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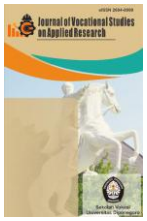

Research Article

Quality Control Analysis Using the PDCA (Plan, Do, Check, Action) Method to Reduce Carton Packaging Returns at PT. App Purinusa Ekapersada Demak

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Abstract

PT APP Purinusa Ekapersada Demak is a packaging company that produces carton sheets and carton boxes for various industries, with more than 100 customers in 2024. However, the company is facing an increase in the number of products returns due to damage that occurs during the distribution process, product non-conformity to the specified specifications, and product handling procedures that are still not running optimally. Analysis of production data and the 2022-2024 return period shows that the total return of carton sheets and carton boxes exceeds the maximum limit set, with the main damage being rust. This study aims to control quality by implementing the PDCA (Plan, Do, Check, Action) method to reduce the return rate and increase production efficiency. The research method uses a qualitative descriptive approach with observation, interview, and documentation techniques. The analysis was carried out through a Pareto diagram to determine problem priorities, a cause-and-effect diagram (fishbone) to identify the main causes, and 5W + 1H and control charts for process evaluation and monitoring. The implementation results showed a significant decrease in the level of damage, especially for rust defects, after improvements were made to human, material, machine, method, and environmental factors. Key recommendations include operator training, evaluation of supplier governance assessments, routine machine maintenance, and updating of standard operating procedures (SOPs) to ensure continuous improvement and increase customer satisfaction.

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1. Introduction

PT APP Purinusa Ekapersada Demak is a company engaged in packaging with a focus on the production of paper-based carton packaging. PT APP Purinusa Ekapersada Demak produces 2 main types, namely carton sheet and carton box. Carton sheet, which is made using a corrugator machine from paper roll material, is available in three types based on fluting thickness: B flute, C flute, and CB flute, and can be sold directly in sheet form. Meanwhile, carton boxes are box products produced from carton sheets through processing on flexo machines, with the support of six inline machines and 3 outline machines. Based on the results of an interview with Mr. Yahya (Quality Control staff) PT APP Purinusa Ekapersada Demak serves more than 100 customers in 2024. PT APP Purinusa Ekapersada Demak can fulfill the demand for carton packaging delivery optimally. Each customer, both from the food and beverage sector, and the chemical industry, has different packaging quality standards. For food and beverage products, packaging must be sterilized and wrapped in paper or bubble wrap to maintain cleanliness, while in the chemical industry, packaging does not require a sterilization process because it is used for products such as electronics, chemicals, and fertilizers.

PT APP Purinusa Ekapersada Demak is still facing problems in returning carton sheet and carton box packaging products from customers, which are caused by damage during distribution, specification mismatches, and suboptimal collection procedures.

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The management of these returns requires clear administration and utilization of a good technology system so that the process of verification and handling of returned goods runs smoothly and efficiently. The lack of an integrated SOP causes obstacles in the process of carton sheet and carton box packaging products and has the potential to increase operational costs. Therefore, the company needs to implement documented and consistent SOPs to speed up returns handling, increase transparency, and maintain efficiency and customer satisfaction. In addition, PT APP Purinusa Ekapersada Demak continues to improve product quality standards and has analyzed production data and warehouse return rates as part of its continuous improvement efforts. Tables 1 and 2 presents data on the production of carton sheets and carton box packaging.

Based on the data in Tables 1 and 2, the number of returns on both carton sheet and carton box packaging products at PT APP Purinusa Ekapersada Demak during the 2022-2024 period continues to increase every year. In carton sheet, the total return for 3 years reached 11.0 kg, far exceeding the maximum return limit set at 6.0 kg. The same thing also happened to carton boxes, where the total return was recorded at 7.0 kg, exceeding the maximum limit of 6.0 kg. The increase in the number of returns of carton sheet and carton box packaging products indicates that the company's quality control has not been running optimally. Therefore, it is necessary to evaluate and improve the production and distribution process so that the return rate of carton sheet and carton box packaging can be reduced to the applicable standard.

