Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th February 2026. Vol. 5. No. 2; e-ISSN: 2808-4519

Implementation of ISMO – Based Maintenance System for Shaker Machines at PT X

Kevin Sholakhudin Nur[1]*, Intania W. Kirana[2]

[1,2] Program Studi Teknik Industri, Universitas Pembangunan Nasional "Veteran" Jawa Timur
22032010196@student.upnjatim.ac.id[1], intania.widyantari.ft@upnjatim.ac.id[2]*

Abstrak

This study examines the implementation of the ISMO maintenance system (Inspection, Small Repair, Medium Repair, and Overhaul) for tobacco screening machines at PT X, located in East Java. The research compares the existing preventive maintenance approach with the ISMO method to evaluate differences in downtime and availability values. The screening machine, developed internally by PT X's engineering team, operates with vertical and horizontal movements to separate non-tobacco materials during processing. Using repair complexity analysis, the study determined the screening machine has a complexity value of 9 as a machine tool. Results indicate that the current company maintenance system achieves 99.86% availability with a total downtime of 580 minutes, whereas the ISMO method results in 97.89% availability with 8,856 minutes of downtime. The ISMO approach requires 3 workers for inspection, 8 for small repairs, 10 for medium repairs, and 11 for overhaul activities. While both methods show excellent availability above 95%, implementing ISMO significantly increases downtime, potentially causing production delays. This study provides a detailed classification of maintenance activities for each ISMO level, offering practical guidance for systematic machine maintenance implementation.

Kata kunci *: Availability; Downtime; ISMO Method; Preventive Maintenance; Repair Complexity; Shaker Machine.*

1. Introduction

Machinery and equipment constitute essential facilities required in tobacco processing operations. Through machine utilization, companies can significantly increase production capacity. Furthermore, the use of this technology serves to ensure consistent quality of processed tobacco. However, machines used continuously will experience performance degradation over time. This performance degradation can be categorized as a form of machine damage [1]. The practical implementation of these processing machines can be observed in operational activities at PT X.

PT X is a tobacco processing company located in East Java. The tobacco processing process includes separation of tobacco stems from leaves, separation of tobacco from non-tobacco related materials (NTRM), tobacco blending, and re-drying. The separation of tobacco from non-tobacco related materials (NTRM) at PT X utilizes a shaker machine. The tobacco shaker machine is a simple machine created by PT X. The working principle of the tobacco shaker machine involves horizontal and vertical vibration. Considering the crucial role of the shaker machine in the production line, a measured maintenance system is required to maintain its performance stability.

ISMO (Inspection, Small Repair, Medium Repair, and Overhaul) is a structured machine maintenance system that enables technicians to systematically identify and classify machine damage based on severity levels, from minor to severe requiring comprehensive repair. By combining the ISMO system and preventive maintenance methods, tobacco processing machine maintenance is conducted periodically to prevent unexpected damage, minimize production downtime, and achieve optimal operational efficiency.

2. Theoretical Framework

2.1. Maintenance

P Machine maintenance is a series of systematic and planned activities aimed at maintaining, repairing, and caring for production equipment to ensure optimal, efficient, and reliable performance throughout its operational lifespan. Maintenance is not merely a repair activity when damage occurs, but rather a comprehensive strategy encompassing routine inspections, periodic maintenance, replacement of worn components, and planned repairs to ensure machines operate according to established technical specifications [2].

2.2. Method ISMO (Inspection, Small Repair, Medium Repair, and Overhaul)

The ISMO method is a planned maintenance method whose activities consist of inspection, small repair, medium repair, and major repair. The ISMO method is capable of classifying machines experiencing performance degradation. Furthermore, as part of preventive maintenance methods, the ISMO method can be used to create scheduling process planning by considering repair cycles and corrective actions. This method is also very easy to use for repair activities. One ISMO maintenance cycle consists of a series of activities between two consecutive repairs. In other words, one ISMO maintenance cycle begins with repair activities and ends with repair [3] .

