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Analysis Application Overall Equipment Effectiveness (OEE) and Six Big Losses in the Production Process PT. PDK

Kenny Halim[1], Ryan Permana[2], Erry Rimawan[3]
[1,2]Student of Industrial Engineering Master Program at Mercu Buana University, Jakarta
[3]Lecturer of Industrial Engineering Study Program at Mercu Buana University, Jakarta

Abstract:- PT. PDK has implemented Total Productive Maintenance (TPM) to improve the effectiveness of the entire production and manufacturing process. In the implementation of the TPM it is still not optimal due to the frequent occurrence of loss and output which causes the production process not to reach the target. This research was conducted to determine the effectiveness of the equipment and manufacturing processes on the production floor in terms of availability rate, performance rate, and quality rate by using Overall Equipment Effectiveness (OEE) analysis and knowing the factors that are the biggest and dominant causes of decreasing the effectiveness of the machine or process manufacturing then identifies the cause and effect of the problem and proposes improvements. This research starts from the calculation of the achievement of Overall Equipment Effectiveness (OEE) and then identifies the most dominant factors causing the reduction of OEE performance through the analysis of Six Big Losses. The results showed that the average OEE value of the production process of PT. PDK for July to September 2018 is 61.7% where the value of this effectiveness is still relatively low because the OEE standard for world class companies is ideally 85%. The most dominant and large factors cause the decrease in OEE performance is a defect factor during the production process with a percentage of 49% and a set up and adjustment factor of 41%. of the overall time loss. The proposed corrective action is to provide training to operators and leaders on standardizing critical processes and training on understanding the ideal engine conditions for use in the production process, creating value stream mapping for each supplier, especially subcont suppliers, and standardizing raw material storage until finished products.

Keywords:- *Total Productive Maintenance, Right First Time, Overall Equipment Effectiveness, Six Big Losses.*

I. INTRODUCTION

Timely production and good quality without downtime production and product defect are the goals of each manufacturing company in meeting customer satisfaction aspects. This is because if the aspect of customer satisfaction can be fulfilled properly it will directly participate in increasing the company's profit because it will increase customer demand and customer trust in the company. Achieving these goals is also the hope or expectations of PT. PDK where this research is conducted.

PT. PDK operates 3 plants consisting of 2 plants for the process of cutting, sewing, and assembling and 1 plant for the stockfitting process. The biggest downtime problem often occurs in the sewing and assembling area where the sewing area is a process of combining one upper component with the other upper through a sewing process, while the assembling process is the upper shoe attachment process with the outsole through a cleaner, primer, and cementing process. 70% of the shoe making process is carried out in the area of sewing and assembling so that if one of these areas cannot run optimally and well then it directly impacts the high output loss and high product defect level so that it will cause huge losses for the company.

To overcome this problem so that it does not keep repeating in the future, the right steps and close collaboration between maintenance and production organizations as a whole are needed to reduce waste / defects, reduce production costs, improve the ability of machinery / equipment, and development of the whole system of care in manufacturing companies (Nakajima, 1988).

The process of evaluating the implementation of Total Productive Maintenance (TPM) is carried out using the Overall Equipment Effectiveness (OEE) value as an indicator to find the causes of ineffectiveness of the machine by calculating the six big losses to find out the most influential factors of the six existing six big losses. With OEE, it can measure whether the production equipment can work normally or not, where OEE will focus on six big losses that cause production not to operate normally (Denso, 2006, P.6). With the calculation of OEE the company can identify

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productivity losses and determine priorities in efforts to increase productivity (Muwajih, 2015).

The purpose of this study was to determine the effectiveness of the equipment and manufacturing processes on the production floor in terms of availability rate, performance rate, and quality rate using Overall Equipment Effectiveness (OEE) analysis. The second goal is to find out the factors that cause the decline in the effectiveness of the engine and the manufacturing process through the measurement of six big losses and identify the factors that have the most influence using the fishbone diagram.

II. RESEARCH METHODOLOGY

In a study research methods are needed that will provide the basis for the research carried out so that the results of the research will be relevant and accountable results. This research was conducted in the production process at PT. PDK focuses on Right First Time and Production Downtime data. In this research methodology, the following steps are carried out:

- Collection of Right First Time (RFT) and Production Downtime data for the period July to September 2018.
- Calculation of Overall Equipment Effectiveness (OEE) and measurement of Six Big Losses.
- Identifying the factors that have the most influence on the decline in the effectiveness of the machine / manufacturing process in measuring Six Big Losses.
- Analysis of cause and effect on factors that have a major influence on decreasing OEE performance.

