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Original Article

Optimizing Warehouse Management in Footwear Commercial Companies: A Case Study on Lean-BPM

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Abstract - *The article presents a case study on optimizing warehouse management in a footwear commercial company using the Lean-BPM methodology. The company experienced low performance in fulfilling complete and on-time orders, resulting in customer dissatisfaction. The proposed model includes tools such as 5S, Multicriteria ABC, Kardex, standard work, and BPM. The implementation of the model resulted in a significant improvement in the On Time, In Full index (OTIF). The study demonstrates that the proposed model can improve warehouse management efficiency in similar companies, which is crucial for business competitiveness and customer satisfaction. The worldwide crisis has created issues for Peru's footwear industry, which is crucial to the country's economy. These challenges include decreased output and exports, as well as the susceptibility of small and medium-sized businesses. Adopting new tools and technology, fostering training initiatives, and enhancing corporate management are critical to the sector's expansion. Inadequate warehousing, physical distribution and inventory management are common causes of customer dissatisfaction in the retail industry. The proposed model addresses these issues by standardizing processes, improving product knowledge, and reducing production errors. The study highlights the importance of implementing effective warehouse management strategies to meet the demands of speed and correct delivery in the competitive business environment.*

Keywords - *ABC, BPM, Footwear, Inventory management, Kardex, Lean warehousing, Picking, Standard work.*

1. Introduction

The competitive environment drives companies to adopt more agile and efficient processes to promote growth and development [1]. In this sense, efficient warehouse management is fundamental for business competitiveness, facilitating more agile customer responses, minimizing costs, and increasing productivity [2]. Companies in the footwear sector exert a significant influence on the Latin American economy. In 2022, the fashion and footwear sector recorded sales worth USD 44,482 million [3]. On the other hand, it is relevant to notice that China stands out as the leading world footwear exporter, reaching a value of USD 38,155 million and representing 29.9% of the total [4].

In general, the leading global footwear producers and exporters come mainly from the Asian continent. In Peru, the footwear industry represents approximately 1.7% of the GDP of the manufacturing area [5] and creates approximately 400,000 jobs per year, representing 26.2% of the sector's GDP [6]. However, there is concern about footwear imports, indicating that national production is not being taken advantage of. Furthermore, in 2020, a 32% reduction in exports was observed, resulting in a 29.2% decrease in the GDP of the footwear sector [7]. In 2020, the sector's production decreased by 32.1% due to the global crisis and the vulnerability of small and medium-sized companies that have been in the market for an average of eight years. This situation requires the improvement of business management, the promotion of training and the adoption of new tools and technologies [8]. Additionally, in the commercial sector, a decrease in customer satisfaction has been evidenced [9]. Common reasons include inefficient warehouse management, inadequate physical distribution, and poor inventory management [10].

This problem has also been identified in research from different countries. For example, a company in Ecuador detected a delay in the preparation of orders due to an inappropriate distribution of spaces in the warehouse, generating errors and delays [10]. Problems related to inadequate product identification and management have also been identified. Another study conducted by a footwear company found that lack of standardization resulted in longer lead times. These results show the value of creating organised and straightforward processes to increase productivity and reduce production errors [11]. According to an article about a footwear company in Lima, the main obstacles to overcome were long service times, disorganized processes, and low production efficiency. In this context, commercial companies must be more efficient in order to meet the demands of speed and correct delivery. For this purpose, a case study was chosen that reflects the main problem of the sector concerning the customer: low performance in delivering complete and on-time orders. Causes such as inefficient warehouse distribution, lack of knowledge of product location, outdated inventory, etc., were identified. In this sense, a model was developed combining the 5S, ABC Multicriteria, Kardex, standard work, and BPM tools.

These tools have proven to be very effective in improving productivity and process management because they are examples of best practices found through literature reviews that show similar problems. Thanks to the Lean Warehousing concept, there is much research on applying Lean tools in warehouses. However, the proposed model presents a change regarding the common ones. Kardex and ABC take the first place in implementing the proposed model, replacing the spot of 5S and standard work. Although some authors indicate that 5S and standard work should be in the first stage because they generate stability for the following steps [12], the proposed change looks to ensure the total order and organization of the warehouse. Also, through the literature review, it could be proven that BPM has not been widely applied in warehouses, especially in the footwear sector and commercial companies. That is why the need to conduct this research has arisen.

To develop the proposal, the article is divided into the following sections: State of the art, which presents the background of the subject from the perspective of various authors; In validation, the concept of the model is explained, and the description of the model is presented with the corresponding indicators: pre-intervention information, flight and simulation runs and post-intervention results.; Discussion; Conclusions and Recommendations for future research.

2. Literature Review

2.1. Warehouse Management Model in the Footwear and Similar Sector

The commercial sector is experiencing accelerated dynamics due to the number of orders randomly placed in terms of time, size, and location. This situation, accompanied by customer demands, poses significant challenges [13]. Therefore, companies are required to identify their opportunities for improvement and develop proposals to counteract them. Based on this method, a model based on the Lean Warehousing method is proposed since the tools are suitable for application in small and conventional size warehouses, standing out for their affordability and systematic simplicity [12]. Some of them are 5S, standard work, etc. On the other hand, a Lean model was divided and framed into three stages: create stability, create flow, and make flow. This ensures that the transfer of knowledge is more efficient and uniform, as well as the durability of improved processes. Also, lean models are not limited to a single sector, so they apply to companies of different sizes and industries [14].

