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Original Article

Applying Lean Warehousing Tools to Improve OTIF: A Case Study in a Logistics SME in the Freight Transportation Sector in Peru

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Abstract - *The study addressed inefficiencies in the packing processes of a logistics SME in Peru, whose primary business is public road freight transportation. Warehouse practices were not properly established, affecting operational performance. Previous research has shown that Lean methodology can optimize these processes by eliminating non-value-added activities. The main challenge identified was the urgent need to reduce response time and improve packing time to meet on-time, in-full (OTIF) delivery, a key factor in customer satisfaction. The research implemented Lean tools, including 5S, Kanban, and Standardized Work, achieving significant improvements in material search time, packing time, and operator response time. The results showed an increase in OTIF from 67% to 77%, demonstrating a positive impact on operational efficiency. This study contributed to advancing the scientific literature on Lean methodologies in the context of logistics SMEs. Future researchers are encouraged to explore the implementation of these tools in other sectors and more complex contexts to maximize their potential.*

Keywords - *Packing, Lean Warehousing, 5S, Kanban, Standardized Work.*

1. Introduction

The transportation service market plays a key role in both global and national economic development. In Peru, this sector represents 5.2% of the Gross Domestic Product (GDP), with a market value of 8.31 billion US dollars [1]. Comparatively, in the United States, the sector contributes an impressive 8.4% to GDP, with a market value of 674.49 billion US dollars [1].

Despite its importance, the sector faces significant challenges, such as warehouse disorganization, inadequate handling, and poor dispatch scheduling—issues highlighted in previous studies [2]. Additionally, the performance of the OTIF (On Time, In Full) indicator, which measures the timely and complete delivery of orders, recorded a low average of 67% in 2023, far below the optimal minimum of 87% [3,4,5].

However, previous studies have not comprehensively addressed the relationship between these operational challenges and their impact on key performance indicators like OTIF, particularly in the Peruvian context. This research aims to fill this gap by analyzing how the implementation of lean tools can mitigate these specific issues. This approach not only provides a contextualized perspective but also contrasts with studies conducted in more developed markets, such as the United States, where lean practices are more widespread [1]. To address these issues, Lean methodology has been recognized as a powerful tool for eliminating non-value-added activities across various sectors, including transportation, where it improves efficiency by optimizing resource use and redesigning warehouses for enhanced effectiveness [6,7].

Among the inefficiencies found in the case study, two main reasons were considered. On the one hand, order and organization have a crucial impact on the development of daily activities. They are a low-priority issue for most workers and companies, as is the case in the case study. On the other hand, the current context of Peru, politically, economically and socially, such as corruption, high prices and culture itself, influences the behavior of both workers and customers, which is why it is chosen to carry out activities informally, which is less expensive and faster than the formal way, but it generates disorder and is counterproductive in the long run.

This study focused on improving operational efficiency and on-time order fulfillment in warehousing operations within the transportation sector, particularly emphasizing the

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OTIF (On-Time In-Full) logistics performance indicator [5,6,7]. The studied company faces a low on-time order fulfillment rate, directly impacting customer satisfaction and operational efficiency.

The main objective of the research was to disseminate and validate the implementation of Lean methodologies, filling the contextual gap in existing research by demonstrating the effective integration of 5S, Kanban, and Standardized Work tools applied to a small-to-medium logistics enterprise in the freight transportation sector.

The key research gap addressed by this study lies in the application of Lean Warehousing tools to small enterprises in the logistics sector, particularly in the context of freight transportation in Peru. While Lean methodologies have been extensively explored in larger manufacturing contexts, their integration into small logistics firms, especially in warehousing and packing processes, remains under-researched. This paper aims to fill this gap, providing a foundation for future investigations into Lean's effectiveness in similar small-to-medium logistics settings.

The article was structured into several sections. The first section, the State of the Art, outlined the background of the topic by summarizing the perspectives of various authors. The Validation section clarified the concept of the proposed model and described its relevant indicators, including pre-intervention data, simulation runs, and post-intervention outcomes. Finally, the article concluded with a Discussion, Conclusions, and Recommendations for future research.

2. Literature Review

The following section provides a literature review of the tools utilized in the operation/warehousing model.

2.1. Lean Warehousing Methodologies Applied to the Logistics Sector

A study demonstrated that lean methodology improves interdepartmental collaboration, reduces operational costs, increases service quality, and improves responsiveness to change [8]. Other studies expanded on this concept, showing improvements in key indicators such as transportation performance, lead time, staff productivity, and OTIF compliance, as well as optimizing truckload capacity [9]. Kotsyuba et al. [10] emphasize the importance of constant communication and training in lean tools such as Kaizen, Kanban, and 5S, while Alsmairat et al. [11] highlight the role of Lean Operation Performance (LOP) in eliminating waste and improving process flow. Another study complements these findings by discussing how the combination of Lean Warehousing and innovation can transform organizational culture and improve business competitiveness [12]. However, Ojasalo [13] warns of challenges in its implementation due to a lack of information and experience.

Although recent literature recognizes the crucial role of warehouses in logistics efficiency, there is a dearth of specific research on waste reduction practices in this environment. Habib points out that although Lean Warehousing shows important results, in developing countries its application is superficial, resulting in limited impacts [14]. However, simple Lean Warehousing tools have accelerated final processes by 13.30%. Yafei underlines the importance of warehousing logistics in the operational cycle and proposes combining the distribution of goods and materials to improve efficiency and reduce costs [15]. It is important to highlight that for the analysis of various authors, Value Stream Mapping (VSM) is used to obtain a description of the areas, including detailed quantitative data that help to identify waste efficiently [16].

This project seeks to use the most effective tools of the lean methodology (Kaizen, Kanban, 5S, among others) in storage logistics processes, in line with the activities mentioned in the previous case studies.

Despite the benefits demonstrated in other contexts, there is still a lack of specific research in the warehouse environment. Therefore, it is necessary to validate and disseminate the use of the lean methodology in this area to optimize logistics processes and minimize the waste of human and material resources.

2.2. Impact of the 5S Methodology in Warehouses

The 5S methodology is emerging as an important tool in the logistics field to improve efficiency and reduce waste. Authors such as Zagzoog [17] highlight significant improvements in safety, productivity, efficiency and cleanliness, along with 20% reductions in inventory costs and 30% reductions in container loading and unloading times.

