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PRODUCT QUALITY CONTROL ANALYSIS TO MINIMIZE PIRN BOBIN SUPPLY'S DEFECTS WITH SIX SIGMA METHOD IN THE TEXTILE INDUSTRY (CASE STUDY PT. X-MAJALENGKA)

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Abstract
The industrial sector is now a new foundation for the people of Indonesia. Quality is a key factor that brings business success, growth and increasing competitive position. The quality of a product is defined as the degree or extent to which products or services are able to satisfy the desires of consumers (fitness for use). In fact, if the product or product can not achieve precisely the purpose for which the item is intended or used, it does not necessarily mean that the consumer or the buyer will make a complaint to the producer.
Different types of methods are developed and applied by industrial societies to produce products of better quality. Six sigma is a method of controlling and improving the quality of Motorola implemented by the company since 1986 and then used by companies large-scale international level.
PT. X-Majalengka, the company is engaged in semi-finished textiles. Research carried out is in part preparation before the weaving process, namely the winding. The number of mismatches that continued to occur on the production floor Grade A winding into a decrease in Gray cloth. Yarn is the main ingredient pembutan fabric gray, yarn used affects the quality of gray cloth produced, of course, to produce gray cloth that grade A then the thread used to be quality yarn, a process for producing quality yarns is the preparation stage is the process of winding, Good thread the warp or weft will experience the process of winding.
By using six sigma analysis showed that the quality Pirn supply bobbins produced by the company has a good process capability. Based on Sigma value calculation, the average value of the company is 2.52 sigma with 169.31 Defect per million Opportunitas (DPMO). This shows a consistent pattern of DPMO and sigma achievement, indicating that the production pattern has been properly managed. And types of disabilities in Pirn product supply bobbins grouped into three types. This type of disability is calculated frequency for 1 year of production from July 2016 until June 2017 that is hairy 72 pirn, deflated loops154 and 245 pirn pirn.

Keywords: *Quality, Quality Control, Six-Sigma, DMAIC.*

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Introduction

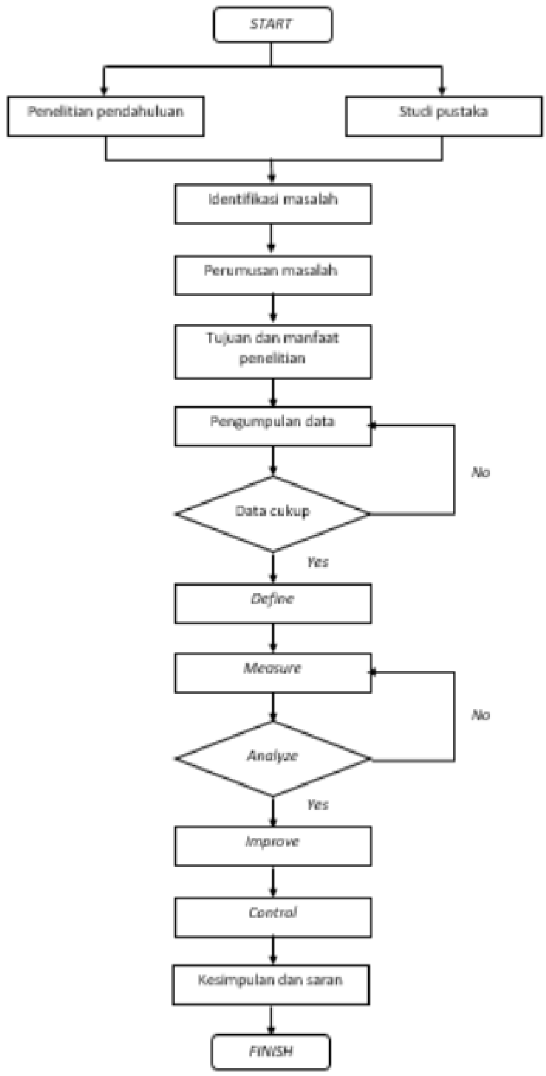
The industrial sector is currently the new focus for the people of Indonesia. As a country experiencing a sector shift, which initially relied heavily on the agricultural sector, it has now begun to shift to the industrial sector. The industrial sector creates vast job opportunities, but with intense competition as well. Increasingly fierce competition forces industrial managers to be able to compete perfectly, one way to survive in industrial competition is to implement product quality control and improvement. The main goal of the company is to get the maximum profit, but besides that the company is required to pay attention to the interests of consumers in meeting their needs, because in the end it is consumers who determine the success of a company. Quality control activities will always be used in both small and large scale industries. The quality of a product is very important to be considered by companies in meeting consumer needs, quality control that is carried out properly will have an impact on the quality of the products produced.

