ISSN No:-2456-2165

Quality Improvement to Reduce Production Cost on Paper Manufacturing Companies

"Case Study Pt.X"

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Abstract:- PT.X is one of the paper producers located in East Java. Currently, the goods quality produced by PT.X are decrease. This is shown from defect rate from 13.60% in 2016 to 15.75% in 2017. To reduce the current problem at company, conducted research using six sigma method. Implementation of Six Sigma is done through the DMAIC stage. The results of the defect identification show that dusting is the most dominant defect, so it is prioritized in the improvement. The result of the improvement shows the increase of sigma level from 2.55 to 2.67. The increased sigma level impact on cost saving value equal to IDR. 1,438,212,308/year.

Keywords:- *Six sigma, quality improvement, cost saving.*

I. INTRODUCTION

Paper is a product that often used everyday, so the demand for paper in the market is very high. Today there are many paper manufacturing companies in Indonesia. Not only the large number of consumers, but also the season in Indonesia is very suitable for the paper manufacturing industry.

PT. X is one of the paper manufacturing company located in east java. Currently, the goods quality produced by PT.X are decrease. This is shown from defect rate from 13.60% in 2016 to 15.75% in 2017. Increased defects will increase company production costs, because the product defects will be rework.

One of method that can be used in quality improvement is six sigma. Therefore, in this research will be used the method to improve quality and reduce production cost at PT. X.

II. LITERATURE REVIEW

A. Six Sigma

Six sigma is a method to improve process capability. The purpose of the six sigma is to reduce the variability in the process thus decreasing defects in the product [1]. Six sigma has been successfully used as a method to reduce waste, improve customer satisfaction, and improve a company's finances [2]. By using this method, the company can understand the fluctuations in a process that makes it possible to determine the cause of the problem.

Motorola defines "six sigma" as 3.4 the number of defects allowed in one million opportunities [3]. Basically 99.99966% of the possibility of producing products according to specifications when applying the six sigma method. Reducing the variation in the process will have an impact on the reduction of costs in the company.

III. METHOD

Implementation of the Six Sigma method can be done by DMAIC (Define, Measure, Analysis, Improvement, and Control).

The define stage is done to define the problem, measure and analysis is done to measure the current sigma level and the analysis of the factors causing the defect that significantly affect the quality problem, the improve stage is done to find the root of cause problem of defects, and the last stage is control, control is done to evaluate the results of improvements that have been done.

IV. RESULT AND DISCUSSION

A. Define

The data taken as the parameter of problems that exist in PT.X is the defect rate data. base on the defect rate data, shows that there is increase in 2016 to 2017. In 2016 the defect rate was 13.60% and in 2017 defect rate was 15.75%.

B. Measure and Analyze

In the next stage calculated current level sigma and defect analysis that contribute greatly in quality problems.

The data taken to calculate the current sigma level is defect data in 2017. From the defect data that has been taken, it is known that the number of defects are 7,051 units from 44,764 units. The calculation of the probability of defective is done using the Poisson distribution equation as follows:

$$P(X = x) = \frac{e^{-\lambda} \cdot \lambda^{x}}{x!}$$

$$\lambda = DPU = \frac{7051}{44764} = 0{,}157515$$

$$P(X = 0) = \frac{e^{-0.157515} \cdot 0.157515^{0}}{0!} = 0{,}85426$$

$$P(X > 0) = 1 - 0{,}85426 = 0{,}14574$$

The result of the defect probability is changed in DPMO, DPMO value is 145.740. The DPMO value is then converted in sigma units and the sigma value is 2.55.

After the current sigma level calculated, the next step is analyzing the defect data. The purpose of the analysis is determine the defects that have a significant effect on quality

ISSN No:-2456-2165

issues. The analysis was carried out by describing the proportion diagram for each type of defect. The diagram is shown in Figure 1.

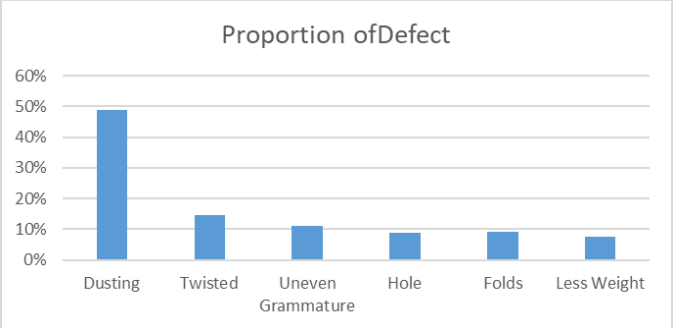

Fig 1:- Proportion For Each Type of Defect in 2017

Figure 1 shows a dusting defect is a defect that has the largest proportion from all defects produced. Based on the results of the analysis, we will focus to reduce the types of dusting defects.

