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Planning Of Raw Material Supplies And Down Time Machine (At Toba Pulp Lestari Pt, Tbk Porsea-Tobasa)

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Abstract: *The status of PT. Toba Pulp Lestari, Tbk Porsea Toba Samosir whose factory is located in the village of Sosor Ladang, Parmaksian subdistrict, Toba Samosir district, Investment (PMA) since May 11, 1990, in accordance with the Letter of Approval of BKPM (National Investment Board) No. 170/III/PMA/1990 and the stock of this company has been sold at Bursa Saham Jakarta and Surabaya (Jakarta and Surabaya Stock Exchange) since 1992 and at New York Stock Exchange (NYSE). PT. Toba Pulp Lestari, Tbk Porsea Toba Samosir is a company which is active in pulp industry intended to meet the demand of domestic and foreign market with "make to stock" manufacture classification*

The fact is that the need for raw material to meet the production target of 240.000 tons per year has not yet met, the quality of raw material was not yet standard, and the net hours of machine working was in average 14 hours 15 minutes for the total available time of 24 hours per day . The plan of the need for raw material budgeted based on SUR (standard usage rate) was 3,8 ton log/ton pulp yet in fact the company did not meet this planned budget. In January, realization of SUR was 4,56 ton log/ton pulp, in February 4,34 ton log/ton pulp, and in March was 4,30 ton log/ton pulp. To solve the problem mentioned above, planning engineering (total productive maintenance) and supply engineering were performed

The result obtained through the application of this system was that the value of OEE (overall equipment effectiveness) has meet the world class standard because it has met the following criteria such as availability 90%, performance 95%, and quality 85%, with OEE (overall equipment effectiveness) 85%. The OEE (overall equipment effectiveness) data of January-March 2011 reveals that after the engineering was performed the value of OEE of January was 85,47%, February was 85,18%, and march was 88,42%.

Keyword: *TOC, OEE, Supply, Operation, Treatment.*

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I. INTRODUCTION

PT. Toba Pulp Lestari Tbk Porsea Toba-Samosir is a pulp industry which aims to fulfill market needs. In the daily production operations, PT Toba Pulp Lestari, Tbk Porsea was born various problems in existing work stations. The raw material requirement is not fulfilled to achieve the production target of 240,000 Ton per year, the quality of the raw material does not meet the standard and the effective production machine time (clock hour) averages 14 hours 15 minutes for the total available time (total available time) 24 hours per day. The planned raw material cost based on SUR (standard usage rate) of 3.8 tons log / ton of pulp was not met, as in January the realization of SUR 4.56 tons log / ton pulp, in February SUR 4.34 tons log / ton pulp, in March SUR 4.30 tons log / ton of pulp. To solve these problems, companies need to develop a system that can help management to easily access root (root cause) and make it easier to solve these problems.

This research was conducted to identify and analyze various things that exist in PT. Toba Pulp Lestari, Tbk Porsea is also looking for alternatives to the production process in order to target production. The theory of constraints (TOC) method is used to identify and develop specific ones for managing the program. The theory of constraint theory (TOC) in its efforts to improve the profitability of the company has provided a system that can minimize production costs based on processes in a production process. Of course with that, management should be able to focus efforts to improve the operations that need and increase capacity (Garrison and Noreen, 2000: 587).

Researchers to conduct research on the Pulp plant, because each factory needs to have different production processes, then also on different conditions, Organizing TOC as one form of strategic company to improve the profitability of the company in order to continue to survive in the existing global competition currently.

