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Original Article

Empirical Validation of a Lean Warehouse Model Using SLP, 5S and ABC in a Peruvian Distribution SME

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Abstract *- The efficient management of warehouse operations is crucial for the liquor distribution sector, where delays and incomplete orders impact service levels and profitability. Previous studies have highlighted the benefits of Lean methodologies, such as Systematic Layout Planning (SLP) and 5S, in optimizing warehouse performance. However, many Small and Medium-sized Enterprises (SMEs) struggle to implement structured solutions. This study addresses this gap through an empirical case study in a Peruvian liquor distribution SME, integrating SLP and 5S to enhance order fulfillment performance. A simulation-based validation demonstrated a 6.51% increase in On-Time In-Full (OTIF) deliveries and a 36.94% reduction in order picking travel distance. These findings underscore the impact of structured warehouse organization on logistics efficiency. The proposed model offers a replicable framework for SMEs facing similar challenges. Future research should explore its scalability in diverse sectors, fostering broader adoption of Lean methodologies in warehouse management.*

Keywords *- Logistics optimization, Process standardization, Warehouse efficiency, Inventory control, Operational improvement.*

1. Introduction

The alcoholic beverage sector has played a crucial role in the cultural evolution of humanity and is highly competitive with a wide variety of brands and products. In 2023, the value of sales in Peru reached US$ 1,609 billion, with a growing trend in future years. The category of beers leads these sales, representing 52.1% of the total, followed by spirits (whiskey, vodka, rum, gin, among others) with 32.6% of the total [1]. The value chain in an alcoholic beverage company requires good management to ensure that each stage contributes to the product's final quality. The actors in the chain gradually add value to the products as they move from one link to another [2]. Alcoholic beverage distributors have a role beyond buying, selling, and transporting products to the final consumer; they connect production and consumption. These activities require efficient management, as challenges include high competition, immediacy and technology. In the commercial sector, there is a constant growth in order returns, resulting in customer dissatisfaction [3]. Also, due to the lack of adequate inventory management policies, there is improper handling of products within the warehouse. In addition, the poor organization of products and warehouse distribution generate delays in travel times. Therefore, the company's service level improves if delivery times are reduced and the quantity of products sold is maximized. As mentioned above, with the objectives of improving the level of service and generating more sales in a liquor distributor, the Systematic Layout Planning (SLP) tool and the 5S methodology emerge as an integral strategy to achieve them. The implementation of 5S is oriented to completely reorganising the storage space and SLP to reduce travel times within the warehouse. Implementing these methodologies is not without challenges, including resistance to change and complexity in sorting. The present study evidences the relationship between the ability to solve inefficiency problems within a warehouse and the economic growth of the distributors within the sector.

2. Literature Review

2.1. Level of Service in the Alcoholic Beverage or Similar Sector

A key service level indicator in logistics and supply chain management is the On Time In Full (OTIF). This indicator reflects the percentage of shipments that arrive on time (On Time), with the product and quantity requested, and at the place indicated by the customer (In Full) [4]. The OTIF is the main indicator of this study. A pilot test validated the implementation proposal that includes the Lean Six Sigma methodology, Poka Yoke tools and process standardization to increase the OTIF indicator of a pharmaceutical product commercialization company. With the implementation, the OTIF increased from 87.50% to 94.26%, the percentage of returns decreased from 17% to 3% and the percentage of rejections from 13% to 2%. [5]. In another study, 5S, Poka Yoke, Kanban and Process Stabilization tools were implemented to increase the OTIF in a logistics operator. The OTIF increased from 63.74% to 87.38%, the time to attend to rejected orders was reduced from 33.26 to 27.54 hours, and the percentage of rejected products increased from 21.76% to 3.45%. [6] Warehouses serve as a direct intermediary between the plant and retailers for product shipment; they also hold safety stocks to provide adequate service levels to retailers.

Warehouses must collectively meet time-based service targets and certain percentages of overall demand must be met from the facility within specific time periods. These service levels depend not only on the distance between customers and warehouses but also on the availability of products in the warehouses. Distribution structures involve the transportation and cargo storage system's spatial layout to move goods between production and consumption locations. Decisions about this layout are important to companies as they allow them to balance customer service levels and logistics costs.

2.2. 5S in the Alcoholic Beverage or Similar Sector

The 5S methodology is a management practice originating in Japan that seeks to improve organization, cleanliness and efficiency in the workplace. 5S is based on the following five principles: Seiri (sort), which eliminates unnecessary items that do not add value; Seiton (set in order), organizes products and materials; Seiso (shine) which tells us how workplaces should be regularly tidy; Seiketsu (standardize) develops visual guidelines to maintain an organized and clean workplace and finally Shitsuke (sustain) which confirms that employees have adapted to the 5S philosophy [7].

The results seen from the application of this methodology show that the application of 5S helps to improve the organizational culture, maintain clean and orderly spaces, reduce time in the search for materials and improve the quality of products or services [8]. In a study, it was possible to reduce the technical gap of unfulfilled orders by implementing a model based on the Lean methodology by applying 5S, ABC and Kanban. A considerable number of small companies suffer economic losses due to stockouts and incorrect stock management caused by inefficient sourcing methods, lack of order within their warehouses, and non-standardization of internal processes in the warehouse. Thus, companies need to adapt to the needs of their customers and respond optimally to their stock requirements.

