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Risk Analysis of Goods Delivery Discrepancies in Manufacturing Companies Using the Failure Mode and Effects Analysis (FMEA) Method

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ABSTRACT

Risk management in the manufacturing supply chain is crucial for maintaining product quality and customer satisfaction. This study aims to identify potential risks of shipping non-conformity, determine problem-handling priorities, and formulate effective improvement strategies at two manufacturing companies, PT XYZ and PT ABC. The research method employed is Failure Mode and Effects Analysis (FMEA), which integrates assessments of Severity (S), Occurrence (O), and Detection (D) to generate a Risk Priority Number (RPN). Data were collected through literature review, field observations, and in-depth interviews with logistics operational staff. The results identified five main failure modes in the shipping process: wrong item specifications, incorrect address labels, damaged goods, barcode scanning errors, and shipping delays. Based on the analysis, wrong item specification emerged as the highest priority risk with an RPN value of 336, followed by incorrect labeling with an RPN of 270. Dominant causal factors identified through the Fishbone diagram indicate that human error due to operator oversight and sub-optimal verification procedures are the primary root causes. As a solution, the study proposes a 5W+1H improvement plan, including standardizing picking SOPs, implementing barcode-based double-check systems, regular employee training, and routine maintenance of scanning devices. Implementing these strategies is expected to reduce the current non-conformity rate of 0.0178% and enhance the companies' operational efficiency.

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Pengelolaan risiko dalam rantai pasok manufaktur sangat krusial untuk menjaga kualitas produk dan kepuasan customer. Penelitian ini bertujuan untuk mengidentifikasi potensi risiko ketidaksesuaian pengiriman barang, menentukan prioritas penanganan masalah, serta merumuskan strategi perbaikan yang efektif di dua perusahaan manufaktur, PT XYZ dan PT ABC. Metode penelitian yang digunakan adalah Failure Mode and Effects Analysis (FMEA) yang mengintegrasikan penilaian terhadap tingkat keparahan (*Severity*), frekuensi kemunculan (*Occurrence*), dan kemampuan deteksi (*Detection*) untuk menghasilkan nilai Risk Priority Number (RPN). Data dikumpulkan melalui studi pustaka, observasi lapangan, dan wawancara mendalam dengan staf operasional logistik. Hasil penelitian mengidentifikasi lima mode kegagalan utama dalam proses pengiriman, yaitu: salah spesifikasi barang, kesalahan label alamat, kerusakan barang, salah scan barcode, dan keterlambatan pengiriman. Berdasarkan analisis, salah spesifikasi barang (*wrong item*) menjadi risiko prioritas tertinggi dengan nilai RPN sebesar 336, diikuti oleh kesalahan label alamat dengan nilai RPN 270. Faktor penyebab dominan diidentifikasi melalui diagram *Fishbone*, yang menunjukkan bahwa *human error* akibat ketidaktelitian operator dan prosedur verifikasi yang belum optimal menjadi akar masalah utama. Sebagai solusi, penelitian ini mengusulkan rencana perbaikan berbasis 5W+1H, yang meliputi standarisasi SOP *picking*, implementasi sistem *double-check* berbasis barcode, pelatihan berkala bagi karyawan, serta pemeliharaan rutin pada perangkat pemindai (*scanner*). Implementasi strategi ini diharapkan dapat menekan angka ketidaksesuaian pengiriman hingga di bawah rata-rata saat ini sebesar 0,0178% dan meningkatkan efisiensi operasional perusahaan.

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INTRODUCTION

Risk management in the manufacturing process is a crucial aspect to ensure product quality and the accuracy of the distribution of goods until they reach customers. In the context of the modern manufacturing industry, freight forwarding has a strategic role because it is directly related to customer satisfaction and supply chain stability. Delivery mismatches such as quantity errors, physical damage, delays, and documentation errors often have a negative impact on the company's reputation as well as operational efficiency. According to Poli et al. (2024), effective risk management in production systems requires the application of analytical methods that are able to identify potential failures before they impact the quality of the final product. This approach is important not only in ensuring compliance with industry standards, but also in fostering a culture of continuous improvement at all stages of the supply chain.

