

Research Article

Quality Control of The Pia Production Process Using Statistical Quality Control (SQC) at UD. Candika Purnama Company

¹Ni Putu Windayanti, ²Ni Ketut Purnawati

^{1,2}Faculty of Economics and Business, Udayana University, Bali, Indonesia

Received Date: 10 May 2024

Revised Date: 21 May 2024

Accepted Date: 25 May 2024

Published Date: 01 June 2024

Abstract: Product quality is a key factor that can provide satisfaction to consumers. In producing high-quality products, companies need to pay attention to production activities, from raw material supervision and the production process to the finished product. By implementing quality control, it is expected to minimize defective products produced during the production process. This research was conducted at UD. Candika Purnama, Dalung, Kuta Utara District. Finding out whether UD. Candika Purnama's quality control measures for the pia manufacturing process were adequate and were the driving force for this research. This study used a quantitative approach to descriptive research. Saturation sampling was the chosen method of sampling. Information on product damage from 2024's first two months was the focus of this research. Check sheets, p-charts, cause and effect diagrams, and quality cost analyses were all part of the statistical quality control tools used for data analysis. Some data points exceeded the Upper Control Limit (UCL), indicating that the quality control was not optimum. The quality cost with an actual defect rate of 28.500 pia units, resulting in a Total Quality Cost (TQC) of IDR 74,736,315.789, was higher than the optimum defect rate of 6.304 pia units, with an optimal Total Quality Cost (TQC*) of IDR 31,521,421.287. This indicates that the quality control of the production process in the company had not yet reached the optimal level. Achieving optimal quality control can be accomplished by making improvements in several key aspects that influence the defect rate, namely man factors, material, machine, and method.

Keywords: Product Quality, Quality Control, Statistical Quality Control, Quality Costs.

I. INTRODUCTION

The rapid growth of the industrial market demands that companies provide products in line with their objectives. Companies are required to continuously innovate to improve effectiveness, efficiency, and performance to compete with other companies (Andespa, 2020). To guarantee their goods are up to par, all businesses must focus on product quality. According to Kotler and Keller (2016), product quality is characterized by how well a product performs its tasks, which includes factors like accuracy, dependability, and durability. Companies must pay close attention to all aspects of manufacturing, from the monitoring of raw materials through the completion of the product, if they want to produce high-quality goods. Damaged or faulty items, however, are typical issues in manufacturing. To fix these problems and keep product quality high, quality control is essential (Audina et al., 2020).

Quality control is an activity carried out to ensure that the production process is conducted as planned. If discrepancies or deviations are found, the production activities can be reviewed to ensure that the products produced align with the company's objectives (Kurniawan and Azizah, 2022). If a company produces products with an increasing defect rate, this will reduce the company's profits as the production cost per unit will rise (Candrawati and Nurcaya, 2020). By implementing quality control, it is expected to minimize defective products produced during the production process. To find out whether the manufacturing process is still under control, it is necessary to quickly identify the main elements creating the most serious flaws (Suparno and Narto, 2022).

Statistical Quality Control is one of the most successful approaches for regulating product quality. Supply chain quality control, or SQC, is a technique for finding and fixing problems in a business by using statistical approaches. In order to make sure that the manufacturing process meets the company's requirements, SQC is used. This encompasses quality control from the beginning to the end (Meldayanoor, 2018). Gaspersz (2006: 169) states that there are four types of quality costs: those associated with prevention, evaluation, internal failure, and external failure. In order to cut down on waste caused by products that don't meet standards, businesses should calculate quality expenses. These costs are directly tied to product quality.

Quality control utilizing SQC techniques has been the subject of several prior research. Research conducted by Ramadan et al. (2018), Panjaitan et al. (2019), Kurniawan and Azizah (2020), Riadi and Azwar (2021), Rucita and Amna (2021), Darmawan et al. (2022) shows uncontrolled results as data tested using p-chart have points exceeding the UCL and



LCL limits. This indicates that there are still deviations occurring in the production process. Research conducted by Ishak et al. (2020), Maulida et al. (2020), Ginting and Supriadi (2021), Rochmoeljati et al. (2022), Rifan and Jufrianto (2023); Fuentes et al. (2023), and many other studies show that quality control using p-chart has no defects exceeding the UCL and LCL limits. This indicates that everything is under control throughout manufacturing, but in practice, certain items nevertheless sustain less-than-ideal damage. Research by Sari and Purnawati (2018), Andika and Sudiarta (2019), and Candrawati and Nurcaya (2020) concludes that the quality control conducted has not yet reached an optimal level because the analysis of production quality costs shows that the actual defect costs are higher than the optimal quality costs.

Research on quality control was conducted at UD. Candika Purnama Company, which produces a product called Pia Candika Purnama. UD. Candika Purnama Company is located at Dalung, North Kuta District, Badung Regency. The process of producing Pia Candika Purnama at UD. Candika Purnama Company has been carried out using modern methods. The production process combines both machinery and human labor. During the production process of pia, UD. Candika Purnama Company has implemented quality control measures. However, the company still discovers many defective Pia products in each production cycle. Some of the damaged qualities include a brittle texture, burnt or pale color, and shapes and sizes that do not meet the company's standards. To initiate improvements, it is necessary to first identify the factors causing poor quality in the pia production at the company. Quality control is expected to provide benefits for the company by reducing the number of damaged Pia products and minimizing costs resulting from these product defects. Therefore, the company must focus on quality control to reduce the risk of defective products and ensure that the quality of the products produced remains optimal.