2.3. SLP in the Alcoholic Beverage or Similar Sector

The Systematic Layout Planning (SLP) tool is used to optimize the layout of a warehouse and reduce travel times. A detailed analysis of the relationships between products, workflows and storage areas is carried out to design a layout that minimizes unnecessary movements and facilitates faster product access. The SLP goes through four phases: localization, which is to establish the area to be organized; general approach, which indicates the analysis of sectors and routes; detailed approach, which details the actual location of each physical element; and installation, which includes the preparation of the installation and definition of the necessary movements of machines and equipment [9]. Many small companies still operate without any process standardization in relation to short-term logistics management, which leads to uncontrolled time and cost of logistics operations. In addition, warehouse operators do not follow standardized processes and often make too many movements to complete their activities [10].

Therefore, in one study, a model composed of SLP components for optimal redistribution, 5S, work standardization, and visual control was implemented. Likewise, with the objective of maximizing the efficiency of warehousing in the brewery industry, another study implemented the SLP methodology and Sales and Operations Planning.

3. Contribution

3.1. Proposed Model

In the 2020 National Logistics Survey, the value of the service level of the companies was obtained where the indicator involving on-time and complete deliveries represents 80.2% concerning the Small Companies. As the company's OTIF of 84.21% is higher, it was decided to set up a technical gap to indicate the improvement opportunity that could be obtained in the company. The OTIF target set by the company was 90%. The technical gap is 5.79%.

The objective of the proposed solution is to improve warehouse management, in addition to raising the company's competitive level and continuous training for operators to adapt to these new changes. The objectives to be achieved with the implementation of these proposed methodologies are the following: improve the distribution of products in the warehouse, reduce returns, reduce picking times and improve working conditions.

Figure 1 presents the proposed model, composed of three fundamental components designed for optimal implementation in the case study. The first is based on inventory management since, with the help of the ABC multi-criteria tool, we will seek to have control and correct product allocation to reduce the search time for this activity. Secondly, the company has an inefficient plant distribution, causing workflow interruptions and leading to bottlenecks. For this, what is expected is to have a correct distribution of the warehouse, which is why the SLP methodology will be used to improve its operational efficiency. Finally, what is sought is greater organization, cleanliness and standardization to improve efficiency and effectiveness within the warehouse, which is why the 5S methodology will be applied, in addition, the work standardization tool will be included to standardize the picking processes.

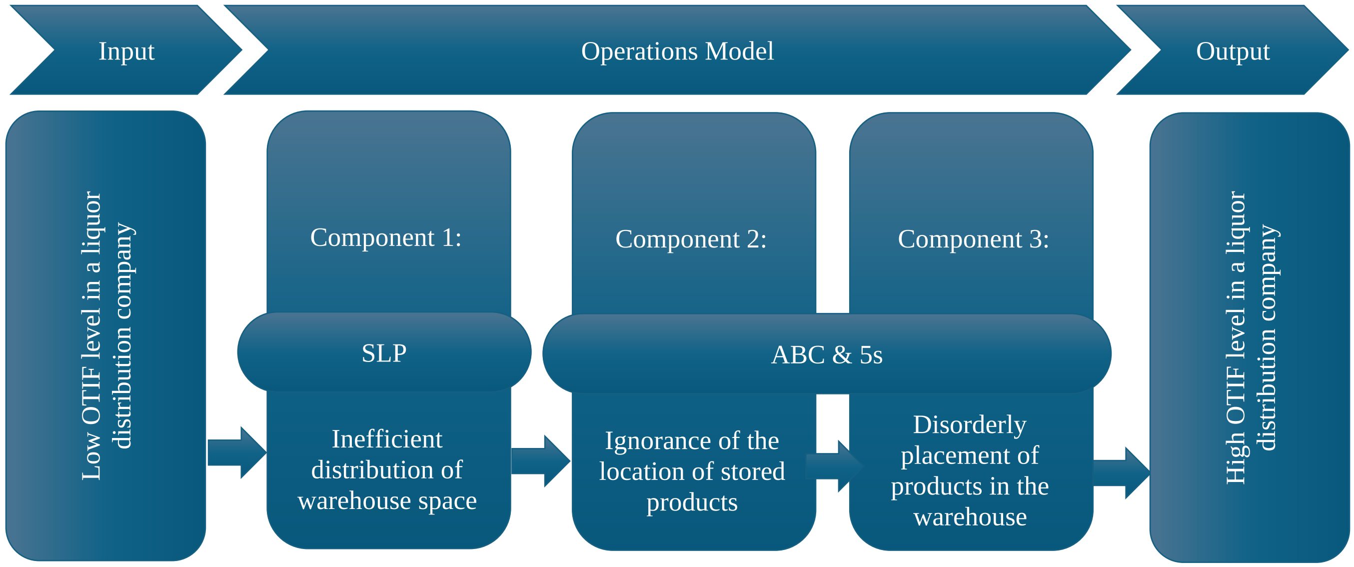


Fig. 1 Proposed model

3.2. Model Components

This operational model tries to solve an issue in a liquor distribution company: On Time In Full (OTIF) service levels have been lagging for quite some time now. The model fixes typical service-level issues in logistics-dependent companies because of poor spatial utilization, inefficient stock control, and general disorder within the workplace. For this model, the author integrated the widely known industry principles of Systematic Layout Planning (SLP), ABC classification, and 5S into a single streamlined process. It contributes to the literature on warehouse optimization by providing a model that integrates spatial relations, ease of access to inventories, and order within the workplace in warehouse design.