III. RESULT AND DISCUSSION

A. Data collect of Right First Time (RFT) and Downtime period July to September 2018

In calculating the accuracy of the results of the production output with quality products, PT. PDK using the data right first time (RFT) to view the company's product quality performance per day and RFT data calculation is carried out in all areas of the production activity that is an area of cutting, sewing, assembling, and stockfitting. Based on the achievement of data RFT can also be known causes of loss of output in each area due to problems of product quality during the production process is running so that from these data the company can identify and focus on improvement of quality on the most dominant factor causing loss of output. For the RFT target of PT. Minimum PDK is 92%. The achievement of RFT data at PT. PDK for 3 months (July to September) can be seen in the table below:

No	Area	Perfomance RFT (%)								
		July			Agustus			September		
		Total Output	Total Defect	Month to Date (MTD)	Total Output	Total Defect	Month to Date (MTD)	Total Output	Total Defect	Month to Date (MTD)
1	Cutting	263.479	131	99,95%	150.117	258	99,83%	80.224	69	99,91%
2	Sewing	263.479	11.826	95,51%	150.117	8.583	94,28%	80.224	3.903	95,13%
3	Assembling	268.838	18.649	93,06%	151.118	17.032	88,73%	82.292	10.317	87,46%
4	Re-Inspection	268.838	0	100,00%	151.118	0	100,00%	82.292	0	100,00%
5	Stockfitting	121.620	4.357	96,42%	51.664	2.372	95,41%	62.953	1.593	97,47%
Total										
6	RFT All Proses/Area			85,66%			79,68%			81,03%
7	Target RFT			92,00%			92,00%			92,00%

Table 1:- Performance RFT period July to September 2018

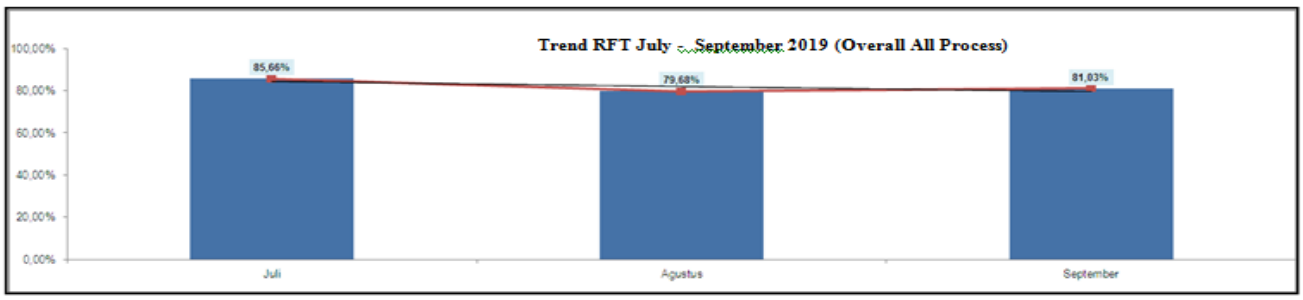

Fig 1:- Trend RFT period July to September 2018

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Based on the data obtained RFT conclusion that there is one month that meet the standards set by the RFT that the company where the achievement of the month of July amounted to 85.66%, in August amounted to 79.68%, and in September amounted to 81.03%. To RFT RFT per area that has the lowest during the last 3 months there in the assembling area with an average achievement of 89.75%. As for the other areas the average already meet the minimum standards prescribed RFT company amounted to 92%. If the calculation of the average total for the past 3 months RFT achievement for all areas amounted to 82.12%.

While in calculating the effectiveness of the production process, PT. PDK using the data production downtime to determine the factors that cause the loss of output due to equipment or machinery and manufacturing processes that do not work effectively. For the target production downtime PT. PDK maximum 5%.

For these targets shared by several departments associated with potential to cause downtime. The division targets include the following: Production department by 2% Engineering 0.7%, 1.45% PPC, Logistic by 0.2%, PCE of 0.5%, development by 0.1%, and costing of 0.05%.

For the calculation of production downtime by (Total Loss Output / Total Target Output) x 100%. The achievement of the data production downtime PT. PDK for 3 months (July - September) can be seen in the table below:

Downtime Loss (Breakdown Loss + Set up/Adjustment Loss)	
Speed Loss (Chokotei Loss+Cycle Time Loss)	
Quality Loss (Startup Loss)	

