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IMPLEMENTATION OF OVERALL EQUIPMENT EFFECTIVENESS TO INCREASE FORKLIFT PRODUCTIVITY AT PT. HAKIM BIMA PRIMA

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ABSTRACT

Implementation of Overall Equipment Effectiveness (OEE) in Enhancing Forklift Productivity at PT. Hakim Bima Prima. Utilizing the OEE measurement method to analyze the forklift's performance in terms of availability, performance, and quality. The research shows that by applying OEE, the efficiency of forklift usage can be significantly improved. The practical implication of this study is the increased forklift productivity and reduced maintenance costs. The implementation of OEE on forklifts can be an effective strategy to enhance efficiency and productivity in the company's environment. The objective of this research is to evaluate forklift performance using OEE as the primary framework. Data collection methods involve monitoring
operational time, non-productive time, and the success rate of forklift missions from March 2023 to July 2023. The results demonstrate that OEE can be effectively used to identify the primary causes of downtime and optimize forklift usage. The main causes of downtime include maintenance, operational disruptions, and unbalanced workloads. By implementing improvements based on OEE findings, forklift productivity significantly increased, with an average improvement of over 80% during the research period. The application of OEE on forklifts offers manifold benefits, including reduced maintenance costs, increased operational uptime, and more efficient resource utilization. This study provides valuable insights for companies relying on forklifts in their operations, emphasizing the importance of equipment performance monitoring and analysis to enhance overall productivity and efficiency.

KEY WORDS: *efficiency, downtime, Forklift, OEE, Productivity Improvement*

NOMENCLATURE

1.0 INTRODUCTION

The increasing number of oil and gas industry companies provides great opportunities for pipeline companies. The demand of pipeline companies depends on the development of oil and gas drilling projects. A pipe line company that produces pipe coating products, especially carbon steel pipes used in oil drilling projects. Pipe coating companies have very high quality standards, because they maintain safety and security for oil and gas drilling projects. Based on these conditions, pipe coating production companies are required to provide maximum results. In the heavy work process, of course, workers use means of transportation, one of which is a forklift.

PT Hakim Bima Prima has several departments, one of which is the Maintenance Facility Department and the Maintenance Facility Department in 2 parts, namely Mechanical Maintenance and Infrastructure maintenance. Considering the number of forklifts used and the many working hours of using these tools, it requires maximum maintenance. There are several ways to use the maintenance system, namely, checking before the tool is turned on, checking per week and periodic service every 1 month of operation. The obstacles faced by Forklift operators are fuel leaks, hydraulic oil, sudden engine shutdown caused by blockages in the fuel filter, broken bearings, damaged tie rods and others.

Based on observation data for the last 5 months of 5 forklifts with a capacity of 4 tons, where the company standardizes forklift readiness is 80%. In the monthly operation period, the Forklift can serve production, which (80%) is found from every month of the Forklift's use period, but in the data found the percentage of the condition of the Forklift in the company is (0.9%) to (63%) with the lowest level of damage in

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March where the Forklift stopped operating for 10 days, and operating for 20 days here we can see that it is still far from effective, in April Forklift 02 suffered damage for 12 days (40 %) could not meet production needs and operated for 18 days (60 %) could meet production needs, in May Forklift 02 did not operate for 8 days (26 %) and operated for 22 days (74 %). Based on the above background, the researcher raised a study entitled The Application of Overall Equipment Effectiveness for Increasing Forklift Productivity at PT. Hakim Bima Prima, from the background description above, it can be identified that the problems that occur include: How to increase the productivity of Forklift machines using the Overall Equepment Effectiveness (OEE) method.

1.1 Overall Equipment Effectiveness (OEE)

Overall Equipment Effectiveness (OEE) is a metric that focuses on how effectively a production operation is carried out. Results are expressed in a general form that allows for comparisons between manufacturing units in different industries. Measurement (OEE) is also commonly used as the main performance indicator. When the maintenance process is carried out individually, (OEE) can identify which machines have good and bad performance.

