Analysis of overall equipment effectiveness (OEE) of the raw mill machine using the DMAIC method in the cement industry

Dimas Mukhlis Fathurohman[1*], Dimas Mukhlis Fathurohman[1]

[1]Department Engineering Management, Universitas Logistik dan Bisnis Internasional, Bandung, West Java
*Corresponding author: dimasmukhlishidayat@ulbi.ac.id

ARTICLE INFO

Article history
Submission: 24th May, 2024
Revised: 26th July, 225
Accepted: 28th July, 2025

Keywords
Downtime
Maintenance
Six Big Losses
Overall Rquipment Effectiveness
DMAIC

https://doi.org/10.22219/oe.2025.v17.i2.147

ABSTRACT

Equipment failures significantly impact machine performance, leading to decreased productivity, increased maintenance costs, and reduced production output. PT XYZ, a cement manufacturing company, experiences frequent downtime in the Raw Mill Machine at Plant 10, resulting in abnormal production volumes and an efficiency index that remains below the standard. To evaluate and improve the performance of the raw mill, this study applies the Total Productive Maintenance (TPM) framework combined with Overall Equipment Effectiveness (OEE) analysis and the DMAIC methodology. A fishbone diagram is employed to identify the root causes of losses. The results show that the OEE value of 80.78% is still below the industry standard of 85%. Among the Six Big Losses, speed losses contribute the most, accounting for 79.81% of the total losses, making them the dominant factor responsible for the low OEE of the raw mill machine.

1. Introduction

The development of the manufacturing industry is increasing competitive because of its growth every year. In the 2023 quarter, the largest contribution to national economic growth will still come from the manufacturing sector. Its contribution increased to 16.77% compared to the previous period (Kemenperin.go.id). Companies must maximize the performance of their machines and equipment to increase their product capacity. To avoid machine damage that stops the production process, companies must carry out regular machine maintenance. To overcome this problem, management alternatives are needed to increase quality productivity, minimize damage, and create a healthy and safe work environment (Musyafa'ah & Sofiana, 2022). Undoubtedly, processes that minimize breakdown time will increase ongoing production efficiency. PT XYZ is the second cement producer in Indonesia and has a 25% market share. The cement industry consists of raw material grinding machines, kilns and cement mills. Historically, it shows that in 2022, machine stops or downtime occurred at the raw mill Plant 10 for 174.6 hours. Of course, this encourages companies to maintain productivity in order to meet market needs. The measurement of the Overall Equipment Effectiveness (OEE) value of the raw mill plant 10 machines was carried out to determine the level of effectiveness of the production process.

OEE is one method that can be used to increase machine effectiveness. Nakajima stated that OEE is a comprehensive measure that shows the level of productivity of machinery or equipment based on its theoretical performance. The OEE method measures machine effectiveness by calculating six big losses and find the factors that cause these losses (Rozak et al., 2019). The results of other research show that low efficiency performance, amounting to 68.29%, is one of the factors causing low OEE values in companies. Apart from that, the most dominant loss, 43.25%, can be reduced by calculating the value of the six big losses (Musyafa'ah & Sofiana, 2022). The method used to analyze this

Please cite this article as: Fathurohman, D., & Fathurohman, D. (2025). Analysis overall equipment effectiveness (OEE) raw mill machine using DMAIC method in cement industry. Operations Excellence: Journal of Applied Industrial Engineering, 17(2), 227-234. doi:http://dx.doi.org/10.22441/oe.2025.v17.i2.147

problem is to determine the value of overall equipment efficiency and six losses (six big losses) which is important in determining the efficiency of industrial machines. To increase OEE, steps are taken first by measuring OEE, calculating the value of the six big losses, and finding the biggest factors that influence increasing the OEE value. Then, using a fishbone diagram, the causes of the problem are identified and analyzed. The aim of increasing OEE is to prioritize repairs to machines that are frequently damaged and problematic (Wibisono, 2021). The results of calculating the value of the six main losses show that a decrease in speed losses of 42.38% is the most significant loss that causes a decrease in engine efficiency.

