INTEGRATING ROOT CAUSE ANALYSIS AND RISK MATURITY INDEX FOR PARCEL DELIVERY DELAYS AND CUSTOMER SATISFACTION AT PT POS INDONESIA (PERSERO)

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Abstract. *This study examined parcel-delivery delays and their implications for customer satisfaction at PT Pos Indonesia (Persero) by integrating Root Cause Analysis (RCA) and the Risk Maturity Index (RMI). A case-study design combined descriptive quantitative evidence and qualitative operational diagnosis using January-December 2025 operational records, supplemented by process observations and internal confirmations conducted from March to May 2026. Of 175,051 shipments exceeding the Service Level Agreement (SLA), 22,700 remained open. InProcess accounted for 17,398 shipments (76.64%), while InVehicle accounted for 5,302 (23.36%). Pareto analysis identified InProcess as the main improvement priority. Fishbone and 5 Whys analyses indicated that the backlog was associated with processing and status-update bottlenecks, inconsistent shipment-aging control, non-standardized escalation, and insufficient integration of real-time dashboards, risk thresholds, risk registers, and cross-functional coordination. The evidence-based RMI assessment produced an average score of 2.36, placing risk management in the Defined level and indicating progress toward Standardized practices, although controls remained partly reactive. CCH records provided contextual evidence of implications for customer satisfaction through 42,072 not-received/redelivery cases, 32,697 delay cases, and 21,393 shipment-information cases; they were not treated as a direct satisfaction score or causal test. A PDCA plan was formulated to strengthen early warning, aging thresholds, scan/status discipline, risk documentation, escalation, and SOP standardization. The findings show that parcel-delivery delays require integrated process control and stronger risk-management maturity to reduce customer uncertainty and improve service reliability.*

Keywords: *Customer Satisfaction; Parcel Delivery; Risk Maturity Index; Root Cause Analysis; Service Level Agreement.*

1. INTRODUCTION

The logistics and delivery industry is increasingly shaped by e-commerce growth, accelerated digitalization, and rising customer expectations concerning speed, timeliness, and shipment-information clarity. Logistics companies are therefore expected not only to deliver goods to their destinations but also to ensure that every distribution stage is transparent, controlled, and compliant with service standards. Timeliness is a critical indicator because it affects perceived service quality, customer experience, and trust in logistics providers (Lin et al., 2023; Do et al., 2023).

PT Pos Indonesia (Persero), a national postal and logistics service provider, faces substantial challenges in maintaining service consistency across high shipment volumes and a complex distribution network. Based on 2025 operational data, 175,051 shipments exceeded the SLA. Of these, 22,700 shipments remained open and required operational follow-up. InProcess was the dominant status, involving 17,398 shipments or 76.64% of all open shipments, whereas InVehicle accounted for 5,302 shipments or 23.36%. These figures indicate that delays occur not only during final delivery but also during processing, status updating, and end-to-end distribution control.

Distribution delays should be treated as a systemic phenomenon. Supply-chain disruptions may propagate from one process point to another when an organization lacks adequate visibility, coordination, and risk-mitigation mechanisms (Christopher, 2022; Ivanov & Dolgui, 2021; Ivanov, 2024; Kalaiarasan et al., 2022). In the PT Pos Indonesia case, the dominance of InProcess status requires deeper root-cause investigation rather than merely counting delays. CCH records also show service implications, particularly 42,072 not-received/redelivery cases, 32,697 delay cases, and 21,393 shipment-information cases.

Previous studies have widely applied RCA through Pareto analysis, Fishbone Diagrams, and 5 Whys to identify operational problems. However, RCA often stops at cause identification without explaining why the same causes continue to recur. In contrast, the RMI explains an organization's readiness to identify, assess, monitor, and mitigate risk continuously (Tubis & Werbińska-Wojciechowska, 2021). This gap supports the integration of RCA and RMI so that delay analysis covers both technical causes and the maturity of risk governance.

Accordingly, this study addresses the high number of over-SLA shipments, the dominance of InProcess among open shipments, weaknesses in risk monitoring and escalation, and the resulting implications for customer satisfaction. The objectives are to analyze package-distribution delay patterns, identify dominant root causes through RCA, assess risk-management maturity through RMI, and formulate improvements using the Plan-Do-Check-Act (PDCA) cycle. The novelty lies in combining RCA and RMI within a single problem-solving framework that connects operational causes, risk-control weaknesses, and implications for customer satisfaction without claiming a direct causal measurement of customer satisfaction.

