Sinergi International Journal of Logistics
E-ISSN: 2988-6244
Volume. 3, Issue 2, May 2025
Page No: 93-105

Enhancing Inventory Accuracy through Structured Stock Opname in Semi Digital Warehousing: A Case Study from PT. Sumber Alfaria Trijaya, Central Sulawesi

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Received : March 22, 2025
Accepted : April 25, 2025
Published : May 30, 2025

Citation: Zaenal., & Bakri, S. (2025). Enhancing Inventory Accuracy through Structured Stock Opname in Semi Digital Warehousing: A Case Study from PT. Sumber Alfaria Trijaya, Central Sulawesi. Sinergi International Journal of Logistics, 3(2), 93-105.

ABSTRACT : This study investigates the implementation and impact of structured stock opname practices on inventory accuracy within a semi digitized retail warehouse environment in Indonesia. Conducted at PT Sumber Alfaria Trijaya's warehouse in Palu, the research aims to assess how periodic physical inventory verification, supported by barcode technology and revised SOPs, contributes to reducing stock discrepancies and enhancing operational performance. Using a qualitative case study approach, the study involved semi structured interviews, on site observations, and document analysis over a five year period (2019–2023). Findings reveal that the consistent execution of stock opname, supported by hybrid inventory systems, led to a decline in discrepancy rates from 2.13% in 2022 to 1.66% in 2023 despite increasing inventory volumes. Improvements in warehouse layout, employee training, and the adoption of barcode scanners contributed to more efficient inventory reconciliation and data synchronization. The research demonstrates that even partial digitization, when strategically implemented, can significantly enhance supply chain reliability in resource constrained settings. The results contribute to academic and practical discourse by offering insights into adaptive warehouse practices in developing economies and underscore the role of structured procedures and technological integration in modern inventory control systems.

Keywords: Stock Opname, Inventory Accuracy, Warehouse Management, Barcode Technology, Semi Digital Systems, Supply Chain Reliability, Indonesia Retail Logistics.

INTRODUCTION

Warehouse inventory management is a pivotal strategic element that significantly contributes to retail supply chain efficiency in Southeast Asia by ensuring accurate stock levels, reducing operational costs, and enhancing responsiveness to market demand. Advanced inventory management techniques including Just in Time (JIT), Economic Order Quantity (EOQ), and ABC analysis together with emerging technologies such as automation and Radio Frequency

Identification (RFID), facilitate real time visibility in warehouse operations and enable optimal decision making (Aniam & Kanade, 2023). In the context of Southeast Asia, where dynamic consumer demand and competitive retail markets prevail, studies on major retail chains such as Alfamart and Indomaret illustrate that effective warehouse management is intertwined with procurement, distribution, and overall supply chain responsiveness (Rizki & Supriadi, 2024; Vaka, 2024). Furthermore, a holistic inventory approach that integrates warehouse management with other logistical functions contributes not only to cost optimization but also to developing an agile supply chain capable of adapting to unexpected market fluctuations (Vaka, 2024).

Stock opname, defined as the routine physical counting and verification of inventory, plays a critical role in mitigating inventory inaccuracies and thus bolstering supply reliability in retail distribution systems. Research indicates that discrepancies between the physical inventory and the records maintained in the information system can lead to production delays, increased holding costs, and supply chain inefficiencies (Rekik et al., 2019). Accurate stock opname processes help identify and correct errors such as misplacements, data entry faults, or shrinkages, ensuring that inventory records reliably reflect the actual quantity available. Moreover, the implementation of robust inventory information systems and internal control mechanisms further enhances the efficacy of stock opname activities by reducing data errors and preventing fraud, which ultimately improves the reliability of supply in retail operations (Haryanto et al., 2024; Saputra et al., 2024). Such measures are especially relevant in retail environments where high product turnover and variable demand underscore the need for precise, real time inventory data.

