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A STUDY ON TOTAL PRODUCTIVITY MAINTENANCE SYSTEMS IN SRD LOGISTICS, SALEM

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Abstract- This study examines the implementation and impact of Total Productivity Maintenance (TPM) systems at SRD Logistics India Private Limited, Salem. TPM is a proactive maintenance strategy that involves all employees in equipment upkeep to maximise operational efficiency and minimise losses. Using a descriptive research design, primary data was gathered from 130 respondents through a structured questionnaire. Statistical tools including simple percentage analysis, Chi-square test, Pearson correlation, and one-way ANOVA were applied. Key findings reveal that 64.6% of respondents are in the early stages of TPM implementation, 73.8% confirm improvement in operation and maintenance skills, and 48.5% strongly agree that TPM enhances overall equipment effectiveness (OEE). The study identifies equipment breakdown (53.1%), Just-in-Time maintenance focus (52.3%), and result-oriented goal formulation (46.2%) as dominant TPM characteristics. Chi-square analysis confirms a significant association between TPM policy orientation and improvement stage selection. ANOVA reveals a significant relationship between educational qualification and perception of TPM productivity contribution ($F = 106.508$, $p < 0.05$). The study concludes that integrating TPM fully into logistics operations—supported by training, employee coordination, and technology—is critical for achieving operational excellence and competitive advantage.

Keywords: *Total Productivity Maintenance, TPM, Overall Equipment Effectiveness, Autonomous Maintenance, Planned Maintenance, Logistics Industry, Salem*

1. INTRODUCTION

1.1 Definition and Meaning of Productivity

Productivity is a measure of the efficiency of production, expressed as a ratio of actual output to the inputs required to produce it. It is measured as total output per one unit of total input. Control managers in a given organization are concerned with maximizing productivity through process-oriented observations and improvements. Productivity refers to the physical relationship between the quantity produced (output) and the quantity of resources used in the course of production (input) — in essence, the ratio between the output of goods and services and the input of resources consumed in the production process.

1.2 What is Total Productivity Maintenance (TPM)?

Total Productivity Maintenance System (TPM) is a strategy that operates on the principle that everyone in a facility should participate in maintenance activities, not just the dedicated maintenance team. This approach harnesses the skills of all employees and seeks to incorporate maintenance into the everyday performance of a facility. TPM is described as a method that integrates both equipment maintenance and the manufacturing process for overall improvement in business processes and increased equipment availability. It is a proactive and comprehensive approach to managing processes, people, the environment, and systems. In organizations that have implemented TPM, the entire team plays an essential role as responsibilities are shared between operators and maintenance experts.

1.3 Four TPM Pillars

The TPM framework is built upon eight pillars: Autonomous Maintenance, Planned Maintenance, Quality Maintenance, Early Equipment Management, Education and Training, Safety, Health and Environment, TPM in Administration, and Focused Improvement. Four essential pillars — Quality Maintenance, Early Equipment Management, Safety and TPM in Administration — are instituted as specific operational needs arise. Quality maintenance is introduced when significant quality issues are raised. Early equipment management is deployed during equipment design or installation phases. Safety, health and environment considerations must always be integrated across all processes.

1.4 Advantages and Disadvantages of TPM

Teams employing a TPM strategy typically experience: reduction in the total workforce required for reactive maintenance, swift rectification of customer complaints, decreased pollution levels through controlled maintenance practices, favourable change in operators' attitude, and higher confidence levels among employees. Direct benefits include reduced accidents and decreased pollution levels. Indirect benefits encompass higher employee confidence, better upkeep of workplaces, and horizontal deployment of new concepts across all departments. However, TPM is considered time-consuming and expensive to implement, particularly for small and medium enterprises.

1.5 Statement of the Problem

The purpose of this research is to study the implementation of TPM at SRD Logistics with the aim of understanding how its benefits are being achieved, how it could be enhanced, and how the gains made could be replicated in similar logistics companies to reduce losses and improve productivity. The company needs to maintain its valuable assets, and the maintenance function must adopt world-class best practices to reach an excellent level of maintenance performance.