C. Improve

At this stage is done to identify the root cause of dusting defects. The first step is determined the critical factor of dusting defects. The determination of critical factors is done by brainstorming and interviews with the expert and management staff. The results of brainstorming and interviews show that there are five critical factors that cause dusting defects, critical factors are setting paper formation, speed winder, dryer temperature, slitter knife and difference shift. Then, the five critical factors are tested by chi-square. The chi-square test is performed to prove whether there is a significant relationship between critical factor and dusting defect.

Chi-square test is done by collected dusting defects data in the company. The results of data collecting and chi-square test for each factors are shown in the Table 1. and Table 2.

Critical Factors	Parameter	Output	Defect
Setting Paper Formation	0.5	890	61
	1	1300	63
	1.5	1290	99
Speed Winder	850 rpm	981	89
	950 rpm	890	81
	1050 rpm	1285	88
Dryer Temperature	50%	1261	91
	65%	1093	88
	80%	971	71
Slitter Knife	A	1209	75
	B	878	76
	C	1098	99
Diference Shift	1	987	81

Critical Factors	Parameter	Output	Defect
	2	981	75
	3	985	112

Table 1. Data Collection of Dusting

Critical Factors	Chi-Square	Chi-Square Table	Result	Test Hipotesis
Setting Paper Formation	7,98	5,99	Significant	Reject Ho
Speed Winder	4,33	5,99	Not Significant	Accept Ho
Dryer Temperature	0,58	5,99	Not Significant	Accept Ho
Slitter Knife	6,35	5,99	Significant	Reject Ho
Diference Shift	7,95	5,99	Significant	Reject Ho

Table 2. Result of Chi-Square Test

After identifying the factors that cause dusting, the next step is provide a proposed improvement. The proposed improvements are shown in Table 3.

Problem	Root Cause	Recomand	Detail of Improvement
Dusting	Setting Paper Formation	Upgrade auto slice on headbox	Upgrade headbox to automate, to make formation easier and can be monitoring directly in DCS
	Slitter Knife	Replacement of slitter knife	Make schedule of replacement slitter knife on winder, 1 weeks for top and 1 month for bottom
	Difference Shift	Provide training to operational staff	Provide training to all operational staff to be more competent and more concerned about quality and maintain the machine

Table 3. Recommendation Of Improvement

D. Control

Control is the last stage in the six sigma method. This stage is done to evaluate the improvement. Evaluation is done by calculating future level sigma and cost saving.

The defect data (after repair) in January 2018 amounted to 518 units from 4028 units. The probability calculation of the defect is the same as that done in the previous stage. The result of the probability calculation of the defective product is then converted in sigma and the sigma value are 2.67.

Calculation of cost savings is done based on the number of defects before and after repair. The product defect will be reworked, so that they need more costs to produce finished goods. The calculation of the cost for rework is as follows:

Operator salary/month = IDR. 4,000,000
Number of Operator = 90 Persons
Cumm. Salary/month = 360,000,000
Available time/month = 43.200 minutes
Salary/minutes = 360,000,000/43,200
= IDR. 8,333.33
Time For Rework = 60 minutes/139 units
= 0.4316 minutes/unit
Energy cost/unit = IDR. 504,898.5
Steam cost/unit = IDR. 555,271.3

Calculation of total costs rework / unit;
= (IDR.8,333.33 x 0.4316) + IDR.504,898.5 + IDR.555,271.3
= IDR.1,063,766.5

The result of the cost saving calculation for the quality parameter is shown in the Table 4.

Before			After		
Total Defect/weeks	Rework costs/units	Total Cost	Total Defect/weeks	Rework costs/units	Total Cost
152	IDR 1,063,766.5	IDR 161,692,508	126	IDR 1,063,766.5	IDR 134,034,579
Costs Saving/weeks			IDR. 27,657,929		

Table 4. Cost Saving

Base on the results of improvements that have been done, the total cost saving in company are IDR. 27,657,929/ weeks, or IDR. 1,438,212,308/year.

V. CONCLUSION

The results of identification quality problem showed, defect that has a significant effect on the quality of PM 1 is dusting. The result of chi-square test shows that the defect factors has significant effect on the problem dusting that are the setting of paper formation, slitter knife, and the difference of shift. Base on the results of analysis factors causing defects, improvements made among others, Upgrade auto slice on the headbox, Creating slitter knife replacement schedule, and provide training to all operational staff. The improvement results show an increase sigma level from 2.55 to 2.67. From the result of the increase of sigma level, the total cost saving are IDR. 1,438,212,308/year.

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