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Submission date: 11-Nov-2026 11:34AM (UTC+0700)
Submission ID: 3086577209
File name: 5_213_Production.pdf (3.29M)
Word count: 4130
Character count: 27041

Jurnal Pengabdian Masyarakat: Bisnis dan Iptek
Vol. 3 No. 2, October 2026, 121-135
ISSN Online: 3064-0415, https://doi.org/10.56447/jpmbistek
Published by LPMM, STMIK Mardira Indonesia, Bandung.

Optimizing Maintenance and Reliability: Accelerates Its Garment Manufacturing Process at PT Cemerlang Jaya Fashion

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Abstract

Frequent unexpected machinery downtime and inefficient maintenance tracking continuously disrupt production schedules and threaten customer loyalty in the fast-paced apparel industry. To resolve these vulnerabilities, this applied research and community service initiative identifies operational bottlenecks and formulates strategic solutions to optimize maintenance and reliability frameworks at PT Cemerlang Jaya Fashion. Utilizing a qualitative approach, a collaborative team of lecturers and students gathered field data through deep engagement with business owners and factory operational personnel. The team analyzed the company's real-world maintenance gaps by benchmarking current floor practices against established operations management theories. The assessment reveals that while the company allocates a substantial budget for upkeep, the absence of standardized documentation for machine failure histories blocks critical performance metrics. To bridge this gap, this initiative delivers a structured digital logging system and a proactive preventive maintenance roadmap tailored to critical garment machinery. Ultimately, these solutions empower PT Cemerlang Jaya Fashion to eliminate costly production delays, maximize equipment efficiency, and secure a highly resilient, competitive supply chain.

Keywords: *Apparel Manufacturing, Equipment Reliability, Maintenance Optimization.*

Introduction

In the apparel manufacturing ecosystem, on-time order fulfillment serves as the primary indicator for maintaining customer satisfaction and loyalty. The physical readiness of production machinery heavily influences the smooth flow of garment production from start to finish. Sudden technical glitches or machine breakdowns frequently trigger delays in product delivery to clients. According to Heizer & Render, strategic operational decisions must optimize asset maintenance management and system reliability to reduce inefficient expenditures while maintaining consistent output quality.

As a highly productive garment vendor partner, PT Cemerlang Jaya Fashion relies on the performance of its industrial machinery—ranging from automatic sewing machines and high-speed overlockers to electric cutting tools and steam iron installations. To minimize operational bottlenecks, the management actively schedules a preventive maintenance program that includes daily, weekly, and monthly agendas. Furthermore, the company allocates a substantial financial commitment to these activities, reaching approximately 7% of the total factory operational costs.

Despite established budget allocations and routine schedules, actual execution on the production floor still reveals a wide gap compared to ideal management parameters. The primary obstacle involves the lack of a formal documentation system for machine failure histories and operational downtime logs. Because of this missing documentation, management faces significant difficulties when evaluating the actual effectiveness of machine utilization through industry-standard quantitative indicators like Overall Equipment Effectiveness (OEE), Mean Time Between Failure (MTBF), and Mean Time To Repair (MTTR).

This entire chain of operational bottlenecks confirms tangible inefficiencies within the factory. The 7% maintenance fund allocation has not yet yielded optimal operational protection for critical machinery. Based on this phenomenon, this in-depth analysis dissects the gap between actual field practices and Heizer & Render's operations management theory. Furthermore, this study evaluates machine reliability indicators through quantitative metrics—calculated from 26 working days of operational data across 12-hour shifts—while formulating long-term strategic solutions to

make the maintenance system at PT Cemerlang Jaya Fashion more effective, efficient, and reliable.

In modern industrial operations, manufacturing systems no longer view maintenance as a reactive damage-control measure, but rather as a core strategic driver of productivity and profitability. When a company optimizes its maintenance and reliability frameworks, it directly takes control of its production floor, transforming potential operational chaos into predictable, high-performing output.

Transitioning from a chaotic baseline to an optimized state requires a fundamental shift in strategy. As West et al. (2024) demonstrate, facilities achieve massive improvements in equipment longevity and operational stability when they actively switch from firefighting corrective maintenance to structured, preventative strategies. This deliberate shift eliminates unexpected machine failures and allows management to plan interventions during scheduled windows rather than scrambling during production emergencies. Similarly, Quiroz-Flores and Vega-Alvites (2022) highlight that when manufacturers merge a preventive maintenance approach with Lean manufacturing models, they systematically eliminate waste, streamline production workflows, and sharply drive up overall operational efficiency.

