

# Reducing Packaging Damage in Distribution through FMEA and 5W+1H: A Case Study in the Textile Industry

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## ABSTRACT

This case study examines packaging damage in the Distribution and Transportation Warehouse of PT Mulia Knitting Factory. Observation, interviews, company records, and assessments from three operational respondents were used to identify failure modes and propose controls. The reported July–September records contain 84 packaging-damage records across 1,894 shipments; the units of these two measures require confirmation before interpretation as a shipment damage rate. The revised Failure Mode and Effect Analysis (FMEA) calculates each respondent's Risk Priority Number (RPN) as  $\text{Severity} \times \text{Occurrence} \times \text{Detection}$  and summarizes each failure mode by multiplying the three mean component scores. Shipment damage has the highest aggregate RPN (356.07), followed by damage during transfer to the vehicle (290.00) and storage damage (101.33). Under the explicit study-specific classification used in this revision, these are very high, very high, and high, respectively. The 5W+1H analysis links proposed customer reports, work instructions, and inspection checklists to material weaknesses, inconsistent handling, and missed defects. No post-implementation results are available; the measures are proposals whose effectiveness requires prospective evaluation. Incomplete documentation of the original rating anchors limits interpretation of the risk scores.

Keywords: distribution warehouse; packaging damage; FMEA; risk priority number; 5W+1H

## INTRODUCTION

Logistics plays an important role in effectively managing the flow of goods, information, and resources to support smooth supply chain operations. Effective logistics management can help companies improve service quality, delivery timeliness, distribution cost efficiency, and product availability in accordance with customer needs. Therefore, every company must ensure that all logistics processes operate effectively and efficiently in order to compete in an increasingly competitive business environment.

One important aspect of logistics activities is the distribution process. Distribution not only focuses on delivering goods to customers, but also on ensuring that products are received in good condition and comply with the company's quality standards. Damage during the distribution process can result in operational losses, increased costs, and lower customer satisfaction.

PT Mulia Knitting Factory is a manufacturing company engaged in the textile and garment industry, producing various types of apparel and textile products under the Rider brand. In its operations, the Distribution and Transportation Warehouse is responsible for managing receiving, storage, packaging, and product delivery to customers. A smooth distribution process is therefore essential for maintaining product quality and meeting customer needs on time.

Based on observations conducted during the internship at the Distribution and Transportation Warehouse

Division of PT Mulia Knitting Factory, a problem was identified involving product packaging damage during the distribution process. The packaging damage was discovered after the goods arrived at their destination and their condition was inspected. This condition has the potential to reduce the quality of products received by customers, increase customer complaints, and generate additional costs for handling damaged products.

To identify the causes of packaging damage and determine improvement priorities, an analytical method capable of systematically evaluating risk levels is required. One method that can be used is Failure Mode and Effect Analysis (FMEA). FMEA is used to identify potential failures, analyze their causes and effects, and determine risk priorities based on the Risk Priority Number (RPN), which is calculated from Severity, Occurrence, and Detection ratings.

Based on these problems, this study aims to identify the factors causing packaging damage in the distribution process at PT Mulia Knitting Factory, analyze the level of risk using Failure Mode and Effect Analysis (FMEA), and propose improvements using the 5W+1H approach to reduce the risk of packaging damage and improve the quality of the company's distribution process.

### **Research Questions and Objectives**

What factors cause packaging damage during the distribution process at PT Mulia Knitting Factory?

What is the risk level of packaging damage based on Failure Mode and Effect Analysis (FMEA)?

What are the effects of packaging damage on product quality and customer satisfaction?

What improvements can be proposed to minimize the risk of packaging damage during the distribution process?

To identify the factors causing packaging damage during the product distribution process.

To analyze the risk level of packaging damage using Failure Mode and Effect Analysis (FMEA).

To determine the impact of packaging damage on product quality and customer satisfaction.

To propose improvements to minimize the risk of packaging damage using the 5W+1H approach.

Effects on product quality and customer satisfaction are examined as reported or potential consequences. Customer satisfaction was not directly measured using a validated survey.

### **RESEARCH METHOD**

This study was conducted in the Distribution and Transportation Warehouse Division of PT Mulia Knitting Factory, a company operating in the textile and garment industry. The study focuses on packaging damage that occurs during the distribution of goods to customers. This issue was selected because packaging damage can affect the quality of products received by customers, increase the volume of bad stock, and cause losses to the company. Therefore, a method is needed to identify the causes of packaging damage and determine corrective actions that are appropriate to the company's operating conditions.

