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Analysis of Product Quality Control Using Statistical Process Control (SPC) at Didik Bag Convection in Bandung

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Abstract*.Didik Bag Convection is a manufacturing business specializing in bag production. However, its production activities often encounter issues related to product quality, such as defects caused by employees' lack of understanding of new sewing machines, the absence of standard operating procedures (SOPs), and an unsupportive work environment. To address these issues, quality control measures are necessary, which can be analyzed using Statistical Process Control (SPC) to identify the root causes of defects in product quality and production processes. The quality control analysis techniques employed include Check Sheets, Pareto Diagrams, Control Charts (P-Charts), and Fishbone Diagrams (Cause-and-Effect Diagrams). The results of this study indicate that the quality control at Didik Bag Convection is within acceptable limits as it falls within normal control boundaries. The number of defective products remains within a reasonable threshold. Based on the Pareto Diagram, damaged stitching defects account for the highest proportion of defects, making up 43.28% of the total defects. Improvements to address stitching defects are needed, which can be achieved using the Fishbone Diagram by focusing on the factors of Man (human resources), Material (raw materials), Machine, Method, and Environmental indicators that influence product defects during production.*

Keywords*: Quality Control, Product Defects, Statistical Process Control, Diagrams*

Abstrak. Didik Bag Convection merupakan usaha manufaktur yang bergerak di bidang produksi tas. Akan tetapi, dalam kegiatan produksinya sering kali ditemukan permasalahan terkait kualitas produk, seperti cacat yang disebabkan oleh kurangnya pemahaman karyawan terhadap mesin jahit baru, belum adanya standar operasional prosedur (SOP), dan lingkungan kerja yang kurang mendukung. Untuk mengatasi permasalahan tersebut, diperlukan langkah-langkah pengendalian mutu yang dapat dianalisis menggunakan Statistical Process Control (SPC) untuk mengetahui akar penyebab terjadinya cacat pada kualitas produk dan proses produksi. Teknik analisis pengendalian mutu yang digunakan antara lain Check Sheet, Diagram Pareto, Control Chart (P-Chart), dan Fishbone Diagram (Diagram Sebab Akibat). Hasil penelitian ini menunjukkan bahwa pengendalian mutu di Didik Bag Convection masih dalam batas yang dapat diterima karena masih dalam batas pengendalian normal. Jumlah produk cacat masih dalam ambang batas yang wajar. Berdasarkan Diagram Pareto, cacat jahitan yang rusak menempati proporsi cacat tertinggi yaitu sebesar 43,28% dari total cacat. Diperlukan adanya perbaikan untuk mengatasi cacat jahitan, yang dapat dicapai dengan menggunakan Diagram Tulang Ikan dengan berfokus pada faktor-faktor Man (sumber daya manusia), Material (bahan baku), Machine (mesin), Method (metode), dan Environmental (lingkungan) yang mempengaruhi cacat produk selama produksi.

Kata Kunci: Pengendalian Mutu, Cacat Produk, *Statistical Process Control*, Diagram

1. INTRODUCTION

Indonesian MSMEs have an important role in growth and development of Indonesian economy. According to statistical data from (KADIN INDONESIA (Indonesia Chamber of Commerce and Industry), 2024) the role of MSMEs is importantly big in Indonesia's Gross Domestic Product (GDP), which is 61% or around Rp9,580 trillion. In addition, MSMEs can also absorb 117 million workers in Indonesia or equivalent to 97% of the total existing workforce. In 2023, Indonesia having 66 million MSMEs, increasing 1.52% from the previous year. The quality from goods and services offered needs to be maintained to ensure

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the sustainability of MSMEs and consumer satisfaction when buying products produced by MSMEs. Therefore, companies can carry out supervision to maintain and protect the quality of goods and services produced so that they remain maintained and able to compete in the market (Hadiyati, 2015; Susanti et al., 2023).

Convection Industry is one of the industry types that produces finished goods, such as bags, clothes and other finished goods (Adji, 2022) In the bag convection industry, the production process from the beginning to finish is very important activity, where in this process it requires accuracy, precision and appropriateness between products requested by consumers with the quality that can be provided by the Company. For that, Quality Control is needed and required to fulfil the quality standards that has been determined and minimize operational costs of the product, so that it can minimize losses and errors during the production process (Kaso et al., 2021).