In fact, if the products or goods cannot achieve the exact purpose for which the goods are intended or used, this does not necessarily mean that consumers or buyers will make complaints to producers. This happens, because as we know that there is a distribution chain between consumers and producers that can hinder the transfer of information or the submission of these complaints. So what if there is no suitability/suitability or the desired goal of the user of the goods, then usually the consumer/buyer will buy other branded goods in the market. So that producers must think of themselves as consumers who need these goods which will ultimately make improvements to the quality of these products.

In this regard, to overcome the problem of product defects, the company must minimize products that do not meet company standards to a minimum so that they can achieve the desired goal, namely good quality standards. This can occur due to several factors, such as the selection of raw materials that are not appropriate, negligent work staff, or not having adequate expertise in making a product and product tools that cannot operate normally. In addition to inspections on the quality of raw materials, product processes and production results. Quality control must also be carried out with statistical methods so that it can be known how big the level of product defects is and how to reduce or minimize the level of existing defects. One of the statistical tools in quality control is the six sigma method.

Based on this explanation, the authors are interested in conducting a study with the title "PRODUCT QUALITY CONTROL ANALYSIS TO MINIMIZE PIRN BOBIN SUPPLY DISEASE WITH SIX - SIGMAPY METHOD IN THE TEXTILE INDUSTRY (CASE STUDY OF PT. X-MAJALENGKA)"

Research methods



Literature review

It is a step to introduce supporting theory from research, useful for increasing understanding of theory from research discussion. Problem Identification Is a development step into more detailed points from preliminary research and research objects

Formulation of the problem

This is a step to narrow down/specialize the problem from the identification process

Research Objectives and Benefits

Is the stage of formulating the objectives of the research and what are the benefits of this research?

Data Collection and Processing

At this stage is to collect data, the data collected is data related to the problems that occur, where the data is obtained from the company PT. X-Majalengka, after the data is deemed sufficient, the data is processed.

Conclusions and recommendations

Conclusions and suggestions contain conclusions from problem solving that have been carried out and suggestions to be input for the company.

The process of making Pirn Bobin Supply

The process of making bobin supply pins consists of several processes that occur on the preparation floor

Results and Discussion

Production Process of Pirn Bobin supply at PT. X-Majalengka

The production system applied to PT. X-Majalengka is a make to order system, so all production results are in conformity with the specifications determined by the customer.

Winding

Winding process is the process of changing the shape of the roll from a cylindrical bobbin into a conical bobbin (pirn bobin supply) for use in the TFO process. The processed raw materials can be in the form of cones or bobbins. The Winding process serves to roll the yarn raw material according to the desired weight and according to the available TFO capacity.

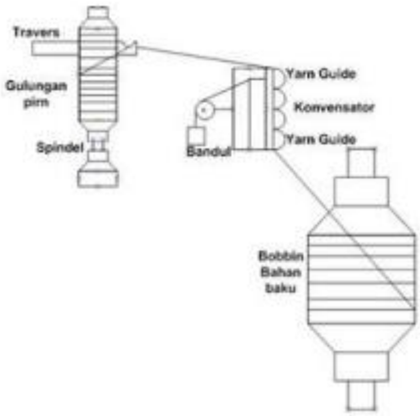


Figure 4.2. Thread path (passing) on the Pirn Winder machine.

