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Pengendalian Mutu Produk Menggunakan Kombinasi Pendekatan PDCA dan SPC pada UMKM Konveksi

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Product Quality Control Using The Combination of PDCA and SPC Approaches in Convection MSMEs

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Abstract— Convection Micro, Small, and Medium Enterprises (MSMEs) still experience product defects outside the target. This is because there is a control system that has not been implemented properly. MSME Convection is pursuing a large quantity target due to orders from customers. However, the percentage control of defects still escapes control. This research aims to determine the causes of dominant defects that occur, control the defect control chart, and reduce production defects. This research method uses a combination of the Plan Do Check Action (PDCA) approach with the Statistical Process Control (SPC) method. This research found that there were four categories of defects in the MSME Convection production process, namely loading, sewing, rubbing, and name tag dimensions. The most dominant problems are sewing defects and loading defects of 85%. Meanwhile, the results of the P-chart analysis show 4 data in the production process in Sep-Dec 2022 which exceed the upper control limit. This research resulted in an overall reduction in defects from 5.84% to 3.19%, meaning a decrease of 45.4%. Meanwhile, dominant defects, namely sewing defects, decreased by 30.8% and loading defects decreased by 24.5%. Meanwhile, the results of the P-chart analysis after improvements showed no deviation in the percentage of defects during 2023. This research has been able to increase production results and reduce production defects so that Convection MSMEs can fulfill customer orders well.

Keywords— PDCA; Quality Control; Defect Reduction; Statistical Process Control; MSME Convection

Abstrak— Usaha Mikro Kecil dan Menengah (UMKM) Konveksi masih terjadi adanya cacat produk diluar target. Hal ini dikarenakan adanya sistem pengendalian yang belum diterapkan dengan baik. UMKM Konveksi mengejar target quantity yang banyak karena pesa dari pelanggan. Namun pengendalian cacat secara persentasi masih luput dari pengendalian. Penelitian ini bertujuan untuk mengetahui penyebab cacat dominan yang terjadi, pengendalian peta ken cacat, dan mengurangi cacat produksi. Metode penelitian ini menggunakan kombinasi pendekatan Plan Do Check Aaction (PDCA) dengan metode Statistical Process Control (SPC). Penelitian ini menemukan terdapat empat kategori kecacatan pada proses produksi UMKM Konveksi, yaitu loading, penjahitan, gosok, dan dimensi nametag. Permasalahan yang paling dominan adalah cacat penjahitan dan cacat loading sebesar 85%. Sementara hasil analisa P-chart terdapat 4 data dalam proses

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produksi pada bulan Sep – Des 2022 yang melebihi batas kendali atas. Penelitian ini menghasilkan adanya penurunan cacat secara menyeluruh dari 5.84% menjadi 3.19%, artinya turun 45.4%. Sementara untuk cacat dominan yaitu cacat penjahitan turun sebesar 30.8% dan cacat loading turun 24.5%. Sementara hasil analisa P-chart sesudah perbaikan tidak terdapat adanya penyimpangan persentasi cacat selama tahun 2023. Penelitian ini sudah dapat meningkatkan hasil produksi dan mengurangi cacat produksi, sehingga UMKM Konveksi dapat memenuhi pesanan pelanggan dengan baik.

Kata kunci— PDCA; Pengendalian Kualitas; Pengurangan Cacat; Statistical Process Control; UMKM Konveksi

I. INTRODUCTION

In the current era of globalization, many convection MSMEs have emerged that produce clothing according to consumer desires. The government provides space for MSMEs to develop and operate to meet clothing needs [1]. All forms of MSME activities have been provided with facilities and training, starting from providing raw materials, and production and marketing processes [2]. However, internally regarding product quality, there is no special assistance from the government [3]. So product control is the responsibility of every MSME in producing its products into the hands of consumers [1]. The various types of MSME products produced require MSMEs to be more concentrated in controlling product quality [4].

The quality of the goods or services produced can attract interest and meet consumer needs. Product quality control greatly influences the quality produced by the company through implemented quality management [5]. Even though the production process is carried out correctly, the potential for errors still exists, which can cause damaged or defective products [6]. Setting quality standards is one method of maintaining product quality, but cases of products being damaged after production still occur [7]. Good product quality depends on effective quality control, with companies applying specific methods to produce high-quality products [8]. Quality control is carried out from the raw material stage to the finished product, adjusted to established standards [9].

This research focuses on women's shirt products produced domestically for local marketing and export to several ASIAN countries. The quality control process still often contains defects in raw materials and finished products which can affect production targets. This convection MSME targets that the percentage of defects should be below 5% for each part. Problems arise because there is no special department to control and record the production process, causing errors and errors in data collection on production results in Convection MSMEs. The report data for each section provides a report on average defects in percentage for 3 months, which can be seen in Figure 1.