Increasingly complex supply chains pose new challenges for companies in ensuring that every process runs according to standards. Mihálcz and Kosztyán (2024) emphasize that the increasing complexity of operations and globalization make risks in the supply chain increasingly difficult to control without a systematic risk evaluation framework. Inconsistencies in the delivery of goods can occur due to minor disturbances in the production, warehousing, or transportation process that are not handled properly. Therefore, companies need a risk analysis method that can provide a structured picture of the type of error, severity, frequency of occurrence, and the company's ability to detect potential disruptions before a mismatch occurs in delivery. Without the application of standardized risk analysis methods, companies run the risk of facing recurring inefficiencies that can hinder their competitiveness in an increasingly competitive market.

Failure Mode and Effects Analysis (FMEA) is one of the widely used approaches to identify potential failures in various sectors, including manufacturing and healthcare. Qiu and Zhang (2022) suggest that FMEA modifications can help predict disruptions to industrial processes such as *job shops*, thus allowing companies to anticipate problems from the production planning stage. In the context of shipping goods, FMEA can be used to map possible failures from the packing stage to the distribution process. This method allows for the systematic identification of sources of non-conformity so that companies can determine treatment priorities based on the Priority Risk Level (RPN). Thus, FMEA is not only a diagnostic tool, but also a decision-making instrument in continuous process improvement.

The use of FMEA in the healthcare sector has also shown its effectiveness in reducing the risk of complex operational processes. Lin et al. (2022) explain that the application of FMEA in the risk analysis of drug use in lung cancer patients helps improve patient safety through the identification of potential clinical and administrative failures. The application of similar principles in the context of manufacturing allows companies to measure and control critical points that could potentially result in delivery mismatches. This shows that FMEA is highly adaptive to be applied to a wide range of industry contexts that require high precision as well as consistent quality control.

In the field of manufacturing production, the combination of FMEA and other quality control methods has proven to be effective in reducing the number of product defects and process non-conformities. Putri et al. (2025) found that the integration of Six Sigma and FMEA methods was able to significantly improve product quality by identifying dominant failures and formulating more focused improvement steps. If this method is applied to the shipping process, manufacturing companies can find the root of the problem of shipping nonconformities, whether caused by human negligence, ineffective labeling systems, or non-standard inspection procedures. Through this approach, companies can create stronger and more efficient preventive controls.

In addition, risk management in the supply chain has a strategic role in the sustainability of the company's operations. Chen et al. (2022) stated that risks in the supply chain, including the distribution process, can be analyzed using a multicriteria approach to determine the priority level of problem solving. Delivery mismatches often have a broader impact than just financial losses, as they can disrupt the sustainability of material flow and reduce customer confidence. By utilizing risk analysis methods such as FMEA, companies have a stronger foundation for formulating more efficient delivery policies as well as making data-driven decisions in quality control.

Risk management in an integrated management system is also an important element for manufacturing companies in creating safer and more consistent operational processes. Ispas et al. (2023) emphasized that a risk-based approach in management system integration helps organizations in improving process effectiveness and ensuring compliance with international quality standards. The implementation of FMEA as part of this system allows companies to identify and manage shipping risks in a measurable manner thereby minimizing the potential for errors that can reduce operational performance.

The development of analytical methods to support FMEA is also ongoing to improve its accuracy in assessing risks. Altubaishe and Desai (2023) show that the integration of FMEA with *multi-criteria decision-making* methods such as AHP-PROMETHEE can help improve the accuracy of supply chain risk evaluation. Meanwhile, Han et al. (2024) propose a *Fermatean fuzzy set* based FMEA approach to produce a more comprehensive risk assessment, especially under conditions of high uncertainty. This development shows that FMEA has high flexibility and is relevant for use in the risk analysis of freight delivery non-conformities in manufacturing companies facing various forms of process variability.

LITERATURE REVIEW

2.1 Logistics Management

Logistics management is a series of integrated activities that aim to ensure the flow of goods, information, and resources runs efficiently from suppliers to end customers. In the context of the manufacturing industry, logistics management is the foundation to maintain the continuity of the production process while ensuring the availability of goods according to market needs. Poli et al. (2024) emphasized that risk management in production systems, including in distribution and logistics, needs to be carried out systematically to prevent operational failures. The application of strong logistics principles helps companies ensure that the planning, storage, and distribution of goods runs effectively.

In an era of modern supply chains that are increasingly complex, logistics management must be adaptive to market demand dynamics, operational challenges, and risks that arise in the flow of goods. Mihálcz and Kosztyán (2024) reveal that risks in the supply chain must be evaluated through a comprehensive assessment framework to maintain the stability of the distribution process. By combining logistics management and risk evaluation, companies can create a distribution system that is more responsive and resilient to disruptions. This effort includes inventory control, optimization of distribution channels, and improved coordination between operational units.