Research according to the opinion of Gaspersz (2008), quality management is a strategy that organizes all activities in the management function, with the establishment of quality policies based on existing goals and responsibilities. The implementation of quality management must involve supervision to control and maintain the expected level of excellence. Control is an effort to maintain the quality or quality of the goods produced so that they are in accordance with the agreed product specifications, according to the opinion (Andespa, 2020). According to Assauri (2016), quality control aims to maintain product quality according to agreed specifications. Meanwhile, Supriyadi (2022) explains that quality control is a strategy that is applied from before, during, to the end of the production process to produce a final product that meets the standards.

According to Sharma et al. (2020), problem solving involves systematic and planned steps using specific methods to identify and solve problems effectively. Problems generally arise due to discrepancies between expected and actual conditions. Furthermore, the PDCA (Plan, Do, Check, Action) method is widely used as a continuous improvement approach in manufacturing industries and can be integrated with quality management approaches such as JIT, TQM, Lean Manufacturing, Six Sigma, and FMEA to reduce product defects and product returns (Isniah et al., 2020; Purwadi et al., 2020).. In this study, PDCA (Plan, Do, Check, Action) with analysis tools such as pareto diagram to determine the priority of the problem, cause-effect diagram (fishbone) to identify the main cause of the problem, 5W+1H technique to explore the problem, and control map to maintain the stability of the production process. This approach provides a systematic framework for recognizing and addressing root causes to improve the quality of carton sheet and carton box packaging products.

2. Methods

2.1 Data Collection Technique

1. Observation
   Researchers conducted research at the company PT APP Purinusa Ekapersada Demak through the observation method by directly observing the

Table 1. Production and return data of carton sheet 2022-2024.

Year	Target all (kg)	Carton Sheet			
		Target (kg)	Production (kg)	Good received by customer (kg)	Return Sheet (kg)
2022	3000	1500	1833	1830	3.0
2023	4000	2000	2255	2251	3.5
2024	5000	2500	2748	2743	4.5
Total	12000	6000	6835	6824	11.0

Source: Primary data processed by the authors, 2025

Table 2. Production and return data of carton box 2022-2024.

Year	Maximum return limit (kg)	Carton Box			
		Target (kg)	Producion (kg)	Good received by customer (kg)	Return Box (kg)
2022	2.0	1500	1833	1832	1.0
2023	2.0	2000	2255	2252	2.5
2024	2.0	2500	2748	2744	3.5
Total	6.0	6000	6835	6828	7.0

Source: Primary data processed by the authors, 2025

production process and operational activities taking place at the factory.

2. Interview
   Researchers conducted research at the company PT APP Purinusa Ekapersada Demak through the interview method to obtain data and informants directly from the company regarding the production process, quality control, and operational strategies on carton sheet and carton box products.
3. Documentation
   Researchers conducted research at the company PT APP Purinusa Ekapersada Demak through documentation in the form of TTBP (return goods receipt), RGS (return good slip), road letters, COA (certificate of analysis) and return data for the period 2022-2024.

2.2 Determination Method

This research uses a descriptive qualitative approach with the PDCA (Plan, Do, Check, Action) method, which is a continuous improvement approach to improve quality and reduce the return rate of carton sheet and carton box packaging at PT APP Purinusa Ekapersada Demak. First, pareto diagrams are used to prioritize problems by identifying the most frequent types of damage based on the frequency of the data. Second, a cause- and-effect diagram (Fishbone) is used to systematically identify the main factors causing damage to carton sheet and carton box packaging products. Third, the 5W+1H technique is used to deepen and detail the problem by asking questions (What, Why, Where, When, Who, How). Fourth, control charts to monitor the stability of the production process by setting upper and lower control limits, so as to detect process deviations early.

3. Results and Discussion

Based on an interview with Informant A2, the quality control department of PT APP Purinusa Ekapersada Demak, damage to carton sheet and carton box packaging products is divided into three main categories: light, medium and heavy. A brief explanation of each category is shown in Table 3. Based on observation data at PT APP Purinusa Ekapersada Demak, the causes of damage to carton sheets and carton boxes are listed in Table 4.

