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Lean Production Model to Improve OTIF Using 5S, Standardized Work and TPM in a Footwear SME: A Case Study

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Abstract

This study presents a production model based on Lean Manufacturing tools to optimize the On-Time In-Full (OTIF) indicator in a Peruvian SME dedicated to footwear manufacturing. The initial diagnosis identified critical inefficiencies in the cementing and lasting areas, linked to disorganization, technical failures, low standardization, and deficient maintenance. These issues resulted in defective products, unplanned stoppages, and low delivery reliability. The methodology employed combined trial testing of the 5S tool with simulations in Arena software to validate the impact of Standardized Work and Total Productive Maintenance (TPM). The results show an increase in OTIF from 80.70% to 88.1%, a reduction in the percentage of defective products from 9.63% to 3.03%, and an improvement in equipment availability from 84.70% to 87.60%. Furthermore, the model underwent an economic evaluation, confirming its viability in resource-constrained environments. This research substantiates that the structured integration of Lean tools enhances operational performance, product quality, and process efficiency in SMEs.

Keywords
Lean manufacturing, 5S, TPM, standardized work, footwear SME

1. Introduction
The footwear industry in Latin America is a sector with significant economic and social impact, ranking as the second-largest producing region globally, exceeded only by Asia (Benavides, 2024). In Peru, the leather and footwear industry contributed approximately USD 150 million to the manufacturing gross domestic product (GDP) in 2024 and generated employment for over 64 000 people, establishing itself as one of the country's most relevant non-primary industrial branches (Ministerio de la Producción, 2024). However, it faces an adverse environment characterized by a sustained decline in production, high informality, and a high concentration of SMEs that must adapt to new demands for efficiency and quality.

One of the primary operational challenges for SMEs in this sector is the low compliance with OTIF deliveries, a key indicator reflecting responsiveness to demand and customer trust. Recent studies (Anzualdo-Espinoza et al., 2023; Campoblanco-Carhuachin et al., 2022) have demonstrated that implementing Lean Manufacturing tools can significantly improve this indicator. Most research has focused on textile companies or large manufacturers, overlooking sectors like footwear, particularly specific process areas such as cementing and lasting.

This research distinguishes itself by integrating three Lean tools rarely addressed together in footwear sector SMEs: 5S methodology, Standardized Work, and TPM. Furthermore, it contributes to scientific knowledge by focusing on the cementing and lasting areas within a Peruvian footwear SME, where critical operational inefficiencies were identified: workplace disorganization, high variability in procedures, and low equipment availability. To solve these issues, we propose an improvement model adapted for resource-constrained contexts, yet possessing high transformational potential.

The validation of the proposed model combines trial testing with simulations in Arena software, allowing for the evaluation of its impact on quality, efficiency, and operational availability. This article is structured beginning with the initial diagnosis; subsequently, the selected Lean tools and their link to the identified problems are described; following that, the results of the functional validation are detailed; and finally, the model's sustainability and its applicability in similar contexts are discussed.

1.1 Objectives

The main objective is to design an improvement model based on Lean Manufacturing tools to increase OTIF in a Peruvian footwear SME.

Specific Objectives:

- To reduce the defective product rate in the cementing area by implementing standardized work procedures.
- To enhance workplace organization and reduce inefficiencies in the cementing area using the 5S methodology.
- To improve machine availability in the lasting area through the application of TPM.

2. Literature Review

The Systematic Literature Review (SLR) aimed at investigating and identifying advancements, limitations, and knowledge gaps applicable to the footwear manufacturing process. The study has employed a descriptive and exploratory approach. The PRISMA methodology was utilized, involving a structured process for searching, selecting, evaluating, and synthesizing relevant articles. In the initial data collection phase, a total of 126 documents were identified. However, after applying the inclusion and exclusion criteria, 20 articles were selected as the final sample for the investigation. Subsequently, the findings from these studies were contrasted to establish the state-of-the-art regarding optimization alternatives in footwear production.

In recent years, manufacturing SMEs have faced the challenge of maintaining competitiveness in increasingly demanding production environments. The footwear sector in Latin America has shown significant gaps in key indicators such as OTIF, final product quality, and operational efficiency, as noted by Benavides (2024). To address this issue, many studies have proposed adopting Lean manufacturing tools, such as 5S, Standardized Work, and TPM, to optimize critical processes in textile and footwear companies.

