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Implementation of the 5S Methodology to Increase Productivity in the Rollers Shades Production in a SME

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Abstract

Small businesses often pay little attention to the continuous improvement of production processes, which negatively impacts productivity and market competitiveness. This study aimed to implement the 5S methodology as a Lean Manufacturing tool in the roller shade production area of an SME, focusing on optimizing resource utilization and improving workflow. The initial diagnostic phase involved the use of an Ishikawa diagram to identify the main causes of inefficiency. The implementation process began with the use of red tags during the Sorting (Seiri) phase and progressed through to the final Discipline (Shitsuke) phase. Implementation was validated using Arena simulation software. The results showed an increase in labor productivity from 0.6 to 0.8 and a 33.3% improvement in meeting the production plan, demonstrating the effectiveness of this methodology in achieving sustainable improvements.

Keywords
5S Methodology, Lean Manufacturing, Productivity, Efficiency, Simulation.

1. Introduction
In Peru, the textile industry, which accounted for 6.9% of manufacturing output and 0.8% of GDP by the end of 2023, heavily depends on small and medium-sized enterprises (SMEs). These businesses are vital drivers of economic activity but face challenges such as limited resources, disorganization, and inefficiencies in production processes (Observatorio PRODUCEmpresarial 2024). In an era shaped by globalization and increasing consumer demands, operational efficiency and competitiveness have become indispensable.

SMEs in the manufacturing sector often struggle to keep pace with rapid technological changes and evolving market demands due to constrained financial and human resources. In this context, Lean Manufacturing principles—particularly the 5S methodology—emerge as practical tools to enhance efficiency and competitiveness. The 5S methodology emphasizes workplace organization, safety improvement, and the standardization of practices, establishing a solid foundation for continuous improvement.

This study examines the implementation of the 5S methodology in a roller shades production SME to address common issues such as waste and disorganization. By systematically eliminating inefficiencies, the company can achieve significant improvements in productivity and resource utilization. Additionally, this research underscores the broader potential of Lean practices in small-scale manufacturing environments, emphasizing their scalability and adaptability. The primary motivation behind this research lies in the potential for substantial productivity gains in SMEs through structured methodologies. This study seeks to answer critical questions, such as the specific impact of 5S on productivity metrics, while exploring how workflow and layout changes drive these improvements.

1.1 Objectives
The main objective of this research is to implement the 5S methodology as a Lean Manufacturing tool in the roller shades production area of the company DECO TORRES. The specific objectives of the following work are:

a) Conduct an initial diagnosis to identify the root causes commonly present in the company's production area.
b) Propose and validate a solution using the 5S methodology to address the identified areas for improvement.
c) Evaluate the performance and results achieved after implementing the 5S methodology.

2. Literature Review
2.1 Lean Manufacturing
Lean Manufacturing is a management methodology that aims to reduce waste and improve quality, time, and production costs through tools such as 5S, Kaizen, and SMED (Rajadell & Sánchez, 2010). By minimizing muda, or non-value-adding activities, Lean Manufacturing enhances operational efficiency and competitiveness.

Medina (2023) highlights seven types of waste, including overproduction, waiting, and defects, which are critical areas targeted by Lean tools. Vargas and Camero (2021) consider the application of Lean philosophy within each organization to be innovative and relevant, emphasizing that its purpose is to eliminate stages that do not add value to operations and do not provide business benefits.

2.2 Use of Ishikawa Diagram in problem diagnosis
When working on continuous process improvement, it is essential to use tools that help identify the root causes of problems. Rodriguez (2023) states in his report that the Ishikawa diagram, also known as the cause-and-effect diagram, is useful for identifying various issues within a company and offers possible solutions by presenting them graphically. This visual representation allows the observation of the factors that cause these problems, ultimately leading to the root cause.

Additionally, Leon et al. (2021) mention that the graphical nature of the cause-and-effect diagram, or Ishikawa diagram, facilitates the formation of groups with relevant information about the problem. This approach increases the likelihood of identifying main causes and sub-causes by considering diverse perspectives.

2.3 5S Methodoly in textile companies
The 5S methodology, originating in Japan, is a structured approach to workplace organization and standardization. Its five principles—Sort (*Seiri*), Set in Order (*Seiton*), Shine (*Seiso*), Standardize (*Seiketsu*), and Sustain (*Shitsuke*)—aim to create efficient and disciplined work environments (Barroeta Ruiz 2021).