No	Kategori Losses		Target % NSP	Based on Loss output July 2018		
				Total Target Output	Total Loss Output	% Prod. Downtime
1	Production		2.0%	324,107	5,987	1.85%
	1.1	SPU Feeding		324,107	2,337	0.72%
	1.1.1	Feeding Computer Stitching		324,107	-	0.00%
	1.1.2	Feeding Stokfit		324,107	2,337	0.72%
	1.1.3	Feeding Auto Cutting		324,107	-	0.00%
	1.1.4	Feeding Cutting Subcont		324,107	-	0.00%
	1.2	PQC Issue		324,107	-	0.00%
	1.2.1	Chemical		324,107	-	0.00%
	1.2.2	AQR Stockfitting		324,107	-	0.00%
	1.2.3	AQR Subcont incoming		324,107	-	0.00%
	1.3	Trial Prod/Cutt.dies trial & QC Check		324,107	592	0.18%
	1.4	Insufficient manpower		324,107	-	0.00%
	1.5	Tooling (Laste/ Cutting Dies)		324,107	-	0.00%
	1.6	Change over		324,107	3,058	0.94%
2	Engineering		0.7%	324,107	3,451	1.06%
	2.1	Machine Downtime		324,107	3,451	1.06%
	2.2	Machine Availability		324,107	-	0.00%
	2.3	Electricity		324,107	-	0.00%
3	PPC		1.45%	324,107	12,743	3.93%
	3.1	Subcont Feeding		324,107	12,743	3.93%
	3.2	Daysheet/Size Label		324,107	-	0.00%
	3.3	Tooling Readiness		324,107	-	0.00%
4	Logistic		0.2%	324,107	2,692	0.83%
	4.1	Feeding Material Upper		324,107	-	0.00%
	4.2	Feeding Material Bottom		324,107	2,092	0.65%
	4.3	Feeding Packaging		324,107	600	0.19%
5	PCE		0.5%	324,107	841	0.26%
	5.1	Quality Downtine (Quality Issue)		324,107	841	0.26%
	5.1.1	Lab issue		324,107	-	0.00%
	5.1.2	Quality Issue Material		324,107	362	0.11%
	5.1.3	Quality Issue Subcont		324,107	56	0.02%
	5.1.4	Quality Issue Outsole		324,107	423	0.13%
6	Development		0.1%	324,107	-	0.00%
	6.1	Unreliability /Product Readiness		324,107	-	0.00%
	6.1.1	Standard Readiness		324,107	-	0.00%
	6.1.2	Product Design Relibility		324,107	-	0.00%
7	Costing		0.05%	324,107	-	0.00%
	6.1	Yield issue		324,107	-	0.00%
	Total Prod.downtime		5.0%	324,107	25,714	7.93%

Table 2:- Data Downtime Production period July 2018

ISSN No:-2456-2165

No	Kategori Losses		Target % NSP	Based on Loss output (Agustus)		
				Total Target Output	Total Loss Output	% Prod. Downtime
1	Production		2.0%	182,452	11,486	6.30%
	1.1	SPU Feeding		182,452	113	0.06%
	1.1.1	Feeding Computer Stitching		182,452	-	0.00%
	1.1.2	Feeding Stokfit		182,452	73	0.04%
	1.1.3	Feeding Auto Cutting		182,452	-	0.00%
	1.1.4	Feeding Cutting Subcont		182,452	40	0.02%
	1.3	Trial Prod/Cutt.dies trial & QC Check		182,452	1,376	0.75%
	1.4	Insufficient manpower		182,452	-	0.00%
	1.5	Tooling (Laste/ Cutting Dies)		182,452	-	0.00%
	1.6	Change over		182,452	9,997	5.48%
2	Engineering		0.7%	182,452	522	0.29%
	2.1	Machine Downtime		182,452	522	0.29%
	2.2	Machine Availability		182,452	-	0.00%
	2.3	Electricity		182,452	-	0.00%
3	PPC		1.45%	182,452	4,690	2.57%
	3.1	Subcont Feeding		182,452	4,690	2.57%
	3.2	Daysheet/Size Label		182,452	-	0.00%
	3.3	Tooling Readiness		182,452	-	0.00%
4	Logistic		0.2%	182,452	240	0.13%
	4.1	Feeding Material Upper		182,452	-	0.00%
	4.2	Feeding Material Bottom		182,452	240	0.13%
	4.3	Feeding Packaging		182,452	-	0.00%
5	PCE		0.5%	182,452	200	0.11%
	5.1	Quality Downtine (Quality Issue)		182,452	200	0.11%
	5.1.1	Lab issue		182,452	-	0.00%
	5.1.2	Quality Issue Material		182,452	-	0.00%
	5.1.3	Quality Issue Subcont		182,452	140	0.08%
	5.1.4	Quality Issue Outsole		182,452	60	0.03%
	5.2	Chemical		182,452	-	0.00%
	5.3	AQR Stockfitting		182,452	-	0.00%
	5.4	AQR Subcont incoming		182,452	-	0.00%
6	Development		0.1%	182,452	-	0.00%
	6.1	Unreliability /Product Readiness		182,452	-	0.00%
	6.1.1	Standard Readiness		182,452	-	0.00%
	6.1.2	Product Design Relibility		182,452	-	0.00%
7	Costing		0.05%	182,452	-	0.00%
	6.1	Yield issue		182,452	-	0.00%
	Total Prod.downtime		5.0%	182,452	17,138	9.39%