The application of 5S in the logistics sector, according to studies such as those by Marin [18] and Abushaika [3], focuses on mitigating key wastes that adversely affect operational efficiency. Additionally, the most applied practices are related to warehouse organization and 5S culture, structure, use of Key Performance Indicators (KPIs), visual management, and the degree of employee involvement and satisfaction, with 5S being the number one lean warehouse practice according to warehouse revenue in Brazil [19].

Baby and Jebadurai [20] point out that transportation, waiting, delay, space, defects, and motion waste are generally eliminated through layout changes, appropriate work rules, visual management tools, and 5S (Sort, Set in Order, Shine, Standardize, Sustain). Research on the implementation of the 5S program in a cosmetics retail company showed that the Seiri, Seiton, Seiso, Seiketsu, and Shitsuke stages significantly improved inventory organization [21]. This included the separation and removal of unnecessary products, efficient organization according to ABC classification, cleaning and disposal of unused materials, continuous standardization of organizational practices, and the establishment of standards to maintain cleanliness and efficiency in merchandise management [21]

This project aims to apply the most effective tools of the 5S methodology in the company's logistics processes. These tools are related to the activities previously mentioned in the case studies. Likewise, it can be observed that each of these cases demonstrates improvements in the evaluated logistics processes, which contributes to a reduction in stock-outs. However, the lack of research on the 5S methodology in the logistics sector is worrying despite the fact that various authors indicate that this methodology can be successfully applied in any type of industry.

Therefore, it is necessary to expand the scientific base that serves as a precedent to optimize logistics processes and minimize the frequent supply problems in the logistics sector by disseminating and validating the use of the 5S methodology.

2.3. Reduction of Lead Time Thanks to Standardized Work in Warehouses

Work standardization emerges as a crucial tool within the Lean methodology to improve business competitiveness, as highlighted by Saravanan [22] and Zarzycka et al. [23]. The first illustrates how Toyota has increased productivity and safety through this practice, optimizing cycle times and employee performance. Schekoldin et al. [24] reinforce these findings by demonstrating how standardization reduces waste and improves operational consistency. Furthermore, Zarzycka et al. [23] highlight how standardization helps in business process management, improving operational compliance.

However, as Goel et al. [25] point out, the application of standardization is an under-researched area, suggesting that there are still unexplored aspects regarding its implementation and effectiveness in different business contexts. In this sense, many companies lack adequate control of activities during their production processes, constantly focusing on reducing costs, improving product quality and increasing productivity to meet customer needs [26]. For example, Santos et al. [21] show that the alterations in the number of boxes that returned empty from the line decreased by approximately 24% in Bin A boxes, and the variation rate in Bin B boxes was reduced by 8.07%. This indicates a development of standardization and stability in the process, as well as an improvement in the continuous flow of materials and greater speed and quality in meeting the needs of the assembly line. Furthermore, the results obtained allowed the creation of a standardized work routine, balancing activities between operators and eliminating activities that did not add value to the product [26].

Ferreira [27] highlights that the implementation of work standardization in a grain transhipment terminal resulted in an 83% reduction in operator movement for the longest possible time and an increase in product unloading efficiency by 14.3%, going from 18 to 22.5 thousand tons per day. These results demonstrate the positive impact of standardized work on process optimization and productivity improvement.

These studies, using data and concrete cases, illustrate both the benefits and contradictions in applying work standardization within the Lean context, underscoring the need for additional research to understand better its effective implementation in various industries and operating environments.

This project strives to implement the most effective tools of the Lean methodology, such as work standardization, in the company's logistics processes. These tools are related to the activities previously mentioned in the case studies. Likewise, it can be observed that each of these cases demonstrates improvements in the evaluated logistics processes, which contributes to a reduction in stock-outs. However, the lack of research on the Lean methodology in the logistics sector is worrying, despite the fact that various authors indicate that this methodology can be successfully applied in any type of industry.

2.4. Kanban Methodology to Optimize Communication in the Logistics Sector

The Lean Kanban tool stands out for its ability to improve efficiency and optimize performance by visualizing work and limiting work in progress [28]. Studies have shown its evolution from a visual management method to its adaptation as software, improving interdepartmental coordination and operational efficiency [29-31]. In truck fleet management and process improvement, Kanban has reduced operational costs and improved delivery efficiency [30, 32]. VSM is used to identify waste and important indicators in processes so that service quality is improved, waste is eliminated, and costs are reduced, as these are core values.

Electronic Kanban (E-Kanban) continues to improve project management and human resource allocation. Its implementation has improved operator visibility and efficiency in die-cutting, eliminating waiting waste and reducing waiting time by 9.6% [14]. Lean Kanban's real-time communication enables flexible task assignments [33].

Chen and [34] highlight that these tools can adjust the division of labor, prevent negative behaviors of members, and respond to market pressures, creating a fair and efficient work environment. Kanban is particularly useful in people-dependent workplaces, addressing problems of delays, unbalanced workloads, and bottlenecks [33]. The implementation of E-Kanban has reduced the total time for ordering and distributing stock by 22 minutes and facilitated the confirmation of delivery of materials, improving the participation of production and logistics executives [32, 35] propose new initiatives such as electronic ordering and the implementation of Kanban in production lines to improve performance.

In summary, although the Kanban methodology has shown significant improvements in operational efficiency in various contexts, there is still a research gap that needs to be addressed to validate and disseminate its use in the logistics sector, thus contributing to process optimization and the reduction of operating costs.

It is evident that the Lean Warehousing methodology has tools that positively impact the performance of the activities of companies in the transport sector. There is not enough evidence of the application of 5S, Kanban and standardized work applied together to small companies in the same sector. For this reason, it is necessary to certify and disseminate the use of the 3 lean tools in the transport sector in warehouse activities.

3. Materials and Methods

According to the sector study described, transport companies encounter various production-related challenges that impede business quality. To address this, efforts have been made to implement Lean methodologies. The management model incorporates appropriate tools to tackle issues such as low lead time. Table 1 (See in Appendix) lists the articles that have contributed to the proposed model.

