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QUALITY CONTROL ANALYSIS OF CARDBOARD PRODUCTS USING SIX SIGMA METHOD IN CV. AGZ

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ABSTRACT

Quality control is an activity that is used by companies to monitor and evaluate production activities and ensure that production activities meet production process standards. The purpose of this study is to help companies find out the causes of defects and create suggestions for improvement using the six sigma method. The six sigma method is one of the tools used to control quality. By using several stages, namely define, measure, analyze, improvement, control. From data processing and analysis, the total production is 160,800 pcs and the number of defects is 4303 pcs. Based on the results of the calculation of DPMO found as many as 80,280 per one million productions. Based on the Pareto diagram, the percentage of the most dominant types of defects is the type of paint defects that are not neat.

Keywords: Quality Control, Quality, Six Sigma

INTRODUCTION

Quality control is a method that is carried out from the beginning to the beginning of a process. Production, the progress of a production process to the end of the production process. By producing products that meet the standards that have been planned and desired. Improve the quality of products that do not meet the specified criteria to maximize achieving good quality (Nursyamsi & Momon, 2022). Quality is a standard feature of our products aimed at meeting customer requirements. By providing consumers with guaranteed quality, manufacturers win consumers' trust and maintain good business relationships. Therefore, the role of product quality is very important. It is a high quality product if it can meet the specifications desired by consumers without any defects (Rimantho & Mariani, 2007).

CV.AGZ is an industry engaged in the production of cardboard boxes in Gresik. The company was founded in 1999 until now. the process of making packaging products produced by CV. AGZ turns paper sheets into cardboard boxes, starting from design, cutting and screen printing. The production itself is almost always using simple machines. This company has implemented standard production process quality control applied by this company, namely prioritizing the quality of screen printing, plong, and cutting. However, in reality there are still products of poor quality. In the production of this packaging there are 3 types of defects that are used as the main research, namely the paint is not neat, the cut is not neat, and the plong is damaged. In this company the number of production for 6 months is 160,800 pcs.

Six Sigma Method

Six Sigma method is a tool commonly used to control the quality of a product. This method has the concept of achieving a quality standard of 3.4 rejections per million opportunities. In the Six Sigma method is divided into several stages. We will improve product quality. This Six Sigma

method can be used to find the cause, so it can be useful for reducing defective products (Laricha Salomon et al., 2015).

The quality control system currently implemented by the company is only done by separating the failed products and the successful products. It will be difficult to improve performance in producing products that can meet specifications in accordance with consumer desires, producers must respond to the consequences that arise when a product quality produced is not suitable (Yadav et al., 2021). The Six Sigma approach (DMAIC) will be applied in quality control of cardboard box products, where this approach has been widely applied to various product activities produced (Yadav et al., 2021), (Pamungkas et al., 2018).

METHOD

Studythis is done on the CV. AGZ which is located in Gresik. This study uses quantitative data that has been obtained during the study. Six sigma data processing (define, measure, analyze, improve, control). Six Sigma is a metric translated in the measurement process using statistical analysis and engineering to minimize defects up to 3.4 DPMO (Defects Per Million Opportunities) by one million possible defects for customer satisfaction (Kusumawati & Fitriyeni, 2017).

According to (Laricha Salomon et al., nd) Six Sigma is an approach in solving and improving processing problems through DMAIC. DMAIC is the essence of Six Sigma It all depends on the customer. The product manufacturing process runs according to everything so that it can produce products that can satisfy customers. The function of the p control chart is to see whether the production quality control has been controlled or not. A statistical tool, this makes the p control chart used as a tool in controlling the quality of cardboard boxes (Khomah & Siti Rahayu, 2015).

Define

This stage is for setting targets for six sigma quality improvement activities (Maulana Ahmad, 2019).

- Define product quality problems that have been determined by the company.
- Define an action plan that must be carried out based on the results of observations and research analysis.
- Setting goals and objectives for improving the quality of six sigma based on observations.

Measurement

This stage was carried out through two stages of sampling which had been carried out for six months (Shokri et al., 2020).

