SITEKIN: Jurnal Sains Teknologi dan Industri, Vol. 20, No. 2, June 2023, pp.800 – 808
ISSN 2407-0939 print/ISSN 2721-2041 online

Analysis Quality Control In Rice Packing Projects To Reduce Defects Using Methods Statistical Quality Control (SQC)

Muchammad Rif'an Aziz[1], Moh. Jufriyanto[2], Hidayat [3]
[1.2.3] Industrial Engineering Study Program, Faculty of Engineering, University of Muhammadiyah Gresik
Jl. Sumatra No.101, Mt. Malang, Randuagung, Kebomas District, Gresik Regency, East Java, 61121
Email: Rifanaziz443@gmail.com

ABSTRACT

The industry is growing rapidly, indirectly forcing business actors to pay attention to the quality of the goods they produce during the production process. Companies must maintain the quality of their products because quality affects how satisfied customers are with a product. PT. XYZ is a company engaged in steel construction and fabrication. The problems that often occur are defects such as Overlap welding defects, Porosity welding defects, and unavoidable Cutting process defects. This study aims to determine the level of damage, identify the factors that cause damage and recommend corrective actions. Statistical quality control methods are used to identify the causes of defects in the production process, with statistical tools including: check sheets, histograms, Pareto charts, Control Chart diagrams, and fishbone diagrams. The results showed that product damage or defects were within reasonable limits but corrective action was needed to reduce defects. It can be seen from the Pareto diagram that the Overlap welding defects are 37.5% more than all product defects. Proposed improvements that need to be implemented by the company are cleaning the material before welding, performing treatment on the welding wire according to the Quality Control department's recommendations, checking the machine's stability before use and carrying out machine maintenance once a week.

Keywords: *Quality control, defective products, statistical quality control, Pareto diagrams, Fishbone diagrams*

Introduction

The industry is growing rapidly, indirectly forcingbusiness actors to pay attention to the quality of the goods they produce during production[1]. Companies must maintain the quality of their products because quality affects how satisfied customers are with a product because quality goods can satisfy customer demands. So businesses must maintain the quality of their products [2]. The company has worked hard to provide good product quality, but product quality problems still occur frequently during the production process. Due to problems in the production process, product quality is still not suitable so that it is classified as a defective product [3]

Quality control is a company's technique and strategy to compete globally with other products [4]. Companies must control quality to maintain and direct product quality [5]. Therefore, every company must implement controls to ensure that the goods' quality meets the company's requirements. Product errors can be reduced by quality control, which starts with raw materials and goes through the process to finished goods [6]. Lack of quality control can result in financial losses for companies due to higher production costs [7]

PT. XYZ is a company engaged in steel construction and fabrication. In accordance with the client's specifications, PT. XYZ performs work sequences from several components and assembles them into one complete component. Packing Rice product is one of the items created by PT. XYZ used by PT. XY, but from observations, there are still obstacles in making packing rice. there is still a product defect of 9.5% with the specifications set by the company at 0.5%. It was identified that the causes of defects in packing rice products were Overlap Welding Defects, Porosity Welding Defects, Cutting Process defects, which are the main sources of defects in Packing Rice Products [8]. PT must control its products' quality before it reaches consumers. XYZ to reduce product errors [9]

After knowing the existing problems, the researchers chose the method of solving Statistical Quality Control problems, also known as SQC [10]. The purpose of Statistical Quality Control (SQC), is a problem-solving strategy to improve manufacturing quality by monitoring, controlling, analyzing, managing and improving Products [11]. A company's ability to satisfy customers and remain competitive depends on quality control. Several quality control techniques existbut this research uses statistical quality control, which utilizes statistics to overcome the problems found [12]. Using statistical methods for quality control is a great way to monitor productivity levels and can also be used to inspect and approve various items produced to prevent defects [13]. Using five statistical tools including check sheets, histograms, Pareto Charts, control chart charts, and Fishbone Charts [14].

