Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

The effect of low oveerall equipment effectiveness (OEE) on working hours and production costs of supplement products

Devilke Yandriyani[1], Maura Linda Sitanggang[2], Indah Masri[3]
[1,2,3]Program Studi Ilmu Kefarmasian, Fakultas Farmasi, Universitas Pancasila

Article Info
Keywords:
Produk Suplemen,
OEE,
Biaya Produksi

ABSTRACT
The pharmaceutical industry has strict regulations and procedures to guarantee a quality system by implementing Good Manufacturing Practices (CPOB) or current Good Manufacturing Process (cGMP). This must be adhered to by the pharmaceutical industry to ensure the safety, efficacy and consistent quality of the products produced. To produce consistent quality, the pharmaceutical industry needs to make continuous or ongoing improvements, one of the improvements that must be made is reducing downtime and reducing defective products. These improvements will increase the effectiveness of the machine. One method that can be used is Overall Equipment Effectiveness (OEE). This research aims to determine the effect of OEE values on working hours and production costs (direct labor & factory overhead) of supplement products by looking at the differences between actual and standard. This research uses descriptive quantitative methods followed by qualitative methods to find the root of the problem. Quantitative by calculating the value of availability level, performance level, quality level, OEE value, working hours and production costs (direct labor & factory overhead). Qualitative with Focus Group Discussion (FGD). The primary packaging production process for supplement products in 2022 shows an availability level of 47.23%, a performance level of 82.50%, a quality level of 95.78%, an OEE value of 37.32%. This shows that the condition of packaging machine X is not in prime condition because the overall OEE value is still below the ideal value of 85%. The low OEE value has an impact on working hours and production costs (direct labor & factory overhead) where the T test results show a significant difference between standard and actual (p-value (1.2829x10-6) ≤ α (0.05).

Corresponding Author:
Devilke Yandriyani
Program Studi Ilmu Kefarmasian, Fakultas Farmasi, Universitas Pancasila
devilkeyan@gmail.com

INTRODUCTION

The pharmaceutical industry has strict regulations and procedures to guarantee a quality system by implementing Good Medicine Manufacturing Practices (CPOB) or current Good Manufacturing Process (cGMP). This must be adhered to by the pharmaceutical industry to ensure the safety, efficacy and consistent quality of the products produced. To produce consistent quality, the pharmaceutical industry needs to make continuous or sustainable improvements (BPOM, 2018). One of the improvements that must be made by the

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

pharmaceutical industry is to reduce downtime and reduce defective products using the Overall Equipment Effectiveness (OEE) method (Arianto, et al., 2021). Overall Equipment Effectiveness (OEE) is a method used to measure machine effectiveness and evaluate machine performance by taking into account several metrics, namely time availability, machine performance and the quality of the products produced. This method has a very important role in minimizing damage, improving machine performance and improving product quality and thereby increasing the effectiveness of machines and systems within the Company.

Low machine effectiveness and machine performance can potentially increase packing process time due to high downtime. This can affect employee wages, where if working hours are on target or less than target, it can save costs and directly affect the production costs of primary packaging for supplement products, where production costs should be reduced to a minimum if the machine is in prime condition, which is Overall Equipment Effectiveness (OEE) value according to standards. Food supplements are concentrate products where the product contains one or more minerals and/or vitamins. Food supplements are consumed in certain and measured amounts to meet the needs of minerals and/or vitamins in the body (BPOM RI, 2009). Vitamins are organic substances or compounds that the body needs in certain amounts for the growth process and maintaining the body's immune system, where vitamins are generally not synthesized by the body so they need to be supplied from food, natural or synthetic ingredients (Triana, 2006).

