Quantitative Analysis of Inventory Record Inaccuracy (IRI): A Case Study on Warehouse Stock Discrepancies

Hanung Wahyuning Linuwih[1], Yuanita Handayati[2]

[1,2] School of Business and Management, Bandung Institute of Technology, Bandung, Indonesia

ABSTRACT: Inventory Record Inaccuracy (IRI) presents critical challenges to warehouse operations by causing inefficiencies, financial losses, and diminished stakeholder trust. This study examines IRI at XYZ Warehouse through the analysis of **Gross Variance** and **Net Variance**, identifying a discrepancy rate of 0.53%, equivalent to 3,089 units or IDR 154,450,000 in potential financial losses. The findings emphasize the importance of accurate inventory management to mitigate these losses and improve operational efficiency. This study serves as a foundation for future research and interventions aimed at addressing IRI and its associated challenges.

KEYWORDS: Financial Impact, Gross Variance, Inventory Record Inaccuracy, Net Variance, Warehouse Management.

1. INTRODUCTION

Efficient inventory management is fundamental to efficient warehouse operations, facilitating the seamless movement of commodities and preserving supply chain efficacy. Nonetheless, Inventory Record Inaccuracy (IRI) continues to be a chronic problem, compromising these aims by generating disparities between actual stock and system records. Such mistakes can hinder order fulfillment, elevate operating expenses, and diminish overall productivity, ultimately undermining stakeholder confidence.

XYZ Warehouse, an essential storage and distribution facility, is not immune to this difficulty. Recent observations indicate substantial inconsistencies in inventory records, with 52.85% of products displaying inaccuracies throughout the 2024 stocktaking procedure. The gaps, measured by Gross Variance and Net Variance, result in a financial effect of IDR 154,450,000, highlighting the necessity for a more profound comprehension of IRI and its implications.

This study seeks to measure the extent of IRI at XYZ Warehouse and examine its financial consequences. The research emphasizes the necessity of addressing IRI to improve inventory accuracy and operational efficiency by concentrating on quantifiable disparities. The findings represent a preliminary step in recognizing essential deficiencies in existing processes and promoting future enhancements in warehouse management.

2. LITERATURE REVIEW

Inventory Record Inaccuracy (IRI) is characterized as the absolute discrepancy between documented and actual inventory quantities [1]. This disparity is a prevalent issue in inventory management, frequently arising from operational errors, human blunders, or system constraints. Research demonstrates that Inventory Record Inaccuracy (IRI) impacts over 65% of inventory records in retail and warehousing settings [1]. These mistakes can disseminate throughout supply chains, resulting in inefficiencies, elevated costs, and consumer discontent [2].

Two principal metrics are employed to evaluate IRI: Gross Variance and Net Variance. Gross Variance denotes the overall extent of inconsistencies, irrespective of direction, whereas Net Variance accounts for the equilibrium of overstatements and understatements in inventory records [2]. These measurements offer a thorough assessment of inventory correctness, emphasizing the magnitude and characteristics of errors.

Operational errors leading to IRI included erroneous item scanning, misallocated inventory, and theft [1]. Moreover, inadequate training, excessive workloads, and antiquated inventory systems intensify disparities [3]; [4]. The cumulative impact of these factors generates a feedback loop that undermines inventory accuracy and complicates warehouse management.

The ramifications of IRI are substantial, affecting both operational and financial performance. Common effects include disrupted order fulfillment, elevated holding costs, and missed revenues resulting from stockouts [1]. From a financial standpoint, these mistakes can lead to significant losses, as evidenced by this study.

Addressing IRI necessitates focused approaches. This paper emphasizes measuring differences and their financial consequences, while other studies underscore the benefits of integrating process enhancements with technology, including real-time tracking systems, to increase inventory accuracy [4];[5]. These observations highlight the essential necessity of continuous endeavors to mitigate IRI and its related hazards.

3. METHODOLOGY

This study employs a quantitative approach to analyze Inventory Record Inaccuracy (IRI) at XYZ Warehouse. The methodology focuses on calculating Gross Variance and Net Variance to measure discrepancies between system-recorded inventory and physical stock. The data was sourced from the 2024 stock opname records, covering 9,123 product types with detailed information on system and physical inventory levels.

The stock opname data was obtained from XYZ Warehouse's annual inventory reconciliation process. Discrepancies were identified and categorized for each product based on system and physical inventory records. Gross Variance was calculated as the absolute sum of discrepancies across all products, while Net Variance accounted for the balance of overstatements and understatements. The financial loss due to discrepancies was estimated using the average product price of IDR 50,000. This estimate provided a clear quantification of the potential financial impact caused by inventory inaccuracies.

