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9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

Inventory Discrepancy Risk Analysis and Mitigation Prioritization at Finished Goods Warehouse Using the House of Risk Method

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Abstract

Inventory discrepancy in finished goods warehouses reduces inventory accuracy and may disrupt warehouse operations and product distribution. This study was conducted at PT Alpha Plastic Manufacturing (a pseudonym), a plastic injection moulding company operating in the plastic manufacturing sector that manages a finished goods warehouse for injection-moulded components supplied for industrial applications. This study aims to analyze the causes of inventory discrepancy and determine appropriate mitigation strategies by integrating the Supply Chain Operations Reference (SCOR) model and the House of Risk (HOR) method. A descriptive quantitative approach was employed using observation, interviews, focus group discussions, company documents, and questionnaires involving three warehouse experts. The SCOR model was used to identify risk events and risk agents, while HOR Phase 1 prioritized risk agents using Aggregate Risk Potential (ARP), and HOR Phase 2 determined preventive actions based on the Effectiveness-to-Difficulty Ratio (ETD). The integration of SCOR and HOR provides a systematic approach to connect warehouse operational activities, priority risk sources, and feasible mitigation strategies. The results identified 10 risk events and 8 risk agents, with six priority risk agents contributing 86.36% of the total ARP value and five priority preventive actions contributing 66.97% of the total ETD value. Based on the investigated case, the findings indicate that strengthening warehouse procedures and operational controls should become the initial priority for reducing inventory discrepancy before implementing advanced inventory technologies.

Keywords: Inventory discrepancy, House of Risk, SCOR, Risk mitigation, Finished goods warehouse.

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1. Introduction

Inventory accuracy is essential in manufacturing because it supports production planning, warehouse control, and product distribution. Accurate inventory records ensure timely deliveries, efficient warehouse operations, and reliable inventory-related decision-making, whereas inaccurate data may lead to stock shortages, overstock, delayed deliveries, and operational inefficiencies [1]. With the advancement of Industry 4.0, warehouse operations increasingly adopt digital technologies such as Warehouse Management Systems (WMS), the Internet of Things (IoT), and real-time inventory monitoring to improve inventory visibility, information accuracy, and operational efficiency. However, digital transformation alone cannot eliminate inventory discrepancies when inventory information is not consistently synchronized with physical inventory movement [2], [3].

Inventory discrepancy refers to a mismatch between physical stock and inventory records maintained in stock cards or inventory information systems, commonly identified during stock opname when actual inventory differs from recorded data [4]. Beyond being an operational issue, inventory discrepancy represents a supply chain risk because inaccurate inventory information disrupts the synchronization between material flow and information flow. Since inventory records support production planning, procurement, and distribution activities, poor information accuracy reduces inventory visibility, weakens supply chain coordination, limits operational responsiveness, and ultimately affects supply chain resilience [5], [6].

Several operational factors contribute to inventory discrepancy, including recording errors, delayed inventory updates, manual stock card practices, inadequate verification, inconsistent stock opname procedures, and weak supervision. These factors reduce inventory reliability and increase the risk of stock shortages and poor inventory-related decision-making [7], [8]. Although digital inventory control technologies improve warehouse visibility and facilitate real-time inventory management, reliable inventory performance ultimately depends on accurate transaction recording, timely information updates, and effective operational control. Therefore, inventory discrepancy should be addressed as a supply chain risk requiring systematic identification and preventive mitigation to support reliable warehouse operations [3], [9].

Various methods have been developed to analyze operational and supply chain risks, including Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis (FTA), Analytic Hierarchy Process (AHP), and the House of Risk (HOR). Among these methods, HOR systematically links risk events with their underlying risk agents and prioritizes preventive mitigation actions, while the Supply Chain

Operations Reference (SCOR) model provides a structured framework for mapping supply chain processes and identifying potential risk events. The integration of SCOR and HOR enables systematic warehouse risk assessment and supports the development of appropriate mitigation strategies [10], [11].

Previous studies have successfully applied the House of Risk method in various industrial sectors, including halal food supply chains, automotive spare parts, traditional beverage industries, and manufacturing systems, demonstrating its effectiveness in identifying dominant risk agents and prioritizing mitigation strategies to improve supply chain performance [12]. However, most previous studies primarily focused on general supply chain risks, such as supplier disruptions, production delays, product defects, and distribution risks. Limited attention has been given to inventory discrepancy caused by inconsistencies between physical inventory movement and inventory information within finished goods warehouse operations, particularly in cases involving recurring discrepancies in finished goods inventory. Furthermore, few studies have integrated SCOR-based process mapping with HOR-based risk prioritization to specifically examine the interaction between material flow and information accuracy as the basis for preventive mitigation. This study addresses this gap by providing a structured risk assessment framework for improving inventory accuracy through warehouse-specific risk identification and mitigation prioritization.