Based on Figure 1, the largest percentage of defects is found in the sewing section at 69% and the loading section at 16%. These two parts will be the focus of this research in terms of reducing the

percentage of defects. So that researchers and the improvement team have high motivation to be able to overcome these problems as well as possible. Two main aspects of this problem phenomenon were identified in women's clothing convection MSMEs, the level of defects in the production process indicates suboptimal product quality that needs to be improved. Then the lack of quality control is caused by several factors, including obstacles in raw material management, production processes, and the lack of a special department for quality control. This identification is the basis for designing effective solutions to improve product quality and quality control in convection MSMEs.

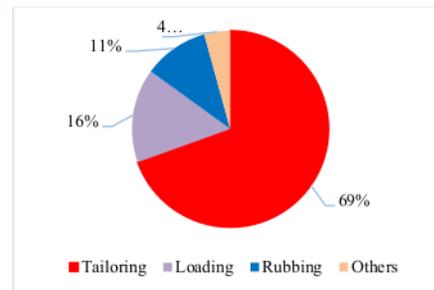


Figure 1. 2022 Defective product data

These convection MSMEs require the right approach and methods in designing improvements. Several previous studies have carried out improvement plans in product quality control using the Plan-Do-Check-Action (PDCA) approach [7], [10]. Each stage of PDCA uses a different method adapted to the conditions of the stage [11]. Some of the methods used can include seven quality improvement tools that are applied at each stage improvement. Other research can also combine the PDCA approach with seven quality improvement tools in a conceptual and orderly manner in its application [12]. Another method for reducing product defects can be increasing the sigma level with the Six Sigma method [13], [14]. However, this method can be applied to large industries with very large mass production so that the analysis is sharper and more in-depth [15]. The convection MSMEs in this study include home industries with a medium capacity of around 500 pcs per day for women's clothing.

The PDCA approach can be combined with other methods to create a continuous improvement scheme. Continuous improvement schemes can be controlled with Statistical Process Control (SPC) which can control the level of effectiveness of quality control with statistical tools [16]. The SPC method is very useful in improving garment product defects using seven quality improvement tools [17]. SPC is an established method or technique in the context of improvement and setting upper and lower limit levels for percentage defect inspection [18].

The formulation of this research problem includes evaluating quality control on Convection products and identifying factors that cause production defects. The new approach in this research combines the PDCA approach with the SPC method so that each stage of PDCA can be used as a tool for improving and controlling product quality. Meanwhile, the dominant part in this research was taken as 80% of the percentage of defects from women's clothing convection MSMEs. So that the dominant part represent corrective action in reducing product defects. This research aims to determine the causes of dominant defects that occur, control the defect control chart, and reduce production defects.

II. RESEARCH METHODOLOGY

This research is quantitative descriptive research which involves problem formulation to investigate and observe social situations as a whole within a certain time, to obtain knowledge or theoretical information. The research location is women's clothing convection MSMEs, located in Bogor Regency, West Java. Data collection was carried out to obtain information directly from the research object, namely the convection MSME workforce. The data collection technique is in the form of direct interviews with employees and convection staff to collect data regarding production problems, including production systems, sewing machine specifications, and seamstress abilities. Secondary data are taken from 2022 as data before improvements and 2023 as data after improvements. The aim is to find out the causes of the many cases of convection product defects [19]. Then carry out field observations on the research object to obtain data [20]. Researchers observed the entire production process, from sewing, and button installation, to finishing. The next stage is studying documents from the company in the form of data that follows what is being researched. The initial step of this research measures the extent to which the samples collected meet the testing requirements or not. The thing that needs to be taken into account is the normality test which can use a formula [21]:

$$N^1 = \left[\frac{\frac{K}{S} \sqrt{N \sum Xi^2 - (\sum Xi)^2}}{\sum Xi} \right]^2 \quad (1)$$

Known amount of data $\sum X$, quadrat of sum $(\sum X)^2$, the sum of quadrats $\sum X^2$, level of confidence/accuracy $\frac{K}{S}$ lots of data (N). If $N^1 < N$ then data is sufficient and vice versa.

The data sources used in this research are primary data and secondary data. The data used in this research includes 3 types, namely quantitative and qualitative. The research steps can be seen in Figure 2.

