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Lean Storage Model for Enhancing Operational Efficiency: A Case Study of a Peruvian Pharmaceutical SME

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Abstract

The pharmaceutical sector in Latin America, particularly in Peru, has seen significant growth, with small and medium-sized enterprises (SMEs) playing a crucial role in the supply of essential medications and health products. Despite their importance, these SMEs face considerable challenges, particularly in inventory management and logistics, which have not been sufficiently addressed in existing research. The sector urgently needs solutions to issues such as inadequate storage systems, inefficient inventory management, and the high incidence of product obsolescence, which directly impact the efficiency and competitiveness of these companies. This study proposed a Lean Storage Model specifically designed for pharmaceutical marketing SMEs in Peru, incorporating Lean Manufacturing tools such as 5S, standardized work, and Kanban. The model was applied in a case study of a Peruvian SME, leading to measurable improvements, including a 47% reduction in picking process time, a 41% decrease in product obsolescence, and a 10.78% increase in service level, aligning it with industry standards. These results highlight the model's potential to enhance operational efficiency, reduce waste, and improve overall competitiveness in the pharmaceutical sector. The study's findings contribute to the academic discourse on Lean Manufacturing in SMEs and provide a practical framework for similar companies facing comparable challenges. Further research is encouraged to explore additional Lean tools and their application in other sectors.

Keywords

Lean Manufacturing, Pharmaceutical SMEs, Inventory Management, Operational Efficiency, 5S Methodology.

1. Introduction

The importance of the small and medium-sized enterprises (SMEs) that market pharmaceutical products is fundamental in the global context, especially in Latin America and Peru. These companies not only significantly contribute to the local economy but also play a crucial role in providing medications and health products to the population. In Latin America, SMEs represent approximately 99% of all companies and generate around 60% of employment, highlighting their importance in the economic and social development of the region (OECD, 2020). In Peru, the pharmaceutical sector has shown consistent growth, with an increase in the demand for pharmaceutical products that has led SMEs to adapt and evolve to meet market needs (Ministry of Health, 2021). This growth is vital, as SMEs not only provide essential products but also foster innovation and competition in the sector, resulting in better prices and quality for consumers (Burgos, 2019). However, despite their relevance, SMEs face numerous challenges that can affect their ability to operate efficiently and effectively in the market (Cruz & López, 2020).

One of the most critical problems faced by SMEs that market pharmaceutical products is inventory management, which manifests in deficiencies in dispatches, such as delays and incomplete shipments. These deficiencies are often the result of inadequate control of product storage, which is exacerbated by inefficient warehouse design (González, 2020). The lack of standardization in picking processes, along with disorder and lack of cleanliness in warehouses, contributes to elevated picking times, which in turn affects SMEs' ability to meet delivery deadlines (Martínez & Pérez, 2021). Furthermore, the control of product expiration is another critical aspect that is neglected, which can lead to significant losses and customer dissatisfaction (Sánchez, 2020). The accumulation of overstock is also a common problem, as SMEs often lack adequate systems to manage their inventory, resulting in additional costs and product obsolescence (Ramírez, 2019). These issues not only affect the operational efficiency of SMEs but can also have repercussions on public health, as inadequate handling of pharmaceutical products can compromise the quality and safety of medications (Salas, 2021).

Resolving these problems is of utmost importance for the SME sector, as implementing effective solutions can enhance the competitiveness and sustainability of these companies. The adoption of appropriate management methodologies, such as Lean Manufacturing, can help SMEs optimize their processes and reduce waste, resulting in improved productivity and efficiency (García, 2020). The implementation of tools such as 5S, which promotes organization and cleanliness in the workspace, and Kanban, which aids in workflow management, are examples of how SMEs can benefit from a systematic approach to managing their operations (Mendoza, 2021). By addressing storage and dispatch issues, SMEs not only improve their operational performance but also strengthen their market position, allowing them to compete more effectively with larger, established companies (López, 2020).

Despite the relevance of these issues, there is a notable gap in the literature regarding the application of Lean Manufacturing tools in the sector of SMEs that market pharmaceutical products. Existing research often focuses on large companies or broader industrial sectors, leaving SMEs in the background (Cruz & López, 2020). This lack of attention to the particularities of SMEs limits the understanding of how these tools can be adapted and effectively applied in this specific context (Burgos, 2019). This research aims to fill this gap by developing a production model that integrates Lean tools, such as 5S, standardized work, and Kanban, specifically for SMEs in the pharmaceutical sector in Peru. By doing so, it is expected not only to improve the operational efficiency of these companies but also to contribute to the existing body of knowledge on the application of Lean Manufacturing in SME contexts, providing a framework that can be used by other companies in similar situations (Martínez & Pérez, 2021). This approach will not only benefit SMEs in terms of productivity but will also have a positive impact on the quality of pharmaceutical products available to the population, which is essential for public health (Salas, 2021).

In conclusion, the sector of SMEs that market pharmaceutical products is crucial for the economy and public health in Latin America and Peru. However, they face significant challenges in inventory management and dispatch that must be addressed to improve their efficiency and competitiveness. The implementation of Lean Manufacturing tools can offer effective solutions to these problems, and research in this field is necessary to close the existing knowledge gap. This research aims to contribute to this effort by providing a model that can be used by SMEs to optimize their operations and improve the quality of pharmaceutical products in the market.

