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Case Study: Implementation of Lean Logistics at Inversiones Karmont S.A.C for Enhancing Distribution Productivity †

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Abstract: The main objective of this research was the application of Lean Logistics philosophy to increase productivity in the distribution area. The methodological approach of this research was quantitative, applied in nature, with an explanatory level of study and an experimental design with a pre-experiment degree. With a sample of 179 orders for Confy Marco mattresses, the study was conducted as a pre- and post-test analysis. For the first part of this research, documentary review was used as the data collection technique, with the registration form used as the instrument. The second part of the research employed observation technique, with the structured observation form used as the instrument. The hypothesis test was conducted using the Student's T-test, which yielded a significance of 0.000 (<0.05), leading to the rejection of the null hypothesis and acceptance of the alternative hypothesis. Productivity before implementation was 61%, and after implementation, it increased to 87%, demonstrating that the application of Lean Logistics improved the productivity of the distribution area at Inversiones Karmont.

Keywords: lean logistics; productivity (efficiency and effectiveness); waste elimination

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1. Introduction

Currently, companies face constant pressure to improve, whether due to intense market competition, the need to expand their product offerings, or the need to retain customers. Therefore, they have seen the necessity to continuously optimize processes, from the procurement of materials to post-sale services, to ensure better service levels for customers and lower costs for the company. According to Cabrera [1], the Lean Logistics philosophy allows for the optimization of flows within the supply chain, such as flows of materials, people, information, and capital, by eliminating waste in production, transportation, processing, stock, and movement, as mentioned by Sharma and Gandhi [2].

Similarly, Hernández [3] asserts that Lean Logistics eliminates waste, reduces work-in-process inventories, and, in turn, decreases process and manufacturing lead times, ultimately increasing the speed and flow of the supply chain. This philosophy also encompasses a vital cultural element crucial for logistics, the concept of "total cost". The focus is not on individual cost factors, such as transportation or storage, but rather on the total cost, according to Goldsby et al. [4]. Along the same lines, Voronova [5] indicates that Lean Logistics primarily aims to continuously eliminate unnecessary losses while simultaneously achieving increased product competitiveness by reducing costs and improving quality.

Indeed, in a changing environment where the primary problem within the supply chain is the bullwhip effect, it is necessary for companies to be agile and responsive.

This means maintaining productivity and effectively utilizing production factors during the execution of products and services to meet customer needs. According to Ramírez et al. [6], productivity is about being efficient in connecting the production of goods and services to the resources used, such as labor, capital, or management. Improving productivity involves achieving a more effective and efficient overall process. It also entails effectively employing production resources to generate and offer goods and services to the market. According to Valverde [7], the goal is to perfect the utilization of these resources to strengthen the organization's competitiveness. Medina [8] mentions that productivity is a strategic element in organizations because products and services cannot be competitive if they are not produced with high productivity standards. To increase productivity, according to Martins et al. [9], it is necessary to improve process methods, which will reduce costs and achieve a competitive advantage.

Quiroz [10], in his journal "*Logistics Profile of Latin America*", discusses the Regional Logistics Development Program for Latin America (CAF-LOGRA), which aims to identify, analyze, promote, execute, and disseminate projects and programs that contribute to the development and competitive performance of national logistics systems in the region, considering economic, social, sectoral, and environmental aspects. In Peru, according to the study "Maturity in Supply Chain Management" conducted by the newspaper Gestion, only 34% of companies have established a management model for handling their distribution chain, while the remaining 66% are still in an incipient or developing state, as reported by Gestion [11].

In response to this situation, many Peruvian companies have improved their supply chains. In this regard, Salvador [12] highlights that the country experienced several significant changes in consumer behavior, leading companies to prioritize new strategies and rethink how they managed their operations. Consequently, they achieved a maturity index of 2.90 in supply chain management. Therefore, this growth challenges Inversiones Karmont S.A.C. to enhance the management of various processes within the supply chain, ensuring efficiency and immediate responsiveness to any incidents that arise at any stage. Specifically, the distribution area, through the implementation of Lean Logistics philosophy, aims to increase productivity.

The objective of the research is to determine to what extent the implementation of Lean Logistics increases the productivity of the distribution area of the company Inversiones Karmont S.A.C. The specific objectives are as follows:

- To determine to what extent the implementation of Lean Logistics increases the efficiency of the distribution area of Inversiones Karmont.
- To determine to what extent the implementation of Lean Logistics increases the effectiveness of the distribution area of Inversiones Karmont.
- To determine to what extent the implementation of Lean Logistics reduces waste in the distribution area of Inversiones Karmont.
- To determine to what extent the implementation of Lean Logistics adds value to the distribution area of Inversiones Karmont.

To this end, the fundamental contribution of the research is to verify how the implementation of Lean Logistics increases the productivity of the distribution area of the company, achieving favorable results in its operation through the elimination of non-value-added activities and/or tasks, which allow for the reduction of order flow time from entry to final delivery to the customer.

