

Quality Control Analysis of Pillow and Bolster Products with DMAIC And FMEA Method Approach in CV. Saiky Indonesia

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ABSTRACT

CV. Saiky Indonesia is one of Indonesia's growing manufacturers of pillows and bolsters. The development of a company certainly requires reasonable quality control so that the quality of the product is maintained. Besides that, quality control is an important thing that the company must do to minimize defective products. On CV. Saiky, Indonesia has not yet reached zero-defect because rejects are still found in the pillow and bolster the production process. Companies can analyze product defects using the six sigma method by formulating DMAIC, Define (problem identification), which is to determine what types of defects exist, Measure (measure) which is to determine CTQ and validate problems from existing data by determining the DPMO value and Value Sigma, Analyze (analyze) Perform analysis using Pareto diagrams and fishbone diagrams, Improve (improvements) at this stage, repair the root problems that have been found and explained in the analyze stage, namely by making FMEA tables, based on FMEA which has been given weighting values, obtained values The highest RPN, after the improvement is carried out in the Control stage, at this stage the SOP is made to control the results of the improvements that occur. This SOP contains the sealer machine implementation process. This research aims to find out how quality control using DMAIC and FMEA methods is applied to manufacturing companies. The results showed that the company that was the object of the study had an average product defect of 8%, meaning that this would be very detrimental to the company because it would affect the company's market and the costs incurred. This shows that the company has not yet achieved six sigma; therefore, this study was made to minimize the number of defects in the company. Based on this research, the recommendation that can be given is that the company needs to place quality control at every stage of the production process, train workers, enter into quality contracts with suppliers so that the materials supplied are of a prime quality, and provide adequate storage (warehouses) to maintain the quality of the materials.

Keywords: Quality Control; DMAIC; FMEA

INTRODUCTION

Quality control aims to quickly investigate the causes or shifts in a process such that an investigation of the process and corrective action can be taken before too many nonconforming units are produced [1-7]. Quality control is essential in the world of production because reasonable quality control and good product quality make it easier for companies to market their products. This is done so that consumers feel confident that the product offered is good. Quality control is needed to keep the products produced by applicable quality standards. The quality standards are raw materials, production processes, and finished products. Therefore, quality control is carried out starting from raw materials, the process of these activities until the finished product is by predetermined standards. The consumer's desire, in essence, is to get satisfaction with the goods he buys. If Consumers are faced with several choices with relatively almost the same price, the product with the same quality is chosen. Quality control carried out correctly will make the company get a good quality impact. However, even though the production process has been carried out properly, production errors are still found where the quality of the production is not by the production standards that have been set, or it is called the product has a product defect. Six sigma is the most popular method that focuses on the customer who pays attention to the process. In addition, six sigma is a tool or tool used to improve processes through customer focus, continuous improvement, and the

involvement of people both inside and outside the organization [8-15]. In minimizing product defects, this study uses the six-sigma method, which is a statistical measurement concept. The six-sigma method, this method strives for a zero-failure rate. The Define, Measure, Analyze, Improve, Control (DMAIC) and Failure Mode and Effects Analysis (FMEA) approaches were used in this study. Define, Measure, Analyze, Improve, and Control (DMAIC) is a continuous improvement process toward the six-sigma target and is carried out systematically based on science and facts [16-24]. At the same time, the Failure Mode and Effects Analysis (FMEA) evaluates the possibility of a failure of a system, design, process, or service to take steps to handle it. The development of small businesses as the basis of the people's economy is one of the strategic steps that need to be followed up with concrete steps. The pillow and bolster business in Bantargebang District cannot be separated from hard work in the marketing field. This business has run a marketing process in selling goods and services offered to consumers or buyers. However, sometimes the marketing process is carried out only based on habit, so there are often situations where a seller cannot compete with other sellers with the same merchandise. One of the reasons those who win in winning the hearts of buyers are those who plan the process of selling their goods carefully, using good marketing principles. Pillow and bolster business CV. Saiky Indonesia are a small industry that has been running for about 5 years.

Every month this business continues to advance and develop. The agribusiness system in this business management starts from production to marketing. Now the pillow and bolster business CV. Saiky Indonesia has been widely known by many people because of the quality of the materials and stitches of the neat pillows and bolsters and the prices are affordable for the middle class.