Field observations at PT Alpha Plastic Manufacturing (a pseudonym), a plastic injection moulding manufacturing company, identified recurring inventory discrepancies in five selected finished goods items during stock opname activities conducted from February to April 2025. The average discrepancy percentage across these five items reached approximately 54%, indicating substantial inconsistencies between physical inventory quantities and warehouse stock card records. These findings suggest that the existing inventory control process has not effectively prevented inventory inaccuracies, highlighting the need for a structured risk assessment approach to identify the underlying causes and develop preventive mitigation strategies.

Based on these conditions, this study aims to analyze inventory discrepancy risk in the finished goods warehouse of PT Alpha Plastic Manufacturing by integrating the SCOR model and the House of Risk method. The SCOR model is used to map warehouse processes and identify potential risk events, whereas the House of Risk prioritizes risk agents using Aggregate Risk Potential (ARP) and determines preventive mitigation strategies through the Effectiveness-to-Difficulty Ratio (ETD). This integrated approach provides a systematic framework for improving inventory accuracy, strengthening warehouse control, and supporting more reliable inventory-related decision-making.

2. Methods

2.1 Research Design

This study employed a descriptive quantitative approach to analyze inventory discrepancy risk in the finished goods warehouse of PT Alpha Plastic Manufacturing (a pseudonym). The research focused on the finished goods inventory management process, including storage, inventory recording, delivery preparation, stock opname, and inventory reconciliation. The study was conducted at PT Alpha Plastic Manufacturing (a pseudonym), a plastic injection moulding manufacturing company located in West Java, Indonesia. The company was selected as the case study because recurring inventory discrepancies were identified in its finished goods warehouse, making it an appropriate setting for investigating inventory-related risks and preventive mitigation strategies.

The study was conducted from February to June 2025. During the observation period, recurring inventory discrepancies were consistently identified in five finished goods items, which became the focus of this research. To maintain research confidentiality, the company identity and sensitive operational information were anonymized. Therefore, the company name used in this manuscript represents a pseudonym approved for academic reporting purposes.

2.2 Data Collection

Data were collected through field observations, interviews, focus group discussions, internal company documents, and questionnaires involving three respondents directly responsible for warehouse and inventory management. The respondents consisted of the Warehouse Supervisor with 10 years of working experience, the PPIC Supervisor with 5 years of working experience, and the Warehouse Administration Staff with 5 years of working experience. They were selected using purposive sampling based on their direct involvement in inventory recording, warehouse operations, stock opname activities, and inventory reconciliation processes, ensuring that the assessments reflected practical knowledge of warehouse operations.

The data used in this study consisted of primary and secondary data. Primary data included stock opname records, stock card data, discrepancy reports, risk event identification, risk agent identification, severity scores, occurrence scores, correlation scores, and implementation difficulty scores. Inventory discrepancy was determined by comparing the physical inventory quantities obtained during stock opname with the corresponding quantities recorded in the warehouse stock cards. The discrepancy percentage was calculated for each of the five finished goods items that consistently experienced inventory discrepancies during the observation period from February to April 2025. The reported average discrepancy of approximately

54% represents the arithmetic mean of the discrepancy percentages across these five finished goods items.

The five finished goods items were selected because they consistently exhibited inventory discrepancies during the observation period and therefore represented the most relevant cases for risk analysis. Secondary data were obtained from scientific journals and previous studies related to inventory management, supply chain risk management, the SCOR model, and the House of Risk method. Severity, occurrence, correlation, and implementation difficulty scores were determined through expert judgment involving the three selected respondents. Each respondent initially assessed the scores independently based on their operational experience, followed by a focus group discussion to establish consensus values. The agreed consensus scores were then used as input for the House of Risk analysis.

2.3 Research Procedure

The research procedure integrated the Supply Chain Operations Reference (SCOR) model and the House of Risk (HOR) method to systematically identify inventory-related risks, prioritize their underlying causes, and determine appropriate preventive mitigation strategies. The SCOR model was first used to map the relevant supply chain activities, particularly the Deliver and Enable processes, because these activities are directly associated with finished goods warehousing, delivery control, inventory recording, and stock opname [13]. **Figure 1** presents the research framework used in this study.