In addition, the effectiveness of logistics management is greatly influenced by the integration of information systems and the accuracy of quality control in the flow of goods. Putri et al. (2025) stated that quality improvement in manufacturing processes, including logistics processes, can be achieved through Six Sigma and FMEA-based quality control methods that help identify process weak points. In the delivery of goods, this step helps reduce recording errors, mismatches in the number of goods, and damage during the transportation process. Therefore, quality-oriented logistics management is an important strategy in improving distribution reliability.

In its implementation, logistics management also requires integration with risk management systems to increase operational resilience. Ispas et al. (2023) assert that a risk-based approach in an integrated management system helps organizations evaluate each logistics activity from the perspective of safety, efficiency, and compliance with standards. This integration allows companies to identify risks early, strengthen internal controls, and encourage more consistent logistics processes. Thus, logistics management focuses not only on efficiency, but also on the company's ability to overcome uncertainties in the distribution of goods.

2.2 Types of decision-making

Decision-making in the context of manufacturing and logistics management is critical to determining the strategic direction of a company, especially in the face of operational uncertainty. Right strategic decisions help companies in allocating resources, choosing distribution methods, and determining risk improvement priorities. Han et al. (2024) explain that the fuzzy-based FMEA method can be used as a tool in decision-making to identify and prioritize risks more accurately, especially in conditions of high uncertainty. Thus, management can make data-driven decisions and comprehensive risk analysis.

In operational decision-making, companies need to consider various alternative solutions using *the multi-criteria decision making* (MCDM) approach. Altubaishe and Desai (2023) suggest that MCDM methods combined with FMEA, such as the AHP–PROMETHEE algorithm, provide more objective and structured risk assessment results. This approach helps companies choose the best course of action from a variety of alternatives, such as shipping routes, packaging methods, or quality check procedures. By using a multicriterion-based analysis framework, companies can improve accuracy in operational decision-making.

Tactical decision-making in the manufacturing process also involves the analysis of potential process disruptions, especially in complex production systems. Qiu and Zhang (2022) show that a modified FMEA approach can predict disruptions in *the job shop* so that companies can make tactical decisions to prevent production and distribution delays. The information obtained from the analysis assists managers in determining corrective and preventive actions to maintain the consistency of the production and distribution processes. Tactical decisions are crucial to maintain the reliability of the supply chain as a whole.

Meanwhile, decisions based on the integration of management and risk systems provide a stronger basis for setting long-term policies. Chen et al. (2022) explain that risk analysis in green supply chains requires a multi-criteria approach that can help companies choose logistics strategies that are environmentally friendly and efficient. The integration of risk analysis in strategic decision-making allows companies to lower potential disruptions, improve distribution efficiency, and strengthen operational sustainability. Thus, risk-based strategic decisions are an important step in supporting a company's competitive advantage.

2.3 Shipping

Delivery is the final stage in the logistics chain that aims to ensure goods reach customers on time, in appropriate quantities, and in good physical condition. A delivery process that is not managed properly can trigger goods mismatches, customer complaints, and financial losses. Shan et al. (2021) revealed that delivery service failures can be assessed using enhanced FMEA so that companies can understand risks such as delays, damages, or misshipments. With this approach, the company is able to identify the critical points that need to be fixed in the delivery process.

In the manufacturing industry, effective shipping requires a robust quality control system to ensure goods have met standards before they are shipped. Chen and Yan (2025) explain that the integration of I–S and FMEA models in the packaging and printing industry has proven to be effective in improving processes and reducing handling errors. By applying a similar concept to the shipping process, companies can strengthen the inspection procedures of goods and improve the accuracy of shipping documentation. This plays an important role in reducing the risk of goods mismatches to customers.

In addition, shipping is also affected by internal factors such as human error and the use of technology in internal logistics systems. Torres et al. (2021) state that human error in the manufacturing process can be classified and measured to understand the patterns that cause failures. In the context of shipping goods, analysis of human errors such as mislabeling, wrong picking, or lack of thoroughness in checking can help companies improve training and supervision. By reducing human error, the effectiveness and accuracy of delivery can be significantly improved.