Based on the data in Table 3 and Table 4, from the interview with Informant A2, the quality control position at PT APP Purinusa Ekapersada Demak routinely evaluates returned carton sheet and carton box packaging products to identify the type of damage that causes non-conformity with customer specifications. This evaluation helps find the root of the problem and takes corrective action so that product quality improves, and customer confidence is maintained.

3.1 Plan

3.1.1 Prioritizing Damage Types

Prioritization is based on the percentage of defect data on carton sheet and carton box. Tables 5 - 7 present the data analysis of the number of carton sheet and carton box defects such as, dirty, dents, tears, waves, cracks and large tears. To find out the results of the amount of damage to return carton sheet and carton box, a pareto diagram is used to help identify the most dominant type of defect. The following pareto diagram is presented in Figure 1. The company can focus improvement efforts on the return problems that have the greatest impact on product quality.

The results of the number of carton sheet and carton box damage during the period 2022-2024. The amount of production of carton sheet and carton box packaging has decreased each year. But followed by an increase in the number of damage returns, both in terms of weight (kg) and percentage of damage. In 2022, the percentage of damage was recorded at 2.99%, then a significant increase to 8.03% in 2023, and again rose to 8.28% in 2024.

Table 3. Types of cartons sheet and carton box damage

No	Damage Category	Type of Damage	Information
1.	Light	Dirty	Damage that is only in the form of stains or dirt on the surface of the material does not affect the function or strength of the cardboard material.
		Small dent	There are small indentations in the material, but they do not interfere with the main structure or function.
2.	Medium	Torn	There are tears in the carton material, but it can still be used with light repairs.
		Wave	The surface of the carton material is uneven or wavy, but it can still be used, although its aesthetics or functionality may be slightly impaired.
3.	Weight	Rotten	Severe damage where the material becomes extremely brittle, pitted, and completely unusable.
		Big Tear	A large tear that causes the material to lose its primary function and cannot be repaired.

Source: Primary data processed by the author, 2025

From the Pareto diagram (Figure 1), the types of damage to carton sheet and carton box packaging products for the period 2022-2024. The most common damage is rotten and large tears, with an amount of 4,482 kg and 3,747 kg respectively. Other return damages are quite numerous, including dirty (1,999 kg), dents (1,300 kg), waves (1,327 kg), and small tears (815 kg). This data suggests that the main focus of quality improvement should be on addressing crop damage, as it has contributed the most to the total damage over the past three years. By controlling the main types of crop damage, it is expected that the number of returned goods can be significantly reduced and the quality of carton sheet and carton box packaging products improved. Despite the increase in production volume, the dominance of crop damage

Table 4. Causes of carton damage

No	Category Damage	Type of Damage	Causes of Carton Damage
1	Light	Dirty	1. The production environment is dusty and less clean so that dust sticks to the surface of the carton sheet and carton box. 2. Imperfect printing process, such as ink leaking or splashing on carton sheets and 3. carton boxes. 4. Lack of operator training resulting in storage negligence in quality control. 5. Contamination of raw materials forever storage that is not deliberately clean. 6. Printing machines that are not routinely cleaned and serviced result in dirty carton sheet and carton box packaging products.
		Small Dents	1. Careless handling of products during the transfer or storage process to the warehouse. 2. Unorganized stacking of carton sheets and carton boxes resulting in excessive pressure on the packaging. 3. Use of inappropriate or rough conveyance during the handling process. 4. The production environment is cramped and inadequate, so the packaging is easily bumped. 5. Operator error in placing carton sheets and carton boxes on pallets.
2	Medium	Tear	1. A poorly calibrated die cutting machine that produces sloppy cuts. 2. Setting the machine speed too fast causes the carton to tear easily. 3. The quality of raw materials is not good so that the carton is easily torn during the production process. 4. Rough handling during the internal transportation process. 5. Packaging method error that caused excessive pressure on the carton.
		Waves	1. Excessive pressure during the pressing or compaction process of carton sheets and carton boxes. 2. High humidity conditions in the production environment cause carton sheets and carton boxes to become soft and bumpy. 3. Incorrect setting of the lamination or pressing machine that causes the surface of the carton sheet and carton box to be uneven. 4. Impact on the corners of the pallet during transfer by forklift. 5. Storage of carton sheets and carton boxes in an unstable position resulting in wave stoppages.
3	Weight	Kropos	1. Poor quality of raw materials, especially the fluting layer which is easily detached. 2. The adhesive process (glue) is not perfect so that the carton layer is easily detached and results in kropos. 3. Excess moisture that causes the carton to weaken and the layers to separate. 4. A poorly calibrated convert machine resulting in defects in the carton layer. 5. Rough handling during the production and shipping process.
		Large Tear	1. Damage due to rough handling in the storage transportation process while in the warehouse. 2. Cutting setting errors that cause large, untidy tears. 3. Carton material that has weakened due to prolonged storage. 4. Excessive pressure during the product packing or fencing process. 5. Unstable environmental conditions, such as the high temperature and humidity of the warehouse that damage the strength of the carton.