This study uses a descriptive method with a case-study approach. The approach was selected because the research focuses on a specific problem within the company, namely packaging damage during the distribution process. Through a case study, the researcher can understand actual field conditions, identify the factors causing the problem, and provide improvement recommendations that match the company's needs. This approach also enables a more in-depth understanding of the distribution process in the Distribution and Transportation Warehouse Division of PT Mulia Knitting Factory.

Data were collected through observation, interviews, and documentation. Direct observations were conducted in the distribution warehouse to examine storage activities, packaging processes, the movement of goods to the

ready-to-ship area, and loading onto distribution vehicles. These observations enabled the researcher to understand actual field conditions and identify activities that could potentially cause packaging damage. Observation was also used to understand the distribution flow from order receipt until the goods were received by customers.

Interviews were conducted with parties directly involved in the distribution process, namely the Warehouse Head, the Quality Control (QC) Team, and the Packing Person in Charge (PIC). The interviews were used to obtain information regarding the causes of packaging damage, warehouse operating conditions, common constraints during distribution, and the control measures that had been implemented by the company. The information obtained from the interviews served as a basis for risk identification and improvement prioritization. In addition to observations and interviews, this study used company documentation. The data included shipment volumes, packaging damage records, bad-stock data, and documents related to distribution activities. Company records showed that packaging damage still occurred during the July-September period and affected product quality. In addition, bad stock caused by packaging damage was higher than other damage categories and therefore required particular attention from the company.

### Respondents and Rating Procedure

The available questionnaire records contain three respondents: the warehouse head, one QC representative, and the packing PIC. The labels “Supervisor,” “QC Team,” and “Packing Staff” in the original score tables refer to these three respondents, respectively; “QC Team” does not represent multiple independent questionnaires. Their positions and tenure are listed in Table 1. Their operational roles provide complementary perspectives on storage, inspection, packing, and dispatch. The available records do not specify formal recruitment criteria or establish statistical representativeness.

Table 1 Respondent characteristics

| No. | Name                     | Position / Unit | Length of Service |
|-----|--------------------------|-----------------|-------------------|
| 1   | Muhammad Firmansyah      | Warehouse Head  | 2 years 1 month   |
| 2   | Wulandari                | QC Team         | 8 years 3 months  |
| 3   | Muhammad Faisal Ramadhan | Packing PIC     | 3 years 8 months  |

Each respondent provided one Severity (S), Occurrence (O), and Detection (D) score for each of three packaging failure modes. Severity concerns the seriousness of failure effects, Occurrence concerns failure likelihood, and Detection concerns difficulty in detecting a failure before release or delivery; a higher D is interpreted as poorer detectability. The retained scores range from 3 to 10. The original documentation does not provide a complete, consistently applicable rating rubric, interviewer instructions, or evidence of rater calibration. It also does not establish whether ratings were completed independently or after discussion. These details cannot be reconstructed from the score tables and are not asserted here.

The earlier probability table used only scores 1, 3, 5, and 10, while the detection table used a 1–3 scale; neither adequately explains the actual respondent scores. These incompatible tables are not used in the revised numerical analysis; the supplied image is retained as contextual material in the appendix. Before repeat assessment, the company should agree and document common S, O, and D anchors, train the raters, and retain the completed questionnaires. The present calculations retain the supplied scores rather than inventing or retrospectively assigning anchors.

### RPN Calculation and Aggregation

For respondent  $r$  and failure mode  $j$ ,  $RPN(r,j) = S(r,j) \times O(r,j) \times D(r,j)$ . Following the component-averaging approach stated in the original manuscript, this revision gives each of the three respondents equal weight: mean  $S(j) = \Sigma S(r,j)/3$ , with equivalent calculations for  $O$  and  $D$ . The aggregate  $RPN(j) = \text{mean } S(j) \times \text{mean } O(j) \times \text{mean } D(j)$ . Calculations use unrounded means, and displayed values are rounded to two decimal places. The aggregate is a descriptive index derived from ordinal judgments, not a measured probability of damage. Failure modes are ranked by descending aggregate RPN. This is a transparent recalculation of the supplied

questionnaire data, not evidence that a final consensus workshop occurred. Multiplying mean component scores differs from averaging individual RPNs. Mean individual RPNs are shown separately as a sensitivity check and are not substituted for the primary aggregate. The three respondents agree on the ordering of the failure modes.