- Analyze the level of sigma and defects per million opportunities

  DPO= $\frac{banrench\ produk}{yang}$.

  DPMO = DPO x 1,000,000 .
- Analyze using control chart (p-chart) which is used for attribute problems.

Analyze

Identify the cause of the problem using Pareto diagrams and fishbone diagrams (Dewi & Puspitasari, nd).

Improve

At this stage, determine the proposed action for quality improvement based on the fishbone diagram that has been made (Dewi & Puspitasari, nd).

Control

At this last stage, the results of quality improvement have been obtained and then applied in the company as a standard for quality improvement in the production of cardboard boxes (Farid et al., 2022).

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RESULTS AND DISCUSSION

Define . phase data collection

Data on the production of cardboard boxes for six months, namely March-August 2021 at CV AGZ Perkasa can be seen in the table below.

Table 1. Production Data for 6 Months

Month	Total production
March	26300 pcs
April	27400 pcs
May	26600 pcs
June	26000 pcs
July	27500 pcs
August	27000pcs

Production data of cardboard product defects

Table 2. Production data and product defects of cardboard boxes

Type of Defect of Cardboard box						
Month	**Number of Products (pcs)**				**Number of Defective Products**	**Percentage**
		Untidy Paint	**Piece Not Tidy**	**Broken Plong**		
March	26300	350	217	132	699	2.6%
April	27400	323	248	134	705	2.5%
May	26600	338	234	133	705	2.6%
June	26000	345	237	143	725	2.7%
July	27500	389	234	139	762	2.7%
Augusts	27000	333	238	136	707	2.6%
Amount	160800				4303	

Stage measure (measurement)

a. **Calculating the average proportion of total defects**

$$p = \frac{\text{total defect total}}{\text{inspection}}$$

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$p = \frac{4303}{160800}$

$\bar{p} = 0.02676$

b. Sigma level measurement

Sigma level March-August 2021 Inspected units(U)= 160800 Defective unit(D)= 4303

Opportunities = 3

*Defect*per Opportunities(DPO)= $\frac{D}{U \times op} = \frac{4303}{160800 \times 3}$

= 0.08028

DPMO=DPO x 1,000,000

=0.08028 x 1.000.000

= 80,280

Levelsigma= 2.9

The results of data processing using the six sigma method, obtained DPMO data of 80,280 obtained a sigma value of 80,280 with a sigma level value of 2,9, which means that every production process there will be no more than 2,9% damage for every 1 million cardboard box units.

c. Process stability measurement

Measurement of the stability of this process is carried out where this process describes the condition of the process to produce a product whose value is stable from time to time.

- Determination of the center line CL
  The line depicting no deviation from the sample characteristics
  $p = p_n$

- UCL determination
  Limits of control over allowable deviations.
  $UCL = p + 3\frac{(1-p)}{n}$

- LCL determination
  Lower control limit data calculated from standard values
  $LCL = p - 3\frac{p\,(1-p)}{n}$

The calculation resultswhich has been calculated as the table above can be analyzed through the control chart diagram as below.

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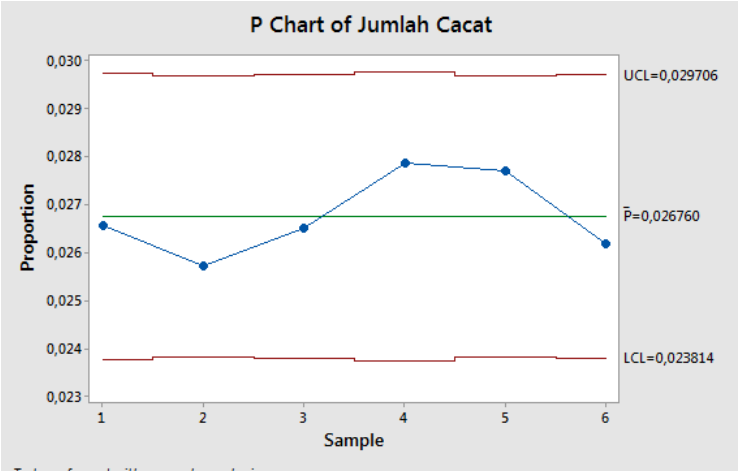

Figure 1. Control chart chart

From the diagram above, it shows that the defective product is still under control, because the line shows that it is in the middle line

Analyze stage

This stage analyzes the Pareto chart based on the processed data to determine the percentage of types of defects in production and the order of types of defects.

