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Empirical Study on Enhancing OTIF in Peruvian Footwear Retail: A Lean Model Integrating 5S, Standard Work, and Inventory Management

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Abstract – The Peruvian footwear retail sector faced persistent difficulties in meeting On Time In Full (OTIF) deliveries, affecting customer satisfaction and operational efficiency. Although prior studies explored Lean tools, few addressed their integrated application in SME warehouse environments, revealing a gap in the literature. This study proposed a Lean model combining 5S, Standard Work, Kardex registration, and multi-Criteria ABC analysis to address warehouse delays, inventory inaccuracy, and spatial disorganization. After implementation, OTIF increased from 71.67% to 87.76%, inventory accuracy improved by 16%, and the cost-benefit ratio reached 16.12. These results demonstrated substantial gains in operational performance and service reliability. The study contributes a replicable framework for optimizing warehousing processes in resource-constrained contexts. Its practical implications suggest that small retail enterprises can enhance competitiveness and customer experience through adapted Lean strategies, without requiring major capital investments. The findings encourage further exploration of Lean applications tailored to the logistics needs of Latin American SMEs.

Keywords**:** Lean Warehousing, Inventory Management, OTIF Performance, OTIF Performance, 5S Implementation

1. Introduction

In recent years, the footwear sector has shown to have a significant impact on the Latin American economy; this is evidenced by the sales value of the fashion and footwear sector, which in 2023 was 48,572 million dollars [1, 2]. In the case of Peru, the footwear sector had a sales value of 3,318.9 million soles and in the last 10 years it has shown an average annual import growth of 13.8% [2]. Likewise, China has become the most important supplier of this industry in the country and in 2021 it consolidated itself as the main exporter of footwear with a value of 47.9 million dollars compared to last year [3].

In Peru, during the last 4 years (2018 - 2022) the commerce sector has remained the fourth largest sector of the economy, contributing approximately 283,210.74 million dollars to the national GDP [4]. Globally, the competitive environment among commercial companies has led to increased demands on the quality of delivery of their products by customers [2]. Taking this into account, it is essential that companies in this sector efficiently manage the growing demand by adapting more agile and efficient processes in order to promote growth and development [5]. However, about 62.3% of commercial SMEs from different countries have presented problems in the management of their warehouses, specifically in the forecasting of inventory [6]. For Atnafu and Balda, the main reason for their poor inventory management is due to the fact that inventory investment for a small company occupies a large percentage of the total budget, but that is not the only reason, since inventory control is one of the management areas that is most neglected [7].

2. State of the art

For the search for scientific articles, 4 databases were used. The selected articles were aligned with the theme and objectives of the research and were no more than 4 years old. A total of 40 articles were obtained, of which 20 stood out as a basis for this project.

2.1 Inventory management model in the retail sector to increase OTIF

The commercial performance of a company is measured by the level of service provided, which is related to adequate inventory and warehouse management [5]. In the case of the retail sector, commercial performance must be higher because a large number of random orders are made in time, size and place, which in turn is accompanied by customer demands [8]. Therefore, it is proposed that the combination of Lean Manufacturing tools, such as Kaizen, Value Stream Mapping and Kanban, with Systematic Layout Planning (SLP) can optimize productivity and efficiency indicators and streamline

processes in factories and workshops [9]. On the other hand, different projects have opted for the implementation of the Lean Warehouse methodology in warehouses. This tool seeks to reduce activities that do not generate value to warehouse operations by recognizing the causes of excess. [10]. Likewise, different studies show that the implementation of Lean Warehousing achieves improvements in time efficiency, productivity and quality in the warehouse; factors that improve the efficiency of a company's logistics processes, which improves productivity ratios and in turn increases customer satisfaction [11]. The most used techniques of the Lean Warehousing methodology are Value Stream Mapping (VSM) 5'S, Pokayoke, Kanban, Jidoka, Hijunka and Standardized Worksheet; these help to create an optimal process flow within the company [12]. This is related to the OTIF indicator, since it guarantees complete and timely deliveries to customers, improving their satisfaction and loyalty, which in turn causes the reduction of costs associated with delays or incomplete shipments [4].