3.2.1. Reconfiguring the Physical Space: The Role of Systematic Layout Planning (SLP)

In the first part of the model, inefficiencies regarding the warehouse's space flow are addressed using SLP. The storage region before the intervention suffered from inadequate organization, which led to excessive internal transportation, picking delays, and material flow blockage. Applying SLP aids in redesigning the facility to improve internal processes by rearranging the order of the goods relative to their operational movement.

The new layout placement of space considerations focuses on the areas of personnel interaction, reduces the bounding cross-traffic, and organizes the movement of personnel and materials in a more economical fashion. The new arrangement of these spaces is the prerequisite for the model where the spatial distribution of the warehouse works with the operational processes instead of against them. This minimizes operational waste in the form of excess movements and delays for floor action and prepares the warehouse for streamlined implementation of stock and organizational techniques.

3.2.2. Smoothing Product Retrieval: Inventory Categorization and Item Positioning

After optimizing the layout of the facility, the second element of the model resolves another widespread issue: inadequate product location knowledge within the storage system. This problem is solved through a strategic inventory management tool, ABC classification, which assigns products based on their relative consumption or business value. Items perceived as A are positioned in zones with high accessibility, while S-classified items are placed in the periphery. This classification system is augmented by an orderly marking and labeling methodology in which every item is assigned a specific place within a standardized location hierarchy. The synthesis of classification and visual indicators enhances both retrieval efficiencies and picking accuracy. Warehouse personnel are empowered to effectively manage and control stock so that response times improve and the alignment of warehouse activities with customer service objectives becomes more streamlined.

3.2.3. Establishing Discipline as Policy: The Stepped Implementation of 5S Methodology

The model's fifth stage addresses the ongoing chaos in the warehouse environment. Even with the improved layout and classification, sustaining operational excellence is impossible without maintaining order and cleanliness in the facility's metrics. To achieve this, the model applies the 5S methodology, which categorizes five practices: Sort, Set in order, Shine, Standardize and Support. Systematic implementation of these steps transforms the warehouse into a well-organized and safe working environment. Unnecessary items are disposed of, while tools and materials are stored methodically. Cleanliness is maintained through routine tasks, and standards set for compliance are defined to ensure long-term adherence. Supplementing these, internal audits conducted at scheduled intervals, along with visual management, provide enforcement of responsibility and motivate the culture of sustained improvement. The outcome of this stage is a warehouse that functions simultaneously in productivity, foresightedness, uniformity, reduced wastage, increased safety, and elevated employee morale.

3.2.4. Final Outcome: A Coherent and Scalable Model for Operational Excellence

The diagrammatic operations model offers a coherent approach where each step sequentially addresses the elements contributing to greater distribution inefficiencies. Beginning with an optimized spatial arrangement, moving through advanced inventory classification and localization, and culminating with the institutionalization of order at a workplace, this model aims at the persistent drivers of low OTIF performance.

This holistic approach-reflected within the boundaries of industrial engineering-illustrates the significance of strategically ordered implementation of conventional techniques framed within a systems approach for substantial performance enhancement. This approach has applications in other similar warehouse settings and marks an advancement in both the theory and practice of supply chain management. In some way, this model depicts how an erratic and inefficient warehouse can be transformed into an orderly and agile system responsive to changing service level expectations and sustained long-term competitive advantage.

3.3. Process Model

Figure 2 illustrates the implementation process of the proposed model for warehouse optimization in a logistics centre. This process is structured into three components: (1) data collection and analysis, redesign using the SLP methodology and validation through time studies, (2) product classification using the ABC analysis and optimized relocation, and (3) application of the 5S methodology with training and evaluation. Finally, the achieved improvements are assessed, and if necessary, the process is iterated to ensure optimization.