Figure 4.3 Raw materials

Figure 4.4 Pirn Bobbin Supply in process

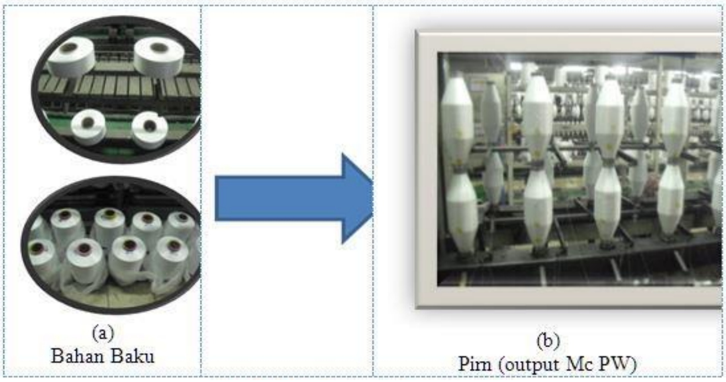


Figure 4.5 a). Raw materials, b).Pirn Bobin Supply

The winding of the yarn on the pirn must be dense, so that the layers of yarn on the pirn will not slip / fall off, during the high-speed twisting process, but the layers of yarn are only unraveled layer by layer, according to the speed of the TFO.

If some of these factors are not considered, the gray fabric produced will have low product quality, because the fabric produced depends on the raw material used for yarn.

The main movements during the winding process are:
1. Thread feeding,
2. Spindle rotation, and
3. Yarn winding.

The requirements for a good pirn roll are:
1. Roll volume must be optimal
2. The roll must be solid so as not to slip easily during the TFO process,
3. The roll should be easy to open on TFO process
4. The thread must not be damaged during the TFO process
5. The reels must be aligned.
6. The thread should not be looped.

As for some of the provisions of quality standards on PW machines, namely:
1. Tension : 0.1 – 0.125 gr/de
2. Hardness: 70 – 85 degrees hardness
3. Production results must not be defective (dirty, brodol, bumps, etc.)
4. Standard weight

To get good quality production (grade A) these conditions must be met, otherwise the production is classified as grade B which can be used for weft. To meet the requirements of the quality standards above, there are several work standards that must be carried out in the field, including:
a. Good quality raw materials (not hairy, not dirty, not lumpy, etc.) and not mixed. To find out whether the raw materials are of good quality and not mixed, it is necessary to inspect the raw materials. The purpose of not mixing is the type of yarn is the same (type of yarn, dinier, lot, remark, or grade).
b. The PW machine process condition setting must be correct. The condition of the machine process is set according to the type of yarn to be processed and the pirn weight (output result) according to the order and adjusted to the condition of the machine used.

c. Pendulum uniformity. The uniformity of the pendulum is an absolute requirement that must be met, because it affects the tension. If the pendulum is not uniform, it can cause the thread to break if the pendulum is excessive, the bobbin is loose (lack of hardness) if the pendulum is too light and the most fatal result can cause the fabric to be channeled (abnormal). Each type of yarn with various diners has its own standard pendulum.
d. The thread passing must be correct. The thread passing must be correct, because if it is wrong (out of line or rubbing against the iron) it can cause the thread to erode so that over time it becomes brittle/broken.

Figure 4.6 Thread passing process on Mc.PW

e. Pirn must be sanded and threaded using after oil. Before the process, the pirn must be sanded so that it is smooth and in winding the thread must use after oil so that the thread sticks to the pirn so that it is easily rolled up and does not break when the engine is started. In winding the thread, the number of turns according to the working standard is three times the turns counterclockwise (z direction).
f. Polishing produced must be appropriate. Polishing is used to distinguish each type of yarn so that the yarn does not mix. For each type of yarn has its own (different) polish.

Figure 4.7 Pirn Bobin Supply that has been polished.

