Indonesian Journal of Computer Science
ISSN 2549-7286 (*online*)
Jln. Khatib Sulaiman Dalam No. 1, Padang, Indonesia
Website: ijcs.stmikindonesia.ac.id | E-mail: ijcs@stmikindonesia.ac.id

Analysis of The Quality of Plastic Sack Products using the Statistical Quality Control (SQC) Method

Rizquina Aldila Putri[1], Dwi Sukma Donoriyanto[2]
raldilaputri@gmail.com, dwisukma.ti@upnjatim.ac.id
[12]Department of Industrial Engineering, Pembangunan Nasional Veteran Jawa Timur University

Article Information

Submitted : 4 Apr 2024
Reviewed: 21 Apr 2024
Accepted : 30 Apr 2024

Keywords

Statistical Quality Control, Quality Control, Defect

Abstract

PT. XYZ produces 2 products, namely outer bags and inner bags. Currently, the company is facing an issue where the number of defective products exceeds the company's standards. The research carried out aims to determine and measure the level of product quality and provide appropriate product improvement suggestions for quality control problems in plastic sack products in PT. XYZ. The method used is statistical quality control (SQC). Based on the results, there are each type of defect at each production stations. The defects that affect product quality are 14,541 kg of holey film defects, 13,849 kg of uneven threads, 22,706 kg of outgoing threads, 17,876 kg of jagged webbing, 10,186 kg of misprinting, 8,846 kg of faded colors, 11,323 kg of inner holes. , and opened seal of 3,206 kg. There are suggestions for improvements that can be proposed for each defect by adjusting the factors in the fishbone diagram.

A. Introduction

Nowadays, the industrial sector plays an important role in fulfilling consumer satisfaction and needs [1]. Industrial business and manufacturing processes are one of the key factors in developing countries [2]. Therefore, quality is something that companies prioritize because it is the most basic factor for customer satisfaction [3]. In simple terms, quality means suitability for use. In other words, all customers expect the products and services they buy to meet their needs. Quality or suitability for use is determined through the interaction of design quality and conformity quality [4]. Of course, companies must pay attention to product quality and fulfil the criteria and rules to determine whether a product will be produced in the good category or if the product does not meet the requirements [5].

Quality issues have now become a global strategy in the industrial world to maintain competition between one industry and another. Industries that have and practice a good quality control program will be able to survive and succeed because a good quality control program can efficiently minimize inefficiencies and increase the industry's competitive ability in the universal market [6], [7]. Quality control is a system that verifies and monitors or maintains the required level of product and process quality through proper planning, use of correct equipment, continuous inspection, and corrective action when necessary [8]. Good quality is obtained from good methods and meets standards that have been set according to market requirements [9].

Statistical Quality Control (SQC) is a quality control effort using a statistical approach [10]. The main reason for using SQC is to identify the causes of cycle variations or errors through information investigation [11]. Today, SQC is used in a variety of industrial and service operations, not only those involving manufactured goods [12]. SQC is also used to monitor production quality, which can help a company produce products in controlled or uncontrolled processes such as material quality processes, quality product results and production results [13]. The SQC method can be used to determine errors in production caused by product defects or damage so that more action can be taken to overcome problems that result in damaged products [3], [10].

PT. XYZ is one of the work units of PT. Perkebunan Nusantara I Regional 4 is engaged in the plastic sack industry, which produces two products, namely outer bags and inner bags, some of the products of which are used for packaging sugar produced by PG-PG within the PT. Perkebunan Nusantara I Regional 4 environment. This company has a quality policy that emphasizes guaranteed quality and customer satisfaction as a top priority. To achieve this, PT. XYZ implements the ISO 9001:2015 quality management system [14]. However, in maintaining the quality of its production, PT. XYZ still often finds product defects that occur at several of its production stations, causing the number of defects to exceed the company's standard limits. Therefore, quality control has an important role in minimizing the number of product defects and can help to increase the efficiency of production activities at PT. XYZ.

Based on the problems experienced above, research entitled "Analysis of the Quality of Plastic Sack Products Using Statistical Quality Control (SQC) Methods in PT. XYZ" is expected to help the company overcome existing problems by providing appropriate improvement proposals to PT. XYZ for plastic sack product quality problems so that they can be resolved through Product Quality Control.

B. Research Method

Place and Time of Research

The research location for the preparation of this final assignment (thesis) was carried out in PT. XYZ is located in Persada Industry Blok S No.6, Jarang Sari, Lolawang, Ngoro District, Mojokerto Regency, East Java. The research will be carried out in January 2024 until the required data is sufficient.

Identification and Operational of Variables

In conducting a study, it is necessary to identify its variables. The related variables for the study are listed below about the study's title.

1. Dependent Variable

The dependent variable is a variable that is influenced or is a result of the existence of the independent variable [15]. In this research, the dependent variable is the quality level of plastic sack products.

2. Independent Variable

The independent variable is the variable that is the cause of changes in the dependent variable or is the main factor in the problem being studied. The independent variables in this research are as follows:

a. Amount of Production at the Production Station

Data on the amount of production from each station will be produced from January 2023 to December 2023.

b. Type and Number of Product Defects per Production Station

There are many types and numbers of product defects at each production station, the most dominant from January 2023 to December 2023.

Data Collection Methods

In conducting research, of course data collection is needed where the data collection methods used are as follows :

a. Interview

Interviews are the process of obtaining information for research purposes by means of questions and answers with the company, especially with the production and quality control departments directly.

b. Observation Method

Data will be collected by direct observation or by direct observation at the research location with the object being studied (product and type of defect that occurs and the causes and effects of the defect).

c. Documentation Method

Documentation is a data collection technique that supports interview and observation methods taken from documents or notes, namely defect-checking reports at production stations.

