

Improvement Of Equipment Maintenance Activities At PT. Multi Star Indonesia, Tbk Based On Maintenance Management System

Ronald Nugroho Surbakti¹, Rosalendro Eddy Nugroho²

^{1,2}Universitas Mercu Buana, Indonesia

Email : ronaldnugrohosurbaktiis@gmail.com, rosalendro.eddy@mercubuana.ac.id

Abstract

This study aims to identify more deeply the waste that results in low productivity and quality in terms of Work Order Compliance data and Operational Breakdown Rate data from 2017 to 2021, to evaluate the implementation of lean maintenance (VSM - Value Stream Mapping) to overcome waste that results in low productivity and quality in maintenance activities through Current State Mapping and Future State Mapping with the Value Stream Mapping method approach, and to evaluate the efficiency and effectiveness of the implementation of the Improvement Maintenance Management System through the Combine & Simplify Maintenance Activities strategy through digitization. The method used in this research is Quantitative Descriptive Method. The results showed that the implementation of FSM and improvement measures in this study have proven effective in reducing waste and increasing the efficiency and productivity of maintenance activities, which is reflected in time savings and a decrease in the duration of maintenance implementation.

Keywords: Improvement, Equipment Maintenance, Maintenance Management System

INTRODUCTION

Global competition through the rapid development of digital technology requires the company PT Multi Bintang Indonesia, Tbk (hereinafter abbreviated as PT MBI) to be able to operate more efficiently without reducing the reliability of existing equipment by utilizing digitalization of operational activities, especially in production equipment

864

IJEBIR, Volume 03 Issue 04, 2024



Copyright at authors some right reserved this work is licensed under a [Creative Commons Attribution-ShareAlike 4.0 International License](https://creativecommons.org/licenses/by-sa/4.0/).

maintenance activities. Production equipment maintenance activities are carried out by a team of operators for basic (general) and engineering teams for special ones (requiring special skills and / or special tools). According to the strategy, maintenance carried out by both the production team and the engineering team is carried out according to three strategies including: Time Based Maintenance (TBM), Condition Based Maintenance (CBM), and Corrective Maintenance (CM).

The implementation of this efficiency is shown by the plan to increase the number of work orders entering 2022 which will be released and regulated in the Maintenance Management System, and must be implemented and closed in each period. The increase in the number of work orders is a problem or gap problem for the coordinator due to the achievement so far which is below the target. Each supervisor who day to day controls and monitors an average of three equipment maintenance activities at the same time results in implementers often waiting to get confirmation from the supervisor so that the implementer can continue the equipment maintenance activity being carried out. This results in waste, including waiting time for the executor, and excess motion for the supervisor. The success indicator for the achievement of a number of work orders that have been released and regulated in the Maintenance Management System is measured through the PM Conformance rate, which is the percentage of the number of work orders released as a plan compared to the number of work orders that have been completed. So that to be able to achieve the targets mentioned earlier, it is necessary to identify more deeply the existing waste based on the Improvement Maintenance Management System. So that to be able to continue to achieve and be accompanied by good quality, it is necessary to improve equipment maintenance activities based on the existing Maintenance Management System by applying Digital Check Sheet Activity so that the implementation of maintenance and supervision activities can be carried out more quickly (efficiently).

In addition to the speed in the implementation of equipment maintenance activities through a number of work orders released to increase productivity, the quality of work effectiveness through work integrity needs to be improved and can be accounted for according to established procedures. This quality issue is a gap problem related to the current productivity and the planned productivity improvement plan entering 2022.

This research is also in line with the Sustainable Development Goals that emphasize the importance of industrial innovation, infrastructure, and community empowerment to support inclusive and sustainable economic growth. Through the implementation of digital technology in equipment maintenance activities, PT MBI not only

865



improves operational efficiency, but also supports the development of a more modern and sustainable industrial infrastructure. By maximizing the use of existing resources and reducing waste through improved maintenance management systems, the company can contribute to the achievement of SDGs targets to build resilient infrastructure, promote inclusive industrialization, and foster innovation.