4.2.2. Production Process Flow

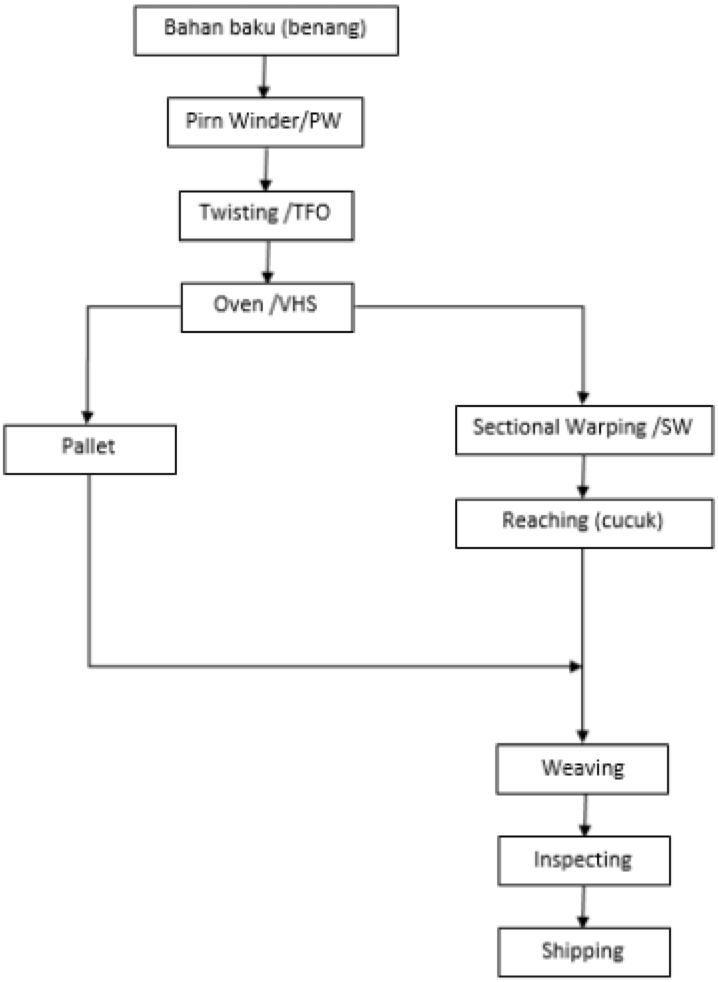


Figure 4.8. Gray Fabric Production Process Flow

Figure 4.9. Production Process Flow of Pirn Bobin Supply

From a series of process flows above, the raw materials will produce coils of pirn bobin supply. After becoming a pirn, the pirn is polished according to the type of yarn before being sent to Mc. The TFO pirn was allowed to stand for 6 hours. The polished pirn results can be seen in Figure 4.5.

Production and Defect

Table 4.4 Production data and defects Pirn Bobin Supply

priode	pirn	berbulu	gembos	looping	jumlah cacat
Jul-16	35.131	2	8	13	23
Agu-16	54.205	6	25	15	46
Sep-16	60.393	3	30	23	56
Okt-16	83.369	10	22	33	65
Nov-16	83.651	16	14	20	50
Des-16	97.470	6	16	30	52
Jan-17	104.305	8	6	27	41
Feb-17	93.451	5	6	22	33
Mar-17	104.379	7	8	21	36
Apr-17	100.265	4	7	14	25
Mei-17	105.668	3	6	15	24
Jun-17	107.436	2	6	12	20
jumlah	**1.029.723**	**72**	**154**	**245**	**471**

DMAIC

Data processing is the stage of processing an existing data into an answer to an existing problem. Data processing contains processing of the data that has been collected. The data processing here is by using the six sigma method which consists of five stages, namely, define – measure – analyze – improve – control (DMAIC).

Define

The define stage is the first process in implementing the six sigma quality improvement method. At this stage there is an identification of the type of defect and the number of defects in the pirn bobin supply product and defines the causes of the defects that are the most potential causes in producing the pirn bobin supply product.

Measure

Measure is the measurement stage, in this study two measurement stages were used, namely the control diagram analysis stage and the measurement stage for Sigma and Defect Per Million Opportunities (DPMO) levels.

The following is the calculation of the mean or average proportion of center line defects / Control Line (CL), Upper Control Limit (UCL) and Lower Control Limit (LCL). To calculate the proportion used the following formula:

$$P = \frac{jumlah\ cacat}{jumlah\ produksi}$$

P-Chart calculation for Pirn Bobbin Supply products during July 2016-June 2017.

1. Calculating the Central Line (CL)

Functions to find out how big the average damage that occurs to the product.

