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Analysis Productivity of Palm Oil Mill using FMEA

Aghib Ritaldi Siregar, Cliff Sangkek, Erry Rimawan
Universitas Mercu Buana
Jl. Raya Meruya Selatan, Kembangan, Jakarta 11650

Abstract:– The main objective of this research is to explore the level of productivity of a palm oil processing plant. Mill of PT. XYZ has never done the measurement of productivity of processing, Company just calculate the cost per unit of fruit processed compared to budget as a measure of good or whether the processing productivity. A model of partial and total productivity measurement was developed and applied to monitor the status of the productivity of the company. The model was tested using the data of January 2016 up to December 2017 collected from companies. Total productivity index of the current period December 2017 is 1,115. In general the productivity of a company either because productivity is more than 1, a minimum ratio of Productivity to be achieved is 1, the generated Output with the same Input (resources) that are used or reach a BEP (Break Even Point) between Output and Input. partial productivity index company to current period December 2017, as compared to the basic period June 2016, to each of the input factors (human, material, capital, energy and other input factors)respectively is 1,133,0813, 2,180, 0264 and 0978. Partial index of Human Energy with the lowest numbers & done repairs to improve the productivity of the total with the FMEA method, processing employee overtime & genset diesel usage is the biggest cost components affecting the cost of partial Human and Energy. Improvements are made based on the recommendation of the largest RPN value, further measurements carried out during the period of repair January 2018 until June 2018. Total productivity Index current period June 2018 was 1.191. Partial productivity index company to current period June 2018, compared to the base period of June 2016, for each factor inputs (human, material, capital, energy and other input factors) respectively is 0.77, 1.02, 1.19, 0.66, 1.89.

Keywords:- *Index, Partial Productivity, Total Productivity.*

I. PENDAHULUAN

The development of the Palm Oil Industry is currently growing in the global market. The high demand for Palm oil globally reflected the increasing export of CPO (Crude Palm Oil) in the country of Indonesia The growth of palm oil fuelled by an increase in the number of world population and the growing trend of oleochemical raw material usage in the food industry, industrial shortening, pharmasi (cosmetics).

Fig 1:- Indonesia CPO Export

Source; Dirjenbun, (2018)

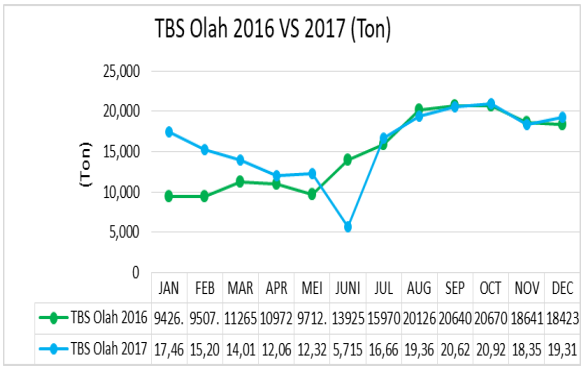

Fig 2:- FFB Processing 2016-2017 Source; PT. XYZ (2018)

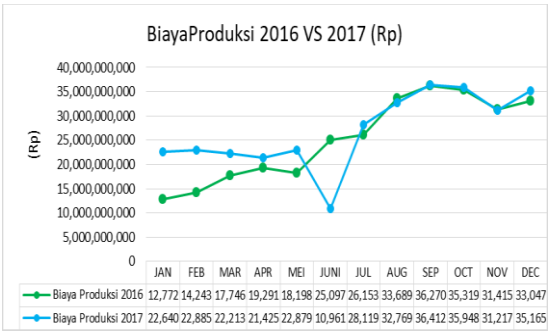

Fig 3:- Production cost data 2016-2017 Source; PT. XYZ (2018)

The mill of PT. XYZ is a company engaged in the processing of palm oil into CPO (Crude Palm Oil) and palm kernel with a capacity of processing 45 Tons/h. Mill of PT. XYZ has never done the measurement of productivity of processing, The company only calculate the cost per unit of fruit processed compared to budget costs as a measure of good

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or whether the processing productivity. Based on the data processing of palm oil production costs contained in the management report monthly views that spending has increased production costs and the resulting products also experienced an increase, but it does increase the cost is directly proportional to the increase in the production of a product reflects productivity has a good one. Therefore it is necessary the presence of productivity measurement to find out how the current productivity.

Productivity with regard to effectiveness and efficiency of utilization of resources (inputs) in producing output. According to Manuaba (1992a) increased productivity can be achieved by holding down the last detail all sorts of costs included in utilizing human resources (do the right thing) and increase the output of most (do the thing right). Measuring productivity can indicate the extent to which these companies can compete, because the higher the productivity of a company then increasingly have high competitiveness.