Studies demonstrate the significant impact of 5S on productivity and operational efficiency. Cruz et al. (2021) reported a 10% increase in productivity in a small textile workshop after implementing 5S, attributed to better organization and reduced downtime. Similarly, Trujillo (2021) observed an 8% increase in productivity in a children's clothing workshop, highlighting the role of 5S in optimizing workflows and improving resource utilization.

The methodology has been widely adopted in manufacturing environments to address issues such as cluttered workspaces and inefficient workflows. In the study by Piñero et al. (2018), the 5S method is considered a tool designed to create an efficient, clean, and safe environment. They concluded that, internationally, implementing 5S in an organization is the first step toward achieving business excellence. The overall goal of 5S is to reduce waste, improve worker efficiency, and foster a culture of continuous improvement.

Barroeta Ruiz (2021) emphasizes that 5S is not merely a cleaning initiative but a fundamental step toward implementing more advanced Lean tools, creating a favorable environment for continuous improvement. Additionally, the 5S tool not only improves workplace conditions but also fosters a culture of organization among workers and throughout the entire organization (Ortiz et al. 2022).

2.4 Simulation as a Validation Tool in Productivity Studies

Simulation tools, such as Arena, play a pivotal role in validating the outcomes of Lean Manufacturing initiatives. Paragon Decision Science (2023) emphasizes that simulations offer a risk-free environment to test process improvements before full-scale implementation.

By modeling pre- and post-implementation scenarios, simulations provide insights into workflow optimizations and potential productivity gains. For instance, simulations can quantify the impact of reduced idle times and streamlined layouts, as demonstrated in this study. The use of simulation tools is particularly valuable for SMEs, where resource constraints necessitate careful evaluation of proposed changes.

Additionally, the Arena simulator helps validate results under various scenarios (Jarufe and Paredes, 2023). Moreover, according to Rodriguez et al. (2021), the use of the Arena simulator allowed for the evaluation of the application's effectiveness under different assumptions, resulting in improvements in key indicators such as efficiency, rework percentage, and others.

3. Methods

The proposed model for this research is based on Lean Manufacturing tools and the 5S methodology as a solution to the main problem identified in the company. The following figure outlines the proposal, starting with an initial diagnosis to identify the company's issues before implementing the 5S methodology and concluding with a simulated improvement scenario using Arena software (Figure 1).

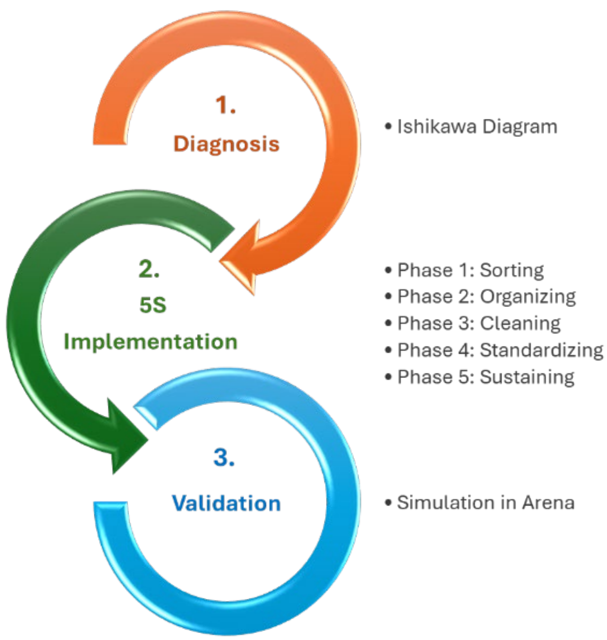

Figure 1. Proposed Model

3.1 Diagnosis

During the diagnosis phase, interviews were conducted with employees to understand the company's current state, identify general problems, and determine root causes using the Ishikawa Diagram.

3.2 Implementation of the 5S Methodology

3.2.1 Phase 1: Sorting

In this phase, observation was the primary technique used to identify and remove items that did not belong in their designated work areas. Red tags (Akafuda) were utilized to facilitate classification and final disposal of unnecessary items.

3.2.2 Phase 2: Set in Order

Items deemed useful in the previous phase were organized into optimal locations to ensure easy access and efficient use.