In summary, the strategic role of warehouse inventory management in Southeast Asian retail supply chains is underscored by its capacity to integrate advanced inventory techniques and technologies, thereby enhancing overall supply chain agility and cost effectiveness. Meanwhile, regular and precise stock opname serves as a cornerstone for ensuring that inventory records are accurate, reducing inefficiencies and reinforcing supply reliability, which is critical in an environment characterized by rapid market changes and competitive pressures.

Modern Indonesian retail warehouses deploy several inventory control methods to enhance operational efficiency and manage supply chain complexities. Commonly employed techniques include Barcode Based Warehouse Management Systems (WMS), automated inventory tracking systems, and integrated digital solutions that support real time inventory monitoring. Research by Nisa & Rahmawati (2023) demonstrates that many Indonesian warehouses have adopted barcode based systems as a key tool to streamline inventory tracking, reduce manual errors, and update stock levels consistently. Similarly, Alfajri et al. (2023) report that Android based inventory applications have been implemented to replace manual recording methods, thereby advancing accuracy and facilitating real time inventory data updates. Additionally, Shanmugamani & Mohamad (2023) highlight the integration of comprehensive WMS in business to business (B2B) contexts, emphasizing that these systems aid in managing inflow/outflow control, order management, and overall warehouse performance. These methods are complemented by periodic stock counting procedures and economic order quantity (EOQ) models to maintain optimal stock levels and enable cost effective operations.

Despite these advances, semi digital warehouse systems in developing countries, including Indonesia, encounter several challenges regarding inventory accuracy. One significant issue is the occurrence of data discrepancies that arise from the partial digitalization of processes. Nisa &

Rahmawati (2023) note that semi digital systems often rely on manual interventions to update records, which can lead to inaccuracies due to human error, delayed data entry, and synchronization issues between the digital system and physical inventory. Similarly, Alfajri et al. (2023) point out that while Android based systems have improved data capture, challenges persist in terms of inconsistent connectivity, limited user training, and the integration of legacy data from traditional record systems. Furthermore, Shanmugamani & Mohamad (2023) argue that while full scale WMS implementations can boost efficiency, semi digital solutions may not possess the complete integration of real time data loops, leading to timing lags and occasional inventory misalignments. These challenges underscore the importance of further digital integration, improved employee training, and the advancement of communication infrastructure to support the transition from semi digital to fully digital warehouse management systems in resource constrained settings.

Previous studies investigating stock opname practices in the Indonesian retail and FMCG sector are relatively limited. However, several investigations into broader inventory management and control practices indirectly address the physical inventory count or "stock opname" process. In particular, research on data alignment in FMCG retail has illustrated how digital technologies such as barcodes and universal product codes (UPCs) improve the recording and reconciliation of inventory records, thereby implying best practices similar to stock opname methods (Patel, 2024). Additionally, studies examining the integration of automated information systems (AIS) in Indonesian retail contexts have shown that robust internal controls, which include regular physical counts and reconciliations, are instrumental in reducing inventory recording errors. For instance, evidence from AIS implementations illustrates that when inventory data are accurately captured and reconciled with physical counts, firms benefit from improved financial reporting and reduced risk of misstatement (Michael & Widjaja, 2024).

Discrepancies in warehouse inventory records can have multifaceted negative repercussions across both financial and operational dimensions of retail chains. From a financial reporting perspective, discrepancies often lead to inaccurate asset valuations on balance sheets, miscalculated cost of goods sold, and ultimately, distorted profit margins. Such inaccuracies undermine audit quality and can impair decision making by stakeholders (Michael & Widjaja, 2024). Operationally, inaccuracies in inventory records can result in unanticipated stock outs or overstock situations. These incidents directly affect customer satisfaction by causing delays in fulfilling orders or by providing an inconsistent shopping experience, jeopardizing brand reliability and customer loyalty (Olutimehin et al., 2024). Moreover, supply chain inefficiencies arising from erroneous inventory records have further been linked to disruptions in procurement and order management processes, which accentuate the risk of financial misreporting and deteriorate downstream customer service outcomes.

