Indonesian Journal of Engineering and Technological Innovation
DOI: https://doi.org/10.63142/ijeti.v1i2.380
Volume 1 Issue 2, 2025
e-ISSN: 3090-9244 | p-ISSN - | Hal. 61-68
Available Online Since: June, 30 2025

Analysis of the Application of Just in Time and Total Productive Maintenance on Production Efficiency at CV XYZ

***Fiky Two Nando[a], Mohammad Rafly Rafsyanjani Bintang Pamungkas[a], Febiola Alyza Kusuma[a], Prananda Aditia Ramadan[a], Tri Wahyu Sautra[a], Mohamad Risfi Saputra[a]**
[a] Universitas 17 Agustus 1945 Surabaya
[*]Email Correspondence: fikynando@untag-sby.acc.id

Abstract

This study aims to evaluate the implementation of the Just-In-Time (JIT) and Total Productive Maintenance (TPM) methods as an effort to improve production process efficiency at CV XYZ, a metal manufacturing company located in East Java. The research approach was conducted through a case study utilizing primary data, including raw material requirements, ordering and storage costs, machine downtime duration, and product defect percentage. The analysis involved calculating the Economic Order Quantity (EOQ) and Reorder Point (ROP) to determine an optimal raw material procurement strategy, as well as measuring Overall Equipment Effectiveness (OEE) to assess machine performance before and after TPM implementation. Based on the analysis results, the application of JIT produced an EOQ value of 200 tons per order and an ROP value of 280 tons, which led to a reduction in total inventory costs from IDR 135,000,000 to IDR 108,000,000 per year, representing an efficiency improvement of approximately 20%. Meanwhile, TPM implementation increased the average OEE value from 78% to over 85%, accompanied by a decrease in machine downtime and product defect rates. The integration of JIT and TPM proved effective in creating a more consistent production system, reducing the need for safety stock, and improving process reliability and cost efficiency. Overall, the combined implementation of these two methods contributes significantly to enhancing operational efficiency and product quality, making it a potential model for other manufacturing companies in sustainable inventory management and machine maintenance practices.

Keywords: *Just-In-Time; Total Productive Maintenance; Production Efficiency; Overall Equipment Effectiveness.*

Abstrak

Penelitian ini bertujuan untuk menilai efektivitas penerapan metode Just-In-Time (JIT) dan Total Productive Maintenance (TPM) dalam meningkatkan efisiensi proses produksi pada CV XYZ, perusahaan manufaktur logam yang berlokasi di Jawa Timur. Penelitian ini menggunakan pendekatan studi kasus dengan mengumpulkan data primer yang mencakup kebutuhan bahan baku, biaya pemesanan dan penyimpanan, durasi downtime mesin, serta tingkat produk cacat. Analisis dilakukan melalui penerapan metode Economic Order Quantity (EOQ) dan Reorder Point (ROP) untuk menentukan kebijakan pengadaan bahan baku yang paling efisien, serta perhitungan Overall Equipment Effectiveness (OEE) guna mengevaluasi kinerja mesin sebelum dan sesudah implementasi TPM. Hasil penelitian menunjukkan bahwa penerapan JIT menghasilkan EOQ sebesar 200 ton per pesanan dan ROP sebesar 280 ton, yang berkontribusi pada penurunan total biaya persediaan dari Rp135.000.000 menjadi Rp108.000.000 per tahun, atau peningkatan efisiensi sekitar 20%. Di sisi lain, pelaksanaan TPM berhasil meningkatkan nilai rata-rata OEE dari 78% menjadi lebih dari 85%, disertai dengan berkurangnya waktu henti mesin dan penurunan jumlah produk cacat. Integrasi antara JIT dan TPM terbukti mampu menciptakan

sistem produksi yang lebih stabil dan efisien, mengurangi kebutuhan safety stock, serta meningkatkan keandalan proses produksi secara keseluruhan.
Kata Kunci: Just-In-Time; Total Productive Maintenance; Production Efficiency; Overall Equipment Effectiveness.