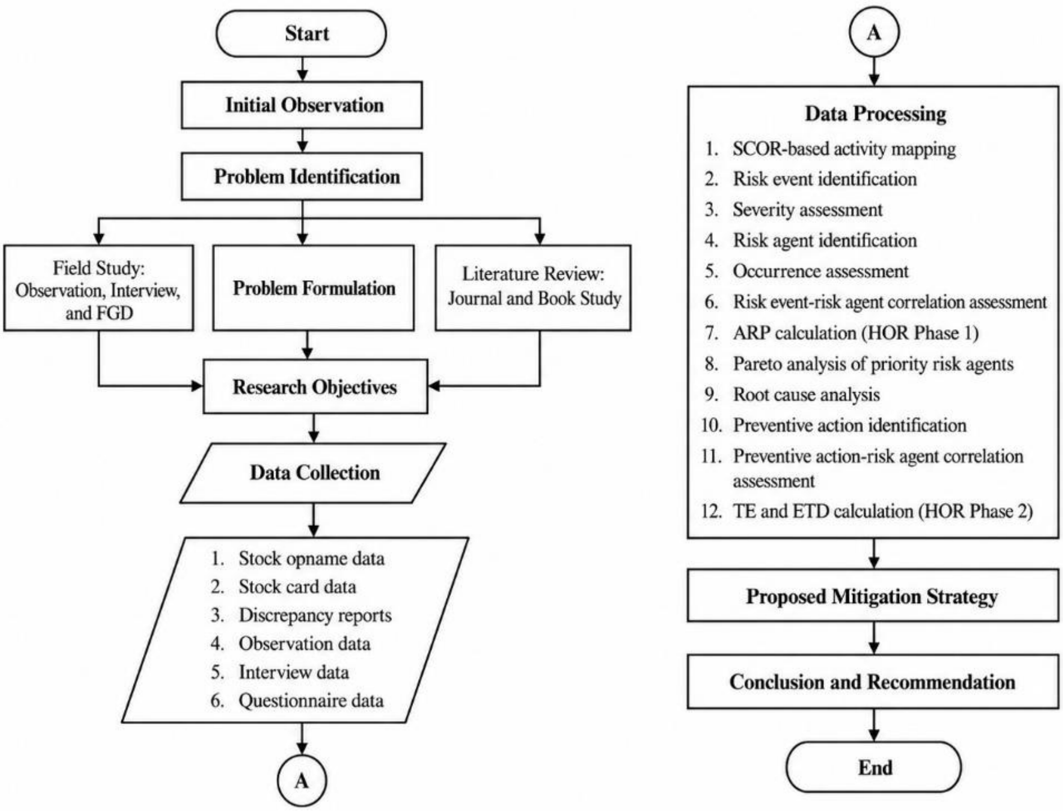

Figure 1. Research flowchart

Figure 1 illustrates that the study began with problem identification and continued with supply chain activity mapping using the SCOR model. The mapped activities served as the basis for identifying risk events and risk agents before being analyzed using the House of Risk method. This framework ensured that the risk assessment was conducted systematically, from process mapping to the selection of preventive mitigation strategies

2.4 House of Risk Analysis

The House of Risk (HOR) method was employed to systematically identify, evaluate, and prioritize inventory discrepancy risks based on their potential impact and underlying causes. The analysis consisted of two phases. HOR Phase 1 was used to prioritize risk agents based on their Aggregate Risk Potential (ARP), while HOR Phase 2 was conducted to determine the most effective preventive mitigation strategies using the Effectiveness-to-Difficulty Ratio (ETD).

In HOR Phase 1, each risk agent was prioritized using the Aggregate Risk Potential (ARP). The ARP was calculated using the following formula [14]:

$$ARP_j = O_j \sum S_i R_{ij} \tag{1}$$

Where ARPj is the aggregate risk potential of risk agent j, Oj is the occurrence score of risk agent j, Si is the severity score of risk event i, and Rij is the correlation value between risk event i and risk agent j. The selected priority risk agents then became the basis for determining preventive actions in HOR Phase 2.

In HOR Phase 2, preventive actions were identified based on the priority risk agents obtained from Phase 1. Each preventive action was evaluated using Total Effectiveness (TE) and the Effectiveness-to-Difficulty Ratio (ETD). The calculation formulas are presented as follows [12]:

$$TE_k = \sum ARP_j E_{jk} \tag{2}$$

$$ETD_k = \frac{TE_k}{D_k} \tag{3}$$

Where TEk is the total effectiveness of preventive action k, Ejk is the correlation between risk agent j and preventive action k, Dk is the degree of difficulty, and ETDk is the ratio between effectiveness and implementation difficulty. Preventive actions with the highest ETD values were selected as priority mitigation strategies because they provide greater effectiveness with lower implementation difficulty. This approach enabled the study to recommend practical mitigation strategies for reducing inventory discrepancy in the finished goods warehouse of the case company.

3.Results and Discussion

3.1 Identification of Risk Event and Risk Agent

The identification of risk events was initiated by mapping warehouse activities using the Supply Chain Operations Reference (SCOR) framework. The analysis focused on the Deliver and Enable processes because these activities are directly associated with finished goods handling, inventory recording, stock control, and stock opname. Based on the mapped activities, risk events were identified through field observations, interviews, and company documentation, while their impacts were evaluated using severity scores. The identified risk events are presented in Table 1.