II. LITERATURE REVIEW

Measurement of productivity has always been an important aspect in a company. This time, the problem of increased productivity, especially in developing countries, has become important for companies manufacturing, strategic planners, policy makers and Government become a major factor affecting the overall performance Company (Arturo, 2004).

Increase the productivity of the organization is an issue that has been used for some time and will continue to be something important. For companies manufacturing is characterized by low resource utilization (machines/equipment, labour, materials, capital, energy, time and others), productivity measurement and improvement is not only desirable but also increasingly be a requirement for the survival of the Organization (Mika, 2002).

Measurement of productivity is the quantification of both output and input production systems resources. This is a pre-requisite for increasing productivity. This shows the gap between the existing and desired status or level of productivity in manufacturing companies. Has stated that low levels of productivity in manufacturing companies imply low growth of the national economy as well as the organization.

FMEA

FMEA is a structured procedure for identifying and preventing as many as possible modes of failure (failure mode). FMEA is used to identify the sources and root causes of a quality problem. According to Chrysler (1995), FMEA can be done by means of:

1. Identify and evaluate the potential failure of a product and its effect.
2. The recording process (document the process).
3. Identifying actions that could eliminate or reduce the chance of potential failure occurs.

III. METHODOLOGY

The approach of this study including literature reviews, observation, discussion, and case studies. A detailed literature review of productivity measurement approach and type of measurement productivity is presented. Productivity measurement practices currently in company palm oil plantations are reviewed. Researchers have conducted field observations to see the overall work environment company, to investigate the work process and procedures, and to observe the productivity tasks practiced in the company. In addition, there are some useful discussions were held with the General Manager, production manager and supervisor at the company.

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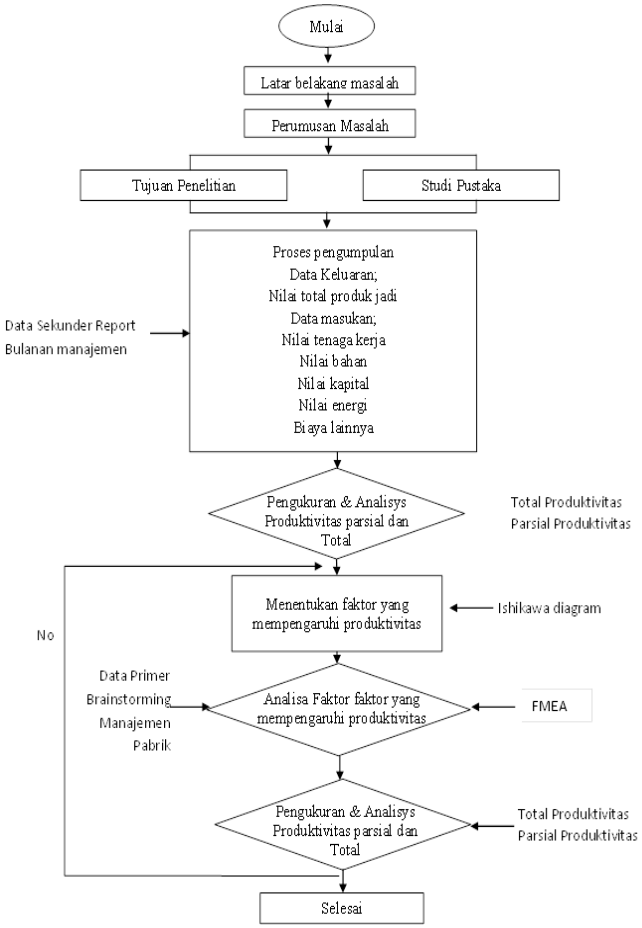

Fig 4:- Flow Chart Penelitian

IV. RESULTS AND DISCUSSION

A. Measurement Productivity

Measurement of productivity is part of diagnosis identifies where improvement activities should be prioritized. It is important to perform the measurements as a basis for analysis, and also to track changes and development for program improvement. The basic purpose behind the measurement of productivity is to help practitioners understand their production process, to ensure that decisions are based on facts, to show where repairs need to be done, to show whether the improvements actually happen.

The selection of the basic period of the Month: the Month is the basis for the calculation of the growth of productivity in the company are defined to be in December 2016, because on the month can be compared directly with the criteria of the current period. January 2017. Applying the model of measurement requires the collection of each of the two quantities, that is, the price or value of each input and output. Thus, data output and input values from the company PT. X to 24 months are compiled as shown in table 1.