Based on the literature review of similar case studies presented in Table 1 (See in Appendix), it is important to propose a model based on the Lean methodology that can increase the OTIF index by reducing the identified root causes. The proposed model consists of this methodology that encompasses the three tools. The model in Figure 1 is composed of 3 components: analysis of the current situation, implementation of the Lean Warehousing model, and validation of the implemented tools.

Based on Table 1 (See in Appendix), it can be identified in the literature that Dhanjibhai, A. and Shankarrao, G. [36] use the 5S tool and standardized work as complements to each other; likewise, Saravanan et al. [22] carry out a VSM to identify critical activities and then implement standardized work for improvement. The main contribution of this model is found in the order of implementation of the tools applied in an SME in the logistics sector. The tool of the first component is the VSM; the second component is composed of the 5S tools, and the Kanban is complemented with standardized work.

This choice of order is because the implementation of the 5S allows the correct distribution and organization of the warehouse to proceed with the correct implementation of standardized work. On the other hand, the review of the literature regarding the digital Kanban proposes the benefits and the objective of the tool but does not have a real implementation; therefore, the proposed model has as contributes to the application of this tool in the logistics sector.

3.1. Proposed Model

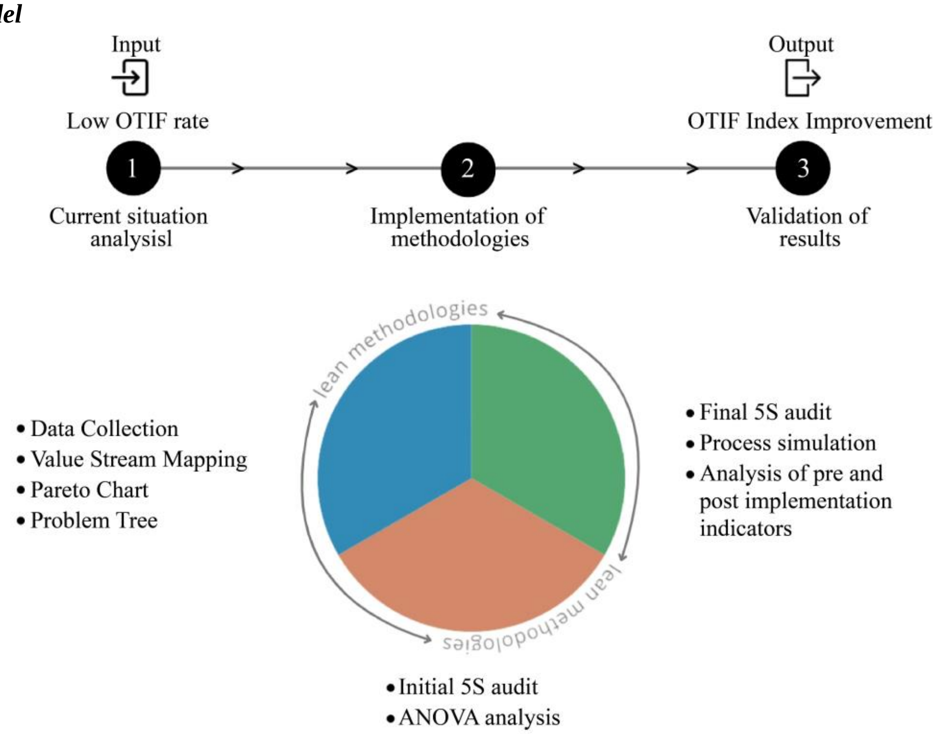


Fig. 1 Composed of 3 components

The model applied in this work is depicted in Figure 1. It is based on the literature review and was applied to fill the gap in the implementation of lean warehousing in small transport companies.

3.2. Model components

The components of the model in Figure 2 are explained below.

3.2.1. Analysis of the Current Situation

It consists of understanding the company and its situation in a particular way, which is why the VSM was used as a tool for the development of this component. This component served as a basis for identifying the activities without added value and thus making the solution proposal. It is worth highlighting that an ABC and P-Q analysis was carried out to identify the standard product. The information was collected through time study and observations made in the company, which allowed the creation of the VSM of the initial situation.

3.2.2. Implementation of the Lean Warehousing Model

The development of this component uses the 5S as a base tool, which consists of 5 phases: Seiri (Classify), Seiton (Order), Seiso (Clean), Seiketsu (Standardize) and Shitsuke (Discipline). Red cards were used to identify unnecessary items. A daily cleaning program was developed in the company. This served as a framework to identify the objectives for each S and achieve their fulfillment. Continuing with the development of the second component, the digital Kanban tool, following the literature of Castellano [30], was used to improve waiting times and improve the response capacity of operators. In order to collect the data, a lane diagram was first made, in which the main communication points were identified; then, through a time study, the activities where communication is critical were established, and the general process was adapted to the digital Kanban system. To finish with the development of the second component, the main purpose of the Standardized Work tool is to modify and create guides for operators, which establish rules and appropriate ways of carrying out the packing activity. Although the respective guides were created and placed in the work areas, the development of this tool was done through the Arena simulation software.

3.2.3. Validation of the Implemented Tools

Validation is carried out by comparing the metrics established in the model. In the case of Standardized Work, the results of the simulation were used. The application of these tools aims to reduce waiting times and optimize logistics activities, to improve the OTIF index in the case study.

3.3. Proposed Model Flow

A visually organized presentation of activities conducted in the Lean Methodology model is sought, specifically within the 3 phases. Figure 2 shows the implementation method of the proposed model.

3.4. Model Indicators

The indicators used in each phase to measure the components of the model and its performance compared to the literature are detailed below.

3.4.1. OTIF Index Percentage (α)

The study by Argiyantari [9] indicates that the proposed Lean model increases the OTIF index indicator to a value of 20% by reducing the lead time by 75% and increasing the On-time indicator by 45%, with the aim of reducing costs and improving customer satisfaction.

$\propto$ = (Number of orders delivered on time and in full)/(Number of total orders)*100

3.4.2. Search Time (β)

The study by A. Makwana and G. Patange [37] indicates that the proposed Lean Six Sigma model reduces this indicator by 65% after the implementation of 5S, with the aim of improving productivity in the case study.