Source: Primary data processed by the author, 2025

indicates the need for improved quality control to reduce the defect rate and improve production efficiency.

3.1.2 Determining the Cause of the Crush Problem

The causes of high cropping defects were elaborated using a fishbone diagram as shown in Figure 2, taking into account the five main influencing factors, namely man, material, environment, machine, and work method. This analysis helps identify the various aspects that contribute to the occurrence of cropping defects, so that improvements can be focused on these areas to reduce the cropping defect rate of carton sheet and carton box packaging products.

Based on Figure 2, there are several factors that cause high rate of return damage to carton sheets and carton box packaging products, namely:

a. **Man**: Damage often occurs due to lack of operator skills and training, low accuracy, and decreased focus due to fatigue, so increased training and supervision is needed so that operators can work according to standards.
b. **Equipment (Materials)**: Poor or inconsistent quality of carton raw materials, including moisture that causes shrinkage, as well as defective materials that do not meet specifications, increases the risk of damage during production and distribution, so the selection and testing of raw materials is crucial.
c. **Environment**: Unstable production environment conditions such as changes in temperature and humidity, poor hygiene, as well as external disturbances such as dust and machine vibration, accelerate carton damage, so maintaining a clean and stable environment is very important.
d. **Machine**: Inaccurate machine settings, such as inappropriate pressure and temperature, as well as lack of machine maintenance and calibration, lead to performance degradation and physical damage to the carton, so regular maintenance is necessary.
e. **Method**: Work procedures that do not comply with SOPs and manual handling methods without clear guidelines lead to production errors, so strict implementation of SOPs and continuous quality control are essential to reduce defects.

3.1.3 Develop Corrective Measures

Once the causes of the cropping defects in carton sheets and carton boxes were identified, corrective measures were organized and detailed as shown in Tables 8 - 11.

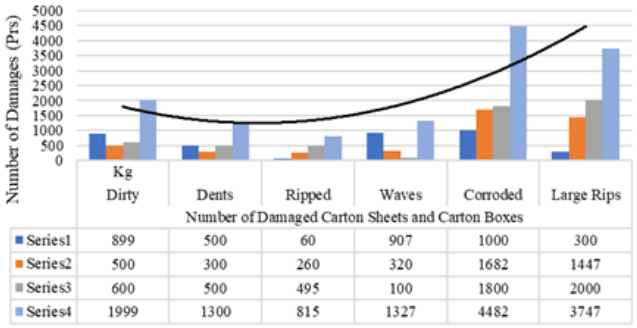

Figure 1. Pareto chart.

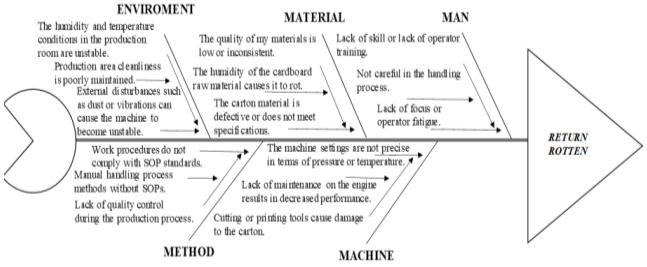

Figure 2. Fishbone diagram.