2.2. 5S

Warehouses are faced with managing small and diverse orders since the preference for next-day or even same-day deliveries generates time-critical operations within a warehouse [15]. In this sense, 5S is a guide to maintaining correct order. The 5S, of Japanese origin, is the acronym for five different actions. These are classification, which involves organizing tasks; Order, where tools and equipment should be kept in easily accessible conditions; Cleanliness, which refers to keeping workplaces clean, including tools and equipment; Standardization, which consists of maintaining and improving the achievements obtained; and Discipline, which is implemented to comply with established standards and maintain a good work environment, and can be applied through group learning [16].

The 5S tool is essential to improve the storage process since it improves the warehouse's design and order. It also stands out for the benefits, such as increased productivity without investing large economic amounts [17]. For example, it allows better visual management, shorter product search times, and elimination of errors in the process. The order cycle time in hours was reduced by 19.95% thanks to the application of 5S [18]. However, waste generation is not the only problem because warehouses face a wide range of challenges in their operations planning [18]. Warehouse activities such as receiving, storage, order picking and shipping are fundamental to every supply chain, and logistics management is more important to address through techniques that optimize the activities involved. Even online retailers must cope with small and heterogeneous orders, as the trend towards next-day or even same-day delivery leads to very time-critical operations within a warehouse [19].

2.3. Standard Work

Standard work is a highly effective tool yet to be widely adopted to optimize business processes [20]. Therefore, it is crucial to expand its implementation in different contexts. It should be noted that the effectiveness of a logistics process depends mainly on an efficient information flow [21]. It is beneficial to eliminate activities that do not generate value by establishing standards and procedures [22]. This tool achieved a 28.09% reduction in dispatch times and a 12.28% increase in OTIF [23]. About order fulfillment, the problem of on-time deliveries and perfect orders was identified. The determined causes were the dispatch of products not requested, fictitious stock, and delays in dispatch. Being an improvement project, implementing the model allowed a reduction of the processing time by 19.12%, and the OTIF indicator increased by 44.33% [10]. Likewise, visual management in this tool is essential so that operators understand the performance of each task following the documentation of standardized activities [24].

Therefore, the importance of evaluating warehouse operations that involve time and cost is highlighted, so the focus is on applying techniques that allow eliminating waste and optimizing activities that add value to the customer [25]. The picking process requires tasks that do not add value to the process. and represent more than 55% of total warehouse operations [26]. With this approach, a standard worksheet was designed as an analysis tool that allowed the operator to understand the time losses in each operation, in addition to serving as a guide to identify the movements and waiting times [27]. Standard work defines how each operator must perform each task in the production system, thus preventing operators from performing random tasks [24]. Therefore, it is essential to create documents to standardize the activities of the process [28].

2.4. ABC and Kardex

The increase in demand in the retail sector in recent years has caused problems in companies' logistics management, affecting distribution and, therefore, the delivery time of orders [29]. This has a negative impact on the service level, causing this indicator to be below 92%, which is the retail sector standard. The commercial performance of a company is measured by the level of service provided [30]. This is related to adequate inventory and warehouse management. In this sense, applying ABC and Kardex tools is crucial to achieve this.

Key performance measures, such as improved service levels, average value and reduced inventory years, show a significant improvement in the management carried out [31]. For example, in a case study applied in a hardware warehouse, it was possible to improve the level of product turnover to 12.5 and the inventory record accuracy indicator to 56.5%. This confirms that the result of applying this tool can be observed in the rapid movement of materials [32]. The case study used ABC analysis to improve key performance indicators, including increasing service levels and reducing the average value and duration of spare parts [33].

2.5. BPM

The main objective of BPM is to redesign a process by using all information gathered in the previous process analysis. The advantageous application of this tool in operational management has been demonstrated thanks to the redesign of a purchasing management process [34]. However, the relevance of implementing BPM lies in improving operational management in the warehouse and administrative management, which plays a crucial role in the shared information flow process. Inefficient warehouse management involves inadequate physical distribution and poor inventory management. In a case study, ABC was used in conjunction with BPM in order to have greater effectiveness in the classification and time spent in the picking process, in addition to establishing a flow and standardising the process in mention to reduce time and costs [10].

3. Innovative Proposal

3.1. Fundamentals

The model was developed through case studies of companies in the same sector or sectors such as footwear. It evidenced the exact root causes of the problem in their warehouse management. This was done through the review and analysis of the articles that allowed the identification of different methodologies and tools. The most predominant methodology for warehouse management is lean warehousing. This involves a series of tools, such as 5S and standard work, which ensure correct order and organization in the warehouse, as well as the standardization of the processes in compliance with the defined times [12].

Table 1. Comparative matrix of the proposal vs. State of the art.