Table 1. Identified Risk Events Based on SCOR Process Mapping

SCOR Process	Warehouse Activity	Code	Risk Event	Severity
Deliver	Delivery preparation	E1	Prepared delivery stock has not been recorded in the system	8
	Outgoing goods management	E2	Outgoing goods have not been recorded on the stock card	9
		E3	Mismatch between physical outgoing goods and system data	9
	Delivery verification	E4	Delivery documents do not match physical goods	8
Enable	Inventory data management	E5	Delay in updating incoming goods stock data	7
	Inventory recording control	E6	Error in inventory data recording	8
	Stock opname control	E7	Error in stock opname calculation	9
		E8	Goods are not counted during stock opname	9
	Inventory data reconciliation	E9	Difference between physical stock and system data	10
		E10	Stock discrepancy is not followed up immediately	8

Source: Processed data, 2026.

Table 1 shows that a total of 10 risk events were identified from the Deliver and Enable processes. Four risk events were associated with the Deliver process, whereas six risk events were identified in the Enable process, indicating that inventory discrepancy was more frequently related to inventory control and information management activities. The highest severity score was assigned to E9 (Difference between physical stock and system data) with a value of 10, followed by E2, E3, E7, and E8, each with a severity score of 9. These findings indicate that weaknesses in inventory recording, stock opname, and inventory reconciliation have a greater impact on inventory discrepancy than physical product movement.

After the risk events were identified, the study identified the risk agents that could trigger those events. Risk agents refer to the causes of risk that may lead to inventory discrepancy. The occurrence score shows how often each risk agent may appear in warehouse operations. The identified risk agents and occurrence scores are presented in Table 2.

Table 2. Risk Agents and Occurrence Scores

Code	Risk Agent	Occurrence
A1	Low warehouse operator accuracy in stock recording	8
A2	Inventory data updates are not performed in real time	9
A3	Inventory data are not rechecked	7
A4	Inventory recording system is still manual	8
A5	Coordination between warehouse departments is not effective	6
A6	Supervision of the inventory process is still weak	7
A7	No consistent SOP for inventory recording and stock opname	7
A8	Warehouse operator workload is too high	7

Source: Processed data, 2026.

Table 2 presents eight risk agents identified as the underlying causes of inventory discrepancy in the finished goods warehouse. The highest occurrence score was assigned to A2 (Inventory data updates are not performed in real time) with a value of 9, followed by A1 (Low warehouse operator accuracy in stock recording) and A4 (Inventory recording system is still manual), each with a score of 8. These findings indicate that inventory discrepancies were primarily caused by weaknesses in inventory information management rather than physical product movement. The identified risk agents were subsequently used as the input for the House of Risk Phase 1 analysis.

3.2 House of Risk Phase 1

After the risk events and risk agents had been identified, House of Risk (HOR) Phase 1 was applied to determine the priority risk agents contributing to inventory discrepancy. In this phase, the relationship between each risk event and risk agent was assessed using correlation values of 0, 1, 3, and 9, representing no, low, moderate, and high correlation, respectively. These correlation values were subsequently combined with the severity and occurrence scores to calculate the Aggregate Risk Potential (ARP) of each risk agent.

To illustrate the calculation process, one example of the ARP calculation is presented using risk agent A1 (Low warehouse operator accuracy in stock recording time), which has an occurrence score of 8. The ARP value was obtained by multiplying the occurrence score by the sum of the products of the severity scores and the corresponding correlation values between each risk event and risk agent A1.

$$ARP_{A1} = 8 \times ((8 \times 1) + (9 \times 9) + (9 \times 3) + (8 \times 3) + (7 \times 1) + (8 \times 9) + (9 \times 9) + (9 \times 9) + (10 \times 9) + (8 \times 1))$$

$$ARP_{A1} = 3832$$

Based on this calculation, risk agent A1 obtained an ARP value of 3,832. Using the same calculation procedure, the ARP values for all identified risk agents were determined. **Table 3** presents the complete House of Risk Phase 1 matrix, including the correlation values, severity and occurrence scores, ARP values, and the resulting priority ranking of the identified risk agents.

Table 3. Matriks House of Risk Phase 1

Businies Processes	***Risk Event* (E_i)**	***Risk Agents* (A_J)**								***Severity of Risk Event* $_i$ (S_i)**
		A_1	**A_2**	**A_3**	**A_4**	**A_5**	**A_6**	**A_7**	**A_8**	
Deliver	E_1	1	9	1	3	3	1	1	1	8
	E_2	9	9	3	9	1	3	9	3	9
	E_3	3	9	3	3	9	3	3	1	9
	E_4	3	1	3	1	9	3	9	1	8
Enable	E_5	1	9	3	3	1	1	3	1	7
	E_6	9	3	9	9	1	3	9	3	8
	E_7	9	1	9	3	1	3	9	3	9
	E_8	9	1	3	1	1	3	3	9	9
	E_9	9	9	9	9	3	9	9	3	10
	E_{10}	1	3	3	1	1	9	9	1	8
O_j		8	9	7	8	6	7	7	7	
ARP_j		3832	4149	2807	2936	1542	2331	3857	1603	
R_j		3	1	5	4	8	6	2	7	

Source: Processed data, 2026.