II. LITERATURE REVIEW

A) Product Quality

According to Heizer and Render (2015: 244), quality is defined as the totality of a product's attributes that the manufacturer claims will meet customers' demands. Two schools of thought within the field of management provide light on why product quality is so crucial: operational management and marketing management (Nasution, 2015: 5). From the perspective of operational management, improving product quality is a key strategy for boosting profitability with the overarching goal of satisfying customers with goods that are on par with or better than what they can get from rivals. Among the four Ps of marketing—product, pricing, promotion, and distribution channels—that may boost sales and broaden a company's market share is product quality, according to marketing management theory. To evaluate the level of product quality, eight criteria can be used as benchmarks: performance, features, reliability, conformity, resilience, functionality, visual appeal, and perceived quality.

B) Quality Control

To guarantee that final goods and services are up to par, quality control is an important procedure. Assauri (2016: 323) explains that quality control is a procedure that ensures manufacturing meets the company's standards. If the results don't match the criteria, the necessary steps to fix them are taken. The purpose of quality control is to ensure that all stages of production run smoothly, resulting in products that meet established standards. To achieve this goal, companies continually monitor production outcomes and use statistical tools to detect issues.

C) Statistical Quality Control

According to Heizer and Render (2015: 258), Statistical Quality Control (SQC) is a method that uses statistical techniques to measure and control product quality. SQC is a tool used to produce products that meet specifications from the beginning to the end of the production process (Yamit, 2018: 202). Statistical quality control aims to quickly investigate the causes of errors and take corrective actions before too many defective products are produced. This statistical method helps companies optimize product quality and minimize the risk of producing non-conforming products.

D) Quality Costs

Quality costs are the expenses incurred or potentially incurred due to poor quality (Nasution, 2015: 162). This means that quality costs are related to the creation, identification, correction, and prevention of defects. Quality costs help management in planning and controlling product quality to avoid producing low-quality products. According to Yamit (2018: 13), quality costs can originate from within the company, which includes costs incurred to ensure that the quality of products produced and services provided meet established standards. External quality costs are those gained after products and services reach the consumer.

III. RESEARCH METHODS

The design of this research is descriptive with a quantitative approach. This study aims to provide an optimal quality control model, identify the factors causing defects in the products, and offer solutions to overcome the quality control challenges in the production process at UD. Candika Purnama. The research was conducted at UD. Candika Purnama was chosen as the location due to the existing problem of producing a significant number of defective products during the

production process, resulting in many products having poor quality. The object of this research is the manufacturing process's quality control for products at UD. Candika Purnama. The variables analyzed according to the main problem and the objectives of this research are: 1) Product Characteristics, 2) Production Volume, 3) Number of Defective Products in the Production Process, and 4) Quality Costs.

The population in this research consisted of the total production output over one month (25 working days), amounting to 60,000 pia units of various product variants such as mung bean, durian, cheese, and chocolate. The sampling method used for product testing was saturated sampling, where all members of the population were included in the sample. The sample examined in this research consisted of 2,400 pia units per day of production, aiming to obtain more representative and accurate results regarding the quality and characteristics of the products. The data analysis technique in this research involved statistical quality control through the following steps:

A) Collection of Defective Product Data with Check Sheet

Data on production was collected by taking samples of products and recording the number of defective products and the types of defects produced using a check sheet. This was done to ensure that the collected data could be easily understood and further analyzed.

B) Creation of P-chart

This research used a p-chart to calculate the proportion of defective products. A tolerance limit of three standard deviations was used to achieve a confidence level of 99.73% for determining whether the production process was within control limits. The choice of a p-chart was based on data representing visually defective products, which are difficult to express numerically. The steps in creating a p-chart were as follows (Montgomery, 2013: 300).

a. Calculating the percentage of defects

$$P = \frac{np}{n}$$

Description:

np = number of defective samples in the subgroup

n = number of samples inspected in the subgroup on the day i

b. Calculating the central line (CL)

$$CL = \bar{p} = \frac{\sum np}{\sum n}$$

Description:

$\sum np$ = Total number of defective samples

$\sum n$ = Total number of samples inspected

c. Calculating the upper control limit (UCL)

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

Description:

$\bar{p}$ = Average proportion of defects

n = number of samples inspected

d. Calculating the lower control limit (LCL)

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

Description:

$\bar{p}$ = Average proportion of defects

n = Number of samples inspected

C) Analysis of Cause-and-Effect Diagram (Fishbone Diagram)

Analysis using a cause-and-effect diagram is used to identify the factors causing damage or defects in the produced products, thereby enabling recommendations and solutions to reduce product damage during the production process. The steps to create a cause-and-effect diagram were as follows:

- Identified the main problem causing product defects.
- Identified the factors that contributed to the main problem.
- Identified specific causes of product defects caused by the predetermined factors.
- Analyzed and evaluated the cause-and-effect diagram to plan effective corrective actions to improve product quality.