This loss factor is evaluated using Pareto and fishbone diagrams. Businesses can benefit from increased productivity based on the findings of this study. According to other research, the OEE value obtained is still lower than the Institute of Plant Maintenance Japan standard of 85%. Therefore, six main disadvantages must be evaluated to find out what causes the tool's overall low level of effectiveness (Susianti, 2020). Next, the largest loss values are ranked using a Pareto chart to find the main driving factors for increasing downtime. Three major disadvantages to it: speed, errors, and configuration and adaptation (Yusuf et al, 2021). Next, in another study, quality loss of 63.54% and speed reduction of 24.87% were the two main factors that caused low OEE values on the Wrapping Line 4 machine (Sibarani et al., 2020). The results of other research show that consistent and continuous implementation of the TPM pillar has increased the OEE value of machines used to serve cancer (LINAC SP) in hospitals. Breakdown loss of 76.29%, setup loss of 9.59%, idling and minor stop loss of 8.80%, and speed loss of 5.29% are factors that influence low OEE values on engines (Sukma et al., 2022).

The results of the analysis using a cause and effect diagram show that the five factors causing the low OEE value on the Wrapping Line 4 machine are humans, machines, materials, methods and the environment. Companies can improve the work environment and layout, provide regular training to operators, create SOPs for component and machine maintenance, provide replacement components, and increase awareness of machine maintenance (Sibarani et al., 2020). In research (Suryapradana & Halim, 2021) it was found that the FPM Department uses small group activities as continuous control to improve the system and reduce the amount of time lost. The performance of the stone crusher has shown an increase in productivity at the end of the period. With an average total equipment effectiveness (OEE) value of 87% and meeting the global standard value of 85%, calculating six major losses can increase OEE. In addition to increasing the OEE value, calculating the six major losses can help increase the OEE value by reducing current waste.

Most waste is caused by slowdowns and equipment that is not functioning properly. Both of these wastes are caused by operator fatigue, invisible machine damage, and poor road conditions in the mining area (Nurwulan & Fikri, 2020). Other research in automotive industry as a result, the ITS-0015 machine that was chosen to be the observed machine was able to lower the monthly machine failure number from 4.7 to 3.5 times/month machine breakdown time from 111 to 85 minutes. In the end, we were able to raise the availability value from 90.8% to 96.0%, which had the effect of raising the OEE value from 87% to 92% (Rozak et al., 2020). Research in various types of business often uses the DMAIC methodology as a principle of continuous improvement. To resolve problems found from the OEE measurement results, the DMAIC (Define, Measure, Analyze, Improve, and Control) framework will be used (Nurprihatin et al., 2017). Furthermore, in other research using the DMAIC approach can increase the availability value from 90.8% to 96.0% and the impact is to increase the OEE value from 87% to 92%. The results of other research on technology for processing waste into fuel using the DMAIC approach, the OEE value can increase by 30.16% after improvements of 45.85% to increase the production process rate (Mujayyin et al., 2020).

2. Methods

This study applies a quantitative–descriptive approach supported by the Total Productive Maintenance (TPM) framework to evaluate the effectiveness of the Raw Mill Machine at Plant 10. The research methodology follows the DMAIC (Define–Measure–Analyze–Improve–Control) stages to identify performance problems, quantify the Six Big Losses, and formulate corrective actions. Secondary production data such as operating time, downtime, output, and defect records were collected from the plant’s daily and monthly production reports.

Please cite this article as: Fathurohman, D., & Fathurohman, D. (2025). Analysis overall equipment effectiveness (OEE) raw mill machine using DMAIC method in cement industry. Operations Excellence: Journal of Applied Industrial Engineering, 17(2), 227-234. doi:http://dx.doi.org/10.22441/oe.2025.v17.i2.147

Define Stage. In this stage, the problem of frequent downtime and low machine effectiveness was identified. The scope of analysis was focused on the Raw Mill Machine at Plant 10. Critical-to-quality (CTQ) metrics were determined based on the Overall Equipment Effectiveness (OEE) framework.

Measure Stage. Machine effectiveness was measured using the OEE indicators: availability, performance, and quality. The values for each ratio were calculated based on actual operating hours, ideal cycle time, and good output. The Six Big Losses—including equipment failure, setup and adjustment, idling and minor stoppage, reduced speed loss, rework, and yield loss—were computed to determine the dominant sources of productivity losses.