Table 3 shows that the ARP values varied among the identified risk agents, indicating different levels of contribution to inventory discrepancy. Risk agent A2 obtained the highest ARP value (4149), followed by A7 (3857), A1 (3832), A4 (2936), and A3 (2807). These findings indicate that delayed inventory data updates, inconsistent inventory recording procedures, low operator accuracy, and manual inventory recording systems were the dominant contributors to inventory discrepancy. The dominance of information-related risk agents suggests that inventory discrepancy was primarily caused by weaknesses in data synchronization and transaction recording rather than failures in physical product handling. Consequently, improving inventory information management should become the initial priority for reducing inventory discrepancy.

To determine the priority risk agents, a Pareto analysis was conducted based on the ARP values obtained from the House of Risk Phase 1 analysis. Pareto analysis was used to determine which risk agents should become the focus of mitigation. This analysis was used because the Pareto principle helps organizations focus on a small number of causes that contribute to most of the problem impact. **Figure 2** presents the Pareto chart of priority risk agents based on ARP value.

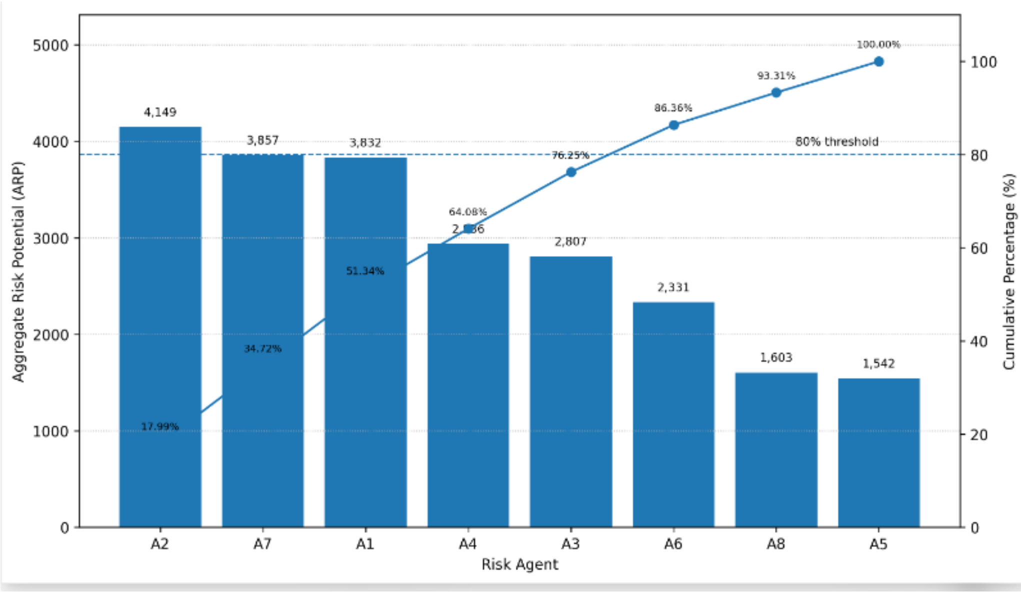

Figure 2. Pareto Chart of Priority Risk Agents

Figure 2 shows that six risk agents were categorized as priority risk agents. These risk agents were A2, A7, A1, A4, A3, and A6. The six priority risk agents contributed 86.36% of the total ARP value. A2 became the highest priority because delayed inventory data updates could affect several risk events, such as unrecorded delivery stock, mismatch between physical and system data, delayed incoming stock updates, and the final discrepancy between physical stock and system data. Similarly, A7 and A1 also obtained high ARP values because inconsistent recording procedures and low operator accuracy directly reduced the reliability of inventory recording and stock opname activities, thereby increasing the likelihood of inventory discrepancy.

The priority risk agents indicate that inventory discrepancy at PT Alpha Plastic Manufacturing (a pseudonym) was influenced by interrelated procedural, human, system, and control weaknesses. Procedural weaknesses were reflected in inconsistent inventory recording and stock opname procedures, while human and system weaknesses were associated with low operator accuracy, manual inventory recording, and delayed inventory data updates. In addition, limited verification and weak supervision reduced the effectiveness of inventory control. These findings further confirm that weaknesses in information management play a more significant role than physical product handling in causing inventory discrepancy, highlighting the need to prioritize improvements in inventory recording and data management.

