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Quality Control Analysis Using the Seven Quality Control Tools in the Production Process of Crinkle Culotte Pants at CV Damar Konveksi

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Abstract: The garment manufacturing industry in Indonesia faces challenges in maintaining product quality, particularly in the production of crinkle culotte pants at CV Damar Konveksi. Product defects, especially in the sewing and finishing stages, have resulted in lower quality and production efficiency. **Objective:** This study aims to analyze and improve quality control in the production process of crinkle culotte pants at CV Damar Konveksi, identifying dominant defects and their causes to recommend corrective actions. **Methodology**: A quantitative approach was used, collecting primary data from direct observations and secondary data from internal records. Data were analyzed using check sheets, scatter diagrams, control charts, Pareto diagrams, and fishbone diagrams to identify defect types, frequencies, and root causes. **Findings:** Out of 450 units produced, 21 were defective (4.6% of total production). The Pareto diagram revealed that asymmetrical stitching and excessive sewing threads accounted for 71.4% of the defects. Control chart analysis showed the process remained within control limits, though significant quality fluctuations occurred across periods. The fishbone diagram identified human factors, suboptimal work methods, and poor machine conditions as the main causes of defects. **Implications**: The study recommends implementing operator training, regular machine maintenance, better enforcement of standard operating procedures, and enhancing the quality inspection system to reduce defects and improve production efficiency. **Originality**: This research provides valuable insights into quality control within garment manufacturing, offering a practical framework for improving product quality and operational efficiency. The use of the Seven Quality Control Tools in CV Damar Konveksi adds originality by providing actionable recommendations for similar manufacturing environments.

Keywords: Crinkle Culotte Pants, Konveksi, Production defects, Quality control, Seven quality tools

INTRODUCTION

The garment manufacturing industry is one of the industrial sectors that continues to grow in Indonesia, in line with the increasing demand for fashion products. Intense competition requires every garment manufacturer to produce products with consistent quality and to meet consumer expectations (Kim et al., 2020; Revita et al., 2021). In practice, product quality deterioration often occurs due to inadequate production supervision, resulting in products that do not meet established quality standards (Hoque & Maalouf, 2022; Umar et al., 2025). One of the garment manufacturers experiencing this issue is CV Damar Konveksi.

CV Damar Konveksi is a garment manufacturing company that faces various challenges in maintaining consistent product quality. One of its main products is crinkle culotte pants. Crinkle culotte pants are currently in high demand due to their comfortable design, flexibility, and alignment with prevailing fashion trends (Safitri, 2025). In the production process, this product goes through several stages, including material cutting, sewing, and finishing (Maharani & Hidayati, 2020). Each of these stages has the potential to generate product defects if the process is not properly controlled (Athallah et al., 2023). Therefore, CV Damar Konveksi needs to implement a systematic quality control method to minimize production defects and improve operational efficiency.

The quality control method applied in this study is the Seven Quality Control Tools. The Seven Quality Control Tools consist of seven widely used techniques in manufacturing industries to identify, analyze, and control quality-related problems (Radianza & Mashabai, 2020). The tools employed include check sheets, histograms, Pareto diagrams, fishbone diagrams, scatter diagrams, control charts and stratification. The application of these quality tools in the production process of crinkle culotte pants is expected to help CV Damar Konveksi identify errors at each stage of the production process and provide a basis for continuous improvement.

Previous research conducted by Wiyono and Khotimah demonstrated that the comprehensive implementation of quality control at the production stage was able to improve product quality and reduce defect rates in the garment industry (Wiyono & Khotimah, 2024) . Furthermore, a study by Prasetyo showed that the application of Statistical Process Control (SPC) could identify variations in production processes and determine dominant defect types, which can be used as a basis for managerial decision-making to minimize defective products in garment manufacturing (Prasetyo et al., 2024). These findings indicate that the implementation of quality control is effective in improving garment product quality, reducing defect levels, and supporting management decision-making. By conducting a quality control analysis using the Seven Quality Control Tools, this study aims to identify the dominant types of defects, analyze the main factors causing these defects, and provide improvement recommendations for CV Damar Konveksi

RESEARCH METHOD

The research process was structured into several stages to ensure a systematic approach in addressing the research objectives. Each stage is designed to build upon the previous one, creating a cohesive framework for analyzing and improving the production process of crinkle culotte pants at CV Damar Konveksi. The stages outlined in this study are illustrated in Figure 1, providing a visual representation of the research workflow. These stages encompass problem identification, data collection, data processing, analysis, and the formulation of conclusions, all aimed at evaluating and enhancing the effectiveness of quality control measures in garment production. This section will detail each stage of the research process, describing the methods and tools used to achieve the study's goals.