Quality control is required to ensure that the products produced by a company can be maintained to ensure that they meet consumer demand, and can be an indicator that can increase consumer interest and consumer satisfaction in shopping (Kala Kamdjoug et al., 2021) Continuing and sustaining quality control can have an impact on the products produced. Although product defects are often found, quality control can reduce the quantity of defects when they can be found faster. So that good quality control is needed to be able to detect failure, damage, or defects earlier.

One of the MSME located in Rancamulya, Bandung Regency wants to carry out a control process on the bag products it produces. The MSME is Didik Bag Convection which produces bags in large quantities every day, to be marketed through e-commerce by third parties, or consumers of Didik Bag Convection. The production process carried out by Didik Bag Convection starts from selecting raw materials, creating bag designs, cutting bag patterns, screen printing bag patterns, sewing bags, and the finishing process. This MSME is able to produce 500-8000 pieces bags every day, depending on the number of bags ordered. In general, bag orders will participate in twin date events such as the 11.11 or 12.12 promo. From the production process carried out, several product defects were found, including broken stitches, dirty printing stains, and errors in labelling certain bags.

This study aims to reduce and minimize the number of product defects in bags produced by UMKM Didik Bag Convection by conducting quality control using the Statistical Process Control (SPC) method, which will begin with identifying the number of defects from each type of defect and analyzing the factors causing product defects which will later be given a recommendation for improvement for UMKM Didik Bag Convection.

2. LITERATURE REVIEW

Quality

Quality is meeting consumer demand or meeting consumer satisfaction, conformity to standards set by the company, and optimization of production costs (Djoko Adi Walujo, 2020). Quality serves as an indicator of the success of a product that will have an impact on increasing the company's profits. In his book (J. M. Juran, 1998) Quality is defined as the suitability of product use in order to achieve customer needs and satisfaction, which is measured by strength and durability, feeling when using the product, product reliability, and the existence of quality assurance. Quality also includes consumer expectations of products produced by the company and is an ongoing activity (Kotler & Armstrong, 2017). Quality must always be maintained to ensure that the product is acceptable to consumers and satisfaction can be generated from the use of the product. Quality covers all aspects of the company, such as labor, products, production processes and the environment, as well as changing conditions that cause quality to be controlled and maintained.

Quality Control

Quality control is a series of activities carried out from the beginning to the end of the production process. (Assauri, 2016) defines quality control as an activity to achieve, protect, and improve production quality which is carried out as a guarantee that the production process is carried out in accordance with established standards (Ariwangsa & Abundanti, 2013; Olivia McDermott, 2023). Quality control is also used to minimize product defects or product damage that occurs during the production process and can harm the company. The purpose of quality control is to ensure that production results comply with predetermined quality standards, reduce inspection and supervision costs, cut operational costs for design and production processes, and provide a guarantee of the quality of the products produced (Assauri, 2016). The quality control factors including process capabilities that are in accordance with existing limits, desired production standards, acceptable levels of product conformity, and how much money will be spent to meet the desired quality. Quality control can be done by understanding the needs and demands of quality improvement, stating quality problems, spreading factors that cause failure or loss, planning and implementing solutions to improvements, standardizing solutions to each problem, and solving problems that arise later in the production process (Montgomery, 1995).

Statistical Process Control (SPC)

Statistical Process Control (SPC) is defined by Lindsay in (Moch. Teguh Fajrin, 2018) as a process monitoring method in order to find the specific causes and effects of a variation and provide corrective action. Statistical Process Control (SPC) is also defined as a problem-solving method for the process of monitoring, controlling, analyzing, managing, and improving products that use statistical methods in the process (Rusdy, 2018). The quality control process using the SPC method has seven tools that can be used as quality control tools (7 quality tools), consisting of a checksheet or table containing data on the number of goods produced and the type of production nonconformity, a scatter diagram that displays the correlation between two variables that affect product quality, a cause and effect diagram or fishbone diagram that shows the main causes that affect quality, a Pareto chart or graph that shows dominant nonconformities that need to be fixed, a process flow diagram that shows a particular process or system, and a control chart that is used for monitoring and evaluating an activity to solve a problem (Olivia McDermott, 2023). *Statistical Process Control* is used to analyze data, control, and improve production processes through sampling and evaluation of results, statistics is an important tool in decision making and quality assurance. Measuring the quality of goods or services, comparing them to specifications, and making improvements if there are differences between actual performance and standards is part of Quality Control. This method helps find and correct production errors and ensures product quality through the process, monitoring, analysis, and management (Bakhtiar, 2013).

3. RESEARCH METHODS

This research was conducted using quantitative research, where the data meeting was conducted using research instruments in the form of interviews and observations conducted at the MSME Didik Bag Convection located in Rancamulya, Bandung. The flow of the research carried out can be seen in the image below.

