Measurement Using the OEE Method and Design Using the Single Minute Exchange of Dies Method to increase Productivity in the Manufacturing Industry

Taufik Roni Sahroni[1*], *Teuku Yuri M* Zagloe[2], *Bagus* Priambodo[3], and *Bagas Caesar* Maulidani[4]

[1]Professor, Department of Industrial Engineering, Faculty of Engineering, Universitas Bina Nusantara, Jakarta, 11530
[2]Professor, Department of Industrial Engineering, Faculty of Engineering, Universitas Indonesia, Depok, 16424
[3]Department of Industrial Engineering, Faculty of Engineering, Universitas Bina Nusantara, Jakarta, 11530
[4]Department of Industrial Engineering, Faculty of Engineering, Universitas Indonesia, Depok, 16424

Abstract. The very rapid development of the manufacturing industry requires companies to be able to increase their productivity. Based on the analysis on the production machine, it is calculated that the Overall Equipment Effectiveness value is only 81%, this figure is still lower than the world class standard. What Affects Low OEE Value Is Performance and Machine Setup and Machine Downtime. This Repair Is Done Using Implementation Design of the Single Minute Exchange of Dies Method by Separating Internal and External Setups, Changing Internal Setup to External. After Getting Improved Internal and External Settings, The Time Reduction Value Is 30%, So It Can Improve Production Performance in The Manufacturing Industry.

1 Introduction

The development of the manufacturing industry, especially the 4-wheeled automotive industry in Indonesia, has experienced very rapid growth, even though there has been an outbreak of the Covid-19 virus so far experiencing problems in production. However, the increasing demand for products causes companies to be prepared to face intense competition. Manufacturers are increasingly aggressive in increasing product competitiveness and improving production process efficiency, effective flow of inventory materials or timely delivery to customers. This causes companies to have to improve the performance of their production processes, especially by implementing Lean Manufacturing [1, 2].

Lean manufacturing concept to minimize setup time reduction. Setup time is the time required to prepare equipment, machines, and systems for operation. Setup is generally carried out at the beginning of production or when there is a change in the type of product to be produced at the work station. Reducing setup time is one of the lean manufacturing applications because it can reduce waste.

The method used to reduce the machine setup duration (changeover) is Single Minute Exchange of Dies. Application of this method to reduce preparation/turnover time in various industries. and also proved that set-up reduction is an effective tool that can be applied to enhance the capability of manufacturing organizations to increase customer satisfaction through better utilization of industrial resources.
In addition to focusing on optimizing and reducing waste in lean, we also need a method that can identify

and measure the level of effectiveness of the production process, namely by using the Overall Equipment Effectiveness method as a measurement of performance and productivity of the production process [3].

1.1 Objectives

This research was conducted to obtain the value of availability, performance rate, quality rate in order to obtain the overall effectiveness of the equipment because it can determine the value of effectiveness and performance. get a reduction in setup time on the machine process by using the Single Minute Exchange of Dies method so that downtime can decrease and increase productivity in the production process. This research combines the concepts of Overall Equipment Effectiveness and Single Minute Effectiveness so that it can be known in a production process and can measure the level of performance so that the production process becomes more efficient and effective.

2 Literature Review

* Corresponding author: Taufik@binus.edu

Previous research was conducted that only measures the performance of production productivity and identifies waste in the production process with Lean Manufacturing and Overall Equipment Effectiveness. However, previous research did not increase improvements to reduce waste in the production process, even though it is important in increasing productivity performance in the manufacturing industry. [4-6].

3 Methods

The method used to improve performance in order to achieve efficient performance. Calculate the performance of each production line after knowing the waste. As well as using the Overall Equipment Effectiveness Method to measure the productivity level of the production process to make it more efficient and effective [7].

This availability value takes into account downtime loss, which is a variety of events that cause production to stop for a long time and is not planned. The changeover time is also taken into account because it is a form of downtime. This changeover time cannot be eliminated because it is a part of setup & adjustment but it can be reduced.

$$\boldsymbol{Availability}\ (\%) = \frac{\boldsymbol{Available\ Time - Downtime}}{\boldsymbol{Available\ Time}} \boldsymbol{x100\%}$$

Performanced rate calculates total production based on product processing time with the ideal amount obtained. In the production process, each product has a cycle time that shows how long the ideal process is to produce a product.

$$\boldsymbol{Performance}\ (\%) = \frac{\boldsymbol{Output\ x\ Cycle\ Time}}{\boldsymbol{Available\ Operation\ Time}} \boldsymbol{x100\%}$$

Quality ratio is a ratio that describes the ability of equipment to produce products that according to the standard.