Initially, this pillow business only marketed its products to small furniture shops around Bantargebang District. To introduce products to the community, entrepreneurs do a way, namely by taking goods paid later / commonly referred to as paying due, the goal is good so that the surrounding community can market and sell products without having to have a lot of capital. Brandy pillows and bolsters are pillows whose manufacturing process uses silicone material, so that these products can be pressed during the packing process (vacuumed) and have a durability of about 1 year. This Indonesian saiky pillow business is precisely located in Bantargebang District. Bekasi is a sub-district located in the

city of Bekasi. This area is very likely to become the center of the economy because it enters the city. This is evidenced by the availability of hospital facilities (Puskesmas), schools, markets, and large shops. So that this area is also a suitable land for the development of medium-sized industries and micro-scale home businesses. Mr. Matsari runs Saiky Indonesia's pillow and bolsters business with 20 employees. The employees are their own family and mostly Central Javanese (Purbalingga), and this business can produce 341040pcs pillows and bolsters in a year. The problem faced by the pillow and bolster business is product quality control. In order to realize the above objectives, this final project is expected to provide suggestions for improving the production process so that the quality produced is maintained. In addition to emphasizing the products produced, quality in the manufacturing industry is also considered in the production process. Even the best is if the attention on the production process is not on the final product.

TABLE 1: Total Defect

No	Month	Total Production	Total Defect
1	January	30000	2535
2	February	28680	1763
3	March	30030	3095
4	April	23700	1492
5	May	30060	3507
6	June	23970	2058
7	July	27030	1475
8	August	30000	2648
9	September	28800	1625
10	October	29550	1976
11	November	29190	1947
12	December	30030	3162
Total		341040	27283

Table 1 historical data on total production and total defects of pillows and bolsters. Within a year CV. Saiky Indonesia has a reasonably high defect rate of around 8%,

which means there are 27283pcs of the total number of defective pillows and bolsters, which is not by the company's defect target of 5%.

TABLE 2: Variant of defect and total Defect

Production Line	Variant of Defect	Total Defect
CUTTING	HUGE SIZE	424
JAHIT	Sewing distance is too big	7372
	Free Stitch	4113
PRESS & SILER	Perforated Plastic	15374

In table 2, it can be seen that the first type of defect is oversize; the standard length and width of the fabric used to make pillows is (52cm x 82cm) and for making bolsters (32cm x 83cm). Usually, during the fabric cutting process, some fabrics exceed the standard. The advantage is that it can reach 7cm from the standard size. However, this type of defect is not too much because the cutting process uses a cloth cutting machine. The second defect is that the sewing distance is too large. The standard size of the sewing distance used is 1mm, and the tolerance is 1.3mm. However, when the sewing process was finished and rechecked, there were stitches for pillows and bolsters too big. The distance can reach 2mm to 3mm.

The third defect is loose stitches. After checking the sewing distance, the next step is to check the loose stitches by slowly pulling the sides of the pillow and bolstering the fabric with stitches. The goal is to ensure that the sewing results are promising.

Moreover, the last one is perforated plastic. After checking the sewing distance, the next step is to check the loose seams, namely by gently pulling the sides of the pillow and bolstering the fabric with stitches. The goal is to ensure that the sewing results are promising. Therefore, we need a way to minimize product defects, pillows, and bolsters.

In this study, the Define, Measure, Analyze, Improve, and Control (DMAIC) and Failure Mode and Effects Analysis (FMEA) methods will improve the production process of pillows and bolsters at CV. Saiky Indonesia.

RESEARCH METHODOLOGY

The steps involved in data processing and analysis are as follows:

(1) Identification of Product Manufacturing Process

The first step in the research is to understand how the production process for pillows and bolsters occurs from raw materials to finished products.

(2) Data Collection

The data collection needed in conducting this research includes data on the amount of production and data on rejected products in the Cutting, Sewing, Press, and Siller process, in January - December 2020 period, as well as observation and interview data to determine the causes of rejects to be able to provide solutions to the company.

(3) DMAIC Method (Define, Measure, Analyze, Improve, Control)

a. Define

At the define stage, problem identification is carried out, starting with defining each type of reject that occurs in the Cutting, Sewing, Press, and Siller processes, then determining CTQ (Critical to Quality) to know what kind of product the customer wants.

b. Measure

In this stage, determine the dominant type of defect, which is CTQ (Critical to Quality), using a Pareto diagram and then measure the value of DPMO (Defects per Million Opportunities) and SQL (Sigma Quality Level) values. Furthermore, the DPMO value is converted to the Six Sigma conversion table to determine the sigma level. The steps required are as follows:

1. DPO Calculation

Knowing DPO (Defect Per Opportunities), which is a measure of failure that shows the number of rejects per opportunity

$$DPO = \frac{\text{Total defect}}{\text{Output x CTQ Potensial}} \dots\dots\dots(1)$$