2. LITERATURE REVIEW

2.1 Distribution Delays, Visibility, and Customer Satisfaction

The state of the art in logistics research indicates that distribution delay cannot be understood as a single failure. It may be influenced by process capacity, interunit coordination, data quality, tracking accuracy, and the organization's ability to respond to risk. Christopher (2022) emphasizes that modern logistics requires integration between product and information flows to maintain service reliability. Supply-chain resilience also depends on early disruption detection, digital visibility, and adaptive responses (Ivanov et al., 2021; Ivanov, 2024).

In delivery services, delays are closely related to service quality and customer satisfaction. Research on logistics service quality shows that timeliness, information quality, reliability, and problem-handling responsiveness affect satisfaction, loyalty, and reuse intention (Akıl & Ungan, 2022; Lin et al., 2023). Do et al. (2023) further emphasize the importance of service quality and price fairness in shaping customer experience. Therefore, shipment statuses that remain open for excessive periods are not merely internal operational issues; they also create uncertainty for customers.

2.2 Root Cause Analysis and Risk Maturity

Root Cause Analysis is a systematic approach to investigating the underlying causes of a problem. In this study, RCA uses a Pareto Chart, a Fishbone Diagram, and 5 Whys analysis. Pareto analysis determines improvement priorities based on the largest contribution to the problem; the Fishbone Diagram organizes causes into People, Methods/SOPs, Machines/Systems, Materials/Data, Environment, and Measurement/Risk Control; and 5 Whys traces the problem to a systemic cause. These tools support evidence-based prioritization and clarify cause-and-effect relationships in quality improvement (Alkiayat, 2021; Sakdiyah et al., 2022; Kumah et al., 2024; Tagaram & Chen, 2024; Tarigan et al., 2024).

The Risk Maturity Index assesses the maturity of risk management. In logistics, RMI indicates whether risks are consistently recognized, assessed, monitored, mitigated, documented, and escalated. Tubis and Werbińska-Wojciechowska (2021) argue that maturity models are important for determining whether logistics processes are moving from reactive handling toward proactive control. Maturity frameworks also reveal whether risk practices have progressed from basic documentation to standardized and integrated processes (OECD, 2021). Integrating RCA and RMI therefore answers two related questions: what causes the delay, and why has the organization not yet prevented its recurrence.

2.3 PDCA as an Improvement Framework

The Plan-Do-Check-Act cycle provides a follow-up framework for RCA and RMI findings. In operational process improvement, PDCA supports solution design, pilot implementation, performance evaluation, and standardization so that corrective action does not remain temporary (Amaral et al., 2022; Slack et al., 2022). In this study, PDCA is used to formulate an early-warning dashboard, shipment-aging thresholds, scan/status discipline, an operational risk register, a cross-functional escalation matrix, and standardized SOPs for controlling InProcess status.

3. RESEARCH METHODS

This study employed a single-case-study design combining descriptive quantitative evidence with qualitative operational diagnosis. A case study was selected because the research sought an in-depth explanation of a contemporary operational problem within its organizational context rather than statistical generalization or a causal test (Yin, 2018). The case focused on one processing-center unit within PT Pos Indonesia (Persero)'s distribution network, particularly sorting, loading, dispatch, interoffice transportation, shipment-status monitoring, backlog handling, and complaint response. The study was prepared in 2026 using a complete 12-month archival period from January to December 2025. The full calendar year was selected to capture recurring conditions across normal and peak operating periods and to reduce bias from a short operational snapshot.

The data sources comprised over-SLA shipment records, open shipment-status records, CCH records, process observations, internal interviews or confirmations, and operational documents related to monitoring, scanning, manifesting, escalation, and risk control. Shipment records were included when they exceeded the applicable SLA and had a recorded final or open operational status. Open shipments were selected for RCA when they had not reached a final status at the monitoring cut-off and retained a traceable InProcess or InVehicle status. CCH records were retained when the category directly concerned non-receipt/redelivery, delivery delay, or shipment information. Other complaint categories were excluded from the interpretation. CCH was used to interpret implications for customer satisfaction, not as a validated satisfaction score or as a basis for causal inference.

Documentation was conducted by consolidating internal dashboards and operational reports. Operational observations and internal confirmations were conducted from March to May 2026. The fieldwork lasted three months and allowed repeated observation and cross-checking across operational shifts and process stages. Observation examined the actual flow of sorting, loading, dispatch, tracking, and handling of problematic shipments. Eight informants were selected purposively because they had direct knowledge of the operational process, customer-service implications, service-quality control, or risk management. As detailed in Table 1, the informants comprised one operational supervisor, two sorting/processing personnel, one dispatcher, one driver/courier, one customer-service personnel, one service-quality control personnel, and one consultant from the Risk Management function of PT Pos Indonesia. Their inputs were used to validate patterns found in operational records and to explain factors that were not visible in dashboards. Data credibility was strengthened through source triangulation among dashboard records, distribution reports, tracking data, CCH records, interviews, observations, and risk-control documents, as well as method triangulation across descriptive analysis, Pareto, Fishbone, 5 Whys, and RMI. Preliminary RCA findings and the RMI assessment were confirmed with personnel familiar with the operating and risk-management processes, and discrepancies were rechecked against the original records.