1.6 Objectives of the Study

The primary objective is to study and assess the method of implementing Total Productivity Maintenance System (TPM) at SRD Logistics. Specific objectives include:

1. Study the implementation strategies of Autonomous Maintenance (AM) and Planned Maintenance (PM) pillars of TPM at the logistics firm.
2. Improve equipment reliability and maintainability.
3. Cultivate equipment-related expertise among operators.
4. Create an enthusiastic work environment that supports continuous improvement.
5. Evaluate the impact of the re-engineered TPM approach on manufacturing and operational performance.

1.7 Scope and Limitations of the Study

The study analyses productivity and maintenance performance against organisational plans and informs top management of deviations. It assists in counselling and pressurising operating management to establish objectives and collects data for consistency with long-range objectives. Limitations include a confined study period, the willingness of respondents to answer accurately, and difficulties encountered in gathering information from certain departments.

2. REVIEW OF LITERATURE

Basheer M. Khumawala (2017) presented an approach to selecting a suitable TPM system aligned with business strategies using the balanced scorecard methodology. The study highlighted that variant product structures, production variety, and unqualified human resources are key challenges for TPM implementation.

J. M. Allwood (2017) developed a methodology for scenario analysis integrating the 'triple bottom line' concerns of sustainability into scenario planning. The study computed a triple bottom line graphic equaliser to explore trade-offs between economic, environmental, and social impacts relevant to industrial sectors adopting TPM.

J. G. Prendergast (2018) examined the basis of various maintenance management strategies in international manufacturing. The study stressed that wherever manufacturing is the primary activity, procedures for equipment maintenance must be planned, and the probability of breakdowns must be factored into production scheduling.

Gabriela Rusu (2018) underlined that motivation has a central role in achieving high organisational performance. Using Herzberg's dual factors theory, the study found that organisational climate dimensions significantly affect employees' intrinsic and extrinsic motivation in industrial firms, directly influencing TPM adoption.

Simon F. Hurley (2019) investigated manufacturing planning and control (MPC) practices associated with successful company performance across 12 countries. Exploratory factor analysis and discriminant analysis identified key factors — including equipment-oriented practices — associated with successful manufacturing performance.

Peter Willmott et al. (2021) traced the origins of TPM to Japan in 1971, designed to improve machine availability through maintenance. They characterised TPM as a proactive approach aiming to identify issues as early as possible and prevent failures before occurrence, embodying the motto 'zero error, zero work-related accident, and zero loss.'

S. Nakajima (2022) emphasised that TPM requires frequent and systematic maintenance by well-trained machine operators. In this framework, operators understand machinery and identify potential problems before they impact production, decreasing downtime and reducing production costs. Nakajima further linked TPM to lean manufacturing, arguing that unpredictable machine uptime disrupts flow and necessitates excess buffer inventory.

Wireman T. (2022) reiterated that TPM, originating in Japan in 1971, is fundamentally a methodology for 'total process management.' Its proactive stance — identifying issues as early as possible and planning preventively — embodies the principle of zero error, zero work-related accidents, and zero loss across operations.

2.1 Research Gap

While substantial literature exists on TPM implementation in manufacturing sectors, there is limited empirical research examining TPM adoption within the Indian logistics industry, particularly concerning the relationship between employee demographics, policy orientation, and maintenance performance outcomes. This study addresses this gap by providing quantitative evidence from a logistics firm in Salem, Tamil Nadu.

3. RESEARCH METHODOLOGY

3.1 Research Design

This study adopts a descriptive research design. Descriptive research reports what has happened and what is currently happening, allowing the researcher to describe the present situation and understand respondent behaviour in relation to TPM implementation. The study was conducted at SRD Logistics Pvt. Ltd., Salem, over a period of three months.