2.3. Preventive Maintenance

Preventive maintenance is scheduled maintenance performed to keep equipment functioning before it breaks down. The objective of preventive maintenance is to reduce the frequency of damage to maintained items. This strategy contributes to minimizing machine damage costs and improving production quality. Thus, production facilities receiving preventive maintenance will ensure smooth operation and ready-to-use conditions for the production process [4]. In the manufacturing industry context, preventive maintenance has proven effective in increasing machine availability and reducing production downtime. Research shows that companies consistently implementing preventive maintenance systems can achieve machine availability rates above 95%, which is the industry standard for efficient operations [5].

2.4. Repair Complexity

Repair complexity is a relative index providing comparative description of a machine's complexity by considering how complicated its repair is. Although there is no absolute measurement of repair complexity for equipment, for objective planning, a relative indicator is determined that provides comparative description of equipment repair complexity. The repair complexity concept is used to determine the size of mechanical maintenance units and determine the number of workers [6].

2.5. Machine Value Availabality

Machine availability is a metric used to measure how often a machine can be operated effectively within a certain time period. The higher the availability, the more optimal the production process that can be performed. Increased machine availability reduces unplanned downtime and contributes directly to increased production output. High availability also ensures production stability, avoiding output decline and product quality degradation due to machine damage [7].

2.6. Availability Consept

With the introduction of repairability that will return the system to operational state, an alternative measure of system performance is availability. Availability depends on reliability and maintainability. To predict system availability, both failure and repair probability distributions must be considered [8]. Availability value can be influenced by several factors Stoppage due to damaged machine components, Time loss due to machine setup process, and Time loss due to shift changes.

The availability calculation formula is as follows:

$$Availabality = \frac{Data\ Productivity - Downtime}{Data\ Productivity} \times 100\% \quad (1)$$

Table 1 : Repair Complexity Table

Number	Machine Categories	Repair Complexity
1	Pabrik penggilingan	15
2	Turbin Uap dan Hidro	14
3	Ketel	12
4	Turbin Uap Kapal	11.5
5	Penerbangan , Mesin Diesel Berat, dan Peralatan Mesin Berat	11
6	berat , kapal, pesawat	10
7	Traktor	9.5
8	Gerbong Kereta Api	9
9	Mesin Perkakas	9
10	Bantalan bola atau bantalan rol	8.5
11	Mesin listrik berat, kereta listrik, instrumen presisi	8.5
12	cadang traktor siklus , mesin industri proses kimia	8
13	Kompresor, mesin hidrolik, peralatan mesin ringan	8
14	Peralatan dan pahat	7.5
15	Peralatan Gas	7
16	Peralatan tengah rendah	7
17	Penimbangan instrumen	7
18	Instrumen Listrik	7
19	Mandi Mesin Penggerak Tanah	6
20	Jam Tangan dan Instrumen Cahaya	5.5

3. Research Method

This research employs a quantitative approach with a case study method to compare the ongoing maintenance system at PT X with the proposed ISMO method implementation. The research was conducted at PT X, a tobacco processing company located in East Java, with data collection during the tobacco processing season period from October 2024 to October 2025. The research object is the tobacco shaker machine that functions to separate non-tobacco materials through vertical and horizontal movements, which is the result of internal development by PT X's engineering team. Primary data was obtained through direct observation of maintenance processes, in-depth interviews with the engineering team and maintenance engineers regarding maintenance procedures and repair times, and field documentation of maintenance activities. Secondary data was obtained from company historical records in the form of maintenance logs and downtime records from PT X's Processing Division, technical documents of machine specifications and maintenance SOPs, and scientific literature related to ISMO methods and maintenance management.

PT X is a tobacco processing company focused on services. In its production process, the company uses a shaker machine that plays a role in separating materials unrelated to tobacco. The working principle of the shaker machine is to perform vertical and horizontal movements resembling filtering activities, with up-down patterns accompanied by left-right swings. This machine technology is the result of internal development conducted by PT X's engineering team. Machine maintenance is a series of systematic activities aimed at maintaining, repairing, and caring for production equipment to ensure optimal, efficient, and reliable performance. Its main targets include damage anticipation, reduction of operational downtime, and extension of production asset service life in the industrial environment. Based on this, this research aims to compare preventive action efforts that have been carried out at the company with the use of prevention using the ISMO method. There are differences in time and availability values.