Furthermore, modern optimization goes beyond simply preventing breakdowns; it actively balances financial and environmental sustainability. Research by Yang et al. (2022) proves that sophisticated preventive maintenance strategies simultaneously optimize energy efficiency and reduce quality costs. By keeping machinery operating at peak condition, companies prevent energy spikes caused by strained equipment and eliminate the production defects that typically arise from degraded machinery.

Ultimately, selecting and optimizing the right maintenance framework dictates a company's competitive edge. Hamasha et al. (2023) emphasize that managers must strategically select specific maintenance types tailored to their unique operational conditions. This targeted alignment ensures that the organization protects its critical assets, eliminates unnecessary maintenance

expenditures, and sustains an uninterrupted, highly reliable production ecosystem. Through these combined approaches, optimizing maintenance transforms a standard factory into an agile, cost-effective, and highly resilient market leader.

Based on the field issue analysis and relevant previous research, this activity identifies the problems and formulates solutions arising from optimizing maintenance and reliability at PT Cemerlang Jaya Fashion.

Method

This study utilizes a qualitative research approach to gain a deep, contextual understanding of operational practices within the garment manufacturing sector. A collaborative team of lecturers and students executed this applied research project, driving the data collection and analysis processes on-site. The team established PT Cemerlang Jaya Fashion as the primary research object, focusing specifically on its factory production floor and operational workflows. To gather rich, primary data, the research team conducted direct field observations and comprehensive interviews with key informants. These informants comprised business owners, management executives, and frontline operational workers who directly manage and execute the company's supply chain management and production processes.

This investigation centers on maintenance and reliability as the core research variables. Rather than analyzing these variables through rigid statistical testing, the study qualitatively explores how equipment upkeep, machine availability, and system reliability directly impact daily production output and overall supply chain efficiency. For the data analysis technique, the research team employs a qualitative thematic analysis. The team systematically transcribes the interview recordings, categorizes the field observation notes, and cross-references these findings with the company's existing maintenance schedules. By synthesizing these diverse data streams, the team maps the explicit gaps between actual factory floor practices and ideal operations management theories, ultimately formulating actionable, structured solutions to optimize the company's asset reliability.

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Results and Discussion

Current Maintenance and Reliability Conditions at PT Cemerlang Jaya Fashion

To secure an uninterrupted production flow, PT Cemerlang Jaya Fashion actively implements a structured machine maintenance system across daily, weekly, and monthly schedules. This system aims to keep all industrial machinery in peak operating condition, thereby minimizing the risk of sudden equipment breakdowns during critical production runs. Based on field observations and interviews, the company enforces a Standard Operating Procedure (SOP) that requires every operator to clean their assigned machines at the end of each working day.

Beyond enforcing these daily SOPs, the company provides basic maintenance education to all new employees during their onboarding process. This training equips operators with the knowledge to handle machinery correctly, execute routine cleaning steps, and take immediate initial action whenever minor machine glitches occur. Through this educational initiative, management actively raises operator awareness regarding the vital importance of continuous equipment upkeep.