β=Time it takes an operator to find the material to use

3.4.3. Average Packing Time (γ)

The study by Saravanan et al. [22] indicates that the proposed Lean Manufacturing model reduces this indicator by 24%, with the aim of reducing operating costs.

γ = (Total packing time)/(Total quantity of orders)

3.4.4. Average Response Time (δ)

The study by Michlowicz [32] indicates that the proposed Lean Manufacturing model reduces the present indicator by a value of 75%, with the aim of increasing production in the case study.

δ=(Total time taken by an operator to respond to a request)/(Total number of orders)

4. Results

4.1. Scenario Description

The study was developed in a Peruvian company that is part of the logistics sector, which is responsible for transporting different types of products, including ceramics, the product on which the research is based. The validation of the proposed model consisted of 2 phases. In the first phase, the 5S tool and E-Kanban were implemented on a small scale in the company. They began with their respective training, as shown in Figure 3. The second phase was the simulation of standardized work with respect to the company's packing based on the information obtained through records and observations.

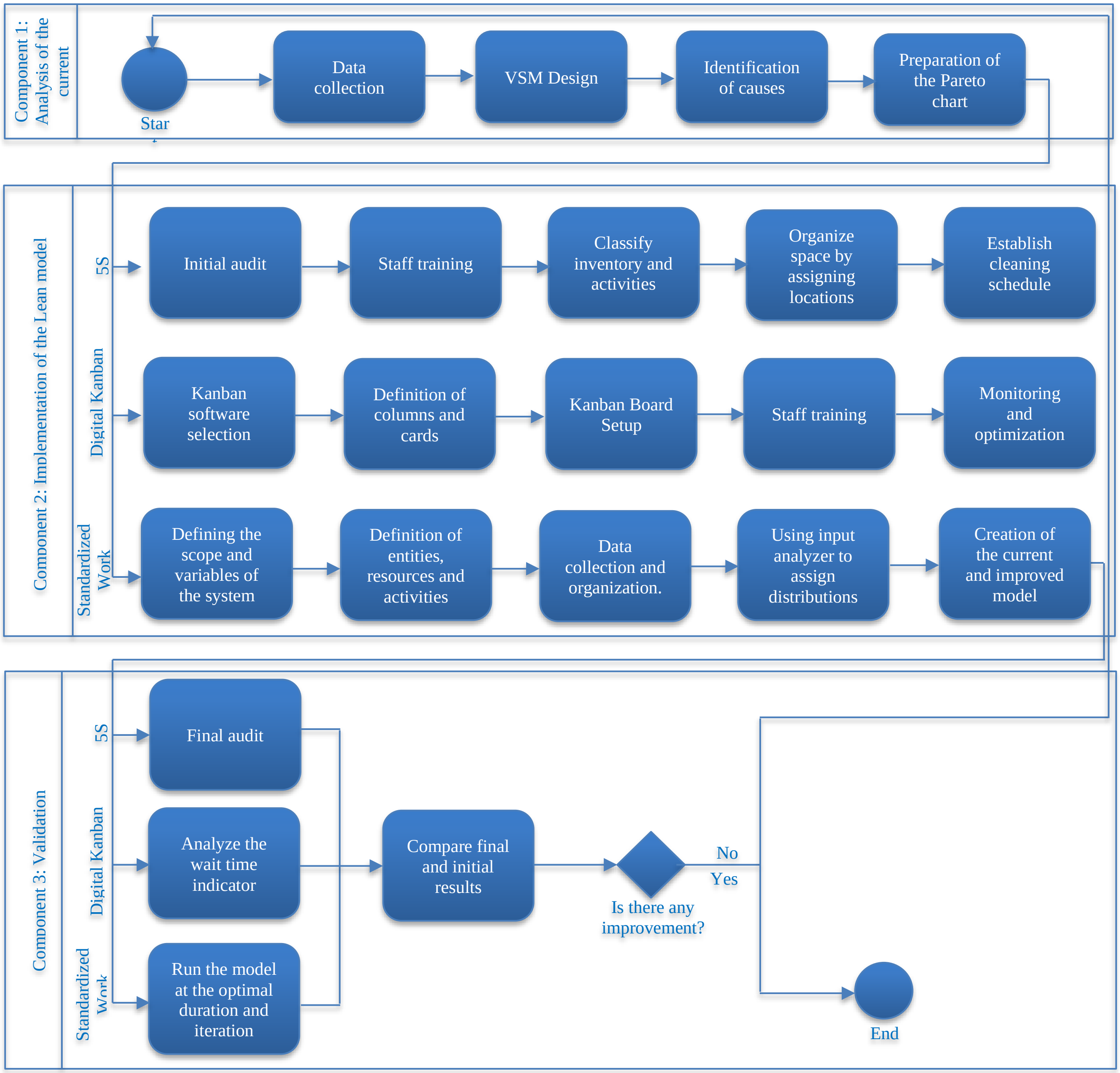


Fig. 2 The flow of the proposed method

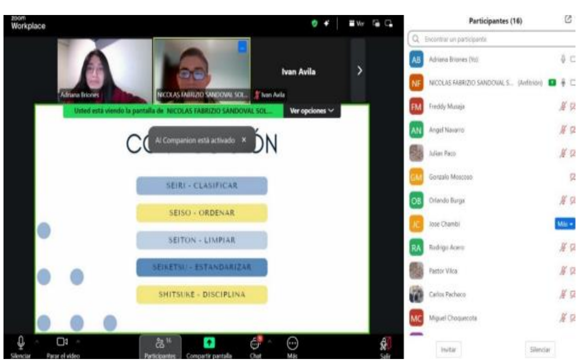


Fig. 3 Staff training

4.2. Initial Diagnosis

In the initial situation, as shown in Figure 4, the general process of transporting the ceramic product in the company presents a low OTIF index, with an average of 67.30% in 2023, which generates an economic loss of 774,671 PEN. The general process of the company was analyzed, and it was found that in 57.14% of the cases, there was poor packing due to the disorganized warehouse and the lack of a truck loading procedure. In addition, there was a 28.57% delay in load planning, which is due to the long communication time between the operator and the administrator.