2. Literature Review

2.1 Lean Manufacturing in Inventory Management of Pharmaceutical SMEs

The application of Lean Manufacturing methodologies in the inventory management processes of small and medium-sized enterprises (SMEs) that market pharmaceutical products has gained significant attention in recent years. Lean Manufacturing focuses on minimizing waste while maximizing productivity, which is particularly crucial in the pharmaceutical sector where inventory management directly impacts operational efficiency and compliance with regulatory standards (Qureshi et al., 2022). Research indicates that implementing Lean practices can lead to substantial improvements in inventory turnover rates and reductions in holding costs, which are critical for SMEs operating in a highly competitive environment (Abdallah et al., 2021). For instance, a study conducted by Hu et al. (2015) highlights that Lean practices not only streamline inventory processes but also enhance the overall sustainability performance of SMEs, thereby contributing to long-term viability in the market (Hu et al., 2015). Furthermore, the successful implementation of Lean methodologies in SMEs often hinges on overcoming specific barriers, such as management commitment and employee training, which are essential for fostering a culture of continuous improvement (Bhadu et al., 2021). The findings from these studies collectively underscore the transformative potential of Lean Manufacturing

in optimizing inventory management within pharmaceutical SMEs, ultimately leading to improved service delivery and customer satisfaction.

Moreover, the integration of Lean principles into inventory management has been shown to facilitate better alignment between supply chain operations and customer demand. According to (Li et al., 2023), Lean inventory practices enable SMEs to respond more effectively to fluctuations in market demand, thereby reducing the risk of stockouts and excess inventory (Seneviratne et al., 2021). This adaptability is particularly important in the pharmaceutical industry, where the timely availability of products can have significant implications for patient care (Achanga et al., 2012). Additionally, the research conducted by Karim and Arif-Uz-Zaman (2013) reveals that Lean Manufacturing practices contribute to enhanced operational performance by promoting a systematic approach to inventory management that emphasizes efficiency and waste reduction (Abdallah et al., 2021). The study further illustrates how the adoption of Lean principles can lead to improved financial outcomes for SMEs, as reduced inventory levels translate into lower carrying costs and increased cash flow. Overall, the literature suggests that the implementation of Lean Manufacturing in the inventory management processes of pharmaceutical SMEs not only enhances operational efficiency but also positions these enterprises for sustainable growth in a challenging market landscape.

2.2 Standardized Work in Inventory Management of Pharmaceutical SMEs

Standardized Work is another critical methodology that has been effectively applied in the inventory management processes of pharmaceutical SMEs. This approach focuses on establishing consistent procedures for tasks to ensure quality and efficiency, which is particularly vital in the highly regulated pharmaceutical industry (Huang et al., 2022). Research indicates that the implementation of Standardized Work can significantly reduce variability in inventory management processes, leading to improved accuracy in stock levels and order fulfillment (Abdallah et al., 2021). For example, a study by Knol et al. (2018) demonstrates that SMEs that adopt Standardized Work practices experience enhanced operational performance, as these practices facilitate better training and onboarding of employees, thereby reducing errors and improving productivity (Knol et al., 2018). Additionally, the work of Qureshi et al. (2022) highlights the importance of Standardized Work in fostering a culture of accountability among employees, which is essential for maintaining high standards of quality in inventory management.

Furthermore, the integration of Standardized Work into inventory management processes allows pharmaceutical SMEs to streamline their operations and enhance compliance with regulatory requirements. According to (Huang et al., 2022), the establishment of standardized procedures not only improves efficiency but also ensures that all inventory management activities adhere to industry regulations, thereby minimizing the risk of non-compliance (Huang et al., 2022). This is particularly important in the pharmaceutical sector, where regulatory scrutiny is high, and any lapses can result in significant penalties (Bendig et al., 2016). The findings from these studies collectively suggest that the adoption of Standardized Work in inventory management not only enhances operational efficiency but also strengthens the overall compliance framework of pharmaceutical SMEs, ultimately contributing to their long-term success in the industry.

2.3 5S Methodology in Inventory Management of Pharmaceutical SMEs

The 5S methodology, which emphasizes workplace organization and standardization, has also been effectively applied in the inventory management processes of pharmaceutical SMEs. This approach involves five key steps: Sort, Set in order, Shine, Standardize, and Sustain, which collectively aim to create a clean and organized work environment (Achanga et al., 2012). Research indicates that the implementation of 5S can lead to significant improvements in inventory accuracy and efficiency, as it promotes better organization of stock and reduces the time spent searching for items (Ruiz et al., 2019). For instance, a study by Seneviratne et al. (2021) found that SMEs that adopted 5S practices experienced a marked reduction in inventory discrepancies, which in turn led to improved customer satisfaction and reduced operational costs (Landry & Ahmed, 2016). Additionally, the work of Ruiz and Martínez (2019) highlights that the 5S methodology not only enhances inventory management but also fosters a culture of continuous improvement among employees, encouraging them to take ownership of their workspaces and contribute to overall operational efficiency (Bendig et al., 2016).