2. Methodology

To carry out the research, the following considerations were established: research design, review of the state of the art, and implementation of Lean Logistics.

2.1. Research Design

2.1.1. Type of Research

Applied research focuses on using theoretical and scientific knowledge to address practical problems and generate concrete solutions that provide benefits and well-being to society, according to Valderrama [13]. The approach is quantitative, as it employs a deductive process where numerical measurement and inferential statistical analysis are used to test previously formulated hypotheses, as expressed by Hernández et al. [14].

2.1.2. Research Design

The research design was experimental at the pre-experimental level, specifically a pre-test/post-test design with a single group. A preliminary test was administered before the experimental stimulus or treatment, followed by a subsequent test after the stimulus, according to Hernández et al. [14].

2.1.3. Population and Sample

The population (N) consisted of 336 mattress orders from Confy made over a period of 10 weeks from January to March 2023. The sample (n) was calculated using the finite population formula, resulting in 179 orders, with a 95% confidence level (z = 1.96) and a 5% estimation error (e = 0.05).

$$\begin{gathered} \text{n} = \text{N}z2p(1-p)/(e2(N-1)+z2p(1-p)) \\ \text{n} = 179 \text{ orders} \end{gathered} \quad (1)$$

2.1.4. Procedure

Information was collected through a document review, with a registration form used as an instrument to record efficiency, effectiveness, productivity, waste, and added value in the distribution area. Subsequently, the observation technique was applied to analyze the problems, with a structured form used to collect information at different stages of the distribution process. This observation provided a more detailed view of reality. After completing the form, the data were analyzed using the SPSS program for quality control. Finally, the results were obtained through statistical tests and compared with the formulated hypotheses.

- General Hypothesis: The implementation of Lean Logistics increases the productivity of the distribution area of Inversiones Karmont S.A.C. This was verified using the Shapiro–Wilk test, where the data followed a normal distribution. The statistics reached a value of 0.909 and 0.890 for both groups with p-values of 0.277 and 0.171, both greater than 0.05. Therefore, the null hypothesis was not rejected, concluding that productivity in both groups had a normal distribution.
- Specific Hypothesis 1: The implementation of Lean Logistics increases the efficiency percentage of the distribution area of Inversiones Karmont. In both cases, the p-value was $\geq$0.05, so the null hypothesis was accepted. Therefore, the alternative hypothesis was rejected, demonstrating that the efficiency pre- and post-implementation of Lean Logistics had a normal distribution.
- Specific Hypothesis 2: The implementation of Lean Logistics increases the effectiveness percentage of the distribution area of Inversiones Karmont. In both cases, the p-value was $\geq$0.05, so the null hypothesis was accepted. Therefore, the alternative hypothesis was rejected, demonstrating that the effectiveness pre- and post-implementation of Lean Logistics had a normal distribution.

2.2. State of the Art

2.2.1. Lean Logistics

Lean Logistics represents a work philosophy that promotes the implementation of effective management in all operations within any logistics process. This is achieved by employing tools, techniques, methodologies, and technologies with the aim of improving the flow of materials and information in the company, as stated by Hernandez et al. [3]. According to Padilla [15], it involves the elimination of waste and the increase in efficiency. Its goal is to eliminate waste, reduce inventories, and accelerate delivery times, thereby improving speed and flow in the supply chain.

The Lean Logistics philosophy, through Lean, enables the optimization of flows in the supply chain, encompassing flows of materials, people, information, and capital. Its objective is to eliminate waste, such as in production, transportation, processing, inventory, and movement.

As stated by Bednár et al. [16], with the application of Lean Logistics, waste has been identified in the transportation of products, including unplanned time, excessive service time, unnecessary routes, and unmet demand. Additionally, Mesa et al. [17] mention the seven principles of Lean philosophy applied to Lean Logistics: overproduction, waiting, incorrect processing, unnecessary movements, defects, resource utilization, and uncompleted tasks.

The Lean methodology is implemented through six phases: selection, planning, measurement, analysis, improvement, and control and monitoring. These stages are described by Meza et al. [17]. Below is Figure 1, which illustrates the phases, activities, and sequence of the Lean Logistics implementation.