Following are some similar studies that discuss quality control, including according to [15] in his research entitledImplementation of Statistical Quality Control to Reduce Defects in Mabell Nugget Products can be concluded: 1. The defects in the nugget product are shape defects, taste defects, and texture defects, 2. Observations found that the main type of defect in the production process is a deformity of 45.76%, 3. Factors causing product defects The nugget consists of machine and material factors. As the relevance of subsequent research, in research [16] entitledDefect analysis on PVC pipe using Statistical Quality Control (SQC) approach to reduce defectsit can be concluded: 1. Defects in PVC pipe products are melting defects, crack defects and perforated defects, 2. Observations found that the main type of defects in the production process were fatigue defects of 46.8%, 3. Factors causing the occurrence of PVC pipe melting defects consists of human factors, machines, materials and methods.

Based on the background above, the problems faced by PT can be identified. XYZ include production discrepancies in Packing Rice products and quality control processes that have not been properly maintained and quality maintained. This study aims to identify the main causes of product damage by analyzing the level of damage to rice packaging products. PT. XYZ. After finding the problem, a suggested solution will be given in relation to the problem at hand..

Research Methods

This research was conducted at PT. XYZ in August and September 2022. Both primary and secondary data are required for the data source for this study. Through interview techniques with the head of the Quality Control department, data will be analyzed using various SQC Statistical Quality Control tools used as follows:

1. *Check Sheet*
   is a data collection sheet that is used to facilitate and simplify data recording. Check Sheets can be used to find out the distribution of the production process, find out the number of defective products, the location of the defects, and the causes of the defects [17]
2. Histogram
   A bar chardisplays some data grouped into several categories at certain intervals [18].
3. Pareto Charts
   Is to identify the problems found from the largest block to the smallest. Its purpose is to help focus on the most common problems in the product. The way it works is by entering the defect data and the amount of production, then looking for calculations looking for the cumulative value, then the results of these calculations are made into a graph[19]
4. *Control chart*
   Is a graph to describe changes over time and illustrate the stability of the work process. The way to do this is to find out which reject products are produced in the production process [20]
   a. Upper Control Limit (UCL) is the allowable deviation control limit [21]
   b. Central line *(CL)* serves as a signal indicating that there is no deviation from the characteristic quality associated with the state of control [22]
   c. Lower control limit (LCL) is the lower control limit determined using standard values [23]
5. Cause and effect diagrams
   This diagram, also called a fishbone diagram or Fishbone diagram, is a cause and effect diagram tool to identify the cause of each problem. It is divided into 2 parts, namely the causes or factors that cause disability and the consequences or problems that arise as a result of these causes[24], [25]

Results and Discussion

Check sheet

namely a simple tool whose purpose is to facilitate the collection and grouping of data to be processed, so that it can be easily understood. Check sheet research data for August – September 2022 is shown in Table 1.

Table 1. Data checksheet. 2022

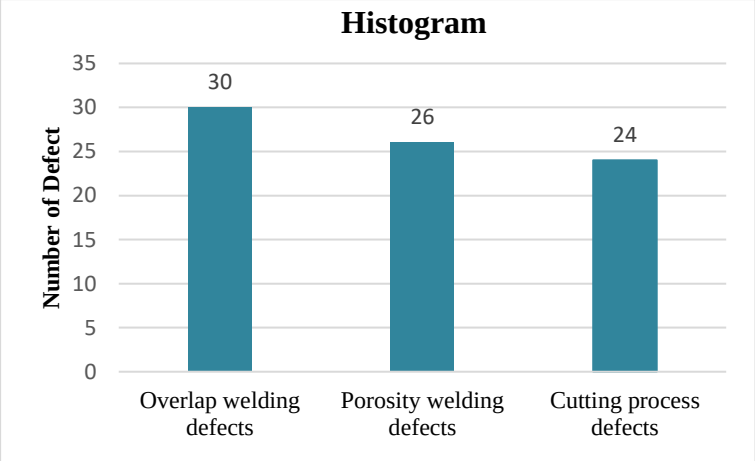
Year	Data/Week	Total Production (Unit)	Type of Disability			Number of Defects
			Overlap welding defects	Porosity welding defects	Cutting Process	
2022	Week 1	1	6	5	4	15
	Week 2	1	6	6	5	17
	Week 3	1	7	4	6	17

Week 4	1	5	6	5	16
Week 5	1	6	5	4	15
Amount	5	30	26	24	80
Average	1				16.00

From the results of Table 1, it can be seen that the total production of PT. XYZ as many as 5 products, with 3 variations of defects, namely 30 defects overlapping welding defects, 26 defects Porosity welding defects, 24 defects in the cutting process, and a total of 80 defects.

