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ANALYSIS OF THE CAUSES OF DEFECTS IN THE MANUFACTURE PROCESS IMPROVING PRODUCTION QUALITY IN PIRN WINDER MACHINE BY USING STATISTICAL PROCESS CONTROL (SPC) METHOD AT PT. XYZ MAJALENGKA

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Abstract
In manufacturing companies, production activities are a very important activity. If the production activities produce a lot of defective products, it will cause losses in the form of additional time and raw material costs for repairing these defective products, so that quality control is needed so that the company can produce products that comply with predetermined quality standards.
This final project research was conducted at PT. XYZ Majalengka where this company is engaged in the service industry, production activities at PT. XYZ Majalengka is carried out based on a make to order response demand strategy, namely the company carries out production activities when there are orders from consumers. This research focuses on the production process of the pirn winder machine which functions to wind yarn raw materials according to the desired weight and according to the available TFO capacity (700 gr, 714 gr, 1000gr or 1500gr).
However, regardless of production quality standards on the pirn winder machine, it does not rule out the possibility that defects will always occur. Therefore it is necessary to have quality control in the production process of this pirn winder machine. Its function is clear to reduce the number of defects and improve the quality of production produced.
Statistical Process Control (SPC) is a statistical analysis used for quality control, starting from monitoring, analyzing, predicting, controlling and improving the production process and product quality through control charts. Statistical quality control using SPC (Statistical Process Control) has seven statistical tools that can be used as tools to control quality, namely, check sheets, histograms, P control charts, pareto diagrams, cause and effect diagrams, scatter diagrams, and diagrams. process.
Keywords: *Manufacture Process, Production Quality, Pirn Winder, Statistical Process Control (SPC)*

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Introduction

In manufacturing companies, production activities are a very important activity. If the production activities produce a lot of defective products, it will cause losses in the form of additional time and raw material costs for repairing these defective products, so that quality control is needed so that the company can produce products according to predetermined quality standards.

However, regardless of production quality standards on the pirn winder machine, it does not rule out the possibility that defects will always occur. Therefore it is necessary to have quality control in the production process of this pirn winder machine. Its function is clear to reduce the number of defects and improve the quality of production produced.

In an effort to improve to reduce the number of defects, PT. XYZ Majalengka uses a quality management measurement tool, namely the p control chart or p chart. However, one measurement tool is not enough to support improvement efforts in reducing the number of disabilities. Because in a production quality control method is needed that can support data processing in order to find out what improvements must be made by a company.

Research Method

Research Stages

- Field Study
    - Observation
    - Interview the head of production
- Data collection
    - Number of production
    - Number of defective products
- Data processing
    - Check sheet
    - Histograms
    - P control chart
    - Pareto charts
    - Cause and effect diagrams
- Research result
    - Research result

Results and Discussion

The data that has been collected is then processed using the statistical process control (SPC) method to monitor and analyze the number of defects in the production process on the pirn winder machine.

CHECK SHEET

Table 1. Check the First Data Sheet

CHECK SHEET MESIN PIRN WINDER						
No MC	Jenis Benang	Jumlah Spindle	Total Periksa	Jenis Kecacatan		
				Putus	Salah Pelewatan	Brodol
1	LK LSI 130-60	256	1792	34	2	4
2	IVI BSY 130-60	256	1792	691	1	74
3	LK BSI 80-60	256	1792	694	1	0
4	LK LSI 80-60	256	1792	473	2	82
5	IVI FINE 80-48	256	1792	466	1	67
6	IVI SENS 60-48	256	1792	471	1	12
JUMLAH			10752	2819	8	239
TOTAL				3066		

HISTOGRAMS

This histogram is useful for seeing which types of defects most often occur in the form of a bar graph that shows the distribution of the values obtained in the form of numbers. The following is a histogram of the number of each type of defect:

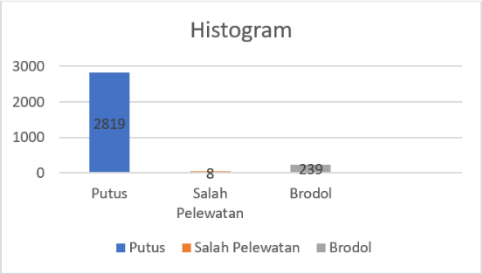

Figure 1. Histogram

P Control Map

The next step after making the histogram is to make a control chart p (p-chart) which is used to see whether the results produced by each process stage are under control or not. The following are the steps in making a p control chart as follows:

a. Calculates the percentage of defects

$$p = \frac{x}{\Sigma n}$$

$$p = \frac{3066}{10752}$$

$$= 0{,}28516$$

b. Calculates the center line or Central Line (CL)

$$\text{CL} = p = \frac{x}{\Sigma n}$$

$$p = \frac{3066}{10752}$$

$$= 0{,}28516$$

c. Calculating the upper control limit or Upper Control Limit (UCL)

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

$$= 0{,}28516 + \frac{3\sqrt{0{,}28516(1-0{,}28516)}}{1792}$$

$$= 0{,}28591$$

d. Calculating the lower control limit or Lower Control Limit (LCL)

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

$$= 0{,}28516 - \frac{3\sqrt{0{,}28516(1-0{,}28516)}}{1792}$$

$$= -\ 0{,}28440$$

Table 2. Calculation of defects for each observation

No MC	TOTAL PERIKSA	JUMLAH CACAT	PROPORSI CACAT
1	1792	36	0.020089
2	1792	692	0.386161
3	1792	695	0.387835
4	1792	475	0.265067
5	1792	467	0.260603
6	1792	472	0.263393
total	10752	2837	1.583147

Table 3. Proportion of Defects, CL, UCL, LCL

PROPORSI CACAT	CL	UCL	LCL
0.020089	0.28516	0.28591	- 0.2844
0.386161	0.28516	0.28591	- 0.2844
0.387835	0.28516	0.28591	- 0.2844
0.265067	0.28516	0.28591	- 0.2844
0.260603	0.28516	0.28591	- 0.2844
0.263393	0.28516	0.28591	- 0.2844

The following is a control chart chart of each type of defect that occurs in the Pirn Winder machine at PT XYZ Majalengka:

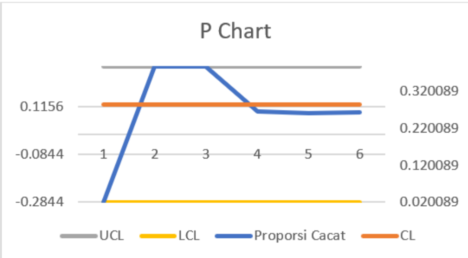

Figure 2. P control chart diagram

PARETO DIAGRAMS

The Pareto chart identifies the causes of the most occurring problems which are indicated by the highest bar graphs, placed on the far left, and so on until the problems that occur least frequently are shown by the lowest bar graphs and placed on the far right side. Calculation of the percentage of values on the Pareto chart:

a. Broken Thread

Persentase = (number of broken threads / total number of defects) x 100%

= 2829/3066 x 100% = 92 %

b. Brodol

Persentase = (brodol amount / total number of defects) x 100%

= 239/3066 x 100% = 0,7 %

c. Pelewatan

Persentase = (Number of pelewatan / total number of defects) x 100%

= 8/3066 x 100% = 0,2 %

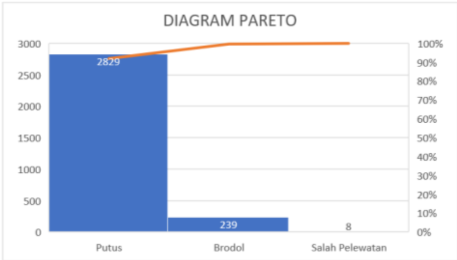

Figure 3. Pareto chart

CAUSE AND EFFECT DIAGRAM/FISHBONE

a. Broken Thread Defects

From the results of the estimation test, it is known that the cause of the broken yarn defects at the twisting stage is due to Machine and Material factors. Below is a fishbone diagram of the Broken Thread defect:

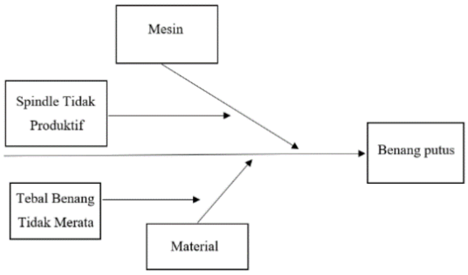

Figure 4. Cause and effect diagram of a broken thread

b. Brodol

From the results of the estimation test, it is known that the cause of brodol thread defects at the twisting stage is due to machine factors. The following is a fishbone diagram of a Brodol thread defect:

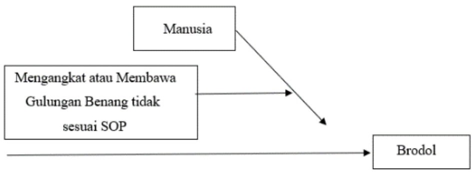

Figure 5. Cause and Effect Diagram of Brodol

c. Pelewatan

From the results of the prediction test, it is known that the cause of the wrong thread passing on the pirn winder machine is due to the human factor. Here is a fishbone diagram of one of the overpasses:

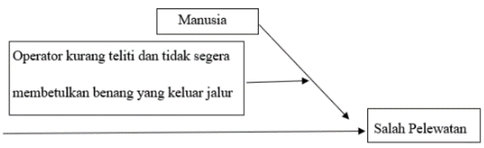

Figure 6. Cause and Effect Diagram of Wrong Passing Yarn

ANALYSIS

During the Covid-19 pandemic, semi-finished fabric production at PT. XYZ Majalengka experienced a decline in production, in one day only two machines could run. From the results of data collection based on data processing check sheets, 6 productions were obtained which included LK LSI 130-60 thread types, 130-60 IVI BSY IVI thread types, 80-60 LK BSI LK thread types, 80-60 LK LSI thread types, IVI FINE thread types 80 – 48 and thread types IVI SENS 60 – 48. From the pirn winder process, all types of yarn were checked equally 1792 times and there were several types of defects, namely broken threads, brodol threads, and missed threads.

Based on the results of histogram data processing, the highest defects were broken yarn defects of 2819 threads, while brodol defects were 239 spools and 8 threads were missed. The results of calculating the p control chart data show that the percentage of defects is 0.28516, CL is 0.28516, UCL is 0.28591, and LCL is –0.28440. And based on the p control chart diagram, there are 2 data that exceed the upper control limits, namely no. 2 and no. 3.

From the Pareto diagram, it was found that the highest percentage of defective threads was 92% with 2829 defective threads. The percentage of defective brodol is 0.7% with a total of 239 defects and the smallest percentage of defects is in misses with a percentage of 0.2% with a total of 8 defects.

From the results of testing the estimation of cause and effect diagrams or fishbone, it is known that the causes of broken yarn defects in pirn winder machines are due to machine factors because the spindle is not productive and the material is due to uneven thread thickness. Furthermore, the cause of brodol thread defects is due to the human factor where the operator in lifting or carrying the spool of thread does not comply with the predetermined soup. And finally, the cause of the wrong pass is due to the human factor, where the operator is not careful and does not immediately correct it when the strands go out of line, causing problems with the thread.

Conclusion

1. Based on the results of production data processing during the final assignment research, it can be concluded that the causes of defects in the production of pirn winder machines are caused by the following factors:
   - Engine factor
     The cause of an unproductive spindle is influenced by several things such as a rotating tensor base, stuck cradle bearing, rocking spindle, rotating pin, defective traverse, defective feedroll, and defective duck eye.
   - Material Factors
     Uneven thread thickness is not caused by PT XYZ's production stages, but by raw material suppliers.
   - Human Factors
     The operator does not pay attention to the applicable SOP.
2. Based on the results of data processing, it has been found that there are many defects in the production process on the pirn winder machine, from the check sheet results during the final project research, for data processing the highest defects are broken yarn defects of 2819 threads, while brodol defects are 239 rolls and wrong 8 threads were missed and the total number of defects that occurred in the pirn winder machine during the three days of production was 3066.
3. The SPC method is very suitable for overcoming or reducing the number of defects in the production process on Pirn Winder machines, because in the SPC there are more than one supporting tool so that the data processing is more thorough.

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