2.2 Application of Multi-Criteria ABC Analysis and Kardex in the Retail Sector

A common problem in retail companies is low productivity in order preparation, because the search for items contributes to the high preparation time and, therefore, affects the delivery time of orders [2]. Likewise, the commercial performance of these companies is measured according to the level of service provided, which is related to adequate inventory and warehouse management [5]. In this sense, applying ABC and Kardex tools is crucial to achieve this.

First, the ABC methodology is an auxiliary inventory management tool that separates and classifies items according to their sales; in this way, it is possible to direct actions towards goods that have greater representativeness [13]. In a study carried out in a distribution center, it was possible to reduce order preparation times, which in turn reduced preparation costs. To do this, a model was developed that consisted of performing an ABC analysis and relocating the SKUs in the warehouse by means of the formulation of a mathematical model. The results were a saving of 3.64 man-hours per day in the picking area and a reduction in costs of approximately 10% ($190) [14].

On the other hand, the Kardex tool prevents a lack of stock that could paralyze sales or the production process, by keeping a record that allows planning and controlling inventory levels [6]. In this way, it helps to improve inventory circulation and storage, which leads to avoiding operational and economic losses [15]. The study was carried out in a distribution company with a low index of complete orders; to solve the problem, a model based on the implementation of Lean Warehousing tools was developed. The multi-criteria ABC and 5S tools were used to reorganize and improve the warehouse, and the Kardex tool to control the company's inventories. Likewise, a Standard Work design and time study were implemented to increase productivity. Finally, the BPM tool served to improve the management of business processes. The results of the research were, first, that the indicator of fully delivered orders increased by 12%; In addition, other indicators increased: inventory record accuracy, location record accuracy, coverage, cycle time and productivity by 16%, 32%, 57%, 3% and 24%, respectively. [16].

2.3 Application of 5S and Standard Work in Inventory Management

Most small commercial companies have problems with excessive amount of cash due to inventory accumulation over a long period due to inventory management slack [6]. This could be solved with the implementation of Lean Warehousing tools such as 5S, as this tool helps the order and distribution of a warehouse by implementing each S which means different actions [4].

In a study developed in a plastic manufacturing company, 5S was implemented to check if it has an effect on the productivity of the company. The results showed that there was a substantial reduction in the search time for materials, as it went from taking 8.6 h to being reduced to 3.1 h. The study also mentions that as the level of 5S evolved each month the productivity level also increased as it went from 75% to 101% [17]. In another study carried out in a footwear retail company, an improvement model was developed that allows optimizing order fulfillment through the implementation of Lean Manufacturing tools such as 5S, Standard Work, among others. The results were that the cycle time was reduced by 27.27%, the number of defective products decreased by 8.90% and in another area by 19.91%. Therefore, it was possible to increase the OTIF value by 44.48% [18].

On the other hand, the Standard Work tool eliminates activities that do not add value, thereby significantly reducing cycle times by up to 50%. Likewise, in many cases the implementation of this tool has improved production times, reducing cycle times and the number of defective products generated in the warehouse [19]. In a study carried out in a consumer

warehouse, a model based on the Lean Warehouse methodology was implemented to reduce economic losses generated by a low OTIF indicator rate. The model consisted of the implementation of three tools applying Slotting, Standardized Work, and Slotting. The results were the increase of the OTIF indicator by 28.94%, also a decrease of 41.53% in the arrival time to the product location and an increase of 12.02% in the efficiency of the operators in the picking process [20].

3. Methodology

Figure 2 presents the proposed model, designed based on the analysis of the literature. In particular, it is based on the analysis of cases that belong to the same sector of companies such as retail and/or footwear, where the root causes of the problems in warehouse management were accurately identified. Therefore, the KARDEX tools were used, 5S, MCABC and Standard World with the aim of having deliveries on time and being able to attend to orders with greater accuracy.