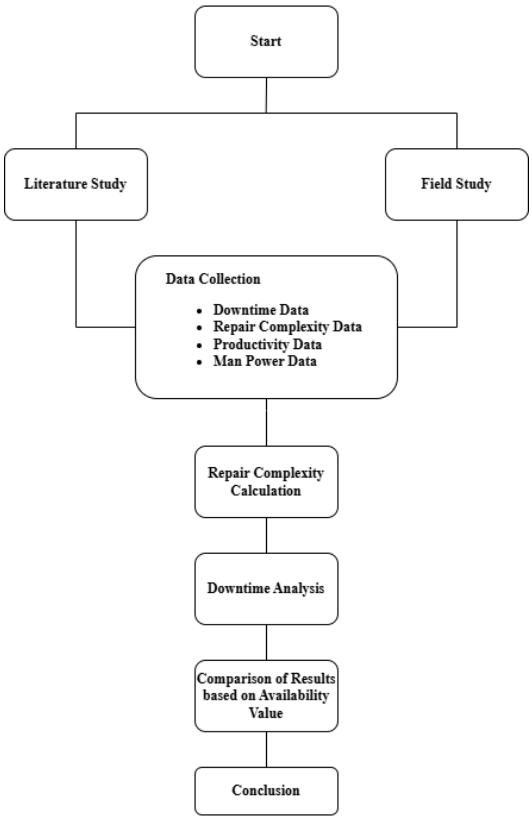

Fig. 1: Flowchart

3.1. Flowchart

The research flow above illustrates the step-by-step process conducted in this study, starting from problem and objective formulation, through data preparation and visualization, to analysis and recommendations. This systematic approach ensures a structured methodology to achieve research objectives effectively.

3.2. Data Collection

Data was collected during the tobacco processing season from October 2024 to October 2025. There are two types of data: primary data and secondary data. Primary data was obtained through direct observation and interviews with the processing and engineering teams. Secondary data was obtained from the company's historical records, including downtime and productivity records.

4. Result and Discussion

4.1. Analitical Repair Complexity

The shaker machine operates continuously during the tobacco processing season. Horizontal and vertical movements can cause wear on machine components, and the tobacco load managed is highly fluctuating and diverse in type. The transmission system uses v-belts connecting the dynamo to the cam shaft. Bearings located on the cam shaft withstand radial and axial loads from vibration movements. The shaker machine works throughout working hours. At PT X there are 3 shifts where each shift counts 7 effective working hours, so the shaker machine works 21 hours if there is no damage. Therefore, repair complexity on the shaker machine is classified as machine tools because the shaker machine only functions as a separator for materials unrelated to tobacco, such as stones, hair, fabric, etc. The shaker machine analysis scoring table is as follows:

Table 2 : Machine Complexity Analysis

Technical Parameter	Weight	Score (1-10)	Description
Jumlah Komponen Penggerak	20%	8	Komponen utama: motor, bearing, belt, cam shaft, frame
Tingkat Presisi	10%	7	Presisi sedang untuk alignment dan clearance
Kompleksitas sistem penggerak	20%	8	Sistem v belt dinamo yang terhubung ke camshaft
Akses Maintenance	15%	8	Akses perbaikan mudah
Skill Teknidi yang diperlukan	15%	6	Skill level menengah
Ketersediaan sparepart	20%	10	Komponen mudah ditemui
Weighted score	100%	8	

In the shaker machine analysis scoring calculation table, a score of 8 was obtained. Assessment is based on the number of drive components, tobacco separation precision level, drive complexity, maintenance access, technician required skills, and spare parts availability. Then it can be seen in the table below that approaches the tobacco shaker machine criteria, namely machine tools.