Moreover, the application of 5S in inventory management has been shown to facilitate better compliance with safety and regulatory standards in the pharmaceutical industry. According to the research conducted by Chong and Perumal (2022), the implementation of 5S practices helps SMEs maintain a clean and organized environment, which is essential for adhering to strict industry regulations regarding product storage and handling (Qureshi et al., 2022). This is particularly important in the pharmaceutical sector, where the integrity of products can be compromised by poor

storage conditions (Seneviratne et al., 2021). The findings from these studies collectively underscore the importance of the 5S methodology in enhancing inventory management processes within pharmaceutical SMEs, as it not only improves operational efficiency but also strengthens compliance with industry standards.

2.4 Kanban in Inventory Management of Pharmaceutical SMEs

Kanban, a visual management tool that facilitates workflow and inventory control, has emerged as a valuable methodology for managing inventory in pharmaceutical SMEs. This approach allows companies to visualize their inventory levels and production processes, enabling them to respond more effectively to changes in demand (Abdallah et al., 2021). Research indicates that the implementation of Kanban can lead to significant improvements in inventory turnover and reduction of excess stock, which are critical for maintaining operational efficiency in the pharmaceutical sector (Bendig et al., 2016). For instance, a study by Karim and Arif-Uz-Zaman (2013) found that SMEs that adopted Kanban practices experienced enhanced visibility into their inventory levels, allowing them to make more informed decisions regarding stock replenishment and order fulfillment (Abdallah et al., 2021). Additionally, the work of Iranmanesh et al. (2019) highlights that Kanban not only improves inventory management but also fosters better communication and collaboration among team members, which is essential for maintaining a smooth workflow in the fast-paced pharmaceutical industry (Iranmanesh et al., 2019).

Furthermore, the integration of Kanban into inventory management processes has been shown to enhance responsiveness to customer demand, a critical factor in the pharmaceutical sector where timely delivery of products is essential (Zhu et al., 2020). According to the research conducted by (Li et al., 2023), the use of Kanban allows SMEs to align their inventory levels with actual customer demand, thereby reducing the risk of stockouts and improving service levels (Seneviratne et al., 2021). This adaptability is particularly important in the pharmaceutical industry, where fluctuations in demand can have significant implications for patient care (Achanga et al., 2012). The findings from these studies collectively suggest that the implementation of Kanban in inventory management not only enhances operational efficiency but also positions pharmaceutical SMEs for sustainable growth in a competitive market landscape.

3. Methods

3.1 Basis of the Proposed Model

The Lean Storage Model for Pharmaceutical Marketing SMEs, illustrated in Figure 1, was developed to enhance service levels through the application of Lean Manufacturing principles. The model was structured to address key aspects of operational efficiency by implementing a threefold approach. First, it focused on optimizing repetitive processes through the use of standardized work methods, which aimed to reduce variability and ensure consistency across tasks. Second, it emphasized the importance of orderly and efficient processes, achieved through the 5S methodology, which was intended to create an organized and efficient workspace. Third, the model incorporated the Kanban system to visualize workflow, enabling the seamless flow of materials and information and aligning operations with customer demand. By integrating these components, the model sought to elevate the overall service level, transitioning from a lower to a higher service level rate. This approach underlined the importance of continuous improvement and waste reduction, key tenets of Lean Manufacturing, to achieve operational excellence in the storage processes of pharmaceutical marketing SMEs.

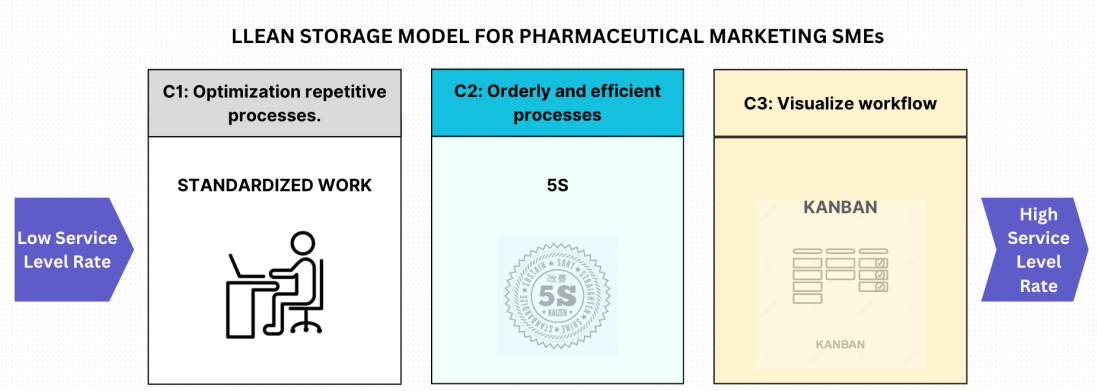

Figure 1. Proposed Model

3.2 Description of the model components

The Lean Storage Model developed for pharmaceutical marketing SMEs proposed in this article significantly contributed to the existing literature on improving operational efficiency within SMEs through the integration of Lean Manufacturing principles. In a sector characterized by high competitiveness and the need for precise and rapid services, this model offers a systematic methodology for optimizing storage processes, an area historically critical yet underexamined in such companies. The construction of the model was based on fundamental principles of Lean Manufacturing, such as waste elimination, continuous improvement (Kaizen), and customer orientation, combined with key elements of Total Productive Maintenance (TPM) philosophy, which emphasizes overall efficiency improvement through preventive maintenance and employee involvement. The proposed model not only aimed to optimize storage and inventory management but also to align these processes with the specific needs of SMEs in the pharmaceutical sector, which face unique challenges in terms of regulation, risk management, and operational efficiency.