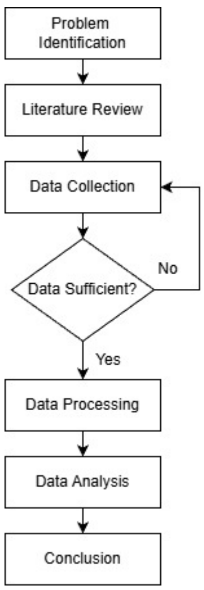

Figure 1. Research Stage

This research focuses on the production process of crinkle culotte pants at CV Damar Konveksi, a garment manufacturing company located in Kalisari, East Jakarta. The unit of analysis in this study is the production process and product defects that occur during the production of crinkle culotte pants. The defects identified include asymmetrical stitching, excess sewing thread, stains, and tears. The primary objective of this study is to analyze and control product defects using the Seven Quality Control Tools to improve product quality.

A quantitative research design with a descriptive analysis approach was adopted. The method was chosen because the main goal of the research is to identify and analyze product defects through the collection of numerical data obtained from observations made during production. This design allows for the measurement of defect prevalence and analysis of variability in the production process, which can be linked to the quality control tools used. The quantitative approach aims to produce data that can be analyzed statistically, providing objective insights into the factors influencing product quality at CV Damar Konveksi.

The data used in this research consists of primary and secondary data. Primary data was collected from production records, including the number of products produced, the quantity of defects found, and the types of defects detected during direct observations at CV Damar Konveksi. Secondary data was obtained from standard operating procedure (SOP) documents related to garment manufacturing, as well as information regarding product specifications and quality regulations applied by the company. This data provides a foundational understanding of the production flow and quality guidelines followed by the company.

Data collection was carried out through direct observation of the crinkle culotte pants production process at CV Damar Konveksi. Observations were conducted over six production periods from June to July. A check sheet was used to record the total production and defect types identified during each observation period. Additionally, data collection was conducted through semi-structured interviews with production workers to gain insights into the challenges they face during production and their understanding of product quality. Additional data was gathered from the company's internal documents, such as production reports and recorded quality assessments.

The collected data was analyzed using the Seven Quality Control Tools to identify, analyze, and control product quality. The analysis began with the use of a Pareto diagram to identify the most dominant defect types in production. Stratification was applied to analyze defects based on different production stages such as cutting, sewing, and finishing. Fishbone diagrams were used to identify root causes of defects, and scatter diagrams and histograms were employed to examine the relationship between total production and defect rates. Finally, p-charts were used to monitor the proportion of defects in each period and assess whether the production process is statistically in control. All analyses were conducted using statistical software to ensure accurate and reliable results.

RESULT AND DISCUSSION

In the Results and Discussion section, data collection, data processing, and data analysis are conducted on the production of crinkle culotte pants at CV Damar Konveksi. The method employed in this study is the seven quality control tools, which consist of check sheets, stratification, histogram, scatter diagram, control charts, pareto diagrams, and fishbone diagrams.

Production Process of Crinkle Calotte Pants

The production process of crinkle culotte pants at CV Damar Konveksi is carried out through several stages, starting from raw material receiving, temporary storage, fabric cutting, component grouping, sewing, waistband elastic installation, pleating process, quality inspection, and finally finishing and packaging. The overall production flow is illustrated in Figure 2.

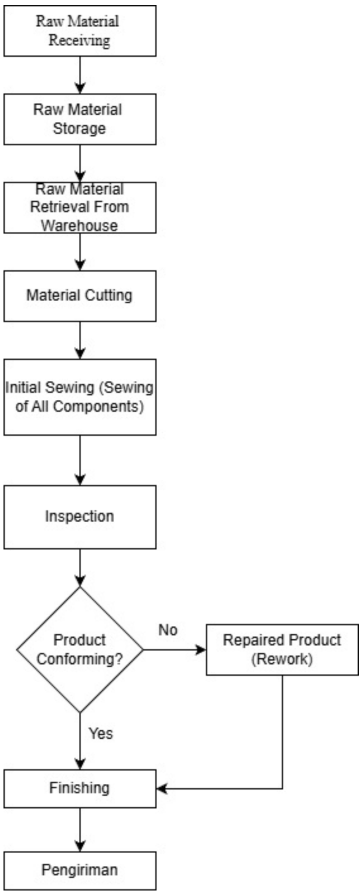

Figure 2. Production Process Flowchart

Production Data and Defect Rate

Production data were obtained from records of production output and defect quantities using check sheets completed by the researcher during observations at CV Damar Konveksi (Malandri et al., 2025). The check sheet presented in Table 1 shows total production and number of defects per period. Observations were conducted over six periods from June to July. Based on these observations, total production reached 450 units with 21 defective units, indicating that 4.6% of the total production was defective.