	Improve Warehouse Layout	Improve Product Location	Reduce Repetitive Movements	Improve Inventory System	Reduce Confirmation Time
[12]	5S	Multicriteria ABC		Kardex	Standard Work Poka Yoke
[34]	5S	Multicriteria ABC		Kardex	
[27]	5S	Multicriteria ABC		Kardex	
[24]			Standard Work		
[23]		5S - SLP		Cyclical Inventory	
[35]	5S		Standard Work	Kardex	BPM
Proposal	5S	Multicriteria ABC	Standard Work	Kardex	BPM

Regarding efficient inventory management, the Kardex and Multicriteria ABC tools were excellent alternatives for achieving correct inventory control and product location [26, 34]. On the other hand, the BPM methodology, which focuses on redesigning and optimizing the administrative processes in a company, was identified [35]. For this purpose, specific tools are used to analyze and improve the process. This was done through the comparative matrix shown in Table 1, which allowed the identification of the tools used in the state of the art according to the goals. Although more tools were found, the tools developed in the case studies with similar processes to those of the company in the present case were chosen. Therefore, the tools found through the literature review were combined to propose a new warehouse management model that focuses on increasing the number of complete and on-time orders measured through the OTIF indicator.

3.2. Proposed Model

Based on the literature review of similar case studies, a warehouse management model was developed focused on counteracting the root causes of the problem to achieve an increase in the OTIF indicator. The model in Figure 1 comprises three components: inventory management, stabilize flow, and organize and standardize.

According to the models reviewed, most of them grouped similar tools with the same objective. For example, on the one hand, the Kardex and ABC tools allow correct inventory management; on the other hand, 5S and standard work ensure order in the warehouse and its processes. This same criterion was followed in the designation of the three components mentioned above. The main contribution of the model lies in the rearrangement of the components. Models were found where 5S and standard work were chosen as the first components, followed by ABC and Kardex [12, 35]. However, the present model presents inventory management tools as the first component and 5S and standard work as the last.

The reason for this choice was to ensure the order in the warehouse thanks to the final implementation of 5S after relocating the products. Likewise, a correct implementation of standard work was sought, especially for the training stage, in order to have the products relocated and the warehouse clean. On the other hand, the literature review showed that, although the BPM methodology has been applied in warehouse case studies, it has not been developed in the footwear sector. Therefore, the proposed model emerges as a first contribution to the application of this tool in the sector, encouraging its implementation in more companies.

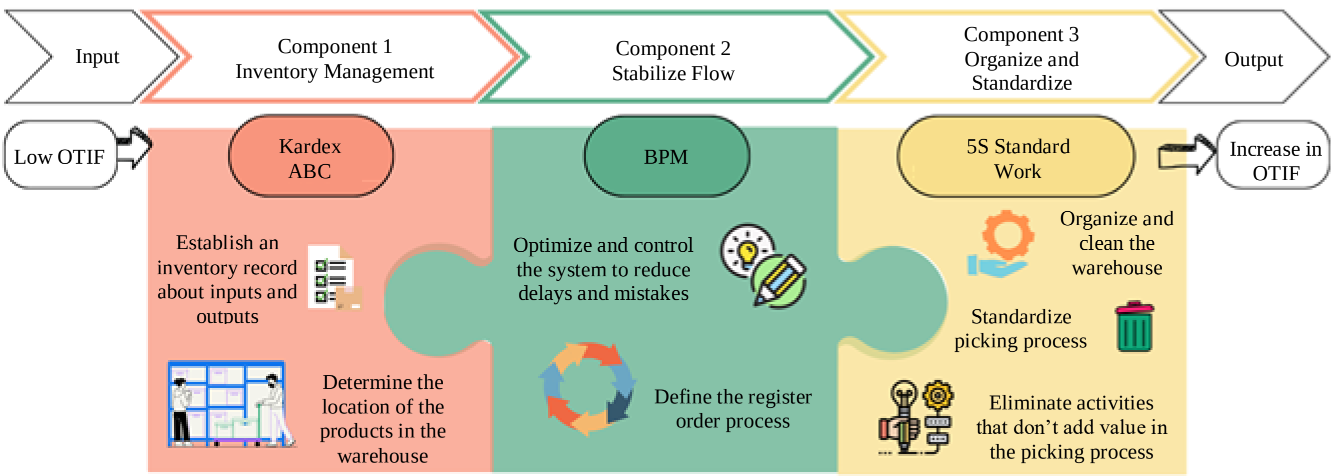

Fig. 1 Proposed model

3.3. Model Components

The model is divided into the three components mentioned previously.

3.3.1. Inventory Management

The first stage looks to ensure the correct location and recording of inventories. First, the Kardex tool made it possible to identify available merchandise by collecting product information according to the brand, supplier, code, etc. This allowed us to notice some criteria for the Kardex template design.

It should be noted that this template was created in a spreadsheet due to the ease of access and editing by the sales advisors and warehouse operators. Once inventory control was established, thanks to Kardex, the next step was to implement the ABC Multicriteria tool. The information previously collected was used to designate product families and classify them. To do this, three criteria were established: average monthly demand, inventory turnover, and contribution margin. Finally, the correct location of the product family was designated according to the category to which it belongs. This distribution is shown on a warehouse floor layout.

3.3.2. Stabilize Flow

The second stage involves the application of the BPM tool. A lane diagram and SIPOC of the current order registration and confirmation process were made as a first step.

