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Analysis of quality control in clothing production using SQC (Statistical Quality Control) and 5W+1H methods

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ABSTRACT

CV Tujuh Pusaka Tala is a start-up company engaged in the clothing and sports jersey convection industry, as well as marching band musical instruments known by the brands 7MJR Store for clothing and SevenMajor for marching band musical instruments. This study was conducted to analyze the quality control of clothing production at CV. Tujuh Pusaka Tala using the Statistical Quality Control (SQC) method and the 5W and 1H approach to minimize defective products. The SQC methods used include Checksheet, Control Map, Histogram, Pareto Diagram and Cause and Effect Diagram to identify and control variability in the production process. While the 5W and 1H approach is applied to understand the main causes of product defects and find the right solution. The results of the study showed that there were 4 types of defects in the production process at CV. Tujuh Pusaka Tala, namely printing defects, screen printing defects, stitching, and material defects. The main factors causing production defects include humans, materials, machines, methods, and the environment. It can be concluded that the quality control of clothing production at CV. Tujuh Pusaka Tala using the Statistical Quality Control (SQC) method and the 5W and 1H approach to minimize defective products has been implemented well so that it can minimize the existence of defective products.

Keywords : Quality control; Statistical quality control; 5W+1H; Defects; Product; Clothing

1. INTRODUCTION

The textile industry sector in this day and age is increasing rapidly and is growing due to the increasing number of consumer demands from within and outside the country. Because of the progress and development of the textile industry sector, this is one of the factors for the number of businesses engaged in the convection industry (Fauziah, 2022).

QC or Quality Control is a series of activities that must be carried out by the company in producing a product which is carried out by carefully monitoring all stages of the production process, starting from the selection of raw materials, materials in the process (Walujo et al., 2020). Therefore, in order to prevent goods that are not in accordance with company standards (second quality) from continuing and to be able to control, select, assess quality, the application of the QC process must be applied so that consumers are satisfied with the results obtained and the company does not lose money (Wicaksana, 2019).

Quality control activities according to are a very broad and complex field because they can affect product quality (Nurkholiq et al., 2019). Therefore, quality control is divided into three parts, quality control of raw materials, where raw materials must have specifications set by the company; Control in the production process, where this control is expected to minimize failures in the production stage. And quality control of the final product, where this control focuses on the final result of the product to be marketed (Chusminah et al., 2019).

Quality control at PT Tujuh Pustaka Tala still needs improvement due to the large number of defective products found in each production.

Table 1. Production Defect Data

Observation	Population	Total Defect	Observation	Population	Total Defect
Week 1	800	75	Week 13	800	1675
Week 2	800	88	Week 14	800	1688
Week 3	800	37	Week 15	800	1637
Week 4	800	39	Week 16	800	1639
Week 5	800	21	Week 17	800	1621
Week 6	800	63	Week 18	800	1663
Week 7	800	26	Week 19	800	1626
Week 8	800	22	Week 20	800	1622
Week 9	800	35	Week 21	800	1635
Week 10	800	25	Week 22	800	1625
Week 11	800	26	Week 23	800	1626
Week 12	800	10	Week 24	800	1610

The figure above is data on the total production defects of the types of defects in the form of screen printing, printing, stitching, and material defects. From the data it is known that the percentage of defects produced is 4.9% while the tolerance given by the company is usually only 3% for defective products, because if the defective product exceeds the predetermined tolerance limit, it will have an impact on consumers or the company.

This research was conducted at the location of Jalan Babakansari 1 No. 70, Babakansari Village, Kiara condong District, Bandung City, West Java 40283. The research was conducted from April 2024 to June 2024.

CV Tujuh Pusaka Tala is a startup company in the t-shirt and sports jersey clothing convection industry, as well as marching band instruments. Known by the brand 7MJR Store for clothing and Seven Major for marching band instruments, this company has been operating for approximately 10 years. With a commitment to quality, innovation, and excellent service, CV Tujuh Pusaka Tala continues to strive to be a leader in the t-shirt and sports jersey clothing convection industry, as well

as marching band instruments. To maintain good product quality, the company needs to maintain and improve the Quality Control process from raw materials to finished materials.