3.2 Sampling and Data Collection

Convenience sampling was employed as the sampling technique. The total sample size is 130 respondents drawn from the logistics facility in Salem. Primary data was collected through a structured questionnaire administered directly to employees across departments. Secondary data was gathered from company annual reports, published websites, books, and journal articles.

3.3 Statistical Tools

The following statistical tools were used for data analysis:

- Simple Percentage Analysis — to compare distributions and describe the relationship between series of data.
- Chi-Square Test — to determine the significance of association between categorical variables $(O-E)^2/E$.
- Pearson Correlation Analysis — to measure the strength and direction of relationships between continuous variables (r ranges from −1 to +1).
- One-Way ANOVA — to test significant differences between group means using the F-ratio (MST/MSE).

4. DATA ANALYSIS AND INTERPRETATION

4.1 Demographic Profile of Respondents

The demographic analysis reveals that 74.6% of respondents are male and 25.4% are female, reflecting the gender composition of the logistics workforce. The dominant age group is 25–30 years (38.5%), followed by 30–35 years (30.8%). Regarding educational qualifications, 40.0% hold diplomas, 23.1% are school-level educated, 20.0% hold degrees, 9.2% hold postgraduate qualifications, and 7.7% hold above postgraduate qualifications. The largest departmental representation is from the marketing department (30.8%), followed by purchase (23.8%) and recycling (16.9%). Work experience is evenly distributed between 0–5 years and 6–10 years (both 33.8%). The majority (55.4%) earn below ₹10,000 per month.

Table 1: Gender Distribution of Respondents

S.No.	Gender	No. of Respondents	Percentage (%)
1	Male	97	74.6%
2	Female	33	25.4%
	Total	130	100.0%

Table 2: Age Distribution of Respondents

S.No.	Age Group	No. of Respondents	Percentage (%)
1	25–30 years	50	38.5%
2	30–35 years	40	30.8%
3	35–40 years	20	15.4%
4	Above 40 years	20	15.4%
	Total	130	100.0%

Table 3: Educational Qualification of Respondents

S.No.	Qualification	No. of Respondents	Percentage (%)
1	School Level	30	23.1%
2	Diploma	52	40.0%
3	Degree	26	20.0%
4	Post Graduate	12	9.2%
5	Above PG	10	7.7%

S.No.	Qualification	No. of Respondents	Percentage (%)
	Total	130	100.0%

4.2 TPM Implementation Status and Planning

A significant majority (64.6%) of respondents are in the early stages of TPM introduction, while 16.2% report program completion. Regarding goal formulation orientation, 46.2% follow a result-oriented approach to TPM policies, 21.5% focus on attainable goals, and 17.7% hold unrealistic expectations. In terms of implementation stages adopted to improve effectiveness, 41.5% are at the preparation stage, followed by preliminary inspection (27.7%) and stabilization (16.2%).

Table 4: Current Status of TPM Implementation

S.No.	TPM Status	No. of Respondents	Percentage (%)
1	Early stages of introduction	84	64.6%
2	Approximately midway	18	13.8%
3	Completed majority, continuing	7	5.4%
4	Program successfully completed	21	16.2%
	Total	130	100.0%

4.3 Maintenance Operations and Equipment Performance

In terms of maintenance staffing, 40.0% of respondents report having fewer than 5% maintenance planners, while 41.5% have 2–5% maintenance operators. Regarding equipment loss types, 58.5% associate gradual cycle time losses with increased speed, while 53.1% cite breakdown as the primary equipment inability. TPM's most effective loss-reduction focus is on equipment breakdown (43.8%), followed by defects and rework (34.6%). The predominant TPM pillar applied to routine maintenance is Just-in-Time (52.3%), followed by training and education (27.7%).