Then, through the AVA matrix, the process was analyzed by identifying all the activities, keeping the activities that add value, and eliminating those that do not add value to flow. Finally, the new process of doing the lane diagram and SIPOC was documented again.

3.3.3. Organize and Standardize

The last stage ensures the total order in the warehouse after product relocation and standardizes the picking process. The 5S tool allowed to have tidy and clean work areas by applying each S: classify, organize, clean, standardize, and maintain.

Red cards were used to relocate, eliminate, or recycle unnecessary items. A format was developed to identify the main cleaning problems. With this, an implementation format was proposed, with activities established to comply with the objective of each S.

Regarding the standard work tool, an analysis of the process was carried out through a time measurement in order to propose improvements in the combined table of operations and the standard worksheet. Finally, the tool is implemented in the warehouse through visual management using the standard work diagram to familiarize the operators with the new process.

3.4. Proposed Process

The process to implement the proposed model is presented in Figure 2.

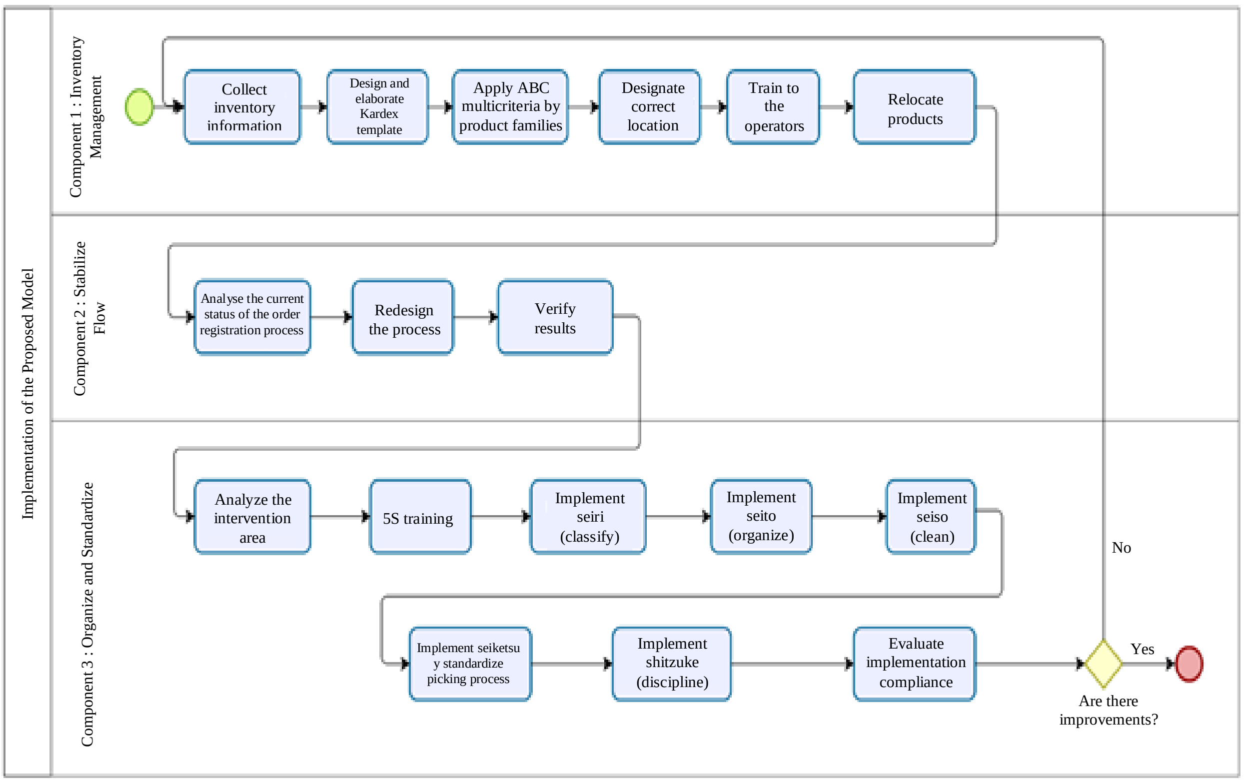

Fig. 2 Implementation of the proposed model process

3.5. Indicators

Eight indicators that are detailed and in line with the model's components are used to assess the proposal's effectiveness and impact.

3.5.1. OTIF

According to the case studies reviewed, this indicator should improve by 33.29% to reach the target value, demonstrating good customer service and satisfaction [14].

$$\text{OTIF}(\%) = \text{On Time} \times \text{In Full} \quad (1)$$

3.5.2. On Time

Measure the number of orders shipped on time regarding the orders received.

$$\text{On Time} = \frac{\text{Orders delivered on time}}{\text{Total orders}} \quad (2)$$

3.5.3. In Full

Measures the number of completed orders fulfilled compared to orders received.

$$\text{In Full} = \frac{\text{Complete orders}}{\text{Total orders}} \quad (3)$$

3.5.4. Movement Time

This indicator refers to the time spent moving during the picking process. The application of the 5S tool can reduce travel time by up to 50% [34].

$$\text{Movement time} = \sum \text{Transfer activities time} \quad (4)$$

3.5.5. Location Registration Accuracy (ERU)

Measures the physical location accuracy regarding the system information. The application of ABC Multicriteria can increase this indicator by 13.33% [12, 35].