$$\boldsymbol{Quality}\ (\%) = \frac{\boldsymbol{Total\ unit\ produced - Number\ of\ defects}}{\boldsymbol{Total\ Unit\ Produced}} \boldsymbol{x100\%}$$

The OEE value is obtained by multiplying the three main ratios

$$OEE = Availability\ x\ Performance\ x\ Quality$$

Single Minute Exchange of Dies (SMED) is an improvement concept that is used to speed up the setup time for changing products from one product to another in order to reduce setup duration [8,9]. the activity of preparing a machine to manufacture an item. Setup in the manufacturing process means all the activities needed to prepare a production tool or machine in order to produce a type of product. Setup time is the duration of time required to carry out the setup activity on the machine. This method reduces the set-up time by classifying the set-up into 2 types, namely internal set-up and external set-up. Internal set-up is a set-up activity that is carried out when the machine is off, while external set-up is when the machine is on and in production.

$$setup\ time = \frac{First\ setup - Final\ Setup}{First\ setup} x100\%$$

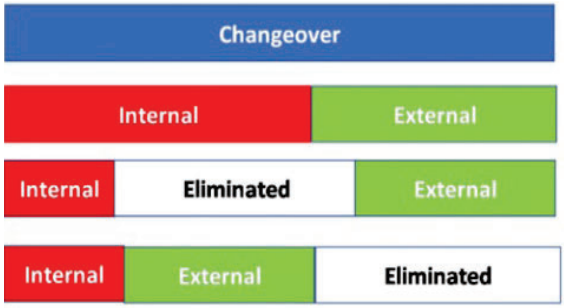

Figure 1. SMED Internal and External

4 Results and Discussions

Overall Equipment Effectiveness

Data obtained from companies related to historical reports for the period January 2021 – December 2021 which will be used to calculate the Overall Equipment Effectiveness (OEE) process value for the Big Press Line machine.

Based on the calculation of the availability of production machines from the data for the period January 2021 to December 2021, namely with an average of only 88% still below the world class standard.

Table 1. Availability

Month	Available Time	Total Downtime	Available Time - Downtime	Availability
Jan-21	18600	2740	15860	85%
Feb-21	17670	2050	15620	88%
Mar-21	19530	2165	17365	89%
Apr-21	18600	2166	16434	88%
May-21	13020	2382	10638	82%
Jun-21	16740	1492	15248	91%
Jul-21	18600	2029	16571	89%
Aug-21	17670	1873	15797	89%
Sep-21	20460	1960	18500	90%
Oct-21	17670	2010	15660	89%
Nov-21	20460	1999	18461	90%
Dec-21	18600	1879	16721	90%
Average				88%

Based on data from January 2021 to December 2021, it is known that the average performance rate value is 95%. The performance rate value is in accordance with international standards. One of the reasons is because of the production performance to increase the value of the performance rate.

Table 2. Performance rate

Months	Available Operating Time	Total Product	Cycle Time	Performane Rate	Performance
Jan-21	15860	141150	0,1	14115	89%
Feb-21	15620	140150	0,1	14015	90%
Mar-21	17365	172050	0,1	17205	99%
Apr-21	16434	152570	0,1	15257	93%
May-21	10638	100460	0,1	10046	94%
Jun-21	15248	140350	0,1	14035	92%
Jul-21	16571	156545	0,1	15654,5	94%
Aug-21	15797	154320	0,1	15432	98%
Sep-21	18500	180330	0,1	18033	97%
Oct-21	15660	151480	0,1	15148	97%
Nov-21	18461	180240	0,1	18024	98%
Dec-21	16721	160450	0,1	16045	96%
Average					95%

Quality rate although its development is unstable and still fluctuating. The achievement of the quality rate value so far is also still lacking. Based on the table, the calculation of the quality rate is known to be an average of 97%. still below the international standard.

Table 3. Quality rate

Month	Total Product	Reject	Quality Rate	Performance Quality Rate
Jan-21	141150	5364	135786,3	96%
Feb-21	140150	4485	135665,2	97%
Mar-21	172050	3613	168436,95	98%
Apr-21	152570	3967	148603,18	97%
May-21	100460	2612	97848,04	97%
Jun-21	140350	4070	136279,85	97%
Jul-21	156545	5479	151065,93	97%
Aug-21	154320	6018	148301,52	96%
Sep-21	180330	4869	175461,09	97%
Oct-21	151480	5302	146178,2	97%
Nov-21	180240	9372	170867,52	95%
Dec-21	160450	6739	153711,1	96%
Average				97%

This OEE value has a fairly positive trend, but is still very far below world-class standards. This is of course caused by several factors that occur and the results of component measurements carried out are also still below the standard so that data processing produces an average OEE value of only 81%. still below the international world class standard.