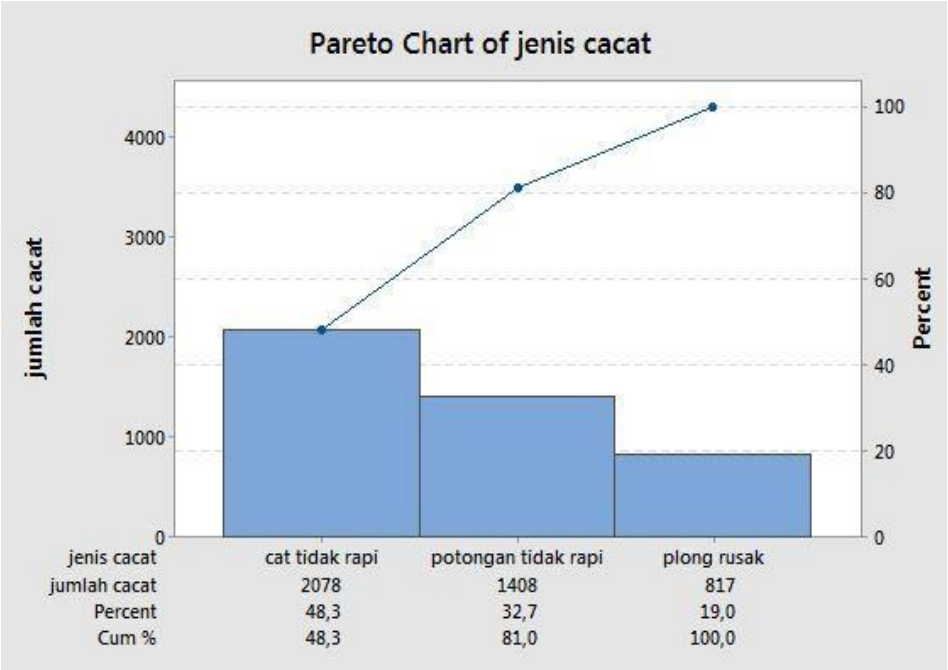

Figure 3. Pareto chart

From the Pareto diagram above, it can be seen that the type of sloppy paint defect is the type of defect with the highest percentage of 48.3%, the two types of imperfect cut defects are 32.7% and the third is the damaged plong defect with a percentage of 19.0%. Thus, the company focuses on making repairs to the type of paint defects that are not neat. Once you know the highest type of defect, use the Fishbone diagram shown below to identify the type of sloppy paint defect.