The author defines five partial productivity company PT. X as follows:

- Human Input: these include the values of the salary and benefits of all employees of the company.
- Input Material: This includes the major raw materials, such as oil palm fresh fruit Bunches, chemicals.
- Input: Capital maintenance costs of the plant.
- Input Energy: these include electrical power and water consumption.
- All kinds of input: the cost of support, such as tax, building maintenance, travel agency, levy

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Bulan	Nilai Tenaga Kerja	Nilai Material	Nilai Capital	Nilai Energy	Nilai Lain - lain	Total Masukan	Total Keluaran
	Rp.1000	Rp.1000	Rp.1000	Rp.1000	Rp.1000	Rp.1000	Rp.1000
Jan-16	279,875	11,943,549	120,477	210,025	218,449	12,772,375	14,533,755
Feb-16	331,701	13,493,213	67,632	134,083	217,037	14,243,666	15,824,107
Mar-16	318,278	17,060,227	67,083	112,084	188,332	17,746,004	20,082,987
Apr-16	335,593	18,697,295	60,465	89,219	108,956	19,291,528	24,616,581
Mei-16	291,985	17,222,858	61,475	388,079	233,751	18,198,149	21,424,067
Jun-16	310,052	24,238,830	172,294	96,614	279,439	25,097,228	25,396,685
Jul-16	330,649	25,531,824	77,623	109,685	103,844	26,153,625	30,329,664
Agt-16	381,820	32,900,105	115,051	80,261	212,040	33,689,276	37,636,245
Sep-16	375,380	35,427,791	75,255	181,026	211,446	36,270,899	44,648,977
Okt-16	422,970	34,196,817	122,157	309,078	268,187	35,319,209	46,749,563
Nov-16	438,480	30,542,151	82,100	108,880	243,973	31,415,584	38,864,054
Des-16	521,121	31,938,875	110,259	239,677	237,303	33,047,235	36,825,739
Jan-17	416,717	21,733,811	154,215	137,083	198,742	22,640,568	35,250,808
Feb-17	428,404	21,749,031	214,352	146,422	346,904	22,885,113	33,439,215
Mar-17	438,638	21,241,788	105,956	183,866	243,320	22,213,568	30,956,746
Apr-17	408,644	20,686,831	96,902	141,684	91,446	21,425,508	26,074,682
Mei-17	435,792	22,023,987	50,026	135,162	234,959	22,879,926	24,180,957
Jun-17	392,727	10,020,026	96,857	142,549	309,401	10,961,560	11,254,193
Jul-17	483,191	27,056,608	107,465	239,760	232,576	28,119,599	32,013,611
Agt-17	501,262	31,729,578	134,023	179,959	224,938	32,769,759	38,087,373
Sep-17	524,509	35,293,764	157,623	243,480	193,467	36,412,843	43,529,581
Okt-17	535,110	34,741,321	115,798	244,780	311,642	35,948,651	44,190,607
Nov-17	482,218	30,106,844	165,894	181,607	280,902	31,217,465	37,964,458
Des-17	596,219	33,427,604	123,502	571,202	446,573	35,165,100	39,690,433

Table 1. Data untuk perhitungan produktivitas

(Source: Data Processing)

B. Partial Productivity Current Period (December 2017)

$$PP_H = \frac{OF}{IH} = \frac{39{,}690{,}433}{596{,}219} = 66.57$$

$$PP_M = \frac{OF}{IM} = \frac{39{,}690{,}433}{33{,}427{,}604} = 1.19$$

$$PP_C = \frac{OF}{IC} = \frac{39{,}690{,}433}{123{,}502} = 321.38$$

$$PP_E = \frac{OF}{IE} = \frac{39{,}690{,}433}{571{,}202} = 69.49$$

$$PP_X = \frac{OF}{IX} = \frac{39{,}690{,}433}{446{,}573} = 88.88$$

Thus, Partial productivity for human, material, capital, energy and others from this process was 66.57, 1.19, respectively 321.28, 69.49 and 88.88.

C. Partial Productivity Index current period (December 2017) base on basic period June 2016.

- *Human Productivity Index*

$$PP_{H-Indeks} = \frac{OP_b}{OP_a} X \frac{IP_{Ha}}{IP_{Hb}} = \frac{39{,}690{,}433}{25{,}396{,}685} X \frac{310{,}052}{596{,}219} = 0.813$$

- *Material Productivity Index*

$$PP_{M-Indeks} = \frac{OP_b}{OP_a} X \frac{IP_{Ma}}{IPM_b} = \frac{39{,}690{,}433}{25{,}396{,}685} X \frac{24{,}238{,}830}{33{,}427{,}604} = 1.133$$

- *Capital Productivity Index*

$$PP_{C-Indeks} = \frac{OP_b}{OP_a} X \frac{IP_{Ca}}{IP_{Cb}} = \frac{39{,}690{,}433}{25{,}396{,}685} X \frac{172{,}294}{123{,}502} = 2.180$$