METHOD

The method used in this research is Quantitative Descriptive Method. The descriptive analysis method in this study is used to analyze the process flow of activities, accuracy, and documentation of basic maintenance activities of equipment at PT Multi Bintang Indonesia through the identification of existing Non Value Added (NVA) activities using the Lean Maintenance approach through the Value Stream Mapping (VSM) method. In addition, quantitative methods are used to measure the quality of maintenance activities through the Packaging Machine Performance Index through Breakdown Rate data as a measure of the efficiency and effectiveness of the implementation of improvements in the form of digital check sheets.

RESULTS AND DISCUSSION

Waste Identification

Table 1. Results of waste identification in maintenance activities on filler machines in packaging bottling lines

No.	Categories Wastes	1	2	3	4	5	Weight	Rank
1.	Transportation	1	5	8	1	0	39	6
2.	Inventory	0	0	1	6	8	67	5
3.	Motion	2	3	10	0	0	38	7
4.	Waiting	0	0	0	4	11	71	1
5.	Over – Processing	0	0	1	4	10	69	3
6.	Over – Production	3	4	7	1	0	36	8
7.	Defect	0	0	1	5	9	68	4
8.	Skills	0	0	1	3	11	70	2

Source: Author Processed Data (2024)

The results obtained from the identification of the weight of each existing waste are then analyzed using the RCFA (Root Cause & Failure Analysis) tool to then know the



root cause of the problem so that it can be used for brainstorming the right counter-measure so that the corrective actions taken can be sustained.

Root Cause and Failure Analysis (RCFA)

Fishbone Ishikawa Diagram Analysis

Data analysis using Fishbone diagrams aims to explore all possible causes of a problem by involving employee expertise in interviews. In this process, common problems are grouped and explored in depth to identify the root cause. Through a two-way discussion between researchers and expertise employees, the goal is to leverage the collective experience of expertise employees to identify the cause of the problem and find appropriate remedial measures.

Table 2. Types of Waste and Problems

No.	Waste	Problems
1	Inventory	Special consumable material (Material)
2	Waiting	Assembly activities are hampered waiting for the presence of a supervisor to confirm every critical step that has been taken (Methode)
3	Over-processing	Machine components are difficult to disassemble resulting in delayed maintenance time (Machine) Missed step assembly & disassembly process (Man)
4	Defect	The installation process is improper because the tools used are worn / not suitable for use (Machine) The prepared material / spare parts are lost / mixed, so using old materials / spare parts results in the filling valve leaking & overfilling (Material) The integrity of the work is not clear through unrepresentative and unaccountable reporting techniques (Methode)
5	Skills	Replacing colleagues who have competence in their fields with colleagues who are not yet competent (Man)

Source: Author Processed Data (2024)

The results of the waste analysis contained in the table will be the basis for identifying the root cause of the problem, which will later help in developing an effective

867



solution to reduce the duration of maintenance activities on the filling machine in the packaging bottling line.

Table 3. Waste Repair Steps

No.	Waste	Problems	Repair Steps
1	Inventory	Special consumable material (Material)	Using a small can alternative to increase quantity without significantly increasing the value of the asset
2	Waiting	Assembly activities are hampered waiting for the presence of a supervisor to confirm every critical step that has been taken (Methode)	Digitizing the confirmation process using digital check sheets
3	Over-processing	Machine components are difficult to disassemble resulting in delayed maintenance time (Machine)	Provision of Tools Management through a special tool kit facility for maintenance
		Missed step assembly & disassembly process (Man)	Digitization of Work Instructions
4	Defect	The installation process is improper because the tools used are worn / not suitable for use (Machine)	Standardize the rejuvenation of tools once every 1 year
		The prepared material / spare parts are lost / mixed, so using old materials / spare parts results in the filling valve	Implementation of material organizer / spare parts in maintenance activities



		leaking & overfilling (Material)	
		The integrity of the work is not clear through unrepresentative and unaccountable reporting techniques (Methode)	Digitalization of reporting utilizes the plan to digitize the confirmation process using digital check sheets
5	Skills	Replacing colleagues who have competence in their fields with colleagues who are not yet competent (Man)	1. Expanding and improving executive skills by implementing functional rotations as On-The-Job Training 2. Provide practical and easily accessible Digital Work Instructions through digital Work Instruction

Table 3 lists the corrective steps needed to address all causes of wastage during the filling machine in the packaging bottling line. All improvement steps contained in the table are the result of analysis and collaboration between the author and the expertise employee.