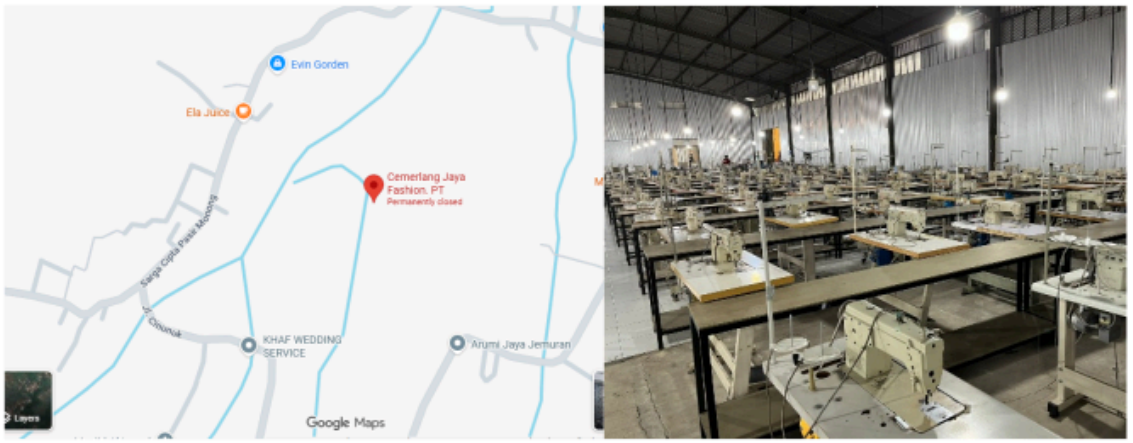


Figure 1. PT Cemerlang Jaya Fashion

In daily operations, the Production Head shoulders the primary responsibility for all maintenance activities. The Production Head actively supervises the execution of the maintenance schedules, ensures that workers strictly follow the SOPs, and coordinates emergency repairs whenever a machine failure threatens to bottleneck the production line. This operational framework demonstrates that the company successfully deploys a preventive maintenance approach, even though several execution limitations still persist on the factory floor.



Figure 2. The Activity at PT Cemerlang Jaya Fashion



Figure 3. The Observation at PT Cemerlang Jaya Fashion

Table. 1 Strategic Recommendation Action Plan Matrix

Action Program	Primary Objective	Responsible Party	Estimated Operational Impact
Digital Logbook Implementation	Provides an automated database for machine failures, OEE, MTBF, and MTTR tracking.	Production Head & IT Department	Enables technical decision-making based on measurable, empirical data.
Safety Stock Procurement for Imported Parts	Eliminates all waiting times for critical steam machine spare parts.	Finance & Logistics	Slashes the MTTR value from 168 hours to less than 24 hours.
SOP Audit & Compliance Enforcement	Enforces stricter discipline for cleaning sewing machine rotary hook components.	Production Head	Boosts lifecycle stability and increases daily MTBF values.
RCM Training Workshop	Builds operator competencies in detecting early mechanical failures.	HRD & External Trainer	Lowers the frequency of failure incidents continuously across the factory floor.

To transform these diagnostic insights into tangible operational success, management must execute a targeted, four-pronged strategic action plan. This matrix outlines immediate, high-impact programs that directly empower PT Cemerlang Jaya Fashion to eliminate inefficiencies and secure peak equipment reliability.

First, the Production Head and the IT Department will deploy a Digital Logbook Implementation. This program replaces scattered paper notes with an automated tracking database that captures machine failure histories, Overall Equipment Effectiveness (OEE), Mean Time Between Failure (MTBF), and Mean Time To Repair (MTTR). By automating this data collection, the

system equips management with the empirical insights they need to make precise, data-driven technical decisions.

Second, the Finance and Logistics teams will immediately execute Safety Stock Procurement for Imported Parts. This proactive inventory initiative targets critical steam machine components, completely eliminating long lead times for imported replacements. By maintaining these vital parts on-site, the company actively slashes its MTTR from an unacceptable 168 hours to less than 24 hours.

Third, the Production Head will enforce a strict SOP Audit & Compliance routine on the factory floor. This program tightens worker discipline regarding daily maintenance, focusing heavily on cleaning the delicate rotary hook components of the sewing machines. Consistent enforcement of these cleaning protocols prevents unnecessary debris buildup, boosts equipment lifecycle stability, and drives up the factory's daily MTBF values.

Finally, the HRD Department and External Trainers will launch a specialized Reliability-Centered Maintenance (RCM) Training Workshop. This educational program builds essential technical competencies among frontline operators, training them to detect early signs of mechanical failure before major breakdowns occur. Ultimately, upgrading the workforce's skills lowers the frequency of unexpected machinery incidents and establishes a continuous culture of operational excellence across the factory floor.

Machine Reliability Analysis Based on Real Company Data

To provide a robust operational analysis, the research team processed real data from operational tracking and field interviews at PT Cemerlang Jaya Fashion. The factory establishes its baseline time parameters as follows: the plant operates 26 days per month with a 12-hour shift per day. Therefore, the factory generates the following Total Potential Operating Time:

Total Potential Time = 26 days X 12 hours/day = 312 hours/month

Total Potential Time per Semester (6 Months) = 6 months X 312 hours = 1,872 hours/semester.