Table 3: Repair Complexity Table

Number	Machine Categories	Repair Complexity
1	Pabrik penggilingan	15
2	Turbin Uap dan Hidro	14
3	Ketel	12
4	Turbin Uap Kapal	11.5
5	Penerbangan , Mesin Diesel Berat, dan Peralatan Mesin Berat	11
6	berat , kapal, pesawat	10
7	Traktor	9.5
8	Gerbong Kereta Api	9
9	Mesin Perkakas	9
10	Bantalan bola atau bantalan rol	8.5
11	Mesin listrik berat, kereta listrik, instrumen presisi	8.5
12	cadang traktor siklus , mesin industri proses kimia	8
13	Kompresor, mesin hidrolik, peralatan mesin ringan	8
14	Peralatan dan pahat	7.5
15	Peralatan Gas	7
16	Peralatan tengah rendah	7
17	Penimbangan instrumen	7
18	Instrumen Listrik	7
19	Mandi Mesin Penggerak Tanah	6
20	Jam Tangan dan Instrumen Cahaya	5.5

Table 4 : Repair Complexity Value

TIDAK.	Peralatan	Nilai Kompleksitas Perbaikan
9	Mesin Perkakas	9

Table 5 : Machine Repair Cycle

Repair Complexity	Repair Cycle					Materials	Periode Distance	Overhaul Repair Period
	Cycle Number	Total					Monthly (t)	Year(T)
		I	S	M	O			
0 Until 30	$O - I_1 - M_1 - I_2 - M_2 - I_3 - S_1 - I_4 - S_2 - 1_5 - S_3 - I_6 - S_4 - O$	6	4	2	2	Steel and Iron	7	1

The table above
contains maintenance cycles with cycle details O - I_1 - M_1 - I_2 - M_2 - I_3 - S_1 - I_4 - S_2 - I_5 - S_3 - I_6 - S_4 - O occurring during the 2025 Growing Season.

4.2. Calculating Downtime

Comparison of downtime based on field observations or observations based on the ISMO method.

Table 6 : Observation Downtime Calculation

Machine Name	Complexity Value	Maintenance Activity	ISMO Multiplier Value (Days)	Machinee Downtime (Days)	Machine Downtime (Hours)	Machine Downtime (Minutes)
Tobacco Shaker	9	Inspection	0,15	0,17	1,3	80
		Small Repair	0,25	0,42	3,3	200
		Medium Repair	0,65	0,54	4,3	260
		Overhaul	1,00	0,08	0,7	40
			Total			580

The table above contains ISMO multiplication indicators obtained according to repair complexity. The completion time obtained for the shaker machine during inspection is 80 minutes, small repair 200 minutes, medium repair 260 minutes, and major repair 40 minutes. Data was obtained during observation and data obtained from the Processing division at PT Indonesia Tri Sembilan. This data is an accumulation during the season period from October 2024 - October 2025.

Table 7 : Downtime Calculation Using ISMO Method

Machine Name	Complexity Value	Maintenance Activity	ISMO Multiplier Value (Days)	Machinee Downtime (Days)	Machine Downtime (Hours)	Machine Downtime (Minutes)
Tobacco Shaker	9	Inspection	0,15	1,35	10,8	648
		Small Repair	0,25	2,25	18,0	1080
		Medium Repair	0,65	5,85	46,8	2808
		Overhaul	1,00	9,00	72,0	4320
			Total			8856

The adjacent table contains data using the ISMO method according to standard rules in Corder's book, 1996; Garg, 1976. The machine downtime obtained is 10.8 hours for inspection, 18 hours for small repair, 46.8 hours for medium repair, and 72 hours for major repair. For example, manual calculation of machine downtime is as follows:

Inspeksi

$$D = Complecity\ Value\ \times n\ \times Working\ Hour \quad (2)$$
$$D = 9 \times 0{,}15\ \times 8$$
$$D = 10{,}8$$

The significant difference in downtime, where observational data yields 580 minutes of downtime while the ISMO method yields 8,856 minutes of downtime, indicates that the ISMO method application is less suitable for PT X's operational characteristics. This is because PT X has spare parts available when machine damage occurs. From observations conducted with PT X's engineering supervisor, they prepare several spare parts that frequently experience damage such as camshafts, while for bearings and v-belts they still use identical machine spare parts.