Analyze Stage. A Pareto chart was used to rank and identify the most significant loss categories contributing to reduced equipment effectiveness. To determine the root causes of dominant losses, a fishbone (cause-and-effect) diagram was developed by categorizing potential contributors into human, machine, method, material, and environmental factors.

Improve Stage. Based on the analysis results, alternative improvement actions were proposed to reduce the dominant loss categories, especially speed loss and machine downtime. Recommendations focused on maintenance activities, operator practices, inspection procedures, and equipment settings.

Control Stage. The final stage involved establishing monitoring procedures to ensure that improvements can be sustained. Key performance indicators (KPIs) related to OEE and downtime were recommended for continuous supervision of machine performance.

3. Results and Discussion

In the **Define** stage, the initial problem of low equipment effectiveness in the Raw Mill Machine was identified by comparing actual OEE performance with the company's target. The analysis began by calculating the three main OEE components—Availability, Performance, and Quality—followed by the computation of the Overall Equipment Effectiveness using the standard formula:

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality} \times 100\%$$

Table 1. *OEE Value* Raw Mill Machine

Period	*Availability (%)*	*Performance (%)*	*Quality (%)*	OEE (%)
January	87.61	98.25	100	86.08
February	51.33	98.22	100	50.41
March	68.64	98.42	100	67.56
April	84.61	98.42	100	83.27
May	96.60	98.27	100	94.93
June	96.87	94.49	100	91.53
July	89.55	86.75	100	77.69
August	97.01	86.91	100	84.31
September	89.10	90.65	100	80.77
October	94.51	93.44	100	88.31

Measure

This calculation helps determine losses caused by tool failure, preparation and setup, product damage, and hidden losses, such as slowdowns, that impact the OEE value. The following is a formula that can be used to calculate the percentage of equipment loss:

$$\text{Equipment Failure Losses} = \frac{\text{Failure and Repair (Hour)}}{\text{Loading Time (Hour)}} \times 100\% \quad (1)$$

$$\text{Equipment Failure Losses} = \frac{31.34\ \text{Hour}}{582.09\,\frac{\text{Ton}}{\text{Hour}}} \times 100\% = 5.38\%$$

Please cite this article as: Fathurohman, D., & Fathurohman, D. (2025). Analysis overall equipment effectiveness (OEE) raw mill machine using DMAIC method in cement industry. Operations Excellence: Journal of Applied Industrial Engineering, 17(2), 227-234. doi:http://dx.doi.org/10.22441/oe.2025.v17.i2.147

The following is a formula that can be used to fine the percentage of Setup and Adjustment Losses:

$$\text{Setup \& Adjustment Losses} = \frac{\text{Total Setup \& Adjustment (Hour)}}{\text{Loading Time (Hour)}} \times 100\% \quad (2)$$

$$\text{Setup \& Adjustment Losses} = \frac{0.74 \text{ Hour}}{582.09 \text{ Hour}} \times 100\% = 0.13\%$$

The following is a formula that can be used to fine the percentage of Idling and Minor Stoppage Losses:

$$\text{Idling \& Minor Stoppage Losses} = \frac{(\text{Non Productive Time (Hour)})}{(\text{Loading Time (Hour)})} \times 100\% \quad (3)$$

$$\text{Idling \& Minor Stoppage Losses} = \frac{549.92 \text{ Jam} - \left(\frac{162084 \text{ Tons}}{300 \frac{\text{Tons}}{\text{Hour}}}\right)}{582.09 \text{ Hour}} \times 100\% = 1.66\%$$

The following is a formula that can be used to fine the percentage of Reduced Speed Losses:

$$\text{Reduced Speed Losses} = \frac{((\text{Operating time} - (\text{Ideal Cycle TIme} \times \text{Actual Product}))}{(\text{Loading Time (Hour)})} \times 100\% \quad (4)$$

$$\text{Reduced Speed Losses} = \frac{549.92 \text{ jam} - (0.00333 \frac{\text{Hour}}{\text{Tons}} \times 162084 \text{ Tons})}{582.09 \text{ Hour}} \times 100\% = 1.67\%$$

The following is a formula that can be used to fine the percentage of Reject and rework losses:

$$\text{Reject \& rework losses} = \frac{(\text{Total Reject}(\text{Ton} \times \text{Ideal Cycle Time } (\frac{\text{Hour}}{\text{Tons}}))}{\text{Loading Time (Hour)}} \times 100\% \quad (5)$$

$$\text{Reject \& rework losses} = \frac{\left(0 \text{ Ton} \times 0.0033 \frac{\text{Hour}}{\text{Tons}}\right)}{582.09} \times 100\% = 0\%$$

