <20 minutes). This improvement demonstrates the direct impact of the location system and warehouse structure. Shipping errors are starting to be controlled, but the figure of 9.8% is still quite high for retail operations. This means that the system has helped address the problem of shipping errors, but there is still no double-check / full scanning validation, so strengthening SOPs and quality control, not just system implementation, is needed. Supply chain response is starting to improve, delays are significantly reduced due to faster picking and fewer errors. However, 14% is still relatively high, meaning bottlenecks likely still exist in the packing and distribution/logistics processes. Customer satisfaction meaurement results show that customers immediately notice service changes, and operational improvements directly impact positive experiences. This reinforces the Service Quality theory that reliability and responsiveness increase customer satisfaction.

3.5 Qualitative Findings from Post-Implementation Interviews

Post-implementation interviews with eight respondents including the business owner, warehouse administrator, and operational staff indicate a high level of user acceptance and a substantial transformation in daily warehouse operations following the adoption of the WMS. Across respondents, there was a consistent perception that work processes became more structured, efficient, and easier to execute. This qualitative evidence aligns closely with the quantitative findings, particularly the 35.4% reduction in picking time, as well as the observed decreases in delivery errors and delays, confirming that the WMS effectively improved operational performance.

Several respondents explicitly described how the system changed their daily workflow. The warehouse administrator noted: "Previously, finding items took 10–15 minutes and relied on memory. Now, I just scan and the location appears instantly it's much faster and eliminates confusion". Similarly, an operational staff member explained: *"*Now the workflow is much clearer. We no longer need to ask around or search manually. Everything is already in the system". These statements illustrate a clear transition from memory-based and experience-dependent processes to system-driven workflows, which reduces cognitive workload and enhances consistency in task execution. This finding is consistent with prior research showing that WMS implementation improves inventory visibility, task efficiency, and process standardization by replacing manual processes with real-time system control (12), (13). In addition, barcode-supported systems have been shown to minimize human error and improve picking accuracy, thereby strengthening overall operational performance (14), (15).

The observed reduction in picking time (48 → 31 minutes) further supports this interpretation. Empirical studies suggest that WMS can improve picking efficiency by 25–40% through optimized routing and reduced search time, which is consistent with the improvements observed in this study. The implementation of location coding and system-guided picking enabled workers to retrieve items more systematically, reducing unnecessary movement and search effort. As highlighted by another respondent: *"*Now we don't have to walk around searching for items. We just check the system and know exactly where to go". Although initial resistance to adopting the new system was reported particularly among staff unfamiliar with digital tools this challenge was effectively addressed through training and gradual adaptation. One staff member shared: "At first it was confusing, but after training and a few trials, it turned out to be easy to use". As a result, 87.5% of respondents perceived the WMS as easy to use and reported increased confidence in performing their tasks. This finding reinforces previous studies emphasizing that user training and system simplicity are critical success factors in technology adoption, especially in SMEs with limited resources (14), (15). From a theoretical standpoint, this aligns with the Technology Acceptance Model (TAM), where *perceived ease of use* and *perceived usefulness* drive user acceptance and system

utilization. The direct benefits experienced by users such as faster picking and fewer errors strengthened both perceptions.

However, when integrating qualitative insights with quantitative outcomes, an important nuance emerges. While operational performance improved significantly, the increase in customer satisfaction (3.1 → 4.0), although substantial, was not fully proportional to the operational gains. This indicates the presence of a performance–perception gap, where improvements in internal processes are not immediately or fully perceived by customers. As noted by the business owner: "Warehouse operations are clearly more organized and faster now, but customers may not fully feel the impact yet, as it also depends on delivery and front-end service". This finding is consistent with prior research suggesting that while WMS enhances order accuracy and speed, customer satisfaction is influenced by broader supply chain factors, including delivery experience and service interaction. Therefore, improvements in warehouse operations must be complemented by enhancements in downstream processes to maximize customer impact.

Overall, this study confirms that a simple and adaptive WMS can significantly improve warehouse performance, even in resource-constrained retail environments. Importantly, the findings demonstrate that technological sophistication is not the primary determinant of success; rather, effectiveness depends on process integration, real-time visibility, and user acceptance. This contributes to the growing body of literature showing that low-cost, user-friendly WMS solutions can deliver substantial operational improvements, particularly for micro and small-scale retail businesses.

3.5 Disussion

Post-implementation interviews with eight respondents (owner, warehouse administrator, and operational staff) reveal a high level of user acceptance and a clear improvement in operational practices following WMS adoption. Respondents consistently reported enhanced work efficiency, clearer task execution, and easier access to inventory information. These perceptions are strongly aligned with the quantitative findings, particularly the 35.4% reduction in picking time and the decrease in delivery errors and delays, indicating that the WMS effectively improved process execution at the operational level.

