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RISK MANAGEMENT IN THE PACKAGE SERVICE HANDLING PROCESS AT PT ABC WITH THE HOUSE OF RISK (HOR) APPROACH

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ABSTRACT

The handling process of Package services at PT ABC faces various risks that may affect delivery timeliness, cargo condition, and service quality. This study aims to identify risk events and risk agents, determine priority risks, and formulate mitigation strategies using the House of Risk (HOR) method. Data were collected through field observations, interviews, questionnaires, and Package transaction data in 2025. HOR Phase 1 identified 12 risk events and 15 risk agents, assessed by severity, occurrence, and relationship to obtain the Aggregate Risk Potential (ARP). Pareto analysis resulted in seven priority risk agents with a cumulative contribution of 80.35%, with the highest ARP found in improper cargo placement in the ship warehouse (667.33). HOR Phase 2 produced seven preventive actions ranked by the Effectiveness to Difficulty Ratio (ETD). The highest priority was implementing a standardized cargo recording form across the port and ship warehouses (ETD 5,621.33), followed by zoning-based reorganization of the port warehouse (ETD 3,861.00) and developing written SOPs for all handling stages (ETD 3,769.00). The results show that standardized recording and work procedures and zoning-based warehouse arrangement are key strategies for reducing handling risks.

Keywords: House of Risk; Preventive action; Package; Risk agent; Supply chain risk management

1 INTRODUCTION

The logistics industry in Indonesia has experienced significant growth along with increasing trade and distribution activities, both domestically and internationally. As an archipelagic nation, Indonesia requires a reliable and efficient logistics system to support the smooth flow of goods between islands and maintain connectivity between regions. Within this system, shipping and logistics companies play a crucial role in ensuring the effective distribution process through integrated supply chain management.

Despite the continued growth of the logistics sector, Indonesia's logistics performance still faces various challenges. This is reflected in the Logistics Performance Index (LPI), which assesses logistics performance across six dimensions:

customs efficiency, infrastructure quality, ease of international shipping, logistics service competence and quality, timeliness, and shipment tracking capabilities (Aziz, 2024). In the 2023 LPI, Indonesia ranked 63rd out of 139 countries, down from 46th in 2018. A significant decline occurred in the aspects of timeliness and shipment tracking capabilities (Ulkhag & Pratiwi, 2025). These two aspects are closely related to handling activities, especially in the process of handing over goods, recording, storing, and placing goods before they are sent.

One of the companies that plays a role in inter-island transportation and distribution services is PT PNI. In developing retail goods delivery services, PT PNI provides Package (*Responsibility and Excellent Delivery*) services, namely retail goods or small cargo delivery services using special bags weighing 3–50 kg per bag and a maximum size of 50 × 50 × 100 cm. This service utilizes PT PNI's ship network spread across various regions of Indonesia. In its implementation, PT PNI plays a marketing role, while operational activities or Package *handling* are carried out by PT ABC as a subsidiary of PT PNI.

Package plays a crucial role for PT ABC as it is one of the company's primary sources of revenue. However, Package's service business targets have not yet been achieved because incoming shipment volumes remain below the expected target. In addition to challenges in achieving targets, Package's *handling process* also faces various operational risks. These processes include receiving goods, sorting and packaging, storage in warehouses and on ships, and finally handing over goods to customers. At each stage, there is the potential for *risk events*, such as sorting errors leading to goods being misdirected, damage due to improper handling, loss of goods due to poor record keeping, and goods being left behind and unable to be loaded onto ships. These risks can lead to delays, damage, loss, increased operational costs, customer complaints, and a decline in the company's reputation.

This issue is increasingly important because the handling process is directly related to the quality of service and the achievement of Package's targets (Shah et al., 2022). In 2025, Package's total shipment volume reached 6,251 shipments, with an estimated *defect rate* of 1–2%. A shipment is considered *complete* when the goods are received by the customer in good condition, without damage, loss, or shortages. However, PT ABC has not yet established a standard for the tolerance limit *for defects* that can be claimed, so assessments are still based on the experience and considerations of the operational team. Although the company has insurance to cover financial losses due to *defects*, the existence of insurance is reactive and cannot prevent risks or address the impact on customer satisfaction and trust.