2. DPMO calculation

Calculating DPMO (Defect Per Million Opportunities) is a measure of failure that shows the number of rejects per million opportunities.

$$DPMO = DPO \times 1.000.000 \dots\dots\dots(2)$$

3. SQL Value (Sigma Quality Level)

Looking for the SQL (Sigma Quality Level) value is an indicator that describes the level of process performance, and to find the sigma value, you can directly look at the six-sigma table as follows:

TABLE 3: Sigma Quality Level

Sigma Level	DPMO
1	690.000
2	308.000
3	66.800
4	6.210
5	320
6	3,4

c. Analyze

This stage is the stage of analyzing, seeking, and finding the root cause of a problem. To find out the cause of the dominant reject, interviews were conducted with production operators and Quality Control operators. This can be analyzed using a fishbone diagram.

d. Improve

This improvement stage is the stage of repairing the problems that have been found and explained in the analysis stage using FMEA (Failure Mode Effect and Analysis). FMEA analysis was performed using an FMEA spreadsheet. The RPN value is sought for each problem, then the RPN value is arranged from the largest to the smallest value. The RPN value results from the multiplication of the severity, occurrence, and detection values for each cause of the problem.

e. Control

The control stage is the last stage in the DMAIC method. After knowing the sigma level value, then a calculation is carried out to determine whether the production is running on the cutting, sewing, press, and siller processes in CV. Saiky Indonesia uses the P-Control Map tools; the P-Control Map is used because the data used in the study is attribute data.

After completing the calculations, the next step is to make a P Control Map find out whether the process is still under control (within control limits) or not. The control phase carried out is only a proposal to be implemented by the company. The main goal at the control stage is to control the existing process so that problems that arise in the aging process do not recur.

RESULT AND DISCUSSION

The data that has been collected from the observations, as shown in the previous chapter, will be analyzed according to the analysis stages contained in the DMAIC method (Define, Measure, Analyze, Improve, Control) as follows:

(1) Stage Define

Data from January to December 2020 shows four defects often occur oversize, too large a stitch distance, loose stitches, and perforated plastic. After knowing the types of defects in the pillow and bolstering the production process, then determining the CTQ value by determining the highest number of defects from the existing types of defects, and knowing the CTQ, namely too large stitches and perforated plastic. It can be seen in the pie chart below

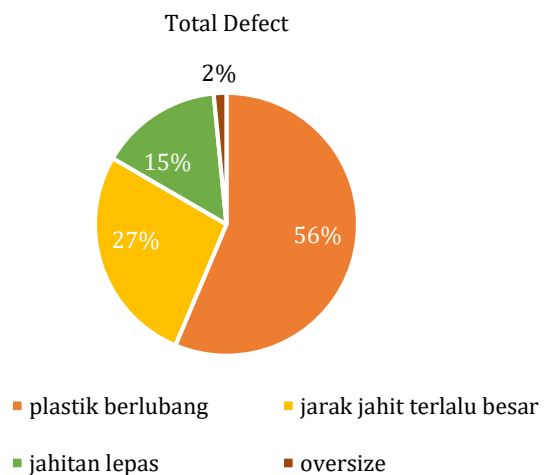


FIGURE 1: Pie Diagram Type of Defect

The data above describes 56% of perforated plastic, 27% too large sewing distance, 15% loose stitches and 2% oversize.

Below is the identification of CTQ on products for pillow and bolster products:

TABLE 3: CTQ Pillow and Bolster

CTQ	DESCRIPTION	TARGET
Sewing distance is too big	Defective sewing distance can reach 2mm to 3mm. Not in accordance with the standard i.e. 1mm to 1.3mm	Hajj distance according to the standard is 1mm to 13mm
Perforated Plastic	Many plastics are not covered or have holes, it could be because the sealer machine is not hot enough.	Perfectly sealed plastic

(2) Stage Measure

Based on the overall DPMO calculation results for one year from January to December 2020, the results are 39693.2, which means there are 39693.2 failures per million possibilities. Moreover, the known SQL value from Table 4.10.

from January to December 2020, which is 3.27, the company has not implemented quality control properly because it is still far from the six-sigma target. It can be seen below the picture diagram 5.2 sigma value comparison.

