Analysis of Reducing Product Defects in Quality Receiving Packing PT XYZ with DMAIC Method

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ABSTRACT

This study aims to analyze and reduce the number of defective products (defects) in the process of quality receiving packing door armrest panels at PT XYZ using the Six Sigma method with the DMAIC approach (Define, Measure, Analyze, Improve, Control). The defect problem was found in the Plant 3 area which had an impact on the non-conformity of product quality received by customers. Data was obtained through direct observation, historical problem data, and cause analysis using cause-and-effect diagrams and 5 Why Analysis. The results of the Define stage showed that the dominant defect type was internal defects due to dust particles. At the Measure stage, it was found that 87.5% of defects originated from internal factors. Analysis was conducted by identifying the root cause through the DMAIC approach. The Improve stage includes implementing corrective actions such as improving checking methods, improving cleaning aids, and reviewing packaging standards. Monitoring was carried out at the Control stage for three months and the results showed that no more defects occurred after the improvements were implemented. This research shows that the DMAIC method is effective in identifying and reducing the number of defects in the packing process at PT XYZ.

Keywords: Defect, Quality Receiving, DMAIC, Grazemark, Continuous Improvement.

INTRODUCTION

Product quality is an important concern for companies in creating a product. Quality products are the main criteria for customers in selecting products offered by the company. Companies are always able to maintain and improve product quality to meet customer desires. With quality products, companies can compete with competitors in controlling the market. Companies must always pay attention to or control or supervise the production process of goods produced so that the quality of a product is maintained and in accordance with the standards set by the company.

Quality control is very important and needs to be realized so that companies know the occurrence of deviations in the production process that will cause defects so that they can be minimized and prevent the possibility of damage as small as possible. One of the crucial stages in the production process is the quality receiving process, which is in charge of ensuring that the products produced have met the quality standards before being forwarded to the next stage or sent to the customer.

PT XYZ is a highly dynamic and competitive manufacturer of auto parts and interiors, has proven to be a successful company in growth and development. Since its establishment in 1988, PT XYZ has become a leading supplier in the auto parts and interior industry in Indonesia. PT XYZ is committed to continuous quality improvement, including in the Quality Reiciving Packing area, which is the final point of packaging before distribution. However, the company's internal data showed that there was still a significant level of product defects in the area, which resulted in increased rework costs, delivery delays, and potential customer dissatisfaction. Therefore, a systematic approach is needed to analyze the root causes and implement effective improvements. This research aims to reduce product defects in the quality reiciving area of PT XYZ, while improving the effectiveness and efficiency of the production process.

Overview

The Importance of Recognizing Defects

Defective products are not categorized as waste, but they are still a major cause of quality degradation. Defects

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are conditions when a product does not meet predetermined specifications in terms of both functionality and quality (Patyk, 2017). By recognizing the types of defects, companies can understand the root causes and improve the inspection system to prevent similar defects in the future (Alshazly, Elfatatry, & Abougabal, 2014).

Types of Defects

Defect classification is important for handling based on technical needs. According to Lamsweerde (2009), defects can be classified into several types such as: completeness, correctness, omission, ambiguity, traceability, testability, and consistency. This classification makes it easier to establish the right approach to quality improvement.

Quality Control Concept

Quality Control (QC) is a systematic process to ensure products meet quality standards. Tests are conducted on samples from the production population to determine whether a batch is accepted or rejected (Kiran, Amarendra, & Lingappa, 2018). In its implementation, QC helps identify deviations early on so that they are not passed on to the next process.

Six Sigma Concept

Six Sigma is a quality improvement method that focuses on reducing variation and process defects through a statistical approach. This method is data-driven and customer- oriented with an emphasis on Voice of Customer (VOC), as well as the use of statistical analysis tools for continuous improvement (Zhan & Ding, 2016). Six Sigma aims to achieve near- perfect quality (3.4 DPMO or defects per million opportunities) and can be applied in various functions, not only manufacturing but also service and administrative (Pinjari, Teli, & Gaikwad, 2017).

DMAIC Approach

DMAIC is a systematic approach in Six Sigma that consists of five stages: Define, Measure, Analyze, Improve, and Control. DMAIC is designed to improve business processes by defining problems, measuring performance, analyzing root causes, implementing solutions, and controlling the sustainability of results (Pyzdek & Keller, 2014). This approach has been proven effective in various studies on improving product quality and process efficiency.

