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ANALYSIS IMPROVEMENT PRODUCTION PROCESS OF MAKING JOINT CARE AIR FILTER MITSUBISHI (CJM) WITH OVERALL EQUIPMENT EFFECTIVENESS AND SIX BIG LOSSES

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Abstract. The performance measurement studies have been performed the method of Overall Equipment Effectiveness. To know the losses that occur in the production process is carried out by the methods of analysis of the Six Big Losses. To find out the cause dominant done with fishbone diagrams, Nominal Group Technique and scatter diagram. The results will be the basis of recommendation improvements to decrease downtime and increase the value of the effectiveness of the company's production machine by performing the calculation of OEE after repair. Objects are examined in this research is the engine Room Temperature Oven Curring for CJM air filter production process. The data used is data one year i.e. January 2017–December 2017 retrieved value Overall Equipemnt effectiveness. Value does not meet the ideal of OEE that is above 85%, machine down time occurs high in February 2017. The results of availability ratio between 66.29%-98.91% derived from the calculation of the loading time for the month of january of 314 hours and the factor cause downtime is machine break, trouble dies, material delay, delay forklifts and set up the operation, calculation time for the month of january 2017, this happens because the speed of production machines is not working optimally.

1. Introduction

One factor supporting the success of a manufacturing industry is determined by the smooth production process. So that if the production process is smooth, the use of effective machinery and production equipment will produce quality products, then the correct manufacturing completion time and cheap production cost [1]. To produce any high quality products required workers who are competent, with good raw materials and processed with machines in prime conditions and processed with the appropriate systems and methods [2] [3]. The company engaged in the development, manufacture and sales of automotive, heavy equipment and industrial machinery. In January 2017 until December 2017 there is a downtime over target in the company, the target that has been determined by the company is 10% while in 2017 exceeds 10%, so there is a decline in production [4]. From the case this research has raised the theme of measurement performance of treatment with the approach of Overall Equipment Effectiveness (OEE), to know the losses that occur in the production process is done by approach method Analysis of Six Big Losses.

1.1. Sample preparation

The following data downtime in the company in January 2017 until December 2017, as in table 1.1 [5] [6] [7] [8] [9] [10].

Tabel 1. Data *Downtime* Produksi *Filter Assy* Tahun 2017

Bulan	***Production Time* Th.2017 (Jam)**	***Down Tme* Th. 2017 (Jam)**	***Down Time* Th. 2017 (%)**	***Target Down Time* Th. 2017 (%)**
Jan	**1843**	472.34	25.60%	10.00%

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Feb	**1750**	345.8	19.80%	10.00%
Mar	**1909**	240.3	12.60%	10.00%
Apr	**2215**	261.6	11.80%	10.00%
Mei	**3240**	236.8	7.30%	10.00%
June	**3049**	487.55	16.00%	10.00%
July	**1840**	467.9	25.40%	10.00%
Aug	**2895**	385.75	13.30%	10.00%
Sept	**2867**	227.5	7.90%	10.00%
Okt	**2632**	626.8	23.80%	10.00%
Nov	**2758**	528.3	19.20%	10.00%
Dec	**2525**	243.9	9.70%	10.00%
Average	**2460**	377	11%	0.00%

Tabel 2. Data *Downtime per-product filter assy* 12 besar tahun 2017

No.	**Kode Prod.**	***Item Product***	***Down Tme* (Jam)**	***Down Time* (%)**	***Target Down Time* (%)**
1.	**CJM01**	*Air Cleaner Assy CJM* FG001	564.79	12.48%	10%
2.	**OF001**	*Oil Filter* FG001	402.52	8.90%	10%
3.	**SOA01**	*Spin On Assy* FG001	392.85	8.68%	10%
4.	**EPA02**	*End Plate Assy* FG002	385.65	8.52%	10%
5.	**WSA01**	*Water Separator Assy*001	378.65	8.37%	10%
6.	**FFA03**	*Fuel Filter Assy* FG003	370.25	8.18%	10%
7.	**EA006**	*Element Assy* FG006	368.84	8.15%	10%
8.	**CA008**	*Case Assy* FG008	350.28	7.74%	10%
9.	**BFA01**	*Body Fuel Assy* FG001	348.68	7.71%	10%
10.	**BA003**	*Bracket Assy* FG003	345.45	7.64%	10%
11.	**IPA002**	*Inner Pipe Assy* FG002	342.35	7.57%	10%
12.	**CBA03**	*Cover Bracket Assy* FG003	274.23	6.06%	10%
		Total	4524.54	100%	-
		Average	377.045	8.33%	-