Table 5: Pillar of TPM Focused on Routine Maintenance

S.No.	TPM Pillar	No. of Respondents	Percentage (%)
1	Training and Education	36	27.7%
2	Just-in-Time	68	52.3%
3	5S	11	8.5%
4	Autonomous Maintenance	15	11.5%
	Total	130	100.0%

4.4 Benefits of TPM Implementation

Regarding benefits of TPM implementation, 48.5% of respondents strongly agree that improvement in overall equipment effectiveness (OEE) is the most significant benefit. Reduction in additional capital investments required was strongly agreed upon by 45.4%, while 47.7% strongly agreed on improvement in equipment availability. Notably, 30.8% strongly disagreed that reduction in number of failures and unplanned downtime has been achieved, indicating this area requires further improvement. Training using seminars (46.2%) is the most strongly agreed educational technique for TPM knowledge dissemination.

Table 6: TPM Benefits — Overall Equipment Effectiveness

Benefit	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Equipment Availability	47.7%	8.5%	10.0%	9.2%	24.6%
Reduction in Failures	29.2%	11.5 %	13.8%	14.6%	30.8%

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Benefit	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Overall Eqpt. Effectiveness	48.5%	32.3 %	8.5%	5.4%	5.4%
Reduction in Capital Investment	45.4%	35.4 %	10.0%	3.8%	5.4%

4.5 TPM Contribution to Productivity

With respect to TPM's contribution to an increase in productivity and facility availability, 39.2% strongly agree, 11.5% agree, 6.9% are neutral, 15.4% disagree, and 26.9% strongly disagree. This distribution indicates that while a majority (50.7%) perceive TPM as productivity-enhancing, a substantial proportion (42.3%) either remain sceptical or perceive limited contribution, suggesting the need for stronger implementation and communication strategies.

Table 7: TPM Contribution to Productivity

S.No.	Response	No. of Respondents	Percentage (%)
1	Strongly Agree	51	39.2%
2	Agree	15	11.5%
3	Neutral	9	6.9%
4	Disagree	20	15.4%
5	Strongly Disagree	35	26.9%
	Total	130	100.0%

4.6 Chi-Square Analysis

H_0: There is no significant relationship between the focused approach to formulating TPM policies and goal and the step taken to improve effectiveness.

H_1: There is a significant relationship between the focused approach to formulating TPM policies and the step taken to improve effectiveness.

Table 8: Chi-Square Test Results

Statistical Test	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	315.000	9	.000
Likelihood Ratio	271.590	9	.000
Linear-by-Linear Association	121.492	1	.000
N of Valid Cases	130	—	—

Result: Since the Pearson Chi-Square value of 315.000 with $p = 0.000 < 0.05$, the null hypothesis is rejected. There is a significant relationship between the TPM policy goal formulation approach and the improvement stage adopted. The Kappa measure of agreement (0.890) confirms near-perfect alignment between the two variables.

4.7 Correlation Analysis

The Pearson correlation between 'stages of loss referring to gradual changes in equipment cycle times' and 'pillar of TPM focusing on routine maintenance' yields a coefficient of $r = 0.863$ ($p < 0.01$, $N = 130$). This strong positive correlation confirms that the nature of equipment cycle-time loss is significantly associated with the TPM pillar prioritised for routine maintenance.

Table 9: Pearson Correlation Results

Variable	Pearson r	Sig. (2-tailed)	N
Stages of Loss (Equipment Cycle Times)	1.000	—	130

Variable	Pearson r	Sig. (2-tailed)	N
Pillar of TPM (Routine Maintenance)	.863**	.000	130

4.8 ANOVA Analysis

H_0: There is no significant relationship between educational qualification and TPM's contribution to an increase in productivity.

H_1: There is a significant relationship between educational qualification and TPM's contribution to an increase in productivity.

Table 10: One-Way ANOVA Results

Source of Variation	Sum of Squares	df	Mean Square	F-Value	Sig.
Between Groups (Combined)	135.123	4	33.781	106.508	.000
Within Groups	39.646	125	.317	—	—
Total	174.769	129	—	—	—

Result: The F-value of 106.508 ($p = 0.000 < 0.05$) is statistically significant, leading to acceptance of H_1. There is a significant relationship between educational qualification of respondents and their perception of TPM's contribution to productivity. Results are significant at the 5% level.