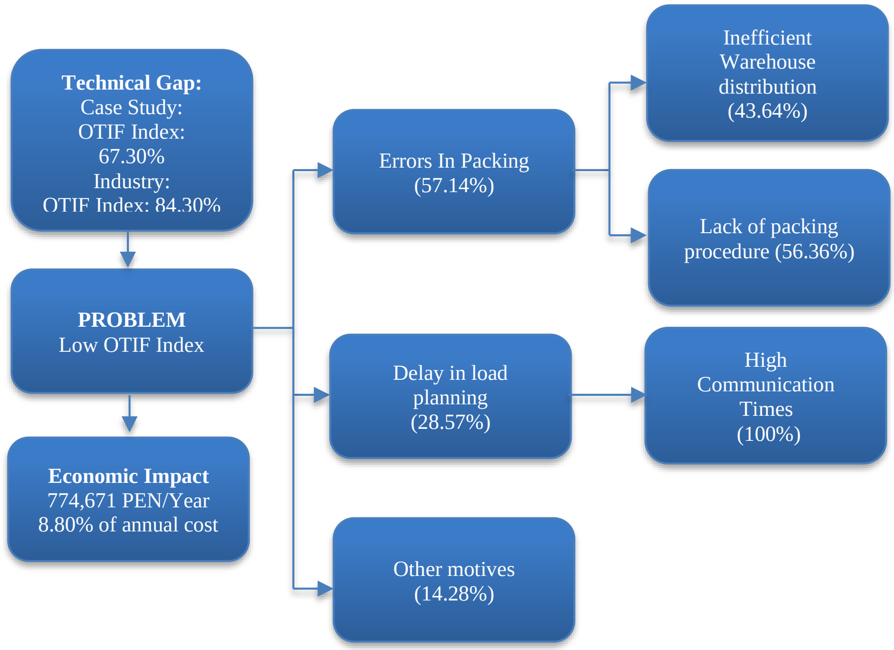


Fig. 4 Problem tree

4.3. Validation Design

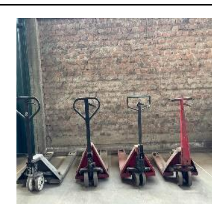
The implementation of the proposed Lean model began with the training of the administrator and operators, with the objective of understanding the importance of the tools and their internal and external benefits. This meeting was held virtually since the operators are usually in other cities. Figure 5 shows evidence of the training carried out.

The pilot began with the implementation of the 5S, the initial audit yielded a result of 36% compliance. Then, the first S (Seiri-Classify) was developed, which seeks to classify the tools to be used; this was done by using the red card, as verified in Figure 5. Labeled materials that do not have a function in the company were discarded after one week.

Fig. 5 Red card

Next, the second S (Seiton-Order) was developed, where a space was designated for each tool and workplace. Table 2 shows a before and after of the application of the tool in the company. Regarding the third S (Seiso-Clean), a daily cleaning program was implemented in the storage area.

Table 2. Before and after the 5s implementation

Before 5S	After 5S
	
	
	

The fourth S (Seiketsu-Standardize) was carried out by applying standardized work, and the fifth S (Shitsuke-Discipline) was carried out through constant monitoring by the administrator. As can be seen in Figure 6, a 34% improvement was obtained in the final audit, which increased mainly due to the compliance of the operators and the continuous control of the administrator.

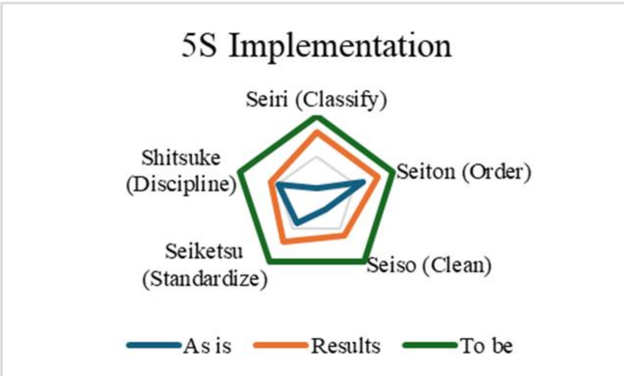


Fig. 6 5S Audit diagram

A lane diagram was made to identify the points where communication takes place. Then, through a time study, it was determined that the loading plan activity, in which the time taken to confirm the availability of the operators prior to placing an order is taken, is critical. The implementation of the E-Kanban focuses on reducing its communication times, this communication is carried out before the activity of loading the merchandise.

Table 3. Board cards activities

Activity	Task type	Priority	Label
Cargo reception	Reception	High	Activities on the patio
Cargo unloading	Unloading	High	Activities in the warehouse
Clean used area	Cleaning	Low	Cleaning activities
Cargo loading	Loading	High	Activities in the warehouse
Picking	Loading	High	Activities in the warehouse
Packing	Loading	High	Activities in the warehouse
Fuel loading	Loading	High	Off-site activities
Cargo shipping	Shipping	High	Off-site activities
Daily cleaning	Cleaning	Normal	Cleaning activities
Truck maintenance	Maintenance	Normal	Off-site activities

First, after defining the E-Kanban software to be used (Click up), the activities carried out in the company were defined and classified according to the type of task, priority and label (location of the activity). Table 3 shows the activities involved in the general process of the company and the activities of the cleaning program established in the third S; the irregular activities of the company are cataloged as other activities, and their description is presented in the detail of each card.

After defining the board's cards and columns, it was configured so that the administrator and operators have access and can update the activities as they are carried out, as seen in Figure 7. In addition, as shown in Figure 8, the software has a stopwatch that allows the operators' response times to be recorded. With this time record provided by the software, it was identified that the operator confirmation time was reduced from 23:39 to 4:58 minutes.