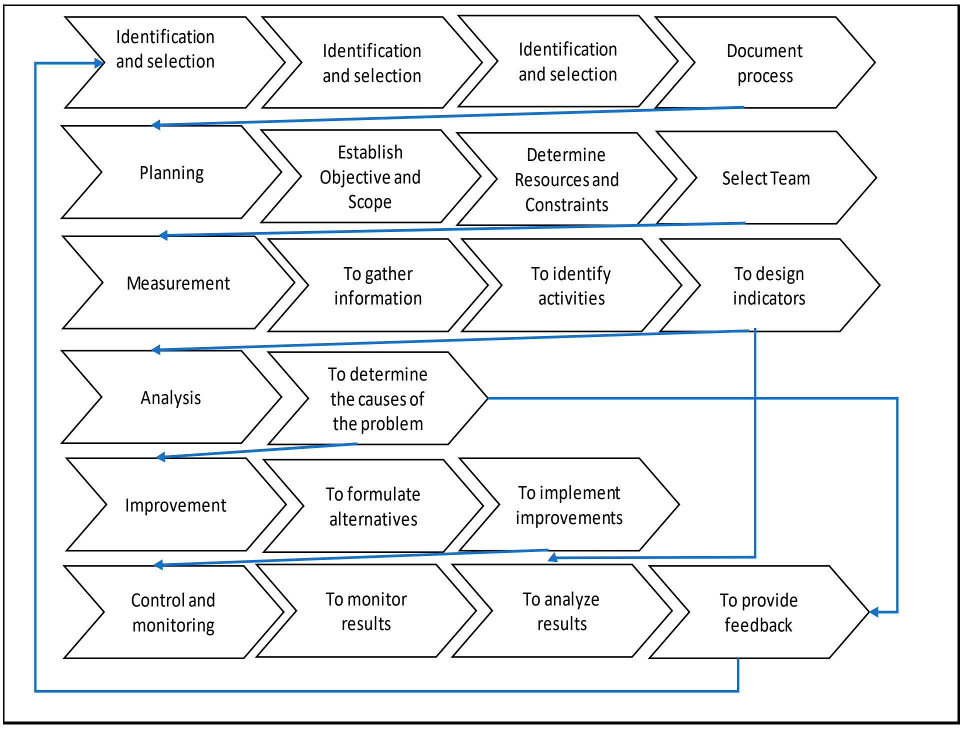

Figure 1. Implementation methodology of Lean Logistics.

According to Mesa and Carreño [17], there are Lean tools applied to logistics that are adapted to meet established objectives, such as the systems of waste identification, value stream mapping (VSM), just-in-time, Tak time, and Jidoka (this tool is reinforced with the 5S technique).

In [18], Lean Logistics is divided into two main dimensions:

- Waste (2): Mesa and Carreño [17] indicate that waste is any human activity that consumes resources but does not generate value. It is indicated by waste using the following formula:

$$x = \frac{\Sigma tNAV}{\Sigma tST} \times 100 \tag{2}$$

where

$tNAV$: time that does not add value;
tST: standard time or total time.

- Value Addition (3): Mesa and Carreño [17] mention that it is an activity involving materials and human work that adds value to the product or service, i.e., what the customer is willing to pay for. It is indicated by value addition using the following formula:

$$x = \frac{\Sigma tAV}{\Sigma tST} \times 100 \tag{3}$$

where
tAV: time that adds value.
tST: standard time or total time.
The evaluation criteria for the value-added index are as follows:

- Value Added Index $\leq$ 75%: ineffective process.
- Value Added Index > 75%: effective process.

2.2.2. Productivity

According to Miranda and Toirac [18], productivity is an indicator that affects companies, and it is highlighted that, although processes are carried out to produce goods, the outputs of these processes can become inputs for another process. To ensure the achievement of objectives, it is crucial to measure the performance of production factors that can indeed influence productivity, such as efficiency and effectiveness.

Similarly, Gutiérrez [19] asserts that productivity is directly related to the quality of the resources used and has little to do with faster production (less time). In general, productivity is measured by the relationship between the results obtained and the resources used. Below is Figure 2, which illustrates the importance of measuring the performance of production factors to ensure goal achievement, as productivity is closely linked to both efficiency and effectiveness.

Productivity is divided into two main dimensions:

- Efficiency (4): As stated by Martins [9], efficiency is a fundamental element for every organization and/or company. It analyzes the level of results obtained and the resources employed to achieve them. Confusion often arises when attempting to evaluate the level of efficiency without considering both results and resources. Its indicator is on-time delivery of orders.

$$\%\ P.E.\ T = \frac{\#\ P\text{On} - \text{time deliveries}}{\#\ Total\ orders} \tag{4}$$

- Effectiveness (5): According to Mayo [20], effectiveness is the state in which an organization or company has achieved its established objectives. It is the indicator that shows the capacity of a company to achieve expected results. Its indicator is the delivery of orders in compliance.

$$\%\ P.E.\ C = \frac{\#\ \text{Orders delivered in compliance}}{\#\ Total\ orders} \tag{5}$$