The following step-by-step mathematical calculations determine the reliability metrics for MTBF and MTTR according to scientific garment manufacturing principles:

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Calculation for the Automatic Sewing Machine Group

- Real Field Data: The rotary hook area experienced 3 failure/jamming incidents within one month. Technical repair actions took an average of 2 hours per incident.
- Total Repair Time (Downtime)} = 3 incidents X 2 hours = 6 hours
- Total Actual Operating Time = 312 hours (Potential Time) - 6 hours (Downtime) = 306 hours}

A. Mean Time Between Failure (MTBF) Calculation:

$$\text{MTBF} = \frac{306 \text{ hours (Actual Operating Time)}}{3 \text{ Incidents}} = 102 \text{ hours}$$

B. Mean Time To Repair (MTTR) Calculation:

$$\text{MTTR} = \frac{6 \text{ hours (Total Downtime)}}{3 \text{ Repair Actions}} = 2 \text{ hours}$$

Calculation for the Downstream Steam Machine Installation

- Real Field Data: The steam machine suffered 1 fatal internal component failure within a one-semester period (the last 6 months). Because the specific spare parts required backordering, the machine remained completely offline for 14 full calendar days.
- Total Repair Time (Downtime) = 14 days X 12 working hours = 168 hours.
- Total Actual Operating Time = 1,872 hours (Potential Semester Time) - 168 hours (Downtime) = 1,704 hours.

A. Mean Time Between Failure (MTBF) Calculation:

$$\text{MTBF} = \frac{1,704 \text{ hours (Actual Operating Time)}}{1 \text{ Incident}} = 1,704 \text{ hours}$$

B. Mean Time To Repair (MTTR) Calculation:

$$\text{MTTR} = \frac{168 \text{ hours (Total Downtime)}}{1 \text{ Repair Action}} = 168 \text{ hours (14 Working Days)}$$

These calculations reveal a sharp contrast in reliability metrics. The sewing machines sustain a normal operating cycle (MTBF) of 102 hours, which demands stricter daily autonomous maintenance to suppress failure frequencies. Conversely, the steam machine's massive MTTR of 168 hours confirms that supply chain and logistics delays for components drive this operational inefficiency, rather than the mechanical complexity of the repair itself.

Identification of Issues and Risks

Based on the research findings, the steam and cutting machines pose the highest level of risk to the production process. A breakdown in the cutting machine halts the initial stage of production because operators cannot cut materials according to the required patterns. Meanwhile, failures in the steam machine bottleneck the final production stage, preventing the team from finishing products on time. Additionally, the rotary hook component in sewing machines represents the part that fails most frequently. Accumulations of fabric dust and thread waste—which operators do not clean regularly—generally cause this damage. If left unaddressed, this condition degrades sewing machine performance and potentially causes product defects. Operator discipline also stands out as a primary risk factor in maintenance execution. Some operators still neglect the cleaning SOPs after using their machines. This negligence accelerates the wear and tear of machine components and drives up failure frequencies. Therefore, human resource discipline remains a critical factor in ensuring the success of the company's maintenance system.

Operational Performance and Strategic Recommendations

From a financial perspective, the company successfully maintains maintenance costs at approximately 7% of total operational expenditures. This control demonstrates that the company effectively manages maintenance spending to prevent it from overburdening overall production costs. The current maintenance system also drives a proactive approach, as

the factory conducts routine machine cleaning and inspections. This method actively reduces the risk of sudden breakdowns that could otherwise bottleneck the production process.

However, the evaluation reveals that the company's maintenance system still suffers from weaknesses in long-term planning. The absence of historical failure and repair data prevents management from conducting machine reliability analyses or planning precise component replacements. Consequently, maintenance activities still rely heavily on past experience and corrective actions after a breakdown occurs.

Based on these analytical findings, the company can implement several key recommendations to boost the effectiveness of its machine maintenance system:

First, the company should digitalize maintenance records through a digital logbook system. This system will track downtime, failure types, repair durations, and spare part replacement histories. Second, management must tighten supervision over SOP compliance by conducting routine audits and enforcing a reward and punishment system for operators. This step directly improves employee discipline in maintaining machine cleanliness and condition. Third, the company needs to re-evaluate its spare parts procurement system, especially for critical, backordered components. Maintaining a safety stock for specific spare parts will significantly minimize the risk of prolonged downtime caused by procurement delays.

By implementing these recommendations, PT Cemerlang Jaya Fashion will transform its maintenance system into a more effective, measurable operation that sustainably supports an uninterrupted production flow.

In the hyper-competitive apparel industry, operational agility and speed-to-market dictate a company's survival. To secure this competitive edge, PT Cemerlang Jaya Fashion must actively transform its factory floor by optimizing its maintenance and reliability frameworks. Basic management principles dictate that organizations must align their internal resources to achieve strategic goals (Foster & Sidharta, 2019). Within a manufacturing plant, this alignment relies heavily on operations management. As Heizer

and Render (2017) emphasize, strategic maintenance and system reliability constitute core operational decisions that directly preserve asset capability, eliminate waste, and sustain consistent output quality.