Table 3:- Data Downtime Production period August 2018

No	Kategori Losses		Target % NSP	Based on Loss output (September)		
				Total Target Output	Total Loss Output	% Prod. Downtime
1	Production		2.0%	123,253	2,878	2.34%
	1.1	SPU Feeding		123,253	10	0.01%
	1.1.1	Feeding Computer Stitching		123,253	10	0.01%
	1.1.2	Feeding Stokfit		123,253	-	0.00%
	1.1.3	Feeding Auto Cutting		123,253	-	0.00%
	1.1.4	Feeding Cutting Subcont		123,253	-	0.00%
	1.3	Trial Prod/Cutt.dies trial & QC Check		123,253	200	0.16%
	1.4	Insufficient manpower		123,253	-	0.00%
	1.5	Tooling (Laste/ Cutting Dies)		123,253	-	0.00%
	1.6	Change over		123,253	2,668	2.16%
2	Engineering		0.7%	123,253	109	0.09%
	2.1	Machine Downtime		123,253	109	0.09%
	2.2	Machine Availability		123,253	-	0.00%
	2.3	Electricity		123,253	-	0.00%
3	PPC		1.45%	123,253	16,365	13.28%
	3.1	Subcont Feeding		123,253	16,365	13.28%
	3.2	Daysheet/Size Label		123,253	-	0.00%
	3.3	Tooling Readiness		123,253	-	0.00%
4	Logistic		0.2%	123,253	3,692	3.00%
	4.1	Feeding Material Upper		123,253	1,260	1.02%
	4.2	Feeding Material Bottom		123,253	2,432	1.97%
	4.3	Feeding Packaging		123,253	-	0.00%
5	PCE		0.5%	123,253	11,467	9.30%
	5.1	Quality Downtine (Quality Issue)		123,253	11,467	9.30%
	5.1.1	Lab issue		123,253	-	0.00%
	5.1.2	Quality Issue Material		123,253	860	0.70%
	5.1.3	Quality Issue Subcont		123,253	10,107	8.20%
	5.1.4	Quality Issue Outsole		123,253	500	0.41%
	5.2	Chemical		123,253	-	0.00%
	5.3	AQR Stockfitting		123,253	-	0.00%
	5.4	AQR Subcont incoming		123,253	-	0.00%
6	Development		0.1%	123,253	1,820	1.48%
	6.1	Unreliability /Product Readiness		123,253	1,820	1.48%
	6.1.1	Standard Readiness		123,253	1,820	1.48%
	6.1.2	Product Design Relibility		123,253	-	0.00%
7	Costing		0.05%	123,253	-	0.00%
	6.1	Yield issue		123,253	-	0.00%
	Total Prod.downtime		5.0%	123,253	36,331	29.48%

Table 4:- Data Downtime Production period September 2018

ISSN No:-2456-2165

Based on data from the achievement of production downtime during 3 months (July to September 2018) concluded that there is no one month reached its specified maximum standard where achievement in the month of July amounted to 7.93%, amounting to 9.39% in August, and in September amounting to 29.48%. For production downtime per department that has the lowest performance in the last 3 months is in the PPC area with an average achievement of 6.95%. As for the other areas the average already meet the standards specified maximum production downtime the company at 5%, although still there is one month that has not reached the standard that the production department in August with an achievement of 6.30%. If the calculation of the total average for the last 3 months is carried out the achievement of production downtime is 12.57%. With the data of the RFT and production downtime can be calculated in detail about the performance of the overall effectiveness of the production process in PT. PDK uses the Overall Equipment Effectiveness (OEE) method

B. Calculation Overall Equipment Effectiveness (OEE)

Based on data from RFT and production downtime has been collected, it can be calculated overall equipment effectiveness (OEE) to determine the availability rate, performance rate and quality rate during the months of July to September 2018. For the OEE calculation using the following formula:

- Availability Rate = (operational time– downtime loss) / operational time x 100%.
- Perfomance Rate = (cycles time product x actual production output) / running time x 100%.
- Quality Rate = (actual production output– total quality loss) / actual production output x 100%.
- Overall Equipment Effectiveness (OEE) = availability rate x perfomance rate x quality rate.