C. Result and Discussion

Data Collection

1. Production Data

Data on plastic sack production at each station in PT. XYZ from January 2023 to December 2023, namely as follows.

Table 1. Production Data for Each Production Station

Month	Production Station (Kg)				
	Extruder	Circular Loom	Printing	Blown Film	Sealing Cutting
January	57.527	98.433	83.129	33.378	16.185
February	69.262	98.776	107.789	42.473	20.032
March	99.654	98.762	143.839	45.076	15.798
April	82.047	85.067	138.096	41.626	14.510
May	99.320	109.876	162.532	53.733	12.171
June	105.647	97.427	129.445	53.162	15.135
July	101.327	105.033	120.816	51.962	12.282
August	106.140	115.747	118.796	51.415	14.853
September	121.685	130.990	120.365	51.331	12.377
October	126.493	123.586	122.485	44.555	12.930
November	88.080	104.494	112.164	45.346	13.711
December	83.964	106.678	108.699	42.497	12.191
Total	1.141.146	1.274.869	1.468.155	556.554	172.175

2. Defect Data for Each Production Station

Below is data on the number of defects in 2023 at the PT. XYZ production station in table 2. as follows.

Table 2. Defect Data for Each Production Station

Month	Production Station Defect				
	Extruder	Circular Loom	Printing	Blown Film	Sealing Cutting
January	1443	2800	1072	727	273
February	1648	3638	1436	873	225
March	2633	3064	2039	968	219
April	2025	2921	1588	982	396
May	2736	3507	2038	1054	249
June	2590	3514	1868	1079	252
July	2532	3200	1439	885	257
August	2150	3583	1630	935	376
September	3077	3986	1585	1039	233
October	3040	3753	1543	959	245
November	2502	3198	1372	971	288
December	2014	3418	1422	851	193
Total	28390	40582	19032	11323	3206

Data Processing

Data processing in this research uses the Statistical Quality Control (SQC) method, which is used to complete the five production stations in PT. XYZ.

1. Extruder Station

a. Checksheet

Table 3. Extruder Station Checksheet

No	Month	Type of Defect	Total

		Total Production	Hole Film	Uneven Thread	
1.	January	57.527	789	654	1.443
2.	February	69.262	879	769	1.648
3.	March	99.654	1.411	1.322	2.733
4.	April	82.047	1.032	993	2.025
5.	May	99.320	1.154	1.582	2.736
6.	June	105.647	1.247	1.343	2.590
7.	July	101.327	1.276	1.256	2.532
8.	August	106.140	952	1.093	2.045
9.	September	121.685	1.754	1.123	2.877
10.	October	126.493	1.844	1.096	2.940
11.	November	88.080	1.166	1.436	2.602
12.	December	83.964	1.037	977	2.014
	Total	1.141.146	14.541	13.644	28.185

b. Histogram

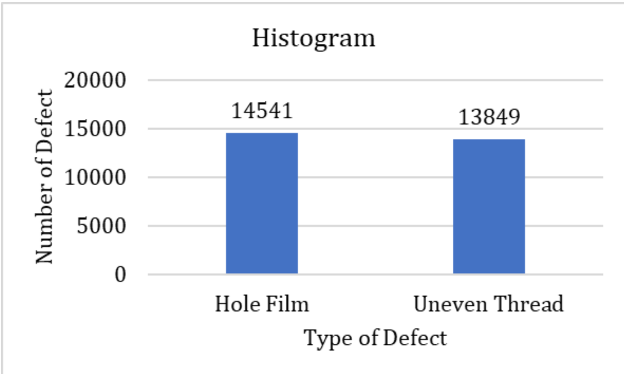

Figure 1. Extruder Station Histogram

Based on Figure 1, it can be seen that the sequence of intervals for the type of each defect that occurs most frequently is perforated film defects at 14,541 kg, followed by uneven thread defects at 13,644 kg.

c. Pareto Diagram

Table 4. Extruder Station Pareto Diagram

Type of Defect	Total Defect (Kg)	Percentage	Cumulative Percentage
Hole Film	14.541	51.6%	51.6%
Uneven Thread	13.644	48.4%	100%
Total	28.185	100%	

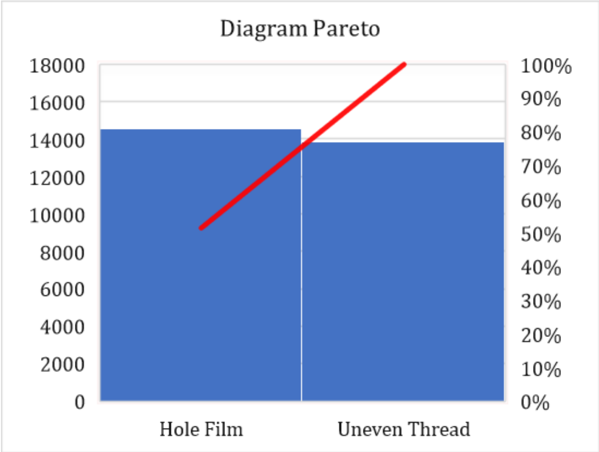

Figure 2. Extruder Station Pareto Diagram

Based on Figure 2, it can be seen that the most dominant type of defect in terms of cumulative percentage is a perforated film, with a rate of 51.6%, followed by uneven thread defects, with a percentage of 48.4%.