Total Productive Maintenance (TPM) is a maintenance system that involves all parties to eliminate breakdowns and downtime, maximize production activities, increase productivity and product quality. One of the metrics used to evaluate machine effectiveness is Overall Equipment Effectiveness (OEE) (Dewi, et al., 2016). OEE is the ratio of how many products are made defect-free compared to how many can be made according to the equipment design. A machine or process is said to have an OEE value of 100% if the production process at the designed maximum capacity produces defect-free products (Singh, et al., 2018). OEE has 3 (three) metrics, namely availability, performance and quality. Availability is the active time or time that equipment is available to be operated.

$$\text{Availability} = \frac{\text{Operating Time}}{\text{Loading Time}} \text{x} 100\%$$

Downtime provided for production includes 365 days per year, 24 hours per day, and 7 days per week. This is an ideal condition. Planned downtime includes vacations. Availability losses include equipment failures and replacements that indicate situations where equipment does not run even though it is expected to run. Performance is the speed at which a manufacturing unit operates as a % of unit capacity. Performance is calculated using the following formula:

$$\text{Performance} = \frac{\text{Net operating time}}{\text{Operating time}} \text{x} 100\%$$

Quality is First Pass Yield or the number of products produced without defects. This refers to the quality level which is a good percentage of the total produced. Yield Quality losses refer to the situation when a line is in production, but there is a loss of quality due to

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

ongoing production. Quality can be calculated using the following formula:

$$\text{Quality} = \frac{(\text{Processed amount} - \text{defect amount})}{(\text{Processed amount})} \text{x}100\%$$

The OEE value can be calculated using the following formula:

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

METHOD

The research method used is descriptive quantitative followed by qualitative to find the root of the problem. This research uses primary data obtained through focus group discussions (FGD) with personnel involved in the primary packaging process for supplement products on packing machine X and secondary data in the form of documentation results carried out by personnel every shift from January - December 2022. Production costs, namely direct labor and factory overhead, are carried out with a T test statistical analysis to see whether there are differences between actual direct labor and factory overhead costs and the standards set by the Company, with the assumption that standard costs have an ideal OEE value.

RESULTS AND DISCUSSION

Overall Equipment Effectiveness (OEE) is a method that can be used to measure machine effectiveness by taking into account the measurement of 3 components, namely availability rate, performance rate and quality rate. At PT Z Company, machine working hours are divided into 2, namely Effective Working Hours and Production Idle Hours. Effective Working Hours are the number of machine operating hours planned for a full month (Total Machine Working Hours) minus Production Idle Hours. Production Idle Hours is time spent setting up or shutting down, maintenance, fixing problems, defects, and adjustments. Data on Effective Working Hours and Production Idle Hours for the period January to December 2022 are presented in Table 1.

Table 1. Data on Effective Hours and Production Idle Hours for Primary Packaging Production Process for Supplement Products in 2022

month	Total Working Hours (minutes)	Production Idle Hour (minutes)	Effective Hours (minutes)
January	17,750	7,350	10,400
February	14,130	6,485	7,645
March	30,105	11,794	18,311
April	18,730	7,741	10,989
May	12,930	5,390	7,540
June	18,255	8,250	10,005
July	23,175	9,535	13,640
August	15,990	6,935	9,055
September	14,535	7,490	7,045
Oktober	18,410	8,475	9,935
November	18,325	7,695	10,630

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

month	Total Working Hours (minutes)	Production Idle Hour (minutes)	Effective Hours (minutes)
December	17,880	6,580	11,300
Amount	220,215	93,720	126,495
average	18,351	7,810	10,541
Persentage	100.00%	42.56%	57.44%

This effective hour is not used 100% in the primary packaging production process because there is downtime that occurs and cannot be controlled. Based on the data in table 2, it shows that in 2022 running time will only be 47.23% and downtime will be 52.77% of the effective hours available in 2022. The downtime value is higher than the effective hours used for running supplement products. This shows that the supplement product production process is ineffective.