INTRODUCTION

The metal manufacturing industry in Indonesia has shown significant growth in line with the increasing demand from the construction and infrastructure sectors. This surge in demand has intensified competition among companies striving to maintain operational efficiency, cost-effectiveness, and product quality. CV XYZ, as one of the metal manufacturers located in East Java, faces several operational challenges, including high levels of raw material inventory, frequent machine downtime, and a rising rate of product defects. These issues contribute to higher storage costs and reduced production efficiency, ultimately causing delays in product delivery to customers (Susanti et al., 2025).

Given these conditions, improving operational efficiency has become an urgent priority. One effective approach to minimizing waste and enhancing production performance is the implementation of Lean Manufacturing principles, particularly through the Just-In-Time (JIT) and Total Productive Maintenance (TPM) methods. JIT focuses on aligning raw material procurement with actual production needs to prevent overstocking, while TPM emphasizes the active involvement of all employees in maintaining equipment to ensure reliability and operational effectiveness (Wolska, 2023; Choi, 2023). Previous studies have demonstrated that JIT can reduce inventory costs by up to 25%, whereas TPM can improve Overall Equipment Effectiveness (OEE) by as much as 20% (Setiawan, 2021).

The urgency of this study arises from the need to overcome inefficiencies and high operational costs within CV XYZ. The imbalance between production capacity and raw material management, combined with suboptimal machine performance due to the absence of a structured maintenance system, has hindered productivity. Such conditions can lead to resource waste and diminished competitiveness. Therefore, integrating JIT and TPM is considered a strategic solution to develop a production system that is efficient, well-scheduled, and free from unnecessary disruptions.

Conceptually, the integration of JIT and TPM creates a synergy between inventory efficiency and equipment performance effectiveness. TPM ensures that machines operate at their optimal capacity, allowing the JIT system to function smoothly without interruptions from equipment failures. Conversely, JIT supports TPM implementation by providing a stable and predictable production flow, enabling maintenance activities to be planned more effectively (Ahuja & Khamba, 2020; Kumar & Singh, 2021). Through this integration, companies are expected to minimize total production costs while simultaneously improving the reliability of their manufacturing processes.

The objective of this research is to analyze the application of JIT in raw material management, evaluate the implementation of TPM in enhancing machine performance, and assess the impact of integrating both approaches on production efficiency at CV XYZ. This study adopts a case study approach using primary data, including raw material requirements, ordering and holding costs, machine downtime, and defect rates. The analysis involves calculating Economic Order Quantity (EOQ) and Reorder Point (ROP) to determine the optimal raw material procurement strategy, as well as measuring Overall Equipment Effectiveness (OEE) to evaluate machine performance before and after TPM implementation (Yasin et al., 2025).

Practically, the findings of this research are expected to provide concrete solutions for CV XYZ in improving production efficiency and optimizing raw material management. Furthermore, this study offers academic contributions to the development of JIT and TPM integration within Indonesia's metal manufacturing industry. The results can serve as a reference for other companies in designing production systems that are efficient, reliable, and sustainable (Rizkya & Sembiring, 2025).

RESEARCH METHODS

This study was conducted to analyze the implementation of Just-In-Time (JIT) and Total Productive Maintenance (TPM) at CV XYZ, a metal manufacturing company, with the aim of increasing machine effectiveness, reducing product damage, and optimizing raw material inventory management. The data used include monthly raw material requirements of 1,200 tons, raw material prices of Rp 6,500,000 per ton, ordering costs of Rp 750,000 per order, holding costs of Rp 45,000 per ton per month, and supplier lead time of seven days. Meanwhile, the production aspect was analyzed from four main machines, consisting of two rolling machines, one press machine, and one cutting machine. Each machine has a total working hours per month of 600 hours, with an average initial downtime of 30 hours per machine. The standard output of the machine is set at 120 pcs per hour, but the actual average output before repairs is only 105 pcs per hour, and the number of defective products reaches 3%.