Table 5. Production quantity 2022-2024.

No	Year	Production Quantity (kg)
1	2022	3,666
2	2023	4,509
3	2024	5,495
Total Number		13,670

Source: Primary data processed by the authors, 2025

Table 6. Number of damaged carton sheets and carton boxes.

No	Year	Dirty (kg)	Dents (kg)	Ripped (kg)	Waves (kg)	Porous (kg)	Ripped Large (kg)
1	2022	899	500	60	907	1000	300
2	2023	500	300	260	320	1682	1447
3	2024	600	500	495	100	1800	2000
Total		1999	1300	815	1327	4482	3747

Source: Primary data processed by the authors, 2025

Table 7. Total damage 2022-2024.

No	Year	Total Damage (kg)	Causing Damage (%)
1	2022	9.12	2.99
2	2023	30.00	8.03
3	2024	38.00	8.28
Total		77.12	19.30

Source: Primary data processed by the authors, 2025

3.2 Do

Improvements at the do stage are carried out using the 5W+1H method to identify and address the causes of defects in carton sheet and carton box packaging products in detail (Table 12 – Table 16). The do analysis is applied to various factors causing defects, namely the man factor (Table 12), material factor (Table 13), environment factor (Table 14), machine factor (Table 15), and method factor (Table 16). The 5W+1H method, which consists of What, Where, When, Why, Who and How questions, is used to systematically investigate the root cause of the problem so that appropriate corrective actions can be formulated and implemented to effectively reduce the defect rate of carton sheet and carton box products.

Table 8. Compilation of improvement steps (What)

No.	Dominant Cause/ Subject matter	What (Idea)
1	Lack of operator skill or training.	Improved skills and training of carton production operators.
2	Low or inconsistent quality of raw materials.	The quality of raw materials is low or inconsistent, the humidity of carton raw materials causes cropping, and the carton material is defective or not according to specifications.
3	The machine lacks maintenance and the settings are not precise.	Imprecise machine settings on pressure or temperature, lack of machine maintenance, broken cutting/printing tools.
4	Work procedures are not in accordance with the SOP.	Application of manual handling process method without SOP (Standard Operating Procedure).
5	Humidity and temperature conditions are unstable.	Maintain the cleanliness of the production area as the main effort to prevent return carton sheet & carton box.

Source: Primary data processed by the author, 2025

Table 9. Compilation of improvement steps (Why)

No	Why (Measures of Success)	When (Time)
1	The lack of skills and training leads to handling errors, product defects, and return carton sheets & carton boxes.	Starting January 2025
2	Hygiene measures and quality control of raw materials are not optimal, so raw materials are easily contaminated or damaged.	Starting January 2025
3	Unmaintained machines and improper settings cause decreased performance and damage to the carton.	Starting January 2025
4	Due to the lack of clear guidelines, processes are inefficient, non- standardized, and potentially result in inconsistent quality.	Starting January 2025
5	Poor cleanliness of the production area causes dust, dirt, and other contaminants to stick to the material, increasing the risk of product defects and returns.	Starting January 2025

Source: Primary data processed by the author, 2025

Table 10. Compilation of improvement steps (Where and Who)

No	Where (Location)	Who
1	Production areas, training rooms, and all process points involving operators.	Production operators, supervisors, and the company's HRD/training team.
2	Raw material receiving area, material storage warehouse, and material quality inspection area.	Quality control team, warehouse operators, and production supervisors.
3	Production machine area.	Machine technicians, machine operators, production supervisors, and maintenance team
4	In the production area where the handling process takes place.	Production manager, quality control and workers responsible for the handling process.
5	Production areas, especially around machines, material storage areas, and internal distribution lines.	A team of production operators, cleaners, production supervisors and quality control.