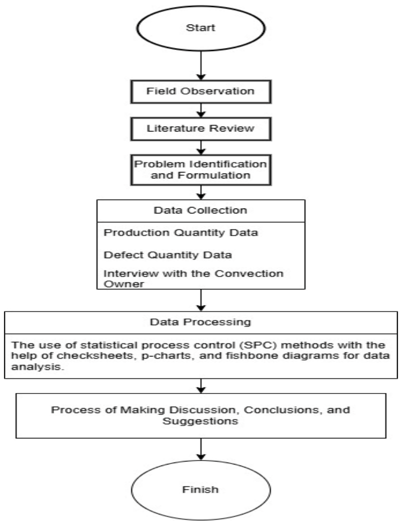

Figure 1. Research Flow

The primary data sources in this study are data on the number of production and the number of product defects categorized into various types of defects during production, observation, and interviews with the owner and employees of Didik Bag Convection. In addition, studying Literature is a secondary data source used as a reference and in-depth study in previous library studies.

The results of the number of production data and the number of product defects were taken during November 2024, starting from November 1, 2024 - November 30, 2024. The data was generated from the results of the calculation and checking process of convection employees during November. Furthermore, data processing will be carried out using the statistical process control (SPC) method with the help of check sheets, control chart (p-chart), and fishbone diagrams.

4. RESULT AND DISCUSSION

Check Sheet

The first step taken is to create a check sheet containing data that will facilitate the analysis process. The check sheet created in this study will contain data on the amount of production, types of product defects consisting of broken stitches, dirty stains, and mislabeling, total defective products, and the percentage of total defective products compared to the amount of production.

Table 1. Product Defect Data Check Sheet

Date	Production Quantity	Types of Product Defects			Total Defective Products	Percentage (%)
		Broken Stitches	Dirty Stains	Mislabel		
1	1300	15	12	8	35	2.69%
2	2200	18	20	10	48	2.18%
3	4100	30	25	15	70	1.71%
4	980	8	6	4	18	1.84%
5	1600	14	10	6	30	1.88%
6	1300	12	8	5	25	1.92%
7	2000	20	15	10	45	2.25%
8	2200	18	16	8	42	1.91%
9	2200	20	18	12	50	2.27%
10	3000	25	22	14	61	2.03%
11	3000	28	20	15	63	2.10%
12	3000	26	24	12	62	2.07%
13	1800	15	12	8	35	1.94%
14	2200	20	16	10	46	2.09%
15	1600	12	10	6	28	1.75%

16	2000	18	15	10	43	2.15%
17	1500	12	8	5	25	1.67%
18	1500	10	8	6	24	1.60%
19	1000	8	5	4	17	1.70%
20	1000	7	6	3	16	1.60%
21	1000	8	6	5	19	1.90%
22	3000	28	20	14	62	2.07%
23	2200	22	18	12	52	2.36%
24	2000	18	14	8	40	2.00%
25	1700	15	12	6	33	1.94%
26	1200	10	8	5	23	1.92%
27	1400	12	10	6	28	2.00%
28	900	8	5	4	17	1.89%
29	700	6	4	3	13	1.86%
30	1200	10	8	5	23	1.92%
Total	54780	473	381	239	1093	1.97%

Based on the data collected in table 1, there are three categories of product defects in bags at UMKM Didik Bag Convection, consisting of 473 broken stitches product defects, 381 dirty stain defects, and 239 mislabel defects, with a total of 1093 defects. The percentage of defective bags compared to the number of products made is 1.97%. From these data, it can be seen that the broken stitches defect category is the category with the highest number of defects compared to other types of defects.

Pareto Chart

The next step is to create a Pareto diagram, which will point out the problem based on the order of the number of occurrences. Before creating a diagram, first create a table of frequency calculations for each type of defect, the percentage of defects, and the Total percentage of defect conservation on the bags produced can be seen in table 2, and the Pareto diagram can be seen in figure 2.