d. Process Diagram

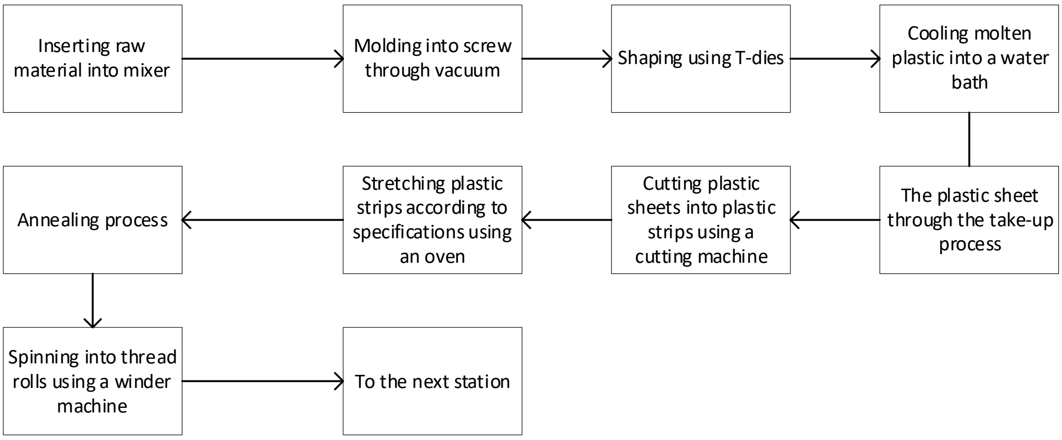

Figure 3. Extruder Station Process Diagram

e. Scatter Diagram

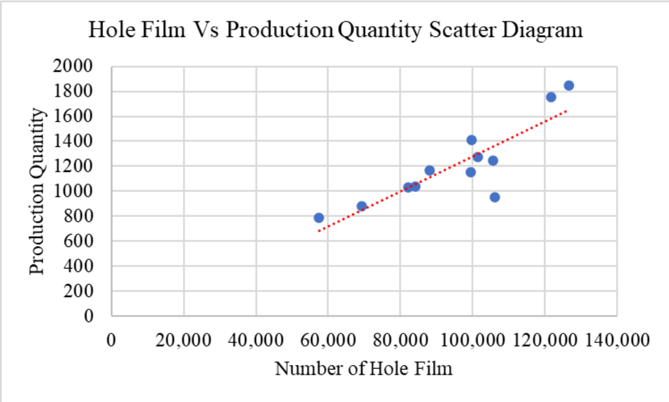

Figure 4. Perforated Film Scatter Diagram

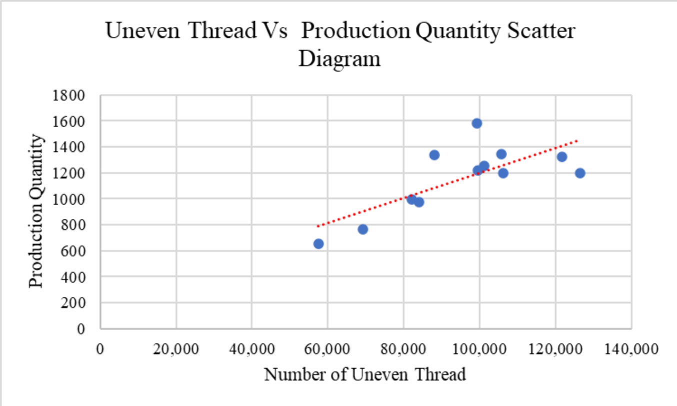

Figure 5. Uneven Thread Scatter Diagram

Based on the graphic form produced in Figures 4 and 5, the scatter diagram has a positive relationship (positive correlation) where an increase in variable So it can be seen that the scatter diagram shows that there is a strong relationship between perforated film defects and uneven thread defects and production quantities.

f. Fishbone Diagram

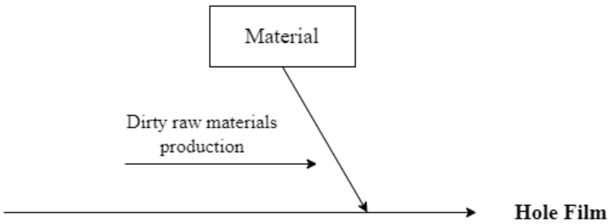

Figure 6. Hole Film Fishbone Diagram

The cause of defects from a material perspective is dirty raw materials. During the process of pouring raw materials, there are usually particles or gravel that can cause the melt to be uneven, which can cause holes in the film.

The recommendations for improvements that can be made are sorting and checking the raw materials first so that while inserting the raw materials into the mixer, it is ensured that the raw materials are clean and there are no dirty particles.

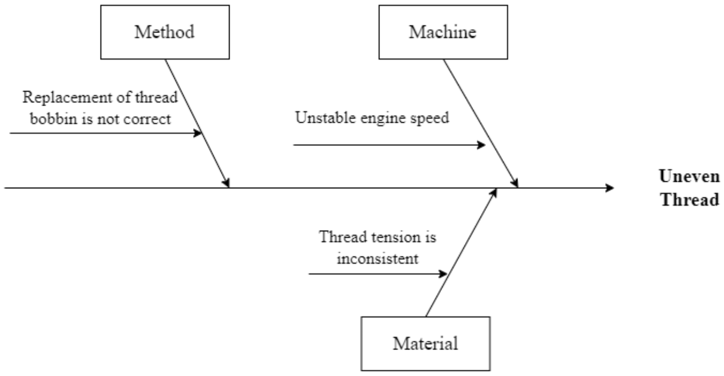

Figure 7. Uneven Thread Fishbone Diagram

The cause of the defect in terms of the method is that the thread bobbin is replaced incorrectly, which can cause uneven thread spinning results. The second thing from a machine perspective is that the machine speed is unstable, which causes the spinning process to cause tangled threads, making the spinning results uneven. And the third, from a material perspective, is inconsistent thread tension, which ultimately means that the plastic thread being spun during the spinning process can come out of line and produce uneven results.

The recommendations for improvements that can be made are by providing training to operators in terms of supervising the yarn spinning process so that the bobbins used are confirmed to be correct and according to procedures, secondly by regularly maintaining the winder machine so that the process and results in yarn spinning are following standards and reduce yields. Defects and the third is to monitor the raw material input process further so that the composition remains consistent and the resulting plastic pieces have the same stress.