Conversely, the ISMO method calculation assumes the company does not have spare parts preparation and follows a structured maintenance schedule based on standard time multipliers (0.15-1.00 days) multiplied by the machine complexity value. This assumption includes damage identification time, spare parts procurement, administrative processes, and repair implementation according to standard procedures, so the total ISMO downtime becomes 15 times greater. With machines operating 21 hours per day during the processing season, the downtime difference of 8,276 minutes (137.9 hours) can cause significant production losses. Nevertheless, the ISMO method offers a more systematic approach to prevent unexpected breakdowns. There needs to be in-depth evaluation regarding unexpected damage risks and long-term impacts on machine lifespan. The ISMO method, although producing higher downtime, is designed to provide prediction and prevent major damage even though PT X conducts major overhauls during the off-season. PT X's maintenance adopts preventive maintenance methods with reactive maintenance methods, but if using the ISMO method there tends to be scheduling in maintenance.

4.3. Number of Workers

Determining the number of maintenance workers is a critical aspect in implementing an effective maintenance system. The appropriate number of workers will affect maintenance execution efficiency, downtime duration, and company operational costs. This analysis compares PT X's actual workforce needs with calculations based on the ISMO method using standard formulas considering machine complexity value (CV), activity multiplier (n), downtime duration (D), and working hours (WH). This comparison aims to evaluate the feasibility and efficiency of human resource allocation in both maintenance approaches.

Table 8 : Actual Number of Workers

Nama Mesin	Nilai Kerumitan	Kegiatan Perawatan	Jumlah Tenaga Kerja
Mesin Shaker	9	Inspection	1
		Small Repair	2
		Medium repair	4
		Overhaul	6

Table 8 shows the actual maintenance workforce composition used by PT X in implementing shaker machine maintenance. This data was obtained through direct observation and interviews with PT X engineers. The maintenance team structure shows the number of workers proportional to work complexity level, from 1 technician for routine inspection to 6 technicians for overhaul. This pattern reflects the company's pragmatic approach that allocates resources based on actual needs and operational experience.

The advantage of this system is flexibility in workforce mobilization, where small teams (1-2 people) can handle routine maintenance without disrupting other operations, while major activities such as overhaul can involve larger teams (6 people) to accelerate completion. However, it should be noted that the maximum number of 6 workers for overhaul indicates that PT X has limited maintenance team capacity, so large-scale workforce mobilization for extended periods can disrupt maintenance activities on other machines in the production line.

Table 9 : Number of Workers Based on ISMO Downtime

Nama Mesin	Nilai Kerumitan	Kegiatan Perawatan	Nilai Pengali ISMO	Jumlah Tenaga Kerja
Shaker Tembakau	9	Inspection	1	1
		Small Repair	3	2
		Medium Repair	17	3
		Overhaul	30	4

Calculation results show lower workforce requirements compared to PT X's actual practice, namely a maximum of 4 workers for overhaul compared to 6 workers in the actual system. This difference is caused by fundamental differences in the approach of both methods. The ISMO method assumes longer downtime duration (based on repair complexity standards), so work can be completed with smaller teams over longer periods.

In the context of PT X operating seasonally (October-October) with tight production targets, the company's actual approach using larger teams (6 workers) to minimize downtime (580 minutes) proves more rational than the ISMO approach which is more workforce-efficient but produces excessive downtime (8,856 minutes). The downtime difference of 8,276 minutes or 137.9 hours can cause production losses whose value far exceeds the cost of adding 2 technicians to the overhaul team. With a difference of 2 workers in the ISMO method, this allows the other 2 workers to be transferred to machines with higher complexity values such as thresher machines, dryer machines, or blending and stem machines that have higher complexity. The manual calculation from the table above is as follows:

Inspeksi

$$Workers = (Cv \times n)/(D \times WH) \quad (3)$$

$$Workers = (9 \times 1)/(1{,}35 \times 8)$$

$$Workers = 3$$

4.4. Availabality Value Comparison

Availability is the percentage of the possibility that a machine can run according to standards within a certain time interval. Availability is also defined as the percentage of a system's operating time within a certain time interval [9]. The availability calculation in the table below is an indicator performed to determine the comparison of machine availability between current maintenance methods.