Histogram

A histogram or bar chart is a tool for displaying data in a certain period and frequency. The recapitulation of product defect data from the research results is shown in Figure 1. It explains the defects in rice packing products, sorted from largest to smallest.



Picture1. Data Histogram Charts

In the data histogram diagram in Figure 1. it can be seen that the most common type of defect is welding defects. Overlap has 30 defects, 26 in porosity welding and 24 in the cutting process.

Pareto Charts

Pareto charts are bar graphs and line graphs that illustrate how data types compare to the whole. The function of the Pareto chart is to identify the leading quality improvement problems from the largest to the smallest. The Pareto diagram for production in August-September 2022 for types of defects using Minitab software can be seen in Figure 2.

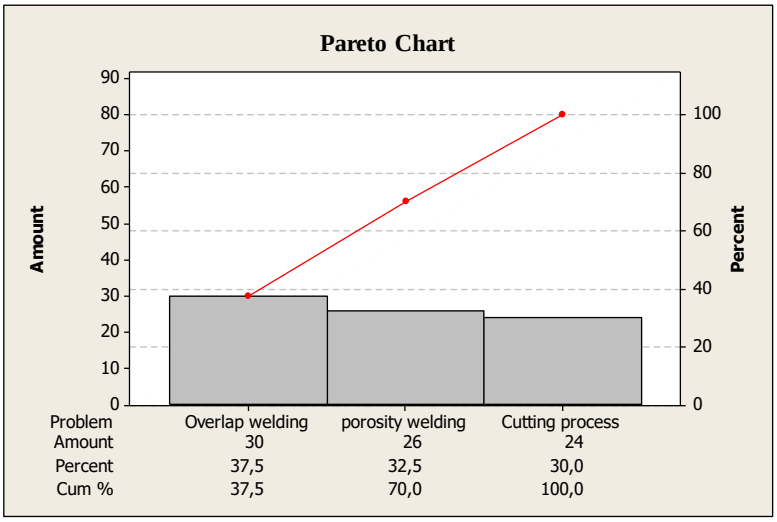


Figure 2. Pareto ChartsPacking Rice.

It can be seen in Figure 2 shows the types of defects that often occur in August – September 2022, namely Overlap welding defects are in first position with a defect percentage of 37.5% with a cumulative value of 37.5%, porosity welding is in 2nd place with the percentage of defects is 32.5% with a cumulative value of 70.0% and third place in the Cutting process is in 3rd place with a percentage of defects of 30% with a cumulative value of 100%. It was concluded that the types of defects that had the highest percentage were Overlap welding, followed by porosity welding and cutting processes.

Control chart diagrams

Control chart is a statistical tool used to determine the manufacturing process under controlled conditions. The control chart contains UCL or upper control limit, CL or control center, LCL or lower control limit and P or the proportion of managed data. If there is data that exceeds the control limit, it can be corrected immediately

Table 2. Control chart calculation data.

Observation to	Number of samples	total disability	Proportion	CL	UCL	LCL
1	1	15	0.067	0.063	0.789	-0.664
2	1	17	0.059	0.063	0.789	-0.664
3	1	17	0.059	0.063	0.789	-0.664
4	1	16	0.063	0.063	0.789	-0.664
5	1	15	0.067	0.063	0.789	-0.664
∑	5	80				
P	16,00					

The following is a description and formula from Table 2.

$$p = \frac{np}{p} \quad (1)$$

$$p = \frac{np}{p} = \frac{1}{15} = 0{,}067$$

Information:

P : The value of the proportion of defects
np : The number of defective products in each certain period
p : Sample data on the amount of production examined in a certain period

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

$$CL = \bar{p} = \frac{\sum np}{\sum n} = \frac{5}{80} = 0{,}063$$

Information:

CL: Center line or center line
$\bar{p}$: Average product defects from total production
$\sum np$: Overall value of defective products
$\sum n$: The overall value of the examined sample data

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

$$UCL = 0{,}063 + 3\frac{\sqrt{0{,}063\ (1-0{,}063)}}{1} = 0{,}789$$

Information:

UCL:*Upper control limit*or upper control limits
$\bar{p}$: Average product defects of the total number of products
n : The total amount in a certain period

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

$$LCL = 0{,}063 - 3\frac{\sqrt{0{,}063(1-0{,}063}}{1} = -0{,}664$$

Information:

LCL: Lower control limit or lower control limit
$\bar{p}$: : Average product defects of the total production
n : Total production in each period

A P-chart diagram is obtained from the calculation results in Table 2, as shown in Figure 3.