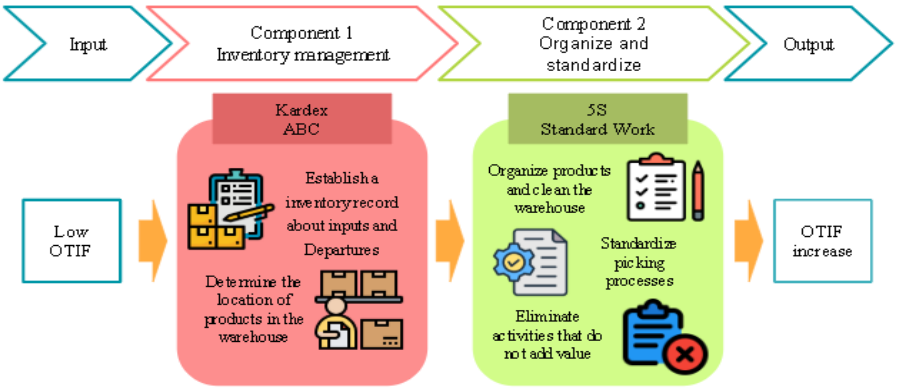

Fig. 1: Conceptual model and its components

Component 1: Inventory management

The first component of the proposed model consists of inventory management, for which the Kardex and Multicriteria ABC tools are developed within the warehouse. This improves the correct location of products and inventory registration. The implementation of Kardex allowed us to collect the necessary information regarding the inventory according to the inputs and outputs of the products, which helped to develop the Kardex template. This template was developed in a spreadsheet for easy access by the warehouse assistant.

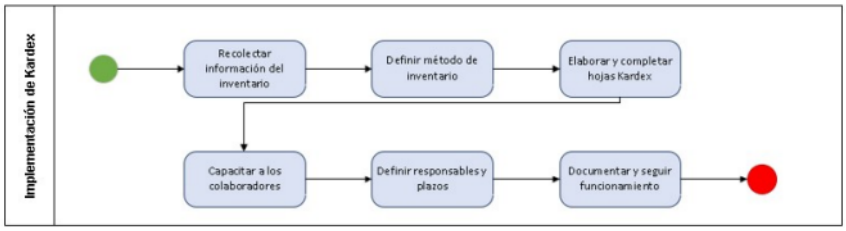

Fig. 2:

The next step was the implementation of the ABC multicriteria, where the qualification criteria were defined, in this case it is by monthly average demand with the help of the warehouse assistant. With the information ready, the families were classified into A, B and C, with classification A being the category with the highest sales and C the lowest. Finally, the location of the products was designated according to the classification of each family.

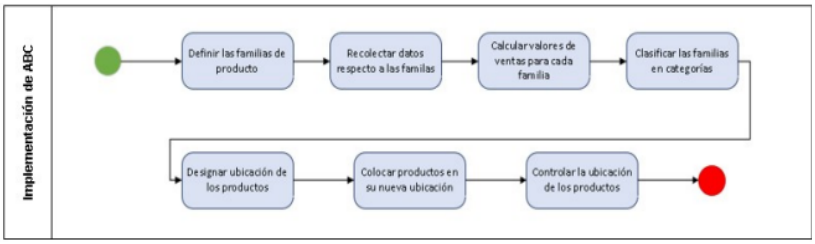

Fig. 3: Kardex template

Component 2: Organize and standardize

The second component consists of the implementation of 5S and Standard Work tools. This allowed the order and relocation of the products, in addition to standardizing the process. The implementation of 5S within the warehouse was decided to divide into two phases. The first will cover planning before the execution of the 5S and the second phase will be about the development of each S within the warehouse which allows for orderly and clean work areas. For which red cards were used to eliminate or relocate the elements.

