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Productivity Improvement in the Picking Process through the Application of Kanban and Inventory Management Approach (WMS) at Droguería Mefar S.A.C.

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Abstract

Pharmaceutical companies face significant inventory management challenges, leading to issues such as lost sales and customer dissatisfaction due to low service levels and poor order fulfillment. This study proposes the implementation of Kanban and a Warehouse Management System (WMS) to enhance inventory visibility and operational efficiency. Kanban, through the use of cards displaying key product information—such as expiration date, batch number, and storage location—improves inventory visibility by 50% and reduces stock preparation time by 30%. Meanwhile, the WMS approach updates inventory data in real time, provides visual alerts for critical stock levels, and optimizes picking routes, resulting in a 30% reduction in picking time and an increase in service level from 85% to 95%. The study evaluates the impact of these tools using key performance indicators such as lost sales and on-time delivery rates. The results show significant improvements across these indicators, including a 25% reduction in Average Picking Time, thereby demonstrating the effectiveness of combining Kanban and WMS for inventory management.

Keywords
Inventory Management Approach (WMS), Inventory Management, Picking, Lost Sales.

1. Introduction
Pharmaceutical distributors play a crucial role in the supply chain, as they are primarily responsible for the distribution of medications.

According to Márquez R. (2019), due to the nature of the products being handled, the commercialization process is considered delicate and selective. Therefore, drug wholesalers hold a significant position within the pharmaceutical supply chain. Additionally, Arana K. (2020) emphasizes that the level of service provided to customers is essential to avoid the overhandling of medications—particularly ensuring that the promised delivery time to clients is met.

As a result, Khalil N. (2018) argues that lost sales tend to increase when customers perceive low service levels, particularly due to delays in delivery times, which leads to unfulfilled potential sales.

In this study, after identifying the issue of lost sales stemming from low service levels—specifically customer dissatisfaction with order delivery times—Kanban and the WMS approach were selected as tools to improve picking productivity. Enhancing this process ultimately leads to better service levels and a reduction in lost sales related to delivery delays.

Considering that small and medium-sized enterprises (SMEs), including microenterprises, represent around 90% of all businesses worldwide and contribute significantly to job creation and the economy (OECD, 2023), and according to the September 2024 "MSME Finance Gap" report published by the SME Finance Forum (supported by the World Bank and IFC), the global financing gap for micro, small and medium-sized enterprises is large, with few possibilities for formal credit. Microsoft Excel can be selected as the mini software for WMS, a software with reasonable cost, versatility and scalability over time, since it can work together with tools such as POWER BI, Google Data Studio, etc.

Mattos. G (2023) presents the implementation of more viable software for material management in one of the warehouses of an assembler of the two-wheeler hub in Manaus, where no warehouse system controls the flow of materials and their addressing. The Excel program developed was an alternative with a more viable implementation cost than a robust system such as the WMS.

First, the statistically significant sample size for time measurements was calculated. Subsequently, a simulation of the supply chain behavior was conducted using Arena software to assess how the implementation of Kanban and the WMS approach and software reduces the average picking time, identified as the primary bottleneck in the operation.

Based on the above, the following research question arises: Is it possible to improve picking productivity—specifically its average time—through the use of the WMS approach and Kanban?

1.1 Objectives

To propose an improvement aimed at reducing lost sales by 20% through the application of Kanban and the Inventory Management Approach (WMS) at Droguería Distribuidora Mefar S.A.C.

2. Literature Review

The relevant literature for this study centers on the use of Kanban and Warehouse Management Systems (WMS) in warehouse operations. This section of the article presents selected sources that served as the foundation for the development of the research. Rodriguez, M. (2022) examines the implementation of the Kanban methodology in a logistics warehousing environment. The researchers conducted a case study in a distribution company, demonstrating how Kanban can optimize inventory processes, reduce waste, and enhance operational efficiency. The study emphasizes the importance of workflow visualization, which is also pursued in the present research as a means of achieving continuous improvement in warehouse management.