Efficient shipping also relies on logistics technologies such as AGV/AMR that support the automation of the flow of goods in the warehouse. Bekishev et al. (2023) emphasized that FMEA can be used to analyze the risks of applying such robotic technology in internal supply systems to ensure that the internal distribution process runs safely and efficiently. The integration of this technology speeds up the process of picking and moving goods, minimizing the risk of non-conformity before goods are sent to customers. Thus, shipping that relies on a combination of quality control and modern technology can improve the reliability and precision of distribution.

METHODS

Failure Mode and Effects Analysis (FMEA)

Failure Mode and Effects Analysis (FMEA) is a highly effective risk analysis method in identifying potential failures in business processes and assessing their impact on operational quality and performance. FMEA is used to map *failure modes*, analyze root causes, and determine risk priorities through *Risk Priority Number* (RPN) values. According to Qiu and Zhang (2022), FMEA is a structured procedure designed to identify as many failure modes in a process as possible and anticipate their impact before incurring losses. Putri et al. (2025) stated that FMEA helps companies systematically understand the sources of problems so that they are able to determine preventive and corrective solutions to reduce quality risks. In the context of shipping goods to manufacturing companies, FMEA is an important tool to identify non-conformities such as misquantities, damage to goods, mislabeling, or delays.

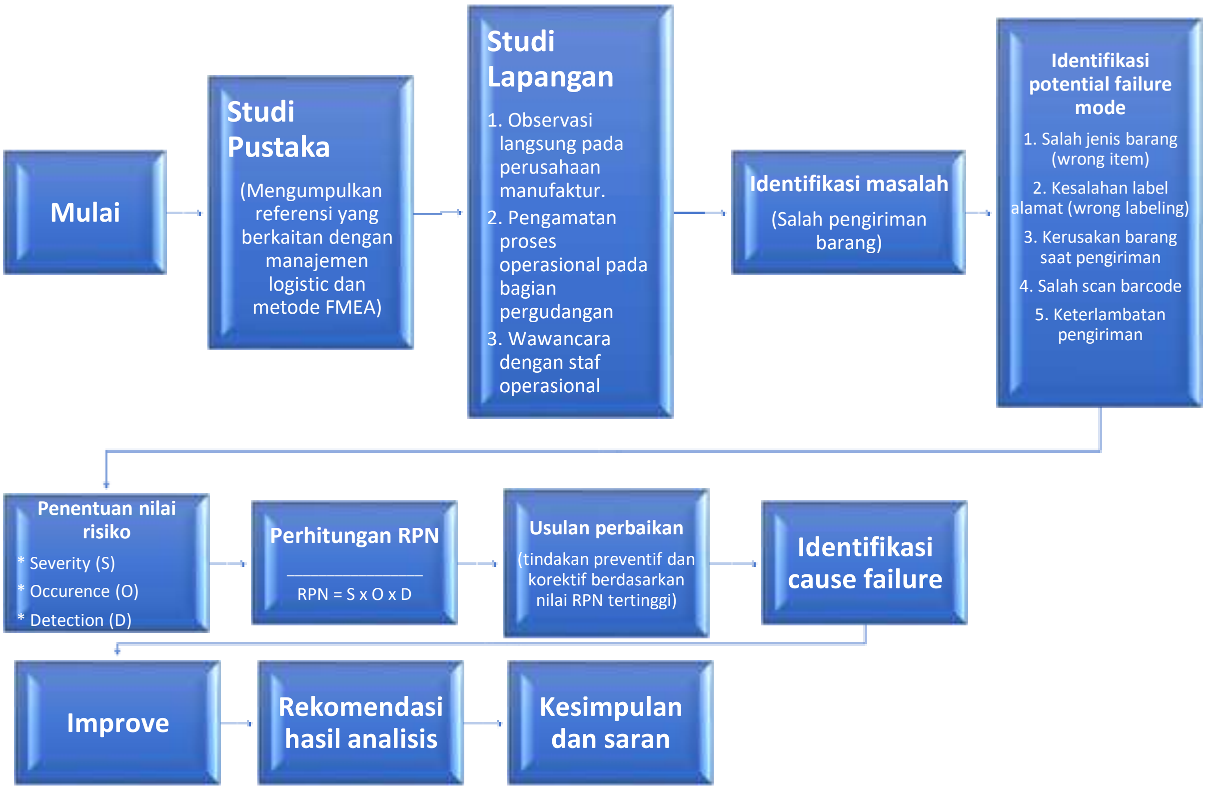

FIGURE 1. *Research Flowchart*

1. Literature Study

At the literature study stage, the researcher collected various references related to logistics management, risk analysis, freight forwarding processes, and FMEA methods. The sources used include scientific books, research journals, industry reports, and articles related to the FMEA method, especially in the context of supply chains and manufacturing systems. References such as Poli et al. (2024), Mihálcz and Kosztyán (2024), and Han et al. (2024) are used to strengthen the theoretical basis regarding risk analysis and FMEA methods. This literature study aims to provide a theoretical foundation and clarify the variables to be analyzed in the research.