Previous research states that quality is an important factor in a company, especially in the production sector (Lintong & Tinangon, 2014). In the Al-Faritsy & Aprilian (2022) study, the defects were untidy stitching, moldy fabric and sewn zippers with the highest percentage of defects being untidy stitching at 58.9%, sewn zippers at 24.1% and moldy fabric at 17%. Product defects are often caused by humans who are negligent in their duties, lack of knowledge and expertise. In addition, machines are also affected by lack of maintenance and unsustainable repairs, methods, materials and the environment (Wirawati, 2019).

Based on several previous research explanations, this study was conducted to analyze the quality control of clothing production at CV. Tujuh Pusaka Tala.

2. METHOD

In research conducted at CV Tujuh Pustaka Tala, using quantitative and qualitative research methods. Quantitative data is data in the form of numbers regarding the amount of production and the number of defects (Schierjott et al., 2019; Sharifi et al., 2018). Qualitative data is data in the form of information about the types of defective products and the causes of defective products (Arikunto, 2021).

At this stage, several problems faced by the company were obtained, namely a high number of product defects and failures (Realyvásquez-Vargas et al., 2018). Furthermore, identification of the causes of failure was carried out. Based on the identification that has been carried out, the method used to solve the problems in the company is to use the Statistical Quality Control method and 5W + 1H. The steps in using the SQC method are:

1. *Chechk sheet*

Organize the production data provided by the company into a table according to the type and total number of defects using microsoft word or excel with the aim of simplifying the data analysis collection process and assisting in determining whether improvements are needed or not.

2. Pareto Diagrams

Make a graph with a pareto diagram by entering data on various types of production defects in the form of a table into Microsoft excel and then making a pareto diagram to find out the most dominant type of defect with a value of more than 80% of defects in production results.

3. Control Chart

Calculating the Percentage of defects

$p = \frac{x}{n}$ …… (1)

Desc:

x : Product population

n : Total defects

Calculating *Central Line* (CL)

$\text{CL} = \bar{p} = \frac{\sum np}{n}$ ……(2)

Desc:

$\bar{p}$: average product damage

$\sum np$: Number of product defects

$\sum n$: Total production quantity

Calculating the *Upper Control Limit* (UCL)

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

Description:

$\bar{p}$: average product defect

n : Production quantity

Calculating the Lower Control Limit (LCL)

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}\ (1-\bar{p}\ )}{n}} \quad \text{..... (4)}$$

Desc:

$\bar{p}$: Avarage defect p.

4. *Fishbone* (Cause and Effect Diagram)

A cause and effect diagram shows the relationship between the problem at hand and its possible causes and influencing factors.

5. 5W+1H

These stages include What, which is asking what defects arise in the product defect, Why, which is asking why the defect can occur, Who, which is asking who is responsible for the screen printing defect process, When, which is asking when the defect occurs, Where to ask where the defect occurs, How, which is asking how the proposed improvements so that the product defect can be reduced (Im et al., 2017).

3. RESULTS AND DISCUSSION

3.1 RESULT

3.1.1 Types of Defects at CV Tujuh Pusaka Tala.

There are 4 types of defective products found at CV Tujuh Pusaka Tala including:

1) Printing defects

Figure 1. Printing Defect

Printing defects are problems that occur when printing or transferring a sample design on a jersey, which can be color deficiencies, imperfections in the print or material damage to the image transferred to the jersey.

2) Screen Printing Defects

Figure 2. Screen Printing Defects

Screen printing defects are flaws or problems that occur in the screen printing process, which is a printing method in which ink is applied to a surface through an area that is not penetrated by the material created with a specific pattern or design.