Source: Primary data processed by the author, 2025

Table 11. Compilation of improvement steps (How)

No	How (How to Implement)
1	Conduct regular training, SOP briefings, work simulations, and periodic evaluations of operators.
2	Implementation is carried out by tightening the inspection of raw materials, maintaining the cleanliness of storage areas, and conducting regular quality testing before use in production.
3	Make proper machine settings according to standards, perform regular machine maintenance, and check cutting/printing tools regularly.
4	The handling process is done manually without following documented or standardized steps.
5	Implement SOPs for production area cleanliness on a regular basis, conduct daily inspections, provide cleaning tools, and training for employees on the importance of cleanliness.

Source: Primary data processed by the author, 2025

Table 12. 5W+1H Man Factors (Lack of skill or lack of operator training)

Type	5W+1H	Description
Key Objectives	What	Improve operator skills and knowledge in the carton sheet & carton box production process.
Reason for Use	Why	Unskilled operators or lack of training can lead to process errors, product defects, and return carton sheet & carton box.
Location	Where	Production areas, training rooms, and all process points involving operators.
Order	When	The implementation time is January 2025.
People	Who	Production operators, supervisors, and the company's HRD/training team.
Methods	How	Conduct regular technical training, skills evaluation, production process simulation, and direct coaching in the field.

Source: Primary data processed by the authors, 2025

Table 13. 5W+1H Material Factors (Low or inconsistent quality of raw materials)

Type	5W+1H	Description
Key Objectives	What	Improve and maintain consistent quality of carton raw materials used in production.
Reason for Use	Why	Low or inconsistent raw material quality leads to product defects and increases carton sheet & carton box returns.
Location	Where	Raw material receiving area, material storage warehouse, and material quality inspection area.
Order	When	The implementation time is January 2025.
People	Who	Quality control team, warehouse operators, and production supervisors.
Methods	How	Establish strict material quality standards, conduct material inspections upon receipt, periodic supplier evaluations, and material sample testing before use in production.

Source: Primary data processed by the authors, 2025

Table 14. 5W+1H Environment Factors (Unstable humidity and temperature conditions)

Type	5W+1H	Description
Key Objectives	What	Maintain stable humidity and temperature conditions in the production room to meet the required standards.
Reason for Use	Why	Unstable humidity and temperature conditions can cause damage to carton raw materials, reduce product quality, and increase returns.
Location	Where	Production areas, especially around machines, material storage areas, and internal distribution lines.
Order	When	The implementation time is January 2025.
People	Who	A team of production operators, cleaners, production supervisors and quality control.
Methods	How	Using temperature and humidity control (HVAC), periodic monitoring, calibration of measuring devices, and training for employees to maintain environmental conditions.

Source: Primary data processed by the authors, 2025

Table 15. 5W+1H Factor Machine (Machines lack maintenance and settings are not precise)

Type	5W+1H	Description
Key Objectives	What	Maintain machine performance so that it is always optimal and precise in the production process of carton sheet & carton box
Reason for Use	Why	Poorly maintained and imprecise machines cause product defects, carton damage, and increase return rates.
Location	Where	Production machine area.
Order	When	The implementation time is January 2025.
People	Who	Machine technicians, machine operators, production supervisors, and maintenance team.
Methods	How	Perform preventive maintenance, check the precision of machine settings, calibrate tools, and record maintenance history regularly.

Source: Primary data processed by the authors, 2025

Table 16. 5W+1H Factors Method (Work procedure is not according to SOP)

Type	5W+1H	Description
Key Objectives	What	Ensure all work procedures in carton sheet & carton box production are in accordance with established SOP standards.
Reason for Use	Why	Work procedures that do not comply with SOPs increase the risk of errors, variations in product quality, and potential returns.
Location	Where	In the production area where the handling process takes place.
Order	When	Implementation time is January 2025.
People	Who	Production manager, quality control and workers responsible for the handling process.
Methods	How	Periodically review and update SOPs, socialize SOPs to all operators, supervise the implementation of SOPs, and provide retraining if needed.

Source: Primary data processed by the authors, 2025

3.3 Check

The evaluation of the improvement was carried out after the improvement process was completed, with a total production of 1,550 carton sheets and carton boxes. This evaluation is done by comparing the defect rate per unit before and after the improvement is implemented. Table 17 shows data on the number of crop defects in the production of carton sheets and carton boxes in January 2025.