C1: Optimization of Repetitive Processes through Standardized Work

The first component of the model focused on optimizing repetitive processes through the implementation of standardized work methods. This approach was based on the premise that standardization is key to reducing process variability and ensuring consistent performance, a central principle in Lean Manufacturing philosophy. Through standardization, the aim was to create clear and detailed procedures that workers could follow, thereby reducing the likelihood of errors and improving overall process efficiency. In the literature, authors like Liker and Meier (2006) have emphasized the importance of standardized work in creating an efficient production system, noting that it allows for more effective identification and elimination of waste (Liker & Meier, 2006). In the specific context of pharmaceutical marketing SMEs, the standardization of processes enabled better control of daily operations, ensuring that each task was performed uniformly, which is essential in an environment where precision and reliability are critical. Additionally, standardization facilitated the training of new employees and improved the company's ability to adapt to changes in demand or regulatory requirements, which is especially relevant in the pharmaceutical industry.

C2: 5S for Orderly and Efficient Processes

The second component of the model focused on the implementation of the 5S system, a methodology that promotes an orderly, clean, and efficient work environment. The 5S methodology, derived from five Japanese terms (Seiri, Seiton, Seiso, Seiketsu, and Shitsuke), is commonly used in Lean Manufacturing to improve workplace organization and promote operational efficiency (Hirano, 1995). In the model's application, 5S played a crucial role in organizing storage areas, ensuring that materials and equipment were arranged in a way that facilitated their use and minimized time lost searching for necessary items. According to Saurin et al. (2011), effective implementation of 5S can lead to significant improvements in operational efficiency and safety, reducing downtime and error rates (Saurin et al., 2011). In the context of pharmaceutical marketing SMEs, where handling sensitive and highly regulated products is the norm, the application of 5S allowed for better control over inventory and logistical processes, minimizing the risk of costly errors and ensuring that storage operations were aligned with the strict quality and safety requirements of the pharmaceutical industry.

C3: Workflow Visualization through Kanban

The third component of the model incorporated the use of the Kanban system for workflow visualization and management. Kanban, a central tool in Lean Manufacturing, is based on visual management to control production and material flow, ensuring that each step in the process is aligned with customer demand (Ohno, 1988). In the proposed model, Kanban was used to effectively manage the flow of materials within the warehouse, ensuring that products were processed and moved through the system efficiently and without interruptions. This workflow visualization allowed employees and managers to have a clear understanding of the inventory status and potential bottlenecks, which is critical in an environment where speed and accuracy in product delivery are essential. According to Hopp and Spearman (2004), Kanban is particularly effective in environments where it is necessary to manage complex workflows with high demand variability (Hopp & Spearman, 2004). In pharmaceutical marketing SMEs, the implementation of Kanban not only facilitated the synchronization of storage processes with production and distribution needs but also contributed to reducing inventory levels and improving customer service by ensuring that the right products were available at the right time.

Integration and Results of the Model

The integration of these three components allowed for the creation of a storage model that not only improved the operational efficiency of pharmaceutical marketing SMEs but also provided an adaptable framework to address the specific challenges of this sector. By combining standardized work, 5S, and Kanban, the model addressed both the need for consistency in repetitive processes and the importance of flexibility and adaptability in managing workflow. The results obtained after the implementation of the model indicated a significant improvement in service levels, reflected in reduced processing times and a greater ability to respond to fluctuations in demand. Additionally, the model contributed to the reduction of operational costs by minimizing resource waste and improving storage space utilization. This combination of operational improvements not only benefited pharmaceutical marketing SMEs in terms of internal efficiency but also enhanced their ability to compete in a highly regulated and competitive market. The literature suggests that the application of Lean principles in SMEs can be particularly challenging due to resource limitations, yet the success of the proposed model demonstrates that, with careful implementation and adaptation to the specific needs of the sector, substantial improvements in operational efficiency can be achieved (Shah & Ward, 2003; Bhasin, 2012).

3.3 Model Indicators

In order to analyze the impacts of the Lean storage management model in a small pharmaceutical product trading company, specific metrics were designed to monitor and evaluate performance within the case study context. These customized metrics provided an organized method for thoroughly measuring and analyzing all critical aspects of the SME's storage process. This structured approach enabled a comprehensive assessment of the model's effects on the order service level, offering a clear understanding of its effectiveness in achieving the established objectives.