Table 2. Running hours and downtime for supplement products in 2022

month	Effective Hours (minutes)	Running (minutes)	Downtime (minutes)
January	10,400	5,830	4,570
February	7,645	2,866	4,779
March	18,311	7,922	10,389
April	10,989	5,330	5,659
May	7,540	4,025	3,515
June	10,005	4,038	5,967
July	13,640	5,253	8,387
August	9,055	4,540	4,515
September	7,045	4,055	2,990
October	9,935	5,970	3,965
November	10,630	5,085	5,545
December	11,300	4,835	6,465
Amount	126,495	59,749	66,746
average	10,541	4,979	5,562
Persentage	100.00%	47.23%	52.77%

Downtime in the primary packaging production process for supplement products in 2022 is due to Opening/Sorting Waste/Products, Approval, Over Set-up Clean-up, Technical Problems, Sorting bulk products and Over 5R in accordance with Figure 1.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

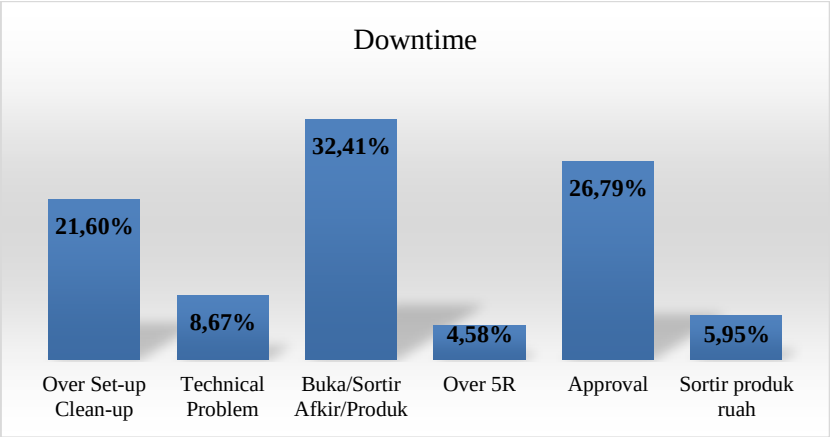

Figure 2. Downtime of the Supplement Product Production Process

The OEE value of primary packaging machines for supplement products from January to December 2022 is presented in Figure 2. and the total OEE value in 2022 is 37.23%. The OEE value is obtained from multiplying % availability, % performance, and % quality (Singh, et al., 2018 and Setiawan, et al., 2021). The OEE value in 2022 will be between 25.48% and 49.92%. Meanwhile, the minimum standard value for Overall Equipment Effectiveness set by the Japan Institute of Plant Maintenance is 85%. Each factor is 90% availability, 95% performance and 99% quality level.

	Jan	Feb	Mar	Apr	Mei	Jun	Jul	Agu	Sep	Okt	Nov	Des
Availability Rate	56,06%	37,49%	43,26%	48,50%	53,38%	40,36%	36,20%	50,14%	57,56%	60,09%	47,84%	42,79%
Performance Rate	89,50%	89,62%	86,06%	87,45%	75,26%	70,98%	74,78%	80,39%	82,59%	86,24%	82,84%	84,05%
Quality Rate	96,40%	93,03%	95,17%	97,00%	95,19%	94,96%	94,12%	96,13%	96,16%	96,33%	95,90%	97,83%
OEE	48,37%	31,26%	35,43%	41,14%	38,24%	27,20%	25,48%	38,75%	45,71%	49,92%	38,01%	35,18%

The actual and standard supplement product production process working hours were carried out with a T test to see the influence of the OEE value on working hours. Standard working hours are assumed to be ideal OEE values. Actual and standard supplement product production process working hours in 2022 are presented in Figure 3.