The following is a formula that can be used to fine the percentage of Yield / Scrap Losses:

$$\frac{\text{Yield}}{\text{Scrap}} \text{Losses} = \frac{\text{Reduced Yield (Ton)} \times \text{Ideal Cycle Time } (\frac{\text{Hour}}{\text{Tons}})}{\text{Loading Time (Hour)}} \times 100\% \quad (6)$$

$$\text{Yield / Scrap losses} = \frac{\left(0 \text{ Ton} \times 0.0033 \frac{\text{Hour}}{\text{Tons}}\right)}{582.09} \times 100\% = 0\%$$

Based on the calculation results, it can be seen that the largest time loss value is *Reduced Speed Losses* amounting to 345.37 hours and *Idling and Minor Stoppage* amounting to 344.8 hours. The following table shows the order of factor percentages *six big losses* machine *Raw Mill* from highest to lowest.

Table 1 Percentage of six big losses in the raw mill

Six Big Losses	Total Time Loss (hours)	Percentage (%)
Reduce Speed Loss	345.37	39.94%
Idle and Minor Stoppage	344.80	39.87%
Equipment Failure Loss	171.74	19.86%
Set-up and Adjustment	2.86	0.33%
Rework Loss	0.00	0.00%
Yield/Scrap Loss	0.00	0.00%

Please cite this article as: Fathurohman, D., & Fathurohman, D. (2025). Analysis overall equipment effectiveness (OEE) raw mill machine using DMAIC method in cement industry. Operations Excellence: Journal of Applied Industrial Engineering, 17(2), 227-234. doi:http://dx.doi.org/10.22441/oe.2025.v17.i2.147

ISSN-p: 2085-1431
ISSN-e: 2654-5799

From factor ordering *six big losses* above, a Pareto diagram can be made that shows the influence *six big losses* on machine effectiveness *raw mill.*

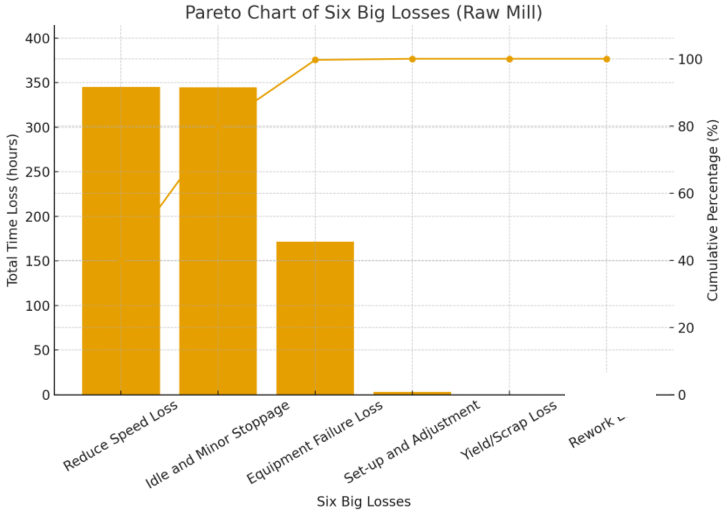

Fig. 1 *Pareto diagram six big losses.*

Based on the results of data processing, the analysis of the processing results is divided into three parts: measurement of OEE values, analysis of losses, and analysis of the causes of problems using cause and effect diagrams or Fishbone. From the results described previously, it is known that the average value of Overall Equipment Effectiveness (OEE) for raw mill machines is 80.78%, which is still below the ideal OEE standard, namely 85%. The availability value, as shown in the following table, is the most significant value.

Table 2 *Raw mill machine OEE value*

Description	Ratio (%)
Availability	85.58
Performance	94.38
Quality	100.00
Overall Equipment Effectiveness (OEE)	80.78

In the six big losses analysis, of the three components, there are two main components that influence production performance, namely Downtime Losses including Equipment Failure Losses and Set-Up & Adjustment Losses, then Speed Losses including Idling and Minor Stoppage Losses and Reduced Speed Losses.