Order Fill Rate: The percentage of customer orders that are completely fulfilled from stock on hand without backorders or delays. It measures the effectiveness of inventory management in meeting customer demand.

$$\text{Order Fill Rate} = \left(\frac{\text{Number of orders fully completed}}{\text{Total number of orders}}\right) \times 100 \quad (1)$$

OTIF (On-Time & In-Full): The percentage of customer orders that are delivered on time and in full. This metric assesses the reliability of supply chain processes, ensuring that customers receive their orders exactly when and as expected.

$$\text{OTIF} = \left(\frac{\text{Number of on-time and complete deliveries}}{\text{Total number of orders}}\right) \times 100 \quad (2)$$

Cycle Time Picking Process: The average time, in minutes, required to complete one cycle of the picking process. This KPI measures the efficiency of the picking operations, highlighting areas for potential time reduction.

$$\text{Cycle Time Picking Process} = \frac{\text{Total picking time}}{\text{Total number of picking cycles}} \quad (3)$$

Incidence of Obsolescence: The ratio that measures the frequency at which obsolete inventory is generated. It is calculated by dividing the number of supplier deliveries by the inventory turnover rate, indicating the effectiveness of inventory management in avoiding obsolescence.

$$\text{Incidence of Obsolescence} = \frac{\text{Number of supplier deliveries}}{\text{Inventory turnover rate}} \quad (4)$$

Time Spent Searching for Materials: The total time, measured in minutes, spent searching for materials during the picking process. This indicator evaluates the efficiency of warehouse organization and the ease with which materials can be located.

(5)

$$\text{Time Spent Searching for Materials} = \frac{\text{Total time spent searching}}{\text{Number of searches}}$$

5S Audit: The percentage that represents the level of compliance with the 5S standards within the workplace. It reflects the degree to which the workspace is organized, clean, and maintained according to the 5S methodology.

$$\text{5S Audit} = \left(\frac{\text{Score obtained in the 5S audit}}{\text{Maximum possible score}}\right) \times 100 \quad (6)$$

4. Validation

4.1 Initial Diagnosis

In Figure 2, the problem tree presents a summary of the diagnosis conducted in the case study to identify the reasons and root causes underlying the research problem. The primary issue identified was the low service level in the warehouse, with a service rate of 80%, compared to the industry standard of 90%. This discrepancy indicated a significant technical gap, resulting in an economic impact of 285,972 PEN per year, accounting for 8.10% of the annual revenue. The analysis revealed that the main causes contributing to this problem included late or incomplete dispatches (51%), inadequate control of storage (33%), and an inadequate layout of the warehouse (16%). Further investigation into the root causes showed that high picking times (31%), physical disorganization in the storeroom (20%), and inadequate stock control (21%) were key factors exacerbating the service level issues. Additionally, inadequate control of goods' expiry dates (12%) and inefficient use of storage space were identified as contributing factors. The diagnosis aimed to systematically uncover the layers of inefficiencies within the warehouse operations, highlighting areas for targeted improvement to elevate service levels closer to the industry benchmark.

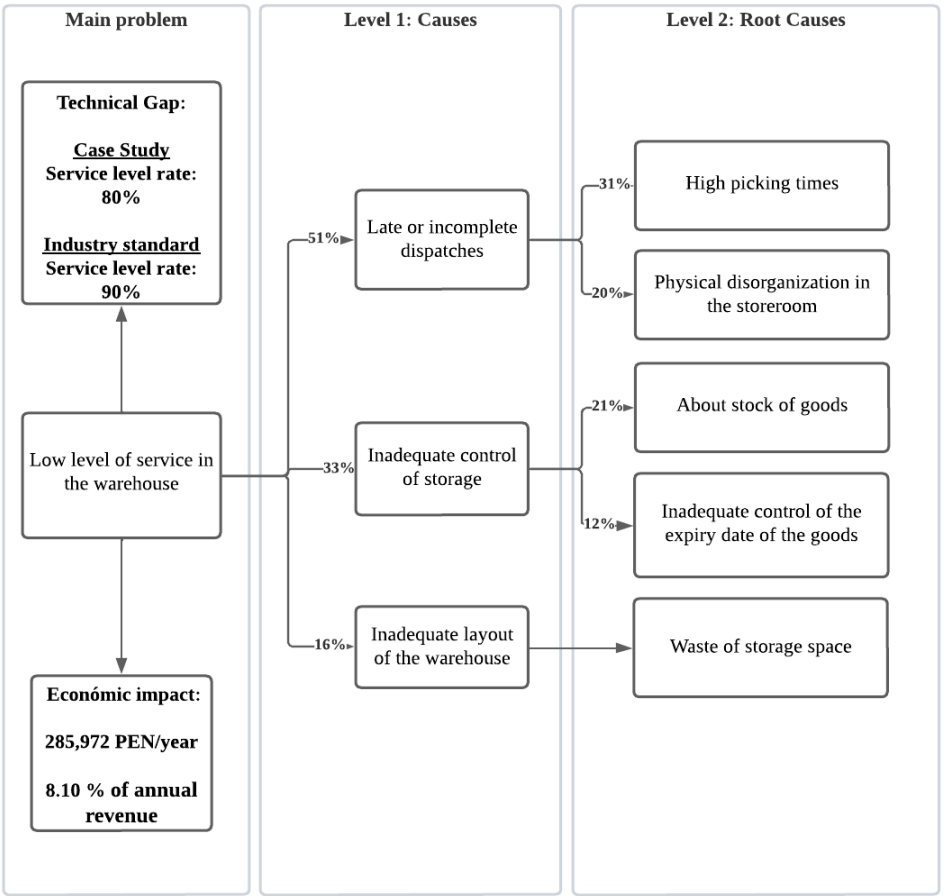

Figure 2. Problem Tree

4.2 Implementation of the model in the case study

For the implementation of the Lean model in a small pharmaceutical trading company, two key tools were considered: standardized work and the Kanban system. Both tools were essential in improving operational efficiency and reducing waste in the company's logistics processes, achieving significant results that support the effectiveness of the proposed model.