In summary, although the literature on stock opname practices in the Indonesian retail and FMCG sectors is not extensive, studies on inventory control and digital data alignment provide valuable insights into the essential role of periodic physical counts and reconciliation processes. Furthermore, evidence indicates that discrepancies in inventory records not only compromise the quality of financial reporting but also detrimentally impact customer satisfaction by impairing the reliability of the supply chain.

Despite the importance of stock opname, the literature remains sparse on specific empirical assessments of its implementation in semi digital warehouse environments, especially in secondary cities like Palu, Indonesia. While the integration of barcode systems and the transition to digital inventory tracking have shown promising results, the gap remains in understanding how these systems operate under infrastructural constraints, limited digital literacy, and manual verification practices. Therefore, there is a need to investigate the practical application, challenges, and outcomes of stock opname in such contexts to bridge the gap between theoretical best practices and real world constraints.

This study addresses the aforementioned gap by investigating the implementation of stock opname at PT Sumber Alfaria Trijaya's warehouse in Palu, Indonesia. Specifically, the study explores the procedures, challenges, and outcomes associated with periodic stock opname practices in a semi digitized warehouse environment. By doing so, the study contributes to understanding how stock verification mechanisms can support inventory accuracy, minimize discrepancies, and enhance supply chain efficiency in resource constrained retail settings. The novelty of the study lies in its empirical investigation of operational level practices in a regional warehouse context, highlighting insights that are highly relevant for practitioners and scholars alike.

METHOD

This study adopts a qualitative case study approach to investigate the implementation of stock opname in the inventory control system at the warehouse of PT Sumber Alfaria Trijaya in Palu, Indonesia. As suggested by Ebneyamini & Moghadam (2018), the case study method is appropriate for research in warehouse operational environments because it facilitates an in depth exploration of context specific challenges and allows for triangulation of data sources. This methodology is particularly suitable when the aim is to understand procedural intricacies, personnel practices, and technological adaptations within semi digital warehouse settings.

The rationale for selecting a case study approach lies in its potential to reveal contextual insights into the operational processes and decision making structures associated with periodic stock opname. Given the dynamic nature of inventory fluctuations in retail logistics and the evolving technological landscape, this approach enables the researcher to capture complex interactions between manual practices and digital tools. Furthermore, the study's focus on a regional warehouse in Palu provides an opportunity to assess how such practices manifest in resource constrained environments.

The data collection was carried out through semi structured interviews, direct observations, and document analysis. In line with Rashid et al. (2019), these methods are integral to achieving methodological triangulation and ensuring the robustness of findings in operational research. Interviews were conducted with four key informants: the warehouse manager, a senior inventory checker, an inventory administrator, and a logistics staff member. Each informant was selected using purposive sampling, as recommended by rRauf et al. (2023), because they possess domain specific knowledge and are directly involved in stock opname activities. This strategy ensured that the collected data was both relevant and rich in operational detail.

Interview sessions lasted between 45 to 60 minutes and were conducted on site during stock opname periods. The questions focused on existing inventory control procedures, the frequency and mechanisms of stock opname, data recording practices, system integration issues, and perceived challenges and opportunities in the process. In addition to the interviews, observations were carried out during one full cycle of the stock opname activity to gain first hand insights into the flow of operations, coordination among team members, and technological usage (e.g., barcode scanning and system data entry).

Document analysis included reviewing standard operating procedures (SOPs), internal inventory records, discrepancy reports, and audit logs. These materials provided critical context and historical data to validate interview responses and observed practices. They also enabled the researcher to identify patterns of inventory discrepancies and to understand the evolution of procedural improvements from 2019 to 2023.