$$\text{ERU}(\%) = \frac{\text{Number of correct locations}}{\text{Number of total locations}} \tag{5}$$

3.5.6. Average Picking Process Time

Standard work tool can reduce cycle time by up to 42% [23].

$$\text{Average picking time} = \frac{\text{Total picking time}}{\text{Number of orders}} \tag{6}$$

3.5.7. Inventory Record Accuracy (ERI)

Measures the accuracy of physical inventory relative to inventory in the system. The Kardex tool can increase the ERI by 28.47% [12, 35].

$$\text{ERI}(\%) = \frac{\text{Correct counts}}{\text{Total counts}} \tag{7}$$

3.5.8. Average Time of the Order Registration Process

The BPM tool could reduce the cycle time by up to 8.19% [35].

$$\text{Average registration time} = \frac{\text{Total register time}}{\text{Number of orders}} \tag{8}$$

4. Validation

4.1. Description of the Scenario

The study was developed in a Peruvian company dedicated to the import and commercialization of footwear that has two warehouses that are distributed differently. In this case, due to the complexity of the distribution, the warehouse dedicated to the preparation of catalogue orders, which has as inventory single pairs of shoes, was chosen. The proposed Lean Warehousing-BPM model was developed and validated in 2 stages. In the first stage, a pilot was carried out for one month. The five tools presented in the model were implemented on a small scale. The second stage is the simulation of the order-taking and picking process based on the data obtained from the pilot.

4.2. Initial Diagnosis

In the initial situation, the company's main problem was low performance in delivering complete and on-time orders. This situation was reflected in a low OTIF index with a value of 56.70%, which had an impact of 13.60% regarding its costs. Thanks to an analysis of the overall process, it was detected that in 45.73 % of the cases, there were mistakes in picking due to inefficient warehouse distribution, lack of knowledge about the location of the products, and repetitive movements. On the other hand, in 31.21% of cases, there was a delay in the registration and order confirmation process due to outdated inventory and delays in confirming the availability of the products ordered. With the information mentioned, the problem tree in Figure 3 was created.

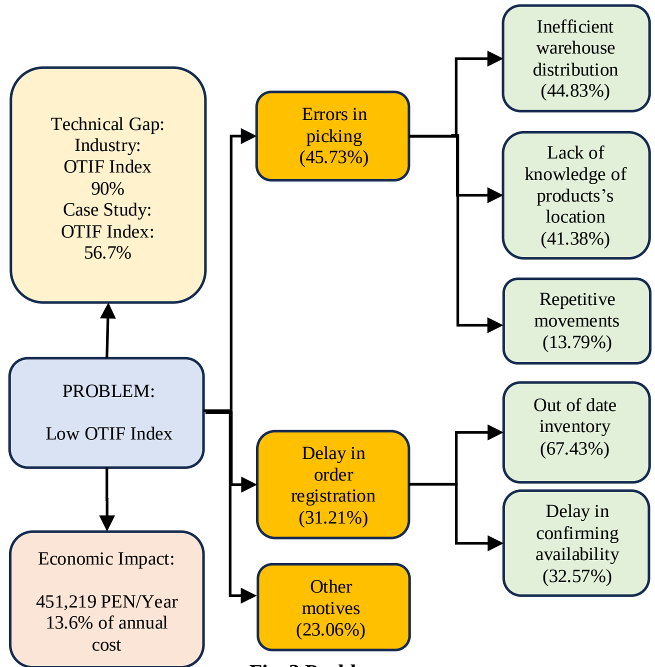

Fig. 3 Problem tree

4.3. Validation Design

In the first phase, the pilot of the five tools was developed in the company in the study. Before the start of the pilot, we explained to the warehouse manager what the proposed model and its implementation consisted of, with the objective that he would support us in the training of each tool. Figure 4 shows evidence of the training conducted by the warehouse manager.

Fig. 4 Training

The pilot started with the Kardex tool. In order to keep a correct record of inventory inputs and outputs, a series of criteria were established to be included in the template, shown in Figure 5, such as code, date, type of movement, quantity, unit value, etc. Thanks to 2 laptops at the operator's workstations, it was possible to work with the template easily through an Excel worksheet. Thus, by controlling the inventory during the pilot, an ERI of 77.93% was obtained.