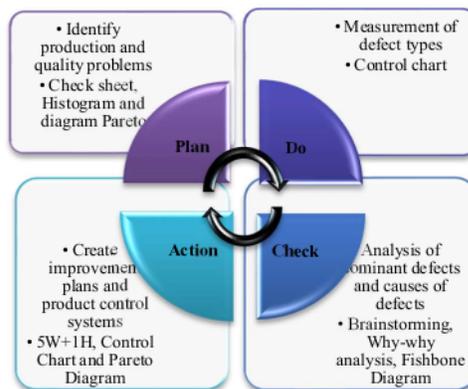


Figure 2. Research stages

Based on Figure 2, the research steps use the PDCA approach, where each stage of the process uses improvement methods and looks for descriptions of quality control and the use of SPC through library research, using references from journals, books, articles, papers, as well as previous theses or research proposals.

A. Plan Phase

In this phase, identify production and product quality problems by using quality improvement tools in the form of production and defect report check sheets for each part. Then it is entered into the Minitab application to determine the distribution of defects in the Histogram and Pareto diagram tools. Production and defect report data collection is carried out by employee representatives every day in each section. This check sheet is initial information about the production process which should be data and entered into the check sheet manually. This is a form of evidence of daily production activities as long as the production machine is operational. The steps for making a Pareto diagram start from the results of the data report on the check sheet/sheet checking the results of defects and types of defects which are filled in by the inspector every month, then input into the

computer in the form of Microsoft Excel. Add up the defects according to the type of defect. Enter the defect data and type of defect into the Minitab-19 software and a Pareto Diagram graph will be formed [22]. Look at the accumulated number of defects, in this research, the improvements that will be made are those that include an accumulation of 80%. Then calculate the proportion of defects for each part using the formula [15]:

$$\text{Defect proportion (\%)} = \frac{\text{Number of defects}}{\text{Number of product inspection}} \times 100\% \quad (2)$$

B. Do Fase

In this phase, the type of defect is used in a control chart before improvement. To use the control chart, enter the Minitab application and find the control chart menu with the P-chart type. According to [23], a Control Chart or Attribute Control Chart is used to control processes using attribute data such as the number of units that failed production (rejected). Attribute data is data that only has 2 values or options such as OK or NG. These types of Control charts include np-chart, p-chart, c-chart, and np-chart [24].

In this research, it is more suitable to use a p-chart, the same as the research carried out [25] which functions to measure the number of defects or nonconformities in the units produced. Use the p-chart if the number of opportunities for defects is constant or fixed. Calculate control charts with the formula for p-chart:

$$\text{Center Line Calculation (CL) } P = \frac{\sum \text{Defect}}{\sum \text{Inspection product}} \quad (3)$$

$$\text{Calculation of Upper Control Limit (UCL) } UCL = \bar{p} + 3 \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \quad (4)$$

$$\text{Calculation of Lower Control Limit (LCL) } LCL = \bar{p} - 3 \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \quad (5)$$

C. Check Fase

In this phase, dominant defect analysis will be discussed using the Fishbone diagram method. The steps for making a Fishbone diagram start from holding a meeting with the operator/technician and leader so that each meeting participant can reveal the cause and effect of a problem. During meetings, the moderator uses 4M+1E (Man, Method, Material, Machine, and Environment). Then one of the meeting participants made a fishbone diagram manually and asked member participants (operators/technicians and leaders) to use why-analysis until a problem could no longer find the cause [26]. The results of this meeting are entered into the computer via Microsoft Visio software to obtain a Fishbone diagram.

D. Action Fase

In this research, the 5W+1H data analysis method was obtained during a follow-up meeting from the Fishbone diagram, where the content of the meeting discussion determined 5W+1H with the

results of mutual agreement, so it is hoped that the improvement phase can be completed according to plan [27]. The steps are: During the meeting, the chairman must appoint someone to be the meeting moderator and meeting resume maker. The series of 5W+1H questions are: what, when, where, who, why, how, and how much. Ask questions repeatedly about each problem to be fixed. The final step is to make a report in Microsoft Excel form and print out it to the member meeting and PIC for improvements. The next step is to make a P-chart according to the steps in the DO phase, namely the P-chart after improvement. Then create a Pareto diagram after improvements to show that there is a significant reduction in the results of the improvement actions. The steps for making a Pareto diagram are the same as the Plan phase, but the difference is that this phase shows the Pareto diagram after improvements.

III. RESEARCH RESULT

Before the data is processed, a data adequacy test is carried out to determine whether the amount of data collected is sufficient for data needs. Testing this data uses a confidence level of 95%, so the value of $k = 2$ and the level of accuracy is 5% so that the value of s is 0.05 which is substituted into formula (1). The amount of data is based on the number of lots or samples per trial/experiment, to collect the data and test the adequacy of the data. If $N_1 < N$ then the data is sufficient and vice versa. Once the data collected is sufficient, a data normality test is carried out. This test uses the help of Minitab-19 software in the normal test menu. If the results of this test show that the P-value is greater than 0.05 then the data is said to be normally distributed.

