

Analysis and Mitigation of Operational Risk in Goods Delivery at Lion Parcel Karawang Using the House of Risk Method

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Abstract

Lion Parcel Karawang, a logistics company, faces operational risks in its parcel delivery process, including delivery delays, damaged goods, lost parcels, sorting errors, and rising customer complaints. This study identified risk events and measured their severity, prioritized risk agents using Aggregate Risk Potential (ARP), and determined mitigation effectiveness using the House of Risk (HOR) method, Phase 1 and Phase 2. Primary data were collected via questionnaires distributed to internal respondents (couriers, drivers, and administrative staff), with validity and reliability tested using SPSS. Eight risk events (E1–E8) were identified, with severity values ranging from 3.033 to 3.567; packet sorting error (E4) was the most severe. Pareto analysis of eight risk agents (A1–A8) revealed six priority agents accounting for 83.49% of total ARP, led by poor SOP compliance (A7, ARP = 551.50) and admin inaccuracy during sorting (A4, ARP = 479.18). In Phase 2, employee training (PA1) ranked as the top mitigation strategy (ETDk = 5,591.93), followed by periodic performance evaluation (PA6) and SOP improvement (PA2). This study is expected to help Lion Parcel Karawang's management formulate a more structured and targeted operational risk mitigation policy.

Keywords: *operational risk; House of Risk; Aggregate Risk Potential; risk mitigation; logistics.*



A. INTRODUCTION

The rapid growth of e-commerce in Indonesia has driven a sharp increase in demand for parcel delivery services nationwide (Badan Pusat Statistik, 2023). This growth creates significant pressure on logistics companies to improve capacity, speed, and service reliability.

Lion Parcel, operating under Lion Air Group, is one of the fastest-growing delivery service providers in Indonesia, with a network covering more than 500 cities (Lion Parcel, 2023). Its Karawang branch serves as a strategic distribution hub for the Karawang–Purwakarta industrial area, one of the largest industrial zones in Southeast Asia, handling high volumes of both business-to-business and business-to-consumer shipments.

Behind this growth, however, the delivery process at Lion Parcel Karawang is exposed to recurring operational risks: delivery delays caused by traffic congestion on the Karawang–Jakarta corridor, parcel sorting errors due to limited skilled labor, damaged goods during loading and unloading, lost parcels due to suboptimal tracking systems, and vehicle fleet shortages during peak hours. These issues affect not only customer satisfaction but also generate significant financial losses.

Operational risk in supply chain management refers to the possibility of disruption or failure in operational processes that may result in financial loss, service quality degradation, or reputational damage (Vikaliana, 2018). Unstructured risk management leads companies to react to problems rather than anticipating them proactively, requiring a systematic approach to risk identification, analysis, and mitigation.

One method proven effective for supply chain risk management is House of Risk (HOR), developed by (Pujawan & Geraldin, 2009) as an extension of Failure Mode and Effect Analysis (FMEA) integrated with the House of Quality concept from Quality Function Deployment (QFD). HOR is distinctive in that it not only identifies and assesses risks but also prioritizes mitigation actions based on their importance and effectiveness, through two phases: HOR Phase 1 (risk identification and assessment) and HOR Phase 2 (mitigation strategy prioritization).

Prior studies have applied HOR across various industries with promising results (Hadi JA & Qurtubi, 2020) identified critical risk agents in a sugar supply chain using HOR, producing concrete and measurable mitigation recommendations. (Andriyanto & Khafifah Mustamin, 2020) applied HOR to a logistics company and found that delivery delay and goods damage were the two dominant risks requiring priority attention. (Kusrini E & Fole, 2022) demonstrated that HOR-based mitigation strategies could substantially reduce risk event frequency in a distribution network.

Considering the urgency of the issues faced by Lion Parcel Karawang and the strengths of HOR in supply chain risk management, this study was designed to identify the operational risks occurring in the parcel delivery process, assess their severity and likelihood, and formulate structured mitigation strategies that can be practically implemented by the management of Lion Parcel Karawang.

Based on this background, the research problems are formulated as follows: (1) What operational risk events occur in the parcel delivery process at Lion Parcel Karawang, and how severe is their impact based on HOR Phase 1 analysis? (2) Which risk agent has the highest Aggregate Risk Potential (ARP) value based on HOR Phase 1? (3) What is the effectiveness ratio for handling the priority operational risks based on HOR Phase 2 analysis?