These conditions demonstrate the need for systematic and proactive risk management. The quality of logistics services can be measured by timeliness, order accuracy, and the condition of goods received (Mentzer et al., 2001). Therefore, the Package handling process can be said to be running well if goods can be delivered on time before the ship's departure, the sorting and recording processes are carried out accurately, and the condition of the goods is maintained throughout the distribution process. Efforts to achieve these conditions require identifying risk sources, assessing risk levels, determining priorities, and developing mitigation strategies appropriate to the company's operational conditions.

One approach that can be used is Supply Chain Risk Management (SCRM) through the House of Risk (HOR) method. The HOR method is a structured framework that integrates the Quality Function Deployment (QFD) and Failure Modes and Effects Analysis (FMEA) approaches to identify risk events and risk agents, determine risk priorities based on the Aggregate Risk Potential (ARP) value, and develop mitigation strategies based on the level of effectiveness and difficulty of implementation (Paillin & Tupan, 2021). HOR consists of two phases, namely the first phase to determine the priority of risk agents and the second phase to determine the most effective mitigation strategy (Dwi Septyanur et al., 2025). This approach is proactive because it not only identifies risk events, but also traces the causes of risks and determines appropriate preventive measures.

The HOR method has been widely applied in supply chain risk management studies across various sectors. In the agriculture and food sectors, HOR is used to analyze tobacco supply chain risks (Oktavera et al., 2022), potato seed production (Wulandari dkk., 2021), and halal risk in rissole-producing MSMEs (Wahyuni dkk., 2021). In the manufacturing sector, HOR is combined with other methods, such as SCOR and Fuzzy Analytical Network Process (Sukendar dkk., 2022), Analytical Hierarchy Process (Sukwadi & Caesar, 2022), as well as Interpretive Structural Modeling and MICMAC analysis (Yustika & Tan, 2021). In the maritime sector, HOR has been applied to the tuna fisheries supply chain during the Covid-19 pandemic (Paillin & Tupan, 2021) and on the national maritime transportation supply chain mapped using the SCOR model (Suswaini et al., 2025). These studies generally focus on the entire supply chain or the production sector, so operational risks at the inter-island retail cargo handling sub-process level, such as sorting errors, damaged or lost goods, and goods left unloaded, have not been widely studied. The novelty of this study lies in the direct application of HOR Phase 1 and Phase 2 to the Package service handling sub-process without SCOR mapping, with specific risk events at the operational level of shipping handling companies.

Based on these problems, this research focuses on the analysis and mitigation of risks in the Package service handling process at PT ABC using the House of Risk method. This research is expected to identify various risks and their causes,

determine priority risks, and produce recommendations for mitigation strategies that can be implemented by the company. Thus, the research results are expected to support the improvement of the quality of the handling process, reduce the potential for defects, increase customer satisfaction, and help achieve the Package service business targets.

2 RESEARCH METHODS

2.1 Research object

The object of this research is the Package service handling process at PT. ABC, a subsidiary of PT.PNI which operates in the field of handling and logistics services. Package is one of PT. PNI's goods delivery services whose physical handling process is carried out by PT. ABC.

2.2 Data collection techniques

Data collection in this study was conducted through a combination of primary and secondary data. Primary data collection in this study was conducted directly in the field through two main methods. First, through direct observation and interviews with parties directly involved in the Package service handling process at PT. ABC. Second, through the distribution of questionnaires to selected respondents who have a real-world understanding and experience with the Package handling process .

Meanwhile, secondary data is data obtained not from primary sources, but from pre-existing documents, literature, or references. In this study, secondary data was obtained from internal documents of PT. ABC, such as standard operating procedures (SOPs) and operational reports. Furthermore, secondary data was also obtained from scientific literature, previous research journals, and other references relevant to the research topic.