The data adequacy test was carried out to ensure the objectivity of the data collected [28]. The goal is to determine the amount of rejected product data that will be used in the next data processing process. This test refers to statistical principles, where the degree of accuracy and level of confidence reflect the level of certainty desired by the researcher. Following are the results of data adequacy test calculations based on the formula (1):

Remarks:
 Amount of data $\sum X$: 7109
 Squared Sum $(\sum X)^2$: 50537881
 Sum of Squares $\sum X^2$: 4330643
 Level of Confidence/Accuracy $\frac{k}{s}$: 20
 Lots of data (N): 12
 Substituted into the equation below:

$$N^1 = \left[\frac{\frac{k}{s} \sqrt{N \sum X i^2 - (\sum X i)^2}}{\sum X i} \right]^2 = \left[\frac{2 \sqrt{12 \times 4330643 - (7109)^2}}{7109} \right]^2$$

$$= \left[\frac{2 \sqrt{51967716 - 50537881}}{7109} \right]^2$$

$$= \left[\frac{20 \times 1195,76}{7109} \right]^2 = [3.36]^2 = 11,32$$

The calculation results of N' (amount of theoretical data) of 11.32 and N (amount of actual data) of 12 indicate that N' is smaller than N. Therefore, it can be concluded that the data that has been collected is sufficient to achieve the level of confidence and degree the accuracy desired in this

analysis. Data processing cannot be said to be normal and sufficient if the results of the normalization test do not comply with the rules [29].

A. Plan Fase

Data processing in quality control is creating a table using the results of a check sheet containing production data and types of defects. The following data processing results can be seen in Table 2.

TABLE 2
2022 PRODUCTION AND DEFECT CHECK SHEET RESULTS

Month To	Loading	Tailoring	Rubbing	Wrong Nametage Size	Total Defect	Total Product Inspection
1	70	456	65	34	625	15100
2	98	376	46	29	549	15235
3	80	359	84	32	555	15653
4	69	328	35	17	449	15356
5	70	336	49	12	467	15123
6	90	364	74	15	543	15007
7	79	349	58	21	507	15025
8	87	363	63	21	534	15152
9	104	494	78	52	728	15980
10	126	513	67	12	718	15880
11	127	521	65	13	726	15904
12	102	482	79	45	708	15745
Amount	1102	4941	763	303	7109	185160

Based on Table 2, for each type of defect each month you can know the number of defects and the amount of production. Table 2 shows that the types of sewing defects are very dominant every month, meaning that the biggest contributor to production problems in Convection MSM [18] in the sewing department. The next step is to create a Histogram diagram to determine the distribution of defects on the graph, which can be seen in Figure 3.

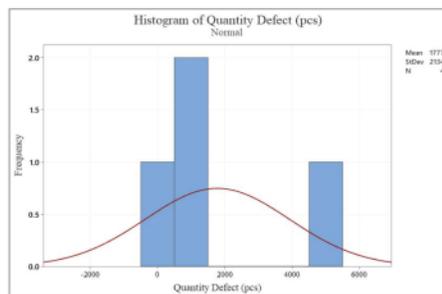


Figure 3. Histogram Diagram

Based on Figure 3, the distribution of defects in terms of numbers each month contributes to normal with an average number of 1777 pcs per month. Histogram diagrams are needed to determine the distribution of examination values for a population in a particular cluster [30]. The next step from Table

2 can also be to create a Pareto diagram which can be seen in Figure 4.

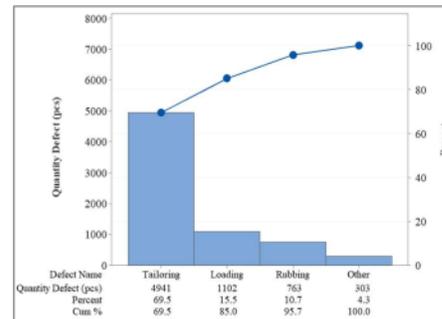


Figure 4. Pareto Diagram before improvement

Based on Figure 4 in the Pareto diagram, the percentage of defects [28] the production process shows that sewing is the most dominant type of defect with a defect percentage of 70%, followed by loading defects with a defect percentage of 15%. Meanwhile, rubbing defects have a defect percentage of 11%, and incorrect name tag/size installation defects have a defect percentage of 4%. Dominant defects are said to be large if the cumulative defects are above 80% and the remaining 20% are minimal defects [24]. For more

details regarding the cumulative percentage in determining dominant defects, see Table 3.

