SPEKTRUM INDUSTRI
Vol. 19, No. 1, April 2021
e-ISSN : 2442-2630
p-ISSN : 1963-6590

SPEKTRUM INDUSTRI

Journal homepage :
http://journal.uad.ac.id/index.php/Spektrum

ANALYSIS OF TERMINAL TRUCK EFFECTIVENESS WITH OVERALL EQUIPMENT EFFECTIVENESS

Muhammad Kareza Abrianto, Devina Puspita Sari , Renanda Nia Rachmadita*
Business Management Study Program, Shipbuilding Department, Politeknik Perkapalan Negeri Surabaya
Jl. Teknik Kimia, Surabaya, 60111, Indonesia

ARTICLE INFO

Article history :
Received : January 2021
Accepted : April 2021

Keywords:
Terminal truck
OEE
Fishbone diagram

ABSTRACT

As a service company, service quality and speed of service are the main focuses of the company. This company is engaged in terminal handling, especially containers. In carrying out operational activities to transport containers from the dock to the container yard, it uses fifty terminal truck. Operational activities for transporting containers are carried out 24 hours a day so that maintenance is needed. Therefore, the operational terminal trucks do not experience sudden damage and disrupt operations. This will have an impact on the time used to be less productive. This study aims to determine the effectiveness of the Terminal Truck by using Overall Equipment Effectiveness (OEE). The results of this study found that the TT was still below the standard set by JIPM, that is 85%. Meanwhile losses, the significant that affect the effectiveness of TT are idling and minor stoppage losses.

INTRODUCTION

Material Handling Equipment (MHE) is an important tool for port service companies due to port productivity is supported by MHE. Besides being able to lighten the work, managing and handling products as well as shipping carried out on a large scale can easily be done using a variety of available equipment. The functions of MHE is to increase productivity and efficiency because the material will move quickly. If MHE conditions are not optimal due to damage, the workload will be even greater because material and product handling is hampered. Of course, this condition must be maintained and controlled so that during operation it can achieve optimal performance.

This port company is a new company, but the equipment used in its operational activities uses new technology. This equipment still has poor reliability. This is indicated by frequent breakdowns of the equipment used. While the management used by the company in an effort to improve equipment performance is still trial and error and management is based on manuals obtained from vendors. This condition will certainly have an impact on the costs incurred not

* Corresponding author
E-mail address: renanda.nia@ppns.ac.id
https://doi.org/10.12928/si.v19i1.19648

e-ISSN : 2442-2630
p-ISSN : 1963-6590

small so that it burdens the production costs and the time used becomes less productive. One of the loading and unloading equipment is the Truck Terminal.

Terminal truck functions to transport containers from the dock to the Container Yard (CY) or vice versa. The problem that arises from the Truck Terminal is that many existing equipment are damaged so that they cannot be operated. This will disrupt the loading and unloading process of containers. Because in loading and unloading activities all tools are integrated with each other. So that if there is a problem with one of the tools, it will have an impact on the loading and unloading process. Figure 1 shows the comparison of the total time breakdown in 2018 and 2019. It can be seen that more Truck Terminals have experienced an increase in total breakdown time from the previous year. This indicates that the Truck Terminal has suffered a lot of damage so that it can disrupt the loading and unloading activity process.