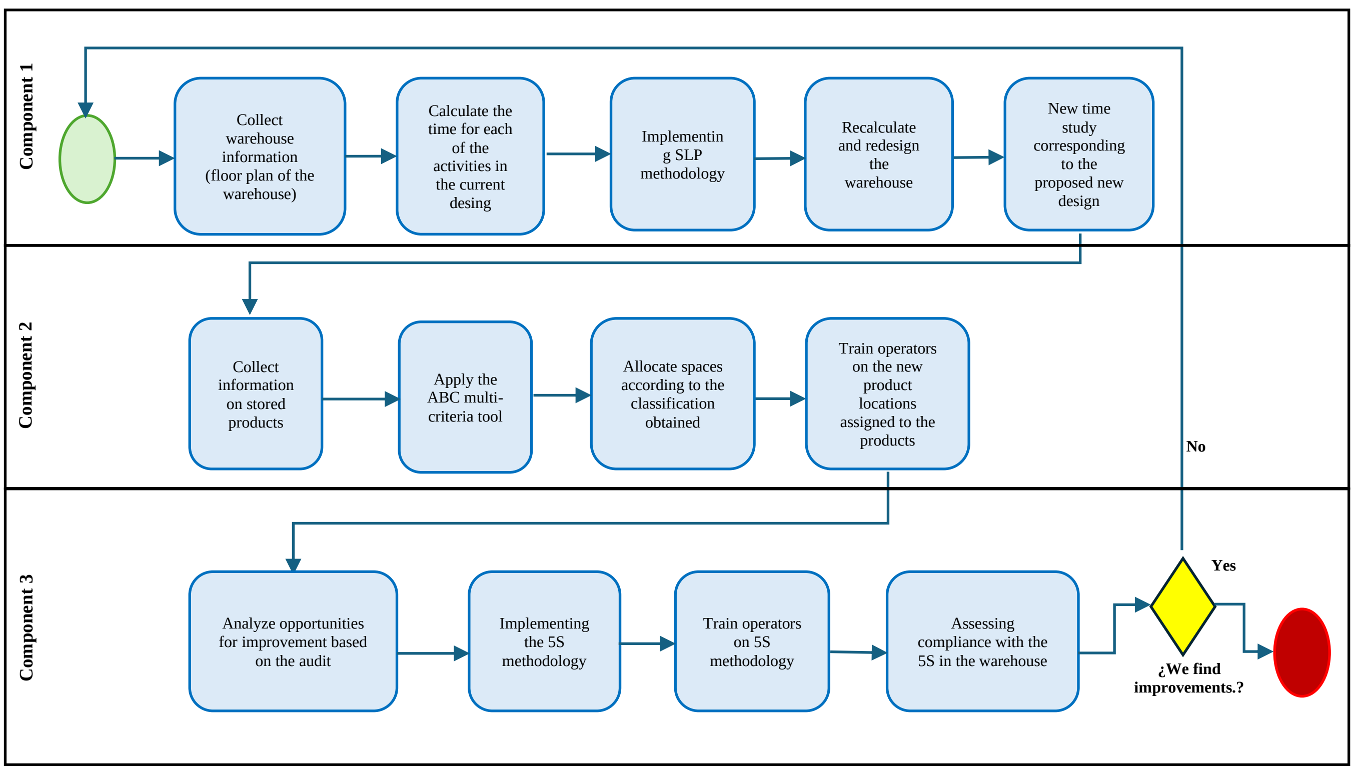


Fig. 2 Implementation process of the proposed model

3.4. Model Indicators

To evaluate the effectiveness of the proposed model, key indicators were defined based on a literature review and the collection of empirical data from the sector to which the case study belongs. These indicators enabled an objective assessment of the model's impact, demonstrating its effectiveness in optimizing the analyzed processes.

OTIF: measures the delivery performance of a supply chain by tracking how often goods are delivered both on time and in the exact quantity ordered.

Objective: Increase OTIF level by 5.79%

$$\text{OTIF} = \left(\frac{\text{Number of orders delivered on time and in full quantity}}{\text{Total number of orders}}\right) \times 100$$

Rejection rate: this rate measures the percentage of orders rejected due to non-conformance specifications.

Objective: Reduce the rejection rate level

$$\text{Rejection Rate} = \left(\frac{\text{Number of rejected items or orders}}{\text{Total number of orders}}\right) \times 100$$

Total average system time: measures the time of the entire order path from picking to dispatch with the objective of measuring in 2 scenarios, before and after implementation

$$\text{Total Average System Time} = \frac{\sum(\text{Time of Order Dispatch} - \text{Time of Picking Start})}{\text{Total Number of Orders}}$$

Objective: Measure the time of purchase order preparation

4. Validation

To properly validate the proposed improvement, a pilot plan was conducted to implement all tools. Arena Software was used to simulate both scenarios, demonstrating quantitative improvements. This model was implemented in a liquor distribution company with the goal of increasing the OTIF level from 84.21% to 90%, indicating a gap to improve 5.79%. The process involves order receipt, picking, packing, and dispatch. Ensuring timely and complete deliveries is crucial for maintaining customer satisfaction and the company's reputation. Immediate actions must be taken to improve this indicator.

4.1. Model Design for Comparison

To design the initial situation in Arena Software, we first measured the time required for each activity within the liquor distribution process, from order receipt to final delivery. We created a table of values, which was then introduced into the Input Analyzer. This program helped us determine the time distributions and their respective types. Subsequently, the model was built in Arena, incorporating these time distributions into their specific activities. After implementing the pilot plan, the process was repeated, and we observed slightly lower time values. We then simulated both scenarios again in Arena and analysed the differences between the time frames to provide evidence of the improvements in OTIF performance. Figure 3 illustrates the improved order management system modelled in Arena Simulator V16 after implementing the proposed model. The process begins with order arrival and preparation, followed by a verification stage determining whether orders proceed or are reassigned in case of discrepancies. Approved orders move through the picking, waiting, packing, and final verification stages. Subsequently, the orders are loaded, distributed, and delivered. This optimized system enhances traceability and operational efficiency, reducing errors and processing times within the supply chain.

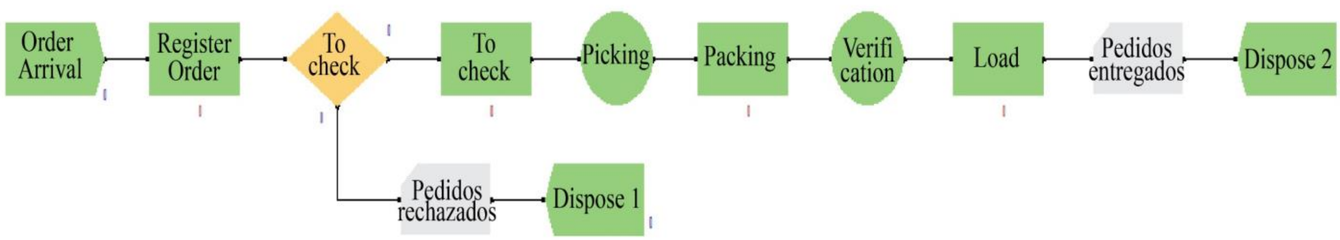


Fig. 3 Improved order management system in arena simulator V16

4.2. Pilot Plan

4.2.1. SLP Implementation

As for the SLP tool, its application took place in a 324 m2 facility where a new environment distribution was designed to minimise unnecessary displacements, facilitating faster access to the products and the preparation of the orders received. Initially, there are 2 aisles formed by 3 rows of racks where the products are stored, and it should be noted that no product has a defined place, and the storage takes place wherever there is some free space. In the final design, we propose a central space equidistant from all the storage space where the picking starts either alone or with the electric elevator, where the operator receives the order, and the batch of products is accumulated and then taken to the dispatch area. Figure 4 shows the final warehouse layout, organized into four main racks and a central picking area. Two operators support the process from opposite ends, while an automated transporter facilitates collection. The arrangement optimizes flows, reduces travel distances, and improves operational efficiency within the warehouse.