3.3 House of Risk Phase 2

House of Risk (HOR) Phase 2 was conducted to determine the most effective preventive actions for mitigating the priority risk agents identified in the previous phase. A total of 10 preventive actions were proposed based on the dominant risk agents and discussions with warehouse personnel. Each preventive action was then evaluated using the Degree of Difficulty (Dk) score, which reflects the level of effort, time, and resources required for implementation. The proposed preventive actions and their corresponding Dk values are presented in Table 4.

Table 4. Proposed Preventive Actions and Degree of Difficulty

Code	Preventive Action	Dk
PA1	Developing and implementing a standard SOP for inventory recording and stock opname	3
PA2	Conducting regular training for warehouse operators on recording and stock opname	2
PA3	Implementing a double-checking system in recording and stock opname	2
PA4	Integrating real-time inventory data updates	4
PA5	Developing a computerized or digital inventory system	5
PA6	Conducting periodic supervision and evaluation of inventory activities	3
PA7	Creating a verification checklist for incoming and outgoing goods	2
PA8	Scheduling regular and structured stock opname	2
PA9	Distributing warehouse operator workload evenly	3
PA10	Improving interdepartmental coordination through regular briefings	2

Source: Processed data, 2026.

Table 4 shows that the proposed preventive actions have different levels of implementation difficulty, with Dk values ranging from 2 to 5. These preventive actions were further evaluated in HOR Phase 2 to determine the most effective mitigation priorities.

After the priority risk agents had been identified, HOR Phase 2 was applied to determine the most effective preventive actions. In this phase, the relationship between each priority risk agent and preventive action was assessed using correlation values of 0, 1, 3, and 9, representing no, low, moderate, and high correlation, respectively. These correlation values were subsequently used to calculate the Total Effectiveness (TE) of each preventive action, which was then combined with the Degree of Difficulty (Dk) to obtain the Effectiveness-to-Difficulty Ratio (ETD).

To illustrate the calculation process, one example is presented using preventive action PA3 (Implementing a double-checking system in recording and stock opname). The TE value was calculated by multiplying the ARP value of each priority risk agent by its corresponding correlation score with PA3.

$$TE_{PA1} = (4149 \times 3) + (3857 \times 9) + (3832 \times 9) + (2936 \times 3) + (2807 \times 9) + (2331 \times 3)$$

$$TE_{PA1} = 122.712$$

The Degree of Difficulty for PA3 was 2. Therefore, the ETD value was calculated as follows

$$ETD_{PA1} = \frac{122.712}{3}$$

$$ETD_{PA1} = 40.904$$

Based on this calculation, risk agent PA1 obtained an TE value of 122.712 and ETD value of 40.904. Using the same calculation procedure, the TE and ETD values for all proposed preventive actions were determined. **Table 5** presents the complete HOR Phase 2 matrix, including the correlation values, Total Effectiveness (TE), Degree of Difficulty (Dk), Effectiveness-to-Difficulty Ratio (ETD), and the resulting priority ranking of the proposed preventive actions.

Table 5. Matriks House of Risk Phase 2

***To be Treated Risk Agent* (Aj)**	***Preventive Action* (PA_k)**										***Aggregate Risk Potential* (ARPj)**
	PA_1	**PA_2**	**PA_3**	**PA_4**	**PA_5**	**PA_6**	**PA_7**	**PA_8**	**PA_9**	**PA_{10}**	
A_2	3	4149	1	9	9	1	1	1	1	3	
A_7	9	3857	3	1	1	3	3	3	1	3	
A_1	9	3832	9	1	1	3	3	1	3	1	
A_4	3	2936	1	9	9	1	1	1	1	1	
A_3	9	2807	9	1	1	3	9	1	1	1	
A_6	3	2331	3	1	1	9	3	9	1	3	
TEk	122712	63896	85400	76592	76592	59552	62408	46274	27576	40586	
Dk	3	2	2	4	5	3	2	2	3	2	
ETD	40904	31948	42700	19148	15318	19851	31204	23137	9192	20293	
R	2	3	1	8	9	7	4	5	10	6	

Source: Processed data, 2026.

Table 5 shows that the ETD values varied among the proposed preventive actions, indicating different mitigation priorities. PA3 (Implementing a double-checking system in recording and stock opname) obtained the highest ETD value (42.700), followed by PA1 (40.904) and PA2 (31.948). These findings indicate that preventive actions with relatively low implementation difficulty provide the highest mitigation effectiveness, making them suitable as priority improvement strategies. Therefore, the ETD values were used as the basis for prioritizing preventive actions through Pareto analysis.

To determine the priority preventive actions, a Pareto analysis was performed based on the ETD values obtained from House of Risk Phase 2. The Pareto principle was applied to identify the preventive actions that contributed most significantly to mitigating the priority risk agents. Pareto analysis was then used to select the main preventive actions from the full list of mitigation alternatives. The purpose was to focus the company's improvement efforts on actions with the largest contribution to mitigation effectiveness. **Figure 3** presents the Pareto chart of priority preventive actions based on ETD value.