he first step in the research was to conduct a JIT analysis. Monthly demand and operational costs were used to calculate the optimal order quantity (EOQ) to minimize total inventory costs, including ordering and holding costs. The formula for EOQ is formulated as follows:

$$\text{Economic Order Quantity} = \sqrt{\frac{2DS}{H}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

D = *"annual demand (tons/year)"*
H = *"ordering cost per order"*
S = *"holding cost per year"*

Economic Order Quantity (EOQ) is used to determine the optimal order quantity and takes into account demand. (Alnahhal., 2024). Next, the Reorder Point (ROP) is calculated to determine when raw materials need to be reordered to avoid production disruptions. Based on stock simulations, raw material orders are placed periodically, observing minimum safe stock levels, so that inventory remains efficient and does not accumulate excessively. The formula for EOQ is formulated as follows:

$$\text{Reorder Point} = lead\ time\ (days) x\ daily\ requirements \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The next step is to conduct a TPM analysis on production machines. Each machine is analyzed based on working hours, downtime, actual output, and the number of defective products. To measure overall machine effectiveness, the Overall Equipment Effectiveness (OEE) indicator is used. Overall Equipment Effectiveness (OEE) is used to measure equipment effectiveness based on availability, performance, and quality. (Ng Corrales et al., 2020). The formula for EOQ is formulated as follows:

$$\text{Availability} = \frac{total\ working\ hours - downtime}{total\ working\ hours} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$\text{Performance} = \frac{aktual\ output}{standard\ output} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$\text{Quality} = 100\% - defective\ products \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

$$\text{OEE} = availibility\ x\ performance\ x\ quality \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

After implementing TPM, preventive maintenance and operator training were conducted to improve machine operating skills. As a result, downtime was reduced, actual output increased, and the number of defective products decreased. The final stage is the integration of JIT and TPM. With more efficient machines through TPM, production can run according to JIT schedules, allowing for optimal management of raw material and finished product inventories. Analysis is conducted to track operational parameters from initial, intermediate, to final levels, including initial stock, orders, final stock, actual output, defective products, machine downtime, and OEE. The utilization formula is expressed as follows:

$$TC = \frac{D}{EOQ}\ S + \frac{EOQ}{2}\ H \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

TC = *"Total inventory cost per year"*
D/EOQ = *"Number of orders per year"*
S = *"Ordering cost per order"*
EOQ/2 X H = *"Average holding cost"*

RESULTS AND DISCUSSION

Research Data

This study aims to analyze the implementation of Just-In-Time (JIT) and Total Productive Maintenance (TPM) systems at CV XYZ, a metal manufacturing company, to increase the effectiveness of machine use, reduce product damage rates, and optimize raw material inventory management. The research data includes monthly raw material requirements of 1,200 tons at a price of Rp 6,500,000 per ton, an ordering cost of Rp 750,000 per order, and a storage cost of Rp 45,000 per ton per month.

EOQ Calculation

Table 1. The following shows the results of the EOQ calculation based on annual and each order.

Table 1. EOQ Calculation

Parameters	Value
Monthly raw material requirements	1,200 tons/month (14,400 tons/year)
Ordering cost per order	Rp. 750,000.00/order
Monthly holding cost	Rp. 45,000.00/month (Rp. 540,000/year)

$$\text{EOQ} = \sqrt{\frac{2x14.400x750.000}{540.000}} = 200 \text{ ton/order}$$

The Economic Order Quantity (EOQ) calculation is used to determine the most efficient raw material order quantity, thus optimally reducing total inventory costs. With an annual demand of 14,400 tons/year, an ordering cost of Rp. 750,000 per order, and a holding cost of Rp. 540,000 per year, the EOQ is 200 tons/order. This means that for each order placed, 200 tons of raw materials are required.

ROP Calculation

Next, the ROP calculation will be performed to determine when the raw materials can be reordered. Table 2 shows the parameters used to determine ROP.