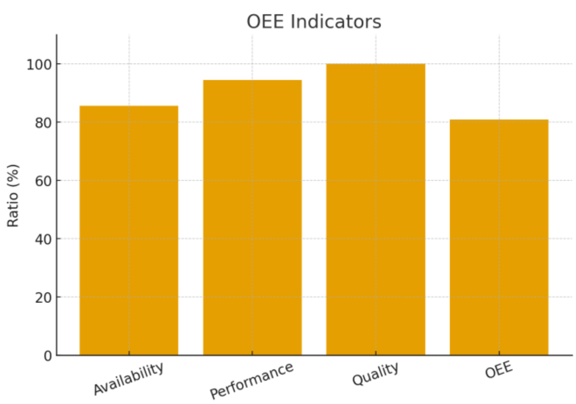

Fig. 2 *Value Overall Equipment Effectiveness.*

Please cite this article as: Fathurohman, D., & Fathurohman, D. (2025). Analysis overall equipment effectiveness (OEE) raw mill machine using DMAIC method in cement industry. Operations Excellence: Journal of Applied Industrial Engineering, 17(2), 227-234. doi:http://dx.doi.org/10.22441/oe.2025.v17.i2.147

In this analysis, it can be seen that the company experienced the largest loss in *speed losses*, with *reduced speed losses* an average of 5.48%, and idle *and* minor stoppages losses amounting to 5.47%, then followed by downtime losses with an average *equipment failure losses* 2.86% and *Set-Up and Adjustment Losses* 0,05%.

Table 3 Raw mill losses value

Losses	Average (%)
Equipment Failure Losses	2.81
Set-Up & Adjustment Losses	0.05
Idling And Minor Stoppage Losses	5.47
Reduced Speed Losses	5.48

Analyze

The analysis of the Six Big Losses indicates that **speed loss** is the dominant factor contributing to the low effectiveness of the Raw Mill Machine. To identify the underlying causes, a fishbone (cause-and-effect) diagram was developed, as shown in Fig. 3. The causes of speed loss were categorized into human, machine, material, method, and environmental factors.

Human factors contribute to speed loss primarily due to inadequate thoroughness during inspection, maintenance, and repair activities. High workload and operator fatigue reduce responsiveness in controlling machine performance. Insufficient attention during routine checks also increases the likelihood of undetected abnormalities.

Machine-related factors include frequent equipment malfunctions such as bag filter fan trips caused by high voltage, limestone reclaimer issues, conveyor belt problems, oil seal failures, and unstable production speeds. Continuous operation of the raw mill without adequate downtime further increases the risk of mechanical failures. Among these issues, *bag filter system problems* emerge as one of the main contributors to reduced operating speed.

Material factors involve inconsistent limestone supply, insufficient feed rate, and material characteristics that do not meet process standards. Low material availability forces the machine to operate at reduced speed. Additionally, oversized residue or improper material granulometry prolongs grinding time and decreases overall throughput.

Method-related factors include lengthy machine setup time, improper adjustment of production speeds, and suboptimal maintenance procedures. Inefficient setup activities significantly increase time losses and reduce effective operating hours.

Environmental factors affecting speed loss include power interruptions or undervoltage from the national electricity provider, kiln breakdowns that disrupt hot gas supply for drying, and full silo conditions that inhibit material flow. Kiln breakdowns, in particular, play a critical role because insufficient hot gas supply directly lowers raw meal drying efficiency and forces operators to decrease the mill speed.

Overall, the fishbone analysis confirms that speed loss is driven by a combination of operational, mechanical, and external factors, with the highest impact originating from machine issues and kiln-related disruptions.

Please cite this article as: Fathurohman, D., & Fathurohman, D. (2025). Analysis overall equipment effectiveness (OEE) raw mill machine using DMAIC method in cement industry. Operations Excellence: Journal of Applied Industrial Engineering, 17(2), 227-234. doi:http://dx.doi.org/10.22441/oe.2025.v17.i2.147