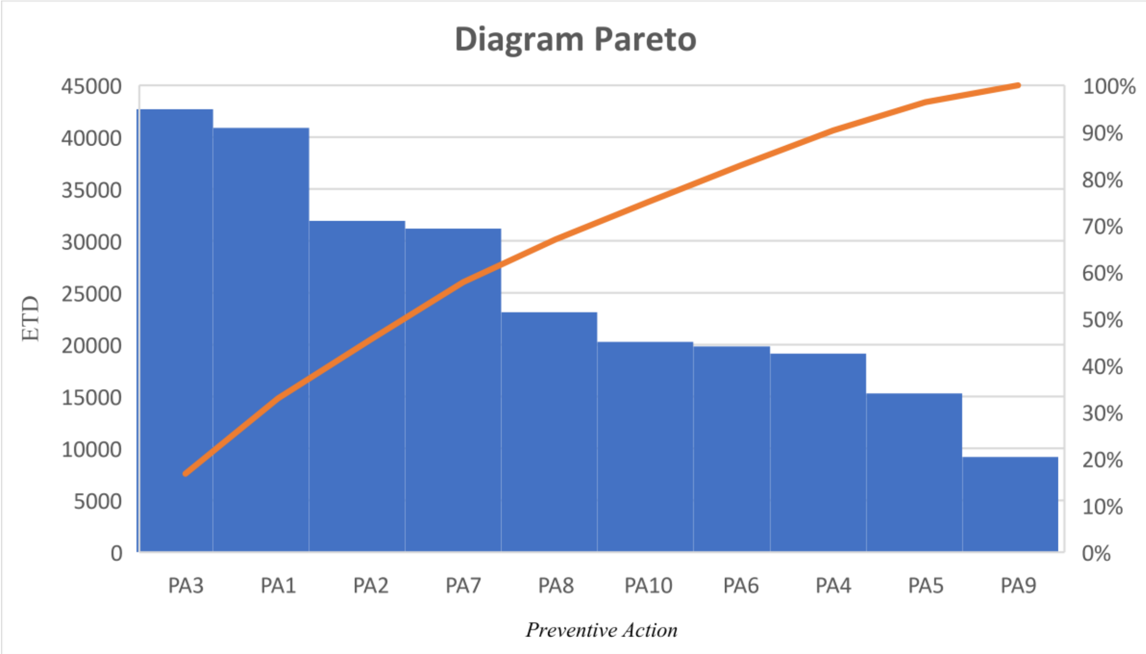

Figure 3. Pareto Chart of Priority Preventive Actions

As shown in **Figure 3**, the first five preventive actions contributed 66.97% of the total ETD value, supporting the selection of PA3, PA1, PA2, PA7, and PA8 as the primary mitigation strategies. These actions emphasize improvements in verification procedures, standardized work practices, operator competence, transaction control, and periodic stock checking, which can be implemented more rapidly than system-based improvements. Although digital inventory integration and computerized inventory systems may provide substantial long-term benefits, the current findings suggest that procedural stabilization should become the initial improvement step. Effective technology implementation depends on operational discipline, standardized procedures, and accurate transaction recording. Therefore, strengthening these fundamental practices is essential before introducing more complex digital inventory systems

The first priority is PA3, namely implementing a double-checking system in recording and stock opname. This action directly addresses A1 and A3 because it improves operator accuracy and ensures that inventory data are checked before being finalized. Double checking also helps detect errors in stock opname calculation, outgoing goods recording, and system data entry. Since this action does not require major investment, it can be implemented through clear role assignment between operators, warehouse admin, and inventory supervisor.

The second priority is PA1, namely developing and implementing a standard SOP for inventory recording and stock opname. This action directly addresses A7 because it creates consistent work standards for all warehouse personnel. The SOP should include the flow of inventory recording, responsibility distribution, stock opname frequency, verification procedures, discrepancy reporting, and follow-up mechanisms. Clear SOP implementation is important because inventory accuracy depends not only on the availability of data, but also on consistent execution by warehouse personnel [8].

The third priority is PA2, namely conducting regular training for warehouse operators. This action addresses human-related risk agents, especially low operator accuracy. Training can improve operator understanding of inventory recording, stock opname procedures, document control, and the importance of inventory data accuracy. Training also helps reduce different interpretations of procedures among operators. This mitigation is relevant because the findings show that inventory discrepancy was not only caused by technical system limitations, but also by human accuracy and work discipline.

The fourth priority is PA7, namely creating a verification checklist for incoming and outgoing goods. This action strengthens warehouse transaction control because each movement of goods must be checked and documented. A checklist can reduce missed recording, incorrect quantity input, and incomplete delivery verification. The checklist also supports the double-checking system because it provides a simple control instrument that operators and supervisors can use consistently.