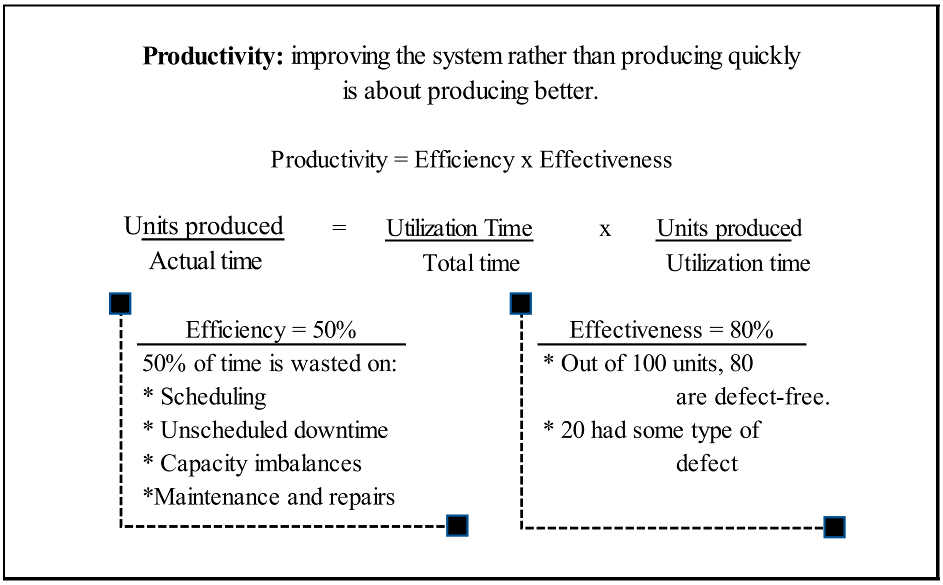

Figure 2. Productivity as a function of efficiency and effectiveness.

2.3. Conceptual Definitions

2.3.1. Lean Manufacturing

From the perspective of Rojas and Gisbert [21], Lean Manufacturing, also known as Lean Philosophy or Agile Philosophy, is a way of working that focuses on the continuous improvement and optimization of production or service systems. Its main objective is to reduce all types of waste, including inventories, lead times, defective products, transportation, and rework, both at the level of equipment and individually.

2.3.2. Lean Thinking

According to Jones and Womack [22], acquiring Lean Thinking surpasses the importance of developing certain human relations skills. This is because it involves continuous awareness by all personnel in the organization and the empowerment of crucial elements to achieve long-term objectives, such as employee and managerial responsibility, process discipline, and constant pursuit of improvements.

2.3.3. Value Addition

Quoting Vinajera et al. [23], value addition is the difference between the value of the product and the value of the input. This means defining and/or determining the value of the product in each process that makes up the supply chain, identifying key points, and fully establishing a mechanism for reducing costs of the final product.

2.3.4. Supply Chain

According to Valles [24], supply chain is a logistics management task that encompasses the planning, direction, transformation, and coordination of all activities related to purchasing, procurement, and collaboration with various partners such as suppliers, intermediaries, external services, and customers. Essentially, it involves the comprehensive administration of the supply chain, integrating supply and demand management both inside and outside the company.

3. Results

Below are the results obtained according to each implemented phase of the Lean Logistics philosophy.

3.1. Training and Education

The purpose of training staff in Lean principles was to achieve successful implementation of Lean Logistics. This was carried out through a series of talks, totaling 12 sessions covering various topics. Next, in Table 1, the phases of Lean Logistics implementation are shown, along with the topics to be developed and the training weeks for the staff.

Table 1. Training schedule phases, topics, and week.

Phases	**Topics**	**Week**							
		1	**2**	**3**	**4**	**1**	**2**	**3**	**4**
1° Phase	Awareness for top management					Awareness for top management			
	Lean principles						Lean principles		
	Concept and measurement of overall productivity				Concept and measurement of overall productivity				
	Value added vs. waste					Value added vs. waste			
	Concept of continuous improvement and Kaizen				Concept of continuous improvement and Kaizen				
2° Phase	Lean techniques 5 s-Part I					Lean techniques 5 s-Part I			
	Lean techniques 5 s-Part II							Lean techniques 5 s-II	
3° Phase	Standardization							standardization	

Each training session is concluded by integrating feedback and reinforcing the concepts, tools, and cases analyzed.

3.2. Improvement Plan Design

Table 2 shows the scope of the implemented project, identifying the problems, project scope, and improvement objectives.

Table 2. Lean Logistics project data sheet.

Project Overview	
During the months of January to March 2023, there were a series of incidents in the distribution area of the company.	
Problems	* Late deliveries (55%) * Incomplete order deliveries (22%) * Deliveries of orders in poor condition (14%) * Non-compliant order deliveries (9%)
Scope	In this research, 179 orders from 2023 were analyzed, and the implementation was carried out from May to July, considering only one type of Confy mattress of 1.5 plz.
Objectives	* Increase efficiency by 8%. * Increase effectiveness by 10%. * Increase the Value-Added Index by 10%. * Reduce waste by 10%.

3.3. Launch

The 5S team oversaw this phase. Additionally, a monitoring and compliance group or committee was formed to ensure the achievement of the proposed objectives.

3.3.1. 5S

Seiri (sorting): During this phase, all unnecessary items in the work area were sorted out. This was carried out by issuing disposal notices or red cards and keeping necessary items as close to the operators as possible. See Tables 3 and 4 for details.