Paint is not neat

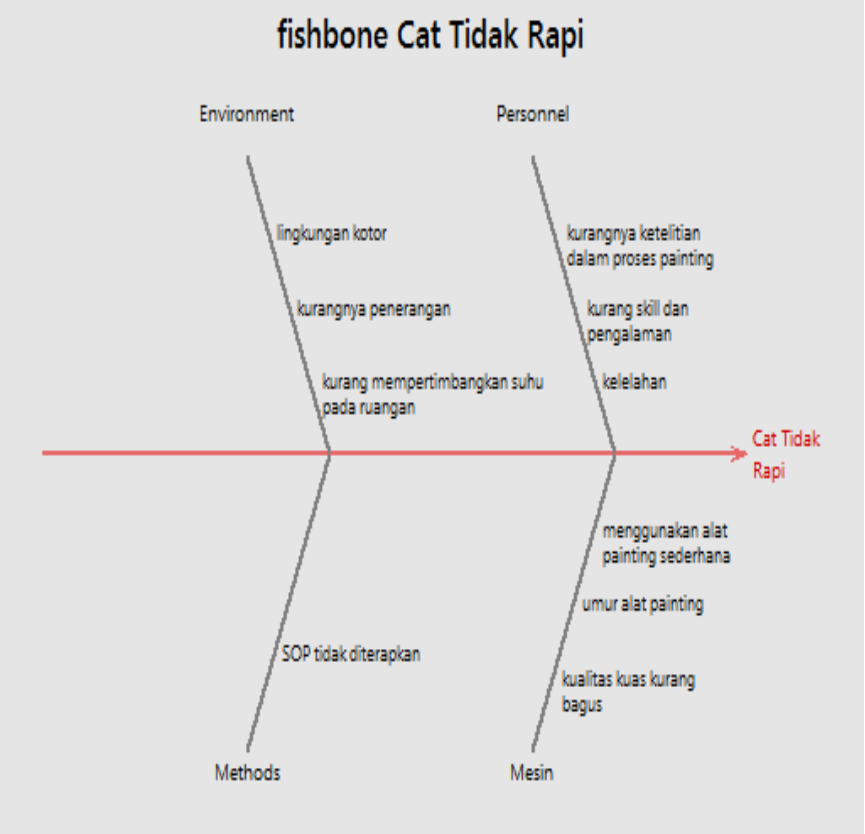

Figure 4. Fishbone Diagram

There are four main causes of paint defects that are not neat, which are caused by human factors, machines/tools, methods, and the environment. The following is an explanation of each of the factors that contribute to the defect.

a. Man
   Human factors related to labor such as lack of skills, physical fatigue and accuracy in the manufacturing/painting process.
b. Machine
   Machine factors that affect defective products are problems in the operation/use of tools/machines such as the age of paint tools that are not useful and the quality of the tools is not prioritized.
c. Method
   Factors regarding the methods and procedures carried out can result in defects in the product, including not applying SOPs.
d. Environment
   Work environment factors also affect product quality. A good environment can make employees more comfortable and minimize product defects. Environmental factors that influence are lack of lighting, hot room temperature, and dirty environment.

Improve stage

During the repair phase, suggestions for correcting the cause of each defect are provided via fishbone diagrams. Below are suggestions for improvements that CV can make. AGZ strives to improve the quality of cardboard box products.

Table 3. Proposed Improvement of Each Cause of Disability

No.	Cause of disability	Improvement Proposal
1	Lack of training	Conducting training after employee recruitment/providing training to workers
2	SOP Error	Changes/adjustments that evaluate periodically as needed
3	Fatigue	Arrangement of rest time / holding a rolling shift
4	Less skilled	Setting work standards
5	engine life/ Screen printing equipment	Perform regular machine checks, replace machines accordingly standard
6	Not enough maintenance	Carry out regular/routine maintenance
7	Brush quality	Looking for quality brush suppliers, and changing brushes when it feels like the brush is not worth it
8	Not enough lighting	Adding lighting sources in each production place, especially on the screen printing
9	Room temperature	Added a cooler so that it can stabilize the room temperature

Control Stage

Is the last analysis stage of Six Sigma which emphasizes on documenting and disseminating new actions that have been taken, including:

a. Perform regular maintenance.
b. Supervise raw materials and employees so that the quality produced is better.
c. Record all defective products every day from each production machine, which is carried out by employees in the production process.

CONCLUSION

Based on the results of research on the production process at CV. AGZ can get several conclusions, namely, the number of production in March-August 2021 is 160,800 pcs with the number of defective products that occur in the production process as much as 4,303 pcs, the results of data processing using the six sigma method obtained DPMO data of 80,280 obtained a sigma level value of 2 ,9. This is certainly a loss if it is not handled, because the number of defects if allowed to occur the level of defects in the product can increase even higher. Based on the Pareto diagram, the highest level of defects is the type of paint that is not neat, so this company is more focused on repairing the defects of the type of paint that is not neat. Factors that can be ignored in all types of defects are the lack of employees carrying out SOPs.

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