Recent studies have documented how the combined implementation of Lean tools can reduce cycle times, eliminate waste, and increase production system efficiency. Jarufe-Majluf et al. (2022) employed Kanban, TPM, and 5S in a textile factory, achieving a 15% reduction in lead times and a 20% increase in OTIF. Bernardo-Saavedra et al. (2023) reported a 22% improvement in delivery compliance in a footwear workshop after applying 5S and process standardization. These findings align with those of Campoblanco-Carhuachin et al. (2022), who integrated work standardization and SMED to reduce unfulfilled orders by 25%, consolidating a significant improvement in operational performance.

The effectiveness of the 5S tool in optimizing the work environment and improving quality performance has been widely documented. According to Vigo et al. (2022), the systematic implementation of 5S in footwear workshops led to a reduction of losses due to disorganization by 22%, while Roca-Limache et al. (2025) demonstrated the application of a Lean model based on the 5S methodology achieved a 54.39% increase in labor productivity and contributed to the reduction of process inefficiencies and defects in a medium-sized footwear company. Castillo et al. (2023) and Acevedo-Aybar et al. (2024) agree that these outcomes stem from process standardization, the elimination of unnecessary activities, and enhanced operational visibility, all of which directly improve productivity.

Furthermore, standardized work has proven to be a key tool for reducing variability in task execution and improving product quality. Multiple studies have shown a significant reduction in defect rates when clear operational sequences are defined and followed. Villena-Cruzado et al. (2025) implemented Lean-TPM practices supported by standardized work procedures and 5S methodology in a Peruvian textile SME, achieving a 60.52% reduction in defective rates and a 36.61% improvement in overall equipment effectiveness (OEE). In the footwear sector, Vigo et al. (2022) observed an 18% decrease in lasting errors after applying standardized procedures, confirming that clearly defined work standards contribute directly to product uniformity and operational efficiency.

As for TPM, its application has been crucial for reducing downtime due to technical failures and improving equipment availability. According to Ávila-Pisco et al. (2023), TPM implementation increased Overall Equipment Effectiveness (OEE) from 54.19% to 72.68% by decreasing unplanned downtime. Quiroz-Flores et al. (2023) reported a 34% reduction in unproductive times through autonomous maintenance in a clothing production line. These findings support Bonifácio and Martins (2021) assert that operator involvement in basic inspection and cleaning tasks reduces the recurrence of failures and strengthens process sustainability.

In summary, recent literature supports the integrated use of Lean tools in footwear sector SMEs as an effective strategy for optimizing order fulfillment. This research aims to contribute to bridging the gap in the joint application of 5S, Standardized Work, and TPM in real contexts of Peruvian SMEs, proposing a comprehensive improvement model validated through simulation and trial testing application.

3. Methods

This research adopts a quantitative-applied approach aimed at improving the operational performance of a Peruvian SME in the footwear sector. The study was supported by the PDCA (Plan, Do, Check, Act) methodology to structure the practical implementation phase.

The main problem was identified as a low OTIF delivery rate, which resulted in an estimated annual loss of approximately USD 3494.79. A technical gap analysis revealed a 5.30% deviation from the industry benchmark (target: 90%, current: 84.70%).

A problem tree analysis was developed to map the primary contributors to the low OTIF performance (see Figure 1). It revealed that 51.5% of the issue stemmed from high defect rates in the cementing area, while 40.7% originated from delays in the lasting process. Root causes included a lack of standardized procedures, disorganized workstations, equipment failures, and ineffective maintenance routines.

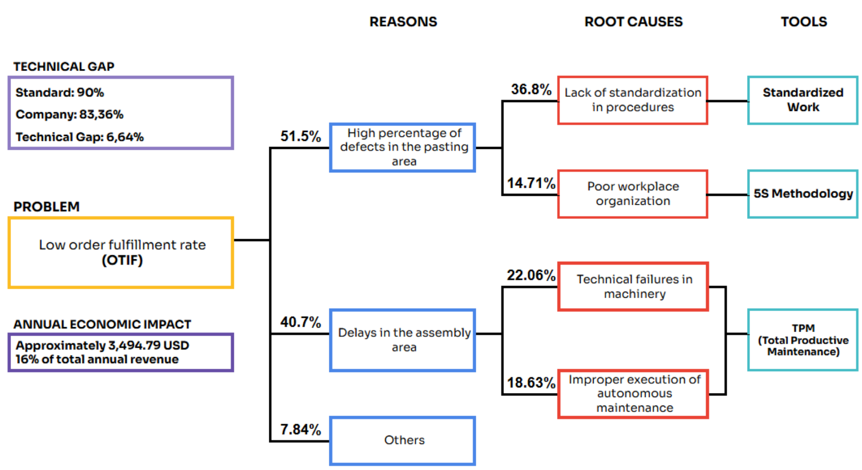


Figure 1. Root cause analysis of low OTIF performance and corresponding lean tools

Subsequently, the measurement phase involved the systematic collection of quantitative data related to OTIF, defect rate, equipment downtime Data were obtained through direct observation, interviews with operators, and review of production and maintenance logs. Standard time measurements were also collected to support the later simulation.