Data analysis followed an inductive thematic coding process. Interview transcripts, observation notes, and documents were coded manually using a two stage process. In the first cycle, open coding was used to identify initial themes, such as "data entry errors," "SOP adherence," "layout inefficiency," and "barcode system utility." In the second cycle, axial coding was employed to cluster the initial codes into broader categories including "Operational Challenges," "Technological Integration," and "Inventory Accuracy Mechanisms." This layered approach allowed for the emergence of nuanced insights and the identification of relationships among themes, aligned with the iterative analytic procedures proposed by Rashid et al. (2019).

To enhance the trustworthiness of the study, confirmability measures were applied. These included audit trails of coding decisions, detailed field notes, and member checks where participants were invited to validate their interview summaries and interpretations. This process minimized researcher bias and ensured that the findings accurately reflected the perspectives of the participants. The researcher also practiced reflexivity by maintaining a reflective journal to track assumptions, methodological decisions, and contextual impressions throughout the research process.

The case study site the warehouse of PT Sumber Alfaria Trijaya in Palu was selected due to its representativeness of semi digital warehousing environments in Indonesian retail logistics. While equipped with an internal inventory application (Alfagudang) and barcode scanning tools, the system still relies heavily on manual documentation and periodic physical counts. This hybrid system offers an ideal setting to examine both the benefits and limitations of current stock opname practices in bridging the gap between digital inventory systems and on ground realities.

The frequency of stock opname in this warehouse is quarterly, and the process involves a cross functional team comprising inventory checkers, warehouse administrators, and supervisory personnel. During each cycle, physical counting is conducted using printed inventory lists, after which the data is verified against the system records. Discrepancies are recorded, analyzed, and reported in a formal audit log. This routine has been consistently followed from 2019 to 2023, as indicated by the annual data showing varying levels of inventory deviation.

Throughout the study, attention was paid to understanding how procedural elements such as FIFO method application, document verification, layout design, and SOP compliance interact to influence inventory accuracy. In particular, the study examined how the transition from traditional to semi digital systems has influenced operational performance, reduced discrepancies, and

supported inventory transparency. Insights from informants indicated that while barcode systems have improved data entry precision, their impact is constrained by limited integration and inconsistent use across different stages of the stock opname process.

Overall, this methodology provided a comprehensive and context sensitive framework for analyzing stock opname practices in a semi digitized warehouse setting. By combining interviews, observations, and document reviews, and applying a rigorous thematic analysis protocol, the study yielded insights into the operational strengths and systemic limitations of inventory control at PT Sumber Alfaria Trijaya's warehouse in Palu. The findings lay the groundwork for practical recommendations on enhancing inventory management through digital integration, SOP refinement, and workforce capacity building.

RESULT AND DISCUSSION

This section presents the key findings of the study on the implementation of stock opname as a strategic mechanism for inventory control at PT Sumber Alfaria Trijaya's warehouse in Palu. The results are structured into four subsections: inventory control procedures, stock opname process, implementation challenges, and optimization strategies. Data interpretation is grounded in the five year inventory discrepancy trend displayed in Table 1 and supported by relevant literature.

Inventory Control Procedures

PT Sumber Alfaria Trijaya applies a hybrid inventory control model that integrates manual documentation with digital systems, primarily using an internal application called Alfagudang and barcode scanning tools. The warehouse relies on the First In, First Out (FIFO) method, especially for perishable goods such as beverages and snacks. Products are arranged to prioritize dispatch based on the earliest receiving dates, supported by barcode labels that aid in tracking. This is consistent with findings from Titong (2024), who emphasizes that proper implementation of FIFO through spatial arrangements and systematic labeling can enhance inventory turnover accuracy.
The application of FIFO not only mitigates the risks of stock obsolescence but also supports the maintenance of product freshness. Although manual processes are still dominant, integration with barcode technology reduces the likelihood of human error and facilitates a smoother flow of inventory. This dual mode control approach mirrors the hybrid model described by Nisa and Rahmawati (2023), who found that combining digital tools with physical verification enhances operational reliability and minimizes stock mismatches.
"For items with an expiry date, especially food and beverages, we strictly implement FIFO. That means the first product that comes in must go out first. We arrange them accordingly on the shelves," (WS, R1).