- *Energy Productivity Index*

$$PP_{E-Indeks} = \frac{OP_b}{OP_a} X \frac{IP_{Ea}}{IP_{Eb}} = \frac{39{,}690{,}433}{25{,}396{,}685} X \frac{96{,}614}{571{,}202} = 0.264$$

- *Misccelenous Productivity Index*

$$PP_{X-Indeks} = \frac{OP_b}{OP_a} X \frac{IP_{Xa}}{IP_{Xb}} = \frac{39{,}690{,}433}{25{,}396{,}685} X \frac{279{,}439}{446{,}573} = 0.978$$

Thus, the Partial index of productivity for Human, Materials, Energy, Capital and Miscellenous from this process is 1,133, 0813, 2,180, 0264 and 0978.

Total Productivity based on Total Output and partial Productivity

The productivity of the company's total for the month to 24 as a function of total output and total input has been calculated as follows;

$$TPF_{24} = \frac{OF}{IF} = \frac{39{,}690{,}433}{35{,}165{,}100} = 1.129$$

Total Productivity based on Partial productivity

$$TPF = \frac{1}{5}(W_{iH}PP_{iH} + W_{iM}PP_{iM} + W_{iC}PP_{iC} + W_{iE}PP_{iE} + W_{iX}PP_{iX})$$

The first measurement of the magnitude of the weighting of each factor to the total input

$$WH = \frac{IH}{IF} = \frac{596{,}219}{35{,}165{,}100} = 0.017$$
$$WM = \frac{IM}{IF} = \frac{33{,}427{,}604}{35{,}165{,}100} = 0.951$$
$$WC = \frac{IC}{IF} = \frac{123{,}502}{35{,}165{,}100} = 0.004$$
$$WE = \frac{IE}{IF} = \frac{571{,}202}{35{,}165{,}100} = 0.016$$
$$WX = \frac{IX}{IF} = \frac{446{,}573}{35{,}165{,}100} = 0.013$$

Total Productivity based on Partial Productivity

$$TPF = \frac{1}{5}(0.017\ X\ 66.57 + 0.951\ X\ 1.19 + 0.004\ X\ 321.38 + 0.016\ X\ 69.49 + 0.013\ X\ 88.88)$$
$$= \frac{1}{5}(1.13 + 1.13 + 1.29 + 1.11 + 1.16)$$
$$TPF = 1.16$$

D. Indeks Total Produktivitas Output Input CurrentPeriod (Desember 2017)

$$TPF_{Indeks} = \frac{OF_b}{OF_a} X \frac{IF_a}{IF_b}$$
$$TPF_{Indeks} = \frac{39{,}690{,}433}{25{,}396{,}679} X \frac{25{,}097{,}228}{35{,}165{,}100} = 1.115$$

Total Productivity index based on Partial productivity of the Current Period (December 2017)

$$TPF_{Indeks} = W_{iH}PP_{iH-Indeks} + W_{iM}PP_{iM-Indeks} + W_{iC}PP_{iC-Indeks} + W_{iE}PP_{iE-Indeks} + W_{iX}PP_{iX-Indeks}$$
$$TPF_{Indeks} = 0.017\ X\ 0.813 + 0.951\ X\ 1.133 + 0.004\ X\ 2.180 + 0.16\ X\ 0.264 + 0.013\ X\ 0.978$$
$$TPF_{Indeks} = 0.014 + 1.077 + 0.009 + 0.004 + 0.013$$
$$TPF_{Indeks} = 1.117$$

Total and partial Productivity Analysis Analysis of the partial and total productivity was conducted in the company of PT. XYZ and also a partial index of productivity index and total productivity by comparing the current period with the basic period.

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Total Productivity Analysis

Bulan	Total Produktivitas	Bulan	Total Produktivitas
Jan-16	1.138	Jan-17	1.557
Feb-16	1.111	Feb-17	1.461
Mar-16	1.132	Mar-17	1.394
Apr-16	1.276	Apr-17	1.217
Mei-16	1.177	Mei-17	1.057
Jun-16	1.012	Jun-17	1.027
Jul-16	1.16	Jul-17	1.138
Agt-16	1.117	Agt-17	1.162
Sep-16	1.231	Sep-17	1.195
Okt-16	1.324	Okt-17	1.229
Nov-16	1.237	Nov-17	1.216
Des-16	1.115	Des-17	**1.129**
AVG 2016	1.169	AVG 2017	1.232

Table 2. The Total productivity of the year 2016-2017 PT.XYZ

(Source: data processing)

Total productivity tends to be flutuatif, the year 2017 total productivity can be seen better if compared to 2016. The decline so far occurred in the period January 2017 of 1,557 to 1,027 in June 2017. Then increase back to November 2017 of 1,216. In the measurement of current period i.e. January 2017 decline ratio amounted to 1,129.