3) Material Defects

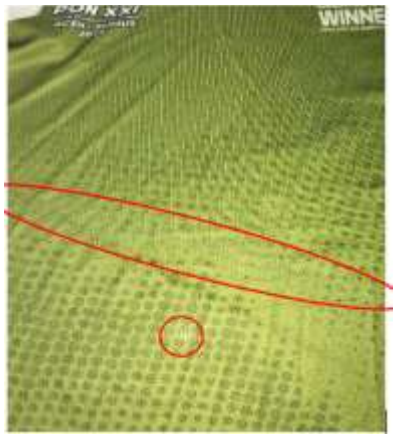

Figure 3. Material Defects

Material Defects are imperfections in the materials used in the production process of clothing or textile products by the convection industry.

4) Stitching Defects

Figure 4. Stitching Defects

Stitching defects are imperfections in the stitching process of a garment. This can include uneven, loose stitching, or may be damaged overall.

The purpose of implementing Checksheet is to facilitate the process of data collection and data analysis, and can identify problems based on variables, and assist in determining whether improvements is needed or not.

Table 2. Data *Checksheet*

Observasion	Sample	Material Defect	Printing Defect	Stitching Defect	Screen Printing Defect	Total Defects
Week 1	800	12	48	5	5	70
Week 2	800	20	50	4	7	81
Week 3	800	1	12	3	4	20
Week 4	800	4	4	2	11	21
Week 5	800	6	12	0	8	26
Week 6	800	31	21	0	7	59
Week 7	800	9	10	1	9	29
Week 8	800	2	11	2	15	30
Week 9	800	1	23	3	14	31
Week 10	800	1	4	8	6	19
Week 11	800	2	6	7	3	18
Week 12	800	3	3	0	4	10
Week 13	800	12	48	5	10	75
Week 14	800	20	50	4	14	88
Week 15	800	1	12	3	21	37
Week 16	800	4	4	2	29	39
Week 17	800	6	12	0	3	21
Week 18	800	31	21	0	11	63
Week 19	800	9	10	1	6	26
Week 20	800	2	11	2	7	22
Week 21	800	1	23	3	8	35
Week 22	800	1	4	8	12	25
Week 23	800	2	6	7	11	26
Week 24	800	3	3	0	4	10
Total	19.200	148	408	70	219	881

It can be seen that for 24 weeks CV Tujuh Pustaka Tala experienced product defects every week with 6 days of work a week. Product defects that often occur include defects in screen printing, printing, stitching and material defects.

Tabel 3. Table Count Control Chart

Proporsi	CL	UCL	LCL
0,09	0,05	0,07	0,03
0,11	0,05	0,07	0,03
0,05	0,05	0,07	0,03
0,05	0,05	0,07	0,03
0,03	0,05	0,07	0,03
0,08	0,05	0,07	0,03
0,03	0,05	0,07	0,03
0,03	0,05	0,07	0,03
0,04	0,05	0,07	0,03
0,03	0,05	0,07	0,03
0,03	0,05	0,07	0,03
0,01	0,05	0,07	0,03

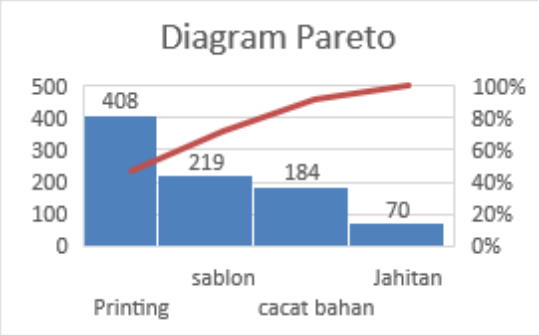

Figure 5. Diagrams Pareto

From the diagram above, it can be seen from the largest to the smallest defect is product defects in the printing process with a total defect of 408 units or 46%, after that defective materials with a total defect of 219 units or 25%, after that defects in screen printing results with a total of 184 units or 21% and finally defects in stitching with a total of 70 units or 8%.