During the analysis phase, an Ishikawa diagram and Pareto analysis were employed to identify the most significant root causes. It was determined that a substantial share of defects originated from inadequate workplace organization and the absence of standard operating procedures, while equipment failures were linked to insufficient autonomous maintenance practices.

To address the identified root causes, the following Lean Manufacturing tools were selected and implemented:

- The 5S methodology was tested in the cementing area to enhance workplace organization.
- TPM was proposed to reduce unplanned downtime in the lasting process.
- Standardized Work was introduced to ensure consistency in critical manual operations.

A simulation model was developed using Arena Simulation Software to evaluate the projected impact of TPM and Standardized Work under controlled conditions. The model was built using real-time operational data and validated through multiple replications.

A 5S closing audit was conducted to assess implementation fidelity. Post-intervention values for OTIF, defect rate, and machine availability were compared to baseline data to quantify improvement. In parallel, a PDCA-based improvement model was adopted to reinforce the sustainability of the interventions and serve as a guideline for future improvement cycles (see Figure 2).

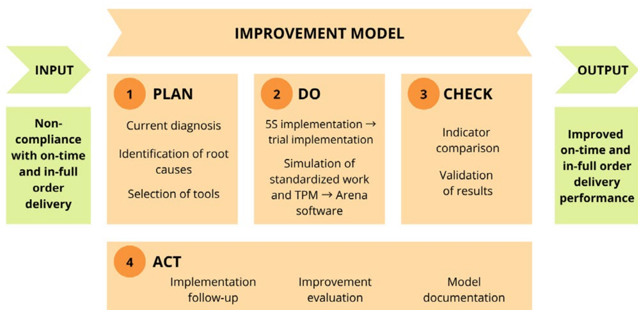


Figure 2. Improvement model based on the PDCA (Plan–Do–Check–Act) cycle

4. Data Collection

To establish the performance baseline of the footwear manufacturing system and support the validation of Lean Manufacturing interventions, a structured data collection process was carried out using real operational data from a Peruvian footwear company. The data were obtained through direct observation, time studies, internal records, quality reports, and maintenance logs covering the full 2024 production year.

The analysis focused on four key performance indicators (KPIs): OTIF, defective unit rate, machine availability, and 5S compliance. These indicators were selected due to their relevance in measuring delivery performance, product quality, equipment efficiency, and workplace organization, respectively.

4.1 OTIF Measurement

The OTIF indicator was calculated based on dispatch and fulfillment records collected throughout 2024. A total of 2722 customer orders were recorded, which defines the denominator of the metric. Out of these, 2197 orders were successfully delivered both on time and in full, comprising the numerator. The OTIF value was calculated using Equation (1):

$$OTIF = \left(\frac{Number\ of\ orders\ delivered\ on\ time\ and\ in\ full}{Total\ number\ of\ orders}\right) \times 100 = \frac{2197}{2722} \times 100 = 80.7\% \qquad (1)$$

To analyze the most critical product line, the "brasileña" model was selected, as it represented 32.89% of all orders and exhibited the highest rate of late deliveries. However, evaluating the full population of 899 orders for this model was not feasible due to time and resource constraints. Therefore, a statistically representative sample was determined using the finite population correction formula, with a 95% confidence level and a 5% margin of error. In this formula, the numerator includes the product of the population size (899), the squared z-score for the desired confidence level (1.96), and the estimated population variance (0.5 × 0.5). The denominator consists of the product of the squared margin of error (0.05) and the population size minus one (899 − 1), added to the same expression used in the numerator. The resulting sample size was 270 orders, as calculated in Equation (2):

$$n = \left(\frac{N \times Z^2 \times p \times (1-p)}{e^2 \times (N-1) + Z^2 \times p \times (1-p)}\right) = \frac{899 \times 1.96^2 \times 0.5 \times 0.5}{0.05^2 \times (899-1) + 1.96^2 \times 0.5 \times 0.5} = 270 \quad (2)$$

This allowed for a focused and statistically valid OTIF analysis of the most critical product type.