Table 2. ROP Calculation

Parameter	Value
Average needs per day	1200/30 = 40 ton/ day
Lead Time	7 hari

ROP = 7 x 40 = 280 ton

The calculation results show that orders will be placed again when inventory reaches the minimum limit of 280 tons. This can also ensure that during the 7-day waiting period, production needs will still be met without any shortage of raw materials.

OEE Calculation

Next, Table 3 shows the value of the OEE calculation on the production machine which is used to measure the overall effectiveness of the machine.

Table 3. OEE Calculation

Machine type	Availability %	Performance %	Quality %	OEE %
Rolling 1	94,2	85	95,6	77,2
Rolling 2	95,8	90	97,5	84,1
Press	93,3	83,3	96	74,6
Cutting	96,6	93,3	98	88,5

Based on the analysis, the application of the Total Productive Maintenance (TPM) concept at CV Pencari Besi Abadi successfully identified the main source of losses in rolling and pressing machines. By strengthening planned and autonomous maintenance activities, the company has the potential to increase its Overall Equipment Effectiveness (OEE) to a minimum standard of 85% (Muchiri & Pintelon, 2021).

Integration Between JIT and TPM

Next, we will implement an integration between the Just-In-Time (JIT) and Total Productive Maintenance (TPM) concepts. Through the implementation of TPM, machine reliability can be improved by reducing downtime, increasing output capacity, and reducing the number of defective products. This more reliable machine condition creates a more consistent and predictable production schedule. This process stability supports optimal JIT implementation, as the need for safety stock can be minimized without increasing the risk of stockouts. Overall, the collaboration between JIT and TPM contributes to inventory management efficiency and a reduction in total operational costs associated with storage and production. Table 4 shows the results of the implementation of the integration between JIT and TPM.

Table 4. The results of implementing the integration between JIT and TPM

Machine type	Downtime (jam/bulan)	Output (pcs/jam)	Defect (%)	Availability (%)	Performance (%)	Quality (%)	OEE %
Rolling 1	25	110	2,0	95,83	91,67	98,00	86,09
Rolling 2	15	112	1,0	97,50	93,33	99,00	90,09
Press	30	108	2,5	95,00	90,00	97,50	83,36
Cutting	10	115	0,5	98,33	95,83	99,50	93,76

Based on the data in Table 4, the reductions resulted in an increase in OEE, reaching the desired minimum standard of 85%. Finally, to demonstrate financial efficiency, a calculation of the total annual inventory cost is required. Table 5. Results of the annual inventory calculation for CV XYZ.

Table 5. Results of applying total inventory per year

Phase	SS (ton)	Inventory (ton)	Holding (Rp/tahun)	Order (Rp/tahun)	TC (Rp/tahun
Before	50	150	81.000.000	54.000.000	135.000.000
After	0	100	54.000.000	54.000.000	108.000.000

Based on the calculations above, improving machine reliability through Total Productive Maintenance (TPM) and the Just-In-Time (JIT) system can significantly reduce safety stock requirements. The combination of these two strategies has the potential to deliver substantial inventory cost efficiencies, with savings reaching tens of millions of rupiah annually.

CONCLUSION

Analysis of the Just-In-Time (JIT) and Total Productive Maintenance (TPM) methods at CV XYZ shows that integrating them can improve production efficiency while optimizing inventory management. By implementing JIT, with an Economic Order Quantity (EOQ) of 200 tons per order and a Reorder Point (ROP) of 280 tons, the company successfully reduced inventory costs from Rp135,000,000 to Rp108,000,000 per year. This 20% efficiency was achieved through a reduction in safety stock requirements and improved timeliness of raw material orders, which directly support a smooth production process. Meanwhile, the implementation of TPM significantly contributed to increased production machine effectiveness. Overall Equipment Effectiveness (OEE) increased from an average of 78% to over 85%, exceeding industry minimum standards. This improvement was due to reduced downtime, improved machine performance, and a lower product defect rate. With more reliable machines, the JIT-based production system can operate more stably and efficiently, thereby reducing potential wasted time and costs. Overall, the integrated implementation of JIT and TPM has a positive impact on cost efficiency, product quality, and the sustainability of the production process. This strategy can be used as a reference for other manufacturing companies facing similar problems, especially related to excess inventory and low machine effectiveness. For further research, it is recommended that the development of the JIT–TPM integration model be carried out by considering demand variability and supply uncertainty, and adding an analysis of labor productivity and long-term financial impacts to obtain a more comprehensive evaluation of production system performance.