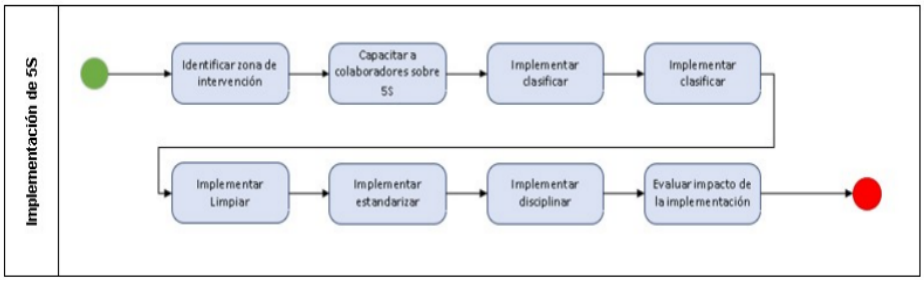

Fig 3: 5S Process

The next implementation, as part of the fourth S of Seiketsu (standardize), was the implementation of the Standard Work tool focused on the picking and packing processes carried out in the warehouse. An analysis of the process was carried out by measuring times, with the aim of proposing improvements and optimizing deliveries. Figure 6 shows the improved model used for the simulation using Software Arena, with the aim of demonstrating that the proposed model can reduce picking and packing times.

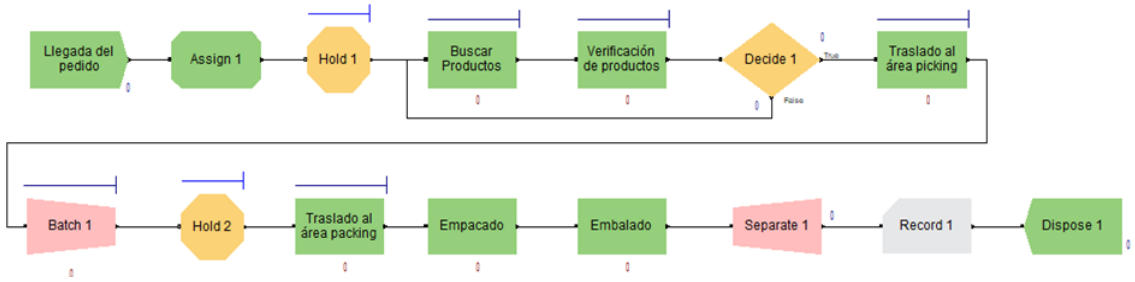

Fig. 4: Standard work simulation model

The sample size was then calculated by applying the finite population formula, since the population size is known and can be counted. The result was that the sample size required for the project was approximately 267 pairs of sandals.

$$n = \frac{(\mathrm{N} * (Z)^2 * (S)^2)}{(\mathrm{N}-1) * (E)^2 + (Z)^2 * (S)^2} \quad (1)$$

$$n = 266.61 \approx 267 \quad \text{Pares de sandalias} \quad (2)$$

5. Results

For the implementation of the Kardex, Multicriteria ABC and 5S tools, pilot tests were carried out for each of them. Below you can see the photographs of the implementation of the tools.

Fig. 4: Implementation MC ABC

Kardex

#	Producto ID	Date	Detail	Input			Output			Balance		
				Quantity	Unit value	Total Value	Quantity	Unit value	Total Value	Quantity	Unit value	Total Value
1	PTT42	6/3/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
2	GST-40	6/3/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
3	GSA-41	6/3/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
4	MN43-44	6/3/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
5	MN41-42	6/3/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
6	MN43-44	6/3/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
7	MS40-41	4/4/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
8	MO41	4/4/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
9	MS36-37	4/4/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
10	MO36-37	6/5/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
11	MO44-45	6/5/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
12	MN45-46	6/5/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
13	MO43	6/5/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
14	SS40-41	6/5/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
15	CC42-43	6/6/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
16	CC40-41	6/6/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
17	MCT44	6/6/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
18	GSJ-41	6/6/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
19	MN44-45	6/6/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90
20	CC40-41	6/6/2024	1				1	S/ 69,90	S/ 69,90	-1	S/ 69,90	-S/ 69,90

Fig. 6: Implementation Kardex

Fig. 5: Implementation 5S

Table 1 shows the indicators that were used to corroborate the improvement of the OTIF through the implementation of Lean tools. As can be seen, the percentage of the indicators ERI (Inventory Record Accuracy), ERU (Location Record Accuracy) and On time increased. This led to an increase in the OTIF (Orders Delivered On Time), which finally increased from 71.67% to 87.76%.