Table 1. Check Sheet of Crinkle Cullote Pants

Period	Data Collection Time	Total Production	Defect Type				Number of Defects	Defect Percentage (%)
			Stain	Tear	Asymmetrical Stitching	Excess Sewing Thread		
1	16 June- 21 June	100	0	2	3	3	8	8.0%
2	23 June - 28 June	100	0	0	1	1	2	2.0%
3	30 June - 5 July	80	0	0	1	1	2	2.5%
4	7 July - 12 July	50	0	2	1	0	3	6.0%
5	14 July - 19 July	100	1	0	2	2	5	5%
6	21 July - 26 July	20	0	1	0	0	1	5%

Startification

Stratification was applied to further analyze the two dominant defects identified in the Pareto diagram, namely asymmetrical stitching and excess sewing thread. Unlike Pareto analysis, which prioritizes defect types based on frequency, stratification was used to classify these dominant defects according to production process characteristics in order to identify the specific stages where defects are most concentrated.

Table 2. Stratification of Defects Based on Production Stage

Production Stage	Asymetrical Stiching	Excess Sewing Thread	Total
Cutting	0	0	0
Sewing	8	7	15
Finishing	0	0	0

Based on Table 2, The stratification results indicate that both dominant defects are exclusively concentrated in the sewing process. No occurrences of asymmetrical stitching or excess sewing thread defects were identified during the cutting or finishing stages. This finding demonstrates that quality problems are not evenly distributed across the production process, but are highly localized in the sewing stage. Based on these results, further root cause analysis was focused on the sewing process using fishbone diagrams to identify contributing factors related to operators, machines, work methods, materials, and the working environment.

Histogram

Histogram is one of the seven quality control tools used to present the frequency distribution of data in order to observe distribution patterns and process variation. In this study, the histogram is employed to analyze the distribution of total production of crinkle culotte pants at CV Damar Konveksi as a basis for evaluating the stability of the production process.

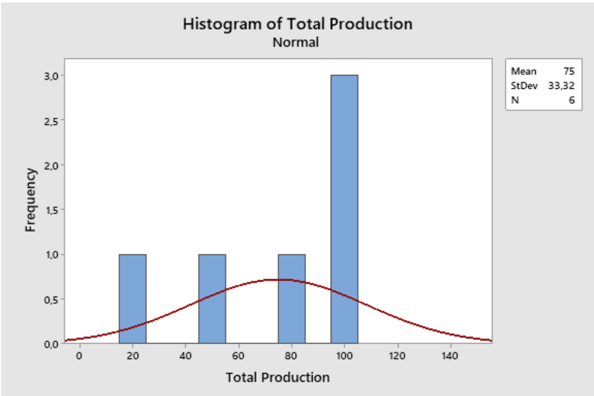

Figure 3. Histogram of Total Production

The Total Production histogram in Figure 3 illustrates the distribution of production data based on six observations, with production values ranging from approximately 20 to 100 units. The average production is 75, with a standard deviation of 33.2, indicating variability in production levels across periods. Most observations are concentrated in the medium to high production range, particularly between 70 and 100 units, while only a small number of observations fall below 50 units. This suggests that total production tends to cluster around certain values, with a noticeable difference between the lowest and highest production levels.

Scatter Diagram

Scatter diagram is one of the seven quality control tools used to analyze the relationship between two variables and to identify patterns or trends occurring within a production process (Nursyamsi & Momon, 2022). In this study, the scatter diagram is applied to examine the relationship between total production and the number of defects, with the aim of determining whether changes in production volume affect the level of defects.