The scope of the analysis focuses on products with high turnover to ensure operational relevance. Results are limited to a single year (2024), restricting the ability to assess trends over time. However, this methodology establishes a robust framework for understanding IRI and its implications, setting the stage for further research and targeted interventions to improve inventory accuracy.

4. ANALYSIS CURRENT IRI MEASUREMENT AND IMPACT

The evaluation of Inventory Record Inaccuracy (IRI) at XYZ Warehouse reveals significant inconsistencies (D) between system-recorded (S) inventory and physical (P) stock. Analysis of nine sample product types from 2023 to 2024 (Table I) indicates a substantial rise in differences, escalating from 2 units in 2023 to 190 units in 2024. This significant increase highlights the escalating seriousness of inventory discrepancies.

Table I. Inventory Discrepancies in Sampling Books: 2023 vs 2024

Code	2023			2024		
	S	P	D	S	P	D
BT-111	405	363	-42	791	835	44
UD-112	1205	1207	2	259	266	7
ND-113	636	637	1	302	311	9
BF-114	830	869	39	84	104	20
BT-115	847	842	-5	771	771	0
NR-116	6463	6527	64	3376	3316	60
NDS-117	1090	1032	-58	2160	2207	47
RS-118	4680	4681	1	605	607	2
NR-119	67	67	0	1930	1929	1
Total Discrepancies			2			190

In light of these concerns, the purpose of this study is to examine the Inventory Record Inaccuracy (IRI) current situation at XYZ Warehouse. The preliminary observation concentrated on nine sample titles, while the investigation will thoroughly examine the 2024 stock opname data to pinpoint significant deficiencies in the warehouse procedures.

Gross Variance was calculated to measure the total magnitude of discrepancies without considering their direction. The formula for Gross Variance is as follows:

$$Gross\ Variance\ =\ \sum abs\ (System\ Inv\ Level - Store\ Inv\ Level)$$

For XYZ Warehouse in 2024, the calculation was:

$$Gross\ Variance\ =\ \sum abs\ (581967 - 585056)$$
$$Gross\ Variance\ =\ 3089$$

The Gross Variance computation for the complete dataset indicated a total deviation of 3,089 units among all product categories in 2024. This constitutes 0.53% of the overall inventory, signifying a considerable discrepancy in inventory accuracy.

Net Variance, on the other hand, accounts for the direction of discrepancies (overstatement or understatement). The formula is:

$$Net\ Variance\ =\ \sum (System\ Inv\ Level - Store\ Inv\ Level)$$

The Net Variance for the same dataset was:

$$Net\ Variance\ =\ \sum (581967 - 585056)$$
$$Net\ Variance\ =\ -3089$$

The Net Variance computation revealed a negative variance of 3,089 units, indicating a general underreporting of inventory in the system. These differences aligned with the tendencies noted in the sample products.

Financial Impact was calculated using the following formula:

$$Estimated\ loss = 3,089\ pcs\ \times\ IDR\ 50.000$$

$Estimated\ loss = IDR\ 154.450.000$

The projected financial loss from inventory anomalies totaled IDR 154,450,000, derived from an average unit price of IDR 50,000. This assessment underscores the significant financial risks linked to IRI, particularly for high-turnover products.

This financial impact underscores the significant economic burden posed by IRI, particularly for high-turnover items. For instance, discrepancies in best-selling fiction titles directly contributed to missed sales opportunities and reduced customer satisfaction.

Operationally, the presence of substantial variances disrupted inventory accuracy, leading to delays in order fulfillment and increased labor costs for manual stock reconciliation. Products with high Gross Variance were often flagged for recounting, straining warehouse resources and diverting efforts from value-added activities. The systemic underreporting identified by Net Variance further complicated inventory planning, creating inefficiencies in procurement and replenishment processes.

Over time, these discrepancies can erode stakeholder trust and hinder the warehouse's ability to meet key performance indicators (KPIs) related to inventory accuracy and customer service. Addressing these issues requires targeted interventions, including improved training for warehouse staff, adherence to Standard Operating Procedures (SOPs), and investments in technology to enhance real-time inventory tracking.

These findings emphasize the interconnected nature of Gross and Net Variances with operational and financial metrics. The analysis provides a robust foundation for identifying critical gaps in existing practices and prioritizing corrective actions to mitigate the risks associated with IRI.