Calculation of total productivity index current period increase if compared to the basic period.

Bulan	Indeks Total Produktivitas	*Growth*	Bulan	Indeks Total Produktivitas	*Growth*
Jan-16	1.124	11%	Jan-17	1.539	35%
Feb-16	1.098	9%	Feb-17	1.444	31%
Mar-16	1.118	11%	Mar-17	1.377	27%
Apr-16	1.261	21%	Apr-17	1.203	17%
Mei-16	1.163	14%	Mei-17	1.044	4%
Jun-16	**1**	**0%**	Jun-17	1.015	1%
Jul-16	1.146	13%	Jul-17	1.125	11%
Agt-16	1.104	9%	Agt-17	1.149	13%
Sep-16	1.216	18%	Sep-17	1.181	15%
Okt-16	1.308	24%	Okt-17	1.215	18%
Nov-16	1.223	18%	Nov-17	1.202	17%
Des-16	1.101	9%	Des-17	1.115	10%

Table 3. Total Index Comparison. The productivity of the current period with the basic period.

(Source: Data Processing)

Current period December 2017 experienced a 10% increase when compared to the basic period June 2016, in which the basic period was a period with the most productivity is low, but if trends seen during the year 2017 productivity current period tend to increase when compared with the trend of the year 2016.

E. Partial Produktivity Analysis

Next do a partial comparison of the productivity of the current period of partial productivity with a basic period in table 4.

Partial Productivity	*Base Period* Jun-16	*Current Period* Des-17	*Change* (%)	*Status*
Human Productivity	81.911	66.57	**-23.04**	*Decline*
Material Productivity	1.048	1.187	**11.71**	*Growth*
Capital Productivity	147.403	321.376	**54.13**	*Growth*
Energy Productivity	262.869	69.486	**-278.3**	*Decline*
Miscellenous Productivity	90.885	88.878	**-2.26**	*Decline*

Table 4. Comparison of Total productivity of current period by Period basis

(Source: data processing)

Partial Productivity input material & capital showed growth with the number of 11% & 54%. But the productivity of the partial input of human energy, and miscellaneous showed decreased with the number of each-23%,-278%,-2%. In table 2 can show the growth and decline of partial productivity. This means that on a partial Human productivity, Energy, and Miscellenous is a partial influence on productivity total.

F. The identification of the cause factor

To find out the factors that lead to low productivity levels used Diagram fish bone-Fishbond (cause and effect) Diagrams in Figure 3 below.

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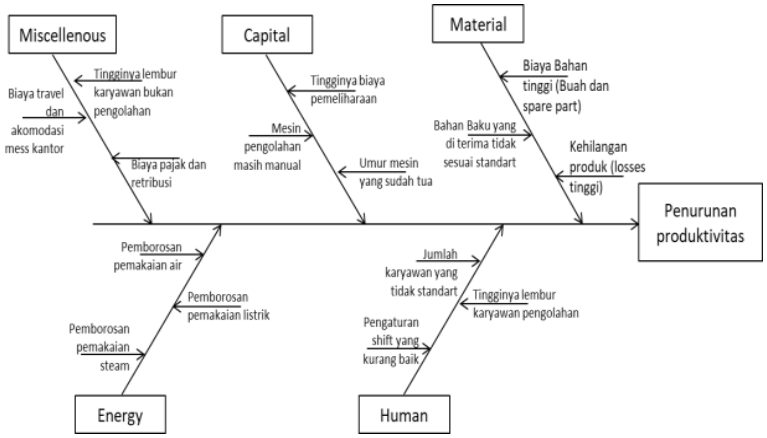

Fig 5:- Diagram ishikawa

G. The Identification of Partial Productivity

- *Partial Human*

Costs on partial Human is the cost of salaries and overtime employees of the mill. Salary and overtime are grouped into two component costs it's costs overtime & salaries became the first person or employee salaries and overtime processing, while the second cost component namely salary and overtime are not direct or public offices, employees and mill staff. Here is a table of labor costs based on the components.