2.3 Data analysis techniques

The Aggregate Risk Potential (ARP) value is used to determine the risk agent's priority level (Pujawan & Geraldin, 2009). The ARP calculation is carried out using Equation (1).

$$ARP_j = O_j \sum_i S_i R_{ij} \quad (1)$$

where ARP_j is the aggregate risk potential value of the j th risk agent , O_j is the occurrence value risk agent j , S_i is the severity value risk event i , and R_{ij} is the value of the relationship between risk event i and risk agent j .

In HOR Phase 2, alternative preventive actions (PA k) are prepared to reduce priority risk agents. Each action is assessed based on the strength of its relationship with the risk agent using a scale of 0, 1, 3, and 9, and the level of implementation difficulty (D_k) is assessed using a scale of 1–5. Next, Total Effectiveness (TE_k) is calculated using Equation (2) (Pujawan & Geraldin, 2009).

$$TE_k = \sum_j ARP_j E_{jk} \quad (2)$$

where TE_k is the total effectiveness of the k th mitigation action, ARP_j is the ARP value of risk agent j , and E_{jk} is the relationship between mitigation action k and risk agent j . To determine the priority of mitigation actions, the Effectiveness to Difficulty Ratio (ETD) is used with Equation (3) (Pujawan & Geraldin, 2009).

$$ETD_k = \frac{TE_k}{D_k} \quad (3)$$

where ETD_k is the ratio of effectiveness to difficulty level, TE_k is the total effectiveness of mitigation measures, and D_k is the difficulty level of implementing mitigation measures.

3 RESULTS AND DISCUSSION

3.1 Risk event analysis

Severity assessment is conducted to determine the severity of the impact if a risk event occurs in the Package service handling process. The assessment uses a scale of 1–5, with higher values indicating a greater impact on operational processes, customers, and the company. The assessment was conducted on 12 identified risk events (Pujawan & Geraldin, 2009).

The assessment results show that errors in shipping goods to the wrong destination ($S_i = 5$) and loss of goods during storage ($S_i = 5$) have the highest impact levels. Both risks can cause financial losses, the need for shipping or replacement of goods, delays, and reduce customer trust in Package services. The risk of goods being left behind and not having time to board the ship also has a high impact with a value of $S_i = 4.67$, because it can cause failure to meet delivery schedules and give rise to customer complaints.

Furthermore, the error in handing over goods to the wrong recipient obtained a value of $S_i = 4.33$, while damage to goods during the handling process and damage due to stacking that did not comply with procedures each had a value of $S_i = 4$. These risks are directly related to the condition and accuracy of receiving goods so that they can have an impact on customer satisfaction, claims, and the company's reputation.

Risks with a moderate level of impact include goods that have been defective or damaged since receipt but are not detected, errors in labeling or marking of Package bags, and damage to packaging due to inconsistencies in size or weight of goods, each of which obtained a value of $S_i = 2.67$. Although these risks do not have as big an impact as loss or wrong destination, they can still trigger further risks at the storage, shipping, and handover stages of goods.

Meanwhile, delays in receiving goods at the warehouse due to queues or labor shortages and errors in recording goods data during receipt obtained a value of $S_i = 2$. Both risks are considered to have a relatively low impact, but can still affect the smoothness of the next process if not immediately addressed. Delays in handing over goods to the ship have the lowest severity value, namely $S_i = 1.67$, because the impact is still relatively anticipable through arrangements or rescheduling. Overall, the assessment results show that risks related to loss, wrong destination, late departure, damage, and handover errors are the risks with the greatest impact on the Package handling process.

3.2 Risk agent analysis

Occurrence assessment is used to determine how frequently a risk agent appears and has the potential to cause a risk event in the Package service handling process. Unlike severity, which focuses on the magnitude of the impact, occurrence focuses on the frequency of the risk agent's occurrence. Assessment is conducted on a scale of 1–5, with higher values indicating more frequent occurrence of the risk agent in operational activities (Pujawan & Geraldin, 2009).