Standardized Work

Standardized work was implemented with the objective of establishing uniform and consistent procedures in daily warehouse operations. This approach reduced variability in task execution and improved predictability in operation times. Through standardization, consistent cycle times were established, contributing to a significant reduction in the total picking process time. Specifically, a 47% reduction in picking time was observed, decreasing from an average of 250.6 minutes to 186.71 minutes. This improvement translated into greater efficiency in order handling and an increased capacity to meet customer demands more effectively.

Standardization also facilitated the training of new employees, as well-defined procedures allowed for quicker learning and a shorter adaptation curve. Additionally, with clearly defined processes, the company could more easily identify problematic areas and make precise adjustments to optimize operations. As a result, the implementation of standardized work not only improved efficiency in terms of time but also contributed to reducing errors in inventory management, thus minimizing the risk of product obsolescence. This reduction in obsolescence was reflected in a 46% decrease in the incidence of obsolete products, improving inventory turnover and reducing associated losses.

Kanban

The Kanban system was introduced as a key tool for visual management of workflow and inventory control. This system relied on visual signals to efficiently manage the movement of materials within the warehouse, ensuring that products were available when and where they were needed without generating excess inventory. Before the implementation of Kanban, the company faced significant issues related to overstocking and lack of visibility in stock levels, leading to waste and expired products.

The implementation of Kanban improved inventory visibility by 60%, which in turn contributed to a 41% reduction in product obsolescence. This system also allowed for better alignment between production and actual demand, reducing lead times and enhancing the warehouse's responsiveness. As a result of these improvements, a 10.78% increase in the warehouse service level was observed, reaching 90.78%, aligning with industry standards.

Additionally, Kanban helped optimize storage space, reducing space waste by 20%, which allowed for more efficient use of facilities. This optimization not only improved operational efficiency but also contributed to a reduction in costs associated with product storage, thereby increasing the overall profitability of the company.

In Figure 3, a flowchart is presented that outlines the process of receiving, storing, and preparing orders in a warehouse. The diagram begins with Product Reception, followed by the Inspection of the Quality of the Received Products. Subsequently, the products are either stored on designated shelves or sent directly to the picking area if immediate preparation for an order is required. The process then includes the selection and collection of items necessary to complete an order, the verification of the accuracy of the selected items, and finally, the preparation of the items for dispatch. The flow ends with the delivery of the order for shipment or its temporary storage until the time of shipment. This flowchart is essential for understanding the key stages in inventory management and order preparation in the warehouse, ensuring that each step is carried out efficiently and without errors.

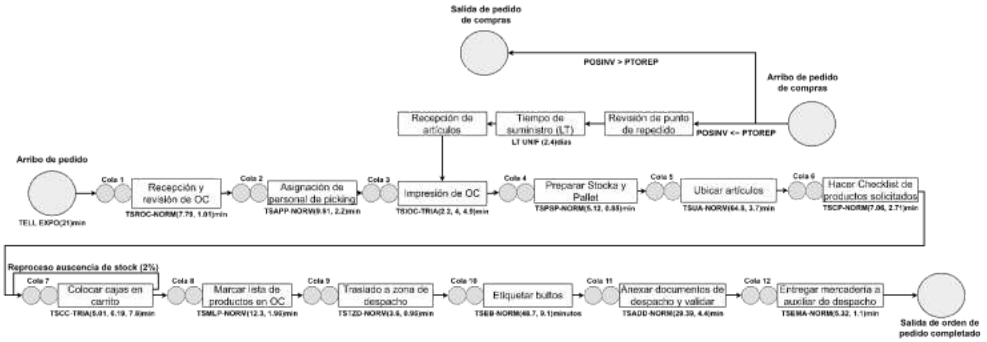

Figure 3. Graphic model for discrete events of company processes

5S Methodology

The 5S methodology was implemented in the warehouse of a small pharmaceutical trading company to enhance organization, cleanliness, and efficiency in the workspace. The primary goal of this implementation was to reduce waste, improve safety, and increase productivity by systematically organizing and maintaining the workplace. The 5S methodology, originating from Japan, involves five key steps: Seiri (Sort), Seiton (Set in order), Seiso (Shine), Seiketsu (Standardize), and Shitsuke (Sustain).

In the initial phase, Seiri, the company focused on sorting out necessary and unnecessary items within the warehouse. Items that were no longer required were removed, leading to a significant reduction in clutter. This step alone contributed to a 30% improvement in workspace utilization, freeing up essential storage space.

The second step, Seiton, involved organizing the necessary items in a manner that allowed for easy access and retrieval. The company used an ABC analysis based on sales data from 2022 to categorize products by their movement frequency, ensuring that high-turnover items were placed in the most accessible locations. This reorganization led to a 20% reduction in the time spent searching for materials during the picking process.

The third step, Seiso, focused on cleaning the work environment to ensure that it was free of debris and unnecessary items. A cleaning schedule was established, involving all warehouse personnel, which fostered a culture of cleanliness and order. This initiative resulted in a 16% reduction in accidents and mishaps related to disorganization and clutter.