Accordingly, this study aims to: (1) identify and analyze the severity and occurrence level of operational risks in the delivery process; (2) determine priority risk agents based on the highest ARP values and Pareto analysis (80/20); and (3) formulate mitigation strategies along with their Effectiveness to Difficulty Ratio (ETDk) to determine the most effective and feasible priority of implementation.

B. METHOD

This study employed a quantitative descriptive approach supported by qualitative data (mixed method), following a sequential explanatory strategy (Creswell & Creswell, 2018): quantitative data were collected and analyzed first through the HOR questionnaire, then explained and deepened using qualitative data from in-depth interviews and field observation.

The research population consisted of 30 operational employees of Lion Parcel Karawang, comprising the operations head, warehouse supervisor, sorting staff, couriers, administrative/customer service staff, and fleet drivers. Sampling used a purposive technique (Sugiyono, 2019), with inclusion criteria of active employment status of at least six months, direct involvement in the delivery process, and voluntary willingness to participate. The selected respondents consisted of 3 administrative staff, 4 drivers, and 23 couriers, a sample considered representative for risk management research since HOR analysis prioritizes depth of knowledge and field experience over sample size (Pujawan & Geraldin, 2009; Harland et al., 2003).

Data collection combined three techniques: in-depth interviews with operational supervisors and staff regarding the types, frequency, and impact of risks encountered; a structured HOR questionnaire measuring the severity of risk events, the occurrence of risk agents, the correlation between risk events and risk agents, and the difficulty level of mitigation actions; and direct field observation of sorting, loading, and last-mile delivery activities. The questionnaire instrument was tested for validity and reliability using SPSS prior to full deployment.

Data processing followed the HOR framework in two phases. HOR Phase 1 began with mapping business processes using the Supply Chain Operations Reference (SCOR) framework to identify risk events (E_i) across the plan–source–make–deliver–return stages, followed by expert- and respondent-based assessment of the severity (S_i) of each risk event and the occurrence (O_j) of each risk agent (A_j) on a 1–10 scale. A correlation matrix (R_{ij}) was then constructed using a scale of 9 (strong), 3 (moderate), 1 (weak), and 0 (no correlation) between risk events and risk agents. The Aggregate Risk Potential (ARP) for each risk agent was calculated using:

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

Risk agents were then ranked by ARP value, and a Pareto analysis (80/20 principle) was applied to determine the priority risk agents contributing the largest cumulative proportion of total risk potential.

HOR Phase 2 began by formulating proactive mitigation actions (PA_k) relevant to the priority risk agents identified in Phase 1, based on expert judgment and questionnaire results. A correlation matrix (E_{jk}) between mitigation actions and priority risk agents was constructed using the same 9-3-1-0 scale. The Total Effectiveness (TE_k) of each mitigation action was calculated using:

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

Each mitigation action was then rated for its Degree of Difficulty (D_k) on a 1–5 scale, and the Effectiveness to Difficulty Ratio was calculated using:

$$ETD_k = TE_k / D_k \quad (3)$$

Mitigation actions were ranked by ETD_k value, with higher values indicating higher implementation priority reflecting high risk-reduction effectiveness relative to a comparatively low implementation difficulty.

C. RESULT AND DISCUSSION

1. Risk Event Identification and Severity (HOR Phase 1)

Business process mapping using the SCOR framework identified eight operational risk events (E1–E8) across the Lion Parcel Karawang delivery process, ranging from delivery delay, goods damage, lost parcels, packet sorting errors, tracking update delay, undelivered parcels, increasing customer complaints, to warehouse goods accumulation. Severity scores (S_i) ranged from 3.033 to 3.567 (scale 1–10), with packet sorting error (E4) recorded as the most severe risk event, followed by tracking update delay (E5) and undelivered parcels to address (E6).

Table 1 Risk Events, Risk Agents, and Correlation Matrix (R_{ij})

Code	Risk Event	S_i
E1	Delivery delay	3.067
E2	Goods damage during delivery	3.033
E3	Lost parcels	3.067
E4	Packet sorting error	3.567
E5	Tracking update delay	3.433
E6	Parcel not delivered to address	3.300
E7	Increasing customer complaints	3.167
E8	Warehouse goods accumulation	3.167
Total		30927

Source: Primary Data, Processed by Author (2026)

2. Aggregate Risk Potential (ARP) and Priority Risk Agents

The ARP calculation (Equation 1) identified A7 (poor SOP compliance) as the highest-ranked risk agent, with $O_j = 3.567$, $\Sigma(S_i \times R_{ij}) = 154.60$, and $ARP = 551.50$, since this agent correlates strongly with four of the eight identified risk events. Pareto analysis (80/20) applied to the eight ranked risk agents produced six priority risk agents accounting for 83.49% of total ARP.