Chen, L. (2021), in turn, investigates the latest technologies in Warehouse Management Systems (WMS), exploring how Internet of Things (IoT)-based solutions are transforming warehouse operations. The study offers a comparative analysis of different WMS platforms, evaluating their impact on inventory accuracy and cost reduction. Regarding inventory management using WMS, Liu, H. (2022) examines how advanced WMS technologies can significantly increase picking productivity. The researchers analyzed multiple optimization strategies, including optimized picking routes, voice-directed systems, and pick-to-light technologies. The results demonstrated an average improvement of 35% in picking efficiency and a 28% reduction in picking errors.

In the same field, Silva, R. (2021) revealed that WMS platforms incorporating route optimization algorithms and dynamic task allocation can boost productivity by up to 42%. These methods were particularly effective in reducing distances traveled and picking times. Finally, Müller, F. (2022) investigated how WMS can simultaneously enhance productivity and worker well-being. The study implemented augmented reality-based picking systems, achieving a 40% increase in productivity and a significant reduction in worker fatigue. The importance of integrating technological optimization with employee wellbeing was strongly emphasized.

Wicki, L. (2021) argues that Industry 4.0 solutions, particularly digitalization in logistics, generate significant improvements in labor efficiency and productivity. By implementing a WMS in three warehouses, the study demonstrates that automation and space reorganization can increase productivity by 40%, with an adaptation period of at least six months. Furthermore, one of the warehouses managed to stabilize its productivity at a level 50% higher than the initial baseline. The results confirm that the adoption of advanced technologies in warehouse management optimizes processes, enhances communication, and accelerates inventory turnover, reinforcing the importance of WMS in logistics performance.

Marina, P. D. B. and Benjamin, D. (2016) analyze the implementation of the Kanban system in the pharmaceutical supply chain as a Lean strategy to improve operational efficiency and service quality. Through a case study of a cooperative group of pharmacists in Greece, the authors identify both the benefits and challenges of this technique. Their field-based research contributes to the discussion on Lean maturity in the healthcare sector. The main findings suggest that adopting Kanban not only provides strategic advantages and improves service, but also enables operational transformation, facilitating the transition from a push logistics system to more efficient and demand-driven models.

Cinthya R., Wida R., Ulfa N., and Erna A. (2023) evaluated the implementation of the Kanban system in pharmaceutical logistics at a hospital in Ponorogo. The average purchasing volume before Kanban was 6,715.7 units, while afterward it was reduced to 2,232.8 units. The final inventory before Kanban was 8,638.6 units, decreasing to 1,656.2 afterward. A paired t-test showed statistically significant differences in purchases, with an effectiveness of 49.362% in purchase reduction and 47.655% in final stock reduction, indicating improvement but still at a modest effectiveness level.

Aleksandra A. and Marija R. (2018) analyze the implementation of WMS in the order-picking process, which represents 55% of total warehousing costs. They argue that eliminating this activity could increase lost sales, and therefore propose improving its efficiency using WMS technology. Their research shows that implementing WMS optimizes employee productivity and enhances key segments of the picking process, contributing to greater operational efficiency in logistics activities.

M. Al-Shboul (2023) investigates how to improve productivity in manual picking processes within a retail warehouse in Jordan using simulation software and WMS. Through various time studies, the simulation indicated that choosing the optimal picking path increases productivity by 29% compared to conventional methods. This productivity gain not only enhances operational efficiency but also leads to greater service satisfaction and reduced warehousing costs. By optimizing picking methods and routes, operators can fulfill a higher number of orders per day, increasing overall labor utilization.

Jaime A. (2023) presents the development of an update program for a supermarket-style warehouse that supports material supply in a manufacturing company in northwestern Mexico. The Kanban tool was applied to improve distribution, organization, and the determination of replenishment points in the production process. A five-step methodology was followed, and 70 materials were selected for storage and inventory level updates in the WMS. The results show a 33.53% increase in the overall delivery metric and a 5.49% improvement in supermarket utilization. It is concluded that updating the supermarket system improves material supply efficiency by increasing on-time delivery performance and enhancing the supermarket's role in the supply process.