Transitioning from reactive firefighting to a proactive culture accelerates the entire manufacturing timeline. When factories shift their strategy from corrective, run-to-failure maintenance to structured, preventative strategies, they drastically improve equipment longevity and stabilize daily production (West et al., 2024). At PT Cemerlang Jaya Fashion, enforcing daily cleaning SOPs and preventative schedules protects critical assets like high-speed overlockers and automatic sewing machines from sudden, costly disruptions. Integrating these preventative maintenance approaches into production management models systematically drives up floor efficiency and removes non-value-added downtime (Quiroz-Flores & Vega-Alvites, 2022). Furthermore, sophisticated preventive maintenance strategy optimization simultaneously lowers quality costs and enhances energy efficiency (Yang et al., 2022). By keeping critical garment machinery running at peak parameters, the company actively prevents the mechanical degradation that typically causes fabric defects, thereby safeguarding product quality.

This focus on operational precision mirrors broader quality management trends in the regional garment sector. Total quality management practices directly elevate final product quality within the Indonesian textile industry (Manik et al., 2023). By maintaining precise machine calibrations through rigorous upkeep, PT Cemerlang Jaya Fashion ensures that its output meets strict vendor standards on the first pass, eliminating time-consuming reworks. However, to maximize these reliability gains, management must strategically select specific maintenance types that match their unique operational conditions (Hamasha et al., 2023).

For PT Cemerlang Jaya Fashion, this strategic selection means addressing its massive 168-hour downstream steam machine MTTR by reforming its logistics. While mechanical skills matter, optimizing inventory management principles, concepts, and techniques solves prolonged supply chain bottlenecks (Gupta & Singh, 2019). By establishing an on-site safety stock for critical, backordered parts, the company actively slashes component waiting times. Ultimately, by combining digital performance tracking, strict SOP

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compliance, and proactive inventory planning, PT Cemerlang Jaya Fashion optimizes its maintenance and reliability frameworks—accelerating its manufacturing process and cementing its reputation as a highly dependable garment partner.

Conclusion

This applied research demonstrates that optimizing maintenance and reliability frameworks directly accelerates the garment manufacturing process at PT Cemerlang Jaya Fashion. The investigation confirms that while the company successfully limits its upkeep expenditures to 7% of total operational costs and enforces basic daily cleaning SOPs, substantial documentation gaps still hinder long-term planning. Real-world data calculations expose a sharp contrast between asset groups: the automatic sewing machines maintain a steady 102-hour MTBF but require rigid autonomous maintenance to suppress frequent minor jams, whereas the downstream steam machine suffers from a massive 168-hour MTTR. This excessive repair timeline stems from backordered spare parts rather than mechanical complexity, proving that supply chain bottlenecks directly threaten the factory's production continuity.

To bridge these operational gaps, the company must execute three immediate strategic interventions. First, management should deploy a digital logbook system to automate the tracking of failure histories, OEE, MTBF, and MTTR, thereby shifting operations from experience-based guessing to data-driven decision-making. Second, the production team must tighten supervision over cleaning SOPs through routine compliance audits paired with a clear reward and punishment system for operators. Third, the logistics department must establish an on-site safety stock for critical, imported steam machine components to slash the current 14-day downtime to less than 24 hours.

From a theoretical perspective, this study validates the operations management principles of Heizer & Render by demonstrating how proactive maintenance directly preserves asset capability in a live manufacturing

ecosystem. Practically, these findings provide garment industry managers with a replicable roadmap to balance maintenance budgets with actual floor protection. For PT Cemerlang Jaya Fashion, implementing these solutions optimizes machine availability, eliminates costly delivery delays, and secures a highly resilient supply chain that protects customer loyalty.

This study acknowledges certain limitations, as the data set covers a specific operational window of 26 working days across 12-hour shifts, which may not capture long-term seasonal production spikes or annual machine wear patterns. Additionally, the qualitative approach limits the generalizability of the findings to broader textile conglomerates. Future research should expand this scope by utilizing quantitative simulation models, such as Reliability-Centered Maintenance (RCM) algorithms, over a full fiscal year. Researchers should also investigate the financial trade-offs of integrating Internet of Things (IoT) sensors into garment machinery to transition the industry from preventive to fully predictive maintenance frameworks.

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