Future State Mapping Design (FSM)

Future State Mapping is created for each maintenance activity that has been determined at the beginning, i.e. weekly & monthly maintenance activities.



Future State Mapping Weekly Care Activities**Table 4. Weekly Care (sourced processed)**

No	Activity	Value Type	Number of Man Power	Duration (Min.)	Information
1	Tools, Material, and Area Preparation (X1)	VA	1	45	Remain
2	Do LOTO at Machine & Digital Confirmation (XX1)	VA	3	10	Combined Activity, becoming 1 worker
3	Remove & Dismantle 10 Filling Valves (X4)	VA	3	50	to 2 workers
4	Clean Parts & Replace All O-Rings, Seals, and Springs Following Membranes & Digital Confirmation (XX2)	VA	3	150	Combined Activity; to 2 workers
5	Assemble & Install 10 Filling Valves & Digital Confirmation (XX3)	VA	3	50	Combined Activity; to 2 workers
6	Release LOTO, Run Test and Digital Reporting & Handover (XX4)	VA	5	30	Combined Activity; to 2 workers
7	Cleaning Area (X11)	VA	2	15	Remain
Total				350	

Source: Author Processed Data (2024)

Future State Mapping Monthly Maintenance Activities**Table 5. Monthly Maintenance for Cleaning & Inspection of Compressed Air Regulator Supply)**

o	Activity	Value Type	Number of Man Power	Duration (Min.)	Information
	Check For Air Leakage & Operating Condition (Y1)	VA	2	25	1 employee
	LOTO Air Supply & Digital Confirmation (YY1)	VA	2	25	Combined Activity; 1 employee



	Cleaning Regulator & Digital Confirmation (YY2)	VA	3	75	Combined Activity; 1 employee
	Release LOTO & Run Test, and Digital Reporting / Record & Handover to Production (YY3)	VA	4	25	Combined Activity; 1 employee
Total				150	

Source: Author Processed Data (2024)

From the FSM table above, it can be seen that the implications of the improvement in the design of the FSM show a decrease in the duration of the monthly maintenance activity "Cleaning & Inspection of Compressed Air Regulator System", where the duration needed in the implementation of this activity which was originally done in 300 minutes has decreased to 150 minutes. In other words, the percentage improvement (saving) for this activity is 50%.

Table 6. Monthly Maintenance for Cleaning & Inspection Main Control Panel, Conduct Functional Test of Door Switces & Lightings)

No	Activity	Value Type	Number of Man Power	Duration (Min.)	Information
1	LOTO Machine & Digital Confirmation (ZZ1)	VA	2	5	Become 1 worker
2	Clean & Check Air Conditioner & Ventilator & Digital Confirmation (ZZ2)	VA	2	15	Addition of Activities; Become 1 worker
3	Vacuum Clean Cabinet & Digital Confirmation (ZZ3)	VA	2	15	Become 1 worker
4	Release LOTO & Digital Reporting & Handover (ZZ4)	VA	2	5	Become 1 worker
Total				40	

Source: Author Processed Data (2024)



Table 6 of the FSM above shows a decrease in the duration of the "Cleaning & Inspection Main Control Panel, Conduct Functional Test of Door Switches Lightings" maintenance activity, from the original 60 minutes to 40 minutes, or in other words there is a time saving of 33%. Similarly, there is a decrease in the number of Man Power (workers) from the original 2 people (including supervisors), to 1 worker by implementing digital confirmation, reporting, and handover in each critical step.

Implementation of Equipment Maintenance Activity Improvement

The improvement of treatment activities, especially in the confirmation and reporting process from what was originally done conventionally and undocumented to digital in general, can be shown in the figure below:

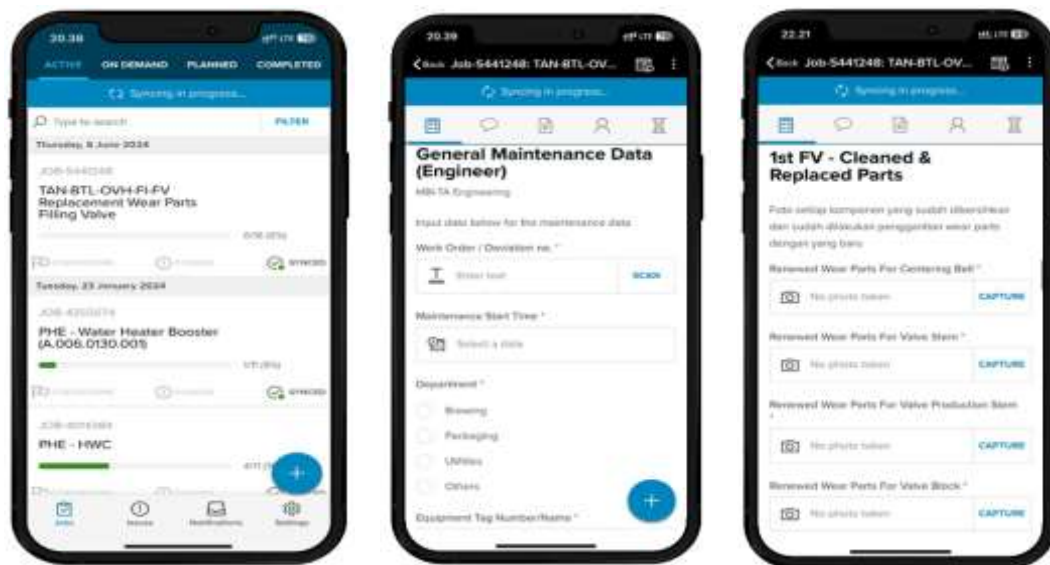


Figure 1. Mobile Digital Check Sheet & Reporting App

Likewise, the impracticality in the use of Work Instruction which was previously in the form of paper to digital WI is shown in the figure below:



Figure 2. Conventional Work Instruction

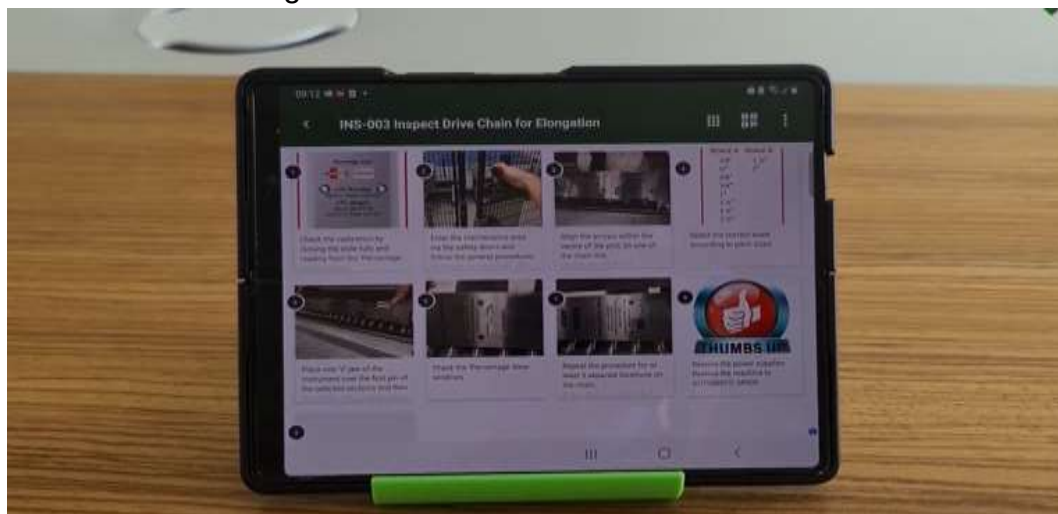


Figure 3. Digital Work Instruction

In addition to digitizing both check sheets & reporting and work instructions above, other implementations are in the management of materials and spare parts from previously not well organized to organized in an orderly manner to minimize human error during execution (example: materials falling and missing).



Figure 4. Material placement during irregular execution



Figure 5. Workbench Facility Organized Material Placement

Analysis of FSM Implementation of Subsequent Care Activities

The research results which include Future State Mapping (FSM) and improvement measures have been presented in the Management Meeting, Kick Off Meeting and Daily Meeting related to maintenance activities on filler machines in the packaging bottling line. This presentation aims to prepare the FSM and all improvement steps that have been made for each stage of weekly and monthly maintenance activities have been implemented in the next maintenance activity on the filler machine in the packaging bottling line. Based on the results of the implementation of the next maintenance activity on the filler machine in the packaging bottling line, savings and a decrease in duration in the implementation of weekly and monthly maintenance activities are obtained after the elimination of Non-Value Added.