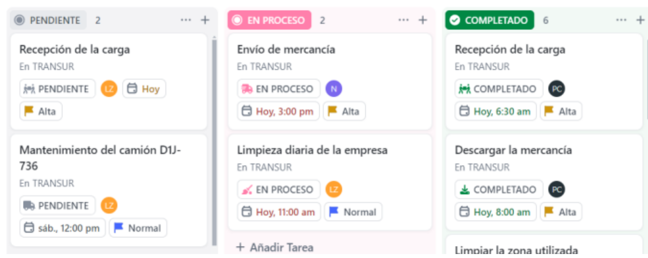


Fig. 7 Company kanban board

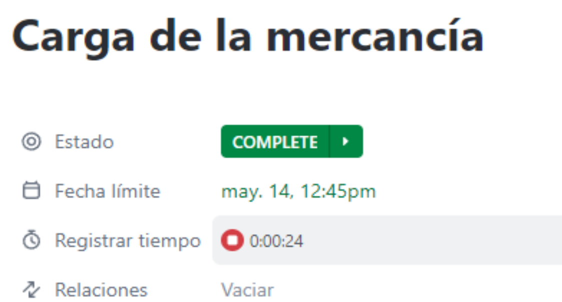


Fig. 8 Example of using a stopwatch

The pilot concluded with the implementation and simulation of standardized work. This methodology was applied to the process of packaging ceramic box pallets. The tools shown in the following figure were used for its implementation. First, an ANOVA analysis was performed to understand the criticality of the execution time of the ceramic pallet packing process for the operators. Then, the combined work chart was created to identify the execution cycle time of the packaging activity.

The initial balance chart was continued to identify the activities that do not meet the ideal Takt Time of the process. Fourth, the ECRS analysis chart is created to identify opportunities for time reduction elimination of activities, among others, to improve the cycle time. Finally, the standard work board is created, which is the final and most important product for the operators to be able to implement the process with the changes.

As a result of the implementation of the improvement, the packing process changed, and the instrument resulting from the application is the standard work board. This is shown in Figures 9 and 10 and explains the step-by-step execution of the standardized packing work.

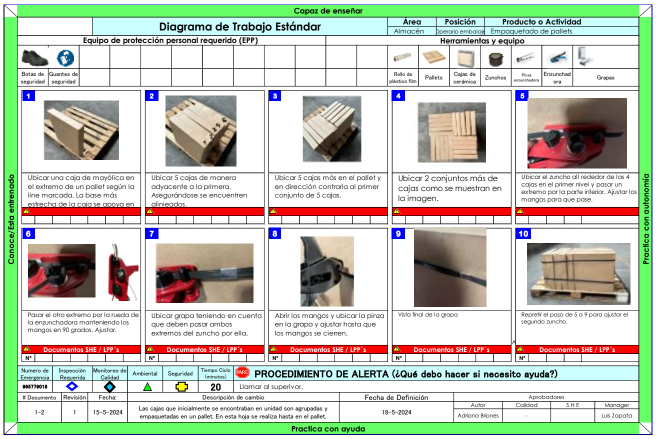


Fig. 9 Standard work board part 1

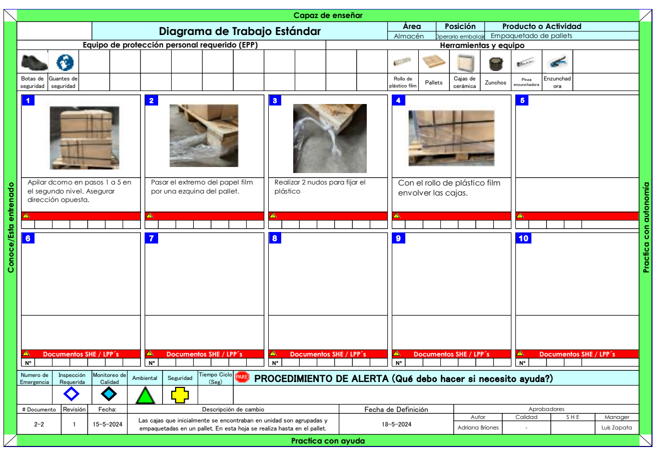


Fig. 10 Standard work board part 2

As a result of establishing and disseminating the standard work activities, a time study was carried out on a significant sample to compare the initial situation and the situation after the implementation of the standardized work. This was used for the second validation phase, a simulation of the process. It was carried out using the Arena Simulator software. The simulation was conducted over a period of 20 hours per day, representing a standard working day, with an average of three orders processed daily. The simulation spanned six days, allowing it to serve as a representative sample for analysis. Both the current process, illustrated in Figure 11, and the proposed process, shown in Figure 12, were modeled for comparison. The diagnostic data was utilized for simulating the current process, while the pilot data informed the simulation of the proposed process. To ensure statistical reliability, the representative sample was determined using a 95% confidence level and a 5% margin of error to account for potential external factors. The sample size, calculated via the “Question Pro” application, comprised 18 orders conducted over six days. A paired t-test was performed using the Output Analyzer to compare the results of the two scenarios. The analysis rejected the null hypothesis, which posited that the means of the two samples were equal. This result provides statistically significant evidence (at the 95% confidence level) that the "ORDER STAY TIME" differs between the two scenarios.

To further strengthen the conclusions, confidence intervals were calculated for the mean reduction in order stay time, which ranged from 36 to 56 minutes (95% CI). Additionally, the effect size, represented by a Cohen’s d value of 10.7, underscores the substantial and meaningful impact of the implemented lean principles. These complementary statistical measures validate the findings and enhance the scientific rigor of the study, further demonstrating alignment with established lean methodologies.