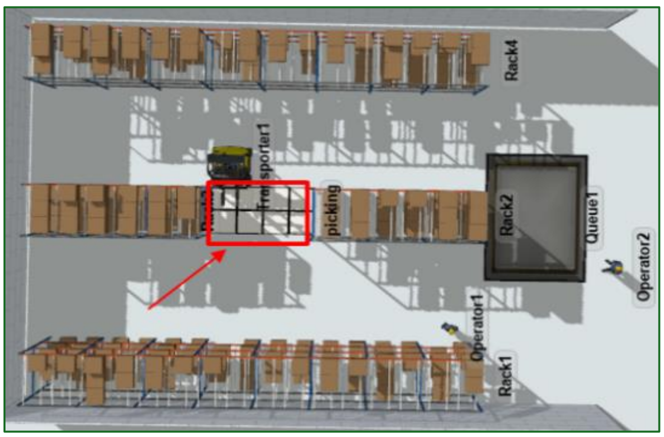
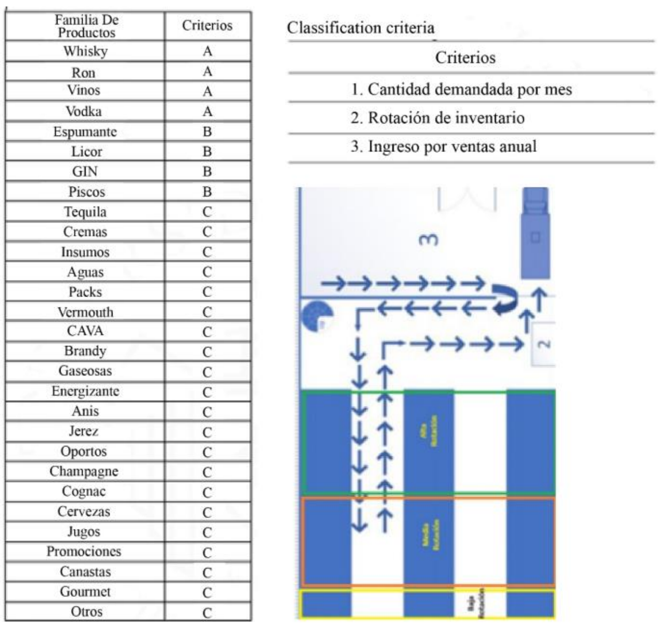


Fig. 4 Final distribution

4.2.2. ABC Implementation

Using the ABC tool, we will locate the products within the warehouse, and they were grouped by families and using criteria, they will be placed in ordered areas in proximity to the dispatch door in terms of high, medium and low rotation. We seek to delimit the spaces organized in such a way as to facilitate both the supply and distribution of stock. Figure 5 illustrates the Multicriteria ABC tool, which classifies product families into categories A, B, and C based on three criteria: monthly demand, inventory turnover, and annual sales revenue. The layout visually segments the warehouse space according to this classification, prioritizing fast-moving items (Class A) for more efficient picking and replenishment.



Familia De Productos	Criterios
Whisky	A
Ron	A
Vinos	A
Vodka	A
Espumante	B
Licor	B
GIN	B
Piscos	B
Tequila	C
Cremas	C
Insumos	C
Aguas	C
Packs	C
Vermouth	C
CAVA	C
Brandy	C
Gaseosas	C
Energizante	C
Anis	C
Jerez	C
Oportos	C
Champagne	C
Cognac	C
Cervezas	C
Jugos	C
Promociones	C
Canastas	C
Gourmet	C
Otros	C

Classification criteria

Criterios
1. Cantidad demandada por mes
2. Rotación de inventario
3. Ingreso por ventas anual

Fig. 5 Multicriteria ABC tool

Figure 6 presents the new layout for product family locations based on ABC classification. Class A products (green) are positioned closest to the dispatch and picking areas to reduce travel time. Class B products (yellow) are placed centrally, while Class C items (gray) are stored in the most distant areas, optimizing operational efficiency.

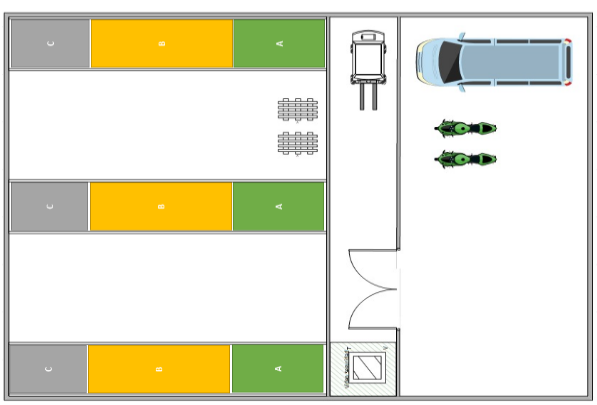


Fig. 6 New product family location

4.2.3. 5S Implementation

Regarding the implementation of the 5s tool with the objective of making the warehouse a more efficient and organized space. First, unnecessary items were eliminated, a specific place was assigned for each type of liquor accompanied by visual aids to facilitate its location, cleaning routines were established, and clear rules were defined to maintain order in the long term. Initially, an audit was carried out to know the current situation and after applying the tool, a high positive impact was achieved, generating an increase in operating efficiency.