METHODOLOGY

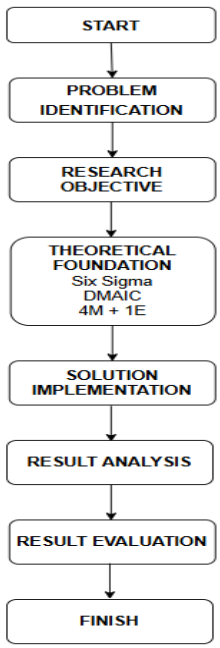

Figure 1. Framework

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This research uses a quantitative approach with the Six Sigma method which focuses on the DMAIC (Define, Measure, Analyze, Improve, Control) approach to identify and reduce defects in the quality receiving packing process at PT XYZ. The object of this research is the door armrest panel product which has a high defect rate in the period April 2023 to March 2024.

DMAIC Stages

Define This initial stage aims to clearly define the problem based on data and customer feedback. Based on the data, there were complaints from two customers, namely Cust 1 (2 cases) and Cust 2 (6 cases) related to defective products. The flow process chart is used to identify the location of the problem, which occurs in the Quality Check (QC) process in the Receiving Packing section of PT XYZ.

Measure At this stage, actual data collection is carried out regarding the number and type of defects. Based on observations from April 2023 to March 2024, 8 defect cases were found with details: 7 cases of internal defects (87.5%) and 1 case of original defect (12.5%). These defects flowed into the next process without being detected at QC Receiving. The trend graph shows an increase in defects, with the peak occurring in March 2024 (4 cases).

Analyze The analysis was carried out using the fishbone diagram method and 5 Why's analysis of the main causal factors of defects, namely:

- Man: Operators did not confirm the repair results properly due to fatigue and work overload.
- Machine/Tools: Many dust particles stick due to ineffective packaging design.
- Material: There is dirt/dust that is difficult to remove just by blowing.
- Method: Manual checking which is not optimal and inconsistent.
- Environment: No tools are available for effective dustremoval. Improvements were made to the checking and packaging methods:
- Revised packaging box design to prevent particles from entering.
- Provide dust removal tools (blower or vacuum).
- SOP double-checking of repair results. After the improvement was implemented in April 2024, the graph shows that the number of defects dropped dramatically to 0 from April to June 2024.

Control This stage aims to ensure that the improvements made can continue to run consistently. Continuous monitoring and periodic audits of SOP implementation and tool effectiveness were conducted. The monitoring results showed stable results with no further defects. The DMAIC methodology has proven to be effective in identifying, analyzing, and addressing the main causes of defects to improve product quality at PT XYZ.

RESULTS AND DISCUSSION

Define

The define stage aims to define the scope of the problem and obtain information about the location of quality problems in the product. At this stage, the process of production flow and inspection of Door Amrest products at PT XYZ is identified.

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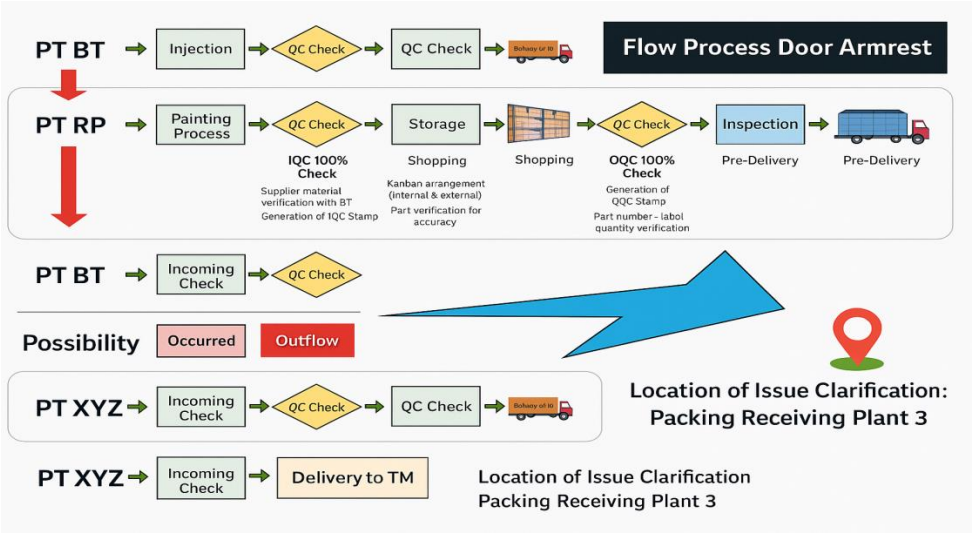

Figure 2. Door Armrest flow process

Measure

At the Measure stage in the DMAIC method, researchers use a pareto diagram and then, collect and measure actual data to understand the extent of *defects* that occur in the *quality receiving* process at PT XYZ.