1. Calculating the production of records (P)

$$P = \frac{np}{n} \quad (1)$$

$$P = \frac{2}{50} = 0.04 \quad (2)$$

2. Calculating the average (CL)

$$CL = \bar{p} \quad (3)$$

$$CL = \frac{\sum np_i}{\sum n_i} \quad (4)$$

$$CL = \frac{138}{1550} = 0.09 \quad (5)$$

description:

$\bar{p}$: average production

$\sum np_i$: total defective products

$\sum n_i$: total sample size

3. Calculating the upper control limit (UCL)

$$UCL = \bar{p} + 3\frac{\sqrt{\bar{p}(1-\bar{p})}}{n} \quad (6)$$

$$UCL = 0.09 + 3\frac{\sqrt{0.09(1-0.09)}}{50} = 0.11 \quad (7)$$

4. Calculating the lower control limit (LCL)

$$LCL = \bar{p} - 3\frac{\sqrt{\bar{p}(1-\bar{p})}}{n} \quad (8)$$

$$LCL = 0.09 - 3\frac{\sqrt{0.09(1-0.09)}}{50} = 0.07 \quad (9)$$

From the results of the control map (Table 18 and Figure 3), it can be concluded that the improvement efforts that have been made in the production process and handling of return carton sheets and carton boxes

Table 17. Total return for January 2025.

Date	Production Targets (kg)	Target number of sample returns (kg)
01/01/2025	50	2
02/01/2025	50	2
03/01/2025	50	3
04/01/2025	50	1
05/01/2025	50	2
06/01/2025	50	4
07/01/2025	50	4
08/01/2025	50	3
09/01/2025	50	2
10/01/2025	50	2
11/01/2025	50	5
12/01/2025	50	6
13/01/2025	50	6
14/01/2025	50	6
15/01/2025	50	6
16/01/2025	50	5
17/01/2025	50	5
18/01/2025	50	5
19/01/2025	50	5
20/01/2025	50	5
21/01/2025	50	4
22/01/2025	50	4
23/01/2025	50	5
24/01/2025	50	5
25/01/2025	50	7
26/01/2025	50	7
27/01/2025	50	6
28/01/2025	50	5
29/01/2025	50	5
30/01/2025	50	6
31/01/2025	50	5
Total	1,550	138

Source: Primary data processed by the authors, 2025

Table 18. Control map calculation.

Proportion/P	CL	UCL	LCL
0.04	0.09	0.11	0.07
0.04	0.09	0.11	0.07
0.06	0.09	0.11	0.07
0.02	0.09	0.11	0.07
0.04	0.09	0.11	0.07
0.08	0.09	0.11	0.07
0.08	0.09	0.11	0.07
0.06	0.09	0.11	0.07
0.04	0.09	0.11	0.07
0.04	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.12	0.09	0.11	0.07
0.12	0.09	0.11	0.07
0.12	0.09	0.11	0.07
0.12	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.08	0.09	0.11	0.07
0.08	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.14	0.09	0.11	0.07
0.14	0.09	0.11	0.07
0.12	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.10	0.09	0.11	0.07
0.12	0.09	0.11	0.07
0.10	0.09	0.11	0.07

Source: Primary data processed by the authors, 2025

are starting to show positive results. This decrease in the damage rate indicates an increase in the effectiveness of the quality control system, so that the company can minimize losses due to defects in carton sheet and carton box packaging products to increase customer satisfaction. Thus, the company needs to maintain and continue to improve the quality control system so that this positive trend can be maintained and even improved in the following months.

3.4 Action

Here are the standards applied to the improvement activities discussed:

1. Lack of operator skill or training
   The lack of operator skills leads to errors in handling carton sheets and carton boxes, so continuous training is required to improve competency and reduce damage.
2. Low or inconsistent raw quality
   Damage due to inconsistent raw materials is addressed by strict evaluation of suppliers and implementation of quality control upon receipt of materials, to ensure materials meet standards.
3. The machine lacks maintenance and the settings are not precise
   Poorly maintained machines and imprecise settings can damage carton sheet and carton box packaging. Therefore, regular maintenance and precise machine adjustments are essential to maintain product quality.
4. Work procedures are not in accordance with the SOP
   Work procedure discrepancies are addressed by revising SOPs, increasing training, and supervision so that workers understand and carry out operational standards correctly.
5. Unstable humidity and temperature conditions
   Fluctuations in humidity and temperature can damage the carton. Stable environmental quality control is required to maintain the strength and durability of carton sheet and carton box packaging products during storage and shipment.