In addition to knowing the performance of equipment, a measure (OEE) can be used as a consideration for new equipment purchase decisions. In this case, the decision-maker knows clearly the capacity of the existing equipment so that the right decision can be made in order to meet customer demand.
By combining with other methods, such as Basic quality tools (such as Pareto Analysis, Cause-Effect Diagram), with The value (OEE) is known, then through this method the factors causing the decline in value (OEE) can be known. Furthermore, through these causative factors, corrective actions can be taken immediately so that it can reduce efforts to find areas for improvement. How to Calculate Overall Equipment or abbreviated as OEE is a way to measure the performance of Forklift machines. Performance Measurement with (Overall Equipment Effectiveness) consists of 3 main components on the machine, namely Availability (forklift availability time), Performance (number of units running) and Quality (quality produced). Retno Astuti (2016) Calculation Results (OEE) are in the form of Percentage (%). In Indonesian, Overall Equipment Effectiveness is called Overall Equipment Effectiveness. OEE measurement is essential to measure the success implemented in a company. In other words, OEE results are the Main KPI (Key Performance Index) from the results of the implementation of Overall Equipment Effectiveness (OEE) using data from "The Six Big Losses", namely:

1.Availability
We always expect our Production Machines to be available when we need them. But sometimes the machine cannot operate according to our expectations in meeting the needs desired by customers. There are two possibilities of unavailability of Production Machinery, including: a breakdown is an engine breakdown that usually lasts more than 10 minutes. The breakdown time will be recorded in the form of "Minutes" until the production machine can operate again. In producing good units. Setup/Adjustments is the unavailability of the Forklift to operate due to damage. The time calculated is the time when the last unit stopped operating until the unit resumed operation.

2.Performance
Performance in OEE calculation is the number of forklift units operating in the available time. This number of units can be both good and broken forklift units. What is categorized as Performance that will be measured includes: Small stop is the stop of the engine for a short time (generally under 10 minutes) but the frequency of occurrence is high (often occurs). The frequent occurrence of these short stops causes the output produced to be reduced. Examples of stopping in a short time such as traffic jams or errors in forklift engines. This Small Stop needs to be recorded on the Tally Sheet so that it is known how often the small stop occurs and how much time it accumulates. Slow Running is a decrease in the speed of the forklift in operation, this often happens when forklift maintenance is not done properly.

3. Quality
What is meant by Quality in OEE is the number of units operating well successfully compared to the total number of units (in the form of good units or damaged units) produced. There is also a mention of Quality as the Yield Rate in the OEE formula. What is taken into account in Quality includes: Startup Defect is a defect caused by the Machine when it first starts production. Defects will usually occur when the machine operates again after the engine is repaired or there is a change in the setting or new model to be produced. Production Defect is a defect that occurs while production is in progress. The defect or damage must be recorded so that preventive measures can be taken.

1.2 Forklift

Forklift machinery is a handling material that is used as a tool to lift, lower, move goods, especially for heavy goods and can also be like a means of transportation. Based on the way it operates, the type of forklift is divided into two, namely manual forklifts and transmissions. Forklift Transmission is a forklift whose operation is the same as a car in general, has a gas pedal, clutch pedal, brake pedal and Forklift Automatic Transmission is a forklift whose operation method is the same as a manual which distinguishes only two pedals, pedal A for gas, pedal B for clutch and brake. The parts include:

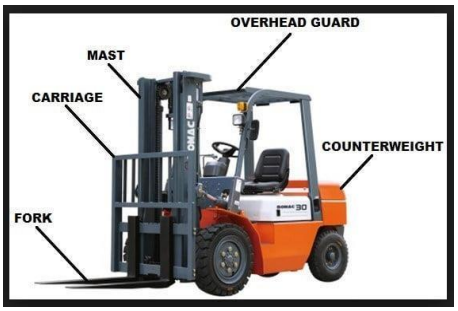

Figure 1. Forklift Parts (Source: Google, 2023)

1. A fork is the main part of a forklift whose function is to carry and lift goods or loads.
2. The Carriage is a part of the Forklift that serves as a link between the mast and fork.

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3. Mast is the main part related to the working function of a fork in a forklift, the mast itself is made of two thick pieces of iron, among which there is a Hydraulic. system, the mast itself functions for lifting and tilting.
4. Overhead guard is a roof or protector for Forklift operators whose function is to protect the operator if while doing his work lifting goods and the goods fall indirectly on the Forklift operator.

Counterweight is the part of the forklift located behind or opposite the position of the fork whose function is to balance the load.

1.2 Maintenance System

Maintenance is a combination of any actions taken to maintain an item or to repair it until it is in an acceptable condition (Rahayu, 2014). Basically, the expected results of machine or equipment maintenance activities include the following two things:

1. Condition Maintenanceis maintaining the condition of the machine or equipment so that it functions properly so that the components contained in the machine also function according to their economic life.

2. Replacement Maintenance is to carry out repair actions and replace engine components on time according to the planned schedule before the damage occurs. According to Assauri (2004) in Shandy (2009), maintenance activities focus on maintaining facilities and equipment that can support smooth production process, especially by reducing or reducing congestion– congestion to be as small as possible or even non-existent.