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

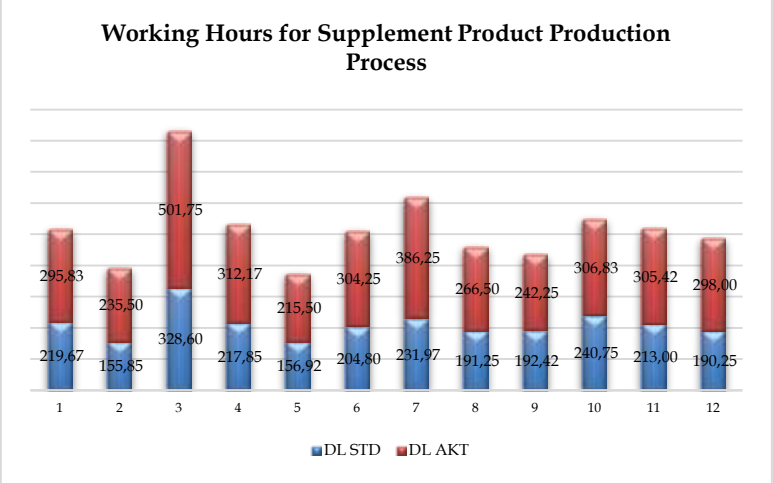

Figure 3. Working hours for the supplement product production process

Table 3. Standard and Actual Working Hours T Test Results

	Working Hours Std	Working Hours Act
Mean	211,9430556	305,8541667
Variance	2.040,065427	5.795,651673
Observations	12	12
Pearson Correlation	0,94137558	
Hypothesized Mean Difference	0	
Df	11	
t Stat	-8,815531513	
P(T<=t) one-tail	1,2829E-06	
t Critical one-tail	1,795884819	
P(T<=t) two-tail	2,5658E-06	
t Critical two-tail	2,20098516	

Standard and actual DL costs are calculated according to the standard manhour for the supplement product production process, namely 2 personnel.

Table 4. Standard and Actual T DL Test Results

	DL Std	DL Akt
Mean	10.886.666,99	15.710.505,13
Variance	5,38264E+12	1,52916E+13
Observations	12	12
Pooled Variance	0,94	
Hypothesized Mean Difference	0	
Df	11	
t Stat	-8,82	
P(T<=t) one-tail	1,2829E-06	

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

	DL Std	DL Akt
t Critical one-tail	1,80	
P(T<=t) two-tail	2,5658E-06	
t Critical two-tail	2,20	

Electricity usage is calculated from working hours and adjusted to the electric consumption of packaging machine X for supplement products, namely 4.5 kW.

Table 4. T Test Results for Standard and Actual Electricity Use

	Electricity Tariff Std	Electricity Tariff Act
Mean	1.063.176,308	1.534.265,432
Variance	51.335.322.386	1,45839E+11
Observations	12	12
Pooled Variance	0,94137558	
Hypothesized Mean Difference	0	
Df	11	
t Stat	-8,815531513	
P(T<=t) one-tail	1,2829E-06	
t Critical one-tail	1,795884819	
P(T<=t) two-tail	2,5658E-06	
t Critical two-tail	2,20098516	

Discussion

The OEE value of primary packaging machines for supplement products from January to December 2022 is presented in Figure 2. and the total OEE value in 2022 is 37.32%. The OEE value is obtained from multiplying % availability, % performance, and % quality (Singh, et al., 2018 and Setiawan, et al., 2021). The OEE value in 2022 will be between 25.48% and 49.92%. Meanwhile, the minimum standard value for Overall Equipment Effectiveness set by the Japan Institute of Plant Maintenance is 85%. Each factor is 90% availability, 95% performance and 99% quality level. Based on the results of the availability, performance and quality values, the lowest value is the availability value, where the availability value in 2022 is 47.23%. This shows that the main cause is the availability factor. The low availability level value is due to the high downtime of the primary packaging production process for supplement products. Downtime in the production process consists of Open/Sort Waste/Products, Approval, Over Set-up Clean-up, Technical Problems, Sort bulk products and Over 5R.

Actual working hours are the working hours used to carry out the actual production process of supplement products and if looked at as a whole from January to December 2022 the actual working hours do not meet the standards that have been set. From the working hours obtained, the cost of producing supplement products can be calculated. The production costs of supplement products are calculated based on actual working hours (direct labor) and electricity usage on primary packaging machine X for the supplement product production process (factory overhead). Material costs are not taken into account

Jurnal Info Sains : Informatika dan Sains
Volume 14 , Number 01, 2024, DOI 10.54209/infosains.v14i01
ESSN 2797-7889 (Online)
https://ejournal.seaninstitute.or.id/index.php/InfoSains

because they do not affect the level of effectiveness of the supplement product production process.