CONTERS **Kardex**

#	Product ID	Date	Detail	Input			Output			Balance		
				Quantity	Unit value	Total value	Quantity	Unit value	Total value	Quantity	Unit value	Total value
1	930023150	21/08/2023	Output				2	S/ 178.35	S/ 356.70	-2	S/ 178.35	-S/ 356.70
2	10033855	21/08/2023	Output				1	S/ 132.68	S/ 132.68	-1	S/ 132.68	-S/ 132.68
3	10034227	21/08/2023	Output				2	S/ 136.78	S/ 273.56	-2	S/ 136.78	-S/ 273.56
4	30025703	21/08/2023	Output				2	S/ 93.25	S/ 186.50	-2	S/ 93.25	-S/ 186.50
5	930019178	21/08/2023	Output				1	S/ 88.50	S/ 88.50	-1	S/ 88.50	-S/ 88.50
6	30025358	21/08/2023	Output				1	S/ 97.45	S/ 97.45	-1	S/ 97.45	-S/ 97.45
7	10035775	21/08/2023	Output				4	S/ 74.36	S/ 297.44	-4	S/ 74.36	-S/ 297.44
8	930029618	21/08/2023	Output				1	S/ 156.92	S/ 156.92	-1	S/ 156.92	-S/ 156.92
9	10034227	21/08/2023	Output				2	S/ 136.78	S/ 273.56	-2	S/ 136.78	-S/ 273.56
10	20031490	21/08/2023	Output				3	S/ 48.50	S/ 145.50	-3	S/ 48.50	-S/ 145.50
11	50005506	21/08/2023	Output				1	S/ 44.76	S/ 44.76	-1	S/ 44.76	-S/ 44.76
12	930023079	21/08/2023	Output				2	S/ 189.72	S/ 379.44	-2	S/ 189.72	-S/ 379.44
13	550001781	21/08/2023	Output				1	S/ 84.39	S/ 84.39	-1	S/ 84.39	-S/ 84.39
14	30024763	21/08/2023	Output				1	S/ 89.65	S/ 89.65	-1	S/ 89.65	-S/ 89.65
15	930018709	21/08/2023	Output				3	S/ 58.23	S/ 174.69	-3	S/ 58.23	-S/ 174.69
16	930023079	21/08/2023	Output				2	S/ 189.72	S/ 379.44	-2	S/ 189.72	-S/ 379.44
17	930019588	21/08/2023	Output				5	S/ 63.78	S/ 318.90	-5	S/ 63.78	-S/ 318.90
18	10035775	21/08/2023	Output				4	S/ 74.36	S/ 297.44	-4	S/ 74.36	-S/ 297.44
18	930019203	21/08/2023	Output				1	S/ 75.53	S/ 75.53	-1	S/ 75.53	-S/ 75.53
20	930019519	21/08/2023	Output				3	S/ 62.34	S/ 187.02	-3	S/ 62.34	-S/ 187.02

Fig. 5 Kardex format for the pilot

Then, the pilot continued with the ABC multicriteria tool. Thanks to the classification of families into categories, it was possible to designate the correct location for the products. As shown in Figure 6, before making the relocation, signs with the number of aisles and levels in the warehouse were implemented. This will allow a better orientation when making the relocation and subsequently when searching for any product. In addition, the operators were given a guide with the location of each product to facilitate their work. This resulted in an ERU of 82.65%.

Fig. 6 Corridor numbering

Thirdly, the BPM tool was implemented. After analyzing the process, it was redesigned to obtain the new improved process. With this, the sales advisors in charge of this process were trained during the first week of the pilot. In addition, as part of the visual management, the SIPOC diagram of the new process was placed in the work area designated for this task. Fourth, the 5S tool was developed.

First, a checklist of the current tools and those necessary for the tasks was made. Later, the red cards were used to identify the materials and assign them to the correct management. For example, Figure 7 shows the management of the boxes in the halls. In this case, it was decided to relocate them accordingly. Likewise, a cleaning sheet was implemented to ensure cleanliness and order in the warehouse.

It should be noted that several control and follow-up forms were added to maintain activities oriented to 5S.

Fig. 7 Implementation of red cards

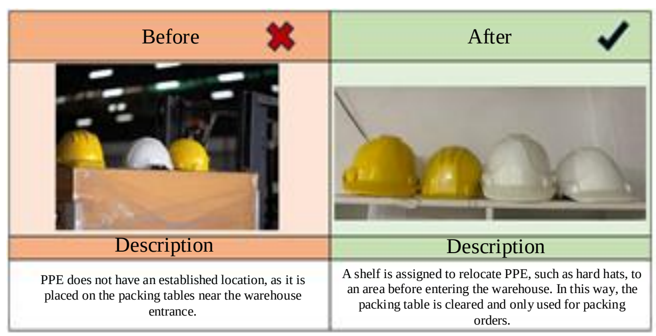

Fig. 8 Rearrangement of EPP's

Finally, a 5S audit was carried out to measure the degree of implementation and compliance of this tool in the warehouse. An improvement of 30% was obtained in the percentage of the final audit compared to the initial one. Figure 9 shows the diagram made with the results obtained. The last tool of the first phase is standard work. Once the process was standardized, visual management was implemented by placing the standard work at the operator's workstations. This served as a guide in the training time operators had and to last the proposed time.