Camilo S. (2018) reports positive outcomes from WMS implementation in several companies. In the case of a wellknown home furniture company, the total distribution center capacity increased by 25%. Additionally, the company improved key performance indicators such as perfect order rate (from 70% to 95%) and sales volume (by 50%). The transition from a manual to an automated, real-time controlled logistics operation was a key driver of this success.

Erika M. (2021) describes a Kanban-based improvement model in the warehouse area of Eternit. The approach included ABC classification, Kanban entry cards, and Kanban exit cards. Results showed a 12% increase in stock control, a 10% increase in worker training, a 10% reduction in unnecessary activities, a 15% improvement in visual control of Kanban items, a 1.5-hour reduction in work order lead time, and a 12% increase in on-time work order fulfillment.

Laura M. (2022) analyzes how implementing E-Kanban optimizes medication management in pharmacies and hospital warehouses. Automation increased order accuracy by 95%, while integration with the ERP enabled real-time inventory management and a 15% reduction in operating costs. Additionally, stockout incidents were reduced by 30%, improving the availability of medicines for patients.

Giselle O. (2023) argues that by addressing internal operational issues and implementing both WMS and Kanban, customer satisfaction can be significantly increased. Clients benefit from more accurate deliveries, better product conditions, and improved product availability. A reduction in time spent locating products and preparing orders contributes to higher customer satisfaction and lowers the likelihood of returns due to dissatisfaction.

3. Methods

This investigation focuses on the significant issue of high lost sales attributable to low picking productivity, a critical challenge with substantial operational and profitability implications. To systematically identify the underlying causes of this situation, a problem tree analysis was employed as a fundamental analytical tool. This methodological approach facilitated a comprehensive identification of both the contributing factors and their interrelationships, thereby establishing a robust foundation for an integrated understanding of the problem and the subsequent development of effective solutions (Figure 1).

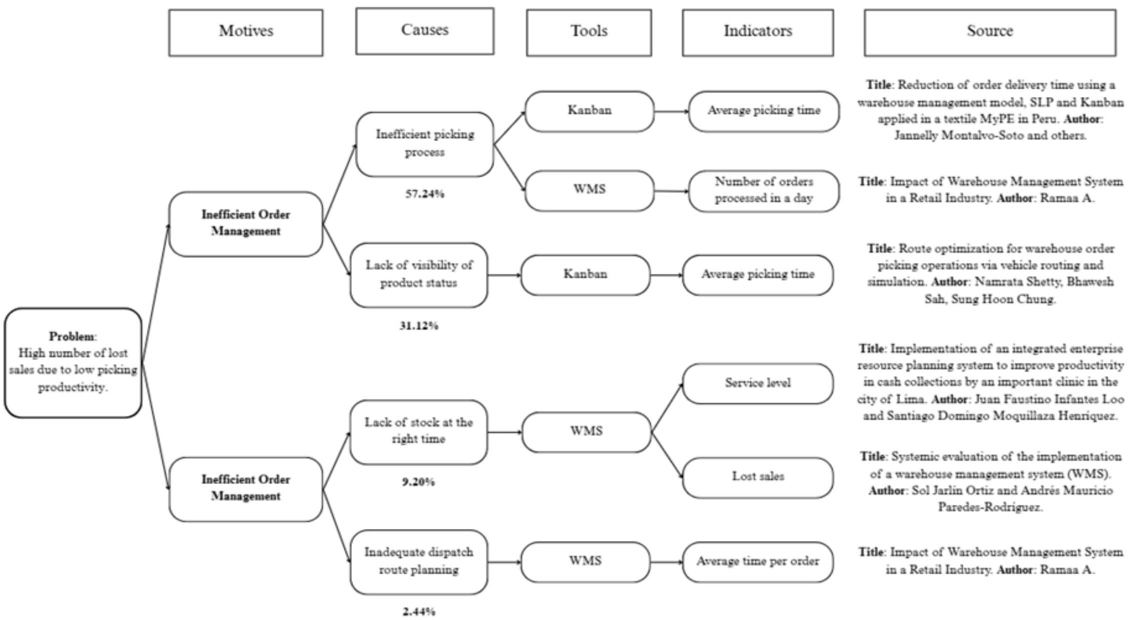

Figure 1. Issue Tree

The methodology employed in this study is based on a design that utilizes historical data analysis and simulation supported by the Kanban and WMS tools, with the objective of ensuring the reliability and representativeness of the obtained results. The application of Kanban and WMS to the case is described below.