Table 1. Internal Informants and Their Roles in the Study

Informant	Number	Role in this study
Operational supervisor	1 person	Explained process control, shipment monitoring, coordination, and problem escalation
Sorting/processing personnel	2 persons	Confirmed processing bottlenecks, scanning, manifesting, and causes of in process status
Dispatcher	1 person	Explained dispatch processes, cut-off times, manifests, and vehicle coordination
Driver/courier	1 person	Provided information on transportation and field-delivery processes
Customer-service personnel	1 person	Confirmed the relationship between delays complaints, and customers' information needs
Service-quality control personnel quality, and service-control practices	1 person	Validated SLA indicators, status-update
Consultant, Risk Management function, PT Pos Indonesia	1 person	Validated the RMI instrument, dimensions, and scores
	Total	**8 persons**

Source: Primary field data, processed by the authors (2026).

The RMI covered seven dimensions: risk awareness, risk identification, risk assessment, risk mitigation, risk monitoring, documentation and learning, and escalation coordination. The RMI was applied as an evidence-based assessment rather than a respondent-level perception survey; consequently, no respondent-average was used in the calculation. The researcher established each dimension score after triangulating operational facts, observations, interviews or confirmations, and supporting documents against the dimension indicators shown in Table 2. The consultant from PT Pos Indonesia's Risk Management function validated the assessment instrument, the relevance of the seven dimensions, and the resulting dimension scores. Scores used a five-level anchor: 1 = Initial/Ad Hoc, 2 = Defined, 3 = Standardized/Managed, 4 = Integrated, and 5 = Proactive/Optimized.

Intermediate decimal scores were allowed when evidence fell between two anchors. All seven dimensions received equal weight, and the overall index was calculated as RMI = (D1 + D2 + D3 + D4 + D5 + D6 + D7) / 7. The five-point range was divided into equal 0.80 intervals: 1.00-1.80 = Initial/Ad Hoc; 1.81-2.60 = Defined; 2.61-3.40 = Standardized/Managed; 3.41-4.20 = Integrated; and 4.21-5.00 = Proactive/Optimized. Therefore, the score of 2.36 was interpreted as Defined and progressing toward Standardized practice.

Table 2. RMI Assessment Instrument and Evidence Indicators

RMI Dimension	Evidence Indicators
Risk Awareness	Risk communication; inclusion of delay risk in daily control; personnel understanding of over-SLA indicators.
Risk Identification	Identification of backlog, missed scans, delayed manifests, aging shipments, and process bottlenecks.
Risk Assessment	Likelihood-impact assessment; quantitative thresholds; prioritization based on severity and aging.
Risk Mitigation	Defined control actions; responsible PIC; preventive and corrective measures; automation support.
Risk Monitoring	Monitoring frequency; real-time dashboard availability; alerting and exception follow-up.
Documentation & Learning	Operational risk register; corrective-action records; lessons learned and periodic review.
Escalation Coordination	Escalation matrix; response deadlines; cross-unit coordination and accountability.

Source: Developed by the authors based on the study framework (2026).