### Risk Classification Criteria

Table 2 defines exhaustive, nonoverlapping categories for this revised analysis. The previously incomplete intervals have been replaced by study-specific working thresholds: low below 30, medium from 30 to below 75, high from 75 to below 150, and very high at 150 or above. This resolves the gaps around 60–75 and 100–150 while retaining the original lower cutoffs for high and very high risk. These revised working thresholds are not presented as a universal FMEA standard or as validated company policy. Company approval is required before using them for operational release decisions. Ranking by continuous RPN remains the primary prioritization method.

| RPN interval        | Category  | Explanation and proposed response                                                                                                                                                                                                   |
|---------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $RPN < 30$          | Low       | The risk may be treated as a low priority for additional mitigation, subject to monitoring and a separate review of severity and safety implications. A low RPN alone does not justify ignoring the risk.                           |
| $30 \leq RPN < 75$  | Medium    | The risk may be considered conditionally acceptable for continued operation under existing controls and management review. Additional improvement actions may be planned to reduce the risk further.                                |
| $75 \leq RPN < 150$ | High      | The risk requires an active mitigation plan. The affected activity should proceed only after appropriate controls have been implemented and the responsible manager has reviewed whether the residual risk is acceptable.           |
| $RPN \geq 150$      | Very high | The risk requires immediate management attention and mitigation. The affected process should be stopped or contained when continued operation presents an intolerable risk, pending effective controls and authorization to resume. |

Figure 3 Supplied probability classification and detection illustration

|                                                                                         | Immediate     | Delayed, but before release | After release   |
|-----------------------------------------------------------------------------------------|---------------|-----------------------------|-----------------|
| Designed and operated as intended                                                       | Effective (1) |                             |                 |
| In place with opportunities for improvement identified                                  |               | Needs Improvement (2)       |                 |
| No detection system exists, or the system is deficient and does not operate as intended |               |                             | Ineffective (3) |

Source: Damayanti (2023).

The explanatory descriptions above adapt the supplied acceptance and mitigation language to the revised continuous intervals. The original ranges of 30–60, 75–100, and 150 or above leave gaps; they are therefore not reinstated. The revised categories remain working criteria for this analysis, rather than evidence that the company has approved a specific stop or release policy. A low RPN does not establish safety or justify ignoring a severe failure. Occupational safety requires a separate assessment; no safety conclusion is drawn from the packaging questionnaires. The 5W+1H method is an analytical approach used to support problem solving and the systematic formulation of improvement proposals. It consists of six basic questions: What,

Why, Who, When, Where, and How. These questions are used to explore information in greater depth so that solutions can be developed in accordance with the problem being addressed.

The 5W+1H method is widely used in process-improvement activities because it helps companies prepare structured action plans. Through this approach, a company can determine what action should be taken, why it is necessary, who is responsible, when it should be implemented, where it should be applied, and how the improvement should be carried out. As a result, the proposed solutions are not merely theoretical but can be applied directly to the company's operating conditions. In this study, the 5W+1H method is used to formulate improvement proposals. Based on the 5W+1H analysis, the proposed improvements focus on three main factors contributing to packaging damage: material, work methods, and human resources. The recommendations include creating a customer report form to monitor the condition of packaging received by customers, preparing work instructions for packaging and shipping, and implementing packing and loading checklists as distribution-process control tools. These improvements are expected to reduce the risk of packaging damage and improve the quality of the distribution process at PT Mulia Knitting Factory.

### Analytical stages and proposed follow up

The investigation proceeded through problem identification, mapping of the process from receipt to dispatch, review of warehouse conditions, and identification of potential failure causes. Damaged-goods records, delivery notes, goods-receipt reports, observations, and operational interviews provided context for the assessment. FMEA was applied to the packaging and distribution process rather than to product design, consistent with the process-oriented use described by Prasetya et al. (2021).

The next analytical stages were selection of improvement priorities and formulation of feasible controls using the bad-stock records and operational accounts. The reconciled respondent scores, aggregation procedure, and risk categories reported in this article govern the final rankings. Administrative staff and other operational personnel may provide process context; the numerical FMEA dataset comprises only the three identified respondents. Implementation planning, evaluation, and standardization are proposed follow-up stages. They would involve daily monitoring, direct observation of adherence, employee feedback, and monthly review of recorded defects. Written procedures, checklist formats, reporting fields, and recording units should be standardized before the pilot. These stages describe a future evaluation plan and are not completed intervention results.