In weekly maintenance activities, namely Replacement of Seals, Springs, and Membranes of Filling Valves, the processing time is reduced from 480 minutes to 400 minutes, resulting in savings of 16%. This time reduction is achieved through improved maintenance activity, replacing conventional methods with digitalization in the form of digital check sheets for confirmation and reporting. For the monthly maintenance activity “Cleaning & Inspection Main Control Panel, Conduct Functional Test of Door Switches Lightings” the duration of work was reduced from 60 minutes to 40 minutes, saving 33% time. In addition, the number of man power (workers) required is reduced from 2 people (including supervisors), to 1 worker with the application of digital confirmation, reporting, and handover in each critical step.

One of the main objectives of this research is to evaluate the efficiency and effectiveness of improvements to the Maintenance Management System at PT MBI by identifying waste in the previous system and applying Digital Check Sheet applications to maintenance activities. The results of this maintenance activity improvement prove that the implementation of FSM and the corrective steps that have been made are proven to be optimal during maintenance implementation to overcome the existence of waste (waste) which results in delays in completing maintenance activity work on filler machines in the packaging bottling line. This is reflected in the increase in productivity of Work Order compliance which was originally below the target (92%) to above the target described in the graph below.

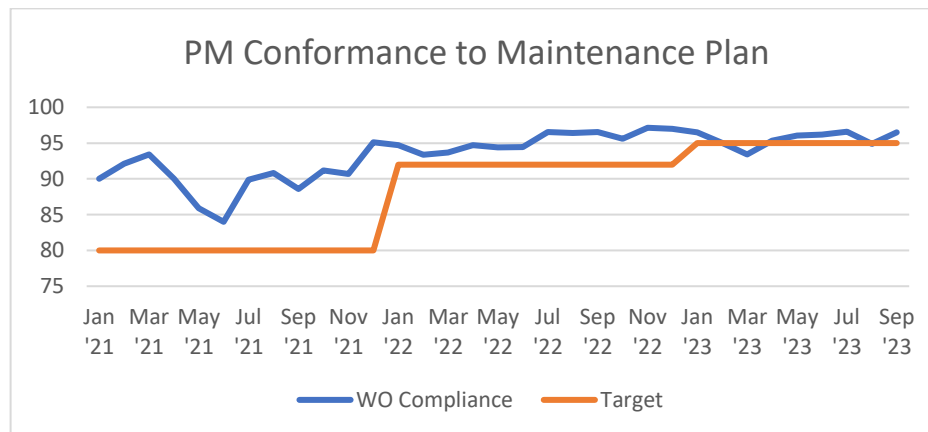


Figure 6. PM Conformance to Maintenance Plan after Improvement Maintenance Management System

As well as reducing production down time from the original 8.06% on average from 2017 – 2021 to 4.45% on average from 2022 – 2023. described in the table below.

Table 7. Breakdown Rate Packaging Line 2022 – 2023

Year	Packaging Line
2022	5,37%
2023	3,52%
average	4,45%

Source processed by Author (2024)

Where in the graph is depicted as shown in the image below:

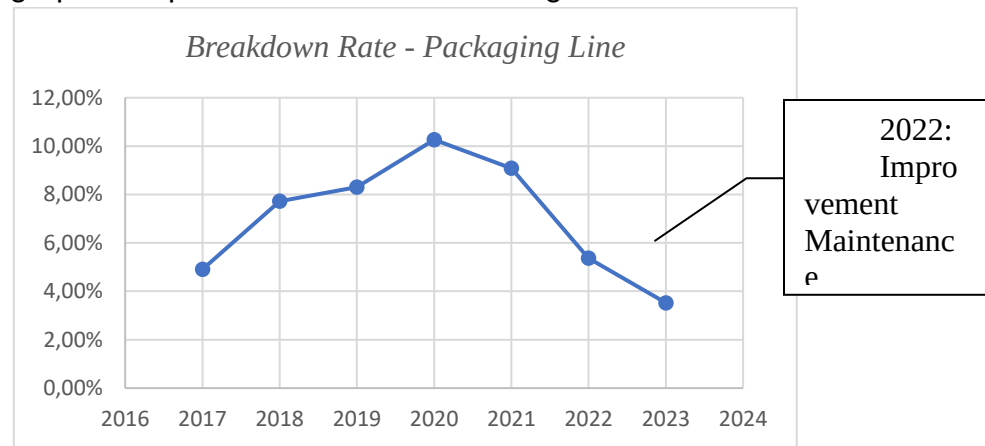


Figure 7. Breakdown Rate – Packaging Line

CONCLUSION

1. Identification of Waste in Maintenance Activities:

This study succeeded in identifying several types of waste that resulted in delays in the completion of maintenance work on the filling machine in the packaging bottling line of PT Multi Bintang Indonesia, Tbk.:

- Waiting: Delay in treatment activities due to waiting for confirmation from a supervisor for any critical steps.
- Skills: Assignment of work to colleagues who are less competent to replace those who have special competencies accompanied by limited resources with the required skills
- Over-Processing: Impracticality in the process of disassembling machine components and missed assembly steps.

- d. Defect: Improper installation due to the use of worn tools or inappropriate materials/spare parts.
 - e. Inventory: Lack of special materials required for maintenance.
 2. Evaluation of Lean Maintenance Implementation to overcome waste that results in low productivity and quality in maintenance activities through the VSM – Value Stream Mapping method approach where through the implementation of Lean Maintenance to the Improvement Maintenance Management System, some of the improvements obtained include:
 - a. Increasing Work Order Compliance Productivity from below the target (92%) to above the target.
 - b. Reducing production down time from the original 8.06% on average from 2017 – 2021 to 4.45% on average from 2022 – 2023.
 3. Evaluation of the Efficiency and Effectiveness of the Implementation of the Improvement Maintenance Management System through digital Check Sheet, Confirmation, and Reporting:
 - a. Significantly reduced working hours in equipment maintenance activities from 840 minutes to 550 minutes, which in other words experienced an improvement of 34%.
 - b. Reduce man power by 1-2 people by implementing the conventional confirmation and handover process through process digitization.

REFERENCES

- Anggoro, Bima. (2023). Analisis Perawatan Mesin Genset Dengan Metode Reliability Centered Maintenance dan Maintenance Value Stream Map Pada Golden Butique Hotel Kemayoran.
- Arintiana, A. I. (2023). Implementasi Lean Manufacturing Untuk Mereduksi Waste Proses Inspeksi QC Produk Pancreatin di PT Metiska Farma Dengan Value Stream Mapping dan Kaizen.
- Batwara, A. et al. (2019) Towards Smart Sustainable Development Through Value Stream Mapping - a systematic literature review.
- Duto, Yoppy Setyo. (2023). Analisis Penerapan Lean Maintenance Untuk Optimalisasi Durasi Overhaul Turbine Inspection (TI) di Perusahaan Operation & Maintenance Pembangkit Listrik PT IP.