A card proposal was developed for the company, which included the following information: product name, line or brand, type, risk level (controlled or uncontrolled), and the proposed SKU to organize products by zones within the warehouse (Figure 2).

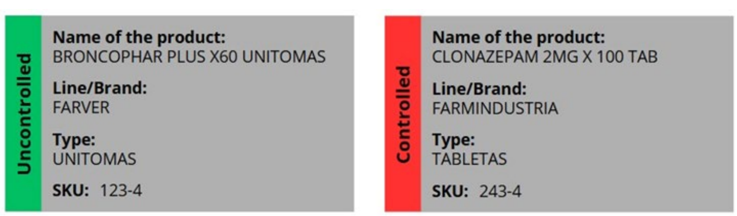

Figure 2. Sketch of Kanban cards by product

To validate that the necessary information was included on the Kanban cards, a meeting was held with the responsible manager. With the objective of making the card as complete and accurate as possible, the final format was agreed upon, which also includes the batch expiration date and the warehouse entry date.

Subsequently, all location information would be integrated into the WMS software to optimize routing. This approach primarily contributes to optimization by providing precise product location within the warehouse and accurate inventory quantities in the system, as well as enhancing information visibility during picking—capabilities that were previously unavailable (Figure 3).

Figure 3. Excel for improving productivity with WMS

In the development and simulation phase, Arena Simulator software was used to design the process that products follow from the order assembly request to dispatch.
To ensure the statistical representativeness of the number of orders to be considered for the simulation, the sample size was calculated using a finite population formula, which is detailed below:

$$n = \frac{N * Z^2 * p * q}{d^2 * (N-1) + Z^2 * p * q}$$

Where:

N: Population size (average of 840 monthly orders)
n: Sample size (67)
Z: Confidence level (1.96)
p: Estimated proportion of the population with the characteristic of interest
(5%) q: Proportion of the population without the characteristic of interest (95%)
d: Margin of error (5%)

This calculation considered confidence parameters and an acceptable margin of error, ensuring that the selected data were adequate for subsequent analysis, resulting in a sample size of n = 67.

This investigation adhered to the methodology outlined in the following phases in Figure 4.