TABLE 3
CUMULATIVE PERCENTAGE

Defect Type	Number of Defects	Defect Percentage	Cumulative Percentage
Tailoring (Wrong Sewing)	4941	70%	70%
Loading (Wrong Material Selection)	1102	15%	85%
Rubbing (Less Fine)	763	11%	96%
Wrong Nametag Size Installed	303	4%	100%
Total	7109	100%	

Based on Table 3, the cumulative percentage of problems taken is 80% which are declared dominantly defective. Therefore, the research team agreed that the dominant defects that will be addressed in this problem are the types of sewing and loading defects.

B. Do Fase

In this phase, create a Control Map (P-chart) to assess other quality control in Pareto convection aims to identify the main problems in quality

control from the largest to the smallest. Simulation of proportion calculations in Jan 2022 can use the formula (2).

$$Defect\ proportion\ in\ Jan\ 22 = \frac{625}{15100} \times 100\% = 0.0414$$

This control chart will display all defects every month as a sample between the number of defects and the number of production [28]. For more details regarding the percentage of defects, see Table 4.

TABLE 4
2022 PROPORTION CALCULATION RESULTS

Month	Number of product inspections	Number of Defects	Defect proportion
1 Jan	15100	625	0.0414
2 Feb	15235	549	0.0360
3 Mar	15653	555	0.0355
4 Apr	15356	449	0.0292
5 Mei	15123	467	0.0309
6 Jun	15007	543	0.0362
7 Jul	15025	507	0.0337
8 Aug	15152	534	0.0352
9 Sep	15980	728	0.0374
10 Oct	15880	718	0.0402
11 Nov	15904	726	0.0407
12 Dec	15745	708	0.0371
Total	121651	7109	0.0584

Based on Table 4, the number of defects in percentage during 2022 is 5.84%, meaning that Convection MSMEs have lost their products in the form of these defects as convection losses. This must be corrected immediately so that MSMEs can increase productivity and reduce production defects. CL, UCL, and LCL calculation simulations in January 2022 can use formulas (3), (4), and (5).

Center Line Calculation (CL) $P = \frac{625}{15100} = 0.0414$

Calculation of Upper Control Limit (UCL) $UCL = \overline{0.0414} + 3 \sqrt{\frac{\overline{0.0414}(1-\overline{0.0414})}{12}} = 0.04299$

Calculation of Lower Control Limit (LCL) $LCL = \overline{0.0414} - 3 \sqrt{\frac{\overline{0.0414}(1-\overline{0.0414})}{12}} = 0.03380$

To see the extent of control that has been carried out, you can use a Control Map diagram. The control chart shows all defects contributing to defects every month can be seen in Figure 5.

Based on Figure 5, several points are outside the standard, namely in samples 4 and 5, but these positions are still safe or normal because they are below the LCL. However, there are positions 9, 10, 11, and 12 in the sample where the percentage of defects is out of control due to several factors that must be corrected immediately.

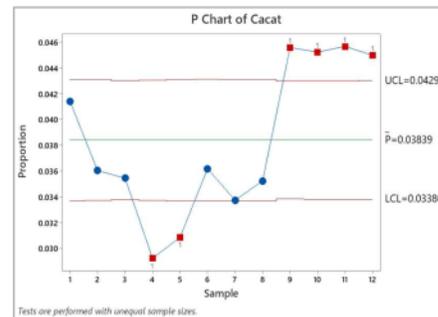


Figure 5. Control chart before improvement

C. Check Fase

In this phase, we will examine the results of the brainstorming that has been carried out by the improvement team with internal MSME parties. The MSME Convection parties involved include Department heads, Section Heads, Production

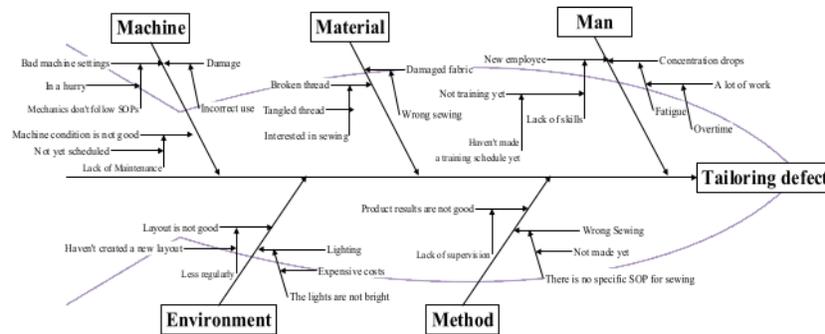
Leaders, Maintenance Heads, and 5 production operators. Brainstorming is carried out by interviews and recording in reports so that the results of the brainstorming become pending notes that must be followed up immediately [31]. The brainstorming results can be seen in Table 6