5. DISCUSSION

This study's findings highlight the complex character of Inventory Record Inaccuracy (IRI) and its significant impact on warehouse management. Gross Variance quantitatively measures the degree of differences, highlighting the pervasive problem of inventory mistakes inside the system. Although constituting only 0.53% of total inventory, this figure may seem negligible; yet, it has considerable operational implications when considered across 9,123 product categories. Simultaneously, the adverse Net Variance underscores a systematic underreporting of inventory, presenting distinct issues for stock planning and fulfillment.

Inconsistencies among product categories expose significant insights into operational inefficiencies. Fiction products often have exaggeration problems, likely due to faults in stock reception procedures or inconsistencies in system updates. Conversely, children's products consistently demonstrate understatement, indicating misallocation or unrecorded transfers during intra-warehouse

transactions. These trends indicate that IRI is unevenly distributed and necessitates focused interventions customized for particular product categories and operational procedures.

The financial ramifications, with an anticipated deficit of IDR 154,450,000, underscore the economic hazards linked to IRI. Significant disparities in top-selling products amplify lost income potential and undermine customer trust due to stockouts or delayed shipments. The financial risks linked to IRI intensify operational inefficiencies, since considerable resources are diverted to manual reconciliation and inventory audits, detracting focus from strategic initiatives.

From an operational standpoint, IRI compromises the integrity of inventory data, which is essential for efficient decision-making in procurement, replenishment, and order fulfillment. The pervasive underreporting revealed by Net Variance indicates that the existing inventory system is deficient in safeguards to avert inaccuracies. This corresponds with previous research [1]; [4], which emphasizes the impact of human mistake and insufficient mechanisms in sustaining IRI.

Addressing IRI necessitates a comprehensive strategy. Implementing thorough training programs for warehouse personnel can markedly decrease data entry inaccuracies and improve compliance with Standard Operating Procedures (SOPs). Moreover, investments in real-time inventory tracking technology, such barcode scanning and RFID devices, can diminish dependence on manual operations and enhance the precision of inventory data. Regular audits and process assessments are essential for detecting and resolving systemic issues, hence promoting ongoing enhancement in inventory management processes.

These findings strengthen the comprehension of IRI and its effects, provide a basis for focused actions to improve inventory precision and reduce related hazards. Subsequent research may build upon these findings by investigating the long-term impacts of IRI on supply chain efficacy and assessing the efficiency of suggested remedies in mitigating differences.

6. CONCLUSION AND RECOMMENDATION

This study emphasizes the significant problem of Inventory Record Inaccuracy (IRI) at XYZ Warehouse, measured by Gross Variance and Net Variance metrics [1][4]. The results indicate a discrepancy rate of 0.53%, corresponding to 3,089 units or IDR 154,450,000 in potential financial losses. These mistakes present considerable issues, encompassing operational inefficiencies, financial hazards, and diminished stakeholder confidence.

To tackle these difficulties, the subsequent proposals are put out, each immediately responding to the findings from the investigation. It is advisable to implement improved training programs to address data entry inaccuracies, as indicated by the inconsistencies in the fiction and children's goods categories. Investments in technology, including real-time tracking systems, are proposed to diminish the 0.53% discrepancy rate and enhance operational precision. Regular audits and assessments are essential to detect persistent systemic problems indicated by the substantial Gross and Net Variances. Customized solutions for high-discrepancy categories will directly target the identified gaps, while improved monitoring facilitates the proactive detection and alleviation of future discrepancies.

7. Augmented Training Initiatives: Deliver extensive training for warehouse personnel to enhance data input precision and compliance with Standard Operating Procedures (SOPs). Training should concentrate on reducing errors in stock receipt and update procedures.

8. Technological Investments: Deploy real-time inventory tracking technology, like barcode scanning or RFID devices, to improve accuracy and diminish dependence on human operations.

9. Regular Audits and Process Evaluations: Perform systematic audits and assessments of inventory management procedures to detect and rectify systemic issues leading to disparities.

10. Category-Specific Interventions: Formulate customized solutions for product categories exhibiting significant differences, such as fiction and children's products, to rectify distinct operational inefficiencies.

11. Improved Monitoring and Reporting: Develop a comprehensive monitoring and reporting system to analyze IRI patterns over time, facilitating the proactive detection of potential issues.

By adopting these recommendations, XYZ Warehouse can rectify the detected problems of 0.53% inventory inconsistencies and systemic underreporting, as evidenced by the Gross and Net Variance findings. These methods will directly improve inventory accuracy, operational efficiency, and mitigate the financial risks identified in this study. These techniques not only tackle the immediate difficulties presented by IRI but also establish a foundation for enduring enhancements in inventory management processes.

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