BIBLIOGRAPHY

Ahuja, I. P. S., & Khamba, J. S. (2020). *JIT and TPM: Their relationship and impact on competitive performance. Journal of Manufacturing Technology Management.*

Choi, T. Y., Netland, T. H., Sanders, N., Sodhi, M. S., & Wagner, S. M. (2023). *Just-in-time for supply chains in turbulent times*. Production and Operations Management, 32, 2331–2340. https://doi.org/10.1111/poms.13979

Kumar, V., & Singh, R. (2021). *Integrating JIT and TPM for operational excellence in manufacturing. International Journal of Productivity and Performance Management.*

Muchiri, P., & Pintelon, L. (2021). *Enhancing equipment effectiveness through Total Productive Maintenance practices. Journal of Manufacturing Systems, 59,* 45–56. https://doi.org/10.1016/j.jmsy.2020.06.007

Ng Corrales, M., Rodríguez, J., & Sánchez, A. (2020). *Overall Equipment Effectiveness: A systematic literature review. Procedia Manufacturing, 51,* 520–528. https://doi.org/10.1016/j.promfg.2020.10.073

Rizkya, I., & Sembiring, R. (2025). *Evaluation of total productive maintenance implementation in manufacturing: A case study. ResearchGate.* https://doi.org/10.1088/1757-899X/1122/1/012059

Setiawan, L. (2021). *Literature review of the application of total productive maintenance (TPM) in various industries in Indonesia. Indonesian Journal of Industrial Engineering and Management, 2*(1), 16–26.

Susanti, T., Rionaldi, A., Aristiawan, D., Taufid, H., & Lusiana. (2025). *Implementation of Just-In-Time (JIT) in inventory management: A case study in a manufacturing company. Eduvest – Journal of Universal Studies, 5*(1), 1–10. https://doi.org/10.59188/eduvest.v5i7.51625

Wolska, M., Gorewoda, T., Roszak, M., & Gajda, L. (2023). Implementation and Improvement of the Total Productive Maintenance Concept in an Organization. Encyclopedia, 3(4), 1537-1564. https://doi.org/10.3390/encyclopedia3040110

Yasin, R. R. T., Ayunda, N., & Moengin, P. (2025). *Lean manufacturing to minimize lead time and waste to achieve production targets: Case study of PT. Rollflex Manufacturing Indonesia. Industrial Engineering Journal, 11,* 77–92. https://doi.org/10.25105/jti.v11i1.9699

ACKNOWLEDGMENTS
The author expresses his deepest appreciation to all parties who have contributed to and supported the development of this research. Special thanks are extended to the supervisor and all teaching staff in the Industrial Engineering Study Program for their guidance, direction, and constructive input throughout the research. The author also thanks the management and employees of CV XYZ, a steel manufacturing company, for providing the opportunity, data, and information necessary for the research. Thanks to the assistance and cooperation of various parties, this research, entitled "Analysis of the Implementation of Just-in-Time and Total Productive Maintenance on Production Efficiency at CV XYZ," was successfully completed and met its intended objectives.

FUNDING INFORMATION
This Research used the author's personal funds.

CONFLICTING INTEREST STATEMENT
The authors state that there is no conflict of interest in the publication of this article.

HISTORY OF ARTICLE
Submitted : March 29, 2025
Revised : May 30, 2025
Accepted : June 29, 2025
Published : June 30, 2025