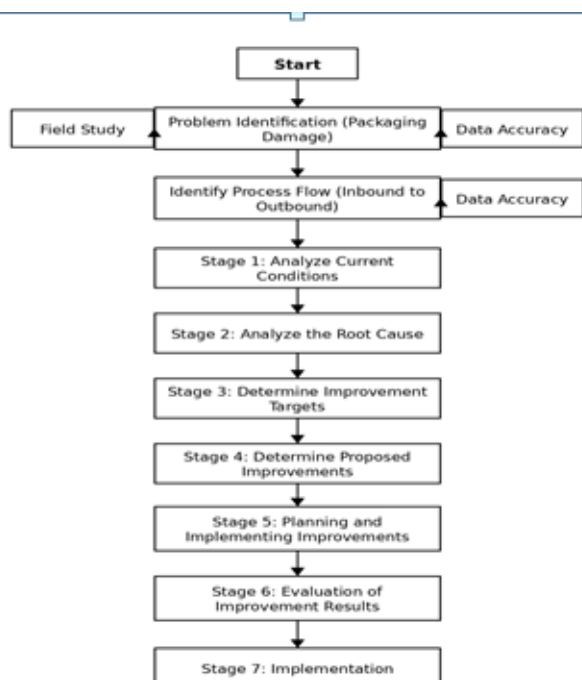


Figure 1 Analytical workflow and proposed implementation stages

## RESULTS AND DISCUSSION

The observed problem concerns packaging damage identified during distribution or at customer receipt. Repacking and potential bad stock are operational consequences described in the source material. The records establish a basis for prioritizing investigation, but do not separately quantify replacement-packaging costs, customer losses, or changes in satisfaction.

Table 3 Monthly packaging damage records

| No. | Month     | Shipments | Packaging Damage |
|-----|-----------|-----------|------------------|
| 1   | July      | 694       | 30               |
| 2   | August    | 500       | 26               |
| 3   | September | 700       | 28               |

Source: PT Mulia Knitting Factory.

Table 4 Bad stock categories

| Bad Stock Category                    | Qty (pcs) | Qty (dozen) |
|---------------------------------------|-----------|-------------|
| Stains / Yellowing                    | 5320      | 443         |
| Reject (holes, tears, termite damage) | 257       | 21          |
| Damaged Packaging                     | 12347     | 1029        |
| Grand Total                           | 17924     | 1494        |

Source: PT Mulia Knitting Factory.

### Reconciled respondent scores

Table 5 Audited respondent-level FMEA calculations

| Respondent        | Failure mode                      | S | O | D  | RPN |
|-------------------|-----------------------------------|---|---|----|-----|
| Warehouse head    | Storage damage                    | 5 | 4 | 4  | 80  |
| Warehouse head    | Damage during transfer to vehicle | 6 | 3 | 9  | 162 |
| Warehouse head    | Shipment damage                   | 6 | 6 | 5  | 180 |
| QC representative | Storage damage                    | 7 | 4 | 4  | 112 |
| QC representative | Damage during transfer to vehicle | 6 | 6 | 10 | 360 |
| QC representative | Shipment damage                   | 7 | 7 | 8  | 392 |
| Packing PIC       | Storage damage                    | 7 | 4 | 4  | 112 |
| Packing PIC       | Damage during transfer to vehicle | 6 | 6 | 10 | 360 |
| Packing PIC       | Shipment damage                   | 9 | 6 | 10 | 540 |

Table 6 Aggregate scores and final risk ranking

| Rank | Failure mode                      | Mean S | Mean O | Mean D | Aggregate RPN | Category  |
|------|-----------------------------------|--------|--------|--------|---------------|-----------|
| 1    | Shipment damage                   | 7.33   | 6.33   | 7.67   | 356.07        | Very high |
| 2    | Damage during transfer to vehicle | 6.00   | 5.00   | 9.67   | 290.00        | Very high |
| 3    | Storage damage                    | 6.33   | 4.00   | 4.00   | 101.33        | High      |