2. Circular Loom Station

a. Checksheet

Table 5. Circular Loom Station Checksheet

No	Month	Total Production	Type of Defect		Total
			Thread Out	Serrated Woven	
1.	January	98,433	1735	1065	2800
2.	February	98,776	1853	1785	3638
3.	March	98,762	1854	1210	3064
4.	April	85,067	1712	1209	2921
5.	May	109,876	1887	1620	3507
6.	June	97,427	2152	1362	3514
7.	July	105,033	1455	1745	3200
8.	August	115,747	1998	1585	3583
9.	September	130,990	2220	1766	3986
10.	October	123,586	1964	1789	3753
11.	November	104,494	2011	1187	3198
12.	December	106,678	1865	1553	3418
Total		1,274,869	22706	17876	40582

b. Histogram

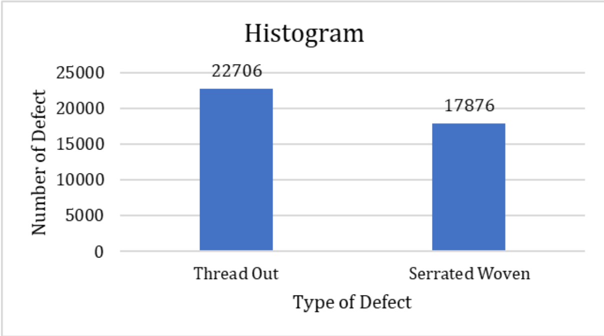

Figure 8. Circular Loom Station Histogram

Based on Figure 8, it can be seen that the sequence of intervals for the type of each defect that occurs most frequently is thread-out defects, amounting to 22,706 kg, followed by serrated woven defects, amounting to 17,876 kg.

c. Pareto Diagram

Table 6. Circular Loom Station Pareto Diagram

Type of Defect	Total Defect (Kg)	Percentage	Cumulative Percentage
Thread-Out	22.706	56%	56%
Serrated Woven	17.876	44%	100%
Total	40.582	100%	

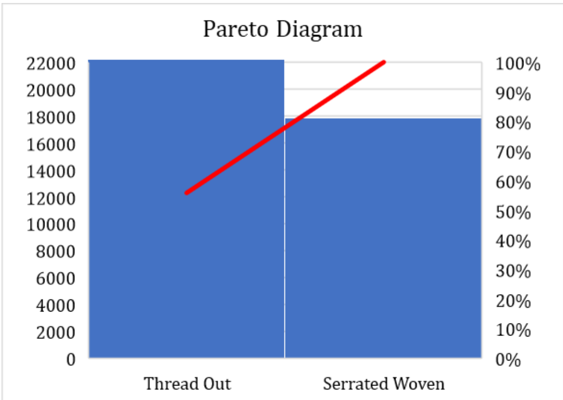

Figure 9. Circular Loom Station Pareto Diagram

Based on Figure 9, it can be seen that the most dominant type of defect in terms of cumulative percentage is thread out, with a percentage of 56%, followed by serrated woven defects, with a percentage of 44%.

d. Process Diagram

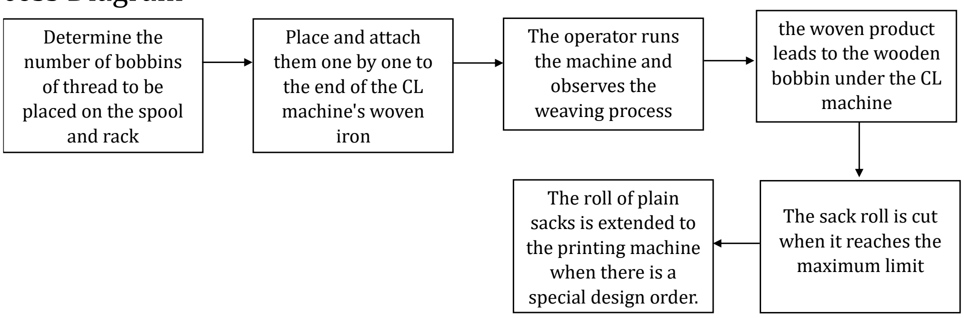

Figure 10. Circular Loom Station Process Diagram

e. Scatter Diagram

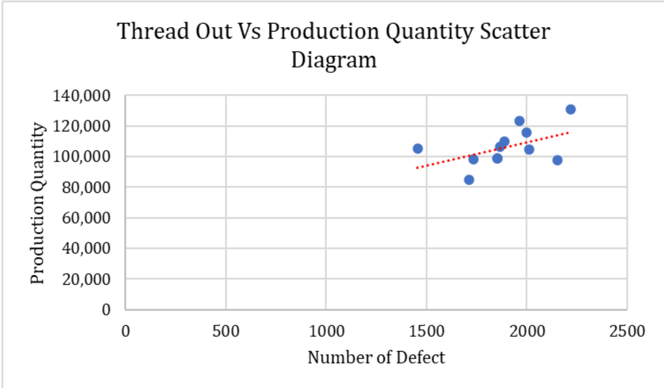

Figure 11. Thread Out Scatter Diagram

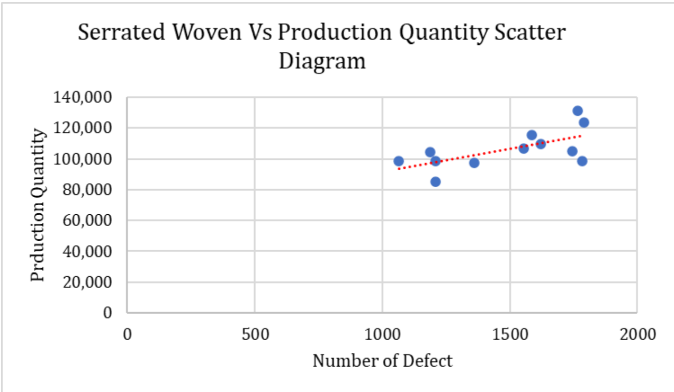

Figure 12. Serrated Woven Scatter Diagram

Based on figures 11 and 12, the resulting graph is a scatter diagram with a positive relationship (positive correlation) with an increased variable. So, there is a strong relationship between outgoing thread defects and serrated woven defects with production quantities.