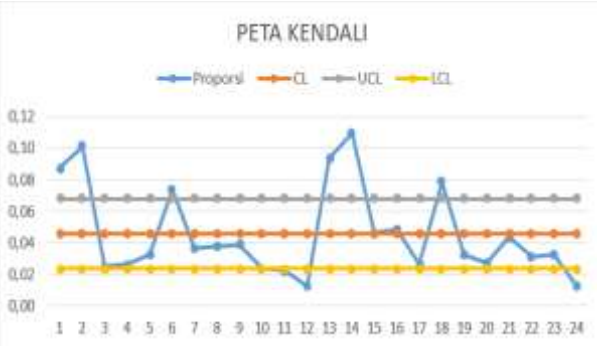

Figure 6. Control Chart

Based on the picture and table above, it can be concluded that on the control map that for 12 weeks, there are 3 weeks the number of product defects exceeds the upper control limit (UCL), namely, weeks 1, 2, 6, 13, 14 and 18. Furthermore, the position that exceeds the line (LCL) is 1 week that exceeds the line, namely weeks 12 and 24.

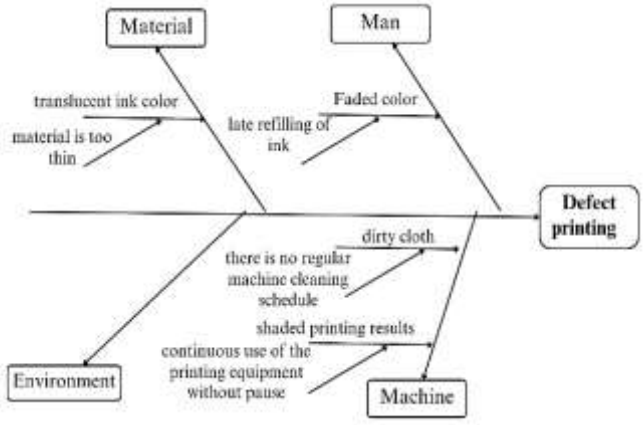

Figure 7. ***Fishbone diagram of printing***

Printing defects have 3 factors that cause defects, namely human factors caused by late refilling of ink so that the color becomes faded, machine factors caused by continuous use of the machine without a break and no routine machine cleaning schedule, and finally material factors caused by materials that are too thin.

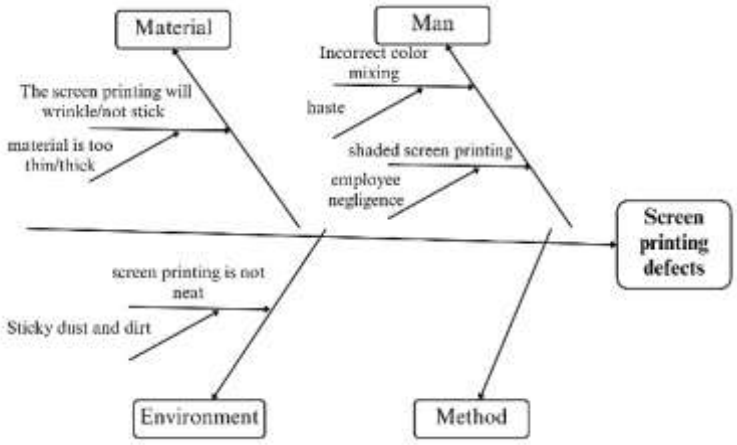

Figure 8. Fishbone diagram of Screen printing

Screen printing defects are caused by 3 factors, namely environmental factors caused by dust and dirt so that the print on the shirt is uneven, human factors caused by rushing and lack of focus on employees resulting in mixing screen printing paint colors less than desired and untidy screen printing results, and finally material factors caused by materials that are too thin so that the screen printing results penetrate to the back of the shirt and if it is too thick the screen printing results are difficult to stick.

3.1.2. *Statistical Quality Control* (SQC)

According to Assauri (Westgard et al., 2018) in his book entitled Production and Operations Management suggests that SQC (Statistical Quality Control) is a system developed, to maintain uniform standards of quality of production results, at a minimum cost level and is an aid to achieving the efficiency of the factory company.

3.1.3. 5W1H Method

The 5W+1H method is 6 types of basic questions used to obtain information (Nugraha & Herlina, 2021). 5W-1H is a method used to find out the problems that occur in detail (Menshchikov & Lepikhin, 2018). In the form of several questions, such as: what, who, where, when, why and how (what, who, where, when, why and how) and usually made in the form of a table, here is about 5W + 1H.