Periode	Gaji Langsung Rp0.10	Gaji Tidak Langsung Rp0.10	Total Gaji Rp0.10	Lembur Langsung Rp0.10	Lembur Tidak Langsung Rp0.10	Total Lembur Rp0.10	Nilai Tenaga Kerja Rp0.10
Jan-16	112,500	45,011	157,512	92,194	30,170	122,363	279,875
Feb-16	131,928	95,514	227,442	67,744	36,515	104,260	331,701
Mar-16	131,281	67,132	198,413	82,087	37,777	119,864	318,278
Apr-16	130,542	104,045	234,587	63,211	37,795	101,006	335,593
Mei-16	125,230	67,357	192,586	61,169	38,229	99,399	291,985
Jun-16	132,466	77,152	209,617	59,386	41,049	100,435	310,052
Jul-16	128,316	48,757	177,074	123,711	29,864	153,575	330,649
Agt-16	132,945	66,598	199,543	141,534	40,742	182,277	381,820
Sep-16	132,918	47,342	180,260	134,525	60,595	195,120	375,380
Okt-16	131,637	83,806	215,442	158,592	48,937	207,528	422,970
Nov-16	133,895	92,034	225,929	146,234	66,316	212,551	438,480
Des-16	185,181	126,192	311,373	139,184	70,564	209,748	521,121
Jan-17	131,914	47,601	179,515	179,841	57,362	237,203	416,717
Feb-17	149,351	75,616	224,967	162,585	40,852	203,437	428,404
Mar-17	151,106	96,497	247,603	151,703	39,332	191,035	438,638
Apr-17	155,312	87,615	242,927	148,387	17,331	165,718	408,644
Mei-17	152,177	94,226	246,404	142,998	46,391	189,389	435,792
Jun-17	183,920	99,379	283,298	70,155	39,274	109,429	392,727
Jul-17	162,444	86,956	249,400	175,780	58,011	233,791	483,191
Agt-17	168,372	90,817	259,189	191,231	50,842	242,073	501,262
Sep-17	161,654	129,038	290,692	187,508	46,309	233,817	524,509
Okt-17	157,051	130,480	287,531	199,078	48,502	247,580	535,110
Nov-17	151,223	135,190	286,413	150,981	44,824	195,805	482,218
Des-17	158,025	129,085	287,109	210,495	98,615	309,110	596,219
Total	**3,491,387**	**2,123,439**	**5,614,825**	**3,240,312**	**1,126,199**	**4,366,511**	**9,981,336**

Table 5. Input labour cost components 2016-2017

(Source: Company Data)

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H. Partial Energy

Partial costs on Energy are grouped into 2 cost components, the component first cost is the cost of fuel oil (FUEL) to the vehicle and genset. The next component of the cost of water and chemical costs service &spare parts of vehicles, generator & water pump. The following table is the cost of Energy based on the components.

Periode	BBM				Bahan Kimia Air	Biaya *Service Spare part*	Nilai *Energy*
	Genset	Loader	Bengkel	Total			
	RP.1000	RP.1000	RP.1000	RP.1000	RP.1000	RP.1000	RP.1000
Jan-16	125,440	9,512	-	134,951	35,879	39,195	210,025
Feb-16	95,050	8,308	-	103,359	29,849	875	134,083
Mar-16	66,825	7,950	108	74,883	26,986	10,216	112,084
Apr-16	66,468	7,263	-	73,731	12,806	2,683	89,219
Mei-16	84,152	6,961	260	91,373	12,544	284,162	388,079
Jun-16	73,260	8,496	80	81,835	12,039	2,739	96,614
Jul-16	53,988	14,832	99	68,919	31,687	9,079	109,685
Agt-16	44,308	16,430	-	60,737	18,567	957	80,261
Sep-16	67,965	17,833	-	85,799	18,540	76,688	181,026
Okt-16	88,723	18,234	-	106,957	17,628	184,493	309,078
Nov-16	75,259	15,195	-	90,453	15,839	2,588	108,880
Des-16	111,053	15,874	-	126,927	19,965	92,785	239,677
Jan-17	93,125	13,641	-	106,766	28,090	2,226	137,083
Feb-17	100,608	11,950	164	112,721	30,608	3,093	146,422
Mar-17	126,692	10,830	60	137,582	26,142	20,142	183,866
Apr-17	113,273	3,661	-	116,934	19,779	4,971	141,684
Mei-17	121,523	-	-	121,523	12,983	655	135,162
Jun-17	123,528	1,435	-	124,964	14,672	2,913	142,549
Jul-17	128,232	16,941	296	145,469	28,231	66,060	239,760
Agt-17	106,715	18,632	-	125,347	21,211	33,401	179,959
Sep-17	104,425	20,417	-	124,842	21,510	97,128	243,480
Okt-17	155,744	22,778	138	178,660	22,710	43,410	244,780
Nov-17	152,520	18,884	105	171,509	10,010	88	181,607
Des-17	159,800	19,391	201	179,393	24,180	367,629	571,202
Total	**2,438,676**	**305,447**	**1,510**	**2,745,634**	**512,454**	**1,348,176**	**4,606,264**

Table 6. Costs of Input Energy 2016-2017

(Source: Company Data)

Table 4.9 shows that the cost of generator of 2,438,676. Further cost is the cost of repairing and 305.447 loader and 1.510. The cost of chemicals water of 512.454. Costs the costs of spare part Service 1,348,176.