The assessment results for 15 risk agents show variations in the frequency of occurrence. The first risk agent, namely the lack of labor in the handling process (A1), obtained a value of $O_j = 2.67$ and is classified as moderate. Labor shortages can occur especially when shipping volumes increase and have the potential to cause delays in the process of receiving and handing over goods. The second risk agent, namely the lack of training for workers related to Package handling procedures (A2), has a value of $O_j = 2$, so it is classified as low frequency. Although it does not occur frequently, the lack of training still has the potential to cause differences in understanding and inconsistencies in the implementation of work procedures.

Risk agent, namely fatigue or human error due to high workloads during peak hours (A3), obtained a value of $O_j = 4$ and is one of the causes that often occurs. High activity at certain times can increase worker fatigue and trigger errors in the sorting, packaging, and handling of goods. Furthermore, high rotation or turnover of workers (A4) obtained a value of $O_j = 3$, while the absence of clear written SOPs for the handling process (A5) obtained a value of $O_j = 3.33$. Both factors show moderate to quite high frequencies and can cause inconsistencies in work implementation.

The weakness of the unintegrated goods recording system (A6) obtained a value of $O_j = 2$. Although the frequency of occurrence is classified as medium-low, this factor has a strong relationship with several risk events that have a high level of severity so that it can still make a large contribution to the ARP value. Meanwhile, the absence of a digital or real-time goods tracking system (A7) obtained a value of $O_j = 2.67$, which indicates that limited visibility of goods positions is still a factor that appears quite frequently in the operational process.

Risk agent, namely the absence of a verification checklist before the goods board the ship (A8), and the ninth risk agent, namely the lack of direct supervision or oversight (A9), each obtained a value of $O_j = 2.33$. The absence of a final inspection can increase the possibility of goods being left behind or not being verified before being loaded, while weak supervision can prevent operational errors from being immediately detected and corrected.

Occurrence value was found in the mismatch of goods placement in the ship's warehouse (A10) with $O_j = 4.67$. This value indicates that the problem of goods placement is the most frequent cause of risk in the Package handling process. A10 is also related to several important risk events, namely the wrong delivery destination, goods left behind not boarding the ship, lost goods, and damage due to stacking, thus making it a risk agent with a high ARP contribution.

Furthermore, mismatched placement of goods in the storage warehouse or port (A11) has a value of $O_j = 4.33$ and is the risk agent with the second highest frequency. This condition indicates that problems with the placement of goods occur

at more than one point in the handling flow , both in the ship's warehouse and at the storage location. The lack of supporting handling facilities such as racks and transportation equipment (A12) obtained a value of $O_j = 2.33$, so its frequency is classified as medium. Limited facilities can make it difficult to arrange goods, although their contribution to the overall risk is relatively smaller.

Inadequate or limited handling aids (A13) obtained the lowest occurrence value, namely $O_j = 1$, which indicates that the general condition of the equipment is still adequate to support daily operational activities. Weather conditions that disrupt loading and unloading schedules or ship departures (A14) obtained a value of $O_j = 1.67$ and are also classified as low because they are external factors that occur relatively rarely and are beyond the company's direct control.

Meanwhile, a sharp increase in shipping volume during a certain period without adjustment of human resource capacity (A15) obtained a value of $O_j = 3.67$. This volume surge can be an indirect trigger for labor fatigue and labor shortages, although A15 is not included in the priority risk agent based on Pareto analysis.

Overall, the occurrence assessment results indicate that misplacement of goods in the ship's warehouse (A10) is the risk agent with the highest frequency, followed by misplacement of goods in the storage warehouse/port (A11) and fatigue or human error of the workforce (A3). These findings indicate that the aspects of goods arrangement and workforce management are the most frequently occurring factors and need to be considered in the risk prioritization stage using the House of Risk method .

3.3 Analysis of HOR Phase 1 results and Pareto evaluation

HOR Phase 1 is used to determine the Aggregate Risk Potential (ARP) value as the basis for determining the risk agent that most influences the Package handling process. The ARP value is obtained from a combination of occurrence , severity , and the relationship between the risk event and the risk agent. The higher the ARP value, the greater the risk agent's contribution to the overall risk potential.