The corresponding mean individual RPNs are 370.67 for shipment damage, 294.00 for transfer damage, and 101.33 for storage damage. Both summarization methods produce the same priority order and categories under Table 2. The shipment-damage RPN varies from 180 to 540 across respondents, indicating substantial differences in perceived risk. The aggregate should therefore guide discussion of controls rather than conceal differences in judgment. Earlier summary values of 75, 180, 280, 240, 48, and 87.6 are not retained as final aggregate results because they cannot be reproduced from the three respondent records using the stated

method. The warehouse head's shipment RPN of 180 remains valid only as an individual score. Previously listed effects such as unsaleable goods, bad stock, and customer rejection are discussed as possible consequences of packaging damage, not as separately scored failure modes. The earlier workplace-accident RPN of 12 is excluded because respondent-level S, O, and D scores for that event are unavailable.

### Distribution Workflow

After packing, packing staff move the goods to the ready-to-ship area. The warehouse administrator or warehouse head signs the delivery note, and warehouse helpers prepare and load the goods onto the vehicle. The driver obtains the accompanying documents from the administrator. The warehouse head coordinates the security check before release. This sequence identifies the packing, staging, loading, and dispatch points at which the proposed instructions and checklists should be applied.

### Interpretation of the Prioritized Failure Modes

Shipment damage is the first priority, followed by damage during transfer from the ready-to-ship area to the vehicle. These stages expose packaging to loading practices, vehicle-space constraints, movement, and handling conditions. Storage damage has a lower relative priority but remains high under the revised classification. Potential consequences include repacking, product deterioration, unsaleable stock, returns, and complaints.

The study does not quantify the separate financial or customer-satisfaction effects of each failure mode. Observation and interview accounts suggest inadequate packaging protection, inconsistent handling, missing written instructions, and incomplete inspection records as contributing factors. FMEA prioritizes the identified failure modes; it does not by itself demonstrate causal effects. Material and environmental explanations should be investigated through linked shipment, packaging, handling, and customer-receipt records.

### Proposed Improvements Using 5W1H

The following measures are proposed controls developed from the diagnosis. Preparation of a form or instruction does not establish routine implementation, employee compliance, reduced damage, or a lower residual RPN. No before-and-after implementation dataset is reported.

| Proposed measure               | Identified issue and mechanism                                                                                                                                                                                    | Responsibility and application                                                                                                       |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Customer report form           | Weak traceability of packaging condition and material performance. Shipment-linked photographs and receipt observations support investigation of recurrent damage; reporting alone does not strengthen packaging. | QC and customer-service staff should collect reports after receipt and review them monthly with procurement.                         |
| Work instructions              | Inconsistent packing and loading. Specify packaging selection, protective material, stacking limits, load restraint, and safe transfer practices to reduce handling variation.                                    | Warehouse head should approve instructions; packing staff and helpers should receive training before a pilot.                        |
| Packing and loading checklists | Missed checks and unclear responsibility. Record packaging integrity, quantity, stacking, vehicle condition, available space, and load restraint before release.                                                  | Packing PIC and designated checker should sign at packing completion and loading; nonconforming loads should be held for correction. |
| Monthly review                 | Recurring issues without documented follow-up. Link damage reports to packaging batches and checklist deviations, assign corrective actions, and verify closure.                                                  | Warehouse head and QC should review pilot records and escalate material issues to procurement.                                       |

## Customer report form

The proposed form should retain tracking number, receipt date, packaging and product condition, photographs, and an optional quality rating. Additional fields should identify packaging type or batch, damage location, affected quantity, and handling observations where known. These fields help distinguish packaging damage from actual product damage and support comparison with dispatch checks. A complaint photograph alone cannot establish whether damage arose from material weakness, loading, transport, or customer handling.

Table 7 Proposed customer report fields

| Field                      | Description                                |
|----------------------------|--------------------------------------------|
| Tracking Number            | Links the report to the shipment log       |
| Date Received              | Date the goods were received               |
| Photo of Goods & Packaging | Upload visual evidence                     |
| Packaging Condition        | Intact / minor damage / severe damage      |
| Product Condition          | Good / partially damaged / totally damaged |
| Quality Rating             | Scale 1-5                                  |

Figure 2 Proposed customer report form prototype

## Customer Report Form

Please complete this digital form with complete information according to the type of packaging damage.

\* Indicates a required question

Tracking Number \*

Your answer

Date Received \*

Your answer

Photo of Damaged Packaging or Product \*

Upload one supported file. Max. 10 MB.