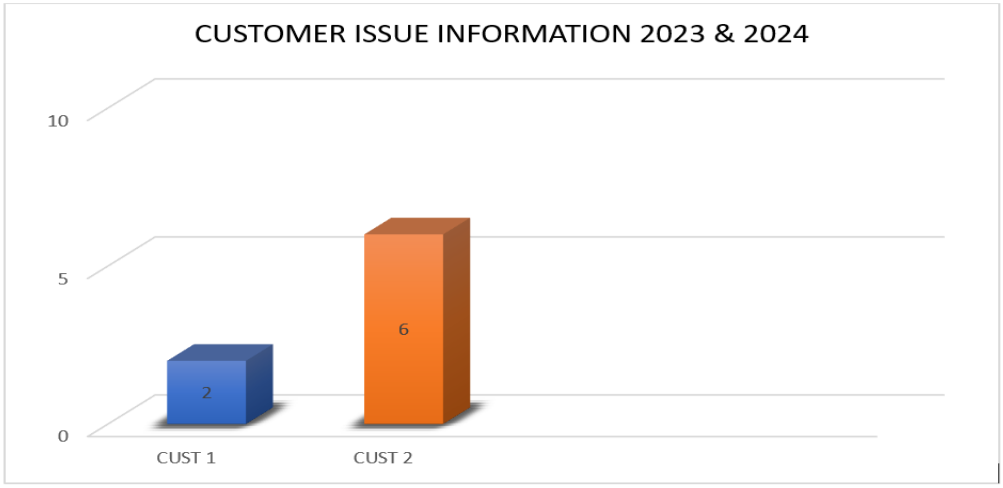

Figure 3. Pareto diagram of problem information.

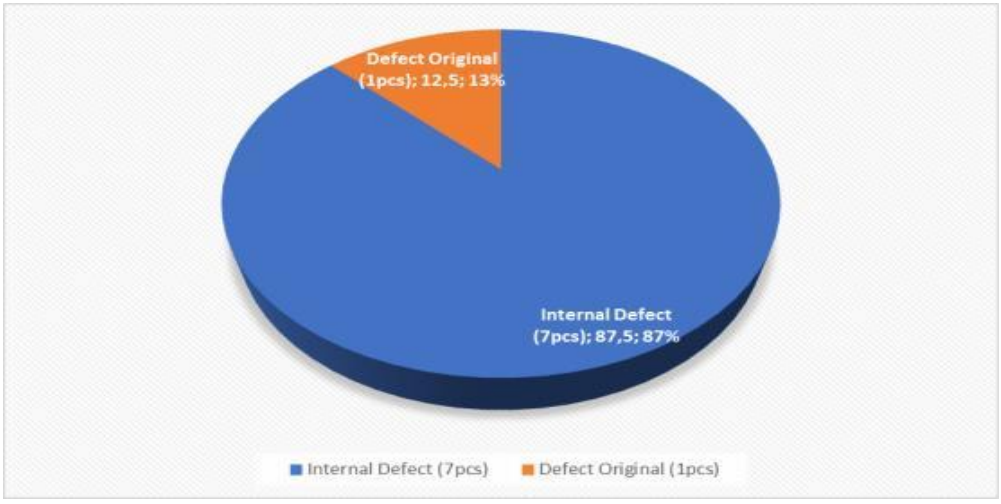

Figure 4. Defect percentage by responsibility

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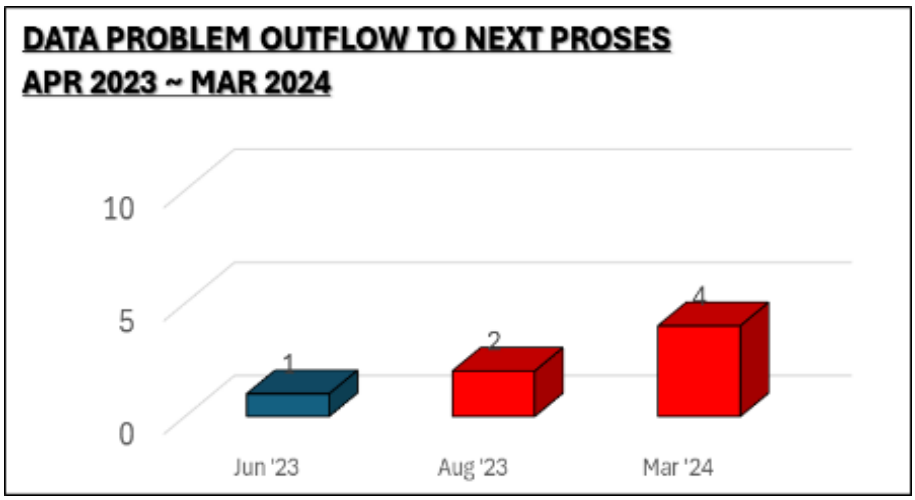