Table 10 : Availabality Value

Company Availability	Ismo Availabality
99,86%	97,89%

Manual availabality value calculation

Campony availabality

$$Availabality = \frac{Data\ Productivity - Downtime}{Data\ Productivity} \times 100\% \quad (4)$$

$$Availabality = \frac{419.329 - 580}{419.329} \times 100\% = 99{,}86\%$$

Ismo availabality

$$Availabality = \frac{Data\ Productivity - Downtime}{Data\ Productivity} \times 100\%$$

$$Availabality = \frac{419.329 - 8.856}{419.329} \times 100\% = 97{,}89\%$$

Based on the World Class OEE standard developed by Nakajima through the Japan Institute of Plant Maintenance, the ideal availability value is > 85% [10]. Data obtained from the company shows that shaker machine maintenance achieves an availability value of 99.86%. Meanwhile, data processing using the ISMO classification method obtains an availability value of 97.89%. Although the availability value using the ISMO method shows a decrease, interpretatively this value is still categorized as standard because it is above the 85% threshold. This decrease occurs because the ISMO method implements a more complex and administrative maintenance schedule according to Corder (1996) standards, which theoretically increases total downtime to 8,856 minutes. Both methods meet global machine availability effectiveness standards. However, the company's current actual system proves superior in keeping the machine operational (minimal downtime) compared to if the ISMO method were implemented purely without modifications to the administrative process and spare parts logistics. Although the ISMO method provides advantages in terms of structured and systematic long-term scheduling, for the case of the shaker machine at PT X, this method is too conservative, causing decreased machine availability efficiency compared to the company's actual system.

4.5. Activity Classification

Machine maintenance activities are performed by the advanced engineering team starting with damage inspection, then proceeding to small repair, medium repair, or overhaul indications. This classification is performed by PT Indonesia Tri Sembilan company to implement maintenance activities.

Table 11: ISMO Maintenance Activity Classification

Maintenance Level	Activity Description
Inspection	1. Conduct visual inspection of machine parts including cam, camshaft bearing, V-belt, and dynamo motor 2. Conduct inspection of iron components on cam assembly 3. Conduct vibration inspection on shaker machine 4. Conduct cleaning if tobacco quality changes occur
Small Repair	5. Perform maintenance activities conducted during inspection activities 6. Replace tobacco filters according to size and type of separated tobacco 7. Check V-belt rubber and replace if necessary 8. Lubricate machine bearings or add grease
Medium Repair	9. Perform maintenance activities conducted in small repair activities 10. Conduct disassembly and comprehensive inspection of shaker machine transmission system (camshaft, bearings, and coupling) 11. Replace worn or damaged camshaft bearings along with their housings 12. Perform alignment (setup) between drive motor and cam axis to reduce excessive vibration 13. Replace camshaft components experiencing wear or cracking after NDT (Non-Destructive Testing) inspection 14. Inspect and repair shaker machine frame experiencing cracks or deformation due to vibration
Overhaul	15. Perform maintenance activities conducted in medium repair activities 16. Conduct comprehensive inspection and dimensional measurement on all critical components (camshaft, axles, bearing housings, frame) to determine usage feasibility 17. Replace all bearings, seals, and worn components with new ones according to factory specifications 18. Repair or replace cam shafts experiencing wear, including machining processes if necessary 19. Repair and strengthen machine frames experiencing fatigue or cracking through welding and structural reinforcement 20. Conduct comprehensive repair of drive motor (dynamo), including rewinding if necessary 21. Conduct repeated sandblasting and painting processes on entire machine body and frame 22. Conduct testing and refinement to ensure machine performance returns to optimal according to initial specifications

5. Conclusion

Based on the comparative analysis results of the maintenance system on tobacco shaker machines at PT X, it can be concluded that this machine has a repair complexity value of 9 classified in the machine tools category. Performance comparison shows that the company's current actual system is superior with achievement of availability value of 99.86% and total downtime of only 580 minutes, while the proposed ISMO method produces an availability value of 97.89% with downtime surge reaching 8,856 minutes. This research provides scientific contribution in the form of empirical validation that standard methods such as ISMO do not always guarantee higher availability effectiveness in the short term when compared with practical company systems that have optimized local spare parts availability. However, this study successfully formulated structured maintenance activity classification that can serve as practical guidance for companies in distributing maintenance tasks more systematically.