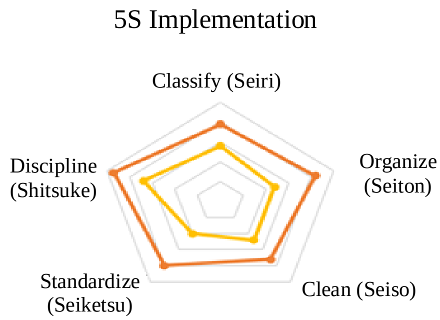

Fig. 9 5S audit diagram

Fig. 10 Standard work diagram

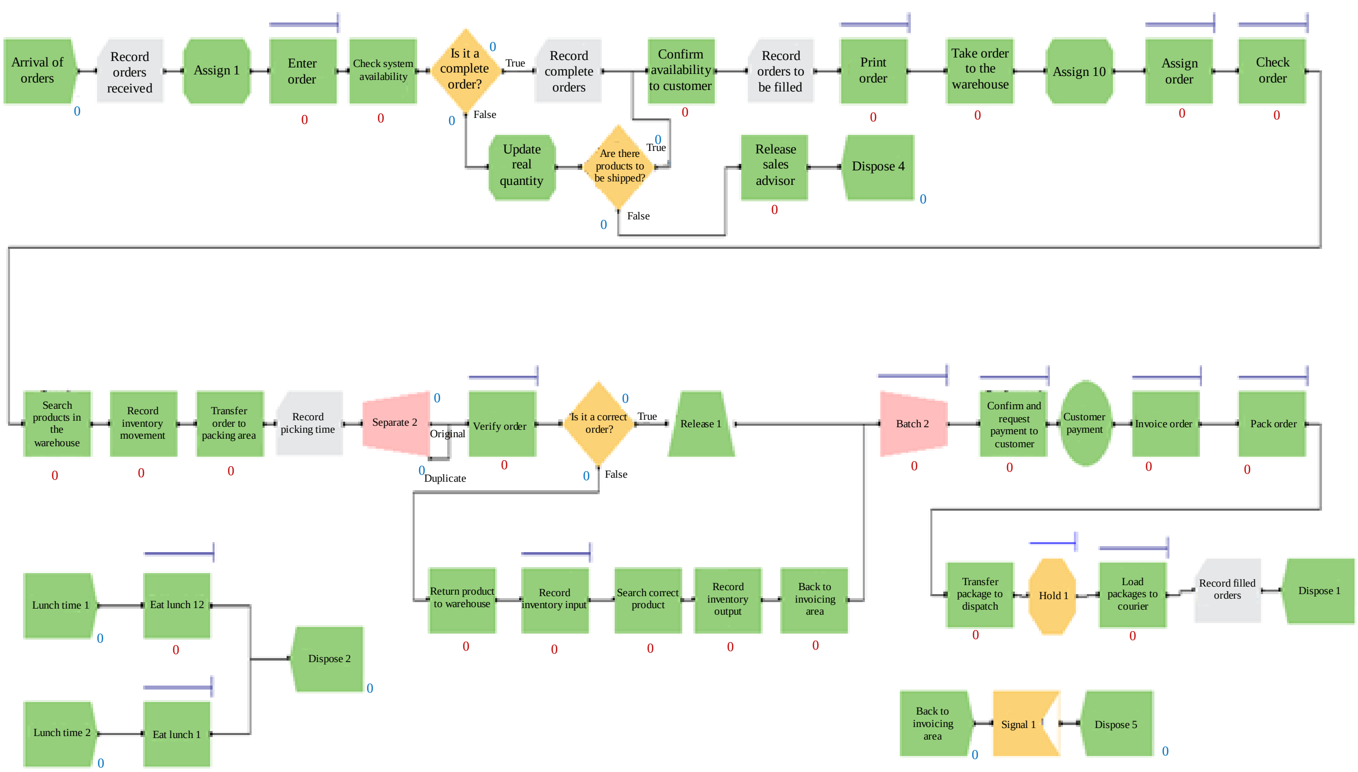

Fig. 11 Simulation model of the improved situation

In the second validation phase, a simulation of the process was performed using Arena Simulator software. The simulation was carried out for 10 hours, representing a working day, and the average number of orders received was 38. According to the desired half-width, the optimum number of replicates was 42. Both processes were modelled: the current one and the proposed process. Figure 11 shows the simulation model of the improved situation in Arena software. It should be noted that the diagnostic data were used for the current process and those obtained from the pilot for the proposed one.

Regarding the scope, the process starts with the arrival of the orders, followed by registration, preparation, invoicing, and subsequent dispatch. The improvement considered changes in product availability, percentage of correct orders, and compliance with the new process, resulting in a decrease in the time dedicated to the process. Finally, due to the implementation of the pilot and the simulation, a reduction of 15.78% and 9.50% of the ERU and ERI, respectively, were achieved. Likewise, regarding the processes, the picking time was reduced by 4%, while the order registration process was reduced by 25.34%. As a result, the On Time indicator was increased by 29.52 % and In Full at 7.77%. This resulted in an OTIF of 89.15%. The findings are presented in Table 2.

Table 2. Results of the indicators

	Indicators	As Is	To Be	Obtained
General	OTIF	56.71%	90%	89.15%
	On-Time	67.14%		96.66%
	In Full	84.46%		92.23%
5S	Transfer time	6.57 min	4.7 min	5.09 min
ABC	ERU	66.87%	80.2%	82.65%
Standard Work	Picking time	11.29 min	10.05 min	10.84 min
Kardex	ERI	68.43%	96.9%	77.93%
BPM	Registration time	16.07 min	11.43 min	12.00 min

5. Discussion

Based on the outcomes derived from applying the suggested model, it was confirmed that the enhancements made to boost the OTIF indicator were successful in attaining the established objectives within the examined conditions. The results were favourable, although it is crucial to assess them in comparison to analogous scenarios outlined in the anticipated outcomes.