Figure 5. Pareto diagram

Based on the data obtained, the problems we received from customers from April 2023 to March 2024 were 8 pcs. The highest percentage is caused by internal QC Receiving factors with a QTY of 7 pcs. From the internal QTY of 7 pcs, the highest Pareto defect occurred in March 2024 as many as 4 pcs with visual problem issues: "Grazemark", indicating that visual inspection needs special attention both in terms of operator training and improvement of inspection methods.

Analyze

At this stage, to improve the quality of a product, the factors that cause product defects are identified, namely the 4M + 1E Analysis. a systematic method that identifies the root causes of problems in the production or operational process. This method is often used in Fishbone (Ishikawa) diagrams and includes five main categories namely: Man, Machine, Material, Method, and Environment.

Table 1. Root Cause Analysis 4M+1

Possibilty	Factor	Why 1	Why 2	Why 3
OCCURED	MAN	-	-	-
	MACHINE	Many dust particles remain on the surface during QC. Receiving opens the packaging box of the panel door armrest for checking.	There is a gap in the box handle that allows outside dust to enter. Vibrations/handling can release dust particles.	Packaging specification concept needs to be reviewed.
	MATERIAL		-	-
	METHODE	If there is dirt/dust, operator manually blows the surface. If not clean, operator wipes the part.	Dust on the part does not come off easily with manual blowing.	No additional tools are used to help remove stubborn dust stuck to the surface.
	ENVIRONMENT	-	-	-
Possibilty	**Factor**	**Why 1**	**Why 2**	**Why 3**
OUTFLOW	METHODE	Operator did not confirm whether the repaired result is OK/still NG.	Operator is fatigued and overloaded.	Operator must inspect and repair simultaneously.

Improve

At the Improve stage, solution development and implementation are carried out based on the results of the root cause analysis in the previous stage. The focus of improvement is directed at reducing the level of product defects, especially Visual Grazemark defects in the Quality Receiving area. The following is a summary of the comparison of conditions before and after improvement:

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Table 2. Improvement items

NO.	ITEM PERBAIKAN (COUNTERMEASURE)	TARGET ACTUAL	TAHUN 2024 MEI	JUN	JUL
1	Review study packaging spec with team TB, QC, QE, QA, Log-eng Supplier PT. BT, & Customer PT. TM	Target Actual			
2	A semi-automated tool is created to remove dust				
3	Socialization for inspectors, not allowed to do process repair, QCs' job is only inspection; if QC finds any cases requiring special handling, then MP does SCW	Target Actual			