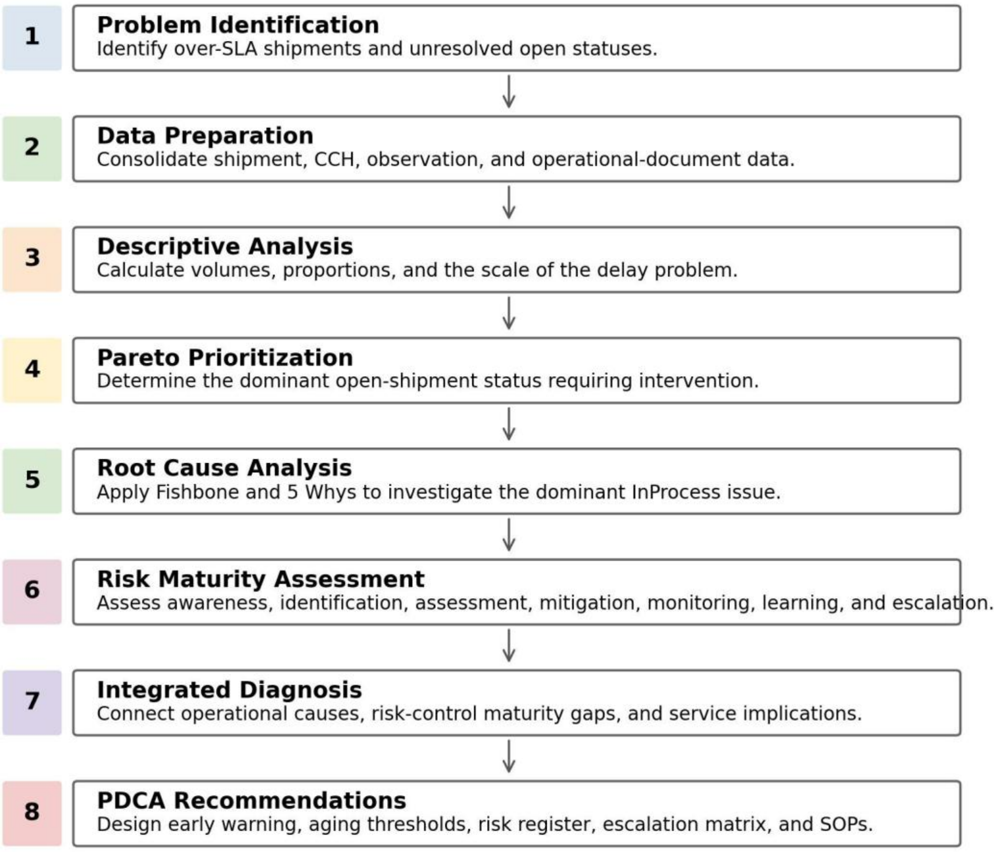
Table 3. RMI Scoring Anchors

Score	Maturity Level	Operational Interpretation
1	Initial / Ad Hoc	Risk is handled after incidents; practices are informal and inconsistently documented.
2	Defined	Risks and basic procedures are recognized and documented, but implementation remains inconsistent.
3	Standardized / Managed	Procedures, responsibilities, and monitoring are implemented consistently across the process.
4	Integrated	Risk controls are integrated with operational data KPIs, and cross-functional decisions.
5	Proactive / Optimized	Early warning, predictive control, learning, and continuous improvement are embedded in operations.

Source: Operationalized by the authors from the RMI framework used in this study (2026).

The analysis was conducted in six stages. First, operational data were summarized to determine the scale of the problem, the proportion of over-SLA shipments, and the status of shipments that remained open. Second, Pareto analysis was used to identify the dominant operational issue. Third, a Fishbone Diagram was used to map contributing causes. Fourth, 5 Whys analysis traced the dominant issue to its systemic root cause. Fifth, RMI assessed maturity across the seven dimensions. Sixth, RCA and RMI results were integrated into a PDCA improvement plan. This sequence connected quantitative evidence, operational diagnosis, risk-governance capability, and actionable process improvement.

Figure 1. Integrated RCA-RMI Research Workflow



Source: Developed by the authors (2026).

Figure 1 shows that the study was not designed to test a statistical hypothesis. Instead, it diagnosed an operational problem and developed improvement recommendations. Quantitative findings from operational data were linked to managerial interpretation and strengthened risk-control mechanisms.

4. RESULTS AND DISCUSSION

4.1 Distribution Delay Profile

PT Pos Indonesia's 2025 distribution performance indicates a substantial delay problem. Of 175,051 over-SLA shipments, 148,160 reached final delivery, 4,191 resulted in failed delivery, and 22,700 remained open. The open-shipment group became the primary focus because it represented unresolved cases still requiring control intervention.

Table 4. Summary of Main Over-SLA Shipment Data in 2025

Indicator	Number/Value	Ratio/Share	Description
Total over-SLA shipments	175,051 shipments	100.00%	Shipments exceeding the service-time standard during 2025.
Final delivery	148,160 shipments	84.64% of over-SLA	Over-SLA shipments that had reached a final status.

Failed delivery	4,191 shipments	2.39% of over-SLA	Last-mile exceptions that wer not the dominant focus.
Open shipments	22,700 shipments	12.97% of over-SLA	Active shipments that had not reached a final status at the monitoring cut-off.
InProcess status	17,398 shipments	76.64% of open shipments	Main issue and primary focus of the RCA.
InVehicle status	5,302 shipments	23.36% of open shipments	Supporting issue that still required monitoring.

Source: PT Pos Indonesia operational data (2025), processed by the authors (2026).

Table 4 shows that the most urgent problem was concentrated in open shipments, especially those with InProcess status. Operationally, an excessive InProcess share indicates potential constraints in processing, data updates, manifesting, scanning, and shipment-aging control. This finding supports the view that logistics disruptions arise from interactions among physical processes, information systems, data visibility, and risk-control mechanisms (Christopher, 2022; Ivanov & Dolgui, 2021; Kalaiarasan et al., 2022).