3.2.3 Phase 3: Shine

The focus of this phase was to identify and address poorly maintained spaces or items. A cleaning schedule and a compliance format were developed to align with the 5S methodology. These tools monitored cleaning activities, identified issues, and enabled corrective actions to optimize the process before proceeding to subsequent phases.

3.2.4 Phase 4: Standardization

In this phase involved creating a Process Operations Diagram (DOP) to ensure all employees understood the necessary activities for roller shades manufacturing.

3.2.5 Phase 5: Sustaining Discipline

In the final phase, active commitment from the entire production team was essential to instill self-discipline and promote continuous improvement. Two audits were conducted, and the results were compared against the established goals.

3.3 Validation

Arena software was used to evaluate changes in key performance indicators, including weekly production output, unit production time, labor productivity, and efficiency. The results demonstrated improvements in these indicators, thereby increasing overall productivity.

4. Data Collection

The present case study was conducted at the roller shade manufacturing company DECO TORRES, which has 2 employees and aims to meet its production plan of 28 rollers shades per week.

4.1 Diagnostic Results

The data collection phase focused on identifying inefficiencies within the roller shade production process. Initial observations revealed disorganization as a significant factor, with tools and materials often misplaced, leading to delays in operations. Furthermore, cleaning schedules were inconsistent, resulting in cluttered and unsafe work environments. These inefficiencies extended production times and reduced overall productivity.

An Ishikawa diagram was utilized to identify the root causes of these issues, including inadequate employee training, poorly organized workstations, and insufficient monitoring mechanisms. Each identified cause was prioritized to form the basis of a detailed action plan aimed at restructuring the workspace.

4.2 Employee Engagement and Feedback

To ensure successful implementation of the 5S methodology, employees were actively involved in the diagnostic process. Their input was critical in identifying specific challenges and proposing practical solutions tailored to their daily workflows. Regular meetings and feedback sessions encouraged collaboration and a sense of ownership, fostering a culture of accountability and continuous improvement.

4.3 Baseline Data

Quantitative data was collected to establish baseline productivity metrics, including weekly production volumes, time per unit, and labor productivity. These metrics served as a reference point for evaluating the impact of the 5S implementation.

4.4 Action Plan Development

Based on the diagnostic findings, an action plan was developed, addressing each phase of the 5S methodology. The plan included measures to categorize and organize tools, establish standardized cleaning and maintenance schedules, and implement visual management systems to streamline workflows.

This structured approach to data collection and diagnostics provided a clear foundation for implementing the 5S methodology and measuring its impact on productivity and operational efficiency.

5. Results and Discussion

5.1 Numerical Results

Following the implementation of the 5S methodology, notable improvements were observed across key productivity metrics. Weekly output increased from 15 to 20 units, while production time per unit dropped by 26.4% (from 1.59 to 1.17 hours). Labor productivity—measured in units per hour—improved by 33.3%, and schedule adherence rose significantly, from 54% to 71%, as summarized in Table 1.

Table 1. Productivity Metrics Before and After Implementation

Parametric Indicator	Before Implementation	After Implementation	Change %
Weekly Production (Unit)	15	20	+33.3%
Production time per unit (Hours)	1.5857	1.1667	-26.4%
Labor Productivity (Unit/M-H)	0.6	0.8	+33.3%
Adherence to the production schedule (Compliance)	54%	71%	+33.3%

The 33.3% increase in productivity translates to 20 additional units produced per month, potentially boosting the company's revenue. The 26.4% reduction in production time frees up approximately 8 hours per week, enabling either a higher production volume or the reallocation of labor to other value-added activities. Improved adherence to the production schedule enhances delivery reliability, offering greater flexibility in internal logistics, more predictability in inventory management, and increased customer satisfaction.

5.2 Graphical Results

During the diagnostic phase, several root causes were identified that contributed to low productivity, including the lack of order and cleanliness, and the absence of process control, meaning they are not continuously monitored to identify the causes of low productivity and to determine areas for improvement. In Figure 2, the Ishikawa Diagram is shown, highlighting the root causes found that lead to low productivity in roller shade manufacturing.