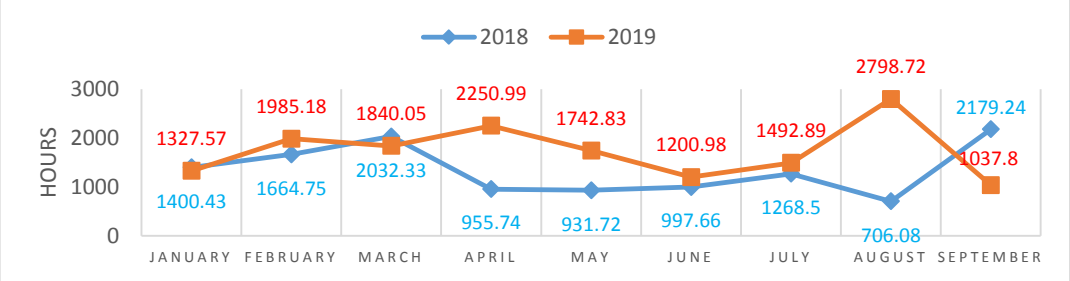

Figure 1. Total breakdown time

Ramachandra et al. (2016) aims to study the measurement of effectiveness of TPM implementation in manufacturing and service industries. It was found that improving Overall Equipment Effectiveness (OEE) is one of the main benefits in TPM implementation and it has been discussed in most of the literature. Halim et al (2018) 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. Daman & Nusraningrum (2020) aimed to evaluate the cause of the low - value OEE of the Excavator Hitachi EX2500 - 6 of EX157 and EX158 units and determine the way to repair so that the equipment performance can be improved. Patil et al. (2015) aims to see how improvement in OEE can be brought by implementing the methods of lean manufacturing to an automobile components manufacturing company.

This study aims to determine the effectiveness of the Terminal Truck by using Overall Equipment Effectiveness (OEE). It is expected that the calculation variables such as availability rate, performance rate, and quality rate can be used by the company to analyze more complex things that are the causes of decreased productivity so as to increase the performance of these tools.

RESEARCH METHOD

A. Terminal Truck

Truck is a means of transportation used to carry large quantities of goods from one place to another. The truck is divided into two parts, namely the head and chassis, this head is often referred to as the head truck which is the driving force of a truck. These trucks are specifically designed to operate at container terminals so they have different specifications from trucks operating on public roads. This truck design has a portable engine that can be removed easily, thus speeding up the truck maintenance process. The company has 50 truck terminal units. The specifications of this truck terminal are, maximum speed 35 km / hour, have a maximum capacity of 60 tons, standard EURO 4 engine, the engine system uses a power pack (portable drive

e-ISSN : 2442-2630
p-ISSN : 1963-6590

machine), equipped with a Wire Guided Navigation System so that it can move automatically (without a driver).

B. Maintenance

Activities maintenance focus on the maintenance of tools and facilities that help the production running smoothly, and also to minimize or even eliminate any bottlenecks on the tool (Assauri, 2008). The good and bad conditions of the tools or machines depend on the system maintenance that is being run, so the maintenance process for the tools or machines that are operated is very necessary (Arwanie, 2010). In the manufacturing industry, maintenance is also a factor that is as important as other factors, such as production activities. Because by using tools / machines that can work optimally, production activities will also run smoothly. The benefits that will be obtained from activities maintenance new will be felt when the system begins to experience disruption or damage.

C. Availability Rate

Availability rate is a ratio that shows the use of time available for machine or equipment operational activities. Based on Rizkia (2015), the formula for measuring availability rate is shown in equation 1.

$$Availability = \frac{Loading\ time - Downtime}{Loading\ time} \times 100 \quad (1)$$

D. Performance Rate

Performance rate is a ratio that shows the ability of a machine or equipment to produce goods. There are factors that are considered in calculating the performance rate, namely: Ideal cycle time, total box handled , and Operation time (machine operating time). Based on Maulidina (2016), the formula for calculating the performance rate is shown in equation 2.

$$Performance = \frac{(Total\ box\ hanled \times ideal\ cycle\ time)}{operating\ hours} \times 100 \quad (2)$$

E. Quality Rate

Quality rate is a ratio that shows the ability of a machine or equipment to produce products according to standards. Based on Maulidina (2016), the formula for calculating the quality rate is shown in equation 3.

$$Quality = \frac{Processed\ Ammount - Defect\ Amount}{Processed\ Ammount} \times 100 \quad (3)$$

F. Overall Equipment Effectiveness

After the calculation of the three major factors were known, then the next is to calculate the value of Overall Equipment Effectiveness (OEE) by the formula shown in equation 4. (Samad, 2012; Pharbu, 2014).