The OEE calculation results during the months of July to September 2018 can be seen in the table below:

No	Data Item (July 2018)		Unit
1	*Output* Per Jam	80	Pairs
2	*Cycle Time / Pair*	1,3	Minutes
3	Total Target *Output* (Juli 2018)	324.107	Pairs
4	Total *Loss Output* (Juli 2018)	25.714	Pairs
5	Aktual *Output* Produksi (Juli 2018)	268.838	Pairs
6	*Downtime Loss* (Juli 2018)	24.873	Pairs
7	*Speed Loss* (Juli 2018)	0	Pairs
8	*Quality Loss (Quality Issue+Defect Cutting+Defect Sewing+Defect Assembling+Defect Stockfitting)* - (Juli 2018)	32.886	Pairs
8.1	*Quality Issue (Startup Loss)* - Juli 2018	841	Pairs
8.2	*Defect Proses Cutting* (Juli 2018)	130	Pairs
8.3	*Defect Proses Sewing* (Juli 2018)	11.826	Pairs
8.4	*Defect Proses Assembling* (Juli 2018)	18.649	Pairs
8.5	*Defect Proses Stockfitting* (Juli 2018)	1.440	Pairs

Table 5:- Data Overall Equipment Effectiveness (OEE) period July 2018

Peralatan Produksi / Loading Time	Six Big Loss		No	Overal Equipment Effectiveness (OEE)	Nilai	Unit
Operation Time	Downtime Losses	1. Breakdown Loss	1.A	Waktu Operasional	421.339	Minutes
		2. Set up & Adjustment Loss	1.B	Downtime Loss (Breakdown Loss + Set up/Adjustment Loss)	32.335	Minutes
			1.C	***Availability***	**92,33%**	**Persentase**
Net Operating Time	Speed Losses	3. Chokotei Loss	2.A	Waktu Running	389.004	Minutes
			2.B	Cycle Time / Pair	1,3	Minutes
		4. Cycle Time Loss	2.C	Jumlah Produk Diproses	268.838	Pairs
			2.D	***Perfomance Rate***	**89,84%**	**Persentase**
Quality Losses	Quality Losses	5. Defect Loss	3.A	Jumlah Produk Diproses	268.838	Pairs
		6. Startup Loss	3.B	Quality Loss	32.886	Pairs
			3.C	***Quality Rate***	**88%**	**Persentase**
			4.A	***Overal Equipment Effectiveness (Availability x Perfomance Rate x Quality Rate)***	**72,80%**	**Persentase**

Table 6:- Results Overall Equipment Effectiveness (OEE) periode July 2018

No	Item Data (Agustus 2018)		Unit
1	*Output* Per Jam	80	Pairs
2	*Cycle Time / Pair*	1,3	Minutes
3	Total Target *Output* (Agustus 2018)	182.452	Pairs
4	Total *Loss Output* (Agustus 2018)	17.138	Pairs
5	Aktual *Output* Produksi (Agustus 2018)	151.118	Pairs
6	*Downtime Loss* (Agustus 2018)	16.938	Pairs
7	*Speed Loss* (Agustus 2018)	0	Pairs
8	*Quality Loss* (*Quality Issue+Defect Cutting+Defect Sewing+Defect Assembling+Defect Stockfitting*) - Agustus 2018	28.445	Pairs
8.1	*Quality Issue* (*Startup Loss*) - Agustus 2018	200	Pairs
8.2	*Defect Proses Cutting* (Agustus 2018)	258	Pairs
8.3	*Defect Proses Sewing* (Agustus 2018)	8.583	Pairs
8.4	*Defect Proses Assembling* (Agustus 2018)	17.032	Pairs
8.5	*Defect Proses Stockfitting* (Agustus 2018)	2.372	Pairs

Table 7:- Data Overall Equipment Effetiveness (OEE) periode August 2018

Peralatan Produksi / Loading Time	Six Big Loss		No	Overal Equipment Effectiveness (OEE)	Nilai	Unit
Operation Time	Downtime Losses	1. Breakdown Loss	1.A	Waktu Operasional	237.188	Minutes
		2. Set up & Adjustment Loss	1.B	Downtime Loss (Breakdown Loss + Set up/Adjustment Loss)	22.019	Minutes
			1.C	**Availability**	**90,72%**	**Persentase**
Net Operating Time	Speed Losses	3. Chokotei Loss	2.A	Waktu Running	215.168	Minutes
			2.B	Cycle Time / Pair	1,3	Minutes
		4. Cycle Time Loss	2.C	Jumlah Produk Diproses	151.118	Pairs
			2.D	**Perfomance Rate**	**91,30%**	**Persentase**
Quality Losses	Quality Losses	5. Defect Loss	3.A	Jumlah Produk Diproses	151.118	Pairs
		6. Startup Loss	3.B	Quality Loss	28.445	Pairs
			3.C	**Quality Rate**	**81%**	**Persentase**
			4.A	**Overal Equipment Effectiveness (Availability x Perfomance Rate x Quality Rate)**	**67,24%**	**Persentase**