D) Calculating Quality Costs

The analysis of Quality Costs comprised costs such as Quality Control Costs (QCC), Quality Assurance Costs (QAC), Total Quality Costs (TQC), and q^* (optimal amount of defects), with the formula as follows (Sari and Purnawati, 2018).

a. Quality Control Costs (QCC)

$$QCC = \frac{R.o}{q}$$

Description:

QCC = Total Quality Control Costs

R = Quantity of production during the period

o = Testing costs

q = Quantity of defective products during the period

b. Quality Assurance Costs (QAC)

$$QAC = c.q$$

Description:

QAC = Total Quality Assurance Costs

c = Quality Assurance cost per unit

q = Quantity of defective products during the period

c. Total Quality Costs (TQC)

$$TQC = QCC + QAC$$

Description:

TQC = Total Quality Costs

QCC = Total Quality Control Costs

QAC = Total Quality Assurance Costs

d. Total defective products

$$q^* = \frac{R.o}{c}$$

Description:

q^* = Optimal amount of defective products

R = Total production during the period

o = Testing cost

c = Selling price of the product

E) Made quality improvement recommendations

Once the causes of product defects and optimal quality costs were identified, recommendations or proposals were developed for taking action to improve product quality so that the company could control quality optimally.

IV. RESULTS AND DISCUSSION

Based on the data collected through direct observation from January to February 2024 using a check sheet, the following data can be obtained:

Table 1: Data Types and Quantities of Product Damages at UD. Candika Purnama Company from January to February 2024

Production Day	Sample	Type of Damage			Number of Defects (units)	Defect Percentage
		Non-conforming Size and Shape (units)	Brittle Texture (units)	Incorrect Color (units)		
1	2400	32	34	27	93	3.875%
2	2400	27	28	30	85	3.542%
3	2400	35	45	30	110	4.583%
4	2400	37	40	31	108	4.500%
5	2400	29	32	26	87	3.625%
6	2400	25	30	28	83	3.458%

Production Day	Sample	Type of Damage			Number of Defects (units)	Defect Percentage
		Non-conforming Size and Shape (units)	Brittle Texture (units)	Incorrect Color (units)		
7	2400	31	30	32	93	3.875%
8	2400	30	39	36	105	4.375%
9	2400	30	30	34	94	3.917%
10	2400	27	28	25	80	3.333%
11	2400	30	28	27	85	3.542%
12	2400	32	30	29	91	3.792%
13	2400	38	42	35	115	4.792%
14	2400	29	27	30	86	3.583%
15	2400	30	35	25	90	3.750%
16	2400	22	32	40	94	3.917%
17	2400	40	51	35	126	5,250%
18	2400	35	38	28	101	4.208%
19	2400	27	32	27	86	3.583%
20	2400	33	31	25	89	3.708%
21	2400	29	32	26	87	3.625%
22	2400	35	40	37	112	4.667%
23	2400	30	30	27	87	3.625%
24	2400	31	27	35	93	3.875%
25	2400	26	30	39	95	3.958%
Total	60.000	770	841	764	2375	98.958%
Average	2400	30.800	33.640	30.560	95.000	3.958%

Source: Processed Data, 2024

Based on the data provided in Table 1 above, it can be seen that out of 2400 samples of pia taken per day or a total of 60,000 pia units over one month, 2375 pia units experienced damage, with an average of 95 pia units damaged. Three categories of damage occur improper shape and size, pia with a brittle texture, and incorrect color. Among these three categories, the highest product damage occurs in pia with a brittle texture, totaling 841 pia units. In contrast, the remaining damage is caused by improper shape and size, amounting to 770, and incorrect color, totaling 764. The highest number of defective products during January-February occurred on the 17th day, with a total of 126 pia units. In comparison, the lowest number of defective products occurred on the 10th day, with 80 pia units.

The next step in identifying quality control is to create a p-chart. Based on Table 1, the control limits using the p-chart from January to February can be seen in Table 2.

Table 2: Control Limits of Pia Candika Purnama Defects for January to February 2024

Description		Quantity
Total Sampled Products (units)		60,000
Total Defective Products (units)		2375
Control Limits	CL	0,040
	UCL	0,052
	LCL	0,028

Source: Processed Data, 2024

After obtaining the results of CL, UCL, and LCL calculations, the next step is to create a p-chart (p-chart) as presented in the following figure:

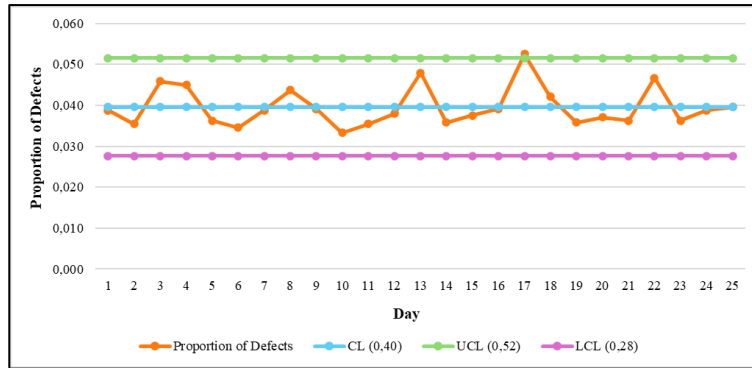


Fig. 1 P-chart of Pia Candika Purnama Product Defects from January to February 2024

Based on Figure 1, it can be seen that there are still processes that are beyond the control limits. Out of the 25 data points, 2 points are close to the control limits, namely on days 13 and 22, and there is 1 point that exceeds the control limit, which is on day 17 at 0.053, indicating that UD conducts the quality control of the production process. Candika Purnama still experiences deviations. Therefore, further analysis is needed to determine the causes of these deviations using a fishbone diagram.