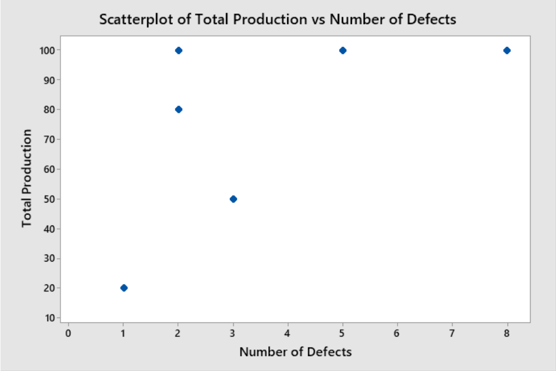

Figure 4. Scatter Diagram

Based on the results presented in Figure 4, there is an indication of a positive relationship between total production and the number of defects, although the observed pattern is relatively weak. The Pearson correlation coefficient was subsequently calculated to determine the strength of the relationship between the two variables. The analysis was conducted using six observations (n = 6) with a significance level of 5%.

$$r = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{(n\sum X^2 - (\sum X)^2)(n\sum Y^2 - (\sum Y)^2)}} = \frac{6(1830) - (21)(450)}{\sqrt{(6(107) - 21^2)(6(39300) - 450^2)}} = 0{,}591$$

Based on the calculations performed, the Pearson correlation coefficient was found to be 0.591, indicating a moderate positive relationship between the two variables. This result is consistent with the p-value obtained, which is 0.22. Since the p-value is greater than the significance level (0.22 > 0.05), the relationship between the number of defects and total production is not statistically significant. This implies that, although a positive tendency is observed based on the scatter plot and the Pearson correlation coefficient, the relationship is not statistically significant. Therefore, the number of defects is not solely influenced by total production but is also affected by other factors, such as operators, machines, work methods, and materials.

Control Chart

Control charts are used to monitor, control, and evaluate the stability of the production process of crinkle culotte pants at CV Damar Konveksi by comparing variations in product quality against the established upper control limit and lower control limit (Hartono et al., 2025). P-chart was used to monitor the proportion of defective items. Although the sample size varied across observation periods, constant control limits were applied by using the average sample size.

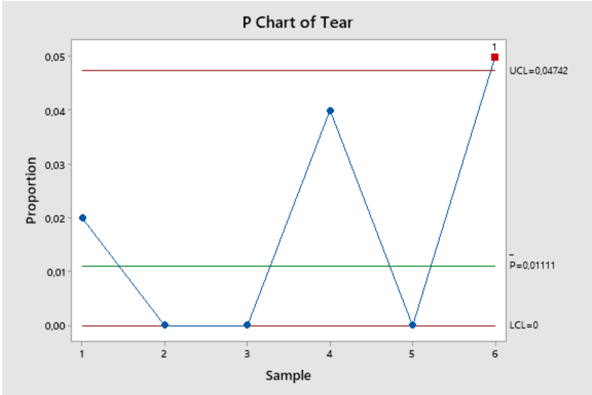

Figure 5. Control Chart of Tear Defects

In order to assess whether the production process is statistically under control, the average proportion, the upper control limit (UCL), and the lower control limit (LCL) must be determined.

$$\bar{n} = \frac{\sum n}{k} = \frac{450}{6} = 75$$

$$\bar{p} = \frac{\sum d}{\sum n} = \frac{5}{450} = 0{,}0111$$

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0{,}0111 + 3\sqrt{\frac{0{,}0111(1-0{,}0111)}{75}} = 0{,}04742$$

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0{,}0111 - 3\sqrt{\frac{0{,}0111(1-0{,}0111)}{75}} = -0{,}0252 \sim 0$$

Based on the calculations, the average proportion of tear defects is 0.01111, with an upper control limit (UCL) of 0.04742 and a lower control limit (LCL) of 0. Since the total production varies across periods, the average production quantity was used in the calculations. Furthermore, the LCL was set to 0 because the calculated value was −0.0252, which falls below the allowable lower limit in a proportion scale. Therefore, the LCL value used in this study is 0. Based on the control chart shown in Figure 5, most data points in the p-chart are within the control limits; however, one point exceeds the upper control limit (UCL). This condition indicates the occurrence of a special cause variation during that period. Consequently, further analysis is required to identify the factors contributing to the increase in tear defects, which can then serve as a basis for determining appropriate corrective actions in the production process.