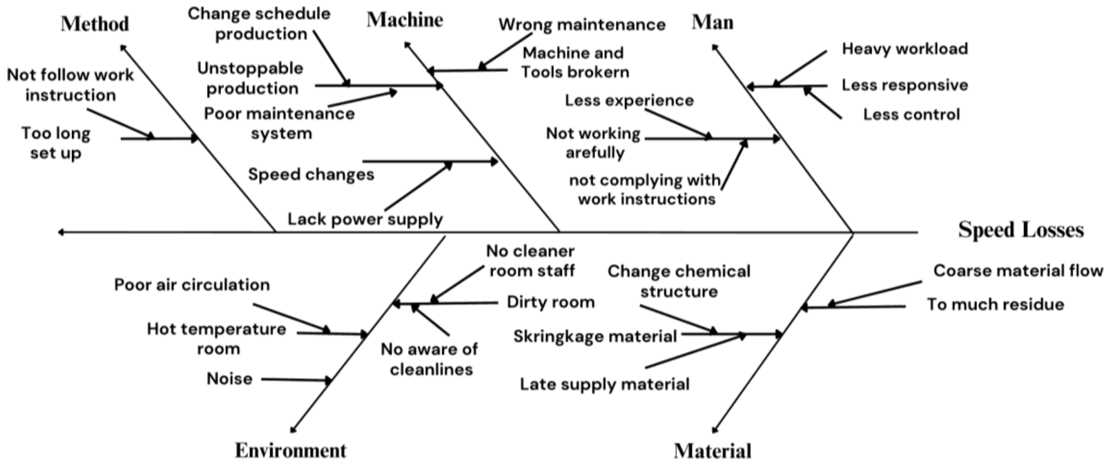

Fig. 3 Fishbone diagram speed losses.

Improve

The results of the analysis of corrective actions on barriers to increasing machine effectiveness can be used to make recommendations to increase machine effectiveness. The following troubleshooting is recommended to resolve issues that are hampering machine performance raw mill: Providing training to operators and employees to improve their capabilities for example, transfer knowledge with global companies. Regularly, operators and employees are evaluated for their skills. This allows them to be more thorough in carrying out maintenance and repairs to ensure that machines and equipment are functioning properly. In addition, efforts are made to carry out regular patrols and re-checks. Schedule regular machine inspections to ensure that the machine is in good condition. Calculate the age of the machine*(life cycle time)* to estimate the time of machine failure. Increase production speed so that the production process produces products in a relatively shorter time. Carry out appropriate machine scheduling by paying attention to operating times. In addition, implementing quality control by increasing coordination in departments concerned with quality or grade *High* on *limestone* by *Mining Department* and *Quality Control*. Carry out forecasting by comparing methods, then choose the best method to use based on the mean absolute percentage error so that inventory can be increased and minimized. *material shortage* by *Supply Department*. Reduce the strength of the separator so that particles that are not suitable or > 90 microns are not sucked in. This can prevent it from happening *rework*.

Control

After carrying out the improvement stages, carry out routine monitoring of the process *mixing* Water and glue raw materials are tested to reduce errors in mixing water and glue according to company standards. Third, to increase operator awareness and reduce the level of defects in paper products produced *sachet,* display installation *Standard Operational Procedure* machine *tubbing* in the engine area. And additions *exhaust fan* for better air circulation and adjustment of operators' personal protective equipment, especially in the hearing area, to ensure that they are comfortable and safe when working.

4. Conclusion

Based on the Overall Equipment Effectiveness (OEE) analysis, the Raw Mill Machine at Plant 10 achieved an OEE value of **80.78%**, which is still below the industry standard of **85%**. The primary factor contributing to the low OEE performance is the **availability ratio**, indicating that the machine's operating time is not fully utilized due to high downtime. In addition, the **performance ratio**, although close to the standard, shows minor inefficiencies that affect production output. Meanwhile, the **quality ratio** consistently reaches 100%, as the company implements a zero-defect policy in the cement production process.

Please cite this article as: Fathurohman, D., & Fathurohman, D. (2025). Analysis overall equipment effectiveness (OEE) raw mill machine using DMAIC method in cement industry. Operations Excellence: Journal of Applied Industrial Engineering, 17(2), 227-234. doi:http://dx.doi.org/10.22441/oe.2025.v17.i2.147

The Six Big Losses analysis confirms that speed loss is the dominant contributor to reduced machine effectiveness, accounting for 690.17 hours or 79.81% of total losses. Therefore, speed loss must be prioritized in improvement initiatives to enhance the productivity of the Raw Mill Machine.

