Overall Equipment Effectiveness (OEE) in Relation to The Production Planning Study in PT Pupuk Kujang Cikampek

Tri Adi Putra¹, Abdul Ro'uf Farizki², Dicky Pratama Setiawan³

Universitas Sunan Gunung Djati¹, Universitas Airlangga², Universitas Pasundan³

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Abstract

Purpose- In planning production, many companies upon request from the marketing of products, but at the PT. Pupuk Kujang Cikampek most priority is the performance of the machine as a standard for production planning so that historical data engine performance is well documented. Therefore, this study analyzes the overall equipment effectiveness (OEE) by a factor of availability, performance efficiency dan rate of quality product in relation to the production planning.

Design/Methodology/Approach- Production Planning over a period of 5 years, only units of ammonia and urea 1B which meet the standards of a world class company in PT Pupuk Kujang Cikampek.

Findings- OEE Values of ammonia and urea units 1A amounted to 75.11% which does not include a world-class, in which the operation of the plant is acceptable to record improvements to be 85%, with the risk of economic loss and there is the plant's competitiveness is low. But for ammonia and urea unit 1B has a value of 87.43% OEE which includes world-class company with the almost perfect operation and competitiveness of the plant is quite good but it should still maintain engine performance through regular and planned maintenance.

Research Limitations/Implications- This research has not revealed the effect of annual maintenance on engine performance, but it has been illustrated that after each repair, the availability value has not been optimum.

Practical Implications- Companies can use the concept of Hansen to calculate the engine improvements that will be made into consideration in planning production will be better in preparing the RKAP. Then the production volume increases depending on the needs of the machine so it needs to improve maintenance management with good maintenance, repair or damage maintenance. 12 days ago will be held.

Keywords- EEO, Production Planning

Paper Type- Research Paper

Introduction

Companies in production apply the principle of focus on products (make to stock), which is the company conducts the production to be stored as inventory assuming the company is ready to support the security of food self-sufficiency. That is because factory machines work 24 hours continuously and focus on delivering products as soon as possible with good product quality and competitive prices. The strategy has a variety of advantages including the possibility of very few product deficiencies, being able to meet demands on time and scheduling and production management more easily, such as applying a constant production pattern (according to machine performance) with less additional costs i.e. only storage costs (Feriyanto, 2008).

In such fierce business competition, PT Pupuk Kujang Cikampek faces with quite serious problems. Companies are required to earn profits to be able to survive, grow and develop. The smooth production process determines one of the factors supporting the success of a chemical industry. If the production process runs smoothly, it will produce a quality product, the right time to complete the production, and low cost of production. The process depends on the condition of the resources owned, such as humans, machines or other supporting facilities, where the conditions in question are conditions ready to use to carry out their production operations, both accuracy, capability or capacity. With a fully automated machine owned, the company is expected to be able to produce products or outputs that are in accordance with the target and be able to anticipate losses that may arise, so that it will increase productivity and product selling prices. Production machines are one of the available resources that must be optimized for use. To ensure that the machine can operate properly and optimally, a good maintenance system is needed.

Factory Kujang 1A						
year	Production Urea(Ton)	On Stream day	Down Time (day)	OSF %	CF %	PF%
2015	463,635	337.43	27.57	92.45	79.65	73.64
2016	460,024	336.24	28.76	92.12	79.31	73.06
2017	480,889	349.20	15.80	95.67	79.83	76.38
2018	384,275	284.18	80.82	77.86	78.39	61.03
2019	409,297	324.24	40.76	88.83	73.18	65.01
r ²	437,131	324.25	40.75	88.84	78.12	69.43

Factory Kujang 1B						
year	Production Urea(Ton)	On Stream day	Down Time (day)	OSF %	CF %	PF%
2015	535,353	338.11	26.89	92.63	91.79	85.03
2016	590,030	361.03	3.97	98.91	94.74	93.71
2017	513,776	333.34	31.66	91.33	89.35	81.60
2018	503,978	333.01	31.99	91.24	87.73	80.04
2019	501,262	321.41	43.59	88.06	90.41	79.61
r ²	534,970	340.12	24.88	93.18	91.11	84.97

Table 1. Operational performance

Source: Annual Report

Based on Table 1, it can be seen that in 2019 the unachievement of production volume / production target is caused by a high down time that is 80.82 days in Kujang 1A (about 22% of the total flow time) and down time 31.99 days (8% of the total time flowing) in Kujang 1B even though the production factor / capacity of its utility is only only fulfilled by 61.03% in Kujang 1A and Kujang 1B only only fulfilled 80.04%, still below 82% based on Key Performance Indicators of large companies in Europe.