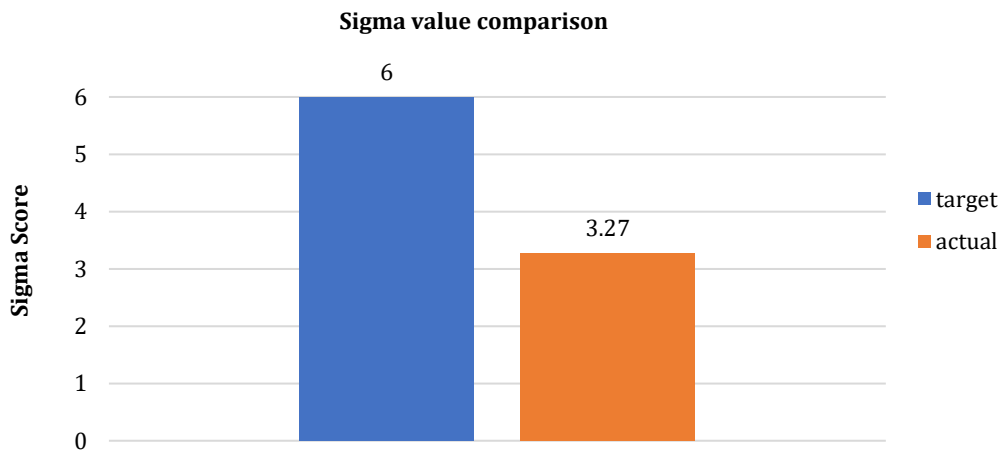


FIGURE 2: Sigma Score Comparison

From the data in the diagram above, the sigma value has not been achieved because the actual achievement only got 3.27 while the target to be achieved was six, so there was a difference of 2.73 from the target to be achieved.

Saiky Indonesia so that repairs can be carried out quickly and accurately; for this stage, the tools used, namely the Pareto Diagram, function to determine the type of defect that is the most dominant in pillow and guiling products. So that improvements can be focused on the most dominant type of defect. To find the cause of the defect in the most dominant type of defect, you can use fishbone diagram tools.

(3) Analyze Stage

The analysis stage is carried out to find out the cause of the current problems in CV.

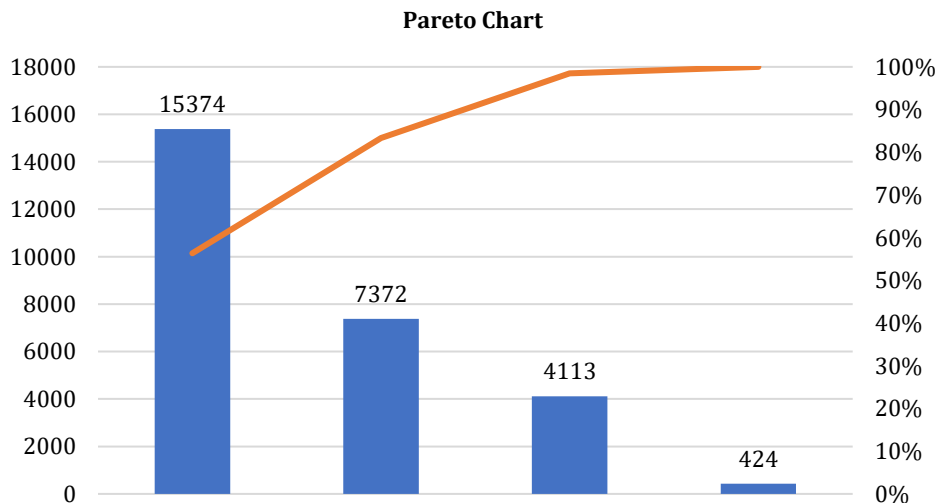


FIGURE 3: Pareto Chart

Pareto diagrams are tools used to find the cause of problems or damage to a product by getting the highest damage data and focusing repairs on the most dominant problems. In addition to analysis using Pareto diagrams, Pareto diagrams are essential because they help determine the main problems faced so that problems can be solved effectively and efficiently. In pillow and bolster products CV. Saiky Indonesia has four defects: oversize, loose stitches, too large sewing distance, and perforated plastic. In the Pareto diagram analysis, the defects used are scattered, meaning that the most significant defect is perforated plastic. After knowing the most significant defect using a Pareto diagram, they are then looking for the cause of the defect using a fishbone diagram. After obtaining the dominant defect, it can be seen in Figure 3 above with the percentage of perforated plastic defects of 56%. Next, focus on repairs on perforated plastic defects because they have the highest percentage of defects.