Figure 1. Air Cleaner Assy

1.2. Method

Total Productive Maintenance (TPM) is a machine maintenance system that involves production operators and all departments including production, marketing and administration development. TPM aims to establish a business culture that pursues complete efficiency of Overall Equipment Effectiveness (OEE) production system. The TPM implementation objectives are the achievement of zero breakdown, zero defect, and zero accident throughout the lifecycle of the production system thereby maximizing the effectiveness of machine use. [11] [12] [13] [14] [15]

Six Big Losses

The purpose of this calculation of six big losses is to figure out the overall effectiveness Effectiveness. [16] These of OEE values can be taken steps to correct or retain those values. The six losses can be classified into three types:

1. *Downtime Losses* :
   a. *Breakdown Losses/ Equipment Failures* sudden damage to machinery/equipment or unwanted damage will of course cause harm, because the engine malfunction will cause the machine to not operate and not produce output. This will result in wasted time and material losses as well as defective products produced more and more;
   b. *Setup and Adjusment Losses* Or losses due to installation and adjustment are all set-up time including adjustment time (Adjusment) as well as the time required for the activities of replacing one type of product to the next product type for the next production process;
2. *Speed Losses*
   a. *Idling and Minor Stoppage Losses* Caused by events such as a short engine stop, engine congestion, and idle time of the machine. In fact, these losses cannot be detected directly without a tracking tool. When the operator is unable to correct stops that are minor stoppage within the specified time, it can be considered as a breakdown*;*
   b. *Reduced Speed Losses* Loss because the machine does not work optimally (decreased speed of operation) occurs if the actual speed of operation of the machine/equipment is smaller than the optimal speed or the engine speed is designed;
3. *Defect Loss*

   Process Defect is a disadvantage caused by the presence of defective products or because the product work is reprocessed. The resulting defect product will result in material loss, reduced production amount, additional costs for rework and production waste increases. Losses due to rework include labor costs and the time required to process and work back or to repair defective products. Reduced Yield Losses due to unused material or raw material waste

Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness (OEE) is a method used as a measuring instrument in the application of TPM program to keep equipment on the condition of Idel by eliminating six big losses on machinery or equipment [17] [18] [19].

Results and discussion

Overall Equipment Effectiveness (OEE)

Tabel 3. Result Overall Equipment Effectiveness (OEE)

Month	Availability Ratio (%)	Perfomance Ratio (%)	Rate Of Quality (%)	OEE (%)
January	90.06	98.9	99.21	88.37
February	66.29	99.46	99.8	65.8
March	84.83	99.51	99.81	84.26
April	75.13	99.27	99.64	74.31
May	87.61	99.44	99.76	86.91
June	72.87	99.16	99.63	71.99
July	92.13	99.47	99.79	91.45
August	89.55	99.36	99.68	88.69
September	70.37	99.21	99.58	69.52
October	91.49	99.49	99.8	90.84
November	98.91	99.23	99.53	97.69
December	80.82	99.25	99.62	79.91
TOTAL				989.74
AVERAGE				82.48

From the results of the calculations on the OEE table above, the average value of OEE during the year 2017 is 82.48% with the lowest OEE value occurring in February 2017 of 65.80%, in April at 74.31%, in June amounted to 71.99%, in September amounted to 69.52% And the month of December amounted to 79.91%. This value does not meet OEE's ideal value of above 85%. This is due to high engine down time in February 2017 while the availability of working hours lower than other months thus affecting the OEE value in the month.

Six Big Losses
Down Time Losses

Tabel 4. *Breakdown Losses* Bulan January 2017 - December 2017

Month	Total Breakdown	Loading Time	Breakdown Losses
January	18.1	314	5.76
February	77.5	299	25.92
March	37.9	329	11.52
April	53.6	269	19.93
May	12.9	314	4.11
June	48.7	209	23.3
July	15.5	314	4.94
August	24.7	314	7.87
September	65.4	269	24.31
October	17	329	5.17
November	2.6	329	0.79
December	38.6	269	14.35

TOTAL	412.5

From the above calculation table, it can be deduced total engine breakdown by 412.5 hours, with the largest percentage of 25.92% occurring in February 2017. It is influenced by the availability of low engine uptime inversely proportional to the total high engine breakdown.