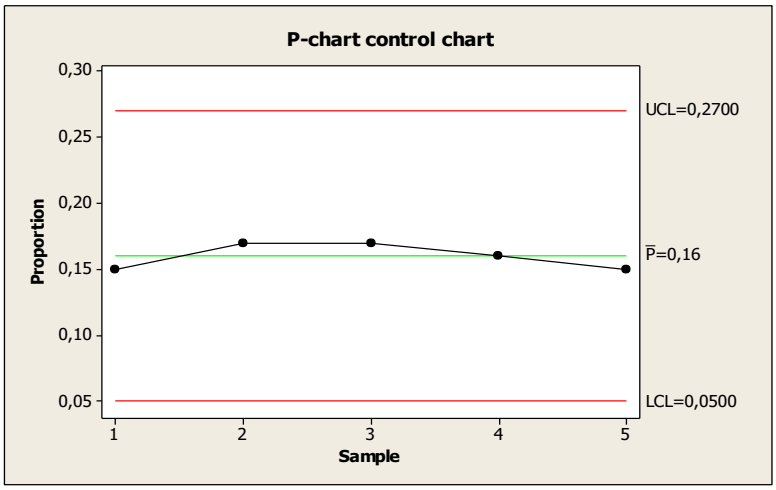


Figure 3. P-chart control chart

From Figure 4, there are no coordinate points found on P or the proportion that crosses the UCL line, the upper control limit, and LCL If the control limit is below, the disability can still be controlled.

Cause and effect diagrams

Cause-and-effect diagrams, or fishbone, are used to analyze/find out what factors cause damage to the product. Figures 4, 5, and 6 show the causal diagrams for each defect and the proposed corrective actions in Tables 3, 4 and 5