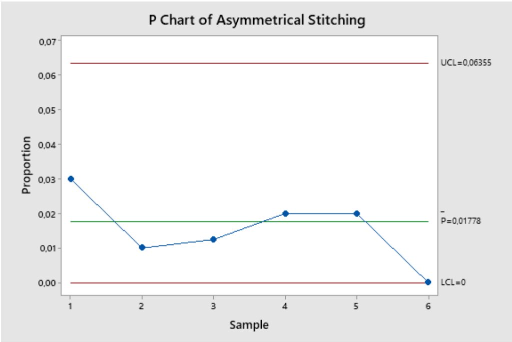

Figure 6. Control Chart of Asymmetrical Stitching Defects

$$\bar{p} = \frac{\sum d}{\sum n} = \frac{8}{450} = 0{,}01778$$

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0{,}01778 + 3\sqrt{\frac{0{,}01778(1-0{,}01778)}{75}} = 0{,}06355$$

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0{,}01778 - 3\sqrt{\frac{0{,}01778(1-0{,}01778)}{75}} = -0{,}0281 \sim 0$$

Based on the results shown in Figure 6, the average proportion of asymmetrical stitching defects is $\bar{P} = 0.01778$, with an upper control limit (UCL) of 0.06355 and a lower control limit (LCL) of 0. All observation points from samples 1 to 6 fall within the control limits, indicating that, statistically, there is no evidence that the process is out of control.

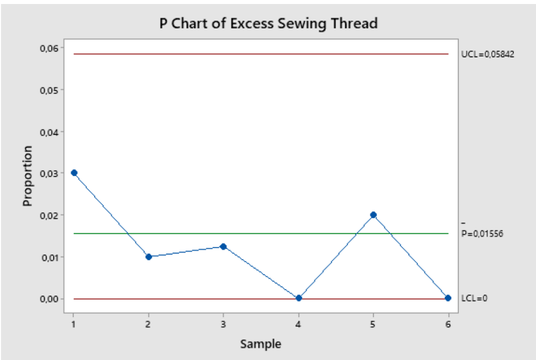

Figure 7. Control Chart of Excess Sewing Thread Defects

$$\bar{p} = \frac{\sum d}{\sum n} = \frac{7}{450} = 0{,}01556$$

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0{,}01556 + 3\sqrt{\frac{0{,}01556(1-0{,}01556)}{75}} = 0{,}05846$$

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}(1-\bar{p})}{\bar{n}}} = 0{,}01556 - 3\sqrt{\frac{0{,}01556(1-0{,}01556)}{75}} = -0{,}02734 \sim 0$$

Based on the results shown in Figure 7, the average proportion of excess sewing thread defects is $\bar{P} = 0.01556$, with an upper control limit (UCL) of 0.05842 and a lower control limit (LCL) of 0. All observation points from samples 1 to 6 fall within the control limits, indicating that, statistically, there is no evidence of process deviation or out-of-control conditions. Although fluctuations in defect proportions across samples are observed, including zero values in the fourth and sixth samples, these variations are still classified as natural process variation (common cause variation).

Overall, the three control charts indicate that the production process remains under control. Although most observation points fall within the control limits, there are certain defect types that require corrective actions

Pareto Diagram

The Pareto diagram presented in Figure 8 shows the priority of quality problems based on the percentage contribution of defects (Wardhani et al., 2024).

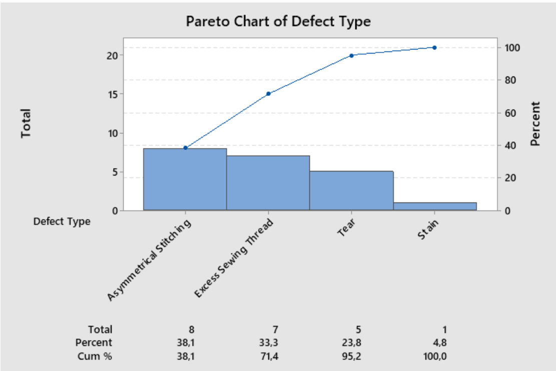

Figure 8. Pareto Diagram

Based on Figure 8, two dominant defects fall within the Pareto principle, namely asymmetrical stitching at 38.1 percent and excess sewing thread at 33.3 percent, with a combined contribution of 71.4 percent of the total defect percentage. Improvement efforts can therefore be focused on these dominant defect types.