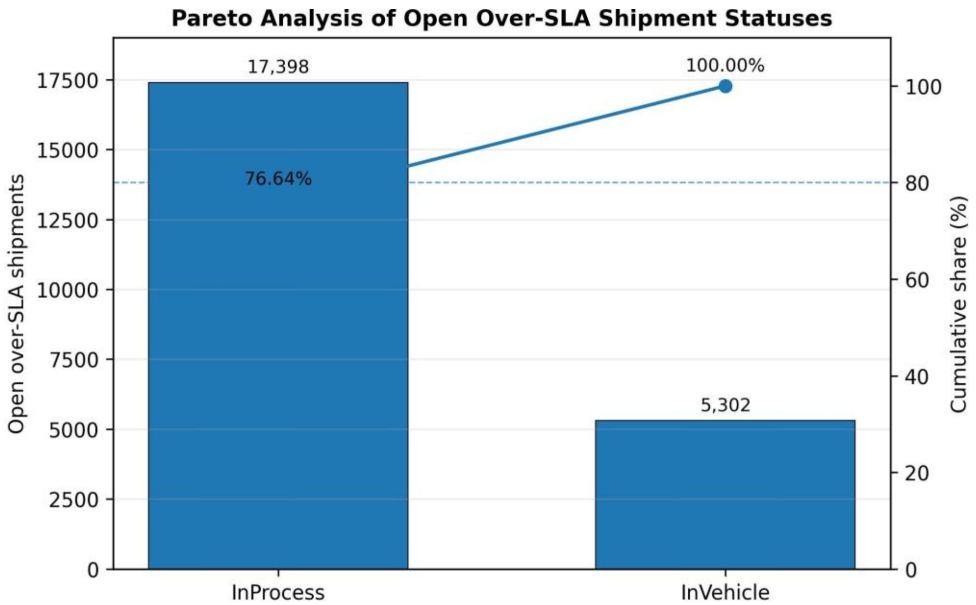
4.2 Pareto Prioritization and Customer-Satisfaction Context

Table 5. Operational Issue Summary and Customer-Satisfaction Context

No.	Operational Issue	Number of Cases	Impact (%)	Cumulative (%)	Priority Class
1	InProcess / Processin	17,398	76.64%	76.64%	A / Vital Few
2	InVehicle / Transportation	5,302	23.36%	100.00%	B / Useful Many
3	CCH: Not Received / Redelivery	42,072	Not included	Context	C / Satisfaction Contex
4	CCH: Delay	32,697	Not included	Context	C / Satisfaction Contex
5	CCH: Shipment Information	21,393	Not included	Context	C / Satisfaction Contex

Source: PT Pos Indonesia operational and CCH data (2025), processed by the authors (2026).

Figure 2. Pareto Analysis of Open Over-SLA Shipment Statuses



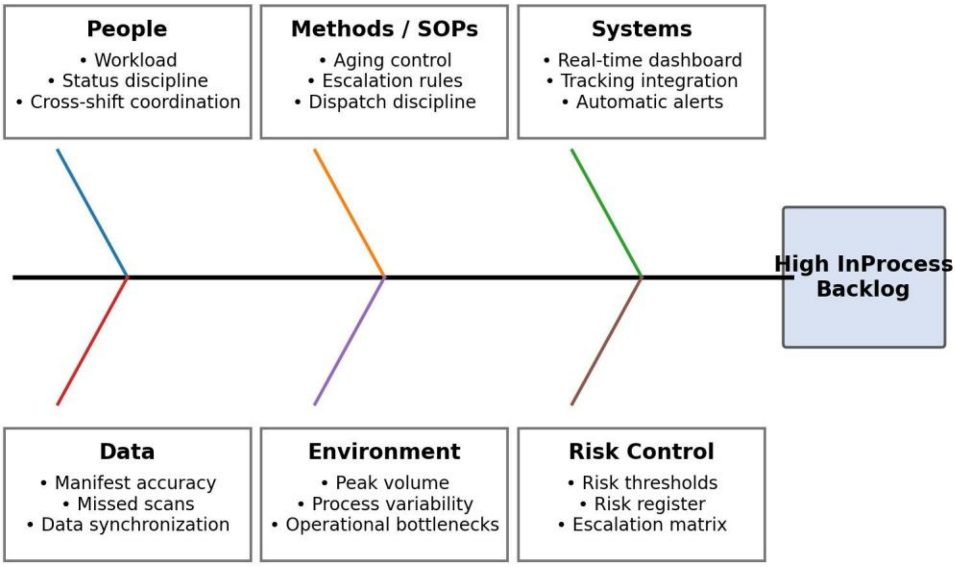
Source: PT Pos Indonesia operational data (2025), processed by the authors (2026).