Add file

Packaging Condition \*

Your answer

Product Condition \*

Your answer

Quality Rating \*

1 2 3 4 5

The customer report form has five proposed uses: identifying damage at receipt, maintaining a traceable complaint history, investigating associations with packaging materials, supplying data for periodic evaluation, and informing procurement or packaging changes. These are intended uses; no completed implementation

dataset is presented. Material type and batch should be recorded alongside the shipment identifier so that complaints can be investigated against dispatch conditions.

### **Work Instructions and Checklists**

The warehouse head should prepare work instructions with input from QC and packing personnel. Instructions should state what packaging and protection to use, why each step is necessary, who performs and checks it, where checks occur, when release is permitted, and how deviations are corrected. Training and observed demonstrations should precede a pilot. Material specifications and maximum stacking limits should be confirmed by the company rather than inferred from this study.

A packing checklist should record packaging condition, protective material, closure, labeling, and visible defects. A loading checklist should record vehicle cleanliness and condition, stacking conformity, space and restraint, loading damage, checker identity, and corrective action. These controls are intended to prevent damage and detect deficiencies before dispatch. Customer reports instead provide feedback after delivery. Together they establish a proposed inspection and feedback process, but their actual effect on Occurrence or Detection has not been measured. Severity should not automatically be reduced merely because administrative controls are introduced.

### **Material Control Responsibilities**

For the material-related proposal, procurement and packaging-material personnel should review shipment-linked feedback when planning purchases. QC should compare packaging type or batch with the reported damage and dispatch inspection records. The packing area is the proposed control point for checking material condition before use. A customer report can identify recurring patterns and support a material investigation, but cannot by itself demonstrate that a low-quality material caused a particular incident. Changes in specifications should follow technical review and pilot evidence.

### **Detailed Action Plan Using 5W1H**

**What:** Prepare standardized instructions for packaging, internal transfer, loading, and dispatch, supported by packing and loading checklists.

**Why:** Observation and interview accounts indicate inconsistent handling and missing written guidance. Instructions are intended to reduce variation; checklists are intended to detect omitted checks before release.

**Who:** The warehouse head should approve the instructions, with input from QC and the packing PIC. Packing staff, helpers, and the shipping team should carry out the relevant steps and record checks.

**Where:** Apply the instructions in packing, staging, and vehicle-loading areas. Make the approved version available at the relevant workstations.

**When:** Introduce a pilot after the instructions have been approved and personnel have received a briefing and practical demonstration. Review the records monthly.

**How:** Document packaging steps, approved protective materials, arrangement of goods, handling methods, stacking and restraint requirements, responsible personnel, inspection points, and the procedure for correcting nonconformities. Monitor adherence during the pilot and revise the instructions using the collected evidence.

### **Proposed Implementation and Evaluation**

Following company approval, a pilot should cover a defined set of comparable shipments and retain a consistent observation unit. The baseline and pilot periods should record total shipments and shipments with packaging damage, damaged product quantities, packaging type, route, load characteristics, and inspection completion. The primary proposed indicator is affected shipments divided by total shipments  $\times 100$ ; damaged

pieces and complaint counts should be reported separately. Any estimates, missing reports, or changes in recording definitions should be disclosed.

The same raters should reassess S, O, and D using a documented common rubric after sufficient pilot observations are available. Baseline and follow-up RPNs should use the same aggregation and classification rules. Changes in shipment mix, route, reporting completeness, or volume should be considered before attributing a difference to the controls. No reduced RPN, percentage improvement, cost saving, or effectiveness claim is assigned in this paper because follow-up evidence is unavailable.

## LIMITATIONS

The assessment relies on three operational respondents in one company and is sensitive to subjective scoring. Complete rating anchors, calibration records, assessment independence, and the rationale for each score are unavailable. The revised aggregation is reproducible, but it cannot repair these missing procedural records. Risk thresholds are explicit study-specific working categories. The source units and periods of company records also require confirmation. These limitations restrict generalization and prevent causal claims about the proposed improvements. Customer satisfaction, residual risk, and intervention effectiveness were not directly measured.

## CONCLUSION

The reconciled FMEA identifies shipment damage as the highest-priority packaging failure mode (aggregate RPN 356.07), followed by transfer-to-vehicle damage (290.00) and storage damage (101.33). These results use the product of unrounded mean S, O, and D scores from the three respondents. Under the explicit revised working thresholds, shipment and transfer damage are very high and storage damage is high. Differences between respondents remain visible in the reported individual scores.