II. LITERATURE REVIEW

2.1 Theory of Constraint

Theory of constraint (TOC) was created by Eliyahu Moshe Goldratt at the beginning of the 1970s.Goldratt was an Israeli physicist who was later involved in the design of a production system to help his friend design a scheduling system for a chicken coop factory. This theory offers a way to overcome obstacles in production and more than that TOC focuses on continuous productivity improvement as well as global measurement of throughput, inventory and total cost. Some definitions of TOC include:
"The theory of constraints recognizes that the performance of any organization is limited by its constraints." (Hansen and Mowen, 2000: 826).TOC is a theory that focuses the manager's attention on obstacles or waste that slow down the production process (Blocher et al., 2001: 175). Meanwhile, according to Garrison and Noreen (2003: 2I): "Theory of constraints maintains that effectively managing the constraints is a key to success".
From that definition, TOC is a management philosophy that focuses on identifying the constraints affecting a company's production process, then optimizing the use of resources with such constraints to maximize throughput and increase profits.

There are five TOC steps used to achieve goals related to the decision making process in order to improve the competitiveness of the company. These steps are as follows: the first step identifies the constraints that affect the production process, the second step exploits the constrained resources, the third step adjusts the activity on unencumbered resources with the constrained activities, the fourth step maximizes the use of constrained resources and the search for a way to overcome the obstacle, then the fifth step to monitor the production process that has been fixed and start searching for new obstacles that may arise.

2.2 Forecasting

Forecasting is a process to estimate some future needs that include the needs in quantity size, quality, time and location required in order to meet the demand for goods or services. Forecasting is the process of estimating some of the future needs which include the needs in the quantity, quality, time, and location required to meet the demand for goods or services. To deal with diverse needs, several forecasting techniques have been developed to simplify and accurately predict the forecast. Current forecasting techniques can be broadly classified into 2 (two) namely, quantitative methods and qualitative methods. Quantitative methods can be divided into time-series methods and causal methods.

2.3 Inventory (Inventory)

2.3.1 Understanding Inventory (Inventory)

Nur Bahagia Senator (2006), inventory is an idle resource (idle resources) whose existence awaits further process. What is meant by further process here may be production activities as encountered in manufacturing systems, marketing activities as found in distribution systems.

2.3.2 Shape and Type of Inventory

In manufacturing business, inventory is always found in various forms of raw materials as input for production process, supplies to assist in the implementation of production process, spare parts to replace damaged components, semi-finished goods work in process), and finished goods ready to be marketed to consumers. The existence of inventory in a business activity can not be avoided, because the goods can not be obtained instantly, but it takes a grace period to get it. The grace period starts from the time of ordering, the time to produce it, the time to deliver the goods to the distributor even up to the time to process the goods in the warehouse until ready for use by the wearer. The time interval between the time of booking is done until the goods are ready to be used is called time off. (Lead time.)

III. MODELING

3.1 Place and time of research

Research conducted at PT. Toba Pulp Lestari, Tbk Porsea l okasi factory is located in Sosor Ladang Village, Parmaksian Subdistrict , Toba Samosir Regency, North Sumatra a wood processing industry Fiber into pulp *(Pulp)* L ama research 3 months (September - November 2010) .
This methodology is something that is very important because the success or failure, as well as the high quality of research results is largely determined by the decision of the author in choosing his research methodology.

3.2 Research methods

The research method used is the *action research* approach , which is a method that solves an indication of the condition, symptoms on existing and ongoing conditions, which is done by collecting data, tabulating and clarifying and interpreting so as to obtain a clear picture of the problems encountered and in the end the proposed development is done.
Stages of Research Process

No	Stages	Information

1	Evaluate the present condition	Invade the condition of the system Wood raw material inventory based on the data and observations obtained .field and the data of the past
2	Analyze the weakness of the situation	The information obtained will analyzed
3	Formulate existing problems	Based on field studies and data Existing data can then be the determination of the problems encountered
4	Set appropriate goals to analyze existing issues	To determine the appropriate raw material inventory control system
5	Collecting data	Collect all the data both primary and data are required data sekunder .
6	Processing data	By using TOC, diagram scatter, quadratic forecasting method and cyclical to determine the method inventory control, OEE for minimize machine *down time* with TPM .
7	Designing information system	Create SOP storage materials raw and maintenance systems with new TPM for weakness of sis tem current information is not repeated .
8	Conclusions and recommendations	Summing up and delivering suggestions to management for follow up

Source: Author Prepared, 2011

3.3 Method of collecting data

The data required in this study were collected in various ways, namely :

1. Make a direct observation, which is to record their own data required obtained on the field observation.
2. Conduct Frequently Asked Questions with related parties in the control *of raw material* inventory.
3. Perform a search of various related documents such as past data, policies and documents related to *raw material* inventory control , *maintenance systems* and others .