4.2 Defective Unit Rate

The defective unit rate was determined using quality control reports and visual inspections conducted across various production stages. The highest rejection rate was observed in the cementing section, which was therefore selected for detailed analysis. During 2024, a total of 2180 dozens were processed in this section, of which 210 dozens were rejected due to quality issues. The defective unit rate was calculated using Equation (3), where the denominator corresponds to the total number of dozens produced (2180), and the numerator represents the number of dozens rejected due to defects (210).

$$Defective\ Unit\ Rate(\%) = \left(\frac{Number\ of\ Defective\ Units}{Total\ Number\ of\ Units\ Produced}\right) \times 100 = \frac{210}{2180} \times 100 = 9.63\% \quad (3)$$

4.3 Machine Availability

Machine availability was assessed using maintenance and production records for the lasting machine, a critical workstation in the footwear production process. In 2024, the machine experienced seven breakdowns, each requiring an average of 72 hours to repair, resulting in a total downtime of 504 hours. The machine was scheduled to operate for 3120 hours over the year, based on 312 working days at 10 hours per day. Therefore, the actual operating time was 2643 hours (scheduled time minus downtime). Machine availability was calculated using Equation (4), where the numerator represents the actual operating time (2643 hours), and the denominator corresponds to the total scheduled time (3120 hours).

$$Availability\ \ Rate(\%) = \left(\frac{Actual\ Operating\ Time}{Planned\ Production\ Time}\right) \times 100 = \frac{2643}{3120} \times 100 = 84.7\% \quad (4)$$

5. Results and Discussion

5.1 Numerical Results

The results obtained after applying Lean Manufacturing tools show a significant improvement in the main KPIs considered in this research. The OTIF fulfillment rate increased from 80.7% to 88.1%, demonstrating an enhanced ability to deliver complete products on schedule.

Regarding the defective product rate, a reduction from 9.63% to 3.03% was observed. This result validates the effectiveness of Standardized Work in decreasing human errors and reworks. Likewise, equipment availability in the lasting area improved from 84.7% to 87.6%, a direct result of TPM implementation, especially the autonomous maintenance pillar, which significantly reduced unplanned stoppages.

Finally, the 5S index in the cementing area increased from 60% to 75%, reflecting that a more organized, clean, and efficient workplace also contributes to minimizing process errors. In summary, these quantitative improvements substantiate the viability of the proposed model for production contexts with operational constraints, such as manufacturing SMEs in the footwear sector. The summary of the results is shown in Table 1.

Table 1. Improvement Results

Indicator	Associated Component	As-Is (Actual)	To-Be (Expected)	Achieved
OTIF	Integrated Solution	80.7%	> 90%	88.1%
5S Methodology Index	5S	60 %	≥ 80 %	75%
% Defective Products	Standardized Work	9.63%	1 %	3.03%
Equipment Availability	TPM	84.7%	90%	87.6%

5.2 Graphical Results

To model the dynamic behavior of the production system, a discrete-event simulation was developed using Arena Software. The model incorporates the sequence of operations, workstations, resource constraints, and failure logic of the real process. Two scenarios were compared: the AS-IS model representing current conditions, and the TO-BE model including the proposed Lean improvements (see Figure 3).