Table 4. Overall Equipment Effectiveness

Month	Availability	Performance Rate	Quality Rate	OEE	WORLD CLASS
Jan-21	85%	89%	96%	73%	85%
Feb-21	88%	90%	97%	77%	85%
Mar-21	89%	99%	98%	86%	85%
Apr-21	88%	93%	97%	80%	85%
May-21	82%	94%	97%	75%	85%
Jun-21	91%	92%	97%	81%	85%
Jul-21	89%	94%	97%	81%	85%
Aug-21	89%	98%	96%	84%	85%
Sep-21	90%	97%	97%	86%	85%
Oct-21	89%	97%	97%	83%	85%
Nov-21	90%	98%	95%	84%	85%
Dec-21	90%	96%	96%	83%	85%
Average				81%	85%

From figure 2, it can be seen that the Setup & adjustment value has a large downtime rate of 60% and a breakdown of 18%. Then it affects the productivity of the current production process which affects the performance of the production performance.

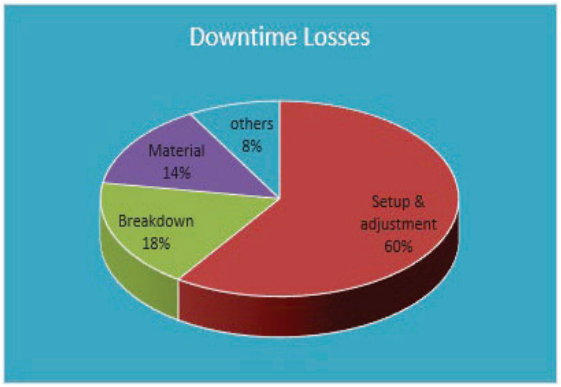

Figure 2. Downtime Losses

Overall Equipment Effectiveness

The first step that must be done is to make direct observations during machine setup in the field. Single Minute Exchange of Dies (SMED) data retrieval starts from the initial setup preparation until the machine is ready for production. Work procedures that have been obtained from direct observation are then recorded every step along with the time required for each procedure carried out. This data will be analyzed at a later stage to reduce setup time.

Table 5. Setup Internal and External Before

No	*Setup* External	Time (sekon)	*Setup* Internal	Time (sekon)
1	looking for a screwdriver	140	Cleaning equipment from the previous process	174
2	prepare raw materials	354	Enter Dies from the "dies in" roller, make sure the selector switch is "OFF"	230
3	prepare pallet	235	Adjust the stroke height to the dies, install the safety block	150
4	checking the condition of playing motor on/off	120	pasang safety block diatas die	123
5	pompa grease handpump	245	install and tighten the upper and lower bolts/nuts	105
6			adjust the position of the dies so they don't collide with the post guide	127
7			do a trial production the results can be good the dies are ready to produce	150
8			bending machine settings	205
9			adjust the position according to the shape	131
10			trimming machine settings	185
11			set the pressure of the press gauge	217
12			piercing machine settings	210
13			Quality check	65
Total Time		1053	Total Time	2072

Table 5 shows the setup time before repair consisting of 2072 seconds for internal setup and 1053 seconds. and Table 6 shows for external setup and setup time after repair consisting of 1691 seconds for internal setup and 505 seconds for external setup. The time reduction is calculated by comparing the internal setup time before and after. So that the reduction in setup time is 30%, this figure is quite good for the application of the Single Minute Exchange of Dies (SMED) concept. With this reduction in setup time, downtime will decrease and production time will increase.

Table 6. Setup Internal and External After Repair

No	*Setup* Eksternal	Time (sekon)	*Setup* Internal	Time (sekon)
1	prepare raw materials	120	Cleaning equipment from the previous process	174
2	prepare pallets	120	Enter Dies from the "dies in" roller, make sure the selector switch is "OFF"	230
3	checking the condition of playing motor on/off	115	Adjust the stroke height to the dies, install the safety block	150
4	hand pump grease pump	150	install and tighten the upper and lower bolts/nuts	105
5			do a trial production the results can be good the dies are ready to produce	150
6			bending machine settings	205
7			trimming machine settings	185
8			set the pressure of the press gauge	217
9			piercing machine settings	210
10			Quality check	65
Total Time		505	Total Time	1691

5 Conclusion

The results of the Overall Equipment Effectiveness value obtained a value of 81%. based on loss analysis, namely performance and setup which are at low OEE values. This research is equipped with an analysis of the application of the Single Minute Exchange of Dies concept which also has an impact on reducing the value of downtime which results in a 30% reduction in setup time.

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