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

$$CL = \bar{P} = \frac{471}{1029.723} = 0{,}000046$$

2. Calculating the Upper Control Limit (UCL) Function to find out whether the damaged product does not deviate / exceed the predetermined limit, if it exceeds the predetermined limit then the production in the company is not normal because the number of products fails to go out of the predetermined limit.

$$UCL = \bar{P} + 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n_i}}$$

$$UCL = 0{,}000046 + 3\sqrt{\frac{0{,}000046(1-0{,}000046)}{12}}$$

$$= 0{,}000046 + 0{,}005873535$$

$$= 0{,}00592$$

Calculating the lower control limit or Lower Control Limit (LCL) Functions to find out whether the damaged product does not deviate / exceed the predetermined limit, if it exceeds the predetermined limit then the production in the company is not normal because the number of products fails to get out of the predetermined limit.

$$LCL = \bar{P} - 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n_i}}$$

$$LCL = 0{,}0 - 3\sqrt{\frac{0{,}000046(1-0{,}000046)}{12}}$$

$$= 0{,}000046 - 0{,}005873535$$

$$= -\,0{,}00583$$

Table 4.6 calculation of the value of the proportion pirn bobin supply during July 2016 – June 2017.

priode	pirn	jumlah cacat	proporsi	CL	UCL	LCL
Jul-16	35.131	23	0,00065	0,00046	0,00592	-0,00583
Agu-16	54.205	46	0,00085	0,00046	0,00592	-0,00583
Sep-16	60.393	56	0,00093	0,00046	0,00592	-0,00583
Okt-16	83.369	65	0,00078	0,00046	0,00592	-0,00583
Nov-16	83.651	50	0,00060	0,00046	0,00592	-0,00583
Des-16	97.470	52	0,00053	0,00046	0,00592	-0,00583
Jan-17	104.305	41	0,00039	0,00046	0,00592	-0,00583
Feb-17	93.451	33	0,00035	0,00046	0,00592	-0,00583
Mar-17	104.379	36	0,00034	0,00046	0,00592	-0,00583
Apr-17	100.265	25	0,00025	0,00046	0,00592	-0,00583
Mei-17	105.668	24	0,00023	0,00046	0,00592	-0,00583
Jun-17	107.436	20	0,00019	0,00046	0,00592	-0,00583
jumlah	**1.029.723**	**471**				

As a rule of thumb (Prawirosentono, 2002) the following criteria are used:
a. If P < LCL, it means that the sample jumps down outside the receiving area (LCL) then check the cause.
b. If LCL < P> UCL, it means that all samples are in the acceptable area, which is called a sample with normal behavior or good process capability.
c. If P > UCL, it means that the sample jumps up outside the acceptance area (UCL) or it can be said that the process capability is low, then check the cause and take corrective action through improving performance in production process activities.
In the P-chart calculation, the value of CL = 0.000046, UCL = 0.00592, LCL = -0.00583.

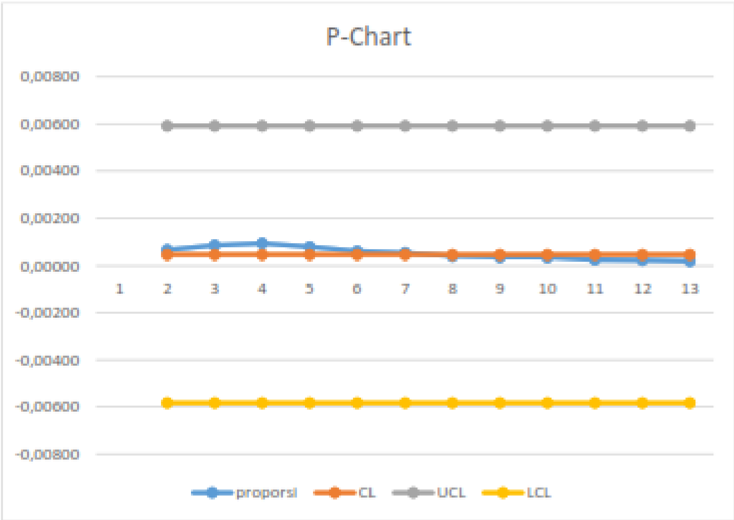


Figure 4.10 P-Chart of Pirn Bobin Supply Failure Proportion for the Period of July 2016J uni 2017.

From the picture above, it can be seen that all P is between UCL and LCL, so the process capability is running well, so it can explain that the process capability is able to meet the desired tolerance limit specifications but still needs control so that defective products reach 0%.