Pareto analysis classified InProcess as the Class A or vital-few issue because this single category represented 76.64% of open over-SLA shipments. InVehicle was classified as Class B because its contribution was smaller, although it continued to affect the distribution flow. The three CCH categories were treated as contextual evidence for implications for customer satisfaction and were not included in the operational Pareto denominator or cumulative percentage. This distinction maintains analytical consistency: the operational Pareto identifies the root-cause priority, whereas CCH illustrates service implications.

Figure 2 confirms that improvement resources should be concentrated on controlling InProcess status. Pareto analysis helps an organization focus resources on the factor generating the greatest impact, while Fishbone analysis and process mapping clarify the cause-and-effect relationships that must be addressed (Alkiayat, 2021; Tagaram & Chen, 2024). The improvement effort should therefore prioritize the critical point contributing most to active delays rather than distribute attention equally across all symptoms.

4.3 Root Cause Analysis of InProcess Status

Figure 3. Fishbone Diagram of the Dominant InProcess Status

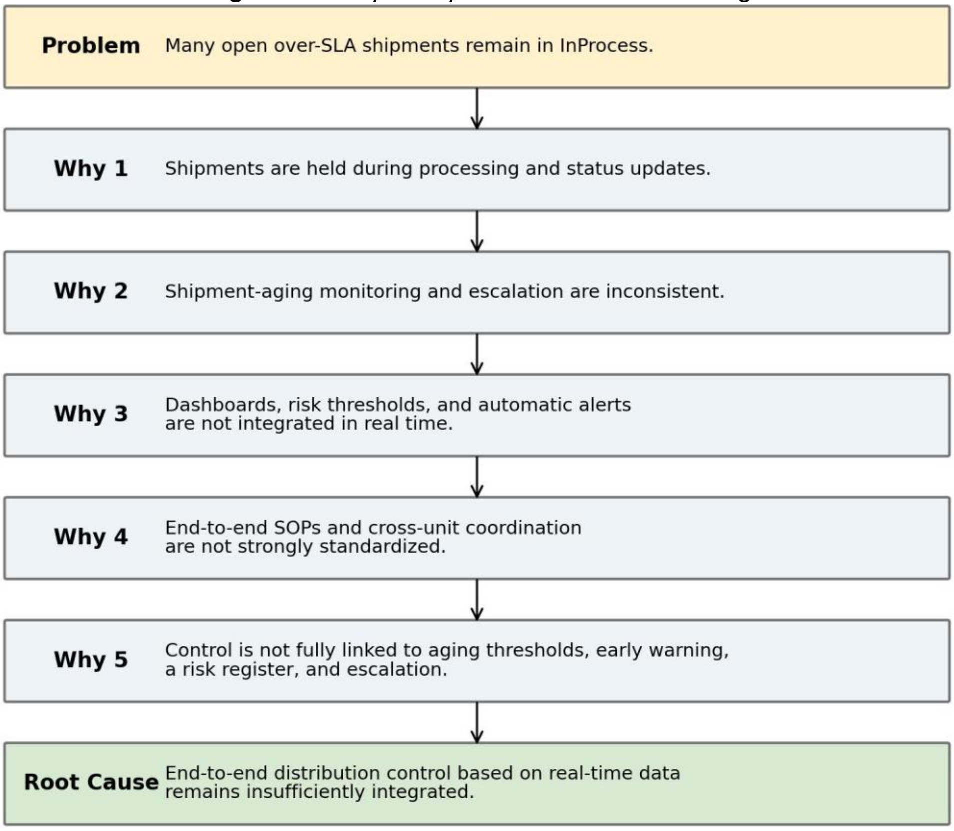


Source: Developed by the authors based on research findings (2026).

The Fishbone analysis indicates that the high InProcess status was not caused by a single factor. Under People, the contributing factors were high workload, inconsistent status-update discipline, and weak coordination across personnel or shifts. Under Methods/SOPs, the causes included irregular shipment-aging monitoring, non-standardized escalation procedures, and inconsistent processing and dispatch discipline. Under Machines/Systems, dashboards were not fully real-time, tracking was not completely integrated, and automatic alerts were unavailable or underdeveloped. Under Materials/Data, the main problems were inaccurate manifests or data, missed scans, and delayed synchronization. The Environment category covered high shipment volume, process variability, and operational bottlenecks. Measurement/Risk Control represented the most strategic weakness because risk thresholds, the operational risk register, the early-warning system, and the escalation matrix were not sufficiently strong.

These findings show that InProcess was produced by a combination of operational bottlenecks and weak risk control. In logistics research, end-to-end visibility and coordination are essential for detecting disruptions early and preventing delay accumulation (Ivanov & Dolgui, 2021; Boysen et al., 2021).

Figure 4. 5 Whys Analysis of the InProcess Backlog



Source: Developed by the authors based on research findings (2026).