Tabel 2. Data Pareto Diagram

No.	Types of Defects	Frequency	Percentage	Cumulative
1	Broken Stitches	473	43.28%	43.28%
2	Dirty Stains	381	34.86%	78.13%
3	Misabel	239	21.87%	100.00%
Total		1093		

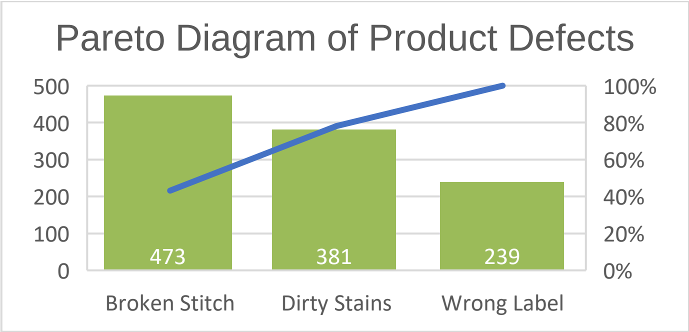

Figure 2. Pareto diagram

The Pareto diagram in Figure 2 shows the sequence of the number of defective events in bag production, with the type of defect Broken stitches having the most defect occurrences as many as 473 pieces with a percentage of 43.28% of the total defects, the type of dirty stain defect as many as 381 pieces with a percentage of 34.86%, and the type of mislabeled defect as many as 239 pieces or 21.87% of all defect products.

P-Chart

P-Chart or control chart becomes the next step that must be made in this study that will be used as one of the quality control tools, because the data attributes and the amount of data checked in each production period are not the same. P-Chart will calculate the upper control limit or UCL (Upper Center Line), lower control limit or LCL (Lower Center Line), and center line or CL. The formulas for the calculations are as follows.

a. Proportion of Defect

$$Pi = \mathrm{np/n}$$

b. Center Line (CL)

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

c. Lower Center Line (LCL)

$$LCL = \bar{P} + 3\sqrt{\frac{\left(\left(\bar{P}(1-\bar{P})\right)\right)}{(n)}}$$

d. Upper Center Line (UCL)

$$UCL = \bar{P} - 3\sqrt{\frac{\left(\left(\bar{P}(1-\bar{P})\right)\right)}{(n)}}$$

Information:

Pi = Proportion of defect

$\bar{P}$ = Center Line

np = Number of product defects

n = Number of production products produced in each production

Table 3. P-Chart Data

Date	Production Quantity	Number of Defects	Percentage (%)	Proportion (Pi)	CL	UCL	LCL
1	1300	35	2.69%	0,026923	0,019953	0,031588	0,008317
2	2200	48	2.18%	0,021818	0,019953	0,028897	0,011009
3	4100	70	1.71%	0,017073	0,019953	0,026504	0,013401
4	980	18	1.84%	0,018367	0,019953	0,033353	0,006552
5	1600	30	1.88%	0,01875	0,019953	0,03044	0,009465
6	1300	25	1.92%	0,019231	0,019953	0,031588	0,008317
7	2000	45	2.25%	0,0225	0,019953	0,029333	0,010572
8	2200	42	1.91%	0,019091	0,019953	0,028897	0,011009
9	2200	50	2.27%	0,022727	0,019953	0,028897	0,011009
10	3000	61	2.03%	0,020333	0,019953	0,027612	0,012293
11	3000	63	2.10%	0,021	0,019953	0,027612	0,012293
12	3000	62	2.07%	0,020667	0,019953	0,027612	0,012293
13	1800	35	1.94%	0,019444	0,019953	0,029841	0,010065
14	2200	46	2.09%	0,020909	0,019953	0,028897	0,011009
15	1600	28	1.75%	0,0175	0,019953	0,03044	0,009465
16	2000	43	2.15%	0,0215	0,019953	0,029333	0,010572
17	1500	25	1.67%	0,016667	0,019953	0,030784	0,009121
18	1500	24	1.60%	0,016	0,019953	0,030784	0,009121
19	1000	17	1.70%	0,017	0,019953	0,033219	0,006686
20	1000	16	1.60%	0,016	0,019953	0,033219	0,006686
21	1000	19	1.90%	0,019	0,019953	0,033219	0,006686
22	3000	62	2.07%	0,020667	0,019953	0,027612	0,012293
23	2200	52	2.36%	0,023636	0,019953	0,028897	0,011009
24	2000	40	2.00%	0,02	0,019953	0,029333	0,010572
25	1700	33	1.94%	0,019412	0,019953	0,030127	0,009778
26	1200	23	1.92%	0,019167	0,019953	0,032063	0,007842
27	1400	28	2.00%	0,02	0,019953	0,031164	0,008741
28	900	17	1.89%	0,018889	0,019953	0,033936	0,005969
29	700	13	1.86%	0,018571	0,019953	0,035809	0,004096
30	1200	23	1.92%	0,019167	0,019953	0,032063	0,007842

Based on table 3, a P-Chart is created in order to show which groups are in the center line or outside the center line (within control limits or beyond control).