Table 1. Audit results

S's	Score	Goal	% EV
SEIRI	11	25	44.00%
SEITON	9	25	36.00%
SEISO	14	25	56.00%
SEIKETSU	4	20	20.00%
SHITSUKE	6	30	20.00%

After the analysis of the current 5S situation and selection of the team responsible for the implementation, the next step is the execution of the tool.

Seiri - Classify

The first S of the 5S refers to "Seiri", which means classification or organization. This consists of identifying, sorting and eliminating the unnecessary from the workspace. The first activity was to identify the products in the warehouse; for this purpose, photographs of the warehouse area were taken. Figure 7 shows the warehouse area with products already identified and organized on pallets within racks. The layout highlights stacked boxes labeled and grouped by product family, facilitating visual management. Clear aisles between racks allow pallet jack movement, supporting efficient picking and replenishment operations within the storage zone.

Fig. 7 Products identified in the warehouse area

Red cards are used to identify and indicate unnecessary items that are useful in the warehouse, allowing visual control over the item's destination. These cards, which contain complete information and their final disposition, are placed in a visible place on the identified items. Figure 8 shows an example of the red card implemented in the case study.

Fig. 8 Red card

The red cards can be completed by the operators or warehouse supervisor, it is very important to point out the category, the reason and the required action. Figure 9 illustrates the implementation of the 5S Red Tag technique to identify and address unnecessary or defective items in the warehouse. Tags indicate product category, reason for tagging, and required action-such as elimination or relocation. This visual tool supports waste reduction, improves organization, and enhances safety by removing obstructive or damaged items.

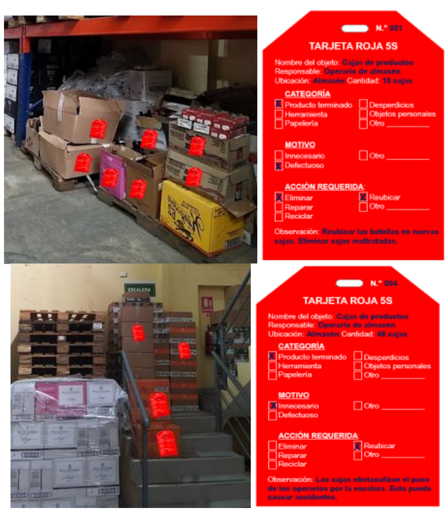


Fig. 9 Implementing red card

Seiton - Order

The second S of the 5S refers to “Seiton”, which means to sort or organize. After having classified and eliminated the unnecessary with the first S, we proceeded to efficiently organize the rest of the elements and products that were left in the warehouse to facilitate daily activities.For the organization of the products and spaces in the warehouse, visual signs are used, such as floor markings, indications on how to organize or use the space and safety, in addition, labels or tags are used to identify the product family. This avoids disorder delays in the search for products and reduces the risk of work accidents.

Figure 10 shows product labeling in the warehouse, where each shelf is clearly marked with the product type and its ABC classification. In this case, vodka is identified as a Class A product. The visual labeling system improves product identification, facilitates picking tasks, and supports inventory control and traceability.

Fig. 10 Product labeling in the warehouse

Seiso - Shine

The third “S” in the 5S refers to “Seiso”, which stands for cleanliness. This involves cleaning the work area and managing for continuous cleanliness. First, the sources of dirt must be identified in the warehouse area, where there is a large amount of dust, debris and obstacles; then, the cleaning products, such as brooms, dustpans, rags, and disinfectants, among others, must be acquired and identified. Finally, a form was created to follow up on the cleaning activities and the frequency they should be carried out.

Table 2. Warehouse cleaning and maintenance plan

No	Activity	Frequency
1	Sweep the floor	Daily
2	Clear warehouse aisles of obstacles	Daily
3	Mop the floor	5 times per week
4	Remove dirt from products	4 times per week
5	Clean desks and worktables	3 times per week
6	Clean shelves, signs, and labels	1 time per week

Seiketsu - Standardize

The fourth “S” of the 5S refers to “Seiketsu”, which means standardization. The objective is to maintain the achievements of the first three S's (Seiri, Seiton and Seiso) through standardized rules and procedures that allow the warehouse to remain organized, clean and efficient on a consistent basis.

To identify opportunities for improvement, a mural is installed where the progress of each S is recorded, allowing the operators to show their daily activities' contribution to the company's improvement and growth. Figure 11 compares the initial audit versus the final audit.

Shitsuke – Sustain

The fifth "S" of the 5S approach, Shitsuke, focuses on discipline and sustained adherence to the standards set. It entails the institutionalization of 5S practice within the culture of the organization through continuous training, leadership engagement, and internal audits. Sustainability in this case study was enhanced by delegating duties to team leaders, keeping a prominent mural monitoring 5S progress, and motivating operators to own their workstations. In addition, refresher training sessions and regular monthly 5S assessment were planned to help instill the significance of sustaining orderliness, cleanliness, and efficiency. All these measures were taken to avert relapse and provide long-term compliance to 5S principles.