Table 8:- Results Overall Equipment Effectiveness (OEE) periode August 2018

No	Item Data (September 2018)		Unit
1	*Output* Per Jam	80	Pairs
2	*Cycle Time / Pair*	1,3	Minutes
3	Total Target *Output* (September 2018)	123.253	Pairs
4	Total *Loss Output* (September 2018)	36.331	Pairs
5	Aktual *Output* Produksi (September 2018)	82.292	Pairs
6	*Downtime Loss* (September 2018)	24.864	Pairs
7	*Speed Loss* (September 2018)	0	Pairs
8	*Quality Loss* (*Quality Issue+Defect Cutting+Defect Sewing+Defect Assembling+Defect Stockfitting*) - September 2018	26.301	Pairs
8.1	*Quality Issue* (*Startup Loss*) - September 2018	11.467	Pairs
8.2	*Defect Proses Cutting* (September 2018)	69	Pairs
8.3	*Defect Proses Sewing* (September 2018)	3.903	Pairs
8.4	*Defect Proses Assembling* (September 2018)	10.317	Pairs
8.5	*Defect Proses Stockfitting* (September 2018)	545	Pairs

Table 9:- Data Overall Equipment Effetiveness (OEE) periode September 2018

ISSN No:-2456-2165

Peralatan Produksi / Loading Time	Six Big Loss		No	Overal Equipment Effectiveness (OEE)	Nilai	Unit
Operation Time	Downtime Losses	1. Breakdown Loss	1.A	Waktu Operasional	160.229	Minutes
		2. Set up & Adjustment Loss	1.B	Downtime Loss (Breakdown Loss + Set up/Adjustment Loss)	32.323	Minutes
			1.C	**Availability**	**79,83%**	**Persentase**
Net Operating Time	Speed Losses	3. Chokatei Loss	2.A	Waktu Running	127.906	Minutes
			2.B	Cycle Time / Pair	1,3	Minutes
		4. Cycle Time Loss	2.C	Jumlah Produk Diproses	82.292	Pairs
			2.D	**Perfomance Rate**	**83,64%**	**Persentase**
Quality Losses	Quality Losses	5. Defect Loss	3.A	Jumlah Produk Diproses	82.292	Pairs
		6. Startup Loss	3.B	Quality Loss	26.301	Pairs
			3.C	**Quality Rate**	**68%**	**Persentase**
			4.A	**Overal Equipment Effectiveness (Availability x Perfomance Rate x Quality Rate)**	**45,43%**	**Persentase**

Table 10:- Results Overall Equipment Effectiveness (OEE) periode September 2018

Based on the data OEE calculation from July to September 2018, it can be concluded that:

- OEE performance in July amounted to 73%, giving an illustration that there is still room for improvement until the OEE score reaches 85% or more. The focus of improvement was shown to improve subcont feeding performance that was processed and sent by suppliers to companies that were not in accordance with the order completion time and delivery time, causing the production process could not run according to the specified production schedule due to the unavailability of the subcont. On the other hand, the focus of improvement is to reduce the quality issue before the production runs and rejects that occur during the production process must also be carried out continuous improvement to anticipate the problem continues to recur.
- August's OEE performance of 67% illustrates that there is still room for improvement to score 85% or more. The focus of improvement was shown to improve performance scheduling in production because based on production downtime data it was concluded that the causes of production downtime were caused more by change over and subcont feeding so that production did not run according to production schedules and improve equipment performance in production. which causes loss output. On the other hand, the focus of improvement is to reduce the quality issue before the production runs and rejects that occur during the production process must also be carried out continuous improvement to anticipate the problem continues to recur.
- September's OEE performance of 45% gives a picture of production having a low achievement in improving performance production downtime where based on data production downtime the biggest cause of downtime is due to subcont feeding and subcont quality issues. Of the two items causing an output loss of 26,472 pairs with the percentage of production downtime of 72.86%.
- Based on OEE performance during July to September 2018 it was concluded that the production process had not been considered perfect and world class because there was still a lot of space that needed continuous improvement.