Based on the results of the analysis using SQC, the next step is to provide an analysis of proposed improvements to reduce the dominant defects that occur, namely printing defects and screen printing defects using the 5W + 1H stages (What, Where, When, Who, and Why + How).

Printing Defect

a) Man

1. What: Faded color.
2. Why: Late in refilling ink.
3. Who: Operator/Employee of the printing department and the person in charge of QC.
4. When: In the printing process during production.
5. Where: In the production room.
6. How: Operators / employees must be more careful and routine in checking the availability of ink on the machine during the production process so that the availability of ink is maintained. In addition, further control and supervision also needs to be carried out to minimize work negligence by operators / employees during the production process.

b) Machine

1. What: Shaded printing and dirty fabric
2. Why: The printing machine is used continuously and there is no regular schedule for cleaning the machine.
3. Who: Operator/Employee of printing department and in charge of QC.
4. When: In the printing process during production.
5. Where: In the production room.
6. How: Make a maintenance schedule for the machine every day such as cleaning the sensor on the printer machine and checking the headprint, so that the machine cleanliness and performance in production are maintained. In addition, resting the machine regularly during production is also important so that the overall production results are maximized.

c) Material

1. What: Translucent ink color.
2. Why: Fabric that is too thin.
3. Who: Operator/Employee of printing and purchasing department.
4. When: In the printing process during production.
5. Where: In the production room.
6. How: Make special records for each material used during production, provide knowledge related to the types of materials used in production including the treatment or treatment that must be carried out on each material when production will take place, so that production operators understand better and the number of defects can decrease.

Sablon defect

a) Man

1. What: Mismatched colors, fabric holes or cuts.
2. Why: In the rush to mix colors, employees lacked focus.
3. Who: Operator/Employee who prints and is in charge of QC.
4. When: In the color mixing process and in the process of cutting off the leftover threads.
5. Where: In the production room
6. How: Employees must record the amount of paint during the color mixing process so that the color remains consistent without any changes, Give a short break (5 minutes) to restore focus and concentration while working.

b) Material

1. What: Sablonan will be translucent / difficult to stick to the fabric.
2. Why: Fabric too thin or thick
3. Who: Operator/Employee who prints and is in charge of QC.
4. When: in the screen pinting process.
5. Where: In the production room.
6. How: Adding notes if the material is too thin, the screen printing process is only one turn or screen printing using a screen printing press, using special screen printing paint that matches the thickness of the material, providing notes so that ordering materials uses a certain thickness so that the splicing process is easier.

c) Environment

1. What: The results of screen printing are less neat (there is deu or dirt that comes with the screen)
2. Why: Less clean during the dust and dirt removal process.
3. Who: Operator/Employee who prints and is in charge of QC.
4. When: In the printing process.
5. Where: In the production room
6. How: Replace the lights to be brighter so that workers/employees are more comfortable and careful during the printing process and the color mixing process.

3.2. DISCUSSION

Based on the explanation above, the results of the study indicate that there are 4 types of defects in the production process at CV. Tujuh Pusaka Tala, namely printing defects, screen printing defects, sewing, and material defects. The main factors causing production defects include humans, materials, machines, methods, and the environment. It can be concluded that the quality control of clothing production at CV. Tujuh Pusaka Tala using the Statistical Quality Control (SQC) method and the 5W and 1H approach to minimize defective products has been implemented well so that it can minimize the existence of defective products.

Previous research conducted by Putra (2019) dan (Njei, 2018), stated that quality improvement in the company is certainly a major concern to be able to provide satisfaction for consumers/customers. The results of the study showed that the most dominant level of defects was the type of peeling glue defect, then the type of uneven sanding defect, then the type of cutting defect and the lowest was the defect of improper bending. In Refangga et al., (2018) research, The most damage type is dent pack as much as 239pcs. From the causal diagram can be known factors causing damage from the most dominant include machinery, raw materials, humans, and methods. Based on the kaizen implementation tools, the recommendations for improvement are routine maintenance and re-adjustment of production machines, more rigorous selection of suppliers with more stringent standards, and improved human resource performance through supervision and briefing.