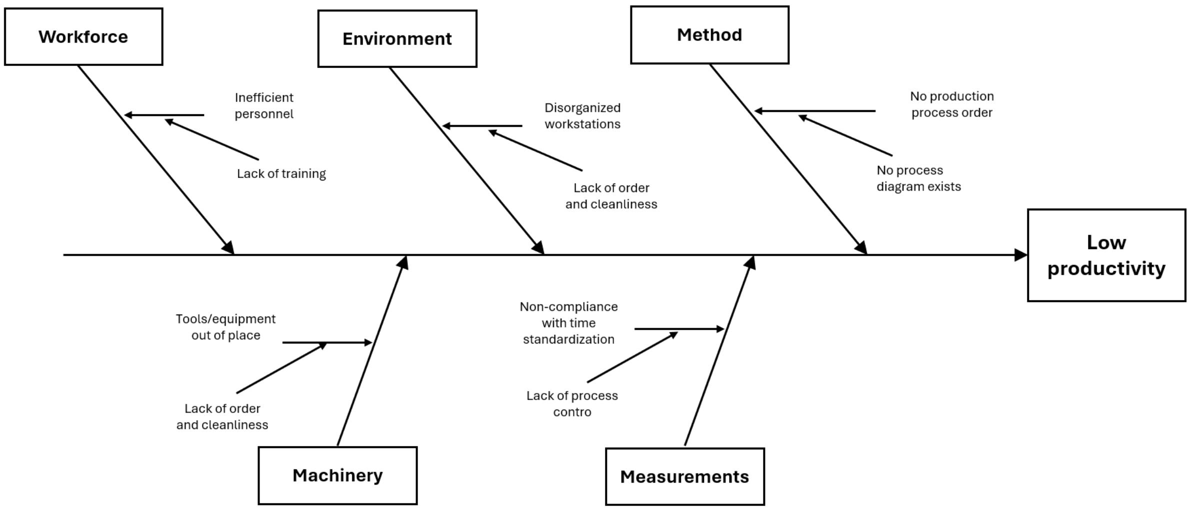

Figure 2. Ishikawa Diagram

On the other hand, during the implementation of the fifth phase, Follow-Up, reinforcement talks and workshops were proposed as training sessions to strengthen the understanding of the Lean methodology and its benefits in the workplace. Additionally, as part of evaluating phase compliance, two audits were conducted for each of the previous phases, where the area supervisor's commitment to the implementation was assessed. A scoring scale from 0 to 100%, with 70% set as the target for each phase, was used. In Figure 3, the results of both audits are shown.

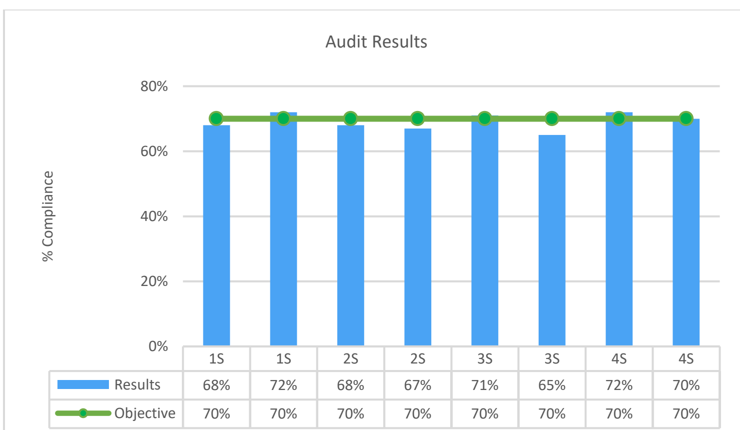

Figure 3. Audit Results

5.3 Proposed Improvements

As part of identifying operational improvement opportunities, it was noted that no Process Operations Diagram (DOP) existed to map the full sequence of activities involved in producing a roller shade from start to finish. As a result, a DOP was developed to clearly outline the steps required for roller shade assembly.

The process begins with the entry of the fabric, which is first inspected, measured, and trimmed to remove excess material and ensure a smooth finish. Simultaneously, the top tube is received, inspected, measured, and cut, with leftover material removed and verified. The fabric and tube are then joined using double-sided tape, rolled, and inspected. Next, the assembly is glued and folded with adhesive tape, stapled to the base, and sealed with caps before being joined with the toe, rotor, connector, and chain. Finally, the finished product is wrapped in protective film.