f. Fishbone Diagram

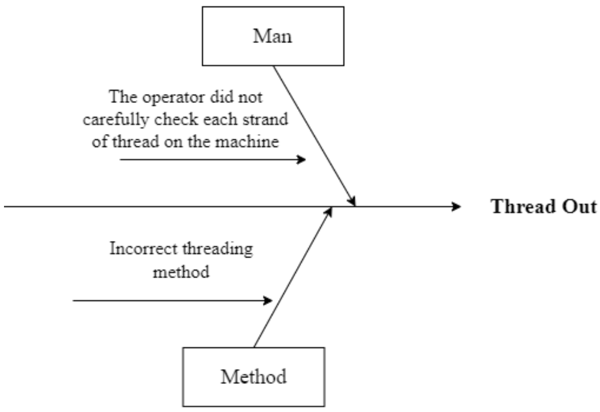

Figure 13. Thread Out Fishbone Diagram

The cause of the defect from a human perspective is that the operator is not careful in checking each strand of thread on the machine, so during the weaving process, the thread can break, causing the thread on the sack roll to come out. The second is in terms of method, namely the wrong way of installing the thread, which causes the thread to come out of the weaving line. The recommendations for improvements that can be made are reducing the number of machines monitored by each operator so that the checking process for each machine is more optimal and, secondly, providing operators with training activities or an evaluation schedule regarding how to install thread on the machine so that the resulting webbing remains up to standard.

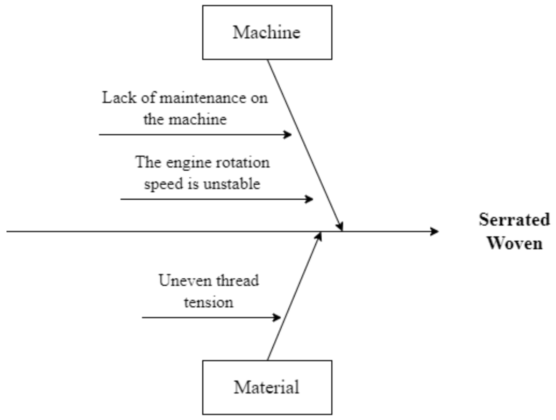

Figure 14. Serrated Woven Fishbone Diagram

The causes of defects from a machine perspective are lack of maintenance on the machine and unstable engine rotation speed. These two things cause the woven product to become loose and make the resulting sack roll jagged. Then the second thing from a material perspective is that the thread tension is uneven, which can also cause the weaving results in the circular loom machine process to become jagged.

The recommendations for improvements that can be made include carrying out maintenance on the circular loom machine periodically at an early stage before production activities start and continuing to monitor the machine while the machine is operating. Second, replace the thread bobbin if you feel the thread tension is not the same so that the woven product remains tight and does not produce a jagged sack roll.

3. Printing Station

a. Checksheet

Table 7. Printing Station Checksheet

No	Month	Total Production	Type of Defect		Total
			Thread Out	Serrated Woven	
1.	January	83,129	527	545	1072
2.	February	107,789	822	614	1436
3.	March	143,839	1118	921	2039
4.	April	138,096	982	606	1588
5.	May	162,532	1054	984	2038
6.	June	129,445	1079	789	1868
7.	July	120,816	765	674	1439
8.	August	118,796	905	725	1630

No	Month	Total Production	Type of Defect		Total
			Thread Out	Serrated Woven	
9.	September	120,365	843	742	1585
10.	October	122,485	619	924	1543
11.	November	112,164	651	721	1372
12.	December	108,699	821	601	1422
Total		1,468,155	10186	8846	19032

b. Histogram

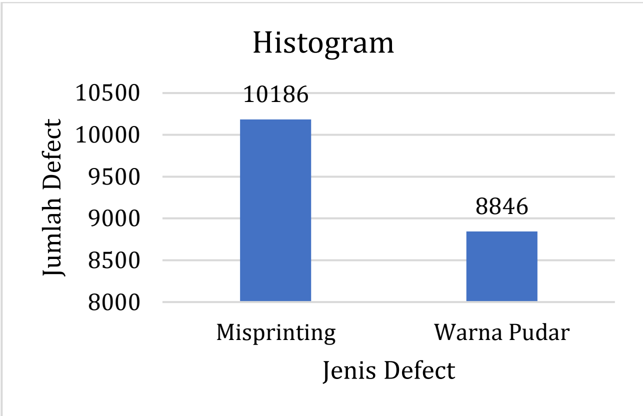

Figure 15. Printing Station Histogram

Based on Figure 15, it can be seen that the sequence of intervals for the type of each defect that occurs most frequently is misprinting defects at 10,186 kg, followed by faded color defects at 8,846 kg.

c. Pareto Diagram

Table 8. Printing Station Pareto Diagram

Type of Defect	Total Defect (Kg)	Percentage	Cumulative Percentage
Misprinting	10.186	53.5%	53.5%
Faded Color	8.846	46.5%	100%
Total	19.032	100%	