The fishbone diagram is a diagram used to identify and analyze the factors causing defects in the pia products at UD. Candika Purnama and to find possible causes of the issues, thereby providing recommendations and solutions to reduce product defects during the production process. Factors influencing and causing defects include man, machine, method, and material.

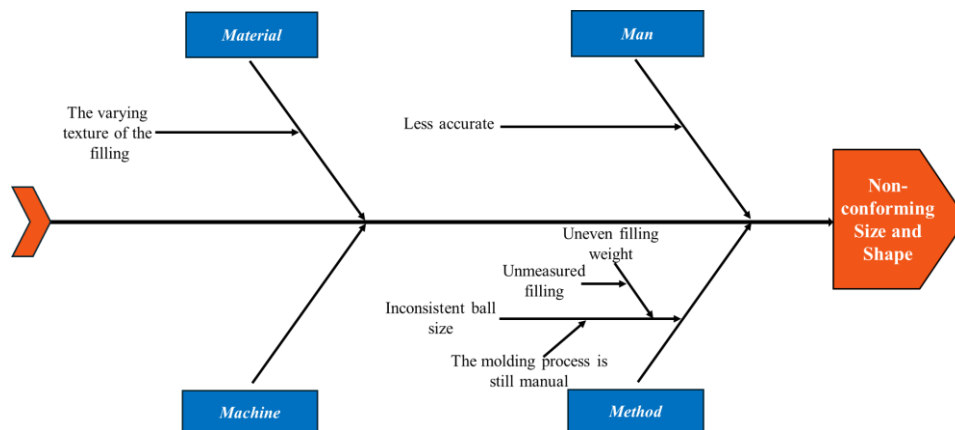


Fig. 2 Fishbone Diagram for Damaged Products with Inappropriate Shape and Size

From Figure 2, it can be seen that the damaged shape and size of the pia are due to several factors, including material, man, and method. One of the reasons for the improper shape and size of the pia is due to the material. This is because of the differences in the texture of the filling in each variant of pia flavor, which makes the shape and size of the pia not always the same. The texture of the variant flavors of Pia is as follows: the chocolate flavor variant has a soft and slightly sticky texture, while the mung beans, cheese, and durian flavor variants have a soft and fluffy texture. These differences can lead to difficulties in maintaining the shape and size of the pia consistently throughout the production process. The damage to the Pia during the molding process is caused by factors such as lack of precision in labor, resulting in inconsistent shapes and varying sizes of the Pia. The damage during the molding process is also due to method factors, where the size of the Pia circles is not appropriate. This is because the molding process is still manual, using hands. Additionally, the damage is also caused by uneven filling weights in the pia, as the filling is not weighed beforehand, leading to mismatched shapes and sizes of the pia.

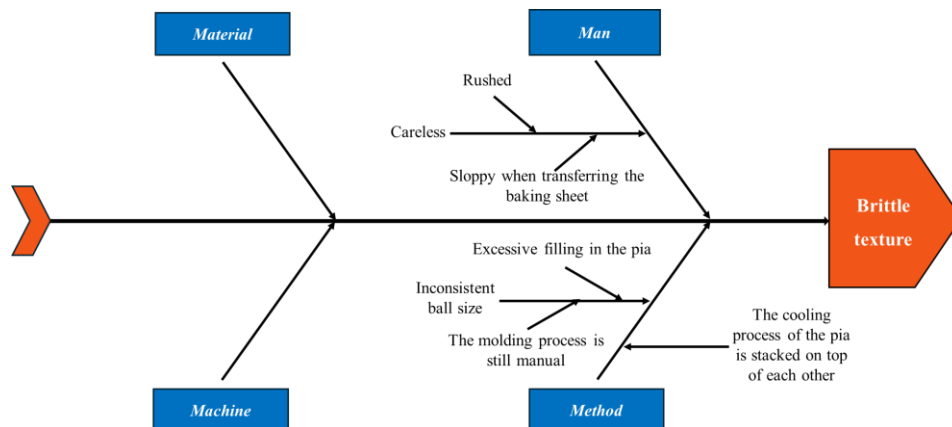


Fig. 3 Fishbone Diagram for Damaged Products with Brittle Texture

From Figure 3, it can be seen that the pia experiencing brittle texture damage is due to several factors including man and method. The careless man factor causes damage to the pia with a brittle texture. Employees being careless is due to them being rushed when removing the baking sheet from the oven. When removing and transferring the fully baked pia from the baking sheet to the cooling sheet, it is done sloppily, with the sheet being slammed down very hard, resulting in many brittle pia. The damage to pia with a brittle texture is also caused by them not being perfectly round according to the company's criteria, which is due to the molding process of pia still being done manually using hands. Excessive filling in the pia causes the pia crust to become thin, making the pia easy to break after baking. Additionally, during the cooling process, stacking the pia on top of each other causes them to become brittle and easily break.