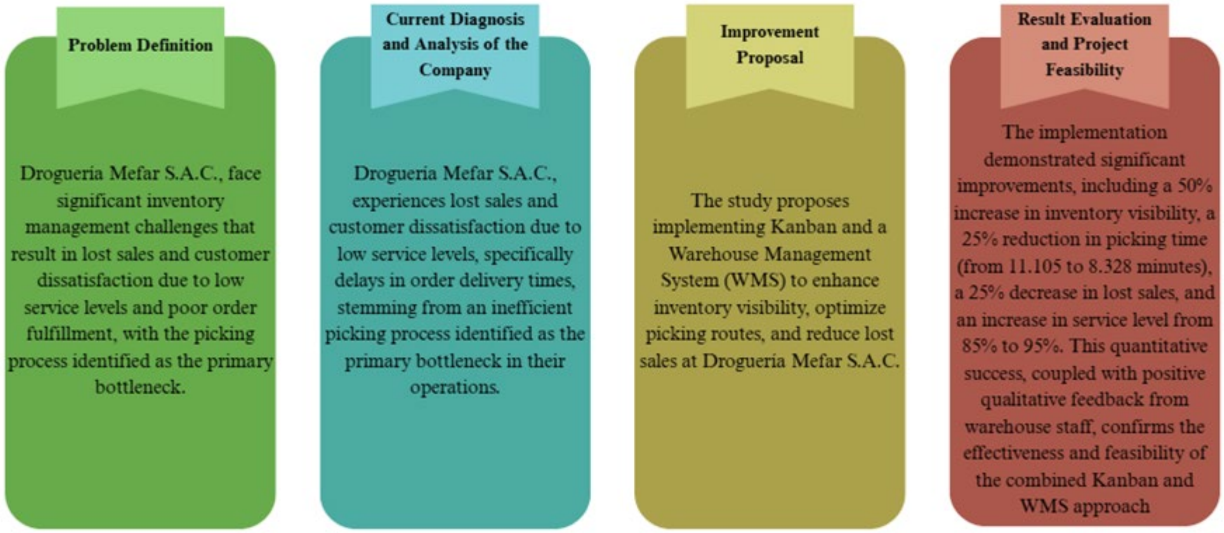

Figure 4. Methodology outlined

4. Data Collection

For this article, as previously mentioned, the case study focused on a Peruvian pharmaceutical distribution company seeking to implement an improvement to optimize the picking process within its supply chain. Pre-test data were collected through time measurements taken during normal business operations based on the ideal sample size determined earlier. The post-test results demonstrated time reductions attributable to the application of Kanban and WMS (Figure 5).

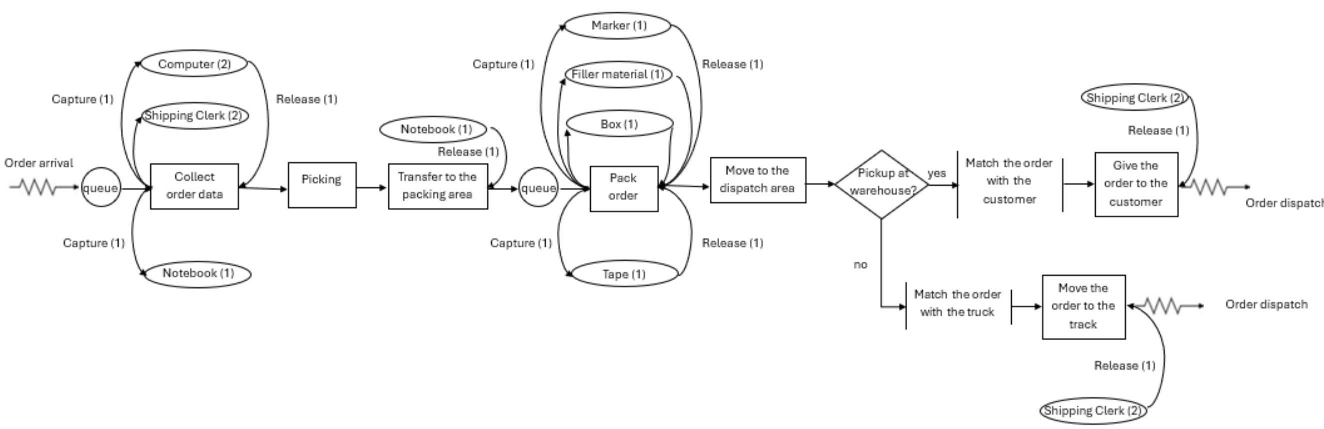

Figure 5. Flowchart

After determining the required representative sample size, reference times were recorded for the 67 orders corresponding to each of the activities described in the previous flowchart. Before incorporating this information into the simulation using the ARENA software, the probability distribution functions that best fit each activity were identified. These data were analyzed using the Input Analyzer module of the software, which allows the determination of the most appropriate distributions. It was established that distributions with a p-value greater than or equal to 0.1 in the Chi-Square and Kolmogorov-Smirnov goodness-of-fit tests were considered the most suitable (Table 1).

Table 1. Distribution function for times per activity

Activity	**Distribution**	**Expressions**
Order Arrival	Triangular	TRIA (0.09, 1.27, 3)
Picking	Uniform	UNIF (3.1, 7.8)
Transfer to packing area	Uniform	UNIF (0.11, 0.63)
Packing	Uniform	UNIF (3, 5.97)
Transfer to dispatch area	Uniform	UNIF (0.22, 0.55)

5. Results and Discussion

5.1 Numerical Results

For the present case study, the Arena software was employed. This discrete-event simulation program facilitates modeling both the original scenario and the optimized scenario in the order management process at Mefar SAC's warehouse. Arena allows for a graphical representation of logistical flows, encompassing activities from order receipt through to final dispatch, including key processes such as picking and delivery.