2. Field Studies

This stage is carried out through direct observation at the manufacturing company where the research was conducted. The researcher observed the operational process in the warehousing section, checking goods, packing process, and delivery procedures to customers. In addition to observations, interviews with operational staff, logistics departments, and quality control departments were conducted to obtain accurate data related to non-conformity in the delivery of goods. The data collected includes the type of non-conformity (e.g. misnumber, damage to goods, mislabel, or misaddress), frequency of incidents, applicable checking procedures, and the flow of shipping documents.

3. Identify the Problem

Based on the results of observations and field data, the researcher identified the main problems that became the focus of the research. The problems found include:

a. The occurrence of inconsistencies in the delivery of goods such as wrong quantity, wrong type of goods, physical damage, or document errors.
b. These discrepancies cause customer complaints, return of goods, and an increase in the company's operational costs.
c. The procedure for checking goods before delivery (*final check*) has not run optimally so that human error can occur.

4. Problem Formulation

Referring to problem identification, the problem formulation in this study is:

a. How to identify the risk of shipping non-conformity using the FMEA method?
b. What are the risk of non-conformities that have the highest RPN value and should be prioritized for improvement?
c. What are the improvement steps that the company can take to minimize the non-conformity of the delivery of goods based on the results of the FMEA analysis?

5. Research Objectives

This research aims to:

a. Know the implementation of the FMEA method in analyzing the non-conformity of goods delivery in manufacturing companies.
b. Identify failure modes, causes, and impacts of nonconformities through *Severity*, *Occurrence*, and *Detection analysis*.
c. Provide appropriate repair recommendations based on RPN values to minimize the risk of non-conformity in the delivery of goods.

6. Analysis and Discussion

This stage is the core of the research, which is to conduct an analysis using the FMEA method, then compile an FMEA table containing failure modes, failure impacts, failure causes, and provide S–O–D (Severity, Occurrence, Detection) assessments. These values are then multiplied to get a *Risk Priority Number* (RPN). The failure mode with the highest RPN value is set as a top priority in the repair effort. At this stage, root cause analysis is also carried out with additional methods such as 5W+1H to provide more specific solutions. The discussion was carried out by linking the results of the field analysis with relevant theories.

7. Conclusions and Suggestions

After all stages of analysis are completed, the researcher draws conclusions based on the results of the RPN calculation regarding the most significant risk in the non-conformity of the delivery of goods. The conclusion also contains the effectiveness of the application of the

FMEA method in identifying and prioritizing operational risks. Suggestions were given as recommendations for improvement, such as improving the accuracy of checking goods, strengthening documentation systems, employee training, standardizing work procedures, and utilizing technology for

RESULTS AND DISCUSSION

The initial stage in this study is to collect supporting data obtained from two manufacturing companies, namely PT XYZ and PT ABC. The main objective of this study is to analyze the risk of non-conformity in the delivery of goods and find appropriate control solutions so that the level of non-conformity can be minimized. Data collection was carried out through observation of the distribution process, interviews with the logistics department, and documentation studies on reports of delivery discrepancies over the past three months. Based on field data, it was found that the two companies experienced several types of delivery mismatches, such as the wrong type of goods, wrong addresses, and damage to the goods during the delivery process. All of this data was then analyzed using the Failure Mode and Effect Analysis (FMEA) method to identify the failure mode, the effect of failure, the cause of failure, as well as the assessment of Severity (S), Occurrence (O), and Detection (D).