Based on the results of the T test to determine the effect of the Overall Equipment Effectiveness (OEE) value on working hours and production costs (direct labor and factory overhead) by looking at the difference between standard and actual, namely that there is a significant difference between working hours and production costs (direct labor and factory overhead) actual and standard with p-value (1.2829x10-6) ≤ α (0.05). This difference is caused by the low Overall Equipment Effectiveness (OEE) value which is influenced by the low level of availability. This low level of availability is due to the high downtime of the supplement production process. The higher the downtime during the production process, the longer it takes area personnel to complete the production process. The supplement production process time is the same as the working hours of area personnel and direct labor costs & electricity usage costs. These high production costs have a negative effect on the Company's net profit with an increase in production costs of 44.31% of the target production costs for primary packaging for supplement products in 2022, causing losses to the PT Z Company.

CONCLUSION

Nilai OEE diperoleh dari perkalian 3 faktor yaitu tingkat ketersediaan, tingkat performa, dan tingkat kualitas, diperoleh nilai sebesar 37.32% dengan kisaran 25.48% - 49.92%. Berdasarkan nilai standar minimum Overall Equipment Effectiveness yang ditetapkan oleh Japan Institute of Plant Maintenance adalah 85% sehingga secara keseluruhan nilai OEE produk suplemen tahun 2022 masih jauh di bawah standar. Adanya pengaruh nilai OEE terhadap jam kerja dan biaya produksi (direct labor dan factory overhead) dengan melihat perbedaan jam kerja dan biaya produksi (direct labor dan factory overhead) aktual dan standar dengan nilai p-value (1.2829x10-6) ≤ α (0.05).

REFERENCES

BPOM, 2018. Pedoman Cara Pembuatan Obat yang Baik (CPOB). Jakarta: Badan Pengawasan Obat dan Makanan.

Kumar, N. dan AjheyaJha, 2016. Quality Metrics and Quality KPI of Pharmaceutical Industry-A Review of Gap in Existing Practices. International Journal of Current Research. Vol. 8, Issue, 01. pp.25285-25288.

Singh, R.K., Clements, E.J., Sonwaney, V., 2018. Measurement of overall equipment effectiveness to improve operational efficiency. Int.J. Process Management and Benchmarking. 8 (2): 246-261.

Arianto, B., Mandagie, K. L., Zulheri, 2021. Analisis Penerapan Total Productive Maintenance dan Kaizen untuk Meningkatkan Overall Equipment Effectiveness pada Line Liquid di PT.PTI. Journal Universitas Suryadarma.

Patel, Chetan, 2017. Improvement in Overall Equipment Effectiveness in Pharmaceutical Company. Thesis. Ahmehabad: Gujarat Technological University.

Theeb, N. A., 2018. Problem Solving and Enhancing the Overall Equipment Effectiveness in

Pharmaceutical Industries. International Journal of Health and Medicine. 1(2): 5-8.

Syaputra, M. J., Utomo, U., Rimawan, E., 2020. Analisa kinerja mesin kemas primer dengan metode overall equipment effectiveness (OEE) di sebuah industri farmasi. Journal Industrial Services, 4(2).

SK Gubernur Jawa Barat No. 561.7/Kep.776-kesra/2022 tentang Upah Minimum Provinsi Jawa Barat Tahun 2023

Dewi, N. C., 2016. Analisis Penerapan Total Productive Maintenance (TPM) dengan Perhitungan Overall Equipment Effectiveness (OEE) dan Six Big Losses Mesin Cavitech PT. Essentra Surabaya. Industrial Engineering Journal, 4: (4).