Table 1: ARP values and risk agent ratings

Nr	Code	Risk agent	ARP	Cum. (%)
1	A10	Mismatch in the placement of goods in the ship's warehouse	667.33	19.72
2	A11	Mismatch in the placement of goods in the storage warehouse (port)	572	36.61
3	A6	Weakness of the non-integrated goods recording system	375.33	47.70
4	A3	Fatigue or human error of the workforce due to high workload during peak hours	309.33	56.84
5	A5	There is no clear written SOP for the handling process.	295.56	65.57
6	A8	There is no verification checklist before the goods board the ship.	252	73.02
7	A7	There is no digital/ real-time goods tracking system	248	80.35
8	A4	High workforce rotation/turnover resulting in inconsistent understanding of procedures	132	84.25
9	A1	Lack of workforce in the handling process	128	88.03
10	A15	Shipping volumes increase sharply in certain periods without adjustments to HR capacity.	90.44	90.70
11	A2	Lack of workforce training regarding Package handling procedures	87.33	93.28
12	A9	Lack of direct supervision during the handling process	70.78	95.37
13	A12	handling facilities (racks, transport equipment, etc.)	60.67	97.16
14	A14	Weather conditions that disrupt ship loading/unloading schedules	55	98.79
15	A13	Handling aids (trolleys, scales, etc.) are in unsuitable condition or are limited in quantity.	41	100

The calculation results show that A10 (mismatch in the placement of goods in the ship's warehouse) has the highest ARP of 667.33, followed by A11 at 572 and A6 at 375.33. The high value indicates that problems with the placement and recording of goods are the main cause of risk in the handling process. Based on the ARP ranking, A10, A11, A6, A3, A5,

A8, and A7 are the risk agents with the highest values. The ARP values and rankings of all risk agents are shown in Table 1.

Next, a Pareto analysis is carried out to determine the priority risk agents using the 80/20 principle. (Liddin & Pulansari, 2024) The ARP value of each risk agent is calculated based on its percentage contribution to the total ARP, then added cumulatively. Risk agents that reach a cumulative threshold of approximately 80% are designated as priority for handling.

The analysis results show that the 80% threshold was reached at A7 with a cumulative contribution of 80.35%. Thus, there are seven priority risk agents : A10, A11, A6, A3, A5, A8, and A7. These seven factors represent the majority of potential risks in the Package handling process and are therefore the primary focus of HOR Phase 2.

3.4 Validation of respondent data against actual data

Severity and occurrence assessments from three respondents were compared with Package's actual transaction data from 2025 to ensure they align with field conditions. The actual data showed that the most frequent risk events were damage to goods due to handling (E5) with 24 incidents, sorting errors leading to wrong destinations (E4) with 19 incidents, and late receipt of goods (E1) with 16 incidents. These three incidents align with the respondents' assessments.

Meanwhile, E9 (lost goods) and E12 (handover errors) were not recorded during 2025, but still received high severity scores of 5 and 4.33, respectively. This indicates that low-frequency risks still require attention because they can have significant impacts if they occur. The 2025 data also shows a defect rate of around 2%, with an increase in defects in the August–October period, supporting the relevance of A15 (volume spike without adjustment of human resource capacity) and A3 (labor fatigue) in the Package handling process.

3.5 Analysis of HOR Phase 2 results

Once the priority risk agents are identified, the next step is to establish preventive actions using HOR Phase 2. Each action is assessed based on its relationship to the risk agent and its implementation difficulty. Then, the Total Effectiveness (TE) and Effectiveness to Difficulty Ratio (ETD) values are calculated. A higher ETD value indicates a more effective action with a relatively lower implementation difficulty, thus becoming a priority.