Measurement of Sigma Level and Defect Per Million Opportunities (DPMO)

DPMO value calculation

$$\text{DPO} = \frac{\text{banyaknya cacat yang ditemukan}}{\text{jumlah produk yang diperiksa x CTQ potensial}}$$

$$\text{DPMO} = \text{DPO x } 1.000.000$$

$$\text{DPO} = \frac{23}{35.131 \text{ x } 3} = 0{,}2182308123$$

$$\text{DPMO} = 0{,}2182308123\text{x } 1.000.000 = 218{,}23$$

Table 4.7 Measurement of Sigma Value and Defect Per Million Opportunity (DPMO)

Priode	Pirn	Jumlah Cacat	Jumlah CTQ Potensial	Nilai DPMO	Nilai Sigma
Jul-16	35.131	23	3	218,23	2,79
Agu-16	54.205	46	3	282,88	2,59
Sep-16	60.393	56	3	309,09	2,00
Okt-16	83.369	65	3	259,89	2,14
Nov-16	83.651	50	3	199,24	2,34
Des-16	97.470	52	3	177,83	2,47
Jan-17	104.305	41	3	131,03	2,62
Feb-17	93.451	33	3	117,71	2,69
Mar-17	104.379	36	3	114,97	2,70
Apr-17	100.265	25	3	83,11	2,88
Mei-17	105.668	24	3	75,71	2,49
Jun-17	107.436	20	3	62,05	3,04
			jumlah	**2031,73**	30,75
			rata-rata	**169,31**	2,56

Analyze

Analyze is a stage for improving quality by identifying the causes of damage, namely Pareto diagrams and causal diagrams.

Pareto Chart (Pareto Chart)

Pareto chart is a statistical tool that is used to determine the type of disability that often occurs. Pareto diagram analysis is able to show defects that often occur in pirn bobin supply products at PT. X-Majalengka, and can take action to deal with defects that often occur. The data is processed to determine the percentage of defective products using the formula:

$$\% \, Kerusakan = \frac{jumlah\ kerusakan\ jenis\ i}{total\ jumlah\ kerusakan\ jenis\ i} \times 100$$

Damage to Pirn Bobin Supply products that often occurs at PT. X Majalengka are:

a. Berbulu sebanyak 72 buah

$$\% \, Kerusakan = \frac{72}{471} \times 100$$
$$= 12{,}61 \%$$

b. Gembos sebanyak 154 buah

$$\% \, Kerusakan = \frac{154}{471} \times 100$$
$$= 32{,}70 \%$$

c. *Looping*sebanyak 245 buah

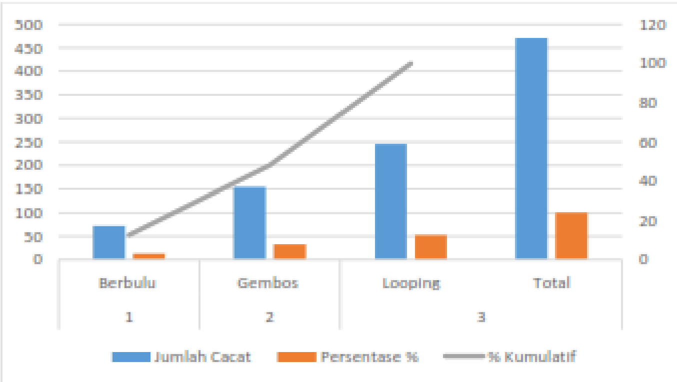
$$\% \, Kerusakan = \frac{245}{471} \times 100$$
$$= 52{,}02 \%$$

The table below shows the number of defects and the cumulative percentage values that will be used to create a Pareto chart.

Table 4.8 Data on the Percentage of Defective Products in July 2016 – June 2017

No	Kecacatan	Jumlah Cacat	Persentase %	Kumulatif %
1	Berbulu	72	12,61	12,61
2	Gembos	154	32,70	47,98
3	Looping	245	52,02	100
	Total	**471**	**100**	

The calculation results and Table 4.5 can be depicted in the Pareto diagram shown in the following figure:



Cause and Effect Diagram (Cause and Effect Diagram) The raw material factors in the production process of pirn bobin supply are yarn that is not hairy and not dirty because if the yarn is dusty before being processed after going through the winding process it will still be hairy 86 and if the yarn is dirty it will result in yarn defects due to different yarn structure. So, the factors of raw materials, people, machines and methods affect the production process. The following describes the influence of factors on the production process to the final product in the form of a cause-and-effect diagram.