The proposed customer report form addresses traceability and feedback, work instructions address inconsistent packing and handling, and checklists address missed inspections and accountability before release. Monthly review is proposed to connect reported defects with corrective actions. These measures have not been verified through before-and-after implementation data. Their effectiveness and any residual RPN reduction must be evaluated prospectively using consistent units, rating anchors, and comparable shipment records.

## REFERENCES

1. Abdussalam, I., & Donoriyanto, D. S. (2024). Analysis of Production-Process Failure Risks in Bakpia Production Using the FMEA Method at Bakpia AS Sidoarjo. *JT-IBSI (Jurnal Teknik Ibnu Sina)*, 9(2), 104-114.
2. Hadi, W., Ladesi, V. K., Azisah, N., Prima, L., & Narayanasamy, R. (2026). Raw Material Logistics Performance Measurement Using OMAX Method. *Jurnal Manajemen Industri dan Logistik*, 10(1), 78-94.
3. Kusnadi, D., & Yulia, E. R. (2023). Website-Based Stocktaking Program Information System. *IMTechno: Journal of Industrial Management and Technology*, 4(1), 21-25. <https://doi.org/10.31294/imtechno.v4i1.1548>
4. Musyaffa, H. A., Roestan, M. R., Nurrajsid, E. S., & Kustiyawan, I. (2024). Risk Study of Raw-Material Storage and Distribution Processes in a Pharmaceutical Industry Warehouse Using the Failure Mode and Effect Analysis Approach. *Jurnal Ilmu Kesehatan dan Gizi*, 2(3), 202-211.
5. Nursani, D., & Rachman, A. (2021). Introduction to Supply Chain Management Module. Jakarta: Center for Education and Training in Government Procurement of Goods/Services, National Public Procurement Agency (LKPP).
6. Prasetya, R. Y., Suhermanto, S., & Muryanto, M. (2021). Implementation of FMEA in Analyzing Production Process Failure Risks Based on RPN. *Performa: Media Ilmiah Teknik Industri*, 20(2), 133. <https://doi.org/10.20961/performa.20.2.52219>

7. Purbasari, R., Jamil, N., Novel, A., & Kostini, N. (2020). Logistics Digitalization in Supporting E-Logistics Performance in the Digital Era: A Literature Review. *Management, Business and Logistics (JOMBLO)*, 01(02), 177-196.
8. Rosih, A. R., Choiri, M., & Yuniarti, R. (n.d.). Operational risk analysis in the logistics department using the FMEA method (Vol. 3, Issue 3).
9. Sabillah, A. S. S., Negoro, Y. P., & Hidayat, H. (2024). Analysis of Fried Instant Noodle Packaging Damage Levels Using Six Sigma and FMEA at PT Karunia Alam Segar. *G-Tech: Jurnal Teknologi Terapan*, 8(2), 1261-1271. <https://doi.org/10.33379/gtech.v8i2.4227>
10. Siregar, M. T., & Hidayat, S. (2025). Automated Pick & Stow Robot System for Sorting in an e-Commerce Warehouse. *Journal of Mechanical, Civil & Industrial Engineering*, 6(4), 17.
11. Siregar, M. T., Zagloel, Y. M., & Setiawan, A. D. (2025). Application of Delphi and Servqual Methods for Quality Improvement of Logistics Services. *Calitatea*, 26(206), 110-118.
12. Wardani, K., & Yudhistira, M. H. (2020). Konsentrasi spasial, aglomerasi dan produktivitas perusahaan industri manufaktur Indonesia. *Jurnal Manajemen Industri dan Logistik*, 4(2), 146-156.
13. Zagloel, T. Y. M., Siregar, M. T., Hidayatno, A., & Setiawan, A. D. (2024). Development of sustainable logistics performance model using system dynamics in urban logistics service companies in Indonesia. *Cogent Business & Management*, 11(1), 2286684.
14. Zahari, M., Harmadi, A., Mustika, M., Manullang, S. O., & Dewi, D. H. (2023). State-Owned Enterprises (SOES): The Ability And The Feasibility During The Industrial Revolution 4.0. *Jurnal Manajemen Industri dan Logistik*, 7(2), 320-333.