C. Six Big Losses Analysis

After calculation and analysis of the data OEE, then the next will be identification of six big losses during the months of July through September 2018. Based on the data obtained by the six big losses can be shown in Table 4 as follows:

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July – September 2018				
Item Six Big Losses	Total Loss Output (Minutes)			%
	July	Agustus	September	
Equipment Failure / Breakdown	4.486	679	142	3%
Set-up and Adjustment	27.849	21.341	32.182	41%
Idling and Minor Stoppages	0	0	0	0%
Reduce Speed	0	0	0	0%
Defect	41.659	36.719	19.284	49%
Reduce Yield Losses	1.093	260	14.907	8%

Table 11:- Six Big Losses Analysis from July to September 2018

To find the root cause of the most large or dominant cause loss of output can be analyzed using Pareto diagram and in figure 1 shows that the factor of defects that occur during the production process runs primarily in the area of assembling and factors set-up and adjustment is the most dominant factor causing low OEE performance during July to September 2018.

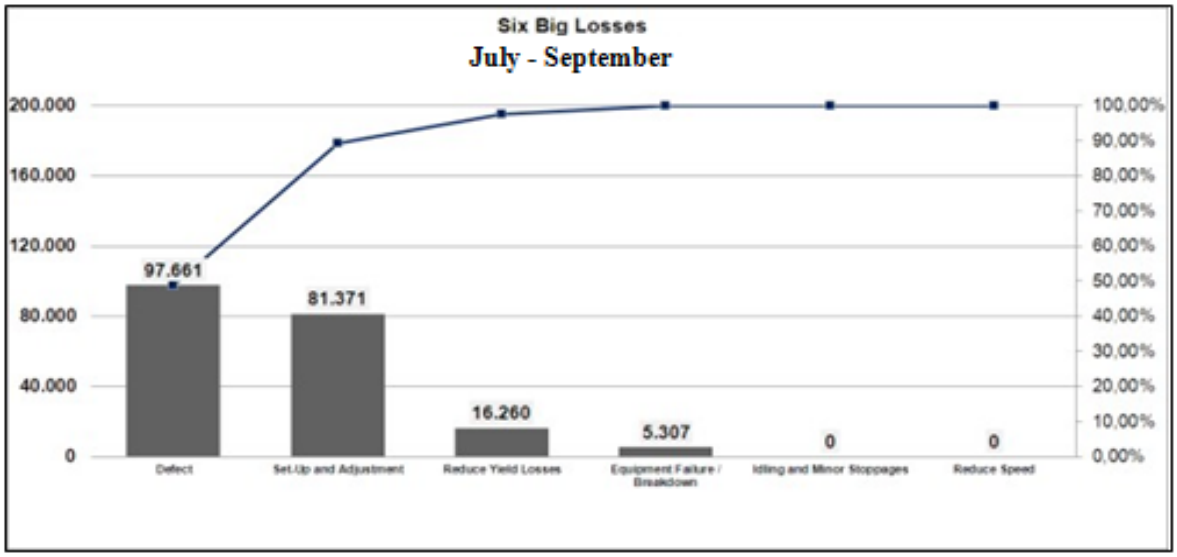

Fig 2:- Pareto Diagram Six Big Losses from July to September 2018

D. Analysis Cause and Effect (Fishbone Diagram)

Based on data from the Pareto diagram to do an analysis of the factors causing six big losses by using a causal diagram (fishbone diagram). From Pareto diagram are, for the most dominant factor and a major effect on the decrease perfomance OEE or productivity of the production is a factor of defect products and factors set-up and adjustment thus necessary to analyze the cause and effect to note an improvement plan what needs to be done to anticipate problems the repeated.

To find out the cause of not achieving the target of production downtime in August, then the identification of these causes will be carried out through a causal diagram (fishbone diagram). In the diagram, there are 6 categories of causes of downtime that is man, machine, material, methods, measurement, and environment. For the fishbone diagram is shown in Figure 3.