4.1 Identification of Potential Failure Modes

Identification of Potential Failure Mode is carried out to find failure points in the delivery process of goods that have the potential to cause non-conformity. Based on observations of the logistics divisions of PT XYZ and PT ABC, several of the most frequent failure modes were obtained, namely:

Delivery Failure Data Table

Company	Total Shipments	Number of Inconsistencies	Percentage
PT XYZ	120,540 items	22 items	0,018%
PT ABC	98,320 items	17 items	0,017%
Total	218,860 items	39 items	0,0178%

Source: Researcher's data, 2025

Table 2. Identify Potential Failure Modes

Potential Failure Mode	Potential Effect of Failure	S	Cause of Failure	O	Current Control Process	D
Wrong Item (Wrong Item)	Goods not according to order (customer complaint), returns increase	8	Human Error When Picking Goods	7	Manual checking by warehouse admin	6

Address mislabeling	Goods are misintended and delayed to the customer	9	Operator inaccuracy when printing labels	6	Supervisor check before loading	5
Damage to goods during delivery	Goods cannot be used by the customer	7	Less strong packaging, impact during distribution	5	Packaging standards are not yet consistent	6
Scan a barcode	Inaccurate shipping data, tracking error	6	Error scanner machine or inaccurate operator	5	Scanner checking standards	6
Delivery delays	Customer production schedule disrupted	8	Transportation constraints & lack of fleet	4	Monitoring of shipments via the system	5

Source: PT XYZ & PT ABC Observation, 2025

4.2 Determination of Severity (S), Occurrence (O), and Detection (D) Values

Severity (S) describes the severity of the impact of failure.

Occurrence (O) indicates the degree of likelihood of failure occurring.

Detection (D) indicates the system's ability to detect failures before reaching customers.

Table 3 FMEA Assessment

	S	O	D	RPN value (S × O × D)
Incorrect specification of goods	8	7	6	336
Address label error	9	6	5	270
Damage to goods	7	5	6	210
Scan a barcode	6	5	6	180
Delivery delays	8	4	5	160

Source: Calculation of the researcher using FMEA

The highest RPN is 336, which is *the wrong specification of the item*, which means this failure should get a top priority to fix. *Address label errors* (RPN 270) also need to be corrected immediately because they have the potential to cause goods to be misplaced. *Damage to goods* and *tracking errors* get middle priority. *Delivery delays* have the lowest RPN, but they still need to be handled to maintain industrial customer satisfaction.

4.3 Risk Priority Number (RPN) Calculation

Risk Priority Number (RPN) is a risk priority number obtained by multiplying Severity (S), Occurrence (O), and Detection (D). The RPN value indicates the severity of the risk and determines the priority of repairs to each *failure mode* in the shipping process of goods in a manufacturing company.

Table 4. Risk Priority Number (RPN) Calculation

Potential Failure Mode (Jenis Kegagalan)	S	O	D	RPN
Wrong Item (Wrong Item)	8	7	6	336
Address mislabeling	9	6	5	270
Damage to goods during delivery	7	5	6	210
Scan a barcode	6	5	6	180
Delivery delays	8	4	5	160

Source: Processed Researcher, 2025

Based on the table, the failure mode with the highest RPN value is "wrong specification of goods" which reaches 336, so it needs to be prioritized for repairs. The high RPN value indicates that the failure has a major impact on the delivery process and customer satisfaction level at PT XYZ and PT ABC.

4.4 Proposed Improvements Based on the Highest RPN Value

The following are proposed improvements to the types of delivery failures at PT XYZ and PT ABC, arranged in the highest RPN order:

Table 5. Proposed Improvement According to High RPN Value

Potential Failure Mode	Causes of Failure	RPN	Proposed Improvements
Wrong Item (Wrong Item)	Human error in picking goods	336	Create and implement a clearer and more structured picking SOP at PT XYZ and PT ABC's warehouses
	Employees are exhausted during picking		Develop a more balanced work schedule and provide adequate rest time to reduce operator fatigue
	Lack of operator precision		Provide regular training on accuracy, use of checklists, and picking standards

	The manual verification system has not been effective		Implementation of barcode-based *double-check* system and automatic verification before goods are *packed*

Potential Failure Mode	Causes of Failure	RPN	Proposed Improvements
Address mislabeling	Operators are less careful when printing labels	270	Write a new SOP specifically for the labeling process and require checking by two officers (*dual verification*)
	Less skilled employees		Conduct daily work supervision by supervisors and provide reprimands for employees who delay work
	Label printers are not calibrated		Perform regular maintenance of the label printer on a weekly basis
	No fixed label standard		Standardizing label formats and minimizing variations to make labels easier to read and paste correctly

Potential Failure Mode	Causes of Failure	RPN	Proposed Improvements
Damage to goods during delivery	Less robust packaging	210	Replacing the packaging material with higher quality,
	Lack of packaging SOPs		Making packaging SOPs according to fragile *goods* and *high-value components standards*
	Less careful handling of goods		Goods handling training for preparation and loading officers
	There is no quality inspection of the packaging		Add one stage of Quality Control after the packing process (Final Check)