Set up and Adjustment Losses

Tabel 5. *Set up and Adjustment Losses* January 2017 - December 2017

Month	Set Up Total (Hour)	Loading Time (Hour)	Set Up Losses (Hour)
January	5.6	314	1.78
February	12.5	299	4.18
March	6.5	329	1.98
April	7.8	269	2.9
May	9	314	2.87
June	6	209	2.87
July	4.5	314	1.43
August	5	314	1.59
September	8.5	269	3.16
October	8	329	2.43
November	1	329	0.3
December	9.5	269	3.53
TOTAL	83.9		

From the calculation results table above obtained time set up engine of 83.9 hours, with the highest set up time in February 2017 amounted to 12.5 hours or 4.18% of the total value of the set up machine. This is because sett up machines for the progressive dies require high accuracy so that the stamping results can conform to the specified standards.

Speed Losses

Idling and Minor Stoppage Losses

Tabel 6 *Idling and Minor Stoppages* January 2017 - December 2017

Month	Non Productive time	Loading Time (Hour)	Idling And minor
January	7.5	314	2.39
February	10.8	299	3.61
March	5.5	329	1.67
April	5.5	269	2.04
May	17	314	5.41
June	2	209	0.96
July	4.7	314	1.5
August	3.1	314	0.99

September	5.8	269	2.16
October	3	329	0.91
November	0	329	0
December	3.5	269	1.3
TOTAL	68.4		

Based on the results of idling and minor stoppages calculations, it can be concluded that the largest percentage of 3.61% occurred in February 2017. This is due to the long time waiting froklift is 8.2 hours because of the limited forklift availability.

Reduced Speed Losses

Tabel 7. *Reduced Speed Losses* January 2017 - December 2017

Month	*Operating Time (H)*	*Ideal Cycle Time (Scd/Pcs)*	*Total Product (Pcs)*	*Loading Time (H)*	*Reduce Speed Loss Time (H)*	*Reduce Speed Loss Time (%)*
January	282.8	3.68	273,590	314	3.12	99
February	198.2	2.91	244,074	29	1.06	35
March	279.1	2.84	352,646	329	1.36	41
April	202.1	2.66	271,345	269	1.47	55
May	275.1	3.34	294,560	314	1.53	49
June	152.1	2	262,150	209	1.28	61
July	289.3	9.18	112,800	314	1.53	49
August	281.2	6.14	163,880	314	1.8	57
September	189.3	5.08	133,205	269	1.5	56
October	301	4.4	245,200	329	1.52	46
November	325.4	7.89	147,350	329	2.5	76
December	217.4	3.61	214,990	269	1.63	61
TOTAL					**20.3**	

Based on the calculation results in the table above, the value of the highest reduced speed losses of 3.12 hours with a percentage of 0.99% occurred in January 2017 and the lowest in February 2017 amounted to 0.35%. This occurs because the speed of the production machine does not work optimally.

Defect Losses / Process Defect

Tabel 8. *Defect Losses*

Month	*NG Product (Pcs)*	*Ideal Cycle Time (Scd/Pcs)*	*Loading Time (H)*	*Scrap Time (H)*	*Scrap Losses (%)*
January	2,177	3.68	314	2.23	71
February	496	2.91	299	0.4	13
March	655	2.84	329	0.52	16
April	981	2.66	269	0.73	27

May	710	3.34	314	0.66	21
June	967	2	209	0.56	27
July	240	9.18	314	0.61	19
August	534	6.14	314	0.91	29
September	568	5.08	269	0.8	30
October	501	4.4	329	0.61	19
November	691	7.89	329	1.51	46
December	823	3.61	269	0.83	31
TOTAL				**10.37**	

Based on the results of the above calculations, for the largest scrap losses is 2.23 hours from a total of 10.36 hours with a percentage of 0.71% occurred in the month of January 2017. This is due to the high Defect case product is 2.177 pcs.