Fishbone Charts

After getting the results from the analysis with the Pareto diagram of the type of defect with the most significant percentage, namely the type of perforated plastic defect with a percentage of 56%, then further analysis is carried out to find out the cause of the perforated plastic defect by using the Fishbone Diagram. Below are the results of the analysis using the Fishbone diagram:

The factors causing the problems that occur in the image above can be described as follows:

- **Human factor**
The human factor plays an active role in the resulting production because humans act as operators even though machines make products. However, humans also greatly influence the manufacture of products. The occurrence defects made by humans can occur due to fatigue and incorrect machine settings. Fatigue can occur due to the large number of targets that wholesale operators must carry out, while incorrectly setting the machine can occur because the operator forgets or is negligent in setting the machine so that the machine's performance is not optimal.

- **Method Factor**
The method factor can occur due to a lack of supervision in the production process, making employee performance less suitable. Due to the lack of supervision, the work system that has been listed in the SOP is not implemented correctly and will affect the results of the products produced.

- **Engine factor**
The engine factor, the cause is the lack of rejuvenation/maintenance where engine maintenance is not carried out every day, which results in decreased engine performance and engine capability in the production process. Refurbishment of machines must be carried out or replacing worn or old machines with new ones and improving the quality of maintenance so that the machine can improve the performance of the sewing machine and improve the quality of production.

After that, proceed to the improvement stage with analysis using FMEA to find out improvement activities based on the RPN value to find recommendations for improvement based on the greatest priority

(4) Improve Stage

TABLE 4: Perforated Plastic FMEA

Items	Defect	Severity	Defect Causes	Occurrences	Current Control	Detection	Recommended Action	RPN
Bolster pillow	Perforated Plastic	4	This rejection occurs due to lack of machine maintenance	4	Teflon inspection on the sealer machine before carrying out the process.	3	Replacing Teflon sealer with a new one	48
Bolster pillow	Perforated Plastic	8	This rejection occurs because the temperature of the sealer engine is not hot enough	7	Temperature check before sealing plastic	4	The company sets a temperature standard for heating plastic	124
Bolster pillow	Perforated Plastic	4	This rejection occurs due to the operator's lack of accuracy	5	Care must be taken when placing plastic in the sealer machine	4	Provided guidance or training	100

The next stage is the Improve stage using the FMEA (Failure Mode and Effect Analysis) tools to determine the priorities for improvement by looking at the most significant RPN value in the FMEA table. Which is used does not work optimally with an RPN value of 124; this is due to the temperature setting on the machine that does not fit, and also there is no standard from the company to determine the engine temperature when used. Therefore, the company must make a temperature standard for the sealer machine to cover the plastic entirely and do not have holes. Of course, this will result in the plastic becoming less sticking or perforated.

After knowing the suggestions for corrective actions in FMEA, it is necessary to have a controller or supervision to control or supervise the quality control of pillows and bolster products at CV. Saiky Indonesia.

(5) Stage Control

At this stage, control is carried out on the ongoing process by providing control proposals, namely by making SOPs for preventive action so that the same incident does not happen again. The following are some proposed SOPs that can be implemented and used as a reference for work standards, namely SOPs on the use of sealer machines. The temperature used by the sealer machine is 4 ° so that the plastic ripens evenly or is well covered. Moreover, clean the Teflon part before using the sealer machine so it does not stick when the plastic heats process. So, the hope is that the plastic can be covered entirely or not perforated.

CONCLUSION

From the results of processing and analysis that has been carried out on the production process of pillows and bolsters CV. Saiky Indonesia, it can be concluded as follows:

- (1) From the identification or analysis that has been carried out, it is known that several types of defects occur in the production of pillows and bolsters in CV. Saiky Indonesia, namely oversize (fabric pieces do not match the standard), loose stitches, too large sewing distance, and perforated plastic.
- (2) From the analysis results, the main factors are causing defects in the pillow and bolster products in CV. Saiky Indonesia, which is known as the engine factor. The lack of maintenance where the sealer machine maintenance is not carried out every day results in decreased engine performance in the process of heating the plastic besides that the Teflon on the sealer machine is rarely cleaned, and there is no standard for setting the temperature so that the heat generated by the machine is maximized.
- (3) From the results of the DMAIC analysis, the proposed improvement was given, namely by making SOPs for the use of sealer machines so that the plastic is evenly covered and does not have holes.

SUGGESTION

The following are some suggestions given by researchers that may be used as material for company consideration, including:

- (1) This research only discusses one type of product: pillows and bolsters made of silicone produced by CV. Saiky Indonesia. It is hoped that further research can discuss all types of products produced by CV. Saiky Indonesia.
- (2) Improved Standard Operating Procedure to make it more transparent and easier to understand. The SOP that must be made is using a sealer machine so that there are no more errors in setting the temperature and constantly checking the Teflon sealer machine before use.

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