The process includes 12 activities, 5 inspection points, and 2 combined tasks. The corresponding Process Operations Diagram (DOP) is shown in Figure 4.

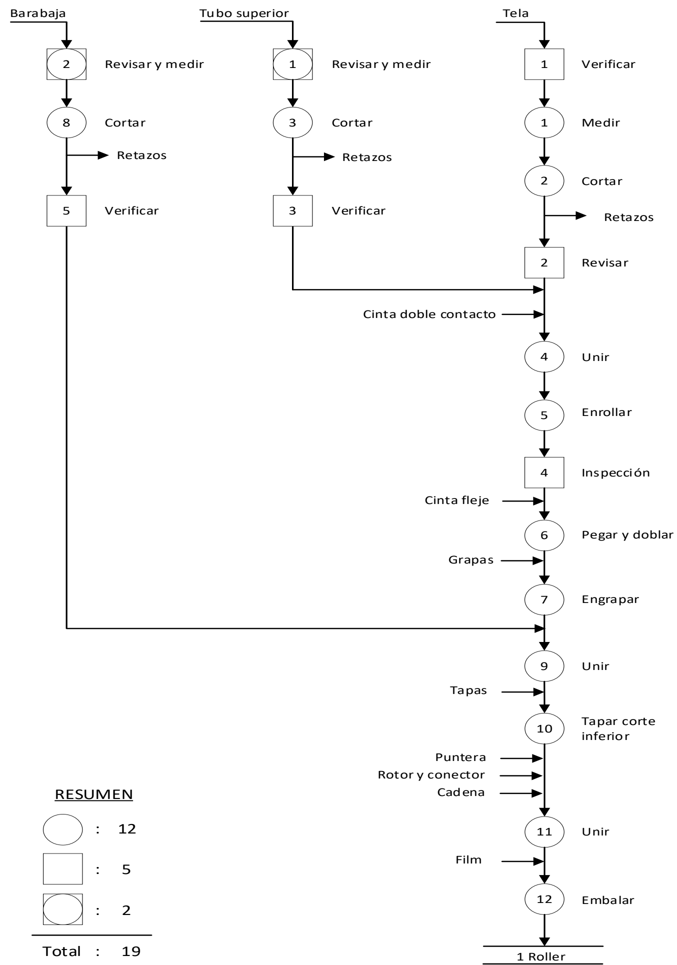

Figure 4. Operations Diagram (DOP)

Beyond the direct improvements in productivity and efficiency, the implementation of the 5S methodology also establishes a solid foundation for future optimizations. The 5S methodology provides a strong base for the implementation of other Lean Manufacturing tools. For example, the organized and standardized work environment resulting from the implementation of 5S facilitates the identification and implementation of Kaizen events for continuous improvement. Furthermore, the integration of 5S with Value Stream Mapping (VSM) can provide a comprehensive view of the production process, enabling the specific application of 5S principles to maximize waste reduction and optimize key workstations in the flow.

5.4 Validation

The implementation of the first two phases of the 5S methodology, 1S (Sort) and 2S (Set in Order), had a significant impact on the production area. These phases focused on eliminating unnecessary items, efficiently organizing the workspace, and assigning specific locations for each tool and material.

The impact of these stages is visually represented in Figures 5 and 6. These figures highlight improvements such as the removal of unnecessary objects that created disorder, the establishment of defined spaces for tools and materials for quick and safe access, and a cleaner, more organized work environment, ultimately increasing efficiency in daily tasks. This visual evidence is essential for validating the effectiveness of the initial phases of 5S, as it reflects how the principles of sorting and organizing translated into tangible improvements in the workplace.

Figure 5. Evidence of the use of red tags (Phase 1: Sort)

Figure 6. Photographic evidence after Phase 2: Set in Order

To validate the results obtained after implementing the 5S methodology in the production area, Arena Simulator software was used. This allowed for modeling both the current state of the process and the improved scenario following the implementation of 5S. The scope of the model included the entire process, from receiving the roller shade fabric to final packaging, with a simulation horizon of 5 days and 5 hours of daily work. Table 2 details the modeled entities, sub-entities, and activities, and Figure 7 illustrates the optimized process after the implementation of 5S (Table 2).