1. Defect Overlap fishbone diagrams

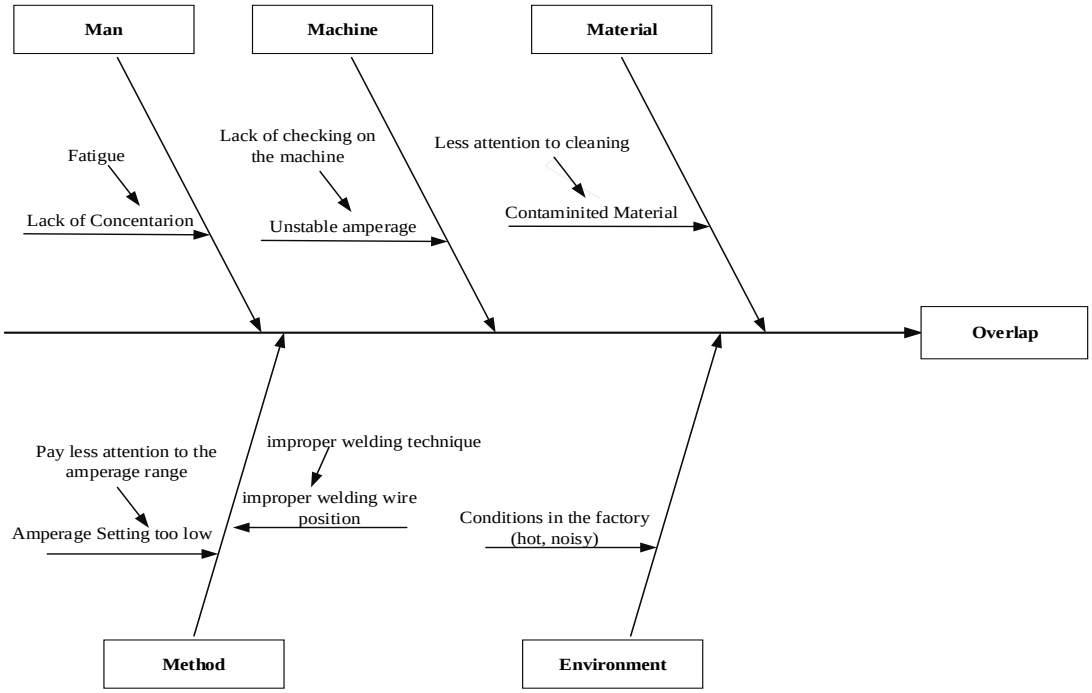


Figure 4. Fishbone Defect Overlap Diagrams

Table 3. Proposed Actions for Repairing Overlap Defects

Factor	Causative factor	Proposed improvements
Man	Lack of Contest	Provide training and warning to operators
Machine	Ampere Unstable	Check the amperage stability every time you are going to carry out welding work
Material	Contaminated material	Clean the material before welding
Method	Welding technique is not correct	Make a good welding Standard Operating Procedure (SOP) method
	Less attention to the amperage range	
Environment	Conditions in the factory (hot, noisy)	Use of personal protective equipment for workers so as not to be disturbed by noise from the production process

Based on the results of the Fishbone diagram analysis in Figure 4, the improvement plan stage that can be carried out to anticipate the potential for Overlap Welding Defects to occur is sourced from the method so that it is necessary to make improvements such as Providing counseling about standard operating procedures implemented by the company.

2. Fisbone Defect Porosity Diagram

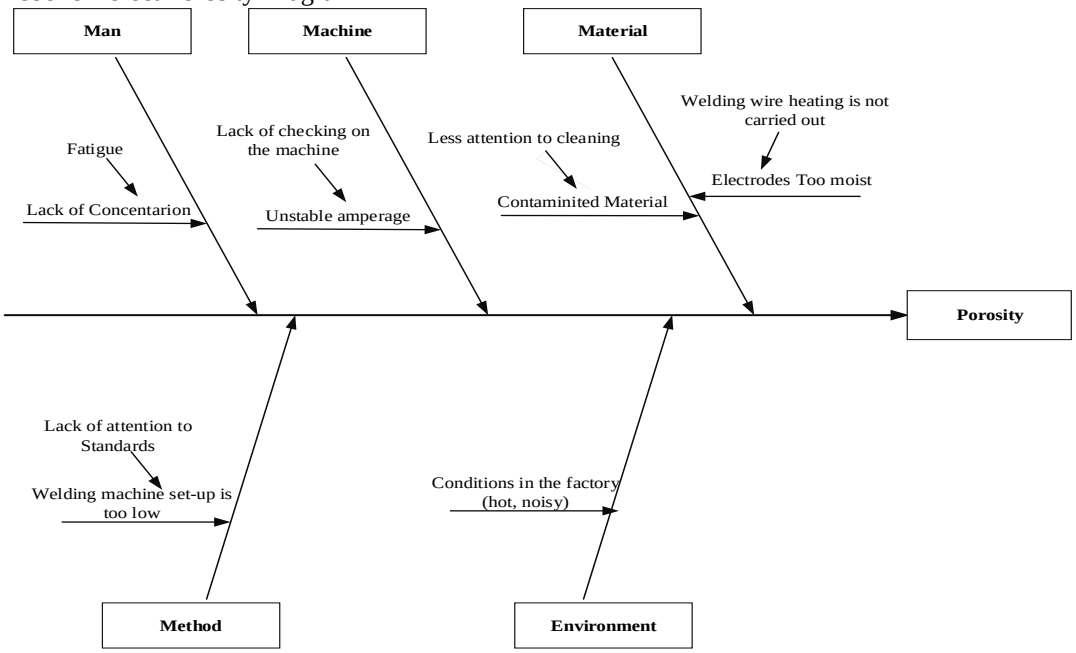


Figure 5. Fishbone Defect Porosity Diagram

Table 4. Proposed Actions to Repair Defect Porosity

Factor	Causative factor	Proposed improvements
man	Lack of Contest	Provide training and warning to operators
Machine	Ampere Unstable	Check the amperage stability every time you are going to carry out welding work
Material	Contaminated material	Clean the material before welding
	The electrode is too moist	Perform treatment on welding wire according to QC recommendations
Method	Welding machine set-up is too low	Make a good welding SOP method
Environment	Conditions in the factory (hot, noisy)	Use of personal protective equipment for workers so as not to be disturbed by noise from the production process

Based on the results of the analysis of the Fishbone diagram in Figure 5, the stages of improvement plans that can be carried out to anticipate the potential occurrence of Porosity Welding Defects are sourced from raw materials so it is necessary to make improvements such as cleaning the material before welding and conducting treatment on welding wire according to the recommendations of the Quality Control department.