Fishbone Diagram

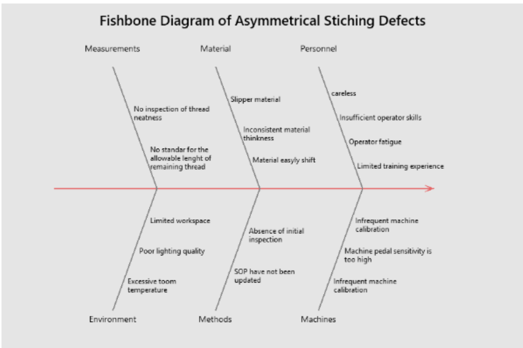

Figure 9. Fishbone Diagram of Asymmetrical Stitching Defects

Based on Figure 9, the fishbone diagram illustrates the causes of asymmetrical stitching defects in the production process. The analysis was conducted by considering six factors, namely man or operator, method, material or fabric quality, machine, measurement, and environment (Eviyanti, 2021). Based on these factors, it is evident that the man or operator factor has the most significant influence on the occurrence of asymmetrical stitching defects. This finding is further supported by the suboptimal implementation of work methods and the poor condition of sewing machines.

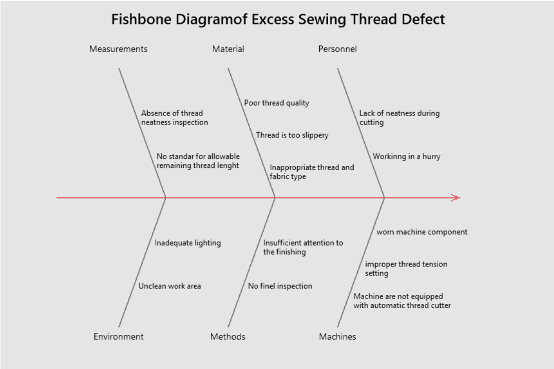

Figure 10. Fishbone Diagram of Excess Sewing Thread Defects

Based on Figure 10, the fishbone diagram presents the causes of excess sewing thread defects in the production process. The analysis was conducted by considering six factors, namely man or operator, method, material or fabric quality, machine, measurement, and environment (Kurnia & Nasarudin, 2023). Based on these factors, it was found that the man or operator factor has the most significant influence on the occurrence of excess sewing thread defects. This finding is further supported by the suboptimal implementation of work methods and the poor condition of sewing machines.

Based on the overall results of the seven quality control tools, a comparative discussion with previous studies is presented to contextualize the findings of this research within the garment manufacturing industry. The findings of this study indicate that asymmetrical stitching and excess sewing thread are the dominant defects in the production of crinkle culotte pants at CV Damar Konveksi. This result is consistent with previous studies in the garment industry, which report that sewing related defects are among the most frequent quality problems due to their high dependency on manual operations and operator skills (Prasetyo et al., 2024; Wiyono & Khotimah, 2024). Similar results were also reported by (Malandri et al., 2025), who found that defects originating from sewing processes contributed the largest proportion of total defects in garment manufacturing. These similarities suggest that sewing operations remain a critical control point in garment production, particularly in small- to medium-scale enterprises.

Furthermore, the fishbone diagram analysis reveals that human factors are the primary contributors to quality defects, supported by machine conditions and non-compliance with work methods. This finding aligns with studies by (Hoque & Maalouf, 2022), which emphasize the significant role of operator competence and machine reliability in determining garment product quality. Antony (Antony et al., 2023) also highlight that human-related factors are frequently identified as dominant causes in quality control studies using the Seven Quality Control Tools. Therefore, the results of this study reinforce existing empirical evidence that improvements in operator training, machine maintenance, and standard operating procedure enforcement are essential to reducing defect rates in garment manufacturing.

CONCLUSION

Overall, the research findings indicate that quality problems in the production of crinkle culotte pants at CV Damar Konveksi are primarily concentrated in the sewing process. This process represents a critical stage in the production of crinkle culotte pants. Based on the results of the Pareto diagram, two major defect types, namely asymmetrical stitching and excess sewing thread, account for 71.4% of the total defects. Although the control chart results indicate that the process is statistically under control, significant quality fluctuations were observed across different periods. These fluctuations suggest that the process has not yet reached a stable condition, indicating that quality control has not been optimally implemented.

Furthermore, the fishbone diagram analysis reveals that the root causes of defects are associated with operator skill levels, machine conditions, non-compliance with work methods, and raw material quality. Therefore, improvement efforts are necessary. Recommended corrective actions include providing training for sewing operators, conducting regular machine calibration and maintenance, consistently enforcing standard operating procedures, and enhancing quality inspection systems at critical stages of the production process.

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