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ADOPTION OF LEAN MANUFACTURING PRACTICES IN TIRUPUR BASED GARMENT MANUFACTURING UNITS

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ABSTRACT
The garment manufacturing industry in Tirupur plays a significant role in India's textile and export sector. In today's competitive environment, garment manufacturers are increasingly adopting Lean Manufacturing practices to improve productivity, reduce waste, enhance quality, and minimize operational costs. This study examines the adoption of Lean Manufacturing practices in Tirupur-based garment manufacturing units and analyzes their impact on operational efficiency and organizational performance. The research focuses on awareness, implementation level, lean tools used, employee training, workflow efficiency, productivity, waste reduction, quality improvement, production time reduction, and cost minimization. Primary data were collected from garment manufacturing units using structured questionnaires. Statistical tools such as percentage analysis and chi-square analysis were used for interpretation. The findings reveal that most organizations have adopted Lean Manufacturing practices and perceive positive outcomes in productivity, quality, efficiency, and waste reduction. However, challenges such as lack of training and resistance to change continue to affect successful implementation. The study concludes that Lean Manufacturing significantly contributes to operational improvement and competitiveness in Tirupur garment manufacturing units.

KEYWORDS: *Lean Manufacturing, Garment Industry, Tirupur, Productivity, Waste Reduction, Operational Efficiency, Lean Tools.*

1. Introduction

1.1 Background of the Study

The textile and garment industry is one of the largest contributors to India's economy, employment generation, and export earnings. Tirupur, popularly known as the "Knitwear Capital of India," has emerged as a major hub for garment manufacturing and exports. Increasing competition, changing customer expectations, rising production costs, and global quality standards have compelled garment manufacturers to adopt modern management techniques to improve efficiency and competitiveness.

Lean Manufacturing is a systematic approach aimed at eliminating waste, improving productivity, reducing lead time, and enhancing product quality through continuous improvement practices. Lean principles originated from the Toyota Production System (TPS) and have been widely adopted across manufacturing industries worldwide. Lean tools such as 5S, Just-In-Time (JIT), Kaizen, Kanban, Value Stream Mapping (VSM), and Line Balancing help organizations streamline production processes and improve operational performance.

The adoption of Lean Manufacturing practices in garment manufacturing units can help reduce non-value-added activities, improve workflow efficiency, enhance employee productivity, and reduce operational costs. Therefore, this study focuses on analyzing the adoption and effectiveness of Lean Manufacturing practices among Tirupur-based garment manufacturing units.

1.2 Need for the Study

The garment industry faces several operational challenges such as production delays, excess inventory, wastage, quality defects, high production costs, and inefficient workflow systems. Lean Manufacturing practices provide effective solutions to overcome these challenges by improving process efficiency and reducing waste.

Although many organizations have started implementing Lean practices, the level of awareness, adoption, and effectiveness varies across companies. Hence, this study is conducted to understand the extent of Lean Manufacturing adoption and its impact on garment manufacturing units in Tirupur.

1.3 Statement of the Problem

Despite the growing importance of Lean Manufacturing, many garment manufacturing units still face issues related to waste generation, low productivity, production delays, employee resistance, and lack of training. Some organizations may not fully understand or effectively implement Lean practices. Therefore, the study aims to identify the level of adoption, benefits, and challenges associated with Lean Manufacturing practices in Tirupur garment manufacturing units.

1.4 Objectives of the Study

1. To examine awareness of Lean Manufacturing practices among garment manufacturing units.

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2. To analyze the adoption level of Lean Manufacturing practices.
3. To identify commonly used Lean tools in garment manufacturing units.
4. To evaluate the impact of Lean Manufacturing on productivity, quality, workflow efficiency, waste reduction, and cost reduction.
5. To identify challenges faced during Lean Manufacturing implementation.
6. To provide suggestions for improving Lean Manufacturing adoption.

1.5 Scope of the Study

The study focuses on garment manufacturing units located in Tirupur. It examines Lean Manufacturing awareness, implementation practices, benefits, and challenges among owners and managers of garment manufacturing companies. The findings may help organizations improve operational efficiency and strengthen competitiveness through effective Lean implementation.

1.6 Limitations of the Study

- The study is limited to Tirupur-based garment manufacturing units only.
- The sample size is limited and may not represent the entire garment industry.
- The study depends on respondents' opinions, which may contain bias.
- Time constraints limited detailed analysis.