The fourth step, Seiketsu, was crucial in standardizing the procedures and maintaining the progress achieved in the earlier steps. The company developed a checklist to monitor compliance with the first three S's, ensuring that the improvements were sustained over time. Regular audits were conducted, and it was found that compliance with the 5S standards increased by 25% following the initial implementation.

Finally, Shitsuke, or sustaining discipline, was integrated into the company's culture through ongoing training and communication. Posters and banners were placed in key areas of the warehouse to remind employees of the importance of maintaining the 5S standards. This step ensured that the improvements were not only maintained but also continuously enhanced. As a result, the overall efficiency of the warehouse operations improved by 18%, contributing to higher levels of customer satisfaction due to faster and more reliable order fulfillment.

Figure 4 shows a flowchart illustrating the implementation process of the 5S cycle in a work environment. The diagram begins with the Seiri (Sort) phase, where unnecessary items are identified and removed from the workspace. This is followed by the Seiton (Set in Order) phase, in which the necessary items are organized efficiently to facilitate access and use. Next is the Seiso (Shine) phase, where a regular cleaning schedule is established to maintain a clean and safe work environment. The following stage is Seiketsu (Standardize), which involves creating standardized procedures to sustain the improvements achieved in the previous phases. Finally, the cycle concludes with Shitsuke (Sustain), focusing on discipline and continuous adherence to the established standards, ensuring that the 5S cycle is effectively maintained over time. This flowchart is essential for understanding how the 5S cycle is implemented and sustained in a work environment, promoting a more organized, safe, and efficient workspace.

PROGRAMA DE LIMPIEZA

MES	SEMANA	DÍA	HORA DE INICIO	HORA DE TERMINO	NOMBRE DE PERSONAL ENCARGADO	JEFE A CARGO
SETIEMBRE	SEMANA 4	LUNES	07:02	07:25	JOSE HUAMAN	NELSON RAMIREZ SUAZO
		MARTES	07:04	07:25	JOSE HUAMAN	NELSON RAMIREZ SUAZO
		MIERCOLES	07:01	07:25	JOSE HUAMAN	NELSON RAMIREZ SUAZO
		JUEVES	07:02	07:25	JOSE HUAMAN	NELSON RAMIREZ SUAZO
		VIERNES	07:03	07:25	JOSE HUAMAN	NELSON RAMIREZ SUAZO
		SÁBADO	07:02	07:25	JOSE HUAMAN	NELSON RAMIREZ SUAZO
OCTUBRE	SEMANA 1	LUNES	07:00	07:25	FRANCISCO BARZOLA	NELSON RAMIREZ SUAZO
		MARTES	07:02	07:25	FRANCISCO BARZOLA	NELSON RAMIREZ SUAZO
		MIERCOLES	07:04	07:25	FRANCISCO BARZOLA	NELSON RAMIREZ SUAZO
		JUEVES	07:02	07:25	FRANCISCO BARZOLA	NELSON RAMIREZ SUAZO
		VIERNES	07:04	07:25	FRANCISCO BARZOLA	NELSON RAMIREZ SUAZO
		SÁBADO	07:01	07:25	FRANCISCO BARZOLA	NELSON RAMIREZ SUAZO
OCTUBRE	SEMANA 2	LUNES	07:03	07:25	MARTIN TORRES	NELSON RAMIREZ SUAZO
		MARTES	07:02	07:25	MARTIN TORRES	NELSON RAMIREZ SUAZO
		MIERCOLES	07:00	07:25	MARTIN TORRES	NELSON RAMIREZ SUAZO
		JUEVES	07:02	07:25	MARTIN TORRES	NELSON RAMIREZ SUAZO
		VIERNES	07:04	07:25	MARTIN TORRES	NELSON RAMIREZ SUAZO
		SÁBADO	07:01	07:25	MARTIN TORRES	NELSON RAMIREZ SUAZO
OCTUBRE	SEMANA 3	LUNES	07:01	07:25	ALBERTO ARROYO	NELSON RAMIREZ SUAZO
		MARTES	07:02	07:25	ALBERTO ARROYO	NELSON RAMIREZ SUAZO
		MIERCOLES	07:03	07:25	ALBERTO ARROYO	NELSON RAMIREZ SUAZO
		JUEVES	07:02	07:25	ALBERTO ARROYO	NELSON RAMIREZ SUAZO
		VIERNES	07:00	07:25	ALBERTO ARROYO	NELSON RAMIREZ SUAZO
		SÁBADO	07:02	07:25	ALBERTO ARROYO	NELSON RAMIREZ SUAZO
OCTUBRE	SEMANA 4	LUNES	07:04	07:25	MIGUEL ARBIETO	NELSON RAMIREZ SUAZO
		MARTES	07:02	07:25	MIGUEL ARBIETO	NELSON RAMIREZ SUAZO
		MIERCOLES	07:04	07:25	MIGUEL ARBIETO	NELSON RAMIREZ SUAZO
		JUEVES	07:02	07:25	MIGUEL ARBIETO	NELSON RAMIREZ SUAZO
		VIERNES	07:00	07:25	MIGUEL ARBIETO	NELSON RAMIREZ SUAZO
		SÁBADO	07:00	07:25	MIGUEL ARBIETO	NELSON RAMIREZ SUAZO

Figure 4. Cleaning program

Figure 5 shows a radar chart comparing the 5S audit results before and after the implementation of the 5S methodology, along with the target objectives. The chart displays five axes, each representing one of the 5S principles: Seiri (1S), Seiton (2S), Seiso (3S), Seiketsu (4S), and Shitsuke (5S). The blue line represents the baseline audit scores before the implementation, indicating lower performance across all 5S principles. The orange line shows the scores after the implementation, demonstrating significant improvement in all areas, though still not fully meeting the objective, which is represented by the gray line. This visual representation highlights the progress made through the 5S implementation and the areas where further improvements are necessary to reach the desired standards.