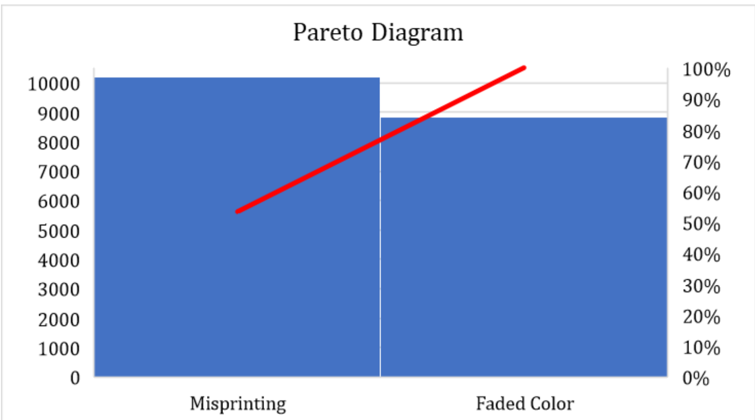

Figure 16. Printing Station Pareto Diagram

Based on Figure 16, it can be seen that the most dominant type of defect in terms of cumulative percentage is misprinting, with a percentage of 53.5%, followed by faded color defects, with a percentage of 46.5%.

d. Process Diagram

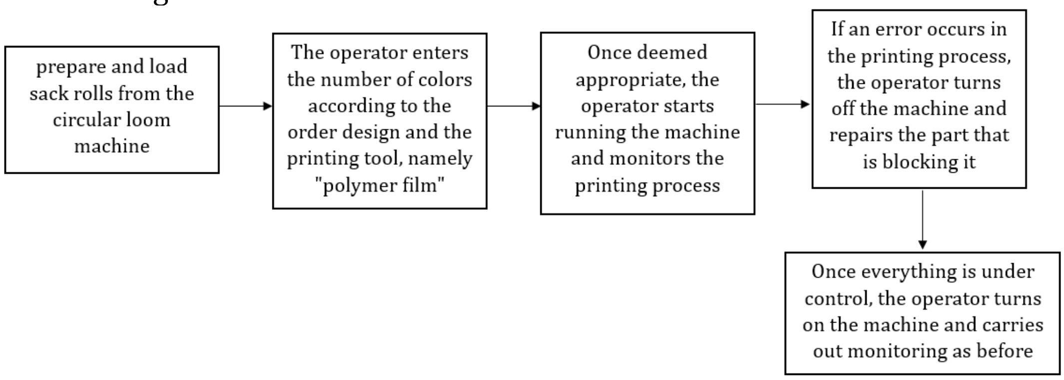

Figure 17. Printing Station Process Diagram

e. Scatter Diagram

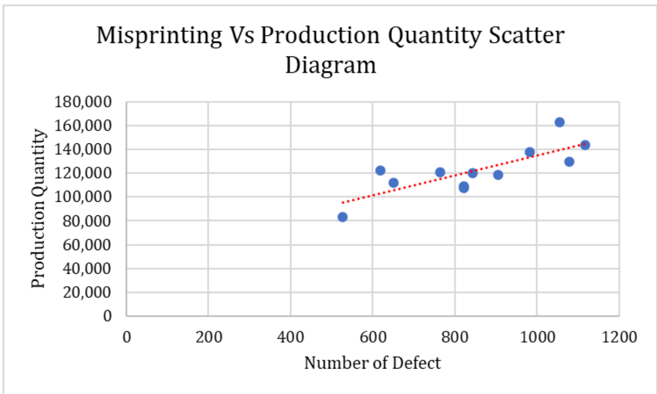

Figure 18. Misprinting Scatter Diagram

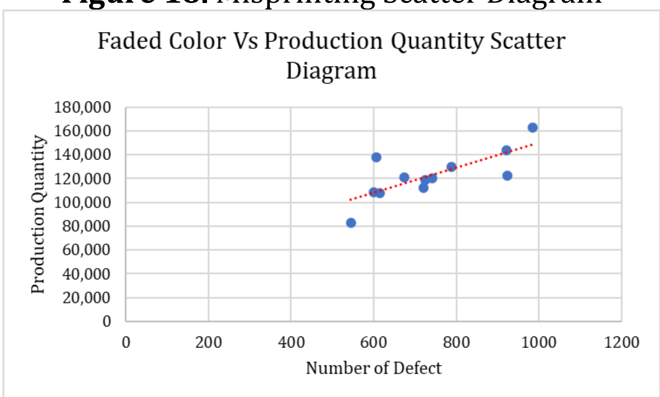

Figure 19. Faded Color Scatter Diagram

Based on figures 18 and 19, the resulting graph is a scatter diagram which has a positive relationship (positive correlation) where an increase in variable So it can be seen that the scatter diagram shows that there is a strong relationship between misprinting defects and faded color defects and production quantities.

f. Fishbone Diagram

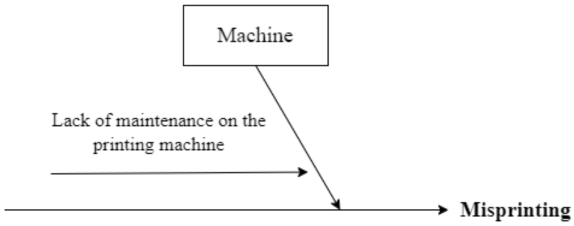

Figure 20. Misprinting Fishbone Diagram

The cause of the defect from a machine perspective is lack of maintenance on the printing machine, which causes the print results to be poor and not in accordance with the design of the plastic sack. The recommendations for improvements that can be made include carrying out maintenance on the printing machine, especially on the printer section, so that the machine is maintained and the printing results on the machine are also good according to the initial design.