The problem faced by the company is regarding the volume / production targets that are not met due to high down time, so it is related to maintenance management that is carried out. To operate efficiently and effectively, companies need to ensure that there are no production interruptions caused by damage, stopping and engine failure (Lazim & Ramayah, 2010). In general, the causes of production disruption can be categorized into three, which are human, machine and environmental factors. The most important factor of these conditions is the performance of the engine used (Wahjudi, D., Tjitro & Soeyono, 2009). The level of efficiency and effectiveness of the maintenance system has an important role in the success and sustainability of a company (Parida & Kumar, 2006). Therefore, the system performance needs to be measured using a performance measurement technique.

Engine stop time has an effect on production volume, so the problem of downtime will be evaluated by the Overall Equipment Effectiveness (OEE) method as an engine performance indicator to monitor downtime at the Toyota Factory. (Amin, 2011)(Nakajima, 1988). The OEE method is an effective indicator for a machine. The overall performance of one piece of equipment or even the entire plant is governed by the cumulative impact of three OEE factors namely availability, performance efficiency and rate of quality products (Elley & Dissinger, 2005)(Borris, 2006). So the OEE value is a percentage obtained from the multiplication of these three factors. World-class companies are companies that have an OEE value of 85%. This value with the following composition: availability ratio of 90% or more, performance ratio of 95% or more, and quality ratio of 99% or more (Nakajima, 1988)(Dal, Tugwell, & Greatbanks, 2000).

The concrete problems in the field, namely in production planning, management does not pay much attention to engine performance, so that the engine breakdown time (unplanned maintenance) cannot be predicted properly, then the machine dies immediately, without being able to predict which machine will experience failure / damage, so the machine cannot produce according to the specified production plan. Therefore, this study intends to analyze the production planning of the ammonia and urea units at PT Pupuk Kujang Cikampek.

Literature Review

Maintenance in an industry is one of the important factors in supporting the smooth production process. Therefore, the production process must be supported by equipment that is ready to work at all times and is reliable. To achieve this, the equipment supporting the production process must get regular and planned maintenance (Daryus, 2007). Equipment maintenance must be conducted very carefully and in an appropriate time to avoid machine failure.

1. Overall Equipment Effectiveness(OEE)

OEE is a metric or measure to evaluate the effectiveness of equipment to identify lost production and other indirect and hidden costs that have a major contribution to the total cost of production (Nakajima, 1988). losses are formulated as a function of a number of exclusive related components, such as: Availability, Performance and Quality(Huang, Dismukes, Mousalam, Razzak, & Robinson, 2003).

In an ideal company, the equipment will operate 100% of the time at 100% capacity, with an output of 100% good quality. In reality, that rarely happens. The difference between an ideal and actual situation is losses. Calculating OEE is an important element of TPM's commitment to reduce equipment losses and related processes. The purpose of OEE calculation is to improve the effectiveness of the equipment. OEE is a comprehensive measure that identifies the level of machine / equipment productivity and performance in theory, namely the relationship between engine performance and capacity (Honda, 2000). This measurement is very important to know which area needs to be increased on its productivity or efficiency of the machine / equipment and this measurement can also show the bottleneck area contained in the production track. OEE is also a measurement tool to evaluate and improve the right way to ensure increased productivity in the use of machinery / equipment. A mathematical formula of overall equipment effectiveness (OEE) is formulated (Nakajima, 1988).

$$\text{OEE} = \text{Availability} \times \text{Performance efficiency} \times \text{Rate of quality product}$$

The OEE components are described as follows:

a. Availability

The first and second six big losses are known as downtime losses which are used to assist in calculating the availability value of a machine. Availability (A) is a ratio that describes the utilization of time available for the operation of a machine or equipment.

b. Performance Efficiency

PE is a ratio that describes the ability of equipment to produce goods. to be more clear, performance efficiency is the result of a comparison of net operation time with operation time, or the ratio of the quantity of products produced multiplied by the ideal cycle time to the time available in the production process (operation time).

c. Rate of quality product

Rate of quality product is the ratio of a better number of products to the total number of products processed. 100% quality means there are no projects that are projected or reworked (Susetyo, 2009).