Table 1: Comparison evaluation indicators

Tools	Indicators	As Is	To be	Results
General	OTIF	71.67%	90%	87.76%
	In full	86.74%		94.74%
5S y Standard Wok	On Time	82.89%	96%	92.64%
Kardex	ERI	74.92%	98%	82.06%
Multicriterio ABC	ERU	68.90%	78%	90.21%

Regarding the economic evaluation of the project, the results can be seen in Table 2. It is concluded that the project is profitable both economically and financially, since the NPV is positive in both evaluations. Likewise, the benefit/cost indicates two aspects; first, in the financial aspect, for each sol invested, the project generates S/16.12; second, in the economic aspect, S/4.92 of benefit will be obtained for each sol invested. Lastly, the time that will be necessary to recover the investment is less than a month from an economic point of view and a little more than two months from the economic point of view.

Table 2: Economic and Finance evaluation

Indicators	Economic	Finance
NPV	S/ 7,559.15	S/ 7,831.57
IRR	65%	32%
Cost-benefit	16.12	4.92
Payback	0.74 moths	2.44 moths

6. Discussion

Based on the results of the implementation, it was confirmed that the improvements for the OTIF indicator achieved the objectives set with the scope and restrictions of the project. Although the results were positive, it was necessary to compare them with the scenarios evaluated with the expected results.

In relation to the first component on the Multicriteria ABC and Kardex tools. According to the analysis of the other cases, an estimated IRE of 98% and an estimated URE of 78% were obtained. In the implementation, an ERI of 82.06% was recorded in which there is still opportunity for improvement to reevaluate the validation and the ERU of 90.21% that shows correct management of product locations, a higher indicator could be obtained considering that the warehouse is smaller than the cases under study.

On the other hand, regarding the second component with the 5S Tools and Standard Work, it was obtained that the On Time indicator could improve on average to 96%, thanks to the implementation an improvement of 9.75% was obtained, going from 82.89% to 92.64%. This indicator can still be improved through other tools, but there was a very close approach to the average.

7. Conclusion

The study demonstrates that integrating 5S, Standard Work, Kardex, and multi-criteria ABC analysis significantly improves the efficiency of a retail footwear warehouse. The On Time In Full (OTIF) indicator increased from 71.67% to 87.76%, inventory record accuracy improved by 16%, and the cost-benefit ratio reached 16.12, revealing tangible operational and financial gains. Spatial reorganization, task standardization for picking and packing, and inventory digitization helped reduce idle times, minimize errors, and strengthen service reliability. This research is important because it shows that small

enterprises can achieve high levels of logistical performance through low-cost Lean interventions, even in environments with infrastructure limitations and fluctuating demand. Furthermore, it addresses a gap in the literature regarding the combined application of Lean tools in retail warehouse operations within Latin American SMEs, offering empirical evidence that links technical improvements to measurable business outcomes. The study expands the scope of Lean Warehousing by proposing a replicable and adaptable model for supply chains constrained by limited investment and workforce capacity. It highlights the value of merging classical organizational tools with digital inventory tracking to manage complexity and variability. Future research should assess the long-term impact of these improvements, include environmental metrics such as warehouse carbon footprint, and explore how organizational culture influences the sustainability of Lean practices. Additionally, incorporating real-time monitoring technologies like RFID systems and predictive analytics would enhance inventory visibility and enable data-driven decision-making in retail SMEs. Lastly, measuring customer satisfaction after implementation would help validate the effectiveness of the model from an end-user perspective and offer further insights into its broader commercial implications.

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