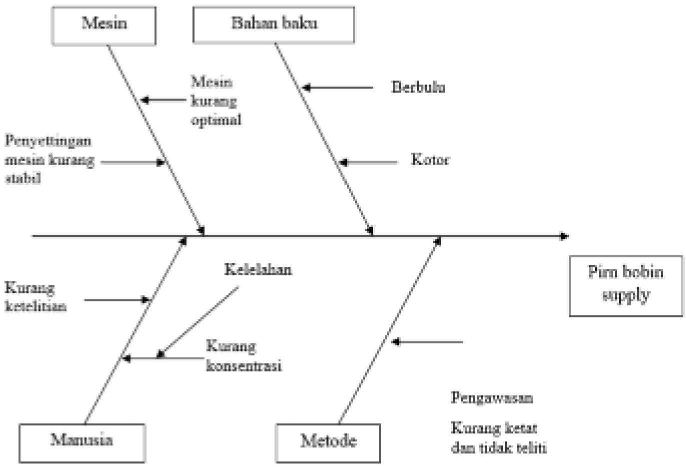


Figure 4.4 Cause and Effect Diagram for Pirn Bobin Supply Products

Improve

The improve stage is the determination of the proposed corrective action plan (action plan) to overcome the causes of defective products.

Recommendations for Improvements

Table 4.9 Proposed Corrective Actions for pirn bobin supply . products

No	Sumber Penyebab Masalah	Penyebab Utama	Usulan Perbaikan
1	Manusia	- Kurang konsentrasi - Kurang teliti	- Melakukan pengawasan yanglebih ketat kepada para karyawan bagian produksi - Memberikan peringatan kepadakaryawan apabila melakukan kesalahan.
2	Mesin	Kurang optimal	Melakukan perbaikan pada mesin yang kurang optimal dan melakukan setting mesin secara berkala dan selalu mengeceknya.
3	Bahan baku	- Berbulu - Kotor	Meningkatkan ketelitian pada saat bongkar dus.
4	Metode	Kurang pengawasan terhadap tenaga kerja dan pengontrolan mesin	Meningkatkan pengawasan terhadap tenaga kerja dan pengawasan kualitas yang bertugas mengontrol mesin.

Control

The control phase is the last operational stage in the Six Sigma quality improvement project. At this stage the procedures and results of quality improvement are documented to be used as standard work guidelines to prevent the same problems or old practices from recurring, then ownership or responsibility is transferred from the Six Sigma team to the person in charge of the process, and this means a Six Sigma project. ends at this stage.

Conclusion

From the research that has been done by the author on Pirn Bobin Supply products at PT. X-Majalengka, the authors can draw conclusions, among others:

1. By using six sigma analysis, it can be seen that the quality of Pirn bobin supply produced by the company has good process capability. Based on the calculation of the Sigma value, the average sigma value of the company is 2.52 with 169.31 defects per million Opportunity

(DPMO). This shows a consistent pattern of DPMO and sigma achievement, which indicates that the production pattern has been managed properly. And the types of defects in Pirn bobin supply products are grouped into 3 types. The frequency of this type of defect is calculated for 1 year of production from July 2016 to June 2017, namely 72 pyrns hairy, 154 pyrns loose and 245 loops.

2. Several factors cause defects in Pirn bobin supply products, namely:

a. at the time of the thread passing process caused by a machine that works less than optimally and is stable during the thread passing process other than that it is caused by humans who lack accuracy and concentration because the preparation of thread passing is done manually,

b. the process of winding the thread caused by the lack of accuracy and concentration decreases when working because the winding of the thread is the same as the process of passing the thread which is done manually,

c. and at the time of running the defect in this process, namely at the time of moving the spool of thread, was caused by the machine setting being less stable and the machine less than optimal.

3. Proposed improvements

a. If the source is human, then carry out stricter supervision of production employees and give warnings to employees if they make mistakes.

b. If the source is the cause of the machine, then make repairs to the machine that is less than optimal and make machine settings periodically and always check it.

c. If the source is the cause of the raw material, it will increase the accuracy at the time of unloading the box.

d. If the source is the cause of the method, it will increase supervision of the workforce and quality control in charge of controlling the machine.

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