3.4 Data source

The data required in this research outline consists of two types of data, namely:

1. Primary data

Primary data includes the current supply control information flow and others.

2. Secondary Data

Number and type *of raw materials* , quantity of production, timing of orders for wood raw materials , quantity of raw material demand , types of damage, realization of maintenance program, failure of repairs, business processes, completeness of facilities and infrastructure covering materials, mechanics, machinery, systems and repair procedures and others.

3.5 Data Processing

Data processing for data solving on this Thesis using Teory Of Constrain approach (TOC).

In implementing ideas as the solution of a problem, Goldratt develops 5 (five) consecutive steps so that the refinement process is more focused and results in better system, as follows:

Step 1: Identify the constraint of the system (identifying the constraint) with using Current Reality Tree (CRT)

Step 2: Constraint exploitation (exploiting the constraint) (to what to change)

3.6 Development of Current Reality Tree (CRT)

From several UDEs formed it was developed with a current reality tree (CRT) diagram that comprises a causal relationship (cause and effect relationship). CRTs also look for relationships between problems that arise, so that the main factors causing obstacles more easily found. For example UDEs Schedule delivery of irregular raw materials from the Supplier resulted in Safety stock of raw materials used before the time set for 20 days so that the quality of wood does not meet the standards and supplies Raw materials are too low for production needs. From the causal relationship is obtained some root causes (causal factors) that can be marked from the absence of arrows into the box. CRT development aims to find the core problem (core conflect) on the production process system at the factory.

Calculation of Forecasting of Raw Materials Needs

Before doing the forecasting needs to be selected the type of forecasting that will be used. The steps of forecasting, namely:

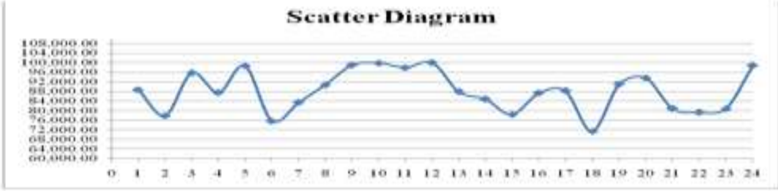
1. Destination Forecasting
   Forecasting demand for wood raw materials from the mill for the next 12 months (January-December 2011.)
2. Making a scatter diagram

3. Wood demand data from January 2008-December 2009 for Mill

Table 1 Data of Raw Material Demand for 2008-2009

Month	Request (Ton)	Month	Request (Ton)
1.	88,740.99	13	87,817.10
2.	77,809.25	14	84,696.58
3.	95,621.38	15	78,390.75
4.	87,468.13	16	87,249.98
5.	98,663.88	17	88,205.67
6.	75,683.91	18	71,407.77
7.	83,335.70	19	90,987.94
8.	90,636.95	20	93,614.87
9.	98,876.65	21	80,813.27
10.	79.279,11	22	79,279.11
11.	80.739,12	23	80,739.12
12.	98.765,67	24	98,765.67

Source : PT. Toba Pulp Lestari, Tbk Porsea



4. Selection of Alternative Forecasting Method
Based on the scatter diagram, the historical pattern of actual demand data indicates instability or large and volatile changes. Forecasting model that matches the demand pattern is Quadratic Method and Cyclical Method

5. Calculation of Forecasting function parameters
To know the requirement of raw materials in the first month of 2011 by using equation of method of Quadratis, that is:
Y (t) = a = bt + ct2
As for knowing Quadratic methods need data about the use of raw materials during the year 2009 to 2010 is like in Table 2.