Potential Failure Mode	Causes of Failure	RPN	Proposed Improvements

Scan a barcode	Scanner error	180	Increase the scanner maintenance schedule every month and replace scanners that are no longer accurate
	Operators lack understanding of procedures		Technical training in scanning and understanding of tracking flows
	The system does not detect barcode anomalies		Implementation of *validation software* that automatically detects invalid barcodes

Potential Failure Mode	Causes of Failure	RPN	Proposed Improvements
Delivery delays	Lack of shipping fleet	160	Add logistics partners or expand internal fleet
	Transportation constraints		Evaluation of distribution routes and the use of *real time tracking systems*
	No transport backup		Provide spare vehicles for high-volume areas such as Cikarang and Karawang

4.4 Identification of Cause of Failure

Cause Failure *Identification* is the process of understanding how a failure can occur and what factors need to be corrected or controlled so that failures do not recur. In this study, *the cause of failure* was identified from the results of observations, interviews, and documentation of delivery failures in the warehouses and logistics departments of PT XYZ and PT ABC. Causal analysis is carried out using a Fishbone (Cause & Effect) diagram that maps the main factors: Man (HR), Method (procedure), Machine (equipment), Material (material/packaging), Measurement (recording system/IT), and Environment (work environment and transportation).

Based on the pareto analysis of the non-conformity data collected during the research period, one type of dominant cause emerged and was categorized as ~86% cumulative, namely wrong specification/wrong picking (wrong item picked) cases where the selected item/delivery bracelet did not match the order/packing list. In both companies, this cause contributes greatly to returns, cutomer complaints, and rehandling costs. The supporting factors include the inaccuracy of the picking operator, non-standardized picking SOPs, and an inoptimal barcode verification system.

4.5 Improve

The Improve stage aims to determine the priority of the improvement plan based on the root of the problem that has been identified. The principle is to target the root of the problem with the highest RPN first, then design clear, measurable, and responsible corrective actions. The researcher used the 5W+1H (What, Who, When, Where, Why, How) method to detail the improvement plan for the main factors found in PT XYZ and PT ABC. The following is a 5W+1H matrix compiled based on Fishbone's main indicators (Man, Method, Machine, Material, Measurement, Environment).

Table 7. Improvement Plan (5W+1H) for the Root of the Problem: Wrong Picking

Indicator	What	Who	When	Where	Why	How
Man (Human Resources)	Improve the accuracy and capacity of picking operators.	Warehouse Manager, Picking Supervisor, HR & Training.	Initial training + refreshment every 3 months; monthly evaluation.	Storage area (zone picking) & training room.	Reduce human error as the main cause of wrong picking.	Standard training modules (SKUs, checklists, simulations), accuracy incentives, task rotation, KPI monitoring per operator.
Method (SOP / Procedure)	Standardize SOP picking, packing, and verification.	QA, Logistics Manager, Operations Team.	Preparation 1 month; implementation & subsequent socialization.	The entire warehouse of PT XYZ & PT ABC.	Eliminate execution variations that trigger errors.	Preparation of step-by-step SOPs, mandatory checklists, dual verification, weekly compliance audits.
Machine (Equipment /IT)	Ensure scanners, label printers, and WMS work reliably.	IT Support, Vendor, Logistics	Weekly/monthly maintenance; upgrade	Area scanning, printing area,	Inaccurate equipment → incorrect	Preventive maintenance, calibratio

		Manager.	when necessary.	WMS server.	scan/label.	n, replacement of old devices, forced match/double scan feature before packing.
Material (Styling & Packaging)	Optimization of slotting, shelf labeling, and packaging standardization.	Warehouse Planner, Warehouse Manager.	Review slots every 2 months; Labeling immediately.	Rack/pallet & packing area.	Poor arrangement & similar packaging → risk of being mistaken.	ABC analysis, barcode-on-shelf labels, similar SKU limiters, packaging standards.
Measurement (Monitoring)	Accuracy KPI determination, RPN monitoring, real-time incident reporting.	Logistics Manager, QA, IT.	Dashboard & KPIs in 1 month; Weekly Review.	Operational dashboard & meeting room.	Detect problem trends faster.	WMS dashboard (accuracy per operator, RPN), threshold notifications, RCA of each incident.
Environment (Lingkungan Kerja)	Improvements to layout, lighting, loading/unloading areas.	Facilities Manager, Logistics Manager.	2-month layout revision; Immediate facility repairs.	Warehouse, loading area, internal route.	The environment is neat & bright → reduce SKU identification errors.	Lane optimization, critical zone lighting, safe forklift lanes, high

						traffic area separation .