Stock Opname Process

Stock opname at the Palu warehouse is conducted quarterly. It involves a structured process that begins with preparing inventory documents, including printed stock lists. Teams composed of warehouse checkers, inventory administrators, and supervisors conduct the physical counts. They

cross reference the actual item count with the system records. Discrepancies are documented in official reports and further investigated through recounts or validation against delivery records. The process aligns with best practices outlined by Destro et al. (2023), which highlight the importance of systematic SOPs that cover pre count preparation, zone based counting, reconciliation, and post count reporting.

The use of barcode scanning devices during stock opname has contributed to higher accuracy in recent years. Data from 2023 show a notable reduction in stock discrepancies compared to 2022, indicating that barcode supported procedures may be mitigating errors typically associated with manual inventory counts. This suggests an increasing effectiveness of the hybrid control system.

"During stock opname, we use barcode scanners to confirm each item. Then we match the physical count with the system. If there's a difference, we investigate. Sometimes it's just a misplaced item or a wrong entry," (IC, R2).

Implementation Challenges

Despite the observed improvements, several challenges persist. One primary issue is data inaccuracy caused by delayed or incorrect manual data entry. Warehouse staff must often transcribe physical counts from paper to spreadsheets or input them into the Alfagudang system, creating potential for transcription errors. These challenges echo the concerns of Nisa & Rahmawati (2023) and Balino & Beeh (2024), who found that semi digital warehouses frequently struggle with synchronization between manual and digital inventory records.

Warehouse layout complexity also hinders efficient stocktaking. In the Palu facility, the placement of goods does not always follow optimal zoning principles, leading to prolonged search times and increased likelihood of missed items. Setyawan & Kusrini (2024) identified such layout inefficiencies as a contributor to inventory discrepancies in high turnover retail warehouses. Furthermore, limited numbers of trained personnel exacerbate the problem. Inexperienced staff may miscount or overlook items, especially under time constraints.

Another challenge concerns physical conditions within the warehouse. For example, damaged packaging or poorly labeled items can make identification difficult during stock opname. Weather related issues such as humidity may also degrade packaging over time, complicating barcode readability. These operational obstacles highlight the importance of infrastructure quality and environmental control in maintaining inventory integrity.

"The warehouse is quite packed during peak season. Sometimes we have to move boxes just to count items, and that takes time. If the label is damaged or missing, it becomes even harder," (Warehouse Staff, R3).

Optimization Strategies

In response to the aforementioned challenges, PT Sumber Alfaria Trijaya has introduced several optimization strategies. Regular staff training sessions are held to improve proficiency in using inventory management tools and adhering to SOPs. These efforts align with the recommendations of Johnson & Ruankaew (2017), who underscore the role of continuous professional development in enhancing warehouse performance and reducing error rates.

Additionally, the company has begun reorganizing warehouse layouts to support logical zoning and streamline item retrieval during counts. Clearer labeling systems and barcode placement standards are also being implemented. These changes aim to improve counting efficiency and reduce the chance of misidentification.

From a technological standpoint, the increased use of barcode scanning has already shown promising results. As seen in Table 1, the discrepancy rate declined from 2.13% in 2022 to 1.66% in 2023, despite a rise in total items inspected. This improvement supports findings by Erlangga et al. (2022) and Sama and Mdemu (2024), who argue that barcoding, particularly when combined with IoT systems, can drastically improve real time data accuracy and reduce operational lag.
"Since we started using barcode scanners more frequently, the number of mismatches has gone down. It's easier to spot missing items or wrong entries right away," (IA, R4).