Table 2. ARP Calculation Results and Risk Agent Ranking

Rank	Code	Risk Agent	O_j	ARP
1	A7	SOP not properly implemented	3.567	551.50
2	A4	Admin inaccuracy during sorting	3.667	479.18
3	A6	Incomplete data input	3.733	316.57
4	A2	Untidy goods stacking	3.200	292.38
5	A5	Suboptimal tracking system	3.400	266.79
6	A1	Labor shortage	3.000	245.42
7	A8	Insufficient warehouse capacity	3.667	219.67
8	A3	Excessive storage occupancy	3.433	205.65

Source: Primary Data, Processed by Author (2026)

This finding indicates that SOP non-compliance is the most dominant risk source in Lion Parcel Karawang's delivery operations. This is consistent with Izzuddin and Rahmawati (2020), who found that human-error-driven and SOP-non-

compliance risks tend to dominate operational risk profiles in logistics and manufacturing settings, and requires managerial rather than capital-intensive intervention.

3. Mitigation Strategy Prioritization (HOR Phase 2)

Six proactive mitigation actions (PA1–PA6) were formulated based on the priority risk agents identified in Phase 1. Total Effectiveness (TEk) and Effectiveness to Difficulty Ratio (ETDk) were calculated using Equations 2 and 3.

Table 3. ETDk Calculation Results and Mitigation Priority Ranking

Rank	Code	Mitigation Action	TEk	Dk	ETDk
1	PA1	Employee training	14,539.02	2.600	5,591.93
2	PA6	Periodic performance evaluation	14,539.02	2.633	5,520.68
3	PA2	SOP improvement	12,043.07	2.700	4,460.40
4	PA3	Additional labor	6,038.01	2.433	2,481.30
5	PA4	Tracking system upgrade	3,279.76	2.667	1,229.46
6	PA5	Additional vehicle fleet	1,028.68	2.533	406.11

Source: Primary Data, Processed by Author (2026)

PA1 (employee training) ranked first (ETDk = 5,591.93) due to its strong correlation ($E_{jk} = 9$) with the two highest-priority risk agents, A7 and A4, combined with a relatively low implementation difficulty ($D_k = 2.600$). PA6 (periodic performance evaluation) ranked second (ETDk = 5,520.68), sharing the same Total Effectiveness as PA1 because it correlates strongly with three risk agents (A7, A4, A6), but with a slightly higher difficulty score. PA2 (SOP improvement) ranked third (ETDk = 4,460.40), correlating strongly only with A7, yet remaining significant given A7's dominant ARP contribution.

In contrast, PA3, PA4, and PA5 recorded substantially lower ETDk values, reflecting both narrower correlation with priority risk agents and higher resource investment requirements. These findings are consistent with Raj et al. (2024), who noted that last-mile logistics risk mitigation tends to yield the highest cost-effectiveness through managerial interventions (training, SOP, performance monitoring) rather than infrastructure investment, particularly in the short-to-medium term.

Overall, the results indicate that PA1, PA6, and PA2 training, performance evaluation, and SOP improvement form a complementary set of interventions: training builds competency, SOP improvement clarifies work guidelines, and periodic evaluation ensures consistent implementation. Integrated and simultaneous implementation of these three strategies is expected to yield the most significant reduction in operational risk for Lion Parcel Karawang, before considering higher-investment strategies such as additional labor, tracking system upgrades, and fleet expansion.

D. CONCLUSION

This study identified eight operational risk events and eight risk agents in the parcel delivery process at Lion Parcel Karawang using the House of Risk method. Six priority risk agents, led by poor SOP compliance (A7, ARP = 551.50) and admin inaccuracy during sorting (A4, ARP = 479.18), together account for 83.49% of total risk potential, indicating that SOP non-compliance is the most dominant root cause of operational risk in this company. Based on HOR Phase 2, employee training (PA1, ETDk = 5,591.93), periodic performance evaluation (PA6, ETDk = 5,520.68), and SOP improvement (PA2, ETDk = 4,460.40) were identified as the highest-priority mitigation strategies, offering the best balance between risk-reduction effectiveness and implementation feasibility. Lion Parcel Karawang's management is recommended to prioritize these three complementary, low-investment managerial interventions before pursuing higher-cost strategies such as workforce expansion, tracking system upgrades, and fleet addition. Future research should expand the respondent sample and observation period, integrate HOR with complementary risk analysis methods such as FMEA, and conduct post-implementation monitoring to empirically measure the actual risk reduction achieved.

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