4. Conclusion

Based on the results of the research, several types of damage were found in carton sheet and carton box products, with rotten crop damage being the most dominant type. The damage is often caused by careless handling, production errors, specification mismatches, and damage during transportation. The implementation of quality control and continuous improvement is essential to reduce defects and improve product consistency in manufacturing industries (Lodgaard & Powell, 2021). Through the implementation of the PDCA (Plan, Do, Check, Action) method, companies are able to identify root causes and perform systematic corrective actions to reduce product returns and improve operational performance (van Assen, 2021). Support from workforce training, employee involvement, regular audits, and process standardization also contributes significantly to quality improvement and customer satisfaction (Khamaludin et al., 2022).

The author suggests that the company should pay greater attention to the implementation of work process instructions and standard operating procedures (SOPs) to control the quality of carton sheet and carton box products. To maintain production quality, raw materials should be strictly inspected before production begins. In addition, regular machine maintenance schedules, operator training, and consistent supervision are required to ensure process stability and minimize defects. The implementation of SOPs and work instructions has been proven to reduce production defects and improve process consistency in manufacturing activities (Purnomo & Rambe, 2021). Furthermore, the application of Lean Manufacturing and continuous improvement approaches can support

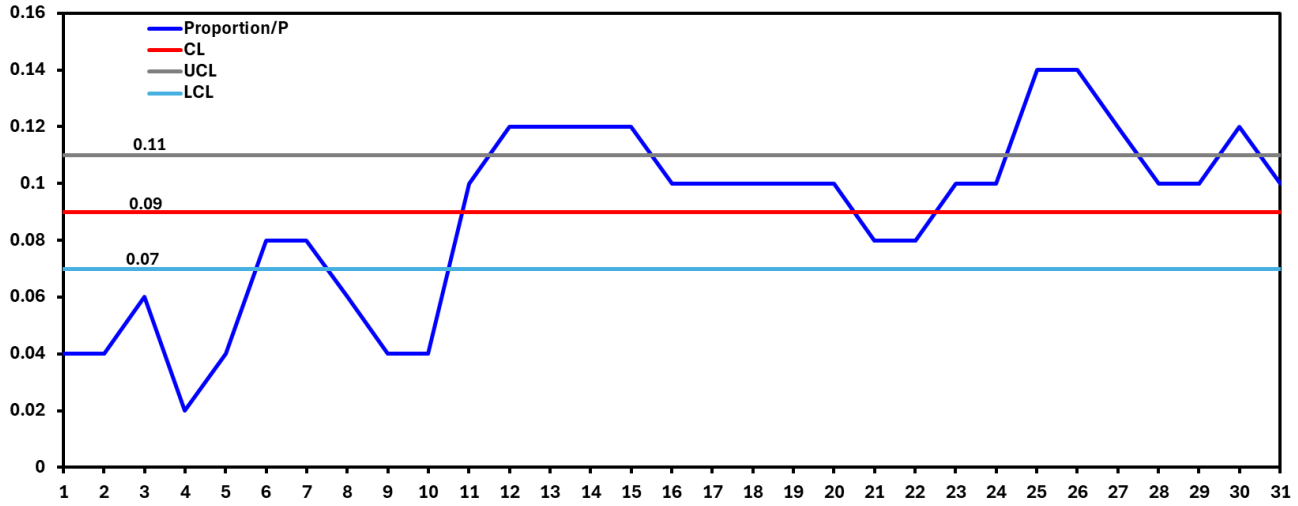

Figure 3. Return carton damage control chart.

defect reduction and increase production efficiency sustainably (Samuel et al., 2021).

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