2. Production Planning

Production planning is one of the various forms of planning that is an introduction to the production process that will be carried out in an effort to achieve the desired goals of the company. Production planning is closely related to inventory control so that most manufacturing companies place the functions of planning and inventory control in one unit. Production planning can also be interpreted as planning about the type and number of products that will be produced by the company concerned in the coming period. The characteristic of production planning is that production control is carried out with the aim of getting results in accordance with what is planned, regarding the quantity, quality, price and time. If the production control reviewed in detail, their characteristics can be seen. (Subayang, 2003), those characteristics are:

a. Production control process

This production control will involve several issues regarding the planning and supervision of the production process of a company. Regarding the type of product and the number of products to be produced in the future.

b. Raw materials control

Raw material is a very important element in production planning.

c. Labor control

d. Quality control

e. Tool maintenance control

Methodology/Materials

1. Hypothesis Development

Figure 1. Research Paradigm
(Hansen, 2002)(Nakajima, 1988)

The hypothesis proposed in the study is: OEE Value for Ammonia Unit and Urea Unit of Kujang Factory 1A and 1B at PT. Kujang Fertilizer is the same as World Class OEE Value which is 85%, described as follows:

2. Method

2.1 Sample and Data Collection

The samples taken for this study are data records in the production and maintenance of PT. Kujang Cikampek Fertilizer during the period 2015 - 2019.

2.2 Measurements

The data obtained were analyzed and interpreted using descriptive statistical analysis. Descriptive statistics are statistics used to analyze data by describing data that has been collected as it is without intending to make conclusions that apply to the public or generalizations. Hypothesis testing using SPSS 16.0 with t test. With the terms / criteria for testing the hypothesis if the significance value is below 0.05 or equal to 0.05 then H_a is accepted. or $t_{\text{observe}} < t_{\text{critical}}$ then H_0 is rejected, H_a is accepted.

Result

1. Measurement

T-Test

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
OEEBB	60	84.0527	13.57119	1.75203

One-Sample Test						
	Test Value = 85					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
OEEBB	-.541	59	.591	-.94733	-4.4531	2.5585

2. Hypothesis testing

With the terms / criteria for testing the hypothesis if the significance value is below 0.05 or equal to 0.05 then H_a is accepted or $t_{\text{observe}} < t_{\text{critical}}$ then H_0 is rejected, H_a is accepted. The calculation results obtained $T_{\text{critical}} = 2$. Based on the average test table, data obtained significance values above 0.05 i.e. 0.591 but the t_{observe} is in the acceptance of H_0 then H_a is accepted. Thus, it is true that OEE urea 1B is not the same as 85% i.e. below is only 84.05% that means not including world-class companies with a classification that is operational activities can be accepted with a note continuing improvement above 85% and moving towards world class accompanied by a slight economic loss and a little low competitiveness. This means that the company's urea 1B unit for operational activities in 2019 can still operate with a record of continuing to increase above 85% in order to go to world class with good competitiveness.

Findings

OEE Kujang 1A value of 75.11%, OEE values range 75% < OEE < 85%, with a classification that is operational activities can be accepted with a record of continuing improvement above 85% and moving towards the world class accompanied by slight economic losses and slightly low competitiveness. While OEE cleaver 1B value of 84.05% is OEE value in the range of 85% < OEE < 95%, with a classification that is good operating activities that are categorized as world class companies with good competitiveness. Therefore to run Kujang factory 1A and 1B, for 2015 PT.PKC must improve the performance of the engine in order to become a world-class company.

Year	OEE value		OEE value	
	Ammonia unit		Urea unit	
	K1A	K1B	K1A	K1B
2015	82.53	91.67	73.50	85.12
2016	81.94	98.46	73.11	93.79
2017	90.95	88.03	76.44	81.64
2018	71.58	88.3	61.09	80.08
2019	74.74	87.6	65.21	79.63
r ²	80.348	90.812	69.87	84.052

Conclusion

The relationship of these factors can be illustrated as follows. A machine that has operating time (good condition / not dead / downtime / availability) will work to produce a product that is the machine will try to perform until it reaches the capacity limit (usually operating below capacity), the ability to produce products according to its capacity is called performance efficiency, and how efficiently it produces good products is called the rate of quality product. So as to assess how effectively the machine produces products with high quality, the availability ratio, performance efficiency and product quality rate are multiplied cumulatively commonly called Overall Equipment Effectiveness (OEE) or overall effective engine performance introduced by Nakajima, 1988.

Implications

This research has not revealed the effect of annual maintenance on engine performance, but it has been illustrated that after each repair, the availability value has not been optimum. Companies can use the concept of Hansen to calculate the engine improvements that will be made into consideration in planning production will be better in preparing the RKAP. Then the production volume increases depending on the needs of the machine so it needs to improve maintenance management with good maintenance, repair or damage maintenance. 12 days ago will be held.

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Corresponding author

Tri Adi Putra¹ can be contacted at: poetra1302973@gmail.com

Abdul Ro'uf Farizki² can be contacted at: abdulrouffarizki@gmail.com

Dicky Pratama Setiawan³ can be contacted at: dickyps10@gmail.com