3. Diagram *fishbone* Proses *Cutting*

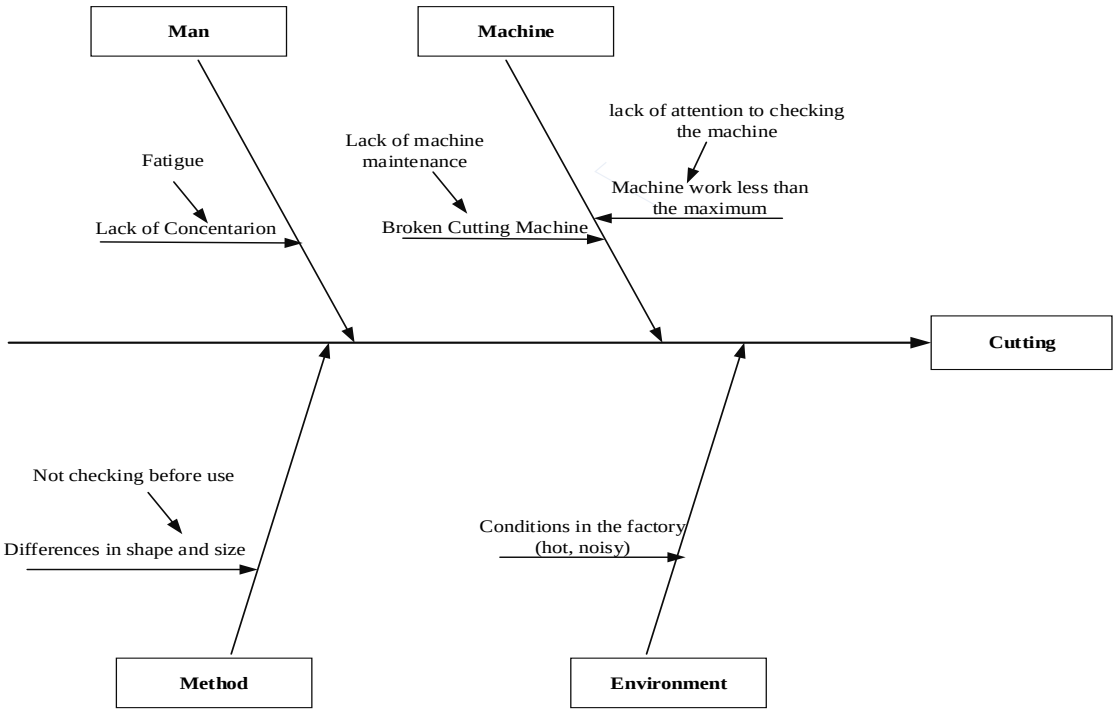


Figure 6. Fishbone Defect Diagram for Cutting Process

Table 5. Proposed Actions for Repairing Cutting Process Defects

Factor	Reason	Proposed improvements
Man	Lack of Contest	Provide training and warning to operators
Machine	Broken Cutting Machine	Perform machine maintenance once a week
	Machine work less than the maximum	Perform maintenance and repair of machines before and after use
Method	Differences in shape and size	Check the machine before the activity takes place
Environment	Conditions in the factory (hot, noisy)	Use of personal protective equipment for workers so as not to be disturbed by noise from the production process

Based on the results of the analysis of the Fishbone diagram in Figure 6, the stage of the improvement plan that can be carried out to anticipate the potential occurrence of defects in the cutting process is that it originates from the engine, so it is necessary to make improvements such as checking the stability of the machine before use and carrying out machine maintenance once a week.