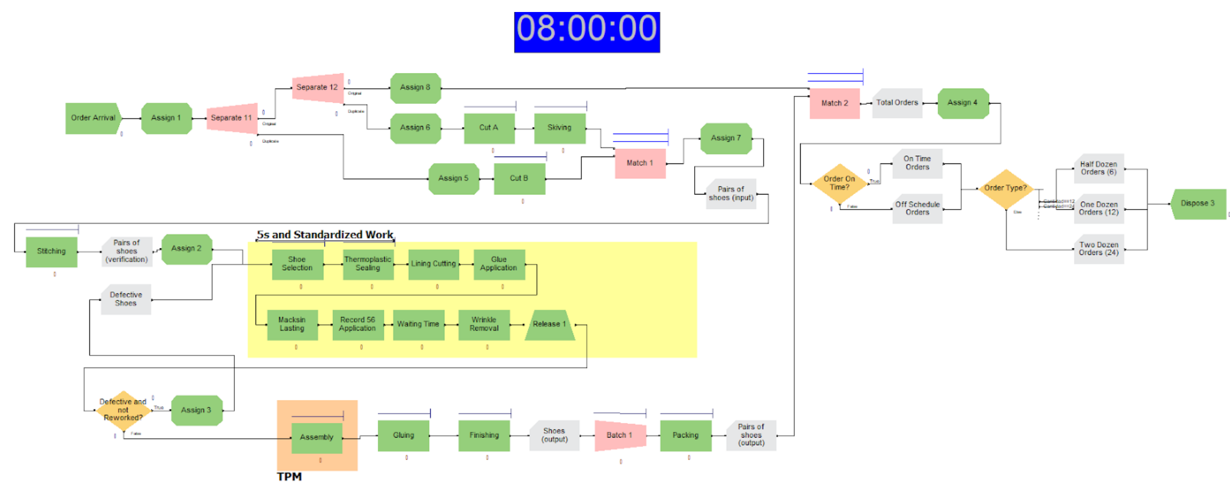


Figure 3. Improved Arena simulation model.

According to Torres Vega (2016), the comparison of means using paired samples involves evaluating two methods applied to the same experimental units to prevent other factors from influencing the results. Figure 4 illustrates the analysis between the AS-IS and TO-BE models, which was obtained using a paired-samples of Student's t-test. The 95% confidence interval for the mean difference ranges from 3.07% to 11.7%. Given that this interval does not include the value zero and the p-value is less than 0.05, it is concluded that the observed improvement in the OTIF rate is statistically significant, validating that the application of task standardization and autonomous maintenance generated a positive impact on delivery reliability.

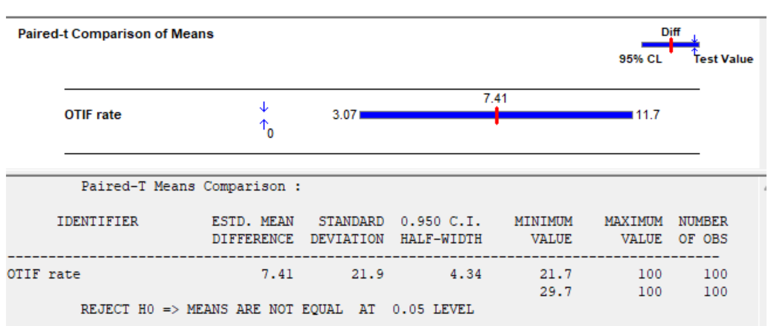
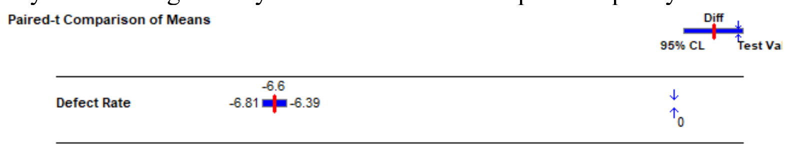


Figure 4. OTIF (%) – Output Comparison Between Models

The implementation of standardized procedures in the cementing area led to a reduction in the proportion of defective products. As illustrated in Figure 5, the TO-BE model exhibits lower means compared to the AS-IS model, reflecting an improvement in process performance. To verify the significance of this difference, a paired-samples of Student's t-test were applied, yielding a 95% confidence interval that ranges from -6.81% to -6.39%. Since this interval does not encompass zero and the p-value was less than 0.05, it is demonstrated that the reduction in the defect rate is statistically significant. This finding supports the hypothesis that work standardization reduces operational variability and production errors, thereby contributing directly to the enhancement of process quality.



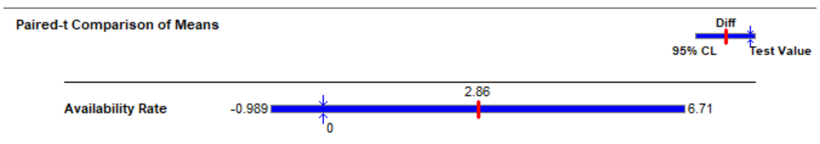
Paired-T Means Comparison :

IDENTIFIER	ESTD. MEAN DIFFERENCE	STANDARD DEVIATION	0.950 C.I. HALF-WIDTH	MINIMUM VALUE	MAXIMUM VALUE	NUMBER OF OBS
Defect Rate	-6.6	1.06	0.211	2.55	6.73	100
				8.33	13.9	100

REJECT H0 => MEANS ARE NOT EQUAL AT 0.05 LEVEL

Figure 5. Defect Rate (%) – Output Comparison Between Models

In the case of equipment availability, a numerical increase was observed following the implementation of autonomous maintenance; however, the difference did not reach statistical significance. As shown in Figure 6, the analysis using a paired t-test, with a 95% confidence level, yielded a confidence interval between −0.989 and 6.71. Since this interval includes the value zero ($p>0.05$), it indicates that the null hypothesis cannot be rejected. Consequently, although the TPM strategy shows positive initial effects on availability, the results suggest that a more sustained and comprehensive implementation is required to achieve statistically significant and long-term sustainable improvements.