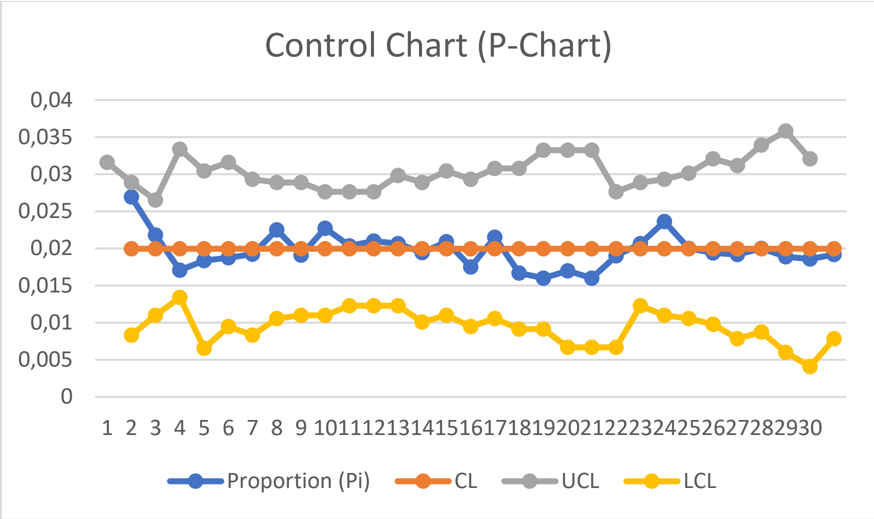

Figure 3. P-Chart

On the P-Chart above, it is shown that the proportion of Defects in bag production in November 2024 does not go outside the upper centerline (UCL) and lower center line (LCL), it can be seen that the performance is running within normal, controlled, and stable control limits, although the largest number of defects is obtained through broken stitches, but these defects are still within the control limits line. Based on the diagram, the upper center line (UCL) is 0.035808 and the lower limit line (LCL) is 0.004096.

Fishbone Diagram

The final step in the Quality Control analysis in this study was to identify the various causes of production defects in bags in November using a cause-and-effect diagram (fishbone diagram). After conducting an analysis using a check sheet and a Pareto diagram, it is known that the type of product defect broken stitches has the highest quantity, so following steps are needed to anticipate and overcome this type of defect. The factors explained in the fishbone diagram in this study are the employee (man), materials, machines, methods, and the environment which can be seen in Figure 4.

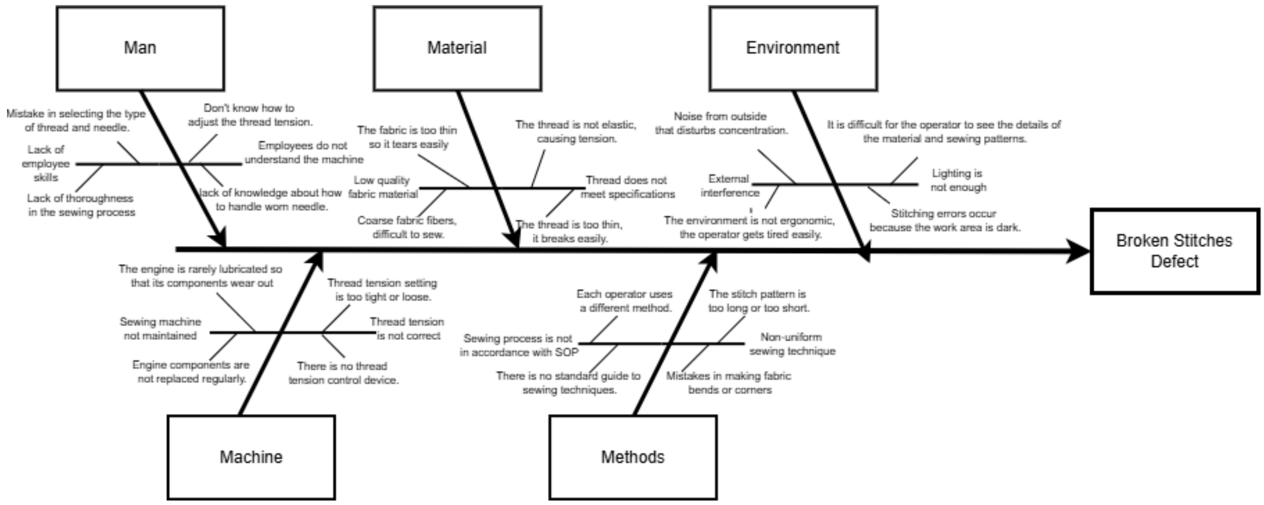

Figure 4. Fishbone Diagram

Human Factor (*Man*)