Conclusion

At PT. By using the statistical quality control method, XYZ shows that the most dominating defect level is the Overlap Welding defect, which is as many as 30 defects with a percentage of 37.5%found in the results of the Pareto chart. Defects in packing rice products show the proportion value that does not exceed the upper control limit (UCL) or lower control limit (LCL) on the P chart indicating that the appearance of this defect is still under control. Method factors, raw material factors and machine factors. Furthermore, the improvements that PT must make. XYZ that needs to be implemented is, Providing counseling about the standard operating procedures implemented by the company, Cleaning the material before welding, Performing Treatment on the welding wire according to the recommendations of the Quality Control department Conducting checks on the stability of the machine before use and carrying out machine maintenance once a week

References

[1] C. I. Parwati and R. M. Sakti, "Pengendalian Kualitas Produk Cacat Dengan Pendekatan Kaizen Dan Analisis Masalah Dengan Seven Tools," 2012.

[2] U. E. Siregar and Y. Setiawannie, "Analisa Pengendalian Kualitas Produk Benang Dengan Metode Statistical Quality Control di PT. X Analysis of Yarn Product Quality Control With Statistical Quality Control Method at PT. X," *IESM Journal*, vol. 2, no. 2, 2021.

[3] B. Harahap, L. Parinduri, A. Ama, and L. Fitria, "Analisis Pengendalian Kualitas Dengan Menggunakan Metode Six Sigma (Studi Kasus : PT. Growth Sumatra Industry)," Online, 2018.

[4] M. Widya, W. Sulastri, D. Eko, and A. Kurniawan, "Analisis Peta Kendali Variabel Pada Pengolahan Produk Minyak Sawit Dengan Pendekatan Statistical Quality Control (SQC)."

[5] M. Syarif, H. Elmas, P. Manajemen, F. Ekonomi, and U. Probolinggo, "Pengendalian Kualitas Dengan Menggunakan Metode Statistical Quality Control (SQC) Untuk Meminimumkan Produk Gagal Pada Toko Roti Barokah Bakery," 2017.