The fishbone analysis identifies five categories of contributing factors to speed loss: machine, human, method, material, and environment. Among these, machine-related issues constitute the most significant contributors, including bag filter fan trips due to voltage instability, limestone reclaimer failures, conveyor belt damage, and defective oil seals. Addressing these mechanical issues is essential for improving machine stability, increasing operating speed, and ultimately raising the OEE performance of the raw mill.

References

Mujayyin, F., Gunarso, D. A., & Mukhsinin, N. D. (2020). Analisis Keandalan Teknologi Pengolah Sampah TPA Menjadi Bahan Bakar Refuse Derived Fuels (RDF) dengan Pendekatan Six Sigma DMAIC. *Jurnal Mekanik Terapan*, *1*(2), 133–141. https://doi.org/10.32722/jmt.v1i2.3360

Musyafa'ah, M., & Sofiana, A. (2022). Analysis of Total Productive Maintenance (TPM) Application Using Overall Equipment Effectiveness (OEE) and Six Big Losses on Disamatic Machine PT. XYZ. *Opsi*, *15*(1), 56. https://doi.org/10.31315/opsi.v15i1.6630

Nurprihatin, F., Jodiawan, P., Fernando, N., & Gurusinga, G. K.-K. (2017). Usulan Perbaikan Performa Mesin Toelasting Glue dengan Integrasi OEE dan Metode DMAIC (Studi Kasus: Perusahaan Manufaktur Sepatu). *Prosiding Seminar Nasional Teknologi Dan Informatika*, 725–732.

Nurwulan, N. R., & Fikri, D. K. (2020). Analisis Produktivitas dengan Metode OEE dan Six Big Losses: Studi Kasus di Tambang Batu Bara. *Jurnal IKRA-ITH Ekonomika*, *3*(3), 30–35.

Rozak, a, Shadrina, a, & Rimawan, E. (2019). Kaizenin world class automotive company with reduction of six big lossesin cylinder block machining line in Indonesia. *International Journal of Innovative …*, *4*(7), 339–344. https://ijisrt.com/assets/upload/files/IJISRT19JL251_(1).pdf

Rozak, A., Jaqin, C., & Hasbullah, H. (2020). Increasing overall equipment effectiveness in automotive company using DMAIC and FMEA method. *Journal Europeen Des Systemes Automatises*, *53*(1), 55–60. https://doi.org/10.18280/jesa.530107

Sibarani, A. A., Muhammad, K., & Yanti, A. (2020). Analisis Total Productive Maintenance Mesin Wrapping Line 4 Menggunkan Overall Equipment Effectiveness dan Six Big Losses di PT XY, Cirebon - Jawa Barat. *Jurnal Rekayasa Sistem & Industri (JRSI)*, *7*, 82. https://doi.org/10.25124/jrsi.v7i2.425

Sukma, D. I., Prabowo, H. A., Setiawan, I., Kurnia, H., & Fahturizal, I. M. (2022). Implementation of Total Productive Maintenance to Improve Overall Equipment Effectiveness of Linear Accelerator Synergy Platform Cancer Therapy. *International Journal of Engineering, Transactions A: Basics*, *35*(7), 1246–1256. https://doi.org/10.5829/ije.2022.35.07a.04

Suryapradana, I., & Halim, A. (2021). Analisis Pengendalian Kualitas Menggunakan Metode Six Sigma Dalam Meningkatkan Kinerja Operasional Divisi Fixed Plant Maintenance Di Industri Pertambangan Pt Berau Coal. *Sebatik*, *25*(2), 335–344. https://doi.org/10.46984/sebatik.v25i2.1542

Susianti, S. N. (2020). Analisis Perawatan Mesin Casting Zinc Menggunakan Metode Overall Equipment Effectivness (OEE) Melalui Pendekatan DMAIC. *JENIUS : Jurnal Terapan Teknik Industri*, *1*(1), 30–37. https://doi.org/10.37373/jenius.v1i1.22

Wibisono, D. (2021). Analisis Overall Equipment Effectiveness (OEE) Dalam Meminimalisasi Six Big Losses Pada Mesin Bubut (Studi Kasus di Pabrik Parts PT XYZ). *Jurnal Optimasi Teknik Industri (JOTI)*, *3*(1), 7–13. https://doi.org/10.30998/joti.v3i1.6130