Paired-T Means Comparison :

IDENTIFIER	ESTD. MEAN DIFFERENCE	STANDARD DEVIATION	0.950 C.I. HALF-WIDTH	MINIMUM VALUE	MAXIMUM VALUE	NUMBER OF OBS
Availability Rate	2.86	19.4	3.85	29.7	100	100
				36.5	100	100

FAIL TO REJECT H0 => MEANS ARE EQUAL AT 0.05 LEVEL

Figure 6. Availability Rate (%) – Output Comparison Between Models

These graphical representations complement the quantitative findings and offer a visual and statistical validation of the system's improved performance after applying Lean Manufacturing tools.

5.3 Proposed Improvements

The proposed model integrates Lean Manufacturing tools sequentially and adapted to the reality of a footwear sector. The 5S methodology, applied as a trial testing, enabled the reorganization of the cementing area, the implementation of visual routines, and the introduction of sustainable order and cleanliness principles. This intervention contributed to reducing errors, improving movement efficiency, and establishing the foundation for work standardization. Along these lines, Standardized Work was designed based on direct process observation, identifying best practices, and defining an optimal sequence of activities. These activities were systematized into an operating manual, whose application significantly reduced task variability and the quantity of defective products (see Figure 7).

Figure 7. Before and after comparison of the cementing area following 5S implementation.

A structured 5S audit was conducted in the cementing section using a 25-item checklist covering the five pillars: Sort, Set in Order, Shine, Standardize, and Sustain (see Figure 8). The initial evaluation yielded a score of 60 out of 100, revealing deficiencies in organization, visual control, and cleanliness. After implementing basic 5S actions such as tool labeling, visual layout improvements, and scheduled cleaning routines, the score increased to 75, indicating a measurable improvement in workplace order and discipline.

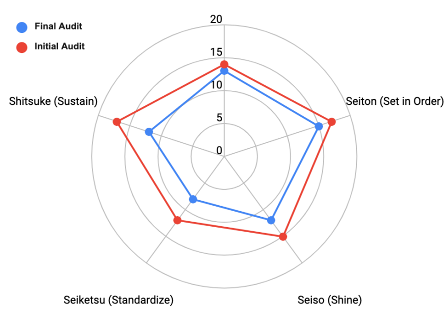


Figure 8. 5S Framework Diagram

In the lasting area, the TPM proposal was validated through simulations using Arena software. These simulations modeled scenarios with autonomous maintenance applied by operators to reduce the frequency of failures. The simulated results demonstrated that this strategy has high potential to increase equipment availability, decrease downtime, and enhance operational efficiency.

In addition, a FIFO-based control system was implemented in the cementing process to ensure proper adhesive curing time. This system was designed in accordance with ASTM D905, which establishes the minimum curing time required for effective bonding in wood-based materials. A curing interval of 8 to 10 minutes was defined and controlled using a color-coded visual rack system (see Figure 9). By applying this standard, it was possible to reduce bonding failures and improve product consistency.

Figure 9. FIFO-based curing rack designed under ASTM D905 guidelines to regulate drying time.

Finally, we recommend extending the application of the model to other areas of the production process, and incorporating new indicators that evaluate environmental, social, or strategic management aspects. These actions will strengthen its impact and increase the company's competitiveness in the medium and long term.

5.4 Discussion

The results obtained following the implementation of Lean Manufacturing tools demonstrate significant improvements in key performance indicators (KPIs), aligning with findings reported in the reviewed literature. For the OTIF indicator, an increase from 80.7% to 88.1% was achieved, representing a notable advance towards the sector standard (>90%). This outcome is consistent with studies by Jarufe-Majluf et al. (2022), who reported a 20% increase in order fulfillment rates by applying Kanban, TPM, and 5S in a textile factory. Similarly, Bernardo-Saavedra et al. (2023) documented a 22% improvement in delivery compliance through the application of 5S and standardized work in footwear workshops. Although the results of this research did not reach the sectoral target, they reflect a positive trend comparable to other successful applications of the Lean approach.