[6] F. Farchiyah, “Analisis Pengendalian Kualitas Spanduk Dengan Metode Seven Quality Control Tools (7 QC) Pada Pt. Fajar Interpratama Mandiri (Fim Printing).”
[7] R. Akbar *et al.*, “Analisis Kecacatan Produk Meja Plywood Menggunakan Metode Seven Tools (Studi Kasus: Teaching Factory SMK Manbaul Ulum),” vol. 19, no. 2, pp. 195–202, 2022.
[8] M. Bachtiar, S. S. Dahdah, and D. E. Ismiyah, “Analisis Pengendalian Kuaitas Produk Pap Hanger Menggunakan Metode Six Sigma Dan Fmea Di Pt. Ravana Jaya Manyar Gresik,” vol. 1, no. 4, 2020.
[9] K. Zilfianah, E. Ismiyah, and A. W. Rizqi, "Quality Control Analysis on Steel Construction Projects Using the Method Statistical Quality Control and Failure Mode and Effects Analysis Analisis Pengendalian Kualitas Pada Proyek Kontruksi Baja Menggunakan Metode Statistical Quality Control dan Failure Mode and Effects Analysis," no. 5, doi: 10.46574/motivection.v5i1.174.
[10] N. Hairiyah, R. Rizki Amalia, E. Luliyanti, J. Ahmad Yani, and T. Laut, “Analisis Statistical Quality Control (SQC) pada Produksi Roti di Aremania Bakery Statistical Quality Control (SQC) Analysis of Bread Production at Aremania Bakery,” *Jurnal Teknologi dan Manajemen Agroindustri*, vol. 8, pp. 41–48, 2019, doi: 10.21776/ub.industria.2019.008.01.5.
[11] R. Ardiansyah, A. W. Rizqi, and Moh. D. Kurniawan, "Quality Control Using Statistical Quality Control (SQC) Approach On Bag Products of UD. FGH," *MOTIVECTION: Journal of Mechanical, Electrical and Industrial Engineering*, vol. 4, no. 2, pp. 129–140, Jun. 2022, doi: 10.46574/motivection.v4i2.118.
[12] A. Saepul Milah, “Analisis Pengendalian Kualitas Produk Eq Spacing Dengan Metode Statistic Quality Control (SQC) Dan Failure Mode And Effects Analysis (FMEA) Pada PT. Sinar Semesta,” *Jurnal Teknologi dan Manajemen Industri Terapan (JTMIT)*, vol. 1, no. 3, pp. 183–201, 2022.
[13] K. Husein and R. Rochmoeljati, “Meminimasi Cacat Produk Bogie Tipe S2e-9c Menggunakan Metode Statistical Quality Control (SQC) Dan Failure Mode Effect Analysis (FMEA) Pada PT XYZ,” 2021.
[14] A. Nurdinia, S. L. Salmia A, and P. Studi Teknik Industri, “Pengendalian Kualitas Kerajinan Kayu Dengan Statistical Quality Control (SQC) Pada UD. Dua Putra Putri,” *Jurnal Mahasiswa Teknik Industri*, vol. 4, no. 1, 2021.
[15] R. Alfatiyah, S. Bastuti, and D. Kurnia, "Implementation of statistical quality control to reduce defects in Mabell Nugget products (case study at Pt. Petra Sejahtera Abadi)," in *IOP Conference Series: Materials Science and Engineering*, Jul. 2020, vol. 852, no. 1. doi: 10.1088/1757-899X/852/1/012107.
[16] R. Ginting and S. Supriadi, "Defect analysis on PVC pipe using Statistical Quality Control (SQC) approach to reduce defects (Case Study: PT. XYZ)," *IOP Conf Ser Mater Sci Eng*, vol. 1041, no. 1, p. 012040, Jan. 2021, doi: 10.1088/1757-899x/1041/1/012040.
[17] T. P. Matondang and M. M. Ulkhaq, “Aplikasi Seven Tools untuk Mengurangi Cacat Produk White Body pada Mesin Roller,” *Jurnal Sistem dan Manajemen Industri*, vol. 2, no. 2, p. 59, Dec. 2018, doi: 10.30656/jsmi.v2i2.681.
[18] A. Ishak, K. Siregar, R. Ginting, and A. Manik, "Analysis Roofing Quality Control Using Statistical Quality Control (SQC) (Case Study: XYZ Company)," in *IOP Conference Series: Materials Science and Engineering*, Dec. 2020, vol. 1003, no. 1. doi: 10.1088/1757-899X/1003/1/012085.
[19] G. Suci Ramadhani, M. Jurusan Statistika FSM Undip, and S. Pengajar Jurusan Statistika FSM Undip, “Analisis Pengendalian Kualitas Menggunakan Diagram Kendali Demerit (Studi Kasus Produksi Air Minum Dalam Kemasan 240 ml di PT TIW),” vol. 3, no. 3, pp. 401–410, 2014, [Online]. Available: http://ejournal-s1.undip.ac.id/index.php/gaussian
[20] H. Anbar Fadhilah, “Analisa Pengendalian Kualitas Produk Packaging Karton Box PT. X dengan Menggunakan Metode Statistical Quality Control,” *Serambi Engineering*, vol. VII, no. 2, 2022.
[21] G. Putra and R. Rosalinda, “Analisis Ukuran Batubara Menggunakan Metode Statistical Quality Control di PT. Mifa Bersaudara,” vol. 6, 2020.
[22] M. Henry Cipta Dinata, A. Pengendalian Kualitas Produk, and D. Andesta, “Mengurangi Kecacatan Produk Menggunakan Metode Statistik Quality Control (SQC) Analysis Of Quality Control Of Pt. Ajg Iron Stairs Products To Reduce Product Defects Using Statistical Quality Control (SQC) Methods.” [Online]. Available: https://ojs.uniska-bjm.ac.id/index.php/jieom/index
[23] A. Rucitra, S. Fadiah, P. Studi Teknologi Industri Pertanian, and F. Teknologi Pertanian, “Penerapan Statistical Quality Control (SQC) Pada Pengendalian Mutu Minyak Telon (Studi Kasus Di PT.X),” 2019.
[24] A. Mulia Rani and W. Setiawan, “Menganalisis Defect Sanding Mark Unit Pick Up Tmc Dengan Metode Seven Tools PT. ADM,” *JISI : Jurnal Integrasi Sistem Industri Volume*, vol. 3, no. 1, 2016, doi: 10.24853/jisi.4.1.pp-pp.
[25] E. Suprianto, “Pengendalian Kualitas Produksi Menggunakan Alat Bantu Statistik (Seven Tools) Dalam Upaya Menekan Tingkat Kerusakan Produk,” 2016.