Table 2. Description of entities, sub-entities, and processes in the simulation

Entity	Sub entity	Activities
Roller shade	Tube	Receipt and inspection of roller shade fabric
	Base	Measuring roller shade fabric
		Cutting and inspecting roller shade fabric
		Receiving and measuring the top tube
		Receiving, measuring, and cutting the base
		Joining, rolling, and inspecting the roller shade
		Joining with adhesive tape, folding, and stapling
		Joining the base with the roller shade
		Packaging of the roller shade

The simulation yielded significant results that support the effectiveness of the implemented improvements. Compared to the initial state, the improvement in the effectiveness of meeting the production schedule increased from 54% to 71%, also demonstrating a 33.3% increase in weekly productivity, rising from 15 to 20 units produced. The above results highlight the importance of applying the 5S methodology, not only in improving the workplace environment but also in achieving more competitive indicators in terms of productivity and efficiency (Figure 7).

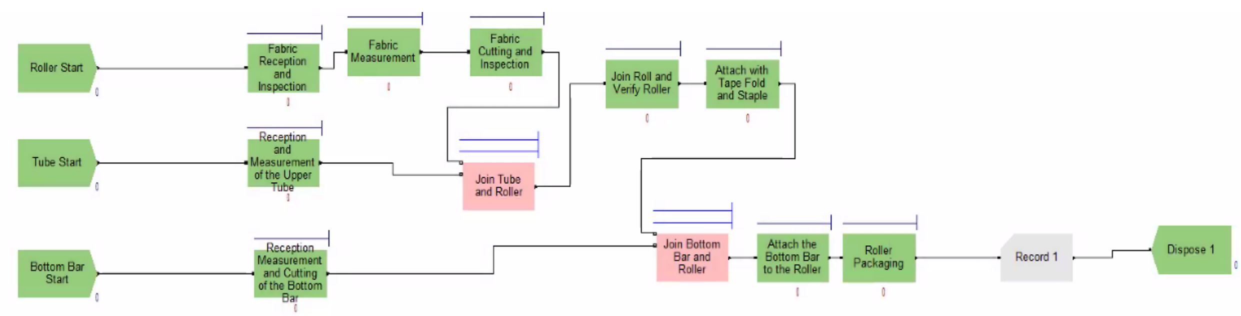

Figure 7. Simulation Model in Arena

6. Conclusion

The implementation of the 5S methodology in the roller shade production area of the company DECO TORRES was successful, demonstrating its applicability in businesses of any size, even those with limited workspace, where execution can be more agile. The proper development of the five stages enabled workflow optimization, reduction of unproductive time, and increased operational efficiency, achieving a significant boost in productivity.

This success was based on a crucial initial diagnosis, which identified the root causes affecting productivity, such as disorganization in workstations, inadequate cleanliness, and a lack of process control. This analysis led to the selection of the 5S methodology as the most suitable Lean Manufacturing tool to address these problems.

The proposed solution, validated through simulations in Arena software, yielded improvements in all evaluated indicators, including a notable increase in labor productivity (from 0.6 to 0.8 units per hour) and a reduction in total production time, optimizing resource use and decreasing waiting times between processes.

Specifically, the post-implementation performance evaluation demonstrated measurable improvements in weekly production, which increased from 15 to 20 units, and a 26.4% reduction in production time per unit. These results confirm the accuracy and benefits of the choice of the 5S methodology for the company, establishing a positive precedent in fostering a continuous improvement culture and enhancing its competitive positioning.

To effectively implement 5S in SMEs, it is suggested to start with a pilot project in a specific area, prioritizing the first three S's (Sorting, Setting in Order, and Shining) to establish an organized base. Actively involving employees from the beginning is crucial, encouraging collaboration and continuous improvement. Furthermore, using visual management tools facilitates the identification and compliance with standards. Finally, conducting regular audits and, if necessary, seeking external support ensures the maintenance of practices and adequate training.

In conclusion, this study significantly contributes by providing a practical and validated framework for SMEs in sectors with resource limitations to implement the 5S methodology, achieving tangible improvements in productivity and efficiency. From a practical perspective, the research clearly and concisely describes the implementation of this tool, offering a guide for those companies in the textile sector that wish to adapt the methodology to their own needs. In addition, it demonstrates the adaptability of Lean Manufacturing principles in environments with limited resources, providing valuable knowledge to the field of operations management in developing economies.

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