Regarding workplace organization, the 5S methodology index increased from 60% to 75%. While the expected threshold of ≥80% was not met, a substantial reduction in disorganization and an improvement in material availability are evident. This aligns with findings reported by Vigo et al. (2022), who identified a reduction of up to 22% in losses due to disorganization after applying 5S in footwear workshops. Likewise, Roca-Limache et al. (2025) demonstrated a 54.39% increase in labor productivity in footwear manufacturing, attributed to reduced inefficiencies and improved workplace organization following the implementation of the 5S model. In this context, the present research reaffirms that 5S is a key tool for improving the work environment, although reinforcing the final stage is required to achieve higher levels.

Concerning product quality, the percentage of defective products was reduced from 9.63% to 3.03% after applying standardized work. This improvement aligns with observations by Vigo et al. (2022) observed an 18% decrease in lasting errors following the application of standardized procedures in footwear. Similarly, Bernardo-Saavedra et al. (2023) documented a significant reduction in defects by introducing work standards in footwear production. Despite not reaching the 1% target, the achieved reduction demonstrates that operational standardization directly contributes to improving quality, especially in contexts of high variability such as the company under study.

Equipment availability increased from 84.7% to 87.6% through the implementation of TPM. This result is consistent with studies by Ávila-Pisco et al. (2023), where availability improved from 54.19% to 72.68% due to reduced unplanned stoppages. Nevertheless, the 90% target was not yet reached, highlighting the need to strengthen feedback cycles and systematically evaluate machine performance.

Finally, the obtained results are consistent with the reviewed literature and demonstrate that the integrated application of Lean tools has a positive impact on operational efficiency, product quality, and order fulfillment. Unlike many studies that analyze the isolated application of tools, this research proposes an integrated model, validated through simulation and pilot tests, which can be replicated in other manufacturing SMEs with similar characteristics. However, gaps still exist in achieving certain standards, indicating that the improvement process must be sustained and accompanied by a continuous monitoring system to consolidate the advances attained.

Despite these positive outcomes, certain limitations should be acknowledged when interpreting the findings. First, the research is confined to a single case study, using historical data from a Peruvian footwear SME just from the 2024 production year, which limits generalize the results to other business contexts or different time periods. Second, the analysis focused on the "brasileña" shoe model, selected due to its high sales volume and significant impact on delivery performance indicators; therefore, outcomes may vary for other product lines. Third, the 5S methodology was implemented as a pilot test, and its long-term sustainability is contingent upon continued management commitment and the consolidation of a culture of organizational discipline. Finally, the validation of the TPM tool was restricted to a simulation model, and its future practical implementation could face barriers such as resistance to change from personnel and the need for investment in training and infrastructure.

6. Conclusion

This research successfully achieved its main objective of optimizing OTIF compliance in a Peruvian footwear sector SME through the integrated application of Lean Manufacturing tools. By analyzing the cementing and lasting areas, root causes linked to workplace disorganization, lack of standardization, and low equipment availability were identified and addressed using different validation techniques.

The results obtained demonstrate significant improvement across all key indicators. The OTIF compliance rate increased from 80.7% to 88.1%, the defective product rate was reduced by 68.5%, and equipment availability reached 87.6%. These improvements confirm the effectiveness of the proposed model from both an operational and technical perspective, particularly in resource-constrained environments.

This study sets itself apart by integrating three Lean tools within a real production context; an approach rarely explored in academic literature, particularly within the footwear sector and specific processes such as cementing and lasting. Furthermore, combining trial testing with Arena software simulation allowed for validating the impact of the improvements before scaling, ensuring sustainability and practical applicability.

Overall, the findings of this research offer a replicable improvement model for small manufacturing enterprises seeking to enhance their competitiveness through efficient management strategies adapted to their operational reality.

References

Acevedo-Aybar, C., Jáuregui-Alfaro, M., Quiroz-Flores, J.C., and Ali, A. Optimizing warehouse management in footwear commercial companies: A case study on Lean-BPM, International Journal of Mechanical Engineering, vol. 11, no. 1, pp. 16–27, 2024, https://doi.org/10.14445/23488360/ijme-v11i1p102.

Anzualdo-Espinoza, B., Malpartida-Gonzales, C., and Macassi-Jáuregui, I. Model based on the lean manufacturing methodology to increase the OTIF of a MYPE company in the textile sector, Proceedings of the 21st LACCEI International Multi-Conference for Engineering, Education and Technology, 2023, https://doi.org/10.18687/laccei2023.1.1.1299.