Table 3. Record of elements in the production area.

Objective		**Sorting the Necessary from the Unnecessary**			**Seiri (Sorting)**	
Panel area						
N°	Item	Quantity	Location	Reason for Card	Suggested Action	Final Decision
1	Wire remnants	2 boxes	Work area	Scrap	Scrap	Sell
2	Tools	3	Table	Necessary	Relocate	√
4	Wire pallet	2	Work area	Necessary	Relocate	√
Upholstery area						
1	Defective irons.	1 pallet	Work area	Unnecessary	Retrieve	Transfer to another location
2	Empty glue cans.	4	Work area	Unnecessary	Scrap	Sell
3	Defective staples	2 boxes	Table	Unnecessary	Trash	√
4	Tools	2	Table	Necessary	Relocate	√
Pressing area						
1	Surplus waype	1 box	Shelf	Unnecessary	Trash	√
2	5-L water bottles	1	Worktable	Necessary	Relocate	√
3	Tools	3	Worktable	Necessary	Relocate	√
4	Calculator	1	Worktable	Unnecessary	Others	Transfer to another location
Bagging area						
1	Excess padded fabric	2 bags	Work area	Unnecessary	Scrap	Sell
2	Gallons of thinner	3	Worktable	Necessary	Relocate	√
3	Empty boxes	2	Worktable	Unnecessary	Scrap	Sell
4	Empty glue cans	2	Worktable	Unnecessary	Scrap	Sell
Closing area						
1	Label boxes	1	Floor	Necessary	Relocate	√
2	Number 40 tape boxes	1	Floor	Necessary	Relocate	√
3	Tools	2	Table	Necessary	Relocate	√
Bagging area						
1	Excess plastic	2 bags	Floor	Unnecessary	Scrap	Sell
2	Excess thread	1 box	Floor	Unnecessary	Trash	√
3	Tools	3	Table	Necessary	Relocate	√

As can be observed from Tables 3 and 4, through sorting, it was possible to determine which items were necessary and unnecessary and the actions to be taken in each case.

Seiton (set in order): Once the first phase was completed, greater effectiveness in work was achieved, as there was more physical space available. This technique of visual control, whose objective is to increase the efficiency and effectiveness of processes by making steps more visible, allowed for real-time visibility to incorporate visual control elements in production and distribution areas. See Figures 3 and 4 for details.

Table 4. Record of items in the distribution area.

Objective		Sorting the Necessary from the Unnecessary			Seiri (Sorting)	
Picking area						
N°	Item	Quantity	Location	Reason for Card	Suggested Action	Final Decision
1	Broken pallets	10	Picking area	Unnecessary	Scrap	Transfer to another location
2	Return logistics mats	3 packages	Picking area	Unnecessary	Others	Transfer to another location
3	Healthy pallets	40	Picking area	Unnecessary	Others	Transfer to another location
4	Return logistics foam block	2	Picking area	Unnecessary	Others	Transfer to another location
5	Rejected foam sheets	4 packages	Picking area	Unnecessary	Others	Transfer to another location
6	Foam block shells	2 packages	Picking area	Unnecessary	Scrap	Sell
7	Foam block bottoms	3 packages	Picking area	Unnecessary	Scrap	Sell
8	Broom	3	Picking area	Necessary	Relocate	√
9	Dustpan	3	Picking area	Necessary	Relocate	√
10	Foam samples	10	Picking area	Unnecessary	Others	Transfer to another location
11	Mattress samples	4	Picking area	Unnecessary	Others	Transfer to another location
12	Plastic sleeves for packaging	4 rolls	Picking area	Necessary	Relocate	√
13	Plates	2	Picking area	Necessary	Relocate	√
14	Scissors	4	Picking area	Necessary	Relocate	√
15	Old tires	3	Picking area	Unnecessary	Scrap	Sell
16	car tire inner tube	2	Picking area	Unnecessary	Scrap	Sell