The 5 Whys analysis showed that shipments remained in InProcess because they were held during processing and status updates. This occurred because shipment-aging monitoring and escalation were inconsistent. Monitoring was inconsistent because dashboards, risk thresholds, and automatic alerts were not integrated in real time. At a deeper level, the dashboard and risk controls were not integrated because end-to-end distribution-control SOPs and cross-unit coordination had not been strongly standardized. The final root cause was therefore an insufficiently integrated end-to-end distribution-control system based on real-time data and linked to risk thresholds, an early-warning system, shipment-aging monitoring, a risk register, and an escalation matrix.

4.4 Risk Maturity and Implications for Customer Satisfaction

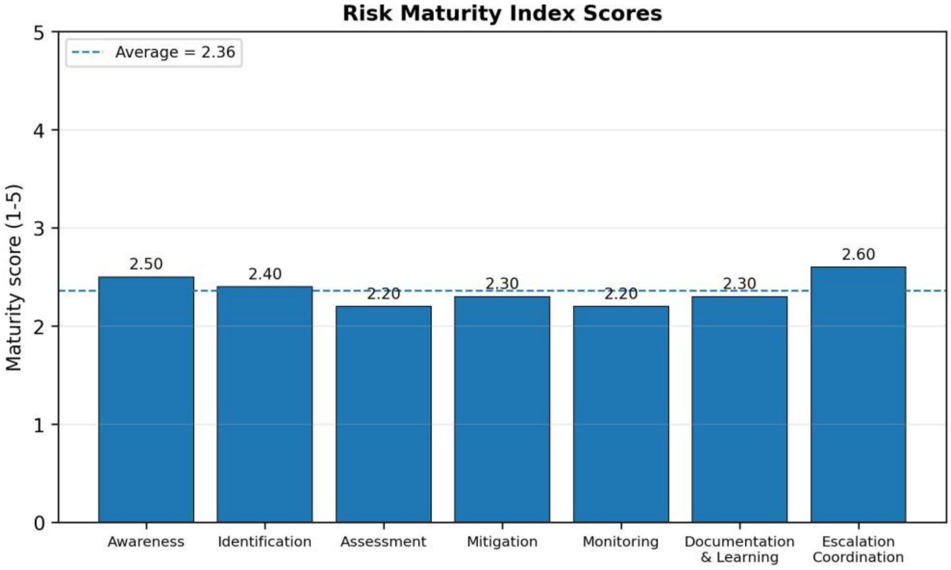
Table 6. Risk Maturity Index Assessment for InProcess Control

RMI Dimension	Score	Key Finding
Risk Awareness	2.50	Employees recognized over-SLA risk, but InProcess risk indicators were not yet fully embedded in daily control.
Risk Identification	2.40	Backlog, missed scans, delayed manifests, and status aging were recognized but not mapped consistently.
Risk Assessment	2.20	Likelihood and impact assessment was not yet fully based on quantitative thresholds.
Risk Mitigation	2.30	Mitigation actions existed, but several remained manual and reactive.
Risk Monitoring	2.20	Monitoring was not sufficiently real-time and lacked robust automatic alerts.

RMI Dimension	Score	Key Finding
Documentation & Learning	2.30	Risk learning existed but had not become a routinely maintained operational risk register.
Escalation Coordination	2.60	Escalation coordination had begun to develop, but response deadlines and PIC responsibilities required clarification.
Average	2.36	Defined level, progressing toward Standardized practice.

Source: Authors' evidence-based RMI assessment (2026).

Figure 5. Risk Maturity Index Scores



Source: Authors' evidence-based RMI assessment (2026).

The average RMI score of 2.36 fell within the Defined interval (1.81-2.60) and was therefore interpreted as Defined with progress toward Standardized practice. The organization had recognized delay risk and documented some procedures, but control was not yet fully integrated or proactive. This finding explains why the InProcess issue could recur: operational causes were identifiable, yet monitoring, thresholds, mitigation, documentation, and organizational learning were not sufficiently mature to prevent recurrence. The integration of RCA and RMI strengthens the diagnosis because RCA identifies the dominant cause, whereas RMI explains why organizational control has not yet been strong enough to prevent it (Tubis & Werbińska-Wojciechowska, 2021).

The implications for customer satisfaction were interpreted through CCH as contextual evidence rather than as a validated measure of satisfaction or statistical causality. The 42,072 not-received/redelivery cases, 32,697 delay cases, and 21,393 shipment-information cases indicate customer uncertainty associated with delivery and information problems. When shipment status does not progress or delivery information is unclear, customers do not receive service certainty. This condition may reduce perceived service quality because logistics users evaluate not only whether a package eventually arrives but also the clarity of information, timeliness, and the company's response when a delay occurs (Akıl & Ungan, 2022; Lin et al., 2023; Do et al., 2023).