ASTM International. ASTM D816-06 (2023), Standard Test Methods for Rubber Cements, West Conshohocken, PA: ASTM International, 2023.

Ávila-Pisco, H., Chiok-Gonzales, D.A., and Flores-Perez, A.E. Application of TPM and lean manufacturing tools to increase OEE: An empirical investigation in the Peruvian textile industry, Proceedings of the CONIITI Conference, vol. 2, pp. 1–6, 2023, https://doi.org/10.1109/coniiti61170.2023.10324213.

Benavides, N. Industria del calzado latinoamericano: un sector en expansión con dependencia asiática, Universo MOLA, 2024, https://universomola.com/industria-del-calzado-latinoamericano-un-sector-en-expansion-con-dependencia-asiatica/?utm_source.

Bernardo-Saavedra, E.A.R., Carpio-Najera, M.A., and Quiroz-Flores, J.C. Production management model based on SLP, 5S, and standardized work tools to increase OTIF rate in a shoe repair shop, Proceedings of the 6th International Conference on Information Management and Management Science (IMMS), pp. 181–188, 2023, https://doi.org/10.1145/3625469.3625511.

Bonifácio, M.A., and Martins, A.C.G. Results of the application of autonomous maintenance in the mitigation of waste generation: Case study in a footwear company in Jaú/SP, Gestão & Produção, vol. 28, no. 2, 2021, https://doi.org/10.1590/1806-9649-2020v28e5519.

Campoblanco-Carhuachin, R., Silva-Castro, D., and Leon-Chavarri, C. Production management model to reduce non-fulfillment of orders in Peruvian garment SMEs through 5S, SMED and standardization tools, Proceedings of the 2nd LACCEI International Multiconference on Entrepreneurship, Innovation and Regional Development (LEIRD), 2022, https://doi.org/10.18687/leird2022.1.1.73.

Castillo, O.R.F., Florian-Sanchez, O.D., and Moreno-Henriquez, R.A. Diseño de un modelo basado en lean manufacturing para la productividad de una MYPE del sector calzado, Proceedings of the 3rd LEIRD Conference, 2023, https://doi.org/10.18687/leird2023.1.1.417.

Jarufe-Majluf, F. M., Paredes-Carrasco, A., Flores-Perez, A., & Collao-Diaz, M. Reduction of order delivery time using Kanban, TPM and 5S in a Peruvian textile factory. An empirical review, 2019 7th International Engineering, Sciences And Technology Conference (IESTEC), 73-78, 2022, https://doi.org/10.1109/iestec54539.2022.00020.

Ministerio de la Producción. Desempeño e importancia de la industria de cuero y calzado 2019-2024, 2024, https://www.producempresarial.pe/wp-content/uploads/2025/02/226-PPT_Industria-Cuero-y-Calzado-2019_2024_06.02.2025-1.pdf.

Quiroz-Flores, J.C., Cáceres-Mauricio, C., and Romero-Vasquez, A.E. Production management model based on LEAN, TPM, DDMRP, and change management tools to reduce lead times in an SME in the garment manufacturing sector, Proceedings of the LACCEI Conference, 2023, https://doi.org/10.18687/laccei2023.1.1.206.

Roca-Limache, C. J., Quispe-León, D. M., & Tupia-De-La-Cruz, E. L. Designing a Lean Production Model Using 5S and Systematic Layout Planning for Efficiency in Footwear Manufacturing: A Case Study, International Journal of Recent Engineering Science, vol. 12, no. 1, pp. 105–115, 2025, https://doi.org/10.14445/23497157/IJRES-V12I1P105.

Torres Vega, P. Simulación de sistemas con el software Arena, Universidad de Lima, Fondo Editorial, 2016.

Vigo, J.M.O., Advincula, E.A., Garcia, J.A.R., Sifuentes, C.T., and Ibañez, C.A.R. Methodology to increase productivity in a production process in a textile company by means of 5S and Standard Work, Proceedings of the 2nd LEIRD Conference, 2022, https://doi.org/10.18687/leird2022.1.1.180.

Villena-Cruzado, C., Rodríguez-Camayo, J., & Tupia-De-La-Cruz, E. Lean-TPM Integration for Quality and Efficiency Improvement in Peruvian Textile SMEs: A Study on Defect Reduction and Equipment Effectiveness, SSRG International Journal of Industrial Engineering, vol. 12, no. 2, pp. 107–118, 2025, https://doi.org/10.14445/23499362/IJIE-V12I2P107.

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