The fifth priority is PA8, namely scheduling regular and structured stock opname. This action helps the company detect inventory discrepancy earlier. Regular stock opname allows the company to compare physical stock with recorded inventory data periodically. If discrepancy is found, the company can trace the cause and correct the data before the problem affects delivery planning or customer fulfillment. Previous studies also state that structured stock opname can improve inventory accuracy when it is conducted consistently and documented properly.

From an implementation perspective, the proposed preventive actions may be introduced in stages according to organizational readiness. Short-term improvements should focus on implementing double-checking procedures (PA3) and verification checklists (PA7) to immediately improve inventory recording accuracy. Medium-term improvements include developing standardized SOPs (PA1), conducting regular operator training (PA2), and establishing structured stock opname schedules (PA8) to strengthen operational consistency. In the long term, after stable procedures and accurate inventory records have been established, the company may implement digital inventory integration and computerized inventory systems to further improve inventory visibility and operational efficiency.

3.4 Discussion

The research findings indicate that inventory discrepancy in the finished goods warehouse is more strongly influenced by weaknesses in information management than by the physical movement of goods. This is reflected in the dominance of risk events within the Enable process, particularly inventory recording, stock opname, and data reconciliation, as well as the high Aggregate Risk Potential (ARP) values of risk agents associated with delayed data updates, manual recording, and low operator accuracy. These findings are consistent with previous studies reporting that inventory inaccuracies mainly result from deficiencies in inventory recording, inventory control, and operational coordination, leading to reduced inventory accuracy and disruptions in supply chain performance [7], [8]. Although these findings were obtained from a single manufacturing company, the identified risk patterns related to manual recording, delayed inventory updates, and insufficient verification represent common challenges in manufacturing warehouse operations, suggesting that improving information management is fundamental to reducing inventory discrepancy.

The application of the House of Risk method enabled systematic prioritization of both risk agents and preventive actions by considering risk severity, interrelationships among risk factors, mitigation effectiveness, and implementation difficulty. The results indicate that the highest-priority mitigation strategies were procedural improvements, including the implementation of a double-checking system, standardized operating procedures, operator training, verification checklists, and periodic stock opname. These priorities indicate that procedural improvements provide higher implementation effectiveness with relatively lower implementation difficulty than technology-based solutions. Therefore, organizations should first strengthen operational discipline and inventory recording accuracy before implementing digital inventory integration as a long-term improvement strateg [10].

From a practical perspective, the proposed mitigation strategies may be implemented gradually according to organizational readiness. In the short term, the company should prioritize double-checking procedures and verification checklists to immediately improve inventory recording accuracy. Medium-term improvements include developing standardized operating procedures, conducting regular operator training, and implementing periodic stock opname, while long-term improvements may focus on digital inventory integration to further enhance inventory visibility and warehouse control after stable operational procedures have been established.

This study contributes to supply chain risk management by integrating the SCOR framework and the House of Risk method to analyze inventory discrepancy in a finished goods warehouse. Unlike previous studies that mainly addressed broader supply chain risks, this research specifically examines the interaction between physical inventory movement and inventory information accuracy through SCOR-based process mapping and HOR-based risk prioritization, providing a structured approach for identifying priority risk agents and selecting feasible preventive actions. Nevertheless, the findings should be interpreted within the operational context of PT Alpha Plastic Manufacturing (a pseudonym). Therefore, future studies involving multiple manufacturing companies or different industrial sectors are recommended to validate the applicability of the proposed mitigation framework under various operational conditions.

4. Conclusion

Inventory discrepancy in the finished goods warehouse of PT Alpha Plastic Manufacturing (a pseudonym) was analyzed using an integrated SCOR framework and House of Risk (HOR) method. The analysis identified 10 risk events and 8 risk agents, indicating that inventory discrepancies were mainly driven by weaknesses in inventory information management, including delayed data updates, inconsistent recording procedures, and inadequate operational control. The HOR analysis prioritized these critical risk sources and recommended practical mitigation strategies, such as double-checking procedures, standardized operating procedures, operator training, verification checklists, and periodic stock opname. Considering the company's operational context, strengthening operational procedures and inventory control should precede the adoption of advanced inventory technologies.

This study demonstrates that integrating the SCOR framework with the HOR method provides a systematic approach for prioritizing supply chain risks and selecting feasible mitigation strategies to improve inventory accuracy and warehouse performance. The proposed framework offers practical guidance for manufacturing companies facing similar inventory discrepancy issues. The study is limited by its single-case design, reliance on three expert respondents, and expert-based risk assessments without post-implementation evaluation. Future research should validate the framework across multiple manufacturing companies and assess the effectiveness of the proposed mitigation strategies after implementation, including the integration of digital inventory technologies with supply chain risk management.

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Authors' Declaration

Authors' contributions and responsibilities - The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation, and discussion of results. The authors read and approved the final manuscript.

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