- Fadilah, Muhammad Fathan. (2023). Rancangan Lean Manufacturing Untuk Mengurangi Pemborosan Pada Proses Pembuatan Sepatu Dengan Pendekatan Metode Value Stream Mapping (VSM) dan Root Cause Analysis (RCA) di Home Industry Sepatu.
- Imaroh, T. S., Mustofa A. (2022) Defect reduction analysis to improve glass bottle packaging products quality using statistical process control (SPC) at PT. Muliaglass Container (MGC). Journal of Social Science 3.5 1003-1018. <https://www.jsss.co.id/index.php/jsss/article/view/402>
- Imaroh, T. S., Widiyani, K. (2023) Supply Chain Performance and Business Sustainability (Study at 212 Mart Batan Indah-Tangsel). Jurnal Cahaya Mandalika. ISSN 2721-4796 (online) 4.3 (2023): 882-896. <https://www.ojs.cahayamandalika.com/index.php/JCM/article/view/2000>
- Ishak F. A. et al. (2018) A case study of LEAN application for shortest lead time in composite repair shop. International Journal of Engineering and Technology (UAE). DOI: 10.14419/ijet.v7i4.13.21341. ISSN: 2227524X.
- Jaffar et al. (2015) Management of seven wastes: A case study in an automotive vendor. Jurnal Teknologi. DOI: 10.11113/jt.v76.5668. ISSN: 01279696.
- Lee J.K.Y. et al. (2021) Sustainability-Oriented Application of Value Stream Mapping: A Review and Classification
- Mostafa, S. et al. (2015) Lean thinking for a maintenance process. . Production and Manufacturing Research. DOI: 10.1080/21693277.2015.1074124. ISSN: 21693277.
- Nadiyah K., Dewi G. S. (2022) Quality Control Analysis Using Flowchart, Check Sheet, P-Chart, Pareto Diagram and Fishbone Diagram. OPSI. DOI: 10.31315/opsi.v15i2.7445. ISSN: 1693-2102.
- Nugroho R. E. et al. (2017) Reduce Product Defect in Stainless Steel Production Using Yield Management Method and PDCA. . International Journal of New Technology and Research (IJNTR). ISSN: 2454-4116.
- Nugroho R. E., Safiq M. (2019). Implementation of Lean Service on the process of training services at PT. TUV Rheinland Indonesia, Academy and Life Care Division. , Academy and Life Care Division. International Journal of New Technology and Research. DOI: 10.31871/ijntr.5.2.8.
- Nugroho T. S., Nugroho R. E. (2020). Improvement of Oil Pack Reject Flexible Packaging on Printing, Lamination and Slitting Processes (A Case Study in PT. XYZ). Saudi



- Journal of Business and Management Studies, 5(02). DOI: 10.36348/sjbms.2020.v05i02.001. ISSN: 24156663.
- Oršič J. et al. (2019) Measuring sustainable performance among logistic service providers in supply chains. Tehnicki Vjesnik. DOI: 10.17559/TV-20180607112607. ISSN: 18486339.
- Paramawardhani H., Amar K. (2020) Waste Identification in Production Process Using Lean Manufacturing: A Case Study. . Journal of Industrial Engineering and Halal Industries. DOI: 10.14421/jieh.1827. ISSN: 2722-8150.
- Parvez A. et al. (2020) Impact of 'check sheet' and 'flow chart' to improve quality and efficiency of finishing unit in a garment industry. Proceedings of the International Conference on Industrial Engineering and Operations Management. ISSN: 21698767.
- Romdani, Reizki Agung. (2022). Optimalisasi Produktivitas Line Machining Assy Dengan Metode Value Stream Mapping dan Metode Eliminate, Combine, Rearrange, Simplify Based Line Balancing.
- Sahara, Fitria Febri. (2023). Analisis Lean Manufacturing Dengan Metode Value Stream Mapping Untuk Mengurangi Waste Pada Sistem Management Corrective Action and Preventive Action di PT Brightgene Biomedical Indonesia.
- Salwin, M. et al. (2021) Using value stream mapping to eliminate waste: A case study of a steel pipe manufacturer. Energies. DOI: 10.3390/en14123527. ISSN: 19961073.
- Sastra, Agnestasia. (2023). Perbaikan Proses Permohonan Ground Support Equipment Melalui Value Stream Mapping (VSM) Dengan Digitalisasi di Industri MRO (Maintenance, Repair, and Overhaul).
- Setiawan, Iwan. (2023). Implementasi Value Stream Mapping Guna Meningkatkan Performa Proses Produksi Gravure Ink Di Sebuah Chemical Company.
- Siadari, Apriyani Tridewi. (2023). Perbaikan Mekanisme Pengajuan Lisensi Instruktur Melalui Value Stream Mapping (VSM) di Industri MRO (Maintenance, Repair, and Overhaul).
- Suhardi B. et al. (2019) Minimizing waste using lean manufacturing and ECRS principle in Indonesian furniture industry. Cogent Engineering. DOI: 10.1080/23311916.2019.1567019. ISSN: 23311916.
- Trimarjoko A. et al. (2021) Value stream mapping and six sigma methods to improve service quality at automotive services in Indonesia. Operational Research in Engineering Sciences: Theory and Applications. DOI: 10.31181/oresta20402036f. ISSN: 26201747.



Wonggiawan, Febry. (2023). Analisis Lean Service Untuk Mengurangi Non Productive Time Pada Pelayanan Kapal Dengan Metode Value Stream Mapping.