To carry out the simulation, various attributes and variables involved in Mefar SAC's storage process were defined. Below, the attributes are presented in detail along with their respective formulas and descriptions, as well as the variables accompanied by their formulas or calculation methods and corresponding descriptions, organized into tables for better understanding (Table 2, Table 3).

Table 2. Attributes

	Formula	**Description**
Type	Disc (0.4224924012 , 1 , 0.7203647416 , 2 , 1 , 3)	Classify the orders according to product types: Type A: Best-selling products (value = 1). Type B: Moderately - selling products (value = 2). Type C: Least-selling products (value = 3).
Order Identification	OrderIdentification + 1	Assign a unique identifier to each order, facilitating its traceability and linkage to the customer.
Picking Time	TNOW	Record the time at which the picking activity begins, allowing for the measurement of its duration.

Table 3. Variables

	Formula	**Description**
Rework	It is configured to occur every 7 orders.	It controls the frequency at which an order requires reprocessing within the workflow.
Average Picking Time	The Record module with the Time Interval type is used to capture the duration of the picking activity. The function TAVG(PickingTime) is employed to calculate the average.	Represents the average time dedicated to the picking activity in the warehouse.
Number of Processed Orders	The attribute *Type* is assigned to classify the orders. The *Count* module is used to count orders according to their type.	Calculates how many orders are completed during a workday.
Average Time per Order	Measured from the receipt of the order until its dispatch. The function *TAVG(TiempoTotalSim)* is used to obtain the average.	Determines the total time required to process a complete order.

Finally, the selected indicators used to evaluate the efficiency of the picking process and the overall productivity of the warehouse, both before and after the implementation of the improvements, are detailed below in Table 4:

Table 4. Indicators for Measuring the Efficiency of the Implementation

	Results before implementation	**Results after implementation**
Average Picking Time	11.105	[7.81 ; 9.23]
Average Time per Order	19.477	[15.7 ; 18.1]
Number of Orders Processed in One Day	39	[31 ; 50]

5.2 Graphical Results

Figure 6 represents the complete flow of activities as a model within the Arena simulation software.

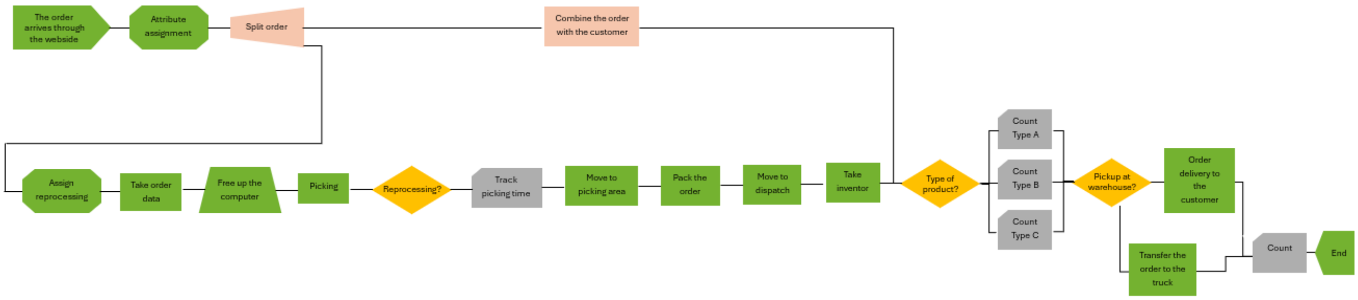

Figure 6. Arena Model

Figure 7 presents a comparative analysis of performance indicators, considering the data obtained from the case study in relation to the characteristic parameters of the corresponding sector.