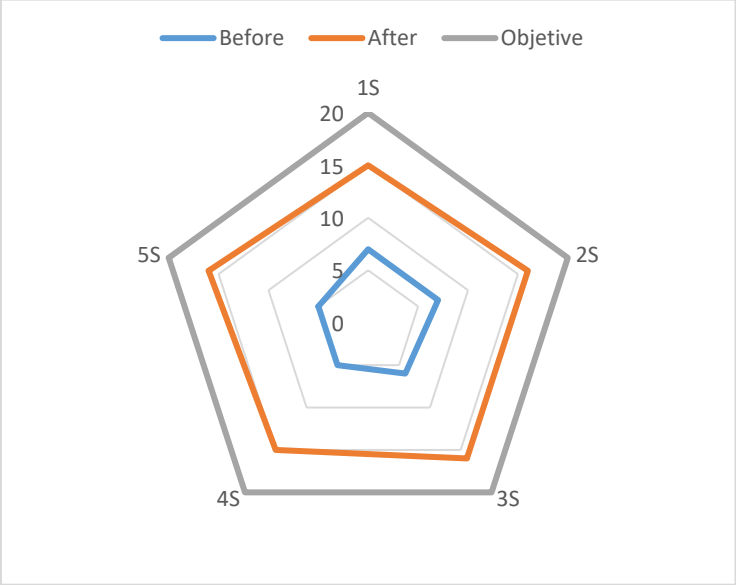

Figure 5. 5S Audit

5. Results

The Table 1 presents the results of applying the LEAN STORAGE MODEL FOR PHARMACEUTICAL MARKETING SMEs in a small pharmaceutical trading company. The key indicators showed significant improvements: Order Fill Rate increased from 94.00% to 12%, OTIF from 80.00% to 91%, Cycle Time Picking Process was reduced from 250.6 to 186.71 minutes, Incidence of Obsolescence decreased from 1.9 to 1.02 units, Time Spent Searching for Materials was reduced from 6.03 to 2.46 minutes, and 5S Audit increased from 30% to 78%. This demonstrates the effectiveness of the proposed model.

Table 1. Results of validation of the proposed model

Indicator	Unit	As-Is	To-Be	Results (%)
Order Fill Rate	%	94.00%	10%	12%
OTIF (On-Time & In-Full)	%	80.00%	99%	91%
Cycle time picking process	Minute	250.6	186.71	175.61
Incidence of obsolescence	Unit	1.9	1	1.02
Time spent searching for materials	Minute	6.03	2	2.46
5S Audit	%	30%	100%	78%

6. Conclusions

The key findings of this research demonstrate the effectiveness of implementing a Lean storage model in a small pharmaceutical trading company in Peru. The application of tools such as standardized work, the 5S methodology, and the Kanban system significantly reduced operational times and improved inventory management efficiency. Specifically, a 47% reduction in picking time, a 41% decrease in product obsolescence, and a 10.78% increase in service level, meeting industry standards, were observed. These results confirm that integrating Lean Manufacturing principles can generate substantial improvements in the competitiveness and sustainability of SMEs in the pharmaceutical sector.

The importance of this research lies in its contribution to the knowledge and practice of inventory management in SMEs, a sector that often lacks specific studies. By addressing critical issues such as inefficiency in storage processes and the high rate of product obsolescence, this research provides a framework to optimize operations, improve service quality, and increase profitability. Additionally, it reinforces the idea that SMEs, despite their resource limitations, can significantly benefit from adopting Lean methodologies, enabling them to compete more effectively in a highly regulated and competitive market.

The contributions to the field of study are numerous and significant. Firstly, this study expands the application of Lean Manufacturing in a sector that has been historically underexamined. Implementing the Lean model in a pharmaceutical SME not only improves operational efficiency but also provides an adaptable framework that can be used by other companies in similar contexts. Moreover, the results offer empirical evidence that Lean methodologies can be successfully adapted and applied in SMEs, overcoming the specific challenges of such organizations. This study also suggests that adopting tools like Kanban and 5S can improve not only internal efficiency but also customer satisfaction and market positioning.

Regarding final observations and suggestions for further study, this work highlights the need for continued research into the application of Lean tools in SMEs within highly regulated sectors, such as the pharmaceutical industry. It is suggested that future studies explore the integration of emerging technologies, such as automation and the Internet of Things (IoT), to further enhance the efficiency and accuracy of inventory management and storage processes. Additionally, it would be beneficial to investigate the long-term impact of Lean model implementation on the sustainability and growth of SMEs, as well as their ability to adapt to changes in demand and market regulations. This call to action encourages researchers to delve deeper into the application of Lean methodologies in SMEs and explore new directions that could contribute to the development of innovative and effective solutions in operations management.

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