4.5 PDCA Improvement Plan

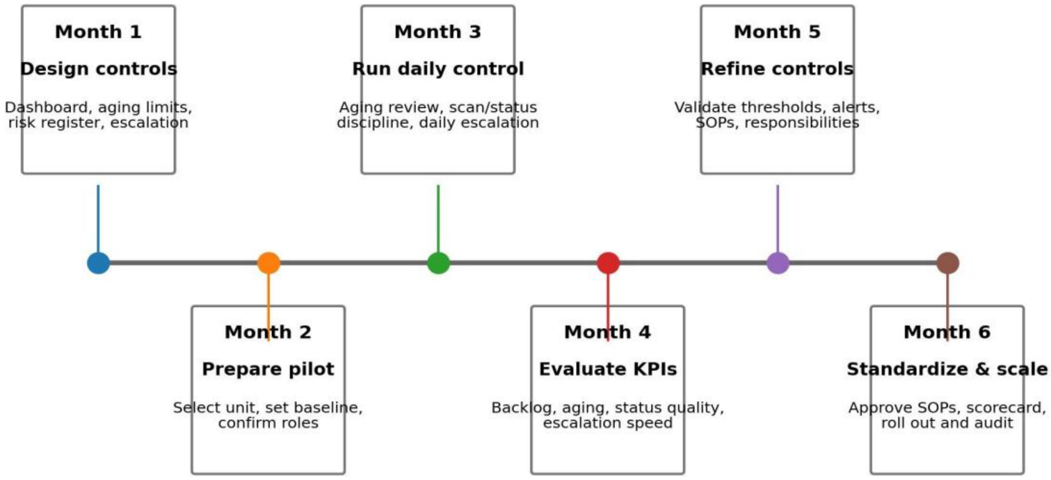
Table 7. PDCA Improvement Plan for InProcess Control

PDCA Stage	Improvement Focus	Expected Output
Plan	Develop an early-warning dashboard, aging thresholds, an operational risk register, and an escalation matrix.	A control design based on status, aging, SLA,process location, and risk level.

PDCA Stage	Improvement Focus	Expected Output
Do	Implement a pilot project for controlling InProcess status in selected operational areas.	Daily monitoring, scan/status discipline, manifest validation, and a daily control room.
Check	Evaluate InProcess volume, threshold breaches, status-update quality, and escalation compliance.	Comparison between baseline and pilot results and an assessment of control effectiveness.
Act	Standardize SOPs and scale up the improvement program.	Institutionalized dashboards, aging-monitoring SOPs, a risk register, and an operational risk scorecard.

Source: Developed by the authors based on the integrated RCA-RMI findings (2026).

Figure 6. Six-Month Improvement Roadmap for InProcess Control



Source: Developed by the authors based on research findings (2026).

The six-month roadmap begins with control design and pilot preparation, followed by daily control, KPI evaluation, validation and refinement, and finally standardization and scale-up. The Act stage is essential because improvement should not stop at recommendation. Successful controls should be institutionalized through SOPs, an operational risk register, a scorecard, and routine evaluation. This sequence is consistent with PDCA principles, in which evaluation and standardization become part of continuous organizational learning and operational process improvement (Amaral et al., 2022; Slack et al., 2022).

CONCLUSION

This study concludes that package-distribution delays at PT Pos Indonesia (Persero) in 2025 were primarily characterized by the dominance of InProcess status among open over-SLA shipments. Of 22,700 open shipments, 17,398 or 76.64% were InProcess, making this category the principal Class A improvement priority. Fishbone and 5 Whys analyses showed that the root cause was not merely a technical processing constraint but an insufficiently integrated end-to-end distribution-control system based on real-time data and linked to risk thresholds, an early-warning mechanism, shipment-aging monitoring, an operational risk register, and a cross-functional escalation matrix. The average RMI score of 2.36 indicated a Defined maturity level with progress toward Standardized practice, meaning that risk processes had begun to be documented and coordinated but remained partly reactive and not yet fully proactive. The proposed PDCA improvement plan includes an early-warning dashboard, aging thresholds, stronger scan/status discipline, an operational risk register, a cross-functional escalation matrix, and standardized InProcess-control SOPs. Theoretically, the study demonstrates the value of integrating RCA and RMI to connect operational causes with risk-governance maturity. Practically, it provides a structured direction for strengthening real-time monitoring, accelerating escalation, reducing customer uncertainty, and improving service reliability. Because CCH was used only as contextual evidence, the study does not claim a causal measurement of customer satisfaction. Future research should extend the observation period, compare multiple operational units, and evaluate the PDCA recommendations through before-and-after indicators and a validated customer-satisfaction instrument.

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