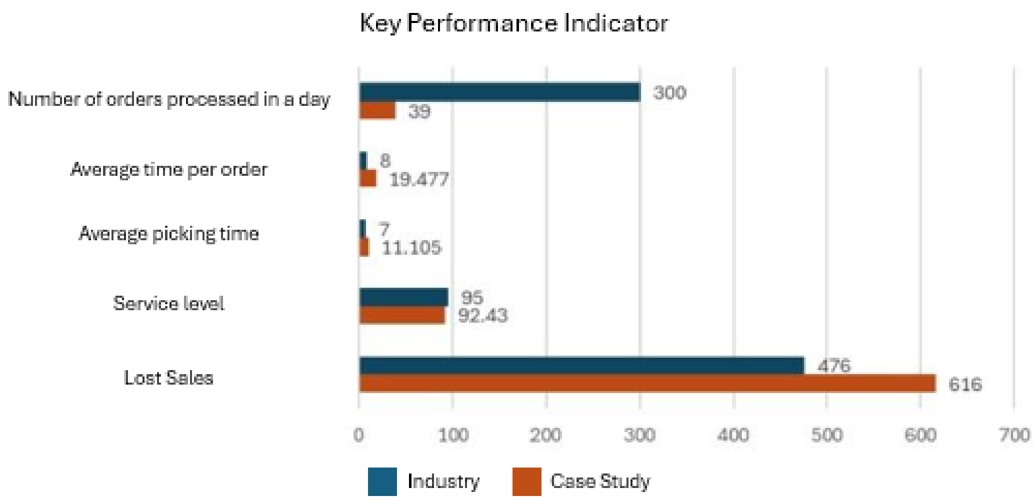

Figure 7. Performance Indicators

Figure 8 provides a detailed overview of the improvements observed in the three previously mentioned indicators, resulting from the implementation of the Kanban tools and the inventory management approach through the Warehouse Management System (WMS).

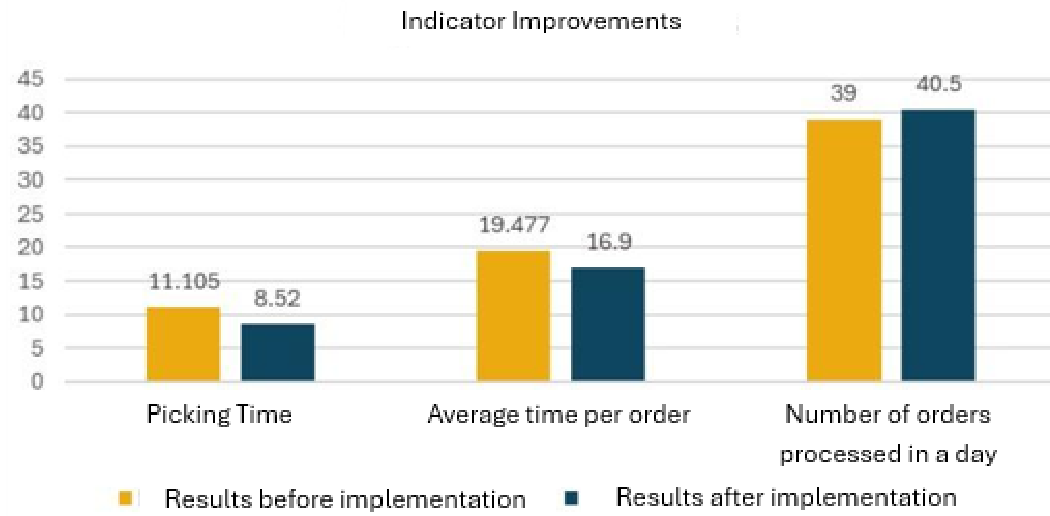

Figure 8. Improvement of the Indicators

Figure 9 presents a detailed analysis of the values recorded during the order data collection. This analysis enables the observation of variability in the activity times, which is useful for identifying patterns, optimizing processes, and improving operational efficiency.

Figure 9. Recorded Values from the Order Data Sample Collection

Figure 10 presents a detailed analysis of the recorded values throughout the picking process. This analysis allows for observing the variability in the activity times, which can be useful for identifying patterns, optimizing processes, and improving operational efficiency (Figure 10).