In the human factor (man), especially sewing employees (bag tailors) that are less careful in the sewing process, in the meaning that convection employees are still wrong when choosing the type of thread and needle, or employees who do not understand how to use a new sewing machine, it is because There are several changes to more modern machines in November, so that employees are still making adjustments. Some employees also don't really understand how to replace worn needles or adjust thread tension, so that the bag production has unstable stitches in some parts of the bag. To overcome this, employee training and development are needed to ensure that each employee has the same knowledge and skills, so that they can operate the machine properly and know when to replace the worn needle or adjust the thread tension. The convection can also provide SOPs for the use of sewing machines, needles, and threads to ensure the consistency between each tailor and the bag standard that are to be made.

Material Factors (Raw Materials)

Cloth and thread are the main raw materials in bags production. At Didik Bag Convection there is a problem with fabrics that are often ordered not according to what is expected. Sometimes there are fabrics that have low quality, such as fabrics that are too thin, coarse fabric fibers, and fabrics that are fragile when sewn. In addition, another major factor is the use of threads that often do not match the specifications of the fabric used, for example when the thread used is very thin so that the sewing is quickly damaged and the thread is not elastic that will cause tension that damages the sewing. To overcome this, fabric quality control is needed that can be carried out between the convection party and the raw material supplier, to ensure the desired quality conformity. In addition, an SOP is needed for selecting threads that are in accordance with the fabric to ensure the strength of the sewing of the bag to be produced.

Machine Factor (Engine)

Sewing machines are the main tool in the bag production process. At Didik Bag Convection, there are sewing machines that are poorly maintained due to being rarely lubricated and the components wear out because they are not replaced regularly, so this will cause problems when sewing the bags. Regarding the inappropriate thread tension settings such as too tight or too loose and the absence of a thread tension control tool, the sewing process is also uncertain, so there are production results that experience broken stitches. Therefore, periodic machine checks and regular and continuous replacement of machine components are needed to ensure the smooth sewing process.

***Methods* Factors (Methods)**

The working method at Didik Bag Convection is not standardized or does not have a binding SOP. This results in various problems such as the use of inconsistent sewing patterns or unclear work procedures, which can produce products with varying quality. In addition, sewing techniques that are not uniform between employees also result in different sewing patterns, some are too long and too short, and there are errors in making fabric corners that result in damaged stitches. To overcome this, the company must establish standard operating procedures (SOPs) that cover the entire production process, from cutting the fabric to the final stage of quality control, such as checking thread tension and testing sewing patterns, also need to be implemented to detect potential defects early.

Environmental Factors

A less supportive work environment, such as poor lighting, too hot a room temperature, or a narrow and irregular work area, can affect employee performance and the quality of the products produced. In addition, noise from outside the convection that interferes with employee concentration, and an environment that makes employees tired quickly can also affect the quality of the stitches produced. To overcome this, the convection must ensure an ergonomic work environment, including providing adequate lighting, good ventilation, and a clean and organized work area (Rumah Perempuan, is an NGO based in Kupang, 2017).

5. CONCLUSION AND SUGGESTIONS

Based on the results of the analysis and discussion of Quality Control on bag production results in November 2024 at Didik Bag Convection, it can be continued that there are still 3 types of product defects consisting of broken stitches, dirty stains, and mislabeled installation, with the highest proportion obtained from broken stitches, which is 43.38% of the total composition of defects. The causes of these defects cannot be separated from the influence of human resources or employees, raw materials, fabrics, and threads, sewing machines used, selection of needles and threads, sewing methods used, and an environment that does not support the production process. Even so, based on the p-chart, quality control at Didik Bag Convection has been carried out under control, within the overall control limits, so that Didik Bag Convection can maintain the quality control process and improve the quality control process, supervision, and review to reduce defects in its production process. Didik Bag Convection is advised to create standard operating procedures for its production process, so that employees have clear references and guidelines for carrying out the production process. SOPs are also needed to ensure that each party has the same knowledge about the standards of the products to be produced. The convection party can also ensure that the work environment has good lighting and smooth air circulation to increase employee focus. On the other hand, for further research, researchers can use other methods to be a tool to help analyze Quality Control of production results.

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