In relation to the implementation of the 5S, it means that the travel time was reduced by 1.87 minutes, and now it will be 4.70 minutes. However, the time obtained after the pilot was 5.09 minutes. This higher-than-expected result could have been further reduced by evaluating a more extended period in the pilot and having supervision in the movements of the operators. Likewise, on the ABC and Kardex Multicriteria tools, according to the literature reviewed, it was estimated to obtain an ERU of 80.20% and an ERI of 96.90%, respectively. The result was an ERU of 82.65% and an ERI of 77.93%. On the one hand, compliance with the ERU highlights the correct management concerning the disposition and location of the products in the warehouse, considering that the target case study is from the same sector. Also, compared to other studies, the model proposed a detailed categorization of the products considering sales and inventory management criteria. On the other hand, non-compliance with the ERI highlights the need to reevaluate the validation method.

For this case, only the pilot was applied due to the complexity of simulating the company’s business model. However, this could be chosen to evaluate the results and detect if there are any differences. By shifting the focus to process tools, a 42% reduction in picking time was established. Nevertheless, implementation and validation of the standard work tool only showed a reduction of approximately 15%. However, it must be considered that the case of the estimated result does not correspond to a company of the same size as this research, so there is also a difference in the process.

Finally, concerning the BPM tool, the literature indicated that the processing time could be reduced by 8%, which does not represent a significant advantage in percentage terms, but it represents an operational advantage. This was evidenced by the result of the order registration and confirmation time obtained, which shows a decrease of around 25% in the processing time. It should be noted that the evaluated process presented several activities that did not add value and generated reprocessing in the aspect of information collection. Thanks to the elimination of these, a significant improvement in terms of time and productivity was achieved. As evidenced by the pilot and simulation results, the objectives were met to a certain extent. However, it is also essential to evaluate the economic and environmental aspects linked to the model and its implementation.

An economic evaluation of the project was carried out over 12 months. For this purpose, the results of the leading indicators that involve the aspects identified in the economic impact of the project were used. The total investment, including the five tools presented in the model, is estimated at 16,496.50 PEN. This ensured that the project had a positive outcome in terms of guaranteed cash flow and, as a result, produced solid and accurate financial indicators, as shown in Table 3. The Net Present Value (NPV) results in 57,379 PEN, which is a value greater than 0, while the Internal Rate of Return (IRR) was calculated at 97.75%, more significant than the COK of 22.80%. In addition, a B/C ratio of 5.97 and a return period of 2 months were obtained, which were appropriate for the project size.

Table 3. Financial indicators of the project

Criterion	Worth
NPV	57,379 PEN
IRR	97.75%
B/C	5.97
Payback	2.01 Months

Regarding the environmental aspect, the Aspects and impacts matrix made it possible to determine the most salient environmental factors of the project. This matrix consists of identifying these aspects and impacts and their subsequent assessment by measuring their implication. In this way, waste generation, which is generated especially in the relocation of products through the ABC tool, was mainly identified. To control this impact that the company generates, a waste management plan will be made available for the knowledge of all operators who operate in the warehouse. This plan is based on managing waste collection to give it a destination by 3R culture. Another impact identified is soil contamination caused mainly by the use of materials with the objective of signalling and organizing warehouse areas.

To expand knowledge regarding projects and counteract the root causes that generate customer-facing problems in companies, the following points are proposed as options to be addressed in future research. It is suggested that the application of the tools used under the Lean Warehousing methodology be expanded in sectors like footwear, which does not yet represent a frequent field of research. Likewise, implementing other tools, including technological ones, could be evaluated but focused on solving problems related to warehouse management. On the other hand, models with different objectives could be covered and proposed to deal with other problems. For example, inventory rotation could be investigated in depth, which represents an internal management problem within the company and for its benefit.

6. Conclusion

The application of the proposed warehouse management model achieved the objective of increasing the number of completed and on-time orders, reflected in the increase of the OTIF indicator to 89.15%. Thus, the gap regarding the sector average was reduced to 0.85%, allowing a reduction in the cost overruns incurred due to this problem. The improvement evidenced was achieved by implementing some of the tools identified. The 5S tool enabled a 22.53% reduction in movement time.

Likewise, Kardex and Multicriteria ABC achieved better ERI and ERU with values of 77.93% and 82.65%, respectively. Regarding process tools, standard work achieved a minimum reduction of 3.98% in picking time. On the other hand, BPM achieved a significant reduction of 25.34% in order registration and confirmation time. When analyzing the literature reviewed, it is concluded that the causes identified in this problem are like other case studies, so the proposal is not limited to the footwear sector.

Furthermore, the project adds to the few cases developed in commercial companies of the sector using the Lean Warehousing methodology. Finally, it is recommended that all the processes be standardized and documented so that the information limitation that occurred in the present case will not occur in a future investigation. By identifying other sector problems, it is concluded that the company is not excluded from participating in other improvement projects.

For example, the inclusion or parameterization of the current system to automate obtaining information regarding the products in the warehouse, precisely the location, could be further explored. Another suggested idea is to reevaluate the process prior to warehouse purchasing to have better supplier management, noticing that this factor can also impact the end customer.

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