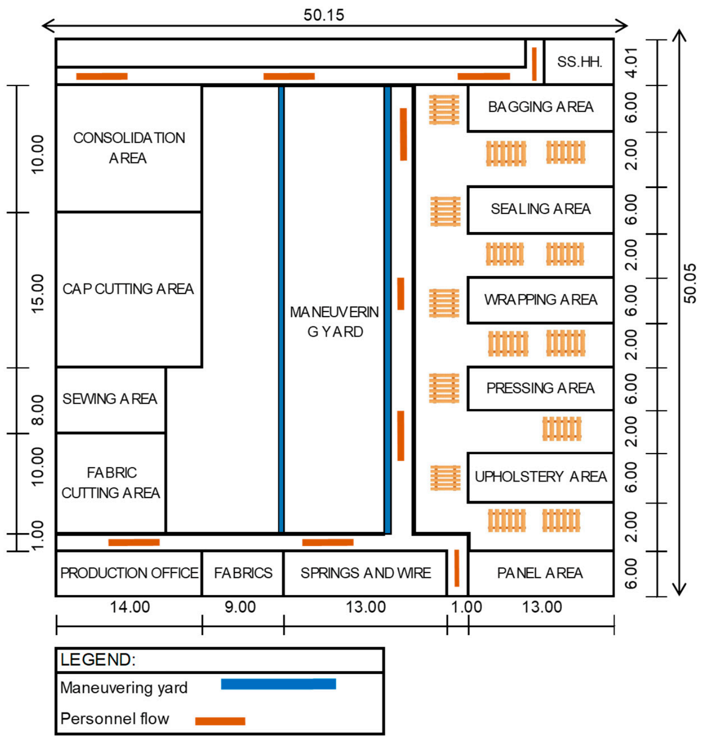

Figure 3. Production area layout.

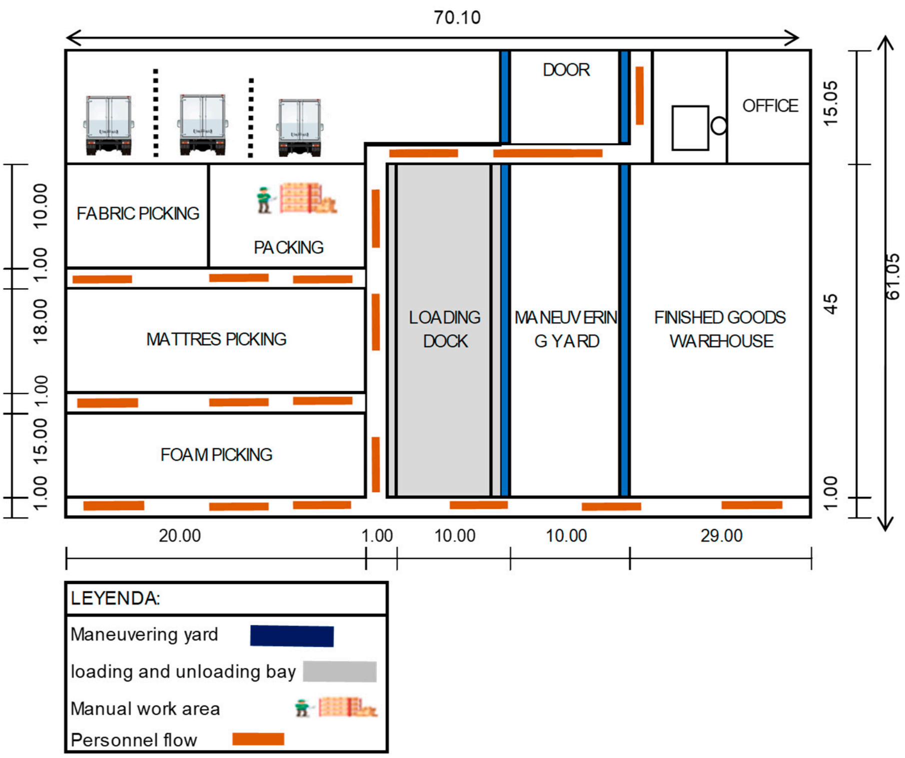

Figure 4. Distribution area layout.

Seiso (shine): In this phase, the objective was to improve the physical appearance while also preventing losses and accidents caused by dirt, as it can demoralize workers and create a negative perception among visitors. On the day of the big cleanup, general cleaning was carried out throughout the production and distribution area. This activity was conducted jointly with the 5S committee. After the big cleanup day, a responsible person was assigned for each area. See Tables 5 and 6 for details.

Table 5. Assignment of cleaning responsibilities in the production area.

Production Area							
Area	**Name**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
Cap cutting area	Henry	x	x	x	x	x	x
Sewing area	Cony	x	x	x	x	x	x
Fabric cutting area	Luis	x	x	x	x	x	x
Assembly of panels	Juan/Christian	x	x	x	x	x	x
Upholstered	July	x	x	x	x	x	x
Pressing	Alex/Luis	x	x	x	x	x	x
Sheathed	Mario	x	x	x	x	x	x
Closed and labeled	Andrew	x	x	x	x	x	x
bagged	Daniel	x	x	x	x	x	x
Supervisor for:					schedule	L–F	Saturday
					Start:	4:40 p.m.	12:40 p.m.
Observations:					End:	5 p.m.	1 p.m.

In both areas, the cleaning was carried out superficially. The goal was to organize, clean, or discard items that were no longer used in the process.

Seiketsu (standardize): During this period, the continuous application of the first "S" practices was ensured so that these improvements would become habits and responsibilities for the staff. Specific actions were taken to guarantee the correct implementation of the first three "S" practices. These actions included 5S audits conducted by the designated committee, brief meetings to address process-related aspects, performance recognition, daily execution of Seiso for 20 min, and scheduling of two deep cleanings per year. Finally, in order to verify and continuously improve the first three "S", periodic checks were conducted based on the criteria presented in Table 7.