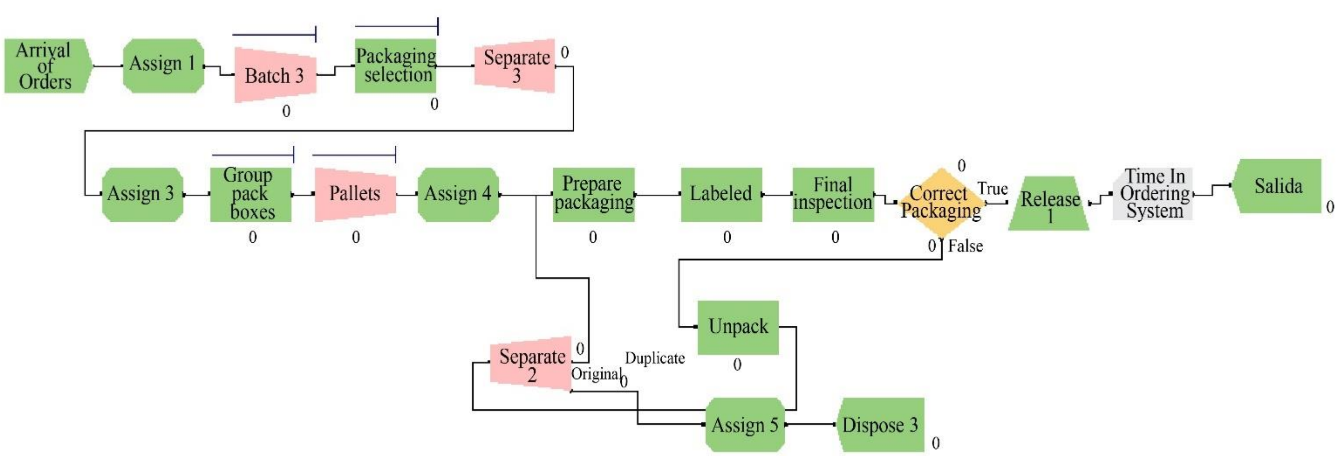


Fig. 11 Simulation model of the original situation

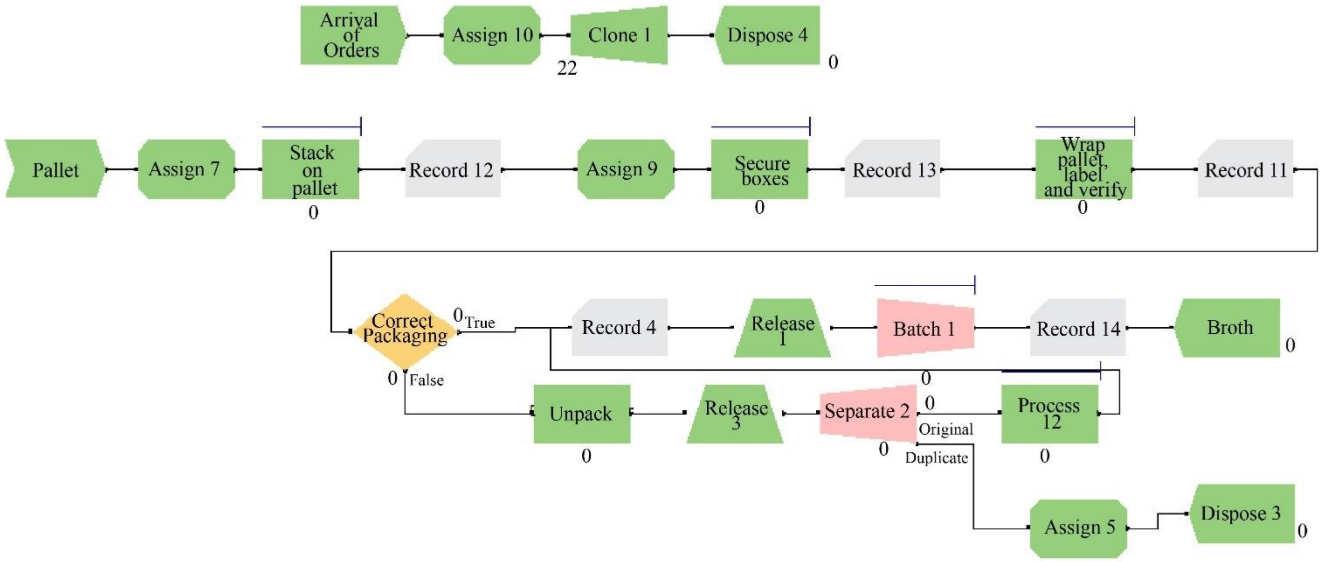


Fig. 12 Simulation model of the improved situation

The implemented improvement of the Lean Warehousing tools introduced changes in the company's overall process; cleaning activities were added, and packing activities were rethought, resulting in the reduction of the total process time. A reduction in the time spent searching for materials by 3.5 minutes was achieved; the average packing time was reduced by 51.4%, while the response time of the operators was reduced by 78.94%. As presented in Table 5, this resulted in an OTIF of 77.78%.

Table 4. Results of the indicators

	Indicators	As Is	To Be	Reached
General	OTIF	67,3%	84%	77,78%
5S	Searching time	8 min	5.4 min	4.5 min
Standard Work	Packing time	105 min	79.8 min	51 min
E-Kanban	Response time	23.65 min	6.36 min	4.98 min

The economic evaluation was carried out by projecting the company's financial cash flow over the next 12 months, from July 2024 to July 2025, taking into consideration the implementation costs of the tools and the result obtained from the simulation of standardized work. It should be noted that the improvement project is not intended to increase sales but to reduce operating costs. With the results obtained in Table 4, the reduction in costs was quantified, also considering the data provided by the company in 2023.

After calculating the company's cash flow, the financial indicators presented in Table 5 were calculated.

The Financial Net Present Value (NPV) is 5,519.23 PEN, which demonstrates the viability of the project; the Financial Internal Rate of Return (IRFR) is 34%, which, when compared to the WACC value of 19.58%, indicates that the project is profitable.

The benefit/cost ratio is 1.57, which means that for each unit invested, 1.57 PEN of return is generated. Finally, the Payback or Recovery Period is 7.66 months; therefore, profits would be generated from that date.

Table 5. Financial indicators of the project

Financial Ratios	
NPV	5 519,23 PEN
IRR	34%
B/C	1,57
Payback	7,66 months

5. Discussion

The results of the research adequately responded to the existing contextual gap regarding the application of the Lean Warehousing methodology using 5S, Kanban and Standardized Work in an SME in the logistics sector. It was validated that the proposed integrated model improves the OTIF indicator, and each tool, in particular, improves the time to search for materials, average packing time and average communication response. These results in operations are reflected economically in the reduction of operating costs, showing that for each unit invested, 1.57 PEN is generated in return.

Regarding the implementation of the 5S, the expected search time for tools was 5.4 min. However, a time of 4.5 min was achieved, which means that a better result was obtained after the pilot. This achievement may be mainly due to the fact that the company has a minimum number of tools, which facilitates their search.

With the implementation of Kanban, a result of 4.98 min was obtained for the average response time of the operators, 1.38 min less than the expected result. Finally, the pilot of the standardized work, from which the data was used for the simulation of the improved model, reduced the average packing time by 54 minutes, while it was expected to reduce only 25.2 min. However, despite all the results obtained, which were better than expected, the OTIF indicator increased to 77%, while it was expected to reach the industry standard of 84% [3,4,5].