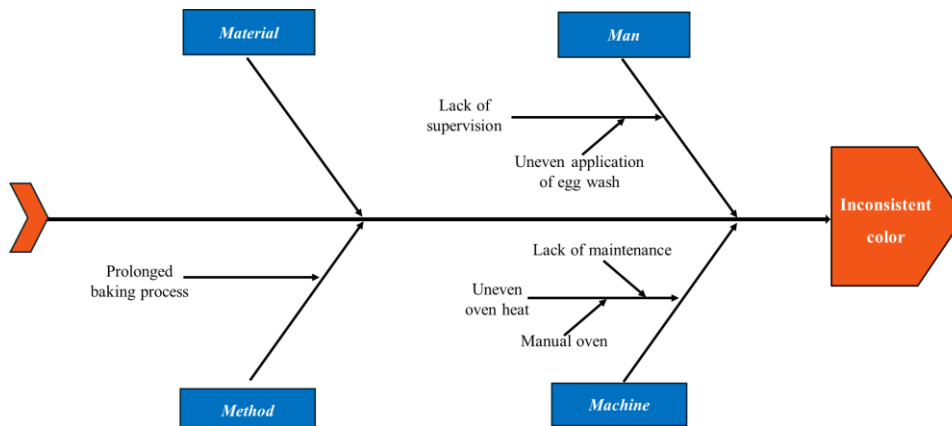


Fig. 4 Fishbone Diagram for Damaged Pia with Inconsistent Color

From Figure 4, it can be seen that the pia experiencing inconsistent color damage is due to several factors, including man, machine, and method. The man factor causes damage to the pia with inconsistent color. This occurs due to a lack of supervision during the pia baking process, especially during the uneven application of egg wash by employees, resulting in the inconsistent color of the pia after baking. Method factors, such as prolonged baking processes, also cause damage to pia products. This occurs due to a lack of supervision by employees regarding the proper timing for flipping the pia, leading to them being burnt. In addition to being influenced by man and production method factors, inconsistent pia color can also be caused by machine factors, especially the oven used in the production process. The company still uses a manual gas-fueled oven, which tends to generate heat unevenly. Lack of maintenance on the oven often leads to clogged fire pipes, resulting in oven heat instability and ultimately causing uneven pia color.

The results of the UD. Candika Purnama Company's pia production quality control operations still include data points beyond the control limits, as seen in the p-chart. Consequently, there has to be more spending and oversight. However, a quality cost analysis is required to determine whether the quality control measures are adequate. In order to obtain ideal quality costs, it is necessary first to estimate the amount of product faults. Then, the costs of quality control, quality assurance, and overall quality cost are calculated. The first expense is the cost of maintaining the manufacturing machinery, which includes IDR 150,000 per month for the stand mixer and IDR 900,000 every three months for the replacement of fire pipes in three ovens.

The expense of inspecting the manufacturing process comes next. In order to ensure high-quality products and a smooth manufacturing process, the corporation must pay for inspections (Sari and Purnawati, 2018) since the supervisor of the production department is responsible for conducting inspections at UD. Candika Purnama Company, the cost to the business of inspections amounts to the supervisor's wage, which is IDR 3,000,000 per month. In order to cover losses caused by damaged Pia goods, UD. Candika Purnama Company has to pay quality assurance fees. The cost price of the damaged Pia product, which is IDR 2,500 per Pia, is the amount the corporation uses to calculate the quality assurance cost per Pia that it produces. The inspection cost must be determined before the real quality cost can be determined. What goes into determining the cost of an inspection are:

a. The annual production quantity (R) is calculated as follows:

$$\begin{aligned} R &= 60,000 \times 12 \\ &= 720,000 \text{ pia units} \end{aligned}$$

b. The inspection officer's cost is IDR 3,000,000 every month, so the annual cost is:

$$\text{IDR } 3,000,000 \times 12 = \text{IDR } 36,000,000.$$

c. The annual machine maintenance cost is as follows:

$$\begin{aligned} \text{The maintenance cost for the stand mixer} &: \text{IDR } 150,000 \times 12 = \text{IDR } 1,800,000 \\ \text{The cost of replacing fire pipes in the oven} &: \text{IDR } 900,000 \times 4 = \text{IDR } 3,600,000 \\ \text{Therefore, the total machine maintenance cost for one year is} & \\ \text{IDR } 1,800,000 + \text{IDR } 3,600,000 &= \text{IDR } 5,400,000 \end{aligned}$$

d. On a daily basis, quality control operations are carried out. About 25 days make up a typical work month. Hence, quality control operations are carried out 300 times in a year, calculated as 25 times multiplied by 12. This leads us to the following computation of the testing cost (o):

$$\begin{aligned} o &= \frac{\text{IDR } 36,000,000 + \text{IDR } 5,400,000}{300} \\ &= \text{IDR } 138,000 \end{aligned}$$

A) Calculation of actual quality costs

Quality Control Costs (QCC) are:

$$\begin{aligned} \text{QCC} &= \frac{R \cdot o}{q} \\ &= \frac{720,000 \times \text{IDR } 138,000}{28,500} \\ &= \text{IDR } 3,486,315,789 \end{aligned}$$