$$OEE = Availability \times Performance \times Quality \quad (4)$$

RESULTS AND DISCUSSION

A. Calculation of Availability Rate

Calculation of Availability Rate of terminal truck number 1 until 4 can use formula 1 so that the value obtained performance rate for the January 2019 - September 2019 period is as in table 1 until table 4.

e-ISSN : 2442-2630
p-ISSN : 1963-6590

Table 1. Calculation of availability rate terminal truck 1

Months	Loading Time (Hours)	Downtime (Hours)	Availability Rate (%)
Jan-19	726,51	10,695	98,53
Feb-19	657,34	41,552	93,68
Mar-19	733,67	640,025	12,76
Apr-19	712,00	479,508	32,65
Mei-19	-	-	-
Jun-19	-	-	-
Jul-19	-	-	-
Agu-19	-	-	-
Sep-19	586,75	11,939	97,97
	Average		**67,12**

Table 2. Calculation of availability rate terminal truck 2

Months	Loading Time (Hours)	Downtime (Hours)	Availability Rate (%)
Jan-19	729,99	6,104	99,16
Feb-19	558,26	0,014	100,00
Mar-19	732,17	285,594	60,99
Apr-19	-	-	-
Mei-19	733,00	450,011	38,61
Jun-19	703,01	3,508	99,50
Jul-19	735,50	558,006	24,13
Agu-19	730,42	66,192	90,94
Sep-19	703.50	11,682	98,34
	Average		**76,46**

Table 3. Calculation of availability rate terminal truck 3

Months	Loading Time (Hours)	Downtime (Hours)	Availability Rate (%)
Jan-19	727,36	92,355	87,30
Feb-19	654,67	157,017	76,02
Mar-19	729,08	5,014	99,31
Apr-19	709,17	9,341	98,68
Mei-19	724,93	5,838	99,19
Jun-19	706,00	145,088	79,45
Jul-19	730,92	139,442	80,92
Agu-19	733,67	657,336	10,40
Sep-19	709,00	21,025	97,03
	Average		**80,92**

B. Calculation of Performance Rate

Calculation of Performance Rate of terminal truck number 1 until 4 can use formula 2 so that the value obtained performance rate for the January 2019 - September 2019 period is as in table 5 until table 8.

e-ISSN : 2442-2630
p-ISSN : 1963-6590

Table 4. Calculation of availability rate terminal truck 4

Months	Loading Time (Hours)	Downtime (Hours)	Availability Rate (%)
Jan-19	726,42	5,506	99,24
Feb-19	656,67	4,344	99,34
Mar-19	728,17	2,756	99,62
Apr-19	707,50	577,176	18,42
Mei-19	732,67	217,604	70,30
Jun-19	710,17	225,006	68,32
Jul-19	728,43	17,674	97,57
Agu-19	722,29	9,109	98,74
Sep-19	700,17	1,176	99,83
Average			**83,49**

Table 5. Calculation of performance rate terminal truck 1

Months	Operating Hours (Hours)	Boxes (Units)	Ideal Cycle Time (Hours)	Performance (%)
Jan-19	496	1235	0,356	88,64%
Feb-19	310	765	0,356	87,85%
Mar-19	58	111	0,356	68,13%
Apr-19	42	80	0,356	67,81%
Mei-19	-	-	-	-
Jun-19	-	-	-	-
Jul-19	-	-	-	-
Agu-19	-	-	-	-
Sep-19	325	914	0,356	100,12%
Average				**82,51**

Table 6. Calculation of performance rate terminal truck 2

Months	Operating Hours (Hours)	Boxes (Units)	Ideal Cycle Time (Hours)	Performance (%)
Jan-19	531	1276	0,385	92,52%
Feb-19	435	1093	0,385	96,74%
Mar-19	302	752	0,385	95,87%
Apr-19	-	-	-	-
Mei-19	133	325	0,385	94,08%
Jun-19	332	757	0,385	87,78%
Jul-19	121	306	0,385	97,36%
Agu-19	476	1170	0,385	94,63%
Sep-19	352	915	0,385	100,08%
Average				**94,88**