Considering that the model investigated was applied to the standard product transported, which is ceramics, it is necessary to extrapolate the model to other products of the company studied to demonstrate the robustness of the proposal. Other products that are usually transported are non-perishable foods and containers. Table 6 shows the results. To reach them, the initial indicators were identified, and the differences in packing other products were understood. Through analysis, expert opinion and estimation – simulation.

Table 6. New scenarios

		OTIF	Search Time	Average Packing Time	Average Response Time
	Unit	**%**	**minutes**	**minutes /order**	**minutes**
Scenario	0. Ceramics	78%	8	51	4,98
	1. Non-perishable foods	84%	6	47	6,34
	2. Packages	77%	11	45	4,56
Statistical Analysis	Average	79%	8	48	5
	Variance (unit ^2)	0,001	6	9	1
	Standard Deviation	0,04	3	3	1

Considering the limitations of the case study approach, it is an SME with 25 employees, of which 20 are involved, so it is easy to implement the tools along with a new culture focused on the Lean methodology. Replicating this implementation would be complicated if there were more employees or the context was different in terms of processes. The reason for choosing the SME is that it had the benefit of being able to apply the proposed model with total transparency and that it allowed working with real problems since there was a prior commitment by those involved.

In this work, research was conducted on the implementation of 5S, Kanban and Standardized Work as a Lean Warehousing model in a small and medium-sized company in the freight transport sector in Peru, mainly applied to the warehouse activity of this type of company. Therefore, it is necessary to expand the research of these methodologies in other areas of the same type of companies for a better understanding of the application of the methodologies. That is, to apply the methodologies to truck loading and unloading activities routing, among other areas that were not part of this research, thus generating a new opportunity to investigate lean methodologies in the transport sector and taking it beyond warehouse activities.

Compared to the techniques used in the state of the art, the proposal combines these applications. It provides a comprehensive scope on the implementation of the tools in the logistics sector. Regarding the results, the research may have better evidence than in the case study; however, by coupling the methodologies, a broader view of the problem is provided, and it does not focus only on one; rather, the results complement each other and end up impacting the main problem in a greater sense. Alternatively, it is suggested for future research to analyze the impact of standard work in the temporary warehouse sector. In this research, the application of standard work was carried out on a standard product, and it was shown that it improves the processing time; however, studying standard work in a warehouse that has various types of products to be dispatched is a new starting point for future research. This is because, in the freight transport sector, temporary warehouses are often used, and the type of material transported depends on the client and can be very variable. Extending the research to this level of complexity is very interesting for future research.

6. Conclusion

The research findings successfully demonstrated that applying the Lean Warehousing model improved the OTIF indicator to 77.78%, reducing the sector’s technical gap by 6.52% and mitigating the associated economic impacts. This was achieved through the implementation of the 5S methodology, Kanban, and the simulation of standardized work, significantly enhancing packing activity times. The 5S implementation notably reduced material search times by 43.75% and increased compliance with audit points by 34%, while Kanban shortened operator response times by 78.94%. Standardized work simulation resulted in a 51.4% reduction in the packing process's average time.

The research is particularly relevant to the logistics sector, which is under-explored, adding valuable insights by applying Lean Warehousing methodologies in freight transport SMEs. These tools serve as foundational contributions to addressing recurrent warehousing issues across industries.

Despite the improvements achieved, a small gap remains between the company's performance and the sector's average, highlighting the necessity for future improvement projects in other areas, such as order delivery, to further enhance the OTIF indicator.

The study addresses a research gap by implementing lean tools in logistics SMEs, particularly within freight transportation. This investigation provides a robust framework for future studies, suggesting broader applications of these methodologies in other areas beyond warehousing.

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

Criteria	Strategic implementation of 5S and its effect on the productivity of plastic machinery manufacturing companies [36]	The lean framework for supporting the pharmaceutical supply chain transformation [9]	Kanban System in the Flow Control Subassemblies as a Component of Lean Manufacturing [32]	Efficiency Enhancement in a Medium-Scale Gearbox Manufacturing Company through Different Lean Tools - A Case Study [22]	Proposed Model
Purpose	Improve productivity by applying 5S and reduce costs.	Improve pharmaceutical transportation operations through Lean thinking.	Analyze the Kanban methodology to increase process efficiency.	Identify through the VSM which part of the process to focus on.	Increase the OTIF index by improving efficiency with Lean tools.
Application of structure	Obtaining data through the initial 5S audit. Data analysis using Minitab. Employee training.	Data collection focused on operations. Action research method. Development of a Value Stream Map.	Outline Kanban's functionality and objectives. Identify the scenarios where Kanban works. Describe how and when to implement it.	Data collection through time study. Video analysis of work-study. VSM design and comparison of cycle time with TAKT time.	Design the VSM to identify key activities, integrate Lean tools according to the literature, propose the model and compare results.
Objective	Reduce search time and create an organized storage area.	Applying Lean thinking and optimizing transportation operations with a value-added orientation	Avoid excess finished product, bottlenecks and delays in order delivery.	Obtain positive results after applying VSM and identify activities that do not add value.	Reduce waiting times, keep the storage area organized and implement standardized work guides.
Results	Improved 5S auditing. Improved productivity.	Cost reduction. Reduced waiting time. Improved truck loading capacity.	Reduced inventory levels. Improved responsiveness. Reduced waiting times. Reduced waste.	Increased productivity. Reduced processing time. Reduced delivery time.	Improved operational efficiency. Reduced waiting time. Improved 5S auditing. Better response.
Differences	It does not have a basis for the implementation of other Lean tools	Lack of implementation of tools that complement the methodology.	Lack of actual implementation and comparison of results.	It does not have a prior simulation to verify the results.	It was simulated to obtain results of standardized work and tools were adapted to the transport of ceramics.
Methodologies/ Tools	5S, Standardized Work, Kaizen.	Lean Thinking, VSM.	JIT, Kanban.	VSM, Standardized Work, Kaizen.	Lean, 5S, Kanban, Standardized Work, VSM.
Sector	Manufacturing industry	Pharmaceutical industry	Manufacturing industry	Manufacturing industry	Logistics industry