Table 2 Calculation of Raw Materials in 2011 at PT Toba Pulp Lestari, Tbk with Quadratic Method

X	Y	X^2	X.Y	X^4	X^2.Y	X^3
1	88.740,99	1	88.740,99	1	88.740,99	1
2	77.809,25	4	155.618,50	16	311.237,00	8
3	95.621,38	9	286.864,14	81	860.592,42	27
4	87.468,13	16	349.872,52	256	1.399.490,08	64
5	98.663,88	25	493.319,40	625	2.466.597,00	125
6	75.683,91	36	454.103,46	1.296	2.724.620,76	216
7	83.335,70	49	583.349,90	2.401	4.083.449,30	343
8	90.636,95	64	725.095,60	4.096	5.800.764,80	512
9	98.876,65	81	889.889,85	6.561	8.009.008,65	729
10	99.786,78	100	997.867,80	10.000	9.978.678,00	1.000
11	97.887,98	121	1.076.767,78	14.641	11.844.445,58	1.331
12	99.886,79	144	1.198.641,48	20.736	14.383.697,76	1.728
13	87.817,10	169	1.141.622,30	28.561	14.841.089,90	2.197
14	84.696,58	196	1.185.752,12	38.416	16.600.529,68	2.744
15	78.390,75	225	1.175.861,25	50.625	17.637.918,75	3.375
16	87.249,98	256	1.395.999,68	65.536	22.335.994,88	4.096
17	88.205,67	289	1.499.496,39	83.521	25.491.438,63	4.913
18	71.407,77	324	1.285.339,86	104.976	23.136.117,48	5.832
19	90.987,94	361	1.728.770,86	130.321	32.846.646,34	6.859
20	93.614,87	400	1.872.297,40	160.000	37.445.948,00	8.000
21	80.813,27	441	1.697.078,67	194.481	35.638.652,07	9.261
22	79.279,11	484	1.744.140,42	234.256	38.371.089,24	10.648
23	80.739,12	529	1.856.999,76	279.841	42.710.994,48	12.167
24	98.765,67	576	2.370.376,08	331.776	56.889.025,92	13.824
300	2.116.366,00	4.900	26.253.866,21	1.763.020	425.896.767,71	90.000

$$\gamma = \left(\sum_{t=1}^{N} t^{2} \right)^{2} - N \sum_{t=1}^{N} t^{2} = 4.900 \ - (24x1.763.020) \ = 8.142.820$$

$$\delta = \sum_{t=1}^{N} t \sum_{t=1}^{N} Y(t) - N \sum_{t=1}^{N} tY(t) = (300\,x2.129.384 - (24\,x27.385.321) = 392.344.570$$

$$\theta = \sum_{t=1}^{N} t^{2} \sum_{t=1}^{N} Y(t) - N \sum_{t=1}^{N} t^{2} Y(t) = (650\,x1684360 \ - (24\,x456.253.631) = 6.327.653.275$$

$$\alpha = \sum_{t=1}^{N} t \sum_{t=1}^{N} t^{2} - N \sum_{t=1}^{N} t^{3} = (300\,x4.900 - (24\,x90.000) = 660.000$$

$$\beta = \left(\sum_{t=1}^{N} t \right) N \sum_{t=1}^{N} t^{2} = (300)^{2} - (24x4.900) = 45.900$$

a, b & c:

$$c = \frac{\theta - (b)(\alpha)}{\gamma} = \frac{6.327.653.275 - (15.870) - (660.000)}{8.142.820} = 509$$

$$b = \frac{\gamma\delta - \theta\alpha}{\gamma\beta - \alpha^{2}} = \frac{(8.142.830\,x392.344.570) - (6.327.633.275\,x660.000)}{(8.142.820\,x45.900) - (6600.000)^{2}} = 15.870$$

$$\alpha = \frac{\sum_{t=1}^{N} Y(t)}{N} - b\frac{\sum_{t=1}^{N} t^{2}}{N} - c\frac{\sum_{t=1}^{N} t^{2}}{N} = \frac{2.129.384}{24} + \left(15.870\,\frac{(300)}{24}\right) - \left(509\,\frac{300}{24}\right)$$

$$= 660.000$$

Y(t) = 600.000 + 15.870t –509t

So forecasting of raw materials for the 25th month (January 2011) is 98.402 Ton.