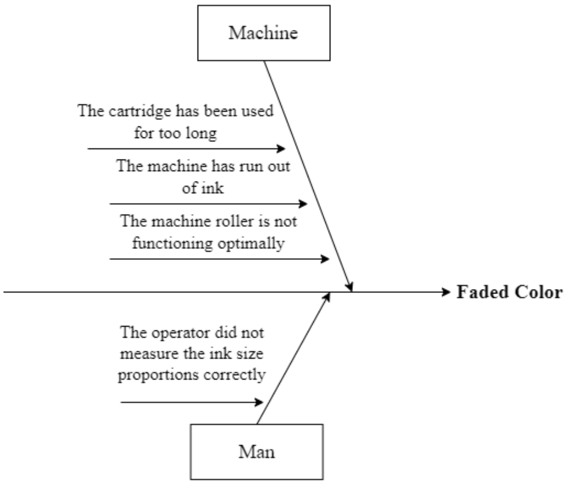

Figure 21. Faded Color Fishbone Diagram

The causes of defects from a machine perspective are that the cartridge has been used for too long, the ink in the printer has run out, and the machine's rollers are not functioning optimally. This causes the color print results on plastic sacks to be less clear. Second, from a human perspective, the operator does not measure the proportions of ink size correctly, so the print results are less sharp.

The recommendation for improvements that can be made is to carry out regular checks by the operator on the printing machine, especially on the ink, cartridge, and roller parts of the machine, so that the print results on the plastic sacks remain in accordance with the predetermined design. Second, make notes regarding the composition of ink used in each design order according to the customer (company) so that the dosage in each production remains the same.

4. Blown Film Station

a. Checksheet

Table 9. Blown Film Station Checksheet

No	Month	Total Production	Type of Defect
			Inner Hole
1.	January	33,378	727
2.	February	42,473	873
3.	March	45,076	968
4.	April	41,626	982
5.	May	53,733	1054
6.	June	53,162	1079
7.	July	51,962	885
8.	August	51,415	935
9.	September	51,331	1039
10.	October	44,555	959
11.	November	45,346	971
12.	December	42,497	851
Total		556,554	11323

b. Process Diagram

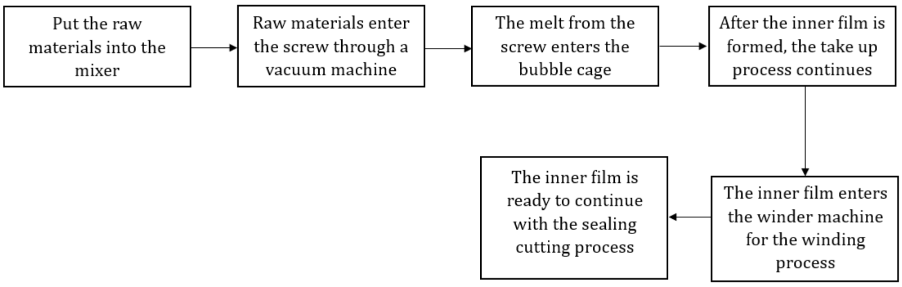

Figure 22. Blown Film Station Process Diagram

c. Scatter Diagram

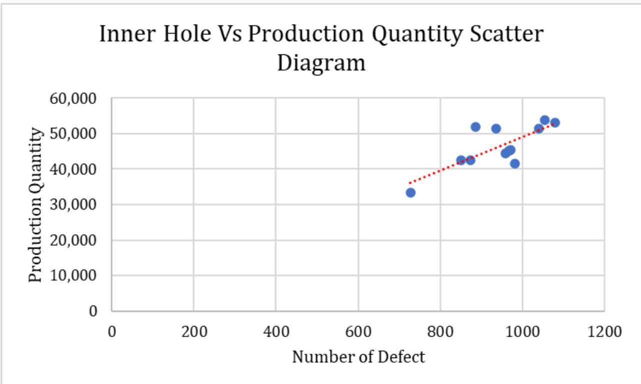

Figure 23. Blown Film Station Scatter Diagram

Based on the form of the resulting graph, it is a scatter diagram that has a positive relationship (positive correlation) where an increase in variable X is followed by an increase in variable Y, which means that the higher production quantity will result in higher inner hole defects. So, the scatter diagram shows that there is a strong relationship between hollow inner defects and production quantities.

d. Fishbone Diagram

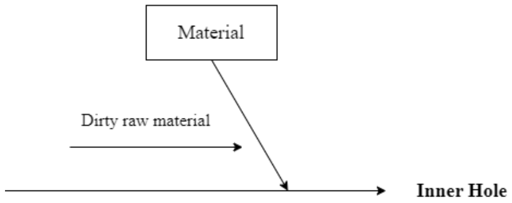

Figure 24. Blown Film Station Fishbone Diagram

The cause of defects from a material perspective is dirty raw materials. During the process of pouring raw materials, there are usually particles or gravel that can cause the melt to be uneven, which can cause inner holes.

The recommendations for improvements that can be made are by sorting and checking the raw materials first so that during the process of inserting the raw materials into the mixer, it is ensured that the raw materials are clean and there are no dirty particles.

5. Sealing Cutting Station

a. Checksheet

Table 10. Sealing Cutting Station Checksheet

No	Month	Total Production	Type of Defect
			Opened Seal
1.	January	16,185	273
2.	February	20,032	225
3.	March	15,798	219
4.	April	14,510	396
5.	May	12,171	249
6.	June	15,135	252
7.	July	12,282	257
8.	August	14,853	376
9.	September	12,377	233
10.	October	12,930	245
11.	November	13,711	288
12.	December	12,191	193
	Total	172,175	3206