TABLE 6
BRAINSTORMING RESULTS

No	Factor	Brainstorming Results
1	Man	Lack of concentration, fatigue, and lack of accuracy in work cause errors Workers do not understand the production process due to a lack of explanation before work begins. Additionally, training is required before work begins, as employees handle various sizes of convection clothing. Many new employees lack experience and lack of skills, which can cause errors in the production process. Mistakes in placing goods during the loading process In a hurry An error or inaccurate setting occurred when setting up the machine before use.
2	Machine	Machine maintenance is still not optimal. Mistakes and mistakes occur in needle selection. Damage often occurs to several sewing machines. Fabric/material is often damaged
3	Material	Thread breaks easily Lack of inspection before use
4	Method	There is no intensive supervision of tailors. There is no SOP for sewing.
5	Environment	Lighting is very minimal in the production area, there are not enough windows and the lights are not bright. The production layout at the convection seeking Allah's blessing is not suitable for the production area criteria.

Based on Table 6, the brainstorming method is used for qualitative data collection. Data was obtained from several parties whose competence is beyond doubt because they are experienced in their

34 ds. After collecting this data, the results will be presented in a Fishbone diagram which can be seen in Figure 6.



8
Figure 6. Fishbone diagram of tailoring defects

Based on Figure 6, the main 17 causes of sewing defect problems consist of 5 factors, namely humans, materials, machines, methods, and the environment. This factor will soon be improved by the ability of MSMEs to facilitate it. The why-why analysis of the causes and effects of sewing defect problems can be seen in Table 7.

Based on Table 7, in determining cause and effect, this research uses why-why analysis, where the root cause of the sewing defect problem can be identified. The Pareto diagram method and the why-why analysis method are always used together in analyzing the causes of problems [32]. The loading defect problem which is the dominant defect, is also related to the Fishbone diagram, which can be seen in Figure 7.

TABLE 7
WHY-WHY ANALYSIS LOADING DEFECT

No	Factor	Why 1	Why 2	Why 3	Why 4
25	Man	Concentration drops	Fatigue	A lot of work	Overtime
		New employees	Lack of skills	Not training yet	Haven't made a training schedule yet
		Bad machine settings	Mechanics don't follow SOPs	In a hurry	
2	Machine	The machine's condition is not good.	Lack of Maintenance	Not yet scheduled	
		Damage	Incorrect use		
3	Material	Broken thread	Interested in sewing	Tangled thread	
		Damaged fabric	Wrong sewing		
4	Method	Wrong Sewing	Tidak ada SOP khusus penjahitan	Not made yet	
		Product results are not good.	Lack of supervision		
		The layout is not good	Less regularly	Haven't created a new layout yet	
5	Environment	Lighting	Lack of lighting in the production area	Expensive costs	
			The lights are not bright		

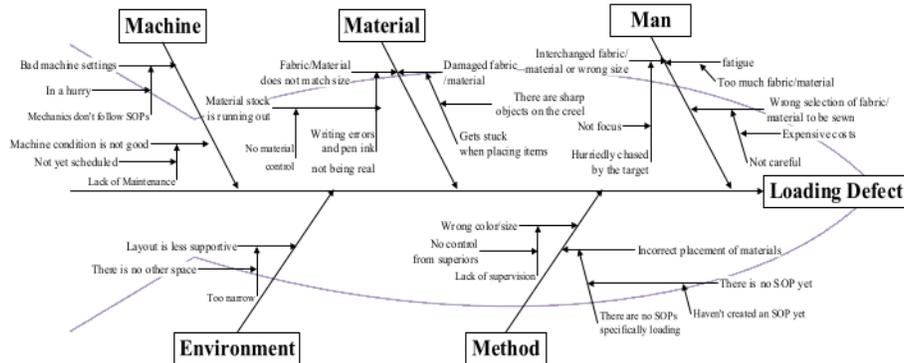


Figure 7. Fishbone loading defect diagram

Based on Figure 7, the main causes of sewing defect problems consist of 5 factors, namely humans, materials, machines, methods, and the environment. This factor will soon be improved by

the ability of MSMEs to facilitate it. The why-why analysis of the causes and effects of sewing defect problems can be seen in Table 8.

TABLE 8
WHY-WHY ANALYSIS OF LOADING DEFECTS

No	Factor	Why 1	Why 2	Why 3	Why 4
		Fatigue	Too much fabric/material		
1	Man	Interchanged fabric/material or wrong size	Hurriedly chased by the target	Not focus	
		Wrong selection of fabric/material to be	Not Careful	A lot of careful work	

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No	Factor	Why 1	Why 2	Why 3	Why 4
2	Method	Incorrect placement of materials	There are no SOPs specifically loading	There is no SOP yet	I haven't created an SOP yet
		Wrong color/size	Lack of supervision	No control from superiors	
3	Material	The fabric/Material does not match the size	Writing errors and pen ink not being real	Material stock is running out	No material control
		Damaged fabric/material	Gets stuck when placing items	There are sharp objects on the creel	
4	Environment	The layout is less supportive	Too narrow	There is no other space	

Based on Table 8, in determining cause and effect, this research uses a why-why analysis where the root cause of the loading defect problem can be identified.