6. Parameter Function Forecasting Cyclical Method

Results Calculation Parameter Function Forecasting Cyclical Methods, as in Table 3.

Table 3 Data Calculation Parameter Forecasting Cyclical Method

X	Y	Sin (2πX/n)	Cos (2πX/n)	SinCos	Sin^2	Cos^2	Y.Sin	Y.Cos
1	87.817,10	0,26	0.97	0.25	0.07	0.93	22.728,82	84.825,17
2	84.696,58	0,50	0.87	0.43	0.25	0.75	42.348,29	73.349,78
3	78.390,75	0,71	0.71	0.50	0.50	0.50	55.430,88	55.430,88
4	87.249,98	0,87	0.50	0.43	0.75	0.25	75.561,10	43.624,99
5	88.205,67	0,97	0.26	0.25	0.93	0.07	85.200,50	22.829,39
6	71.407,77	1,00	0.00	0.00	1.00	0.00	71.407,77	0,00
7	90.987,94	0,97	0.26	-0.25	0.93	0.07	87.887,98	-23.549,50
8	93.614.87	0,87	-0.50	- 0.43	0.75	0.25	81.073,29	-46.807,44
9	80.813,27	0,71	-0.71	-0.50	0.50	0.50	143,87	-57.143,87
10	79.279,11	0,50	-0.87	-0.43	0.25	0.75	39.639,56	-68.658.09
11	80.739,12	0,26	-0.97	-0.25	0.07	0.93	20.896,90	-77.988.34
12	98.765.67	0,00	-1.00	0.00	0.00	1.00	0,00	-98.765.66
13	88,74	0,99	-0.26	-0.97	0.25	0.07	0,93	-22.967.94
14	77.809,25	-0,50	-0.87	0.43	0.25	0.75	-38.904,63	-67.385.14
15	95.621,38	-0,71	-0.71	0,50	0,50	0,50	-67.614,83	-67.614,83
16	87.468,13	-0,87	-0,50	0,43	0,75	0,25	-75.750,02	-43.734,07
17	98.663,88	-0,97	-0,26	0,25	0,93	0,07	-95.302,40	-25.536,19
18	75.683,91	-1,00	0,00	0,00	1,00	0,00	-75.683,91	0,00
19	83.335,70	-0,97	0,26	-0,25	0,93	0,07	-80.496,45	21.568,95
20	101.636,95	-0,87	0,50	-0,43	0,75	0,25	-88.020.65	50.818,48
21	100.876,65	-0,71	0,71	-0,50	0,50	0,50	-71.330,89	71.330,89
22	99.786,78	-0,50	0,87	-0,43	0,25	0,75	-49.893,39	86.418,35
23	97.887,98	-0,97	-0,26	-0,25	0,07	0,93	-25.335,37	94.552,94
24	99.886.79	0.00	1,00	0.00	0,00	1,00	0,00	99.886,79
	2.129.366,22	0,00	0,00	0,00	12,00	12,00	-51.981,52	41.735,88

a = 88,723.59   b = -4,331.76   c = 3,477.97

$$Y(t) = a + b\sin\frac{2\pi}{n} + c.\cos\frac{2\pi t}{n} \quad \text{.....................................}(5.2)$$

$$Y = 88.723{,}59 - -4.331{,}76\sin\frac{2\pi t}{n} - 3.477{,}97\cos\frac{2\pi t}{n}$$

So forecasting of raw material requirement for 25th month (January 2011) is 86,264.18 Ton. The calculation of the amount of wood raw material needs for the period January to December 2011 with the Cyclical method seen in Table 4.