Quality Assurance Costs (QAC) is:

$$\begin{aligned} \text{QAC} &= c \cdot q \\ &= \text{IDR } 2,500 \times 28,500 \\ &= \text{IDR } 71,250,000 \end{aligned}$$

Total Quality Costs (TQC) is:

$$\begin{aligned} \text{TQC} &= \text{QCC} + \text{QAC} \\ &= \text{IDR } 3,486,315,789 + \text{IDR } 71,250,000 \\ &= \text{IDR } 3,557,565,789 \end{aligned}$$

B) Calculation of optimum quality cost

Based on the calculation of quality control costs, the number of damaged pia that bear the minimum cost (q^*) can be determined as follows.

$$\begin{aligned} q^* &= \sqrt{\frac{R \cdot o}{c}} \\ &= \sqrt{\frac{720,000 \times \text{IDR } 138,000}{2500}} \\ &= 6,304,284 \text{ pia units} \end{aligned}$$

Therefore, the quality cost is generated by UD. Candika Purnama Company with the optimal number of damaged pia is as follows:

Quality Control Costs (QCC) are:

$$QCC^* = \frac{R.o}{q}$$

$$= \frac{720,000 \times \text{IDR } 138,000}{6,304,284}$$

$$= \text{IDR } 15,760,711,287$$

Quality Assurance Costs (QAC) is:

$$QAC^* = c.q$$

$$= \text{IDR } 2,500 \times 6,304.284$$

$$= \text{IDR } 15,760,710$$

Total Quality Costs (TQC) is:

$$TQC^* = QCC^* + QAC^*$$

$$= \text{IDR } 15,760,711,287 + \text{IDR } 15,760,710$$

$$= \text{IDR } 31,521,421,287$$

The calculation of the amount of damage and the costs of actual and optimal quality has been done. Next, a comparison of the actual quality costs incurred by the company with the optimal costs that should be incurred can be seen in Table 3.

Table 3: Comparison of Actual and Optimal Costs for Pia Candika Purnama Company

Indicator	Actual	Optimal	Difference
Number of Defects (units)	28,500	6,304,284	22,195,716
Quality Control Cost (IDR)	3,486,315,789	15,760,711,287	12,274,395,498
Quality Assurance Cost (IDR)	71,250,000	15,760,710	55,489,290
Total Quality Cost	74,736,315.789	31,521,421.287	43,214,894.502

Source: Processed Data, 2024

Based on Table 3 above, it can be observed that the optimal number of defects, which is 6,304,284 pia units, is smaller than the actual number of defects, which is 28,500 pia units. Additionally, the actual quality control cost of IDR 3,486,315,789 is lower than the optimal quality control cost of IDR 15,760,711,287. However, the total actual quality cost of IDR 74,736,315,789 is higher than the total optimal quality cost of IDR 31,521,421,287. This is because, compared to the ideal quality assurance cost of IDR 15,760,710, the real quality assurance cost of IDR 71,250,000 is higher. This suggests that the company's assurance of quality efforts is still not at its best.

Based on the data in Table 2, a graph can be created showing the total quality cost and the level of Pia product defects incurred by the company as follows:

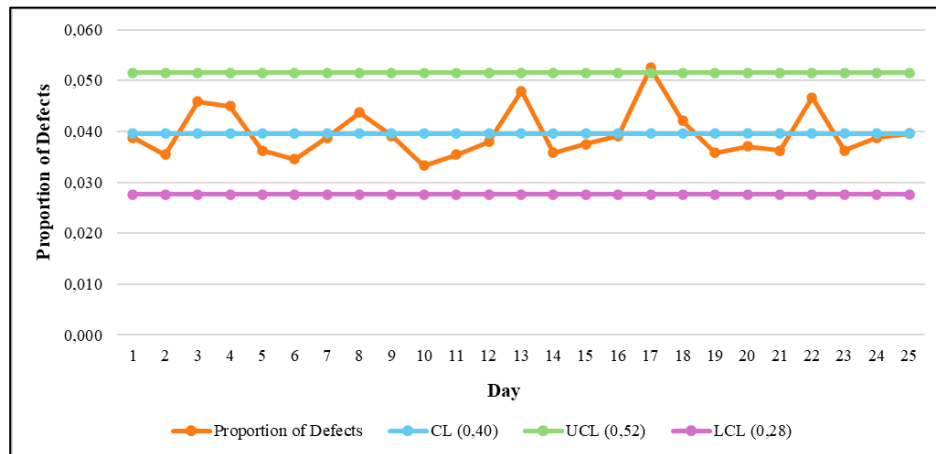


Fig. 5 Quality Cost of Pia Products at UD. Candika Purnama Company

Figure 5 above shows that during the year 2024, the number of defects in pia products at UD. Candika Purnama Company has 28,500 pia units. In maintaining its quality, the company has incurred the following costs: the quality control cost (QCC) amounts to IDR 3,486,315,789, and the quality assurance cost (QAC) is IDR 71,250,000, resulting in a total quality cost (TQC) of IDR 74,736,315,789. When compared with the quality cost at the optimal defect level of 6,304,284 pia units, where the optimal quality control cost (QCC*) is IDR 15,760,711,287, and the optimal quality assurance cost (QAC*) is IDR

15,760,710, the total optimal quality cost (TQC*) is IDR 31,521,421,287. Based on this cost analysis, it can be concluded that the quality control measures are still suboptimal because the actual total quality cost is higher than the optimal total quality cost for the company.