A representative statement *"Previously, finding items took 10–15 minutes; now I just scan and the location appears immediately it is much faster and eliminates confusion"* reflects a transition from memory-based processes to system-driven workflows. This transformation reduces cognitive workload and enhances operational consistency. Recent studies confirm that WMS implementation significantly improves inventory visibility and task efficiency, primarily by replacing manual processes with real-time, system-based control mechanisms (13), (14). Furthermore, digital warehouse systems supported by barcode scanning have been shown to minimize errors and improve picking accuracy, which directly

contributes to operational performance improvements. These results are in line with research findings (15) that the use of barcode technology in warehouse management systems can improve accuracy, time efficiency, enable real-time monitoring, reduce losses due to operational errors, and facilitate the creation of inventory reports quickly and automatically.

The observed reduction in picking time (48 → 31 minutes) is consistent with empirical evidence indicating that WMS can improve picking efficiency by 25–40% through optimized routing and reduced search time . This supports the argument that structured location systems and real-time guidance are critical drivers of warehouse productivity. Additionally, prior research highlights that WMS enhances stock accuracy and operational productivity by enabling real-time tracking and integrated data management, which reduces discrepancies between physical and recorded inventory .

Although initial resistance to the new system was identified, this challenge was effectively mitigated through training and gradual familiarization. As a result, 87.5% of respondents perceived the WMS as easy to use and reported increased confidence in performing tasks. This finding is supported by recent studies emphasizing that user training and system simplicity are key determinants of successful WMS adoption, particularly in SMEs with limited technological resources . From a theoretical perspective, this aligns with the Technology Acceptance Model (TAM), where *perceived ease of use* and *perceived usefulness* drive user acceptance and system utilization.

However, an important insight emerges when integrating qualitative and quantitative findings: while internal operational performance improved significantly, the increase in customer satisfaction (3.1 → 4.0) was significant but not proportional to operational gains. This suggests the existence of a performance–perception gap, where improvements in back-end processes require time, consistency, and complementary service enhancements to be fully perceived by customers. Previous studies also indicate that while WMS improves order fulfillment accuracy and speed, customer satisfaction is influenced by broader supply chain factors such as delivery experience and service interaction .

Overall, this study confirms that a simple and adaptive WMS can significantly improve warehouse performance, even in resource-constrained retail environments. Importantly, recent literature highlights that WMS does not need to be technologically complex to deliver value; rather, its effectiveness depends on process integration, real-time visibility, and user adoption. These findings contribute to the growing body of research demonstrating that low-cost, user-friendly WMS solutions can produce substantial operational improvements, particularly for micro and small-scale retail businesses.

4. Conclusion

This study demonstrates that the implementation of a simple Excel-and-barcode-based Warehouse Management System (WMS) has effectively improved warehouse management

performance at Istika Grosir Kediri. The initial conditions characterized by fully manual processes, absence of location coding, and fragmented, non-integrated recording systems resulted in low inventory accuracy, prolonged picking times, and a high incidence of operational errors. Following the implementation of the WMS, inventory accuracy improved from 74.8% to 86.5%, indicating a moderate but meaningful enhancement in stock control. In addition, picking time decreased by 35.4%, while delivery errors and delays were reduced by 28.5% and 36.4%, respectively, reflecting significant improvements in operational efficiency and process reliability. These operational gains contributed to an increase in customer satisfaction from 3.1 to 4.0, suggesting that improvements in internal processes have begun to translate into better service performance. Overall, the findings confirm that a simple and adaptive WMS can serve as a practical and effective solution for improving warehouse efficiency and supporting supply chain performance, particularly in micro-scale retail businesses with limited resources. However, the results also indicate that operational improvements do not automatically translate proportionally into customer satisfaction, highlighting the need for complementary enhancements in customer-facing services.

Despite these contributions, this study has several limitations. First, the relatively short observation period of two months may not fully capture the long-term sustainability and consistency of system performance. Second, the use of a single case study limits the generalizability of the findings to other organizational contexts. Third, the implemented WMS remains relatively basic, relying on Excel and barcode technology without integration into broader enterprise systems. Future research is therefore recommended to extend the observation period, incorporate multiple case studies across different industries, and develop more advanced and integrated WMS solutions. Such developments may include integration with Point-of-Sales (POS) systems, procurement and inventory planning modules, as well as mobile-based applications for real-time scanning and monitoring. Additionally, future studies should explore the integration between operational improvements and customer experience management to better understand how warehouse efficiency can more effectively translate into higher customer satisfaction.

Content Attribution (If you use AI assistance)

The author acknowledges the use of Grok (built by xAI) as a supporting tool in the preparation of this research paper. Grok was utilized to assist in generating ideas, structuring the manuscript (including Statement of Problem, Research Objectives, Identifikasi Masalah, and Conclusion sections), paraphrasing academic sentences, and improving logical flow.

All AI-generated content has not been copied verbatim. Every section has been thoroughly reviewed, revised, and refined by the author to ensure accuracy, validity, and academic integrity. The author independently conducted data collection, before–after analysis, result interpretation, theoretical contributions, and conclusions. The author assumes full responsibility for the final content of this study.

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