X	Y	Y'	Error	e ^2
1	88.740,99	86.264,18	2.476,81	6.134.570,90
2	77.809,25	87.378,92	-9.569,67	91.578.612,10
3	95.621,38	88.548,40	7.072,98	50.027.024,19
4	87.468,13	89.692,91	-2.224,78	4.949.628,55
5	98.663,88	90.734,42	7.929,46	62.876.294,91
6	75.683,91	91.601,98	-15.918,07	253.385.085,04
7	83.335,70	92.236,50	-8.900,80	79.224.293,45
8	90.636,95	92.594,69	-1.957,74	3.832.753,07
9	98.876,65	92.652,17	6.224,48	38.744.213,39
10	99.786,78	92.404,99	7.381,79	54.490.845,41
11	97.887,98	91.870,03	6.017,95	36.215.755,27
12	99.886,79	91.083,71	8.803,08	77.494.189,37
13	87.817,10	90.099,67	-2.282,57	5.210.117,86
14	84.696,58	88.984,93	-4.288,35	18.389.947,38
15	78.390,75	87.815,45	-9.424,70	88.824.972,34
16	87.249,98	86.670,95	579,03	335.280,84
17	88.205,67	85.629,43	2.576,24	6.637.017,26
18	71.407,77	84.761,87	-13.354,10	178.331.920,15
19	90.987,94	84.127,35	6.860,59	47.067.712,98
20	93.614,87	83.769,16	9.845,71	96.938.008,62
21	80.813,27	83.711,69	-2.898,42	8.400.819,12
22	79.279,11	83.958,86	-4,679,75	21.900.089,49
23	80.739,12	84.493,82	-3.754,70	14.097.805,24
24	98.765,67	85.280,14	13.485,53	181.859.517,50
	Jumlah			1.426.946.474.44

7. Calculation of Deviation Forecasting Method To get the best forecasting method between the selected methods, it is necessary to calculate the error rate of each method then the smallest error selected to generate the forecast. Based on the above SEE calculation results, it can be seen that the smallest SEE is the Cyclical Method.

8. Determination of Inventory Methods From the cyclical forecasting calculation result data as seen in Table 5.9, it is seen that the policy of inventory control method applied by the company is the periodic method of statistical inventory control called SIC.

3.7 Calculation of OEE (Overall Equipment Effectiveness)

OEE overall equipment effectiveness method is a method used as a measuring tool in the application of TPM program in order to keep the equipment in ideal conditions with the removal of six big losses of equipment. This OEE measurement is based on measurement of three main risks, namely Availability ratio, Performance ratio, Quality ratio.

1. Availability Ratio

Availability ratio is a ratio that describes the utilization of time available for the operation of machinery or equipment. Nakajima (1988) states that availability is the ratio of operation time, by eliminating equipment downtime, against loading time.

Thus the formula used to measure availability ratio is:

$$Availability = \frac{operation\ time}{loading\ time} = \frac{loading\ time - downtime}{loading\ time}$$

Loading time is the amount of time available in the production plan per month minus the planned down time

Loading time = total available time-planned down time

2. Performance Ratio

Performance Ratio is a ratio that describes the ability of the equipment in producing goods. This ratio is the result of Operating Speed Rate and net operating rate. Operating Speed Rate equipment refers to the difference between ideal speed (based on equipment design) and actual operating speed. the net operating rate measures the maintenance of a speed over a given period.

$$Performance\ rate = \frac{processed\ amount\ x\ theoretical\ cycle\ time}{operation\ time}$$

3. Quality ratio

Quality ratio is a ratio that describes the ability of the equipment to produce in accordance with the standard. The formula used for the measurement ratio is: $Quality\ rate = \frac{processed\ amount\ \ defect\ \ amount}{processed\ \ amount}$

3.8 Analysis and Discussion

The inventory planning policy based on periodic or periodic review shows that EOQ (Q *) is 172,868,788.88 Ton then POQ is 58,810.96 Ton per 20 days while the available safety stock according to the inventory method planned by the company is equal to average of 46,009.59 tons per 20 days.

OEE Calculation Analysis

The OEE calculation analysis is done by looking at the effectiveness of the use of machines during the period of May to July 2010. OEE measurement is a combination of time factor, production speed and quality of operation of the machines used.