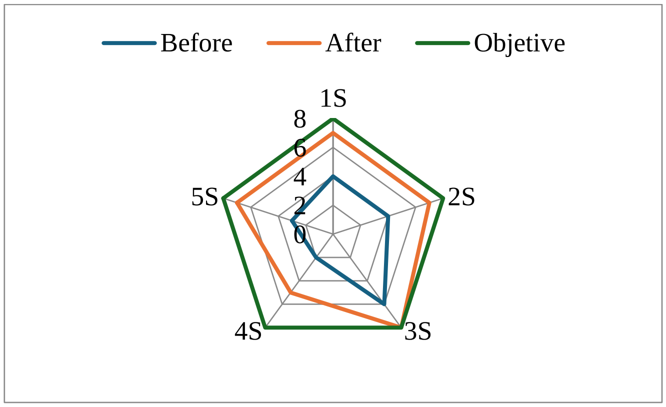


Fig. 11 5S audit results

This diagram compares the two audits carried out; the initial value corresponds to a total score of 44 points, while the result was 83. The initial value corresponds to a total score of 44 points, while the result was 83. This represents an increase of 31.2% thanks to the pilot plan implemented.

4.3. Simulation

The main objective of the number of replicates is to find a tolerance amount to reduce the margin of error in the simulation model of the process, in this case, of the activities of a liquor distributor. For this we will use the T-STUDENT distribution table and find the appropriate values to enter them in the statistical formula.

We will take, for 5 replications, 4 degrees of freedom at 0.005 and obtain a value of 4.6041. This value will be entered to obtain the calculation of the number of replicates needed to reduce the percentage error to 0.01.

Table 3. T-Student degrees of freedom table

Degrees of Freedom	0.25	0.1	0.05	0.025	0.01	0.005
1	1	3.077	6.313	12.70	31.82	63.65
2	0.816	1.885	2.92	4.302	6.964	9.925
3	0.764	1.637	2.353	3.182	4.540	5.840
4	0.740	1.533	2.131	2.776	3.746	4.604
5	0.726	1.475	2.015	2.570	3.364	4.032
6	0.717	1.439	1.943	2.446	3.142	3.707
7	0.711	1.415	1.894	2.364	2.998	3.499
8	0.705	1.396	1.859	2.306	2.896	3.355
9	0.700	1.383	1.833	2.262	2.821	3.249
10	0.696	1.37	1.81	2.22	2.763	3.16
11	0.693	1.363	1.795	2.201	2.718	3.105

$$\boldsymbol{n} = \left[\frac{t_{\left(n' -1,1-\alpha/2\right)} \cdot S\left(n'\right)}{e}\right]^2$$

With 5 replicates, we obtain a standard deviation of 0.0308, and the value of the t distribution with (n-1) degrees of freedom is 3.7469; replacing the formula, we obtain n = 133. Looking at the comparative of the ranges, we can confirm that it is feasible to find that our scenario model meets a requirement, performs well within tolerance and is of good accuracy in performing the analysis. Figure 12 presents the Confidence Interval Analysis of On Time In Full (OTIF) performance. The first dataset, with 133 observations, shows an average OTIF of 0.842 and a 95% confidence interval between 0.837 and 0.848. The second dataset, with 5 observations, yields a higher average of 0.858, with a narrower confidence interval from 0.820 to 0.897. This comparison suggests a slight performance improvement, though the smaller sample size in the second set may limit statistical robustness.

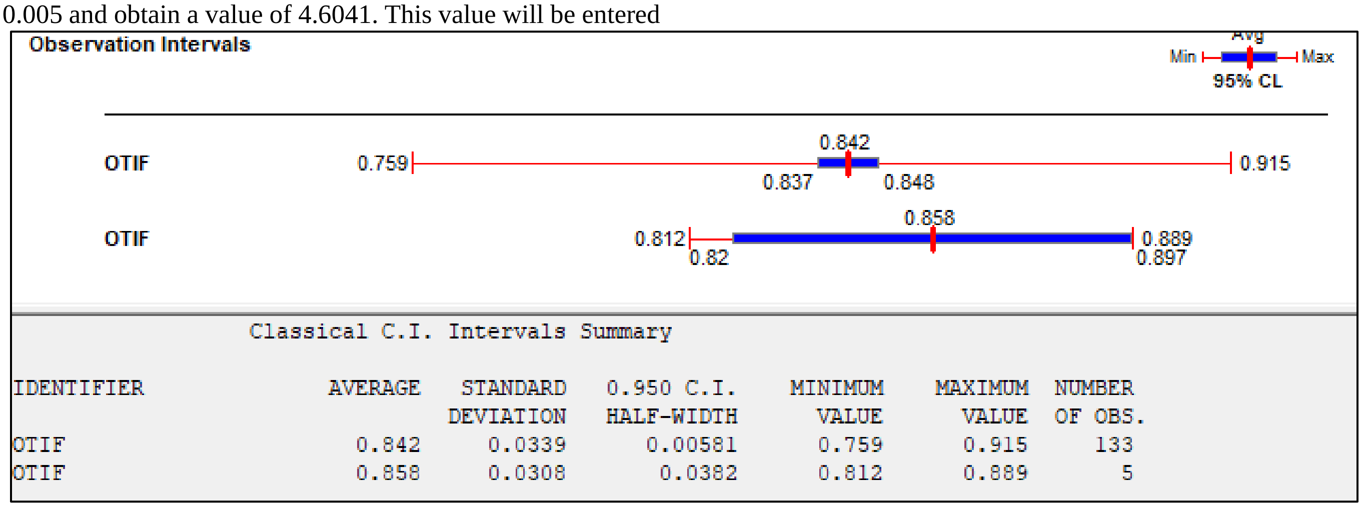


Fig. 12 Confidence interval analysis of OTIF performance

Table 4 presents the validation results of the proposed warehouse management model based on Lean tools and SLP. The OTIF indicator improved from 84.32% to 89.79%, confirming a 6.51% increase in delivery reliability. Order picking travel distance was reduced by 36.94%, reflecting greater layout efficiency. The ABC tool lowered backorder rates from 15.8% to 10.3%, while the 5S implementation raised compliance with procedures from 36.39% to 66.6%, an 83.06% improvement. These results demonstrated the model's effectiveness in addressing the operational issues identified.