Influence Six Big Losses

The highest losses in dominance by the breakdown factor losses of 412.5 hours or 69.27% as in the table below:

Tabel 9. Persentase *Six Big Losses*

No.	***Six Big Losses***	***Total Time Losses***	***Total Commulative***	***Persentase (%)***	***Cummulative (%)***
1	*Breakdown Losses*	412.5	412.5	69.27	69.27
2	*Set Up and Adjusment Losses*	83.9	496.4	14.09	83.36
3	*Idling and Minor Stoppages*	68.4	564.8	11.49	94.85
4	*Reduced Speed Losses*	20.33	585.13	3.41	98.26
5	*Yield/Scrap Losses*	10.36	595.49	1.74	100
6	*Rework Losses*	0	595.49	0	100
	TOTAL	595.49			

Check Sheet

From the map data of air filter making process flow is data obtained during the research both from observation and document then in the form of data sheets and tables.

Tabel 10. *Check Sheet* per-1 product

Check Sheet production time of CJM air filter		
NO	***Process***	***Hours***
1	*Cover Assy*	*0,202*
2	*Case Assy*	*0,2077*
3	*Element Assy*	*6,23*
4	*Assy Air Cleaner*	*0,333*
5	*Packaging Elemet Assy*	*0,333*

Stratification

Stratification the contribution of Quality Control Company in the effort to control the quality of repairs, as in the table [20]:

Tabel 11. Stratification the contribution of Quality Control

No	Factor	Type of cause
1	Machine	Drying process of Sub Assy Manual (Room Temperature)
2		Unstable production process
3		unstable process jig lock
4		Manual process sub assy element to jig
5		Install time element unstable
6		Design Jig Triming Progresive referring to Jig design Manual
7		At the design of manual jig punching position below
8		The actual punching on the position of Assy jig
9		Clamp roll on the material is less maximum
10		Triming result on Jig condition Burry reversed
11	Material	Dent material
12		Unstable Material with draw
13		Wavy Material
14		Burry-scratched material
15		No protective Material,
16	Metodh	Old checking process
17		No production sample
18		Pending employer approval
19		No production stock
20		Limited stock material storage
21	Man	Employees are new
22		No training
23		Old install element
24		Operator lacks understanding install element
25		No Standard install element yet
26	Environment	Machine dirty table
27		Many liquid glue
28		Glue spill
29		Not done cleaning when setting
30		No Stoper Assy

Improvement Plan

1. Improvement plans are using a 5W + 1H tool consisting of *Why, What, Where, When, Who* dan *How***.**

Tabel 12. Improvement Plan 5W + 2H

No.	Dominant Factor	Why	What	Where	When	Who	How	How Much
1	Drying process of Sub Assy Element is still manual (Temperature room)	No available data processing time calculation of the process of drying element ASSY	Made machine oven drying element assy	line fiber assy	2nd Week of november 2017	chaerun & Team	Oven machine drying Element Assy as reference to speed up the production process	25.20%
2	No available stopper jig	Element Assy not in center position	Modification stopper JIG contained of the machine Oven	line fiber assy	2-4nd november 2017	chaerun & Team	Stopper JIG Element Assy as a reference to the stability of the condition element assy	24.50%
3	No available standart install element assy	Frequent process error	Standardized process of element assy	line fiber assy	Week 1 December 2017	chaerun & Team	standart install element assy as reference production process	20.30%

2. There are three recommended improvement plans in the company, as follows::
   a. Made mesin *oven element assy*
   b. Modification jig stopper machine *oven element assy*
   c. Made standard process production element *sub assy*

Conclusion

A study has been conducted from the analysis results in 2017, for the three largest percentage factor six big losses can be seen the largest percentage value is the breakdown losses with a percentage of 69.27% (412.5 hours), to two sets up and adjustments losses With a percentage of 14.09% (83.9 hours), and to three idling and minor stoppages with a percentage of 11.49% (68.4). Once known factor six big losses in the analysis on actual production process using the map process flow, there is a longest time is the process of oven room temperature element assy is 6.23 hours (85.28%) and the lowest data is in the process of stamping cover assy 0.202 hours (2.76%) For one product and the absence of periodic maintenance on the Jig install element assy, resulting in a jig dent and ASSY element results are not as standard. Implementation of improvement as an effort to increase the effectiveness of production element assy CJM among others is made of Element Assy Oven machine CJM, created Jig Stopper machine Oven Element Sub Assy CJM, made Standard production process Element Sub Assy CJM.

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