Nevertheless, this research has limitations in assessment aspects that only focus on technical parameters without involving maintenance cost estimation analysis due to limited company data access. Therefore, future research directions need to integrate cost variables to evaluate the economic value of each method and modify ISMO standard multiplier values to be more relevant to field operational conditions. Considering that the ISMO method heavily relies on disciplined scheduling to maintain long-term machine performance, future research is recommended to develop more comprehensive preventive maintenance schedules. This scheduling is important to ensure that although there is an increase in downtime initially, machine reliability is maintained and asset economic life can be optimally extended compared to the actual system that tends to be reactive.

Acknowledgments

The authors wish to express sincere gratitude to PT X for granting access to conduct this research and for valuable data support from the Processing Division, with special appreciation to the engineering team for their cooperation and technical insights regarding the tobacco shaker machine maintenance system. We are deeply grateful to Universitas Pembangunan Nasional "Veteran" East Java, particularly the Industrial Engineering Department, for facilitating this research through internship programs and On-the-Job Training (OJT), and to our supervisors and lecturers for guidance, constructive feedback, and continuous support during the research process. Finally, we thank all parties who directly and indirectly contributed to the completion of this study, which was conducted as part of academic requirements and received no external funding or grant support.

References

[1] M. I. Pasaribu *et al.*, “ANALISIS PERAWATAN (MAINTENANCE) MESIN SCREW PRESS DI PABRIK KELAPA SAWIT DENGAN METODE FAILURE MODE AND,” vol. 9, no. 2, hal. 104–110, 2021.

[2] A. Nugraha, R. Setiawan, dan D. Pratama, "Perancangan Sistem Manajemen Pemeliharaan Mesin Berbasis Computerized Maintenance Management System (CMMS) di Industri Manufaktur," *Jurnal Teknik Industri*, vol. 25, no. 2, hal. 167-176, 2020.

[3] K. W. Wirakusuma, A. Pranata, P. Purba, dan K. Muhammad, “Pendekatan Metode ISMO Dalam Menyusun Penjadwalan Perawatan Gearbox dan Rantai Pe ngangkut Ore Departemen Circular Sintering PT . IRNC,” vol. 4, no. 1, hal. 10–18, 2023.

[4] K. Pranata dan J. Saifudin, “Penerapan Sistem Perawatan Mesin Niagra Filter Menggunakan Metode Preventive Maintenance Dengan Klasifikasi ISMO di PT XYZ,” vol. 19, no. 2, hal. 218–229, 2024.

[5] I. P. Saputra, N. K. Sari, dan M. Rizaldi, "Analisis Penerapan Preventive Maintenance dalam Meningkatkan Availability Mesin di Industri Tekstil," *Jurnal Optimasi Sistem Industri*, vol. 19, no. 2, hal. 112-120, 2021.

[6] S. Winarto, “Artikel Perencanaan Perawatan Pompa Distribusi I pada Unit Water Treatment Plant Berdasarkan Metode Ismo,” 2023.

[7] A. S. Purba, N. F. Pujo, N. Pamungkas, dan N. Yuniarsih, “Studi Pengaruh Nilai Availability Mesin Stamping Terhadap Jumlah Hasil Produksi,” vol. 16, no. 2, hal. 98–103, 2024.

[8] R. Anugerah dan M. Puteri, “ANALISIS PENGARUH NILAI AVAILABILITY DAN WAKTU DOWNTIME TERHADAP PRODUKTIVITAS MESIN PADA AUTOMATIC AMPOULE FILLING DAN SEALING MACHINE DI PT . INDOFARMA , TBK,” no. November, hal. 1–4, 2014.

[9] I. Murni, T. Ahmad, L. Asril, dan R. Novivanto, “ANALISIS PERFORMANCE BAND SERVICE MESIN ATB-I3 DENGAN PERHITUNGAN AVAILABILITY,” *J. Sains Ilmu Teknol. Ind.*, vol. 4, no. 2, hal. 1–9, 2024.

[10] G. Agusti, “Analisis Efisiensi Produktivitas Menggunakan Metode Overall Equipment Effectiveness Pada Industri Manufaktur Automotive Components di PT Kawasan Industri Modern Cikande Serang,” vol. 1, no. 2, hal. 2318–2343, 2025.