Table 2: Priority of preventive action based on ETD value

Nr	Code	Preventive action	ETD	Cum. (%)
1	PA3	Implementation of a uniform standard goods recording form between warehouses (ports–ships)	5,621.33	24.32
2	PA2	Reorganization of port warehouses based on zoning with uniform location labels with ship warehouses	3,861.00	41.02
3	PA5	Preparation and implementation of written SOPs for all stages of the <i>handling process</i>	3,769.00	57.33
4	PA1	Reorganization of ship warehouses based on zoning with clear goods location plans	3,003.00	70.32
5	PA6	Implementation of mandatory verification <i>checklist</i> before goods are loaded onto the ship	2,891.33	82.83
6	PA7	<i>checkpoint</i> status column to the goods recording form at each <i>handling stage</i>	2,298.67	92.77
7	PA4	<i>shift</i> schedules and reserve workers during peak hours	1,670.40	100

Based on discussions with the three respondents, seven preventive actions were formulated to address the seven priority risk agents, namely PA1 (reorganization of ship warehouses based on zoning with a clear goods location plan), PA2 (reorganization of port warehouses based on zoning with uniform location labels with ship warehouses), PA3 (implementation of standard goods recording forms that are uniform between port warehouses and ships), PA4 (arrangement of additional shift schedules and reserve workers during peak hours), PA5 (preparation and implementation of written SOPs for all stages of the handling process), PA6 (implementation of a mandatory verification checklist before goods are loaded onto the ship), and PA7 (addition of a checkpoint status column to the goods recording form at each handling stage).

The calculation results show that PA3 is the first priority with an ETD of 5,621.33 because it is strongly related to the weakness of the non-integrated goods recording system (A6) and has the lowest level of difficulty (Dk = 1,000). The next priorities are PA2 with an ETD of 3,861.00 and PA5 with an ETD of 3,769.00, so that these three actions cumulatively contribute approximately 57% of the total ETD value. The complete sequence is shown in Table 2, with the following sequence being PA1 (3,003.00), PA6 (2,891.33), PA7 (2,298.67), and PA4 (1,670.40).

PA1 actually has the highest Total Effectiveness value (6,006.00) because it handles A10 which has the largest ARP, but is ranked fourth because its implementation difficulty is higher (Dk = 2,000). In general, these results indicate that standardization of recording and work procedures and zoning-based warehouse arrangement provide high effectiveness with a relatively low level of difficulty, while actions requiring additional resources such as PA4 can be implemented at a later stage.

4 CONCLUSION

Based on the research results, the Package service *handling process* at PT ABC has 12 risk events spread across the stages of receiving, sorting and packaging, storage, and handover of goods, with the highest risk events being goods sent to the wrong destination (E4) and goods lost during storage (E9), each with a severity value of 5. Subsequent identification found 15 risk agents that were potential causes, then through the calculation of Aggregate Risk Potential (ARP) and Pareto analysis, 7 priority risk agents were obtained with a cumulative contribution of 80.35%, namely A10, A11, A6, A3, A5, A8, and A7. Based on HOR Phase 2, 7 preventive actions were formulated to address these priority risks, with PA3 being the implementation of a uniform standard goods recording form between port-ship warehouses as the main strategy with an ETD value of 5,621.33, then PA2 being the rearrangement of port warehouses based on zoning with an ETD value of 3,861.00, and PA5 being the preparation and implementation of written SOPs for all stages of the handling process with an ETD value of 3,769.00. These three actions excel because they are strongly related to risk agents that contribute significantly to ARP while having a low level of implementation difficulty. These results indicate that standardization of recording and work procedures as well as improving the layout and placement of goods are the most effective steps to reduce potential risks in the Package handling process. These three strategies can be an initial priority for PT ABC, while other preventive actions can be implemented gradually according to the company's resource readiness to improve service reliability and quality on an ongoing basis.

Following these findings, further research is recommended to measure actual changes in conditions after *preventive actions* such as PA3 or PA2 are implemented, for example by comparing *defect rates* before and after implementation. Next, the same approach could be applied to other shipping services within PT. PNI, or to *handling companies* at different ports, to obtain a more diverse and comparable picture of risks.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

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