After identifying the causes of Pia product damage at UD. Candika Purnama Company, the next step is to propose general actions to reduce the level of product damage. The improvements that the company can implement to address the damage caused by the following factors are as follows:

a. Man

Provide regular guidance to employees on procedures and work instructions before the production process starts. Create and display rules and prohibitions in the production area to ensure employees are more disciplined and careful in their work. Tighten supervision during the pia production process in the company, both by supervisors and production employees. This will help ensure compliance with established work procedures and improve product quality.

b. Method

Use of tools or specific equipment such as molds and other shaping tools to help create consistent sizes and shapes of pia rounds. Use of accurate scales to weigh dough or filling accurately during the molding process; this can help ensure each dough or filling round has the same weight according to the established standard. Use of a digital timer with an audible alarm to help employees know the right time to flip the pia during the baking process to prevent them from burning.

c. Machine

Routine inspections of the oven are conducted to prevent unexpected damage and optimize machine performance. Consideration of using electric ovens could be beneficial for the company to generate even and consistent heat during the production process.

d. Material

Conduct research and development related to the raw materials used for the pia filling to improve the consistency of the filling texture. Determine the appropriate composition ratio between the raw materials mix for the pia filling to achieve the desired texture. Determine the processing method that suits the characteristics of the raw materials used to ensure consistency in the texture of the resulting pia filling.

V. CONCLUSION AND SUGGESTIONS

Based on the research findings, it can be deduced that UD. Candika Purnama Company's assurance of quality is still subpar because the degree of impairment is still outdoors the p-chart's boundaries of control, particularly at data point 17 where the value of 0.053 exceeds the Upper Control Limit (UCL). The analysis of the fishbone diagram shows several main factors causing damage to the pia products, including manpower, method, machine, and material factors. The analysis of quality costs in the year 2024 indicates that the actual product damage at UD. Candika Purnama Company amounts to 28,500 pia units, with Quality Control Costs (QCC) amounting to IDR 3,486,315,789 and Quality Assurance Costs (QAC) amounting to IDR 71,250,000, resulting in a Total Quality Cost (TQC) incurred by the company of IDR 74,736,315,789. Meanwhile, at the optimal damage limit of 6,304.284 pia units with quality control costs at the optimal point (QCC*) amounting to IDR 15,760,711,287 while the optimal Quality Assurance Costs (QAC*) amount to IDR 15,760,710, resulting in total optimal quality cost (TQC*) of IDR 31,521,421,287. From the analysis of these costs, it can be concluded that the quality control costs are still not optimal because the actual quality costs are higher than the company's optimal quality costs.

Based on the research findings, the suggestions that can be given to the company are as follows. Address products that experience shape and size discrepancies can be done by using tools such as molds and other shaping tools to help create consistent sizes and shapes of pia circles, using accurate scales to weigh the dough or pia fillings precisely, conducting research and development on the raw materials for the pia fillings, providing regular guidance to employees on procedures and work instructions. To address products that experience damage in terms of brittle texture can be done by implementing regulations and prohibitions in the production area to ensure employees are more disciplined and careful in their work and using tools such as molds and accurate scales to produce consistent pia shapes. To address products with mismatched colors, digital timers with audible alarms can be used, and ovens should be regularly checked to prevent unforeseen damages, considering the use of electric ovens and tightening supervision over production activities in the company. A suggestion to the company regarding damaged products during the production process is to offer damaged pia products at a lower price than the normal selling price. Additionally, it is important to ensure that customers are provided with clear information about the condition of the products they purchase to avoid dissatisfaction later on. This is also being done to reduce the quality assurance costs carried by the company.

V. REFERENCES

- [1] Andespa, I. (2020). Analisis Pengendalian Mutu Dengan Menggunakan Statistical Quality Control (Sqc) Pada Pt. Pratama Abadi Industri (Jx) Sukabumi. *E-Jurnal Ekonomi dan Bisnis Universitas Udayana*, 2, 129.
- [2] Assauri, S. (2016). *Manajemen Operasi Produksi Pencapaian Sasaran Organisasi Berkesinambungan*. Edisi 3. Jakarta: PT Raja Grafindo Persada.