Table 6. Assignment of distribution area cleaning responsibilities.

Distribution Area							
Area	**Name**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
Fabric picking	Pedro	x		x		x	
Mattress picking	Pedro	x	x		x		x
Foam blocks	Johnny	x	x	x	x	x	x
Handwork	Johnny	x	x	x	x	x	x
Supervisor for:					schedule	L–F	Saturday
					Start:	4:40 p.m.	12:40 p.m.
Observations:					End:	5 p.m.	1 p.m.

Table 7. Evaluation criteria of the first three items.

Evaluation	Criterion		Grade (0–3)	Score %
Sorting	Are there any unnecessary items in the area?			
Setting in order	Is the work area organized and tidy?			
Shine	Are the items, machinery, and work area clean?			
Total score				
Classification of the total score obtained				
0–2	Deficient		Legend:	
3–5	Fair	Deficient	0	
6–7	Good	Excellent	3	
8–9	Excellent	Evaluated area:		
Responsible:		Date:		

Therefore, standardization proposes a consistent way of performing tasks and procedures that contributes to the maintenance of the areas.

Shitsuke (discipline): After applying each phase of the 5S methodology, the following results were obtained. See Table 8.

Table 8. Results of 5S implementation.

5′s	Points Total	Grade
Sorting	18	90%
Setting in order	17	85%
Shine	18	90%
Standardize	16	80%
Discipline	18	90%
Total	87	87%

From the results, it can be confirmed that the company Inversiones Karmont is at a very good measurement scale, achieving a score of 87 out of a total of 100 points, equivalent to 87%.

3.3.2. Easy and Simple Quality Control (JIDOKA)

This tool was developed through four steps: detect anomalies, stop, correct the abnormal condition, and investigate the causes. The following presents Figure 5, in which mattresses free of faults or defects are illustrated, that is, mattresses with guaranteed quality.

Figure 5. Mattresses with easy and simple quality control.

3.4. Stabilization of Improvements

In Figure 6, the improved value stream mapping (VSM) of the production process is shown where the sub-processes of sealing-labeling and packaging were identified as the most time-consuming. After the implementation of Lean Logistics, these sub-processes and the entire production process were improved.

Non-value-adding activities were eliminated, although there are still some activities that do not add value but are part of the process.

- In the production area: The indicators for value addition and over-processing were 77% and 23%, respectively. According to the value-added index criterion, the process is effective, meaning that non-value-adding processes and times were eliminated.
- In the distribution area: The ratios of value addition and over-processing were 76% and 24%, respectively. According to the value-added index criterion, the process is effective, indicating that non-value-adding processes and times were eliminated.

The following presents Table 9, in which the results obtained after the implementation are shown, in terms of efficiency, effectiveness, and productivity.

Table 9. Efficiency, effectiveness, and productivity of the distribution area (post).

Frequency:				**Monthly**				
Objective:				Measure the performance of the area				
Conceptual expression				Efficiency Relationship that allows determination of the level of orders delivered at the time of the total requested.		Effectiveness Relationship that allows determination of the level of orders delivered in accordance with the total requested.		Productivity Indicator that allows determination of the performance of the area.
Weeks	Date Start	End	Requested Orders	Orders Delivered on Time	Post-Efficiency	Orders Delivered in Accordance	Post-Efficacy	Post-Global Productivity
1	12 June 2023	16 June 2023	18	18	100%	17	94%	94%
2	19 June 2023	23 June 2023	17	16	94%	17	100%	94%
3	26 June 2023	30 June 2023	18	17	94%	16	89%	84%
4	3 July 2023	7 July 2023	19	18	95%	18	95%	90%
5	10 July 2023	14 July 2023	18	16	89%	15	83%	74%
6	17 July 2023	21 July 2023	17	15	88%	15	88%	78%
7	24 July 2023	28 July 2023	18	17	94%	17	94%	89%
8	31 July 2023	4 August 2023	19	18	95%	17	89%	85%
9	7 August 2023	11 August 2023	17	17	100%	16	94%	94%
10	14 August 2023	18 August 2023	18	17	94%	17	94%	89%
Total			179	169	94%	165	92%	87%