C. Calculation of Quality Rate

Measurement of the value quality rate in service companies is different from manufacturing companies. This is because service companies do not produce defect products so that the measurement of the quality rate on the TT device is based on the ability of the tool to handle containers. As a company engaged in services container handling, this quality calculation is then carried out according to the tools used by the company. The quality of services handling can be seen from the ability of the tool to handle containers.

e-ISSN : 2442-2630
p-ISSN : 1963-6590

Table 7. Calculation of performance rate terminal truck 3

Months	Operating Hours (Hours)	Boxes (Units)	Ideal Cycle Time (Hours)	Performance (%)
Jan-19	405	1005	0,370	91,89
Feb-19	37	60	0,370	60,05
Mar-19	296	692	0,370	86,57
Apr-19	316	831	0,370	97,38
Mei-19	344	929	0,370	99,92
Jun-19	210	484	0,370	85,34
Jul-19	438	1039	0,370	87,84
Agu-19	17	20	0,370	43,56
Sep-19	258	667	0,370	95,73
Average				**83,14**

Table 8. Calculation of performance rate terminal truck 4

Months	Operating Hours (Hours)	Boxes (Units)	Ideal Cycle Time (Hours)	Performance (%)
Jan-19	489	1331	0,322	87,64
Feb-19	465	1323	0,322	91,61
Mar-19	491	1366	0,322	89,58
Apr-19	40	5	0,322	4,03
Mei-19	37	94	0,322	81,81
Jun-19	165	405	0,322	79,04
Jul-19	558	1628	0,322	93,95
Agu-19	504	1451	0,322	92,70
Sep-19	473	1468	0,322	99,94
Average				**80,03**

D. Calculation of Overall Equipment Effectiveness

The calculation of the value of Overall Equipment Effectiveness is obtained from multiplying the value of availability rate, performance rating and quality rate. With that calculation, the value can be obtained Overall Equipment Effectiveness for the January 2019 - September 2019 period as in Table 9.

Table 9. Calculation of Overall Equipment Effectiveness

Terminal Truck	Availability Rate (%)	Performance Rate (%)	Quality Rate (%)	OEE (%)
TT-112	67,12	82,51	100	55,38
TT-115	76,46	94,88	100	72,55
TT-119	80,92	83,14	100	67,28
TT-121	83,49	80,03	100	66,82

Based on table 9 it can be seen that the largest OEE value on TT-115 is 72.55% and for the OEE value the smallest was in TT-112 of 55.38%. The OEE value in table 4.19 is the OEE value for the period January 2019 to September 2019.

The OEE value on the TT-112, TT-115, TT-119, and TT-121 is still below the JIPM standard, that is 85%. The low OEE value is due to the low values availability, performance, and *q*uality. These three indicators are indicators that have involvement with human factors or it can be said that human resources in calculating the value of OEE are very large. Human factors

e-ISSN : 2442-2630
p-ISSN : 1963-6590

influence the calculation of OEE value because humans are directly related to the tools used by companies. However, apart from human factors, the decline in OEE value is also caused by uncontrollable factors such as weather and conditions of the tool. The TT which has a work system is interconnected with the Container Crane, if the weather conditions are bad then the CC will stop working and the TT will also stop working because operator safety is also important.

CONCLUSIONS

Based on the results of the OEE calculations at the Truck Terminal, it shows that the OEE value in the January-September 2019 period ranges from 55.38% to 72.55%. The respective OEE values for the six TT's were as follows 55.38% for TT-112; 72.55% for TT-115; 67.28 for TT-119; 66.82% for TT-121. These values are still below the JIPM (Japan Institute of Plant and Maintenance) standard, which is 85%. The low level of availability is due to the high breakdown rate so that the TT is not ready to be used for the loading and unloading process. As a service company, performance rates can be influenced by other factors such as controllable factors such as human factors and uncontrollable factors such as weather that does not support optimal operation.