D. Action Fase

In this phase, the results of the improvement plan using the 5W+1H method will be discussed, the results of the control chart after improvements, and the results of the Fishbone diagram after improvements during 2023. The results of the improvement plan can be seen in Table 10.

TABLE 10
DETERMINING 5W+2H FOR IMPROVEMENT PLANS

No	What	Why	How	Who	When	Where
	What is the problem	Why must it be addressed?	How to deal with it	Who is in charge?	When will it be implemented?	Where is it implemented?
1	There is no employee training yet	The need for skill up	Conduct scheduled theoretical and practical training for each operator	Head of Division	Oct-22	Training room
2	Interchanged fabric/material or wrong size	Establish a culture of delegation and good communication between shifts	Conduct a briefing session before work with the correct preparation of tools and working conditions.	Production Leader	Nov-22	Production area
3	Concentration drops	Be disciplined in working and dividing your time with adequate rest	Comply with rest hours by prohibiting working during breaks	Head of the department	Dec-22	Depart entry area
4	Bad machine settings	So that the machine settings follow the manual book	Schedule regular sewing machine maintenance	Head of Maintenance	Jan-23	Production area
5	The machine's condition is not good	So that the machine can operate normally	Carry out maintenance according to schedule and check the machine	Head of Maintenance	Jan-23	Production area
6	Adanya kerusakan pada mesin	So that operators understand how to improve and operate machines	Create SOPs for the use of sewing, overlock, and rubbing machines	Head of Division	Jan-23	Production area
7	Damaged fabric/material	So that material damage can be reduced	Clean materials from dust and dirt to avoid interference during loading	Head of Division	Feb-23	Warehouse Area
8	Broken thread	So that the thread does not break when used in the machine	Checking materials before use, including raw materials for fabric/materials and needles	Head of Division	Feb-23	Loading area
9	The fabric/Material does not match the size	So that color/size errors don't happen again	Increase worker awareness of SOPs and prohibit smoking in work areas	Head of Division	Mar-23	Warehouse Area
10	Wrong color/size	Special work requirements for loading reduce color errors	Adding employees to the loading process to help each other and increase efficiency.	Head of the department	Mar-23	Loading area
11	lack of lighting in the production area	So that lighting in the production area meets standards	Add lights in the production area as needed	Kepala Departemen	Apr-23	Production area
12	The layout is less supportive	So that the production process flows forward without going back and forth	Memperbaiki desain tata letak produksi	Kepala Departemen	Apr-23	Production area

After analyzing the problem, the next step is to compile some corrective actions that have been carried out. This aims not only to eliminate identified error factors but also to prevent the possibility of similar problems arising in subsequent production stages [33]. All forms of improvement can be conceptualized according to the Kaizen approach which starts from field analysis that occurs every day and is known to the implementing operator [34]. It is hoped that these improvement efforts can increase the efficiency, quality, and sustainability of the entire MSME Convection production process, which consists of:

1. Man:

- Conduct scheduled theoretical and practical training for each operator
- Conduct a briefing session before work with the correct preparation of tools and working conditions
- Comply with rest hours by prohibiting working during breaks

2. Machine:

- Schedule regular sewing machine maintenance.
- Carry out maintenance according to schedule and check the machine
- Create SOPs for the use of sewing, overlock, and rubbing machines

3. Materials:

- Clean materials from dust and dirt to avoid interference during loading
- Checking materials before use, including raw materials for fabric/material and needles

4. Method:

- Increase workers' awareness of SOPs and prohibit smoking in work areas
- Adding employees to the loading process to help each other and increase efficiency

5. Environment:

- Add lights in the production area as needed
- Improve production layout design

To view production report data and production defect reports for 2023, see the control chart or P-chart in Figure 9.