- [3] Audina, J. C., Fadiryani, F., & Pawellangi, S. A. R. (2020). Analysis Quality Control of UMKM Tiga Bintang Snack Stick Product Using Statistical Quality Control (SQC). *Natural Science: Journal of Science and Technology*, 9(3), 67–72.
- [4] Candrawati, A. A. D., & Nurcaya, I. N. (2020). Analisis Pengendalian Kualitas Produk Telur Asin Pada Ud. Sari Luwih Di Desa Padang Luwih. *E-Jurnal Manajemen Universitas Udayana*, 9(6), 2332.
- [5] Darmawan, M. R., Rizqi, A. W., & Kurniawan, M. D. (2022). Analisis Pengendalian Kualitas Produk Tempe Dengan Metode Statistical Quality Control (SQC) Di CV. Aderina. *SITEKIN: Sains, Teknologi dan Industri*, 19(22), 295–300.
- [6] Fuentes, G. B., Sevilla, E. S., Tabacon, M. G., Lagamon, R. T., & Namoco, C. S. (2023). Utilizing Statistical Quality Control (Sqc) Tools For Analyzing Defects In A Small-Scale Local Shoes Production Company. *Sci.Int. (Lahore)*, 2023, 35 (5), pp.639-642.
- [7] Ginting, R., & Supriadi, S. (2021). Defect analysis on PVC pipe using Statistical Quality Control (SQC) approach to reduce defects (Case Study: PT. XYZ). *IOP Conference Series: Materials Science and Engineering*, 1041(1), 012040.
- [8] Heizer, Jay and Barry Render. 2015. *Operations Management (Manajemen Operasi)*. Jakarta: Salemba Empat.
- [9] Ishak, A., Siregar, K., Ginting, R., & Manik, A. (2020). Analysis Roofing Quality Control Using Statistical Quality Control (SQC) (Case Study: XYZ Company). *IOP Conference Series: Materials Science and Engineering*, 1003(1).
- [10] Kotler, P. and Keller, Kevin L. 2016: *Marketing Management*. 15th Edition. New Jersey: Pearson Pretice Hall, Inc.
- [11] Kurniawan, F., & Azizah, F. N. (2022). Usulan Pengendalian Kualitas Berdasarkan Analisis Menggunakan Metode Statistical Quality Control pada Produksi Telur Puyuh Proposed Quality Control Based on Analysis Using Statistical Quality Control Method on Quail Egg Production. *Rekayasa Sistem Dan Industri*, 9(1), 21–27.
- [12] Maulida Arianti, S., Rahmawati, E., & Yulianti Prihatiningrum, R. (2020). Product Quality Control Analysis Using Statistical Quality Control (Sqc) on Marine Works in Business Amplang Samarinda. *International Journal of Management, Innovation & Entrepreneurial Research*, 6(1), 70–77.
- [13] Meldayanoor, R. Amalia, R., & Ramadhani, M. (2018). Analisis Statistical Quality Control (SQC) Sebagai Pengendalian dan Perbaikan Kualitas Produk Tortilla di UD. Noor Dina Group. *JURNAL TEKNOLOGI AGRO-INDUSTRI*, 5(2), 132–140.
- [14] Montgomery, D. C. (2013). *Introduction to Statistical Quality Control (Seventh Edition)*. John Wiley & Sons, Inc.
- [15] Montgomery, D. C. (2013). *Introduction to Statistical Quality Control (Seventh Edition)*. John Wiley & Sons, Inc.
- [16] Nasution, N. (2015). *Manajemen Mutu Terpadu (Total Quality Management) (Edisi Ketiga)*. Bogor: Ghalia Indonesia.
- [17] Panjaitan, M. A., Suryantini, A., & Jamhari, J. (2019). Quality Control of Raw Materials for Candied Carica Using P-Chart Analysis and Fishbone Diagram. *Jurnal Aplikasi Manajemen*, 17(3), 416–425.
- [18] Ramadan, Y. R., Bambang, E., Desia, E., & Fadah, I. (2018). Analysis of quality control of rice seed products with the introduction of sqc model (Statistical Quality Control at ud. mayang srie-mayang jember district). *International Journal of Scientific and Technology Research*, 7(5), 199–202.
- [19] Riadi, D., & Azwar, A. G. (2021). Base Single Part Product Quality Control Using Statistical Quality Control (Sqc) Method in Pt Dirgantara Indonesia Machining Department. *Prosiding Seminar Sosial Politik, Bisnis, Akuntansi Dan Teknik (SoBAT)*, 506–516.
- [20] Rifan, M., & Jufriyanto, M. (2023). Analysis Quality Control In Rice Packing Projects To Reduce Defects Using Methods Statistical Quality Control (SQC). 20(2), 800–808.
- [21] Rochmoeljati, R., Nugraha, I., Artha, N., & Mulia, C. (2022). Welding Quality Control Using Statistical Quality Control (SQC) Methods and Failure Mode Effect Analysis (FMEA) at PT. XYZ. 2022, 39–45.
- [22] Rucitra, A. L., & Amna, A. U. F. (2021). Integration of Statistical Quality Control (SQC) and Fault Tree Analysis (FTA) in the quality control of resina colophonium production in Company X. *IOP Conference Series: Earth and Environmental Science*, 924(1).
- [23] Sari, N. K. R., & Purnawati, N. K. (2018). Analisis Pengendalian Kualitas Proses Produksi Pie Susu pada Perusahaan Pie Susu Barong di Kota Denpasar. *E-Jurnal Manajemen Unud*, 7(3), 1566–1594.
- [24] Suparno, S., & Narto, N. (2022). Analisis Kualitas pada Produksi Tahu menggunakan Metode Statistical Quality Control (SQC). *Jurnal Optimalisasi*, 8(2), 139.
- [25] Yamit, Z. (2018). *Manajemen Kualitas Produk & Jasa*. Yogyakarta: EKONESIA.