b. Process Diagram

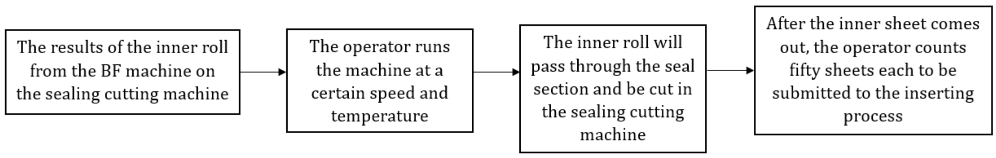

Figure 25. Sealing Cutting Station Process Diagram

c. Scatter Diagram

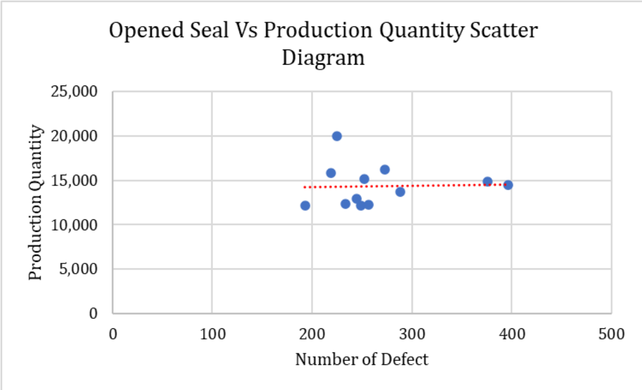

Figure 26. Opened Seal Scatter Diagram

Based on the form of the resulting graph, it is a scatter diagram which has a positive relationship (positive correlation) where an increase in variable So it can be seen that the scatter diagram shows that there is a strong relationship between opened seal defects and production quantities.

d. Fishbone Diagram

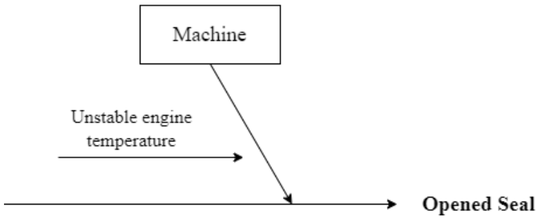

Figure 27. Opened Seal Fishbone Diagram

The cause of the defect from a machine perspective is a lack of maintenance on the machine, so the temperature setting is sometimes unstable, which causes holes in the seal if the temperature is too high. The recommendations for improvements that can be made are carrying out routine maintenance on the machine and always ensuring that the temperature that has been set is appropriate so that the seal is tight and does not open (holes).

D. Conclusion

Based on the results of data processing, there are five production stations, and there is each type of defect at each production station, including the extruder station with hole film defects and uneven threads amounting to 28,390 kg, at the circular loom station with exit thread defects and jagged webbing amounting to 40,582 kg, at the printing station with misprinting defects and faded colours amounting to 19,032 kg, at the blown film station with hollow inner defects amounting to 11,323 kg, and at the sealing cutting station with open seal defects amounting to 3,206 kg. Then, there are also suggestions for improvements that can be made for each production station to overcome quality problems in plastic sack products at PT. XYZ.

E. References

[1] B. Gopi and N. Samat, "The influence of food trucks' service quality on customer satisfaction and its impact toward customer loyalty," *British Food Journal*, vol. 122, no. 10, pp. 3213–3226, 2020.

[2] A. Jamwal, R. Agrawal, M. Sharma, and A. Giallanza, "Industry 4.0 technologies for manufacturing sustainability: A systematic review and future research directions," *Applied Sciences*, vol. 11, no. 12, p. 5725, 2021.

[3] S. M. Arianti, E. Rahmawati, and R. R. Y. Prihatiningrum, "PRODUCT QUALITY CONTROL ANALYSIS USING STATISTICAL QUALITY CONTROL (SQC) ON MARINE WORKS IN BUSINESS AMPLANG SAMARINDA," 2020.

[4] D. C. Montgomery and G. C. Runger, *Applied statistics and probability for engineers*. John wiley & sons, 2020.

[5] R. Lina, "Improving Product Quality and Satisfaction as Fundamental Strategies in Strengthening Customer Loyalty," *AKADEMIK: Jurnal Mahasiswa Ekonomi & Bisnis*, vol. 2, no. 1, pp. 19–26, 2022.

[6] G. Santos *et al.*, "New needed quality management skills for quality managers 4.0," *Sustainability*, vol. 13, no. 11, p. 6149, 2021.

[7] C. Li, Y. Chen, and Y. Shang, "A review of industrial big data for decision making in intelligent manufacturing," *Engineering Science and Technology, an International Journal*, vol. 29, p. 101021, 2022.

[8] M. Nikolaenko and L. Bal-Prylypko, "Development of an integrated food quality management system.," *Slovak Journal of Food Sciences*, vol. 14, 2020.

[9] M. Ridwan, "Purchasing Decision Analysis in Modern Retail," *AKADEMIK: Jurnal Mahasiswa Ekonomi & Bisnis*, vol. 2, no. 1, pp. 1–9, 2022.

[10] 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*, IOP Publishing, 2020, p. 012085.

[11] E. F. Winata and S. Sugiyono, "Analysis of Safety Shoes Product Quality Control at PT. BINA USAHA SEJAHTERA With Statistical Quality Control (SQC) Method Case Study of PT Bina Usaha Sejahtera (BINUSA)," *Indonesian Journal of Business Analytics*, vol. 4, no. 1, pp. 297–314, 2024.

[12] M. Flores, R. Fernández-Casal, S. Naya, and J. Tarrío-Saavedra, "Statistical quality control with the qcr package," *R Journal*, vol. 13, no. 1, pp. 194–217, 2021.

[13] K. N. Nadhif and A. Kusumawardhani, "Quality Control Analysis on Production Process Of Garment at Golden Flower LLC Ungaran," *Diponegoro Journal of Management*, vol. 10, no. 2, 2021.

[14] I. Nazmia, E. Silalahi, and M. Asbari, "Implementation Analysis of ISO 9001: 2015 in the Food Industry: A Narrative Literature Review," *Journal of Information Systems and Management (JISMA)*, vol. 2, no. 3, pp. 25–33, 2023.

[15] D. Selvamuthu and D. Das, "Introduction to Probability, Statistical Methods, Design of Experiments and Statistical Quality Control." Springer.