Table 4. Validation results of the proposed model

Tool	Validation Method	Indicators	Unit	Before Improvement	After Improvement	Variation
Selection Model	Simulation	On-Time In-Full (OTIF)	Percentage	84.32	89.79	6.51%
SLP	Simulation	Order picking travel distance	Minutes	14.13	8.91	-36.94%
ABC	Pilot test	Backorder percentage	Percentage	15.8	10.3	-34.81%
5S	Pilot test	Compliance with procedures	Percentage	36.39	66.6	83.06%

5. Discussion

The findings of this case study are consistent with the previously researched literature on Lean-based warehouse optimization. The OTIF rate improvement of 6.51% and picking travel distance reduction of 36.94% further support the effectiveness of incorporating SLP, ABC, and 5S as structured approaches. For example, Burgos and Mejía [7] achieved OTIF improvement in a pharmaceutical company with Lean Logistics implementation. Also, Ríos and Villar [8] reported substantial delivery improvement after implementing a blended Lean approach in a logistics operator. The combining SLP and 5S, as described by Kawakami-Arévalo et al. [12], also showed strong results in small-scale manufacturing. What makes this study different is the comprehensive application of these tools in a Peruvian liquor distribution SME, illustrating the need to apply Lean thinking to small business realities in Latin America where logistical inefficiencies severely hinder service and impact competitiveness.

5.1. Study Limitations

While there is reason to be optimistic about the findings, several limitations need to be recognized. This study was limited to a single Small-to-Medium Enterprise (SME) and a particular region, which, in turn, limits how broadly the results can be applied. The positive changes observed are results from the specific operational context of this company, and other organizations may produce different results. In addition, the duration of the assessment period right after implementation was short, which restricts understanding of how these changes will be sustained over time. The human element comes into play: the achievement of effectiveness in Lean application, in this case 5S, is dependent on the regular attendance of the warehouse personnel. Any subsequent changes to the team composition, shift/change in management focus, or organizational culture may alter the impacts of these as results are directly tied to result in sustainability.

5.2. Practical Implications

The case is a practical guide for small and medium-sized intermediate (SME) companies that aim to enhance performance in their warehouses without incurring capital expenditures. Through spatial reorganization in the form of SLP and product placement driven by ABC analysis, along with improved workplace order brought about by 5S discipline techniques, the company met operational key performance indicators and improved the overall workplace environment. These enhancements are not merely quantitative; they automate countless operations, minimize operational burdens, and streamline spatial organization for employees. In settings where there are limitations on operational resources and every second of working hours is critical, implementing a sequential Lean approach like the one described can tremendously bolster sustained service enhancement and operational agility.

5.3. Future Works

In foresight, other research might investigate the application of this Lean model to other industry sectors such as food logistics, pharmaceutical distribution, or clothing. Its implementation in medium and large-scale companies could reveal how complex systems would apply, enhancing understanding of the model's versatility and resilience. An equally interesting avenue of study would be to expand the set of performance indicators by adding productivity per employee, full cycle lead time, and logistical costs per order. Implementing new technologies such as RFID or other data analytic tools could further improve picking accuracy and real-time tracking. Finally, Lean adoption's impact on organizational dynamics over an extended period needs further exploration, especially regarding employee disengagement, attrition, and cultivation of a sustained improvement culture.

6. Conclusion

This study demonstrates the successful integration of Lean tools-specifically SLP, 5S, and ABC classification—into the warehouse operations of a Peruvian liquor distribution SME. The proposed model, based on evidence and conducted simulations, resulted in improved delivery dependability and internal logistics efficiencies. These advancements mitigated existing inefficiencies and demonstrated the transformative potential of methodological frameworks to address operational performance in inadequately resourced settings.

Significant contributions included enhancing procedural discipline and organization by applying the 5S methodology concerning workplace order. Alongside operational efficiency, 5S improved the overall order and safety of the workplace. This corroborates Marnova and Tung's [11] explanation of the positive impact 5S has on safety, cleanliness, and general employee engagement within hazardous goods storage areas. This organizational change within the case study not only bolstered efficiency but also enhanced employees' compliance with the standardized procedures-critical for enduring success. Additionally, incorporating ABC analysis facilitated a more intelligent approach to inventory localization, enabling quicker access to high-rotation products and reducing unnecessary handling time. These benefits are consistent with the logistical advantages outlined by Kucera and Suk, who emphasize the development of material flow strategies and warehouse organization using appropriate product categorization, as outlined in their work on warehouse logistics. Through consumption and turnover ranking, the organization improved space allocation and order-picking precision without the aid of sophisticated technologies. The proposed Lean-based model offers a scalable and low-cost pathway to operational improvement for SMEs in similar distribution sectors. Its strength lies in its ability to synchronize spatial optimization, inventory control, and workplace discipline through well-established yet often underutilized industrial engineering tools.

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