Table 1. Stock Opname Data and Inventory Discrepancies (2019–2023)

Year	Total Items Inspected	Matching Items	Mismatched Items	Discrepancy Percentage (%)
2019	15,200	14,950	250	1.64%
2020	16,100	15,780	320	1.99%
2021	16,750	16,420	330	1.97%
2022	17,400	17,030	370	2.13%
2023	18,100	17,800	300	1.66%

The trend shown in Table 1 confirms that stock opname remains an effective inventory control mechanism, particularly when paired with technological integration and procedural consistency. The decrease in the discrepancy rate, despite the increasing volume of items inspected annually, illustrates the warehouse's growing capability to manage operational complexity.
In conclusion, the results of this study provide empirical support for the strategic value of hybrid inventory systems in semi digital warehouse environments. While manual processes continue to pose challenges, especially in terms of data accuracy and staff competency, the integration of barcode technologies and SOP improvements have yielded observable benefits in stock opname performance. These findings offer actionable insights for similar retail distribution centers operating under resource constraints.

This study highlights the practical relevance of structured stock opname in minimizing inventory inaccuracies and enhancing supply chain reliability in a semi digitized warehouse environment. The five year trend presented in Table 1 supports this premise by demonstrating a consistent improvement in inventory compliance, particularly the reduction of discrepancy rates from a peak of 2.13% in 2022 to 1.66% in 2023. This trend reflects the effectiveness of procedural refinements and technological interventions, notably the implementation of barcode based verification, enhanced SOPs, and increased staff training.
Structured stock opname contributes not only to operational transparency but also to strategic inventory governance. The theoretical model proposed by Avcı et al. (2020), which uses Markov decision processes to account for uncertainty in inventory levels, finds empirical relevance in this study. When periodic stocktaking is executed consistently, it reduces ambiguity in inventory records and supports more accurate forecasting and replenishment decisions. Thus, the structured stock opname process in PT Sumber Alfaria Trijaya's Palu warehouse serves as a mechanism for maintaining inventory state awareness, which is critical in high volume retail operations.

Furthermore, Bhat & R (2023) emphasize that AI based inventory systems rely on accurate and timely inventory data to function effectively. In this regard, structured stock opname forms the foundational layer of input quality. The barcode supported stocktaking process used in Palu ensures that digital records align with physical realities, reducing error propagation into AI driven inventory forecasting or automated reordering systems. These theoretical frameworks reinforce the importance of regular, structured, and tech assisted stocktaking to build resilient and data reliable inventory systems.
Digitization is another central theme. As Perera et al. (2023) and (Soesanto et al., 2024) demonstrate, technological tools like barcoding, RFID, and IoT can significantly reduce human errors and enhance real time visibility. While the Palu warehouse has not adopted RFID, the gradual shift toward barcode based verification is already showing positive effects. This case aligns with Anggara et al. (2024), who argue that web based QR code tracking can significantly reduce human error and increase centralized oversight. The steady decline in discrepancy rates at the Palu site validates these claims and shows that incremental digitization, even when full WMS implementation is not feasible, can improve inventory performance.

Moreover, digitization supports operational resilience, particularly in environments subject to fluctuations in demand or disruptions in supply. Farohi et al. (2023) show that digital tools increase supply chain flexibility and economic performance. In Palu, the integration of barcode technology has allowed for faster verification and more accurate tracking, reducing the risk of stockouts or overstock situations. This capacity to respond swiftly to operational deviations is a hallmark of resilient logistics, confirming the strategic importance of technology supported inventory practices. Comparative insights from other developing economies strengthen the relevance of Indonesia's incremental digitization. Muhalia et al. (2021) report that partial digitization in Kenyan supply chains, such as the use of tracking systems in the absence of full WMS, still led to significant improvements in inventory reliability. The Indonesian case mirrors this experience, especially in resource constrained regions like Palu, where infrastructure and workforce readiness may not yet support full scale automation. This cross national evidence supports the view that tailored digital strategies aligned with local constraints and supported by staff development can effectively enhance inventory control outcomes.