1. OEE value in low period of 64.90% due to the ratio of Performance efficiency is very low that is equal to 71.15% and the ratio of Rate Of Quality of 92.56% is still below the ideal ratio of 99%, but the ratio of Availability high that is equal to 98,725 above ideal value that is 90%.
2. OEE value in the period of June increased by 71.15% but still below the ideal ideal OEE expected 85% due to the ratio of the Rate Of Quality of 86.63% low and the ratio of Performance Efficiency of 62.88% and still below the ideal ratio of 95% but the high Availability value of 99.11% above the ideal value of 90%.
3. The value of OEE in the period of July decreased by 64.47% due to the ratio of Performance Efficiency decreased by 79.62%, the ratio of Rate of Quality fell by 81.64%.
4. Overall the value of OEE is still low and still far below normal, the value of the overall use of the equipment of the machine is still below the standard set by the Japan Institute of Plant Maintenance (JIPM) of 85%.
5. This means that we need to improve the OEE values to be ideal with Total Preventive Maintenance (TPM) solutions.

IV. CONCLUSION

Conclusions

After doing research to identify and analyze the constraints contained in PT. Toba Pulp Lestari, Tbk Porsea as well as looking for alternatives to optimize the production process in order to fulfill the production targets, it can be drawn some conclusions and suggestions include:

1. The result of problem identification with that two requirement to fulfill production target based on constraints found in CRT ie the use of raw materials must be in accordance with established SOP and minimize Down time of production machine and step more concrete is, it is necessary to calculate the forecasting of raw materials and maintenance.
2. Overall OEE value is still low and still far below normal, the effectiveness value of the overall equipment of the machine is still below the standard set by Japan Institute of Plant Maintenance (JIPM) that is 85%. This means that we need to improve the OEE values to be ideal with Total Preventive Maintenance (TPM) solutions.

Suggestions

1. The company must improve the inventory system by considering the type of wood raw material available.
2. The company shall improve the maintenance system of the production equipment.
3. To socialize the importance of applying all elements of TPM to all employees in the company.
4. We recommend that companies run the proposed system to improve productivity.

REFERENCES

[1]. Blocher, Edward J., Kung H. Chen, dan, Thomas W Lin, (2001), Manajemen Biaya Dengan Tekanan Stratejik, McGraw Hill, USA.
[2]. Campbell, Robert J., (1992), *Competitive Cost-Based Pricing System for Modern Manufacturing*, USA : Quorum Books
[3]. Daryus Asyari, “Manajemen Pemeliharaan Mesin” Universitas Darma Persada, Jakarta
[4]. Dwi Priyanta, MSE, Ir, 2000, “Keandalan Dan Perawatan”
[5]. Fogarty, Donald W., John H Blackstone & Thomas R Hoffman, 1991, *”Production & Inventory Management”,* Shouth Western Publishing CO, Cincinnati, OH.
[6]. Garrison, Ray H., dan. Norren, Eric W (2003), *Managerial Accounting*, 10th ed., McGraw-Hill Companies, Inc.
[7]. Hansen, Don R., dan Mowen, Maryanne M (2000), *Management Accounting*, 6th ed., USA : International Thompson Publishing.
[8]. Indrajit, Richardus Eko, 2003, “Manajemen Persediaan", Penerbit Andi.
[9]. Nur Bahagia Senator, 2006, “Sistem Inventori", Penerbit ITB
[10]. Ristono Agus, 2008, ”Manajemen Persediaan”, Penerbit Graha Ilmu.
[11]. Ginting Rosnani 2007, “Sistem Produksi”, Graha Ilmu
[12]. Sinulingga Sukaria 2008, “Pengantar Teknik Industri”. Graha Ilmu
[13]. Sinulingga Sukaria,2011, “Metode Penelitian”, Edisi 1, USU Press
[14]. Sofian, Assauri, 1998, ”Manajemen Persediaan”, Penerbit Andi.

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