Maintenance is a maintenance activity for production facilities, so that it can provide several important benefits, including:

1. Production machines and equipment can be used for a relatively longer period of time.
2. The implementation of the production process can run smoothly and stably.
3. Suppressing as little possible heavy damage to the machinery and production equipment used.
4. Process and quality control will be carried out properly
5. The company will be able to reduce maintenance costs incurred due to repairs to equipment damage.
6. Coordination between parts in the factory can run well.

Some maintenance techniques that have been widely used in various industries including the process industry are as follows:

1. Reactive Maintenance (Breakdown or Reactive Maintenance), this maintenance technique is oriented towards repairing damage that has occurred and is most widely used because it is quite simple, flexible, and cheap, especially for non-critical machines and equipment for production.
2. Corrective Maintenance, this maintenance technique aims to improve the performance and initial condition of the manufacturer's factory. This is done by making modifications to the initial design of the equipment.
3. Preventive Maintenance, this maintenance technique aims to minimize the damage to the machine at a certain time, avoiding damage, and maximize the life of the equipment. This goal is achieved by conducting scheduled inspections to maintain the operating conditions and environment of the equipment at the optimal point.
4. Predictive Maintenance, this maintenance technique aims to predict when an equipment will be damaged so that adequate preparations in dealing with it can be done as early as possible without having to disrupt the production process. This technique demands sophisticated and expensive diagnostic equipment and adequate personnel knowledge of the various pre-damage symptoms that arise. For example, changes in vibration or vibration, abnormal sounds, temperature in an equipment.

1.3 Maintenance Goal

Maintenance activities are generally carried out to prevent damage to forklifts used for production activities too quickly, besides that maintenance activities must have effective, efficient, and low-cost criteria. The following are some of the objectives of maintenance activities, including:

1. Extend the service life of the Forklift.
2. Maintain the function of the Forklift machine.
3. Guarantee the optimum availability of Forklift machines.
4. Ensuring the operational readiness of Forklift machines.
5. Reduce Forklift engine downtime.
6. Guarantee the safety of the User.
7. Guarantee customer satisfaction.

Preventive Maintenance This type of maintenance is the opposite of repair maintenance, this maintenance is done to prevent and fix problems before machine failure occurs. In this case, the inspection is an important activity for making reports and planning routine maintenance for the next activity so that it is more precise and fast. The standard steps taken to carry out this type of treatment are:

1. Cleaning the Forklift spare part area such as cleaning dust, cleaning the remaining lubricant that is scattered, cleaning the remnants of scrap, and others.
2. Inspection of the engine after use, such as checking the oil level, checking whether there are bolts in the engine that are loose, or loose and exposed cables, etc.
3. Lubrication of spare parts of the Forklift that may require it.

2.0 METHOD

This research was conducted by the author from March to August 2023 on the company PT Hakim Bima Prima which is located at the Tangkalan, Kampung Baru, Pangakalan Brandan, Langkat, Sumatera Utara, Indonesia.

The types of data collected in this thesis research are as follows: Primary data is data that can be received directly from the source, data on the results of monthly forklift preventive maintenance and data on maintenance and repair schedules for each unit, in 2023. The data collection method is a technique or way carried out by researchers to collect data. Data collection is carried out to obtain the information needed in order to achieve the research objectives needed in conducting

From the above data collection, to make this study more regular, the author designed an arrangement in data processing in the research on forklift maintenance using the Overall Equipment Effectiveness (OEE) Method. The author uses several stages in this study, the following are the stages in data processing in this study: Identification of problems in the

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company PT. Hakim Bima Prima.

1. Data Collection.
2. Conducting forklift damage data analysis in each unit.
3. The results of the data check each unit.
4. The results of the repair data for each unit.
5. Determine the results of forklift maintenance using the Overall Equipment Effectiveness (OEE)

Method, with the formula:
OEE = Availability x Performance x Quality
Availability = {(*operation time* − (*Down time* + *planned dow time*)) / Operation Time)} x 100%
Performance = {(*operation time* − (*Down time* − *planned downtime*)) /Operation Time)} x 100%
Quality = {((*operation time*−*down time*)/operation time) x 100 % }

3.0 RESULT

3.1 Improvement Maintenance

Based on the OEE values obtained, the values for all OEE forklifts 2 to 6 are below 80%. The implementation of Improvement through the OEE method by implementing maintenance and operational improvements. Based on the results of the downtime data above, the damage is caused by three factors, the first factor is the lack of engine maintenance, this is caused by the fact that the machine is rarely cleaned and the infrequent checking of the machine before and after use, the cause of this failure is caused by the company not doing preventive maintenance. The second factor is the work attitude factor that there is no checklist for the use of the machine and the machine works beyond the maximum limit of use, the cause of this failure is because the operator is not careful and does not work according to the SOP for the use of the machine in the company. The third factor is caused by the absence of replacement of new engine components, the cause of this failure is due to the lack of cost to replace old engine components.