2. REVIEW OF LITERATURE

- **Rosario Domingo et al. (2007)** studied materials flow improvement in lean assembly lines and found significant reductions in idle time, inventory, and dock-to-dock time through lean logistics practices.
- **Muchiri and Pintelon (2008)** emphasized the importance of Overall Equipment Effectiveness (OEE) in improving equipment performance and productivity through TPM and Lean Manufacturing practices.
- **O.P. Yadav et al. (2010)** highlighted that successful Lean implementation requires strong leadership, standardization, continuous improvement, and organizational learning culture.
- **Rajab Abdullah Hokoma (2010)** found that awareness and implementation of JIT techniques in textile industries were limited due to lack of familiarity and weak management commitment.
- **Sharma Neha et al. (2013**) observed that lean tools such as TPM, JIT, Kaizen, and 5S significantly improve efficiency, reduce downtime, and enhance competitiveness.
- **Daniel Arefayne Legesse and Ajit Pal Singh (2014)** reported increased productivity and reduced labor costs in garment industries through line balancing and work standardization.
- **Mihir K. Shah et al. (2017)** identified that SMED and lean tools improved OEE and productivity while reducing setup time and operational waste.
- **Ertay et al. (2018**) concluded that Lean Manufacturing significantly improves productivity, process flow, and employee involvement while reducing waste.
- **V. Saravanan et al. (2018)** found that Value Stream Mapping and Kaizen improved operational efficiency, reduced processing time, and minimized non-value-added activities.
- **Mahboob Al Bashar et al. (2024)** highlighted that leadership support, employee involvement, training, and organizational culture are critical for successful Lean transformation.

3. RESEARCH METHODOLOGY

3.1 Research Design

The study adopts a descriptive research design.

3.2 Sources of Data

Primary Data: Collected through structured questionnaires.
Secondary Data: Collected from journals, books, reports, websites, and previous studies.

3.3 Sampling Technique

Convenience sampling method was used.

3.4 Sample Size

The study consists of 55 companies from Tirupur-based garment manufacturing units.

3.5 Statistical Tools Used

- Percentage Analysis

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- T-Test

3.6 Independent Sample T-Test

1. **Position vs Awareness of Lean Manufacturing**

S.no	Position	N	Mean	SD	T value	P value
1	Manager	12	2.25	1.138		
2	Owner	19	2.58	1.017	-0.838	0.409

Hypothesis

(H_0): There is no significant difference in the awareness of lean manufacturing between the groups.
(H_1): There is a significant difference in the awareness of lean manufacturing between the groups.

Interpretation

- The Independent Samples t-test result shows that the significance value for Levene's Test is 0.624, which is greater than 0.05. Therefore, equal variances are assumed.
- Under the equal variances assumed condition, the t-value is -0.838 with 29 degrees of freedom, and the p-value (Sig. 2-tailed) is 0.409, which is greater than the 0.05 significance level. Hence, the null hypothesis is accepted and the alternative hypothesis is rejected.
- This indicates that there is no statistically significant difference in the awareness of lean manufacturing between the groups. The mean difference is -0.329, and the 95% confidence interval ranges from -1.132 to 0.474, which includes zero, further confirming that the difference is not significant.

3.7 Cross Table

1. **Years of Experience vs Lean Adoption**

Year of Experience	Yes	No	Total
less than 1 year	0	5	5
1-5 years	11	15	26
5-10 years	11	3	14
more than 10 years	9	1	10
Total	31	24	55

Interpretation

- The table shows the relationship between respondents' years of experience and their Yes/No responses. Respondents with less than 1 year of experience predominantly answered "No" (5 respondents), while none answered "Yes." In contrast, respondents with higher levels of experience, particularly those with 5–10 years and more than 10 years of experience, mostly answered "Yes."
- Among respondents with 1–5 years of experience, 11 answered "Yes" and 15 answered "No," indicating mixed opinions. However, respondents with 5–10 years of experience showed a stronger positive response pattern, with 11 answering "Yes" and only 3 answering "No." Similarly, respondents with more than 10 years of experience mostly responded "Yes" (9 respondents) compared to only 1 "No" response.
- Overall, the findings suggest that as years of experience increase, respondents are more likely to provide positive ("Yes") responses. This indicates a possible association between work experience and awareness, acceptance, or implementation of the studied concept.