I. Analysis of the Failure Mode and Effect Analysis (FMEA)

Then the identification and calculation of RPN for potential failures that cause the onset of direct employee overtime costs and costs of usage of solar on table 5 and 6 as follows;

Table 7. Failure Mode Effective analysis and after a Brainstorming

(Source: Data Processing)

Potensial Cause Mechanism of Failure	RPN	*Risk*	*Waste*	*Recomendation Action*
Akses jalan rusak dan Jarak lokasi panen afdeling berbeda-beda ke lokasi pabrik	**280**	Pabrik akan memperlambat proses pengolahan untuk menunggu TBS sehingga jam olah akan panjang dan mengakibatkan lembur pengolahan akan tinggi	Jam Lembur karyawan pengolahan akan tinggi sehingga biaya lembur karyawan pengolahan akan tinggi	Melakukan proses pengolahan dengan mengggunakan 1 shift
TBS masuk dari kebun Inti & pihak ketiga tidak teratur	**343**			Mengatur ulang jam kerja pengolahan sesuai trend jam masuk TBS
Tidak mengikuti SOP sortasi	100	Buah mentah dan lewat matang mempunyai potensi minyak dan kernel yang tidak optimal. Buah mentah akan membuat proses perebusan, proses pemipilan dan pelumatan lebih lama		Memperketat pengawasan terhadap proses sortasi
Kurangnya jumlah karyawan sortasi	144			Menambah karyawan harian jika TBS masuk tinggi
Kurangnya pengetahuan tentang kriteria standart buah	112			Melakukan training dan sosialisasi tentang sortasi buah
Tidak adanya pemeliharaan mesin	**252**	Kerusakan mesin saat pengolahan akan menambah jam pengolahan lebih lama, untuk mejaga kualitas bahan baku TBS meisn -mesin pabrik harus ready saat pengolahan		Mengembangkan sistem maintenance
Tidak tersedianya sparepart pengganti	**210**			Membuat list minimun stock dan melakukan reorder spare part yang kritis
Design mesin tidak sesuai	175			Spesifikasi mesin disesuaikan dengan kebutuhan material balance, seperti kapasitas pompa, power motor.
Kesalahan operator dalam pengoperasian	196			Dilakukan trainining dan refreshment tentang SOP & autonomous maintenance ke setiap operator
Steam dari boiler tidak stabil	**336**	Saat proses pengolahan pabrik seharusnya menggunakan turbin sebagai sumber listrik, akan tetapi karena turbin tidak mampu menahan beban listrik maka genset juga hidup secara paralel saat pengolahan	Pemakain solar akan tinggi	Memeberikan bahan bakar tambahan pada boiler ketika bahan bakar dari mesin press tidak continue
Terjadi beban kejut saat pengolahan (ada overload mesin)	180			Dilakukan trainining dan refreshment tentang SOP & autonomous maintenance ke setiap operator
Terjadi kebocoran steam di station-station pengolahan	**294**			Selalu melalukan drain steam trap dan melakukan penutupan valve steam setelah selesai proses pengolahan dan mengganti pipa steam yang bocor di proses pengolahan
Utility Turbin turun	120			Dilakukan perawatan rutin dan overhaul
Tidak ada bahan bakar lain selain fiber dan cangkang saat pengolahan untuk boiler sebagai penghasil uap untuk memutar turbin listrik	**320**	Saat tidak ada pengolahan TBS , yaitu pada hari minggu, hari libur nasional dan setelah proses pengolahan selesai (turbin mati) sehingga genset akan hidup untuk kebutuhan listrik mengganti turbin		Menggunakan bahan bakar tandan kosong untuk bahan bakar boiler
Lokasi Jauh dari akses PLN	**378**			Membuat schedule pemakaian genset untuk penerangan, dengan sistem 6 hidup 2 jam mati

Table 8. Recommendation

(Source: Data Processing Brainstorming)

J. Measurement After Improvement

Total Productivity Analysis

Total productivity after improvement is 1,191. Where the Total this increase productivity when compared the basic period and the period before committing to improvement. Table 9 will show the total productivity trend against basic period.

Productivity	*Base Period*	*Before Improvement*	*After Improvement*					
	Jun-16	Des-17	Jan-18	Feb-18	Mar-18	Apr-18	Mei-18	Jun-18
Total Productivity	1,012	1,129	1,153	1,13	1,138	1,256	1,257	1,191

Table 9. Comparison of Total productivity period after repair and repair before against basic period.