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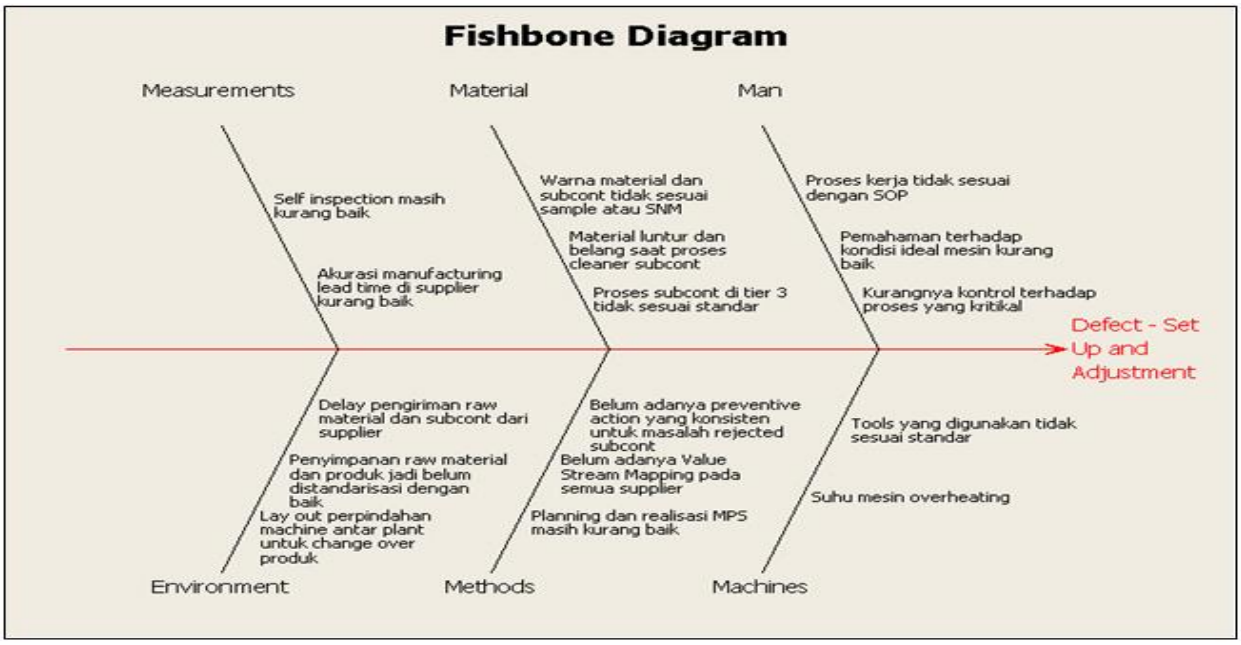

Fig 3:- Fishbone Diagram Defect , Set Up Adjustment periode July to September 2018

IV. RECOMMENDATION FOR IMPROVEMENT

Based on the fishbone diagram, the recommendations for improvementsthat need to be made for defect and set-up and adjustment problems include:

- Ensure workers / operators do work in accordance with the SOP and understand it well through regular control and evaluation.
- Providing training to production and operator leaders regarding ideal engine and equipment conditions by being involved in checking tools, temperature and pressure on the engine.
- Standardize critical process control so that the production and quality teams can prioritize and focus on problems that have a major impact on product defects.
- Perform a subcont cleaner process earlier when raw material is entered in the incoming production by the QC team to prevent the problem from happening when the outgoing process in tier 3 (subcont supplier).
- Ensuring the difference in color of raw material produced with sample development has been communicated with buyers and suppliers to obtain color allowances so as not to hinder the production process.
- Conducting audits regularly at subcont suppliers to ensure suppliers have processed according to the S4 (Swatch Subcont Standard Specification) standard and the subcont inspection process has been adjusted to the SOP.
- Creating a value stream mapping for each subcont supplier so that the actual details of the subcont process are known and can know what processes can be removed or carried out by kaizen to produce optimal conditions and improve subcont delivery time.
- Conduct regular evaluations and are consistent with every corrective action from subcont suppliers to ensure that the same problem does not recur in the future.
- Create an SOP on standardization of storage for raw material, subcont, and finished products so that they can be adjusted to the product conditions to prevent color changes and color shifts in raw material, subcont, and finished products.
- Ensure that the quality team that is directly involved when inspecting raw material, subcont, and finished products understands well the inspection methods and standards carried out by conducting regular training and evaluation.
- Provide input so that the planning of MPS planning is adjusted to the actual lead time at the supplier of raw material and subcont to prevent the production stop due to unavailability of feeding material and subcont.

V. CONCLUSION

Based on the results of the research that has been obtained, the following conclusions are obtained:

- Based on the calculation of Overall Equipment Effectiveness (OEE) in the production process at PT. PDK from July to September 2018 obtained OEE values ranging from 45.43% to 72.80%. The value of effectiveness is classified as very low because the OEE value standard for world-class companies is ideally 85%.
- The biggest and dominant factors cause loss of output so that the low OEE value is Defect when the production process is running and set up and adjustment with the total time losses of 29,839 minutes with a percentage of 90%.
- Factors that cause a defect and set up and adjustment are:

a) human factors: lack of control, lack of understanding of the ideal condition of the machine, and nonstandard work processes, b) machine factors: engine temperature is too hot and tooling is used in the assembling process nonstandard, c) material factor: material color is inconsistent and subcont process does not match S4 standard specifications, d) method factor: the absence of value stream mapping especially subcont suppliers, preventive action is not consistently implemented, and production plans are not adjusted to the lead time process in suppliers, e) measurement factors: poor self- inspection and inaccurate planning accuracy, f) environment factors: shipping delay from suppliers, storage of raw materials and non- standardized products, and layout of engine displacement.

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