REFERENCES

Ahuja, LPS, Khamba, JS. (2008). Total Productive Maintenance: Literature Review and Directions. *International Journal of Quality & Reliability Management, 25(7),* 709–756.

Arwanie, MN. (2010). Analisis Faktor *Six Big Losses* pada Mesin Cane Cutter yang Mempengaruhi Efisiensi Produksi Pabrik Gula PTPN II Sei Semayang. *Tugas Akhir Sarjana*. Universitas Sumatera Utara.

Assauri, S. (2008). *Production and Operations Management*. Jakarta: LPFEUI.

Corder, A. (1996). *Teknik Manajemen Pemeliharaan*. Jakarta: Erlangga.

Daman, A., Nusraningrum, D. (2020). Analysis of Overall Equipment Effectiveness (OEE) on Excavatator Hitachi EX2500-6. *Dinasti International Journal of Education Management and Social Science, 1(6),* 847-855.

Halim, K., Permana, R., Rimawan, E. (2018). Analysis Application Overall Equipment Effectiveness (OEE) and Six Big Losses in the Production Process PT. PDK, *International Journal of Innovative Science and Research Technology, 3(12),* 695-705.

Herwindo, Rahman, A., Yuniarti, R. (2014). Pengukuran *Overall Equipment Effectiveness* (OEE) Sebagai Upaya Meningkatkan Nilai Efektivitas Mesin Carding (Studi Kasus: PT. XYZ), *Jurnal Rekayasa Dan Manajemen Sistem Industri, 2(5),* 919-928.

Maulidina, A. D., Rimawan, E., Kholil, M. (2016). Analisa Total Productive Maintenance Terhadap Produktivitas Kapal/Armada Menggunakan Metode Overall Equipment Effectiveness Pada PT. Global Trans Energy International. *Journal of Industrial Engineering & Management Systems,* 9(1), 1-18.

Patil, N., Ghanwat, D., Kadam, S., Katkade, S. (2015). OEE Improvement on a Bottleneck Process, *IJSRD - International Journal for Scientific Research & Development, 3(02),* 1291-1293.

Pharbu, MV. (2014). Optimization of Overall Equipment Effectiveness in A Manufacturing System. *International Journal of Inovative Research in Science, Engineering and Technology, 3(3),* 1192–1196.

Ramachandra, CG., Prashanth, PM., Srinivas, TR., Raghavendra, MJ. (2016). OEE - A Tool to Measure the Effectiveness of TPM Implementation in Industries - A Review. *GRD Journals-Global Research and Development Journal for Engineering, 1(12),* 92-96.

Rizkia, I., Adianto, H., Yuniati, Y. (2015). Penerapan Metode Overall Equipment Effectiveness (OEE) dan Failure Mode And Effect Analysis (FMEA) Dalam Mengukur Kinerja Mesin Produksi Winding NT-880N Untuk Meminimasi Six Big Losses. *Reka Integra Jurnal Online Institut Teknologi Nasional, 03(04),* 273–274.

e-ISSN : 2442-2630
p-ISSN : 1963-6590

Rozaq, MI. (2015). Penerapan *Overall Equipment Effectiveness* (OEE) dalam Implementasi Total Productive Maintenance (TPM) Studi Kasus di PT. Adi Satria Abadi Kalasan. *Tugas Akhir*. Universitas Pembangunan Nasional "Veteran" Yogyakarta.

Samad, MA. (2012). Analysis of Performance by Overall Equipment Effectiveness of the CNC Cutting Section of a Shipyard. *ARPN Journal of Science and Technology, 2(11)*, 1091–1096.

Syukron, A., Kholil, M. (2013). *Six Sigma Quality For Business Improvement.* Yogyakarta: Graha Ilmu.