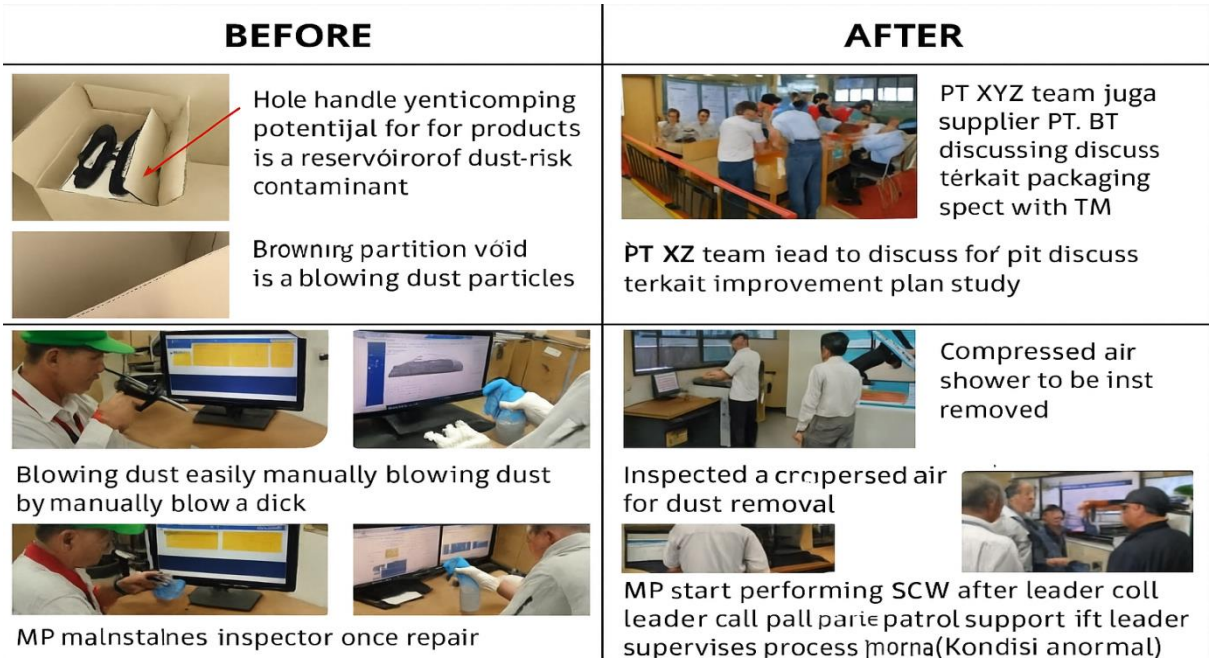

Figure 6. Before After after Improve

Implementation of the improvement started in May 2024 and is targeted to be completed by July 2024. The results of this action are expected to improve the consistency of inspection quality and reduce the number of Grazemark defects.

Improvement Implementation Timeline (May-July 2024):

- Packaging Review: May - July 2024
- Manufacture of Dust Aids: May - July 2024
- Socialization of Inspector Duties: May - July 2024

All activities are carried out in parallel to accelerate improvement results and ensure the entire process is on target.

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Figure 7. Monitoring Result

After the implementation of the improve stage, monitoring was carried out on the number of Grazemark defects in the Quality Receiving process. The monitoring results showed a significant change. In March 2024 (before the improvement), the number of defects was recorded as 4 pcs. After the improvement (April 2024 to June 2024), the number of defects was successfully reduced to 0 pcs (Zero Defect). This achievement was supported by the manufacture of dust removal tools (shower air), standardization of cleaning and visual inspection methods, preparation of standard operating procedures (SOP) and standard field checks (STD). Collaboration with customers in the study of packaging specification improvement.

Control

At this stage, researchers carry out controls to improve quality and minimize defective products in the quality reiciving process. The following steps are applied:

1. Create and enforce Work Instruction (WI) for visual inspection, part cleaning, and packaging procedures.

2. Conduct periodic training for QC Inspector, SCW (Support Correction Worker), and operators regarding the new standard.

3. Installation of visual guides (sample defect/OK photos) in the inspection area to clarify quality standards.

4. Establish an early warning system (EWS): if a defect is found, immediate corrective action and root cause analysis are conducted.

CONCLUSIONS

Based on the results of the application of the DMAIC method in the defect reduction project in the Quality Receiving process at PT XYZ, it can be concluded that the main problem found is the high defect of "Grazemark" which comes from dust contamination and inspection process mismatches. The number of defects was recorded as many as 8 cases in the period April 2023 - March 2024, with the highest defects occurring in March 2024 (4 cases). Through the 4M analysis method (Man, Machine, Method, Material), it was found that the main root cause was internal factors, namely imperfections in the process of checking and cleaning parts. Various corrective actions were taken such as making dust removal tools (air showers), improving packaging design, and dividing inspection and repair tasks more clearly. Implementation of continuous controls such as process standardization, regular training, monitoring, and monthly audits successfully maintained quality stability. Monitoring results after improvement showed a decrease in defects to Zero Defect from April 2024 to June 2024. Thus, the implementation of DMAIC has proven effective in reducing defects in the Quality Receiving process, improving work efficiency, and meeting customer quality expectations. In order for the improvement results to be sustainable, it is recommended to conduct regular evaluations of the Quality Receiving process to ensure the implementation of standards is carried out consistently. Improving the competency of human resources through continuous training is also important to ensure a good understanding

of part inspection and cleaning procedures. In addition, documentation and monitoring systems need to be strengthened so that any findings and improvements are well documented and can be used as a basis for continuous improvement.

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