The experience at PT Sumber Alfaria Trijaya also aligns with global best practices that advocate a stepwise approach to digitization. The current strategy, which blends legacy manual practices with barcode enabled digital tools, reflects what Tikwayo & Mathaba (2023) call a "resilience enhancing integration model." This model emphasizes interoperability and adaptability rather than wholesale replacement, suggesting that resilience and reliability are not solely functions of high tech investments but also of procedural robustness and workforce competence.

These findings also demonstrate the need for continuous investment in human capital. The observed discrepancy patterns, particularly the reduction seen in 2023, can be linked to ongoing staff training programs and the standardization of operational procedures. As Johnson & Ruankaew (2017) argue, training and SOP refinement are critical levers in ensuring inventory integrity. In Palu, improved staff familiarity with barcode scanning and the Alfagudang system has

contributed to better adherence to stock opname protocols, fewer input errors, and increased efficiency in post count reconciliation.

The findings further reveal that layout optimization and procedural alignment are key to efficient inventory operations. Studies by Setyawan & Kusrini 2024) confirm that warehouse spatial arrangements significantly influence stocktaking accuracy. At the Palu warehouse, adjustments in zoning and clearer labeling have begun to address earlier challenges of misplacement and inefficiency. This illustrates how even low cost interventions, when strategically implemented, can yield significant accuracy improvements.

Moreover, structured stock opname plays a critical role in bridging operational and financial data systems. Michael & Widjaja (2024) argue that inventory discrepancies compromise financial reporting and audit reliability. In Palu, discrepancy logs and audit trail reviews have been integrated into monthly reporting systems, fostering stronger alignment between warehouse operations and financial documentation. This integration serves as a foundation for more accurate cost accounting, asset valuation, and audit preparedness.

Lastly, the role of stock opname in enhancing customer service continuity should not be underestimated. Olutimehin et al. (2024) found that inventory inaccuracies often manifest in delayed order fulfillment and stockouts, eroding customer trust. In contrast, the operational improvements at PT Sumber Alfaria Trijaya have enabled more accurate forecasting and timely replenishment, thereby reducing service disruptions. These improvements are not merely internal efficiency gains; they translate into external value in the form of enhanced brand reliability and customer satisfaction.

In sum, the discussion reinforces the multidimensional value of structured stock opname operational, technological, financial, and strategic. Supported by theoretical models and comparative case evidence, the findings from PT Sumber Alfaria Trijaya's warehouse in Palu illustrate how even under semi digital conditions, structured and iterative inventory practices can drive meaningful improvements in accuracy, reliability, and supply chain performance.

CONCLUSION

This study has demonstrated that structured stock opname significantly improves inventory accuracy and operational efficiency in semi digital warehouse environments. At PT Sumber Alfaria Trijaya's warehouse in Palu, consistent application of quarterly stock opname procedures, supported by barcode technology and revised standard operating procedures, led to a measurable decline in inventory discrepancies from 2.13% in 2022 to 1.66% in 2023. These results affirm the effectiveness of hybrid inventory systems in retail logistics settings where full digital integration remains a challenge.

The implementation of structured counting routines, strategic warehouse layout adjustments, and targeted staff training contributed to improved data reliability and synchronization between physical inventory and digital records. Technological interventions such as barcode scanning enhanced real time inventory tracking, while operational audits reinforced compliance and accountability. The study contributes to the growing body of knowledge on adaptive warehouse

management by highlighting how procedural rigor, even within limited resource contexts, can generate substantial gains in inventory control and supply chain continuity.

Future research should explore the scalability of these findings across different retail sectors and regions, particularly in environments with diverse digital readiness. Further investigation into the long term impact of integrating IoT and AI based inventory analytics within similar hybrid systems would also be valuable to strengthen predictive capabilities and responsiveness.

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