BPOM RI, 2009. Nomor HK.00.05.1.23.3516 tentang Izin Edar Produk Obat, Obat Tradisional, Kosmetik, Suplemen Makanan dan Makanan yang bersumber, mengandung, dari bahan tertentu dan atau mengandung alkohol.

(Triana, Vivi, 2006. Macam-macam vitamin dan fungsinya dalam tubuh manusia. Jurnal Kesehatan Masyarakat. I (I)). Dan WHO, 2004. Vitamin and Mineral requirements in human nutrition (2nd Edition). ISBN 92.)

Vorne, 2015. Six Big Losses (Online). Tersedia: https://www.vorne.com/learn/tools/six-big-losses/six-big-losses-executive-summary.pdf, diakses pada Kamis, 03 November 2022.

Aristriyana, E., Fauzi, R. A., 2022. Analisis Penyebab Kecacatan Produk Dengan Metode Foshbone Diagram dan Failure Mode Effect Analysis (FMEA) pada Perusahaan Elang Mas Sindang Kasih Ciamis. Jurnal Industrial Galuh. 4 (2): 75 – 85.

Pamuji, 2008. Pengukuran Produktivitas Pekerja Sebagai Dasar Perhitungan Upah Kerja Pada Anggaran Biaya(Studi Kasus). Tesis. Sumatera Utara: Universitas Sumatera Utara.

Undang-Undang Republik Indonesia Nomor 13 Tahun 2003 tentang Ketenagakerjaan.

Peraturan Pemerintah Republik Indonesia Nomor 35 Tahun 2021 Tentang Perjanjian Kerja Waktu Tertentu, Alih Daya, Waktu Kerja dan Waktu Istirahat, dan Pemutusan Hubungan Kerja.

Mulyadi. 2010. Sistem Akuntansi, Edisi ke-3, Cetakan ke-5. Penerbit Salemba Empat, Jakarta.

Husni, P., Ekawati, A. Y., 2018. Analisis Overall Equipment Effectiveness (OEE) pada Proses Pengemasan Primer di Industri Farmasi. Farmaka. 16: 1.

Winantari, A.G., Kardoko, H., Mubarok M.F., 2019. Analisis Akar Penyebab Masalah Dalam Meningkatkan Overall Equipmnet Effectiveness (OEE) Mesin Pengisi Krim ke Tube PT. Kimia Farma Plant Watudakon.

Zulheri, Mandagie K. L., Arianto, B., 2021. Analisis Penerapan Total Productive Maintenance dan Kaizen Untuk Meningkatkan Overall Equipment Effectiveness Pada Line Liquid di PT. PTI.

Corrales, L., Lamban, M. P., Korner, M. E. H., Royo, J., 2020. Overall Equipment Effectiveness: Systematic Literature Review and Overview of Different Approaches.

Mwanza, B.G., Mbohwa, C., 2015. Design of a total productive maintenance model for effective implementation: Case study of a chemical manufacturing company.

Saipudin,S., 2019. Analisis perhitungan Overall Equipment Effectiveness (OEE) untuk meningkatkan nilai Efektivitas mesin line 7 pada PT. UPA.

Alamsyah, Firman, 2015. Analisis Akar Penyebab Masalah Dalam Meningkatkan Overall Equipment Effectiveness (OEE) Mesin Stripping Hipack III dan Unimach di PT Promedrahardjo Farmasi Industri, Tesis. Jakarta: Universitas Mercu Buana.

Peraturan Menteri Energi dan Sumber Daya Mineral No. 28, 2016. Tarif Tenaga Listrik Yang Disediakan Oleh PT Perusahan Listrik Negara (Persero).

Setiawan, B., Latif, F. A., Rimawan, E., 2021. Overall Equipment Effectiveness (OEE) Analysis: A Case Study in the PVC Compound Industry. IJIEM (Indonesian Journal of Industrial Engineering & Management). 3 (1): 14-25.

Stefana, E., Cocca, P., 2022. Resource Overall Equipment Cost Loss indicator to assess equipment performance and product cost. International Journal of Productivity and Performance Management.