3.2 Forklift repair results using the OEE method

Based on the results of research that has been carried out using the OEE method related to forklift problems, it is necessary to make proposals to minimize the risk of damage. The proposed improvements are:

1. The company conducts regular checks before and after use so that the machines used can be monitored more frequently.
2. The company provides trainings to provide understanding of the employees to further improve the effectiveness of the machine.

3.3 Data Retrieval After Improvement

Forklift productivity imorpvement will be carried out in June until the following months, in accordance with the work program above and the monitoring of OEE values will be carried out from June to August and the data is as follows

Table 1. Operation time

Forklift	June 2023 (Hours)	July 2023 (Hours)
Forklift 02	540	558
Forklift 03	540	558
Forklift 04	540	558
Forklift 05	540	558
Forklift 06	540	558

Table 2. Down time

Forklift	June 2023 (Hours)	July 2023 (Hours)
Forklift 02	0	36
Forklift 03	0	396
Forklift 04	0	18
Forklift 05	0	72
Forklift 06	108	180

Table 3. Planned down time

Forklift	June 2023 (Hours)	July 2023 (Hours)
Forklift 02	2	2
Forklift 03	2	2
Forklift 04	2	2
Forklift 05	2	2
Forklift 06	2	2

4.0 DISCUSSION

Based on the data above, the Availability, Performance and OEE calculations after improvement from June to July 2023 are carried out as follows:

Table 4. OEE June 2023

No Forklift	Availability	Performance	Quality	0EE
Forklift 02	99,37%	99,63%	100,00%	99,00%
Forklift 03	99,37%	99,63%	100,00%	99,00%
Forklift 04	99,37%	99,63%	100,00%	99,00%
Forklift 05	99,37%	99,63%	100,00%	99,00%
Forklift 06	90,37%	89,63%	90,00%	72,90%

Table 5. OEE July 2023

No Forklift	Availability	Performance	Quality	0EE
Forklift 02	93,91%	93,19%	93,55%	81,87%
Forklift 03	93,91%	93,19%	93,55%	81,87%
Forklift 04	97,13%	96,42%	96,77%	90,63%
Forklift 05	87,46%	86,74%	87,10%	66,07%
Forklift 06	90,68%	89,96%	90,32%	73,69%

Based on the calculation above, the OEE value in June forklift 6 is still below 80%, while other forklifts are already above 80%. In July, forklifts 5 and 6 were still below 80%, while other forklifts were above 80%. So that improvements continue to be made so that all forklifts can achieve OEE above 80% every month. Before the implementation of forklift OEE improvement, none of them were above 80%, with the implementation of improvement there were only two forklifts

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that had a value of 80%, with the data that forklift productivity increased after the implementation of this OEE.

Comparison Table of Forklift maintenance before and after using the Overall equipment effectiveness method

Table 6. OEE July 2023

Forklift	OEE before Improvement		
	March	April	May
Forklift 02	4,47%	6,40%	2,45%
Forklift 03	73,69%	51,20%	31,09%
Forklift 04	73,69%	72,90%	52,45%
Forklift 05	23,02%	34,30%	31,09%
Forklift 06	9,21%	15,17%	16,49%
No Forklift	OEE After Improvement		
	June	July	
Forklift 02	99,00%	81,87%	
Forklift 03	99,00%	81,87%	
Forklift 04	99,00%	90,63%	
Forklift 05	99,00%	66,07%	
Forklift 06	72,90%	73,69%	

With the proposal to use the Overall equipment effectiveness (OEE) method for forklift maintenance, the company will be better able to manage existing maintenance and can also maximize and optimize the company's profits in the future.

5.0 CONCLUSION

Based on the results of the analysis and discussion and then the desired goal from the results of the previous chapter, the author draws the conclusion from the stated goal that to increase the effectiveness of the work of the Forklift, in order to reduce the percentage of damage by using the Overall Equipment Effectiveness (OEE) method is to improve the performance of the maintenance process in each Forklift unit by 80% and above, where initially all forklifts were below 80%.

5.1 Recommendation

Based on the research carried out on the Forklift Unit maintenance process, there are several suggestions that the author wants to convey:

1. The need to improve work methods and standards in the forklift unit maintenance process, so that there are no delays in the production process that cause customers complain.
2. The need for supervision of the maintenance process according to Work Instruction.
3. It is necessary to improve the standard hours in the Forklift unit maintenance process so that it can increase the productivity of the Forklift in achieving the direct hours of the Rigger department.
4. To measure the benefits and accuracy of the research, it is necessary to conduct further research on the application of improved work methods to forklift productivity.

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