According to Refangga et al., (2018), the results of the study showed that there were 9 (nine) types of product defects in type x lenses during the period of December 2019. Among them: Bubble, Mold Defect, Thicknes Out, Edge Problem, Crack, Rellease, Lint, Scratches and Prishm. From the calculation results, the average sigma level was 5.3 with an average DPMO value of 242. Based on the Pareto diagram, improvements were prioritized on the 3 (three) most dominant types of defects. Namely the Bubble defect type with a defect percentage of 52%, Thicknes Out 30% and Mold Defect 10%. Then a cause and effect analysis was carried out using fishbone, it was found that human factors, materials, tools, machines, environment and methods were the factors causing the occurrence of the three types of defects. The improvement stage was carried out by proposing improvements using the 5W + 1H method as a form of improvement in improving quality. This study was conducted to analyze the quality control of clothing production at CV. Tujuh Pusaka Tala using the Statistical Quality Control (SQC) method and the 5W + 1H approach to minimize defective products. The SQC methods used include Checksheet, Control Map, Histogram, Pareto Diagram and Cause and Effect Diagram to identify and control variability in the production process. While the 5W + 1H approach is applied to understand the main causes of product defects and find the right solution. It can be concluded that there are 4 types of defects in the production process at CV. Tujuh Pusaka Tala, namely printing defects (2.1%), screen printing defects (1.1%), sewing (0.4%), and material defects (1%). The main factors causing production defects include humans, materials, machines, methods, and the environment (Rinjani et al., 2021).

This study aims to analyze the quality control of clothing production at CV. Tujuh Pusaka Tala using the Statistical Quality Control (SQC) method and the 5W + 1H approach to minimize defective products. So that its contribution is to increase control of reducing defective products in the company. The limitation of this study is the minimal research object, which is only at CV. Tujuh Pusaka Tala. It is hoped that further researchers are advised to conduct research in several companies and add research variables (Chusminah et al., 2019). There are four types of defects with six sub-types of defects found in black waring products, namely: 1) Damaged Woven Fabric includes the sub-type of Dirty Warp/Weft defects, 2) Torn Woven Fabric includes the sub-type of Warp/Weft Netting defects, 3) Loose Woven Fabric includes the sub-type of Loose Warp and Miss Pick defects, 4) Less Heavy Woven Fabric (kg) includes the sub-type of Thick/Thin Yarn and Double Pick defects. From the results of the analysis using the New Seven Tools Method, in using the New Seven Tools method, the factors that must be immediately corrected are as follows: 1) Machine factors, 2) Method factors, 3) Human factors. 4) Environmental factors, 5) Material factors, 6) Measurement factors. (Chusminah et al., 2019)

4. CONCLUSION

In the production process of t-shirts, jersey, and kameja in the CV Tujuh Pusaka Tala confection, there are 4 types of production defects that are often found, namely defects in the printing process, defects in the screen printing process, defects in stitching, and defects in materials. From October 2023 - March 2024 there were 4.6% of the total production defects, including printing defects 2.1% screen printing defects 1.1%, stitching defects 0.4% and material defects 1%. Among the 4 types of production defects are influenced by man, material, machine, method, environment factors, for example, there is no schedule for checking the machine, there is no SOP sheet on each machine, workers who are less focused due to lack of rest or disturbed by environmental factors, lack of lighting, rushed work due to target pursuit.

Proposed improvements using the 5W1H method, these proposals are man, operators/employees must be more careful and routine in checking the availability of ink on the machine during the production process, recording the amount of screen printing paint during the color mixing process. Machin are creating a maintenance schedule for machines every day, resting machines regularly during production is also important so that overall production results are maximized. Material are making special notes for each material used during production, providing knowledge related to the types of materials used in production and adding notes if the material is too thin the screen printing process is only 1 time back or screen printing using a screen printing press, using special screen printing paint that matches the thickness of the material, providing notes for ordering materials using a certain thickness. Environment are change the light to a brighter one.

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