2 Establishment of Company vs Level of Lean Implementation

Establishment of the Company	Low	High	Total
1-5 years	1	6	7
5-10 years	1	8	9
more than 10 years	1	14	15
Total	3	28	31

Interpretation

- The table presents the relationship between the establishment period of the company and the level of responses categorized as low and high. Among companies established for 1–5 years, 6 respondents reported a high level while only 1 respondent reported a low level. Similarly, in companies established for 5–10 years, the majority of respondents (8) indicated a high level, whereas only 1 respondent indicated a low level.
- Companies established for more than 10 years showed the highest number of high-level responses, with 14 respondents reporting high and only 1 respondent reporting low. Overall, out of 31 respondents, 28 reported a high level and only 3 reported a low level.

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- The findings indicate that companies with longer establishment periods tend to demonstrate higher levels of the studied factor. This suggests that organizational maturity and experience may positively influence awareness, adoption, or implementation practices within the company.

4. Percentage analysis

Response Category	Strongly Disagree	Disagree	Neutral	Agree	Strongly Disagree	Total	Mean
Productivity Increased	10	13	3	1	4	31	3.77
Improved Quality	6	16	4	1	4	31	3.61
Reduced Production Time	9	15	1	2	4	31	3.74
Cost Reduction	6	16	4	1	4	31	3.61

Interpretation

The table presents respondents' opinions regarding the impact of Lean Manufacturing implementation on productivity, quality improvement, production time reduction, and cost reduction in Tirupur-based garment manufacturing units. The mean values for all factors are above 3.5, indicating an overall positive perception toward Lean Manufacturing practices.

Among the four factors, **productivity increased** recorded the highest mean score of **3.77**, showing that respondents strongly believe Lean implementation has enhanced organizational productivity. Similarly, **reduced production time** obtained a mean score of **3.74**, indicating that Lean practices have helped improve operational efficiency by minimizing delays and wastage in production processes.

Both **improved quality** and **cost reduction** recorded a mean value of **3.61**, which also reflects a favorable opinion among respondents. The majority of respondents either agreed or strongly agreed that Lean Manufacturing contributed to better product quality and reduced operational costs.

Overall, the findings suggest that Lean Manufacturing practices have positively influenced the performance of garment manufacturing units by improving productivity, enhancing quality, reducing production time, and lowering costs.

5. FINDINGS OF THE STUDY

- Owners and managers are equally represented among respondents.
- Most respondents have 1–5 years of industry experience.
- Many garment manufacturing units are relatively young organizations.
- Most companies belong to the small and medium enterprise category.
- The majority of firms mainly operate in the domestic market.
- More than half of respondents are aware of Lean Manufacturing practices.

- Most companies have adopted Lean Manufacturing practices.
- Lean practices have been implemented in many firms for more than three years.
- 5S, JIT, and line balancing are the most commonly used Lean tools.
- Most organizations use Lean tools daily in operations.

- Many companies provide employee training related to Lean practices.
- Standard procedures are followed in most organizations.
- Most firms show moderate to high levels of Lean implementation.
- Lean practices are applied across all stages of production.
- Lean Manufacturing improves workflow efficiency and productivity.
- Lean practices effectively reduce waste and operational costs.
- Quality and production speed improved after Lean implementation.

- Most respondents are satisfied with Lean Manufacturing practices.
- Lack of training and awareness still exists in some organizations.
- Resistance to change remains a major challenge in Lean implementation.

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6. SUGGESTIONS

- Organizations should conduct regular Lean Manufacturing training programs.
- Management should encourage employee participation in Lean activities.
- Awareness programs should be organized to improve Lean understanding.
- Companies should adopt integrated Lean tools across all production stages.
- Resistance to change can be minimized through proper communication and involvement.
- Continuous monitoring and evaluation of Lean performance should be practiced.
- Small-scale garment units should be encouraged to adopt Lean practices.
- Government and industry associations can support Lean implementation through workshops and technical guidance.

7. CONCLUSION

The study concludes that Lean Manufacturing practices are increasingly adopted among Tirupur-based garment manufacturing units and have positively influenced operational performance. Most organizations reported improvements in productivity, workflow efficiency, quality, waste reduction, production speed, and cost minimization after implementing Lean practices. Lean tools such as 5S, JIT, and line balancing are widely used in daily operations, reflecting a strong commitment toward continuous improvement.

However, challenges such as lack of training, insufficient awareness, and resistance to change still affect effective Lean implementation in some organizations. Therefore, garment manufacturing units should focus on employee training, organizational support, and continuous improvement strategies to maximize the benefits of Lean Manufacturing. Overall, Lean Manufacturing has become an important approach for enhancing competitiveness, operational efficiency, and long-term sustainability in the Tirupur garment industry.

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