(Source: Data Processing)

Total productivity after repair experience a uptrend compared to the period prior to the repair. The increase productivity index after an improvement against the prior improvements each January 2018 climbed 2.08%, February 2018 rose 0.09%, rising 0.79% March, April rose 10.11%, may rose 10.18% 5.21% ride, June. When compared to the basic period June 2016, in which the basic period was a period with the lowest productivity can be said to be the current period June 2018 is the period after repair experience the increase of 15% compared to the basic period June 2016.

Total productivity index calculation result it's. 1,177. Where is the index of this productivity increase if compared to the basic period and the period before committing to improvement. Table 10 will show the total productivity trends toward the basic period.

Productivity	*Base Period*	*Before Improvement*	*After Improvement*					
	Jun-16	Des-17	Jan-18	Feb-18	Mar-18	Apr-18	Mei-18	Jun-18
Total Productivity	1,000	1,101	1,139	1,117	1,125	1,241	1,242	1,177

Table 10. Comparison of total productivity index period after repair and repair before against basic period.

(Source: Data Processing)

The highest productivity improvements during the period was in May of 1.242 2018, while the lowest in February amounted to 1.117.

- *Partial Productivity Analysis*

Then do a comparison of partial productivity period after repair and repair before against basic period which can be show on table 11.

Partial Productivity	*Base Period*	*Before Improvement*	*After Improvement*					
	Jun-16	Des-17	Jan-18	Feb-18	Mar-18	Apr-18	Mei-18	Jun-18
Human Productivity	81.911	66.57	51.857	44.825	54.652	70.288	71.969	62.761
Material Productivity	1.048	1.187	1.206	1.199	1.189	1.304	1.307	1.241
Capital Productivity	147.403	321.376	181.746	121.486	182.859	265.47	365.097	149.712
Energy Productivity	262.869	69.486	157.418	123.619	134.726	196.914	215.422	173.622
Miscellenous Productivity	90.885	88.878	142.402	80.154	157.662	161.439	109.063	171.551

Table 11. Comparison of partial productivity period after repair and repair before against basic period.
(Source: Data Processing)

Table 11 productivity after partial improvement on the Human factors of the lowest was in February 2018 of 44.82 and most in may 2018 of 71.96. Factor of the Material as the lowest February 2018 amounting to 1.19 and most high may 2018 of 1.30. Factors of Capital the lowest February 2018 of 121.48 and most in may 2018 of 365.09. Energy factor is the lowest February 2018 of 123.61 and most in may 2018 of 215.42. Miscellenous factor least February 2018 of 80.15 and most big in June 2018 of 171.55.

Then a comparison of the partial index of productivity after the repair period and before the improvement of the base period shown in table 12.

Partial Productivity	*Base Period*	*Before Improve*	*After Improvement*					
	Jun-16	Des-17	Jan-18	Feb-18	Mar-18	Apr-18	Mei-18	Jun-18
Human Productivity Indices	1	0.86	0.63	0.55	0.67	0.86	0.88	0.77
Material Productivity Indices	1	1.1	1.15	1.15	1.14	1.25	1.25	1.19
Capital Productivity Indices	1	2.27	1.23	0.82	1.24	1.8	2.48	1.02
Energy Productivity Indices	1	0.59	0.6	0.47	0.51	0.75	0.82	0.66
Miscellenous Productivity Indices	1	1.71	1.57	0.88	1.74	1.78	1.2	1.89

Table 12. Comparison of partial productivity period after repair and improvement against the basic Period before.
(Source: Data Processing)

Table 12 productivity after partial improvement on the Human factors of the lowest was in February 2018 of 0.55 and the most in may 2018 of 0.88. Factor of the Material as the lowest March 2018 of the most high and 1.14 in may 2018 of 2.48. Factors of Capital the lowest February 2018 amounted to 0.82 and the most in may 2018 of 2.48. Energy factor is the lowest February 2018 of 0.47 and most in may 2018 amounted to 0.82. Miscellenous factor least February 2018 of 0.88 and the greatest in June 2018 of 1.20.

V. CONCLUSION

The productivity of the Total December 2017 which is the current period based on total output input of 1,129. While total productivity index of the current period is the month of December 2017 is 1,115 . But partial productivity factor human energy, and miscellenous showed decreased with the number of each - 23%, - 278%, - 2% . Repair biaya berdasarkan analysis FMEA and the factors that most affect employees ' overtime is the engine breakdown during processing and raw material do not continue. Whereas the use of diesel genset which most affect the turbine is not able to

withstand the burden of processing so that when electrical turbine genset shared parallel roads and no other power source for electrical needs of an enterprise environment genset. The results of the improvements have a good impact to productivity, the increase in the productivity of the company's total after the repairs against before repair IE December 2017 each January 2018 climbed 2.08%, February 2018 rose 0.09%, rising 0.79% March, April rose 10.11%, may rose 10.18% 5.21% ride, June.

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