Figure 10. Recorded values during the picking process in the sample

5.3 Proposed Improvements

The first proposal consists of implementing the Kanban tool, a visual methodology designed to optimize product organization at Mefar S.A.C. This tool was implemented through the use of physical cards containing key information such as the product name, type, expiration date, and SKU, which enable more effective identification and location within the warehouse, significantly contributing to the improvement of the company's operational processes.

The second proposal involves the Warehouse Management System (WMS), designed to monitor and optimize the flow of products within the warehouse, including receipt, storage, and dispatch. Its implementation allows real-time inventory management and the establishment of optimal routes to expedite picking. Additionally, it includes visual alerts for critical inventory levels, enhancing control and planning.

Below, the improvements in inventory visibility and the reduction in picking time after implementation are shown in Table 5:

Table 5. Quantification of the Improvement

	Improvement/Reduction
Inventory Visibility	+ 50%
Picking Time	- 25%

After the implementation of the Kanban tool, inventory visibility improved by 50%, enabling workers to locate products more easily. As a result, picking time was reduced by 25%, decreasing from 11,105 minutes to 8,328 minutes.

However, it is important to note that the present research is based on the application of process improvement tools in small and medium-sized enterprises, such as Mefar S.A.C., a Peruvian SME dedicated to pharmaceutical distribution. This type of organization represents the vast majority of the business structure both in Peru and worldwide. At the national level, micro, small, and medium-sized enterprises (MSMEs) account for approximately 99.4% of all formal companies, while globally SMEs represent about 90% of all business entities. These figures highlight their economic relevance but also demonstrate that their structure, resources, and capabilities may limit the application of certain management systems when compared to large-scale enterprises.

Some of the potential limitations include scalability challenges in large warehouses and technological constraints. Although the Excel-based WMS was designed for a medium-sized operational environment with a manageable number of products and staff, in larger warehouses with more complex material flows and a higher volume of references, these tools may lose effectiveness. In such cases, it would be necessary to implement more advanced technologies, such as barcode scanners or automated WMS platforms that integrate processes digitally. Therefore, the sustainability of the model will depend on a gradual investment in technology and the continuous improvement of the staff's digital capabilities.

5.4 Validation

For the creation of the Kanban cards, we gathered basic yet functional materials such as cardstock, and black, red, and green markers, along with adhesive tape for attachment. These supplies were selected to develop a clear and easy-tounderstand visual system for warehouse personnel. Each card was designed to include key product information, such as product name, type, brand or line, SKU, entry date, and batch expiration date. This format helped to establish a systematic order within storage zones, thus facilitating product identification and handling.

Subsequently, a pilot test was conducted at the facilities of Mefar S.A.C., during which the Kanban cards were physically placed on all products located on a selected shelf. This implementation allowed for the evaluation of the tool's impact in a real operational environment. The feedback received from warehouse staff was highly positive, highlighting the ease of locating products and the improved organization in the workspace. This qualitative result was supported by a significant quantitative improvement: the time required for the picking activity was reduced from 11,105 minutes to 8,328 minutes, representing a 25% decrease and demonstrating the effectiveness of the proposal (Figure 11).

Figure 11. Testing Kanban Cards in the warehouse

6. Conclusion

From the foregoing, it is concluded that the implementation of Kanban tools and the Warehouse Management System (WMS) approach at Mefar S.A.C. has resulted in a significant improvement in the productivity of the picking process and inventory management. Due to the enhancement in picking, the company experienced a 25% reduction in lost sales, thanks to the implementation of these tools, which provide better inventory visibility and optimized routing during picking through the inventory management system. Additionally, a more rigorous control over stock levels was achieved.

As a result, the level of customer service was improved by reducing delivery times and enhancing product availability during critical periods. This progress not only contributes to cost savings by avoiding product loss due to expiration but also reduces environmental impact by minimizing pharmaceutical waste. Moreover, the visual control within the warehouse has simplified staff tasks, increasing each operator's efficiency and decreasing the time spent searching for products, positioning Mefar as a more efficient and sustainable company within the pharmaceutical sector.

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