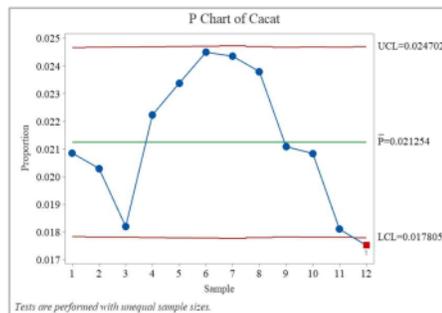


Figure 9. Control chart after improvement

Based on Figure 9, the p control chart analysis after improvement, UCL and LCL values are determined for the new control chart. Revision involves deleting data outside the control limits, and then reprocessing the remaining data, namely data that is still within the control limits after elimination [35]. These steps aim to produce a follow-up control map, which provides an overview of the level of reject production that Convection MSMEs should have. Meanwhile, the results of production and defect reports for 2023 or as data after improvements can be seen in the Fishbone diagram Figure 10.

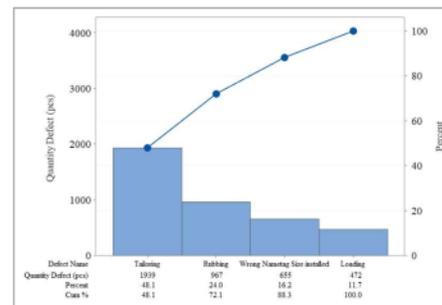


Figure 10. Pareto diagram after improvement

Based on Figure 10, the results of the Pareto diagram during 2023 or after improvements show that there is a reduction in the cumulative percentage of sewing defects to 48.1% and loading defects by 11.7%. The corrective actions that have been taken for the two dominant defects, namely sewing defects and loading defects, have been carried out properly. However, in the results, there are still other defects that have increased due to limited research in making improvements.

IV. DISCUSSION

Analysis using SPC emphasizes the importance of quality control in meeting consumer needs. The use of SPC to monitor and standardize production, especially the reject rate, revealed that women's clothing convection production was uncontrolled, indicated by data exceeding control limits on the control chart p. Pareto analysis highlighted tailoring as the main defect, followed by loading, with a total of 7109 defect cases. Five Whys analysis and fishbone diagrams identify causal factors, including humans, machines, methods, materials, and the environment. Improvement steps, such as tailor training, careful material selection, and monitoring during the sewing process, are formulated using the 5W+1H approach. Revised data on the p control chart shows the proportion of production rejects which are now within control limits, which is

expected to become the production quality standard [22]. Other researchers use the Statistical Quality Control (SQC) method which can be used as a method to control the quality of the products

produced with proposed improvements that can be made by the company [28]. The comparison of research results both before improvement and after improvement can be seen in Table 11.

TABLE 11
COMPARISON OF RESEARCH RESULTS

No	Parameter	Unit	Before Improvement	After Improvement	Ratio (%)
1	Number of defects	Pcs	7109	4033	43.2
2	Number of product inspection	Pcs	121651	126246	3.78
3	Percentage of defects	%	5.84	3.19	45.4
4	Reduced sewing defects	%	69.5	48.1	30.8
5	Reducing loading defects	%	15.5	11.7	24.5

Based on Table 11, overall this research has succeeded in reducing defects in percentage by 43.2%, and increasing production volume by 3.78%. Then this has the effect of reducing dominant defects starting from sewing defects and loading defects. This research has had an impact on Convection MSMEs being able to compete with other MSMEs in the field of women's clothing manufacturers.

This research includes a body of knowledge on quality and reliability engineering where the research includes quality control and the ability to control quality periodically and continuously. In theory, the implications of this research can be used as a reference by other researchers in terms of applying the PDCA approach combined with the SPC method. Meanwhile, the practical implications of this research can be used as a reference in terms of controlling the quality of a product so that the percentage of defects each month can be controlled and increased. So similar companies can implement a continuous improvement system with the PDCA approach combined with the SPC method as a tool at every stage of the process.

V. CONCLUSION

Controlling product quality at convections during 2022 with the implementation of product quality control for sewing defects at MSME convections is still not under control. This research found that there were four categories of defects in the MSME Convections production process, namely loading, sewing, rubbing, and name tag dimensions. Meanwhile, the results of the P-chart analysis show 4 data in the production process in Sep-Dec 2022 which exceed the upper control limit (UCL), and 2 data in April and May 2022 which exceed the lower control limit (LCL). The main causal factors that contribute to this damage include humans, machines, materials, work methods, and environmental factors. The most dominant problems are sewing defects and loading defects.

This research resulted in an overall reduction in defects from 5.84% to 3.19%, meaning a decrease of 45.4%. Meanwhile, dominant defects, namely sewing defects, decreased by 30.8% and loading defects decreased by 24.5%. Then the results of the P-chart analysis after improvements showed no deviations in the percentage of defects during 2023. The improvement actions that have been carried out in quality control have succeeded in controlling the quality control chart and can overcome deviations that occur. In future research, the researcher recommends continuing comprehensive defect improvement using the Lean Manufacturing method. Using the Lean concept approach can reduce waste in non-value-added activities in each section.

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