Source: Processed Researcher, 2025.

Table 8. Implementation Priorities Based on RPN & Ease of Implementation

No.	Improvement Priorities	Categories	Priority Reasons
1	SOP & Verification Improvements	Method	It is quick to implement and has a direct impact on picking accuracy.
2	Operator Training & Work Rotation	Man	Reduce human error through skill improvement & reduce fatigue.
3	IT & Equipment Upgrade (WMS, scanner, printer)	Machine & Measurement	Validation automation reduces reliance on manual checking.
4	Slotting & Labeling	Material	Moderate but significant effort in preventing wrong picks.
5	Layout & Facilities Improvements	Environment	Requires greater investment; medium-term effects.

Table 9. Action Plan

Time	Activities
Weeks 1–4	Compile SOP picking & checklist; Prepare operator training materials.
Month 2	First batch operator training; installation of shelf labels; re-slotting for top-100 SKUs.
Months 2–3	Implementation of dual verification for critical transactions; activation of the forced match feature in WMS.
Month 3	Evaluation of accuracy KPIs; calculation of RPN decrease; follow-up improvements.
Month 4 onwards	Preventive routine equipment maintenance; SOP compliance audits every month.

4.6. Recommendations for Analysis Results

The recommendations are prepared to provide strategic direction to companies in reducing the risk of non-conformity in the delivery of goods based on the results of the FMEA analysis. This recommendation refers to the root of the problems found in the delivery process at PT XYZ and PT ABC, especially related to packing errors, wrong label attachment, data input errors, and inconsistencies in shipping documents.

Table 10. Recommended Improvements

Yes	Root Cause	Problem Description	Recommended Improvements
1	Workers are not thorough in the process of packing and verifying goods	The operator's inaccuracy leads to the wrong number of goods, wrong items, and wrong data input so that the goods are not suitable when received by the distributor.	Strict supervision by supervisors, implementation of *a double check system* before goods are shipped, and regular training on precision and accuracy of work for warehouses and logistics.
2	Packaging and labeling SOPs are not going well	Many carriers do not follow SOPs, such as QR/Barcode labeling procedures and packing standards, leading to misaddresses, mislabeling, and misidentification of goods.	Management needs to conduct regular socialization of SOPs, evaluate compliance every month, and provide penalties and rewards to improve SOP discipline.
3	Inaccurate manual labeling system	Label attachment errors or incorrect barcode input often occur during the process *of loading* goods to distribution trucks.	Using a scanner-based labeling automation system, improving the performance of barcode devices, and performing *routine maintenance* of printer label machines.
4	Lack of oversight of shipping documents	Document errors such as inappropriate amounts, inappropriate POs, and incomplete documents cause returns from the distributor.	Implementation of *Document Verification Point* (DVP) at the end of the process, as well as document digitization using an integrated ERP system to minimize human error.
5	Machines and work tools experience a decrease in performance	Unmaintained weighing machines, barcode scanners, or label printers cause severe errors, label misprints, and process delays.	Perform *regular preventive maintenance* , reschedule machine service, and replace tools that have passed the optimal life of use.

Source: Processed Author, 2025

CONCLUSIONS AND SUGGESTIONS

This study successfully identified five main failure modes in the freight forwarding system at PT XYZ and PT ABC using the Failure Mode and Effects Analysis (FMEA) method. Based on the analysis of severity, frequency, and detection, it was found that wrong item specifications were the highest priority risk with an RPN value of 336, followed by address label errors with an RPN of 270. The results of the analysis through the Fishbone diagram show that the root of the main problem comes from human error due to operator inaccuracy and manual verification procedures that are not optimal, which has a direct impact on the average delivery non-conformity of 0.0178%.

As a strategic solution, the study formulated a 5W+1H-based improvement plan that focuses on standardizing SOP picking and implementing a double verification system based on barcode technology. This strategy includes strengthening supervision through a double-check system, periodic training to improve employee competencies, and regular maintenance of technical devices such as scanners and label printers. By integrating improvements in method, labor, and technology aspects, the company is expected to minimize operational risks preventively, reduce return rates, and maintain service quality standards for sustainable customer satisfaction.

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