5. FINDINGS

- The majority (74.6%) of respondents are male, reflecting the predominantly male workforce in the Indian logistics sector.
- 38.5% of respondents belong to the 25–30 years age group, indicating a young workforce engaged with TPM systems.
- 40.0% of respondents hold diploma qualifications, which is the most common educational level at the firm.
- 30.8% of respondents work in the marketing department, followed by purchase (23.8%) and recycling (16.9%).
- Experience is equally distributed between 0–5 years and 6–10 years, each at 33.8%.
- 55.4% of respondents earn below ₹10,000 per month, indicating a workforce of largely entry-level operators.
- 64.6% of respondents are in the early stages of TPM introduction, highlighting that full-scale implementation is still in progress.
- 46.2% of respondents follow a result-oriented approach in formulating TPM policies and goals.
- 41.5% identify the preparation stage as the key step to improve equipment effectiveness.
- 73.8% of respondents confirm improvement in operation and maintenance skills through TPM training.
- 58.5% associate gradual equipment cycle time losses with increased speed; 53.1% cite breakdown as the primary equipment inability.
- 52.3% prioritise Just-in-Time as the core TPM pillar for routine maintenance.
- 48.5% strongly agree that ensuring clean and lubricated equipment is the primary advantage of autonomous maintenance.
- 48.5% strongly agree that improvement in overall equipment effectiveness is the most significant benefit of TPM.
- 39.2% strongly agree that TPM contributes to an increase in productivity and facility availability.
- Chi-square analysis confirms a significant association ($p < 0.001$) between TPM policy goal orientation and improvement stage selection.
- A strong positive Pearson correlation ($r = 0.863$) exists between equipment cycle-time loss stage and the routine maintenance pillar applied.
- ANOVA confirms a significant relationship ($F = 106.508$, $p < 0.05$) between educational qualification and perceived TPM productivity contribution.

6. SUGGESTIONS

- The TPM team must be empowered to formulate and execute cost-reduction actions effectively. Clear metrics and accountability structures should be established to translate TPM objectives into measurable financial outcomes.

- Organisations should leverage Overall Equipment Effectiveness (OEE) as the central performance metric, enabling operators and maintenance staff to collaboratively identify improvement opportunities and ensure equipment performance, availability, and quality align with operational targets.
- Future research and managerial attention should extend to product characteristics, vertical integration, automation levels, model mix, and market requirements as additional factors contributing to manufacturing and logistics performance.
- Investment in skill development through structured training programmes — including seminars, slide presentations, and retreats — is essential to build equipment-related expertise among operators and maintenance personnel.
- Companies should institutionalise a planned maintenance schedule to reduce reliance on reactive breakdown maintenance, thereby improving uptime predictability and enabling lean logistics operations.
- Communication channels between operators, maintenance staff, and senior management must be strengthened to ensure TPM team development is perceived consistently across all levels and shifts.

7. CONCLUSION

This study demonstrates that Total Productivity Maintenance Systems are a critical enabler of operational efficiency and equipment performance at SRD Logistics India Private Limited. The empirical findings from 130 respondents confirm that TPM implementation, though currently in its early stages at the firm, is already generating positive outcomes in terms of skill development, maintenance coordination, and equipment effectiveness. Statistical analyses — including Chi-square testing, Pearson correlation, and ANOVA — validate significant relationships between TPM goal orientation, equipment management, and productivity outcomes. The study concludes that strengthening communication, deepening employee training, and institutionalising planned maintenance practices will be critical to realising the full potential of TPM. As the Indian logistics sector continues to expand, organisations that embrace comprehensive maintenance strategies will gain measurable competitive advantages in cost efficiency, equipment reliability, and customer satisfaction.

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