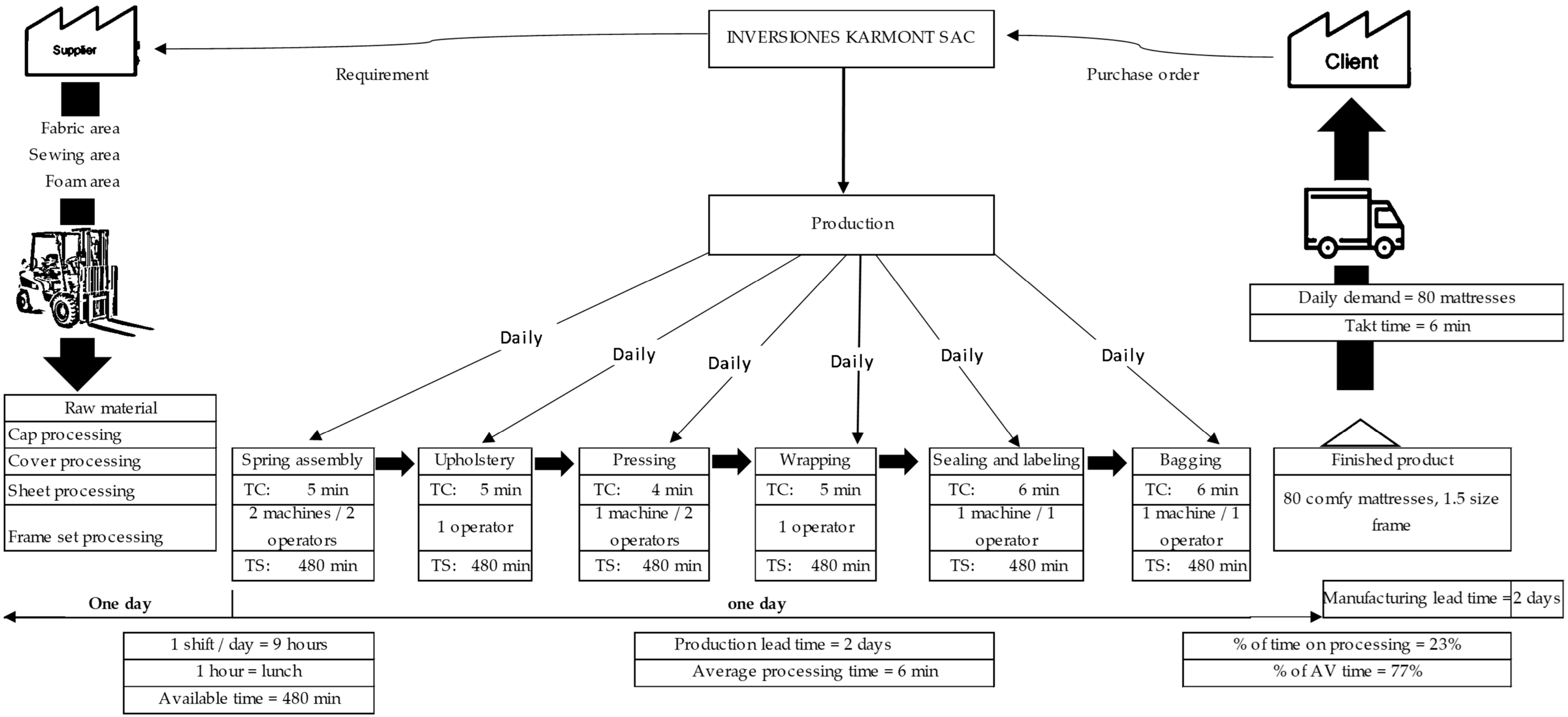

Figure 6. Improved value stream mapping of the production process.

From the previous table, it is affirmed that productivity efficiency reached 87%, thus achieving a very good rating.

3.5. Standardization

The procedure manual was documented, detailing each process from the order placement to the product delivery to the customer.

Line balancing according to demand (Tak time) was achieved. To define the Tak time, it was considered that the customer requests include specific characteristics, and therefore, the required quantity was evaluated.

$$\begin{gathered} Tak\ time = \frac{Available\ time\ per\ day}{Daily\ customer\ demand} \\ Tak\ time = 2\ \text{h}\ per\ order \end{gathered} \tag{6}$$

where

Weekly customer demand: 20 orders

Daily customer demand: 4 orders

Available time per day: 8 h

The aim was to achieve the reception, production, and dispatch of an order within 2 h to meet customer demand.

4. Discussion

The elaboration of the present research was based on the implementation of Lean Logistics; the assessment of productivity before (pre-test) the implementation of the improvement was 61%, and after the implementation of the improvement, a result of 87% was obtained, achieving an increase of 26%. Considering the results obtained, the null hypothesis was rejected, and the alternative hypothesis was accepted with a significance of 0.000 (<0.05), thus corroborating that the implementation of Lean Logistics increased productivity. These encouraging results coincide with those stated by Espejo [25], who conducted a study for 20 weeks and determined that the implementation of Lean Logistics increased productivity. In the study, they initially obtained an increase from 36.10% to 84%, achieving a variation of 47.9%, which allowed them to shorten the time from entry to delivery of orders. These results also coincide with those of Molina and Mora [26]. Through the implementation of the Lean Logistics philosophy, they managed to eliminate activities and/or tasks that do not add value, which in turn were generating bottlenecks within the operations, achieving an increase in overall productivity of 20.21%; the productivity was 93.40% before implementation and 73.19% after implementation.

For the first specific objective, i.e., to determine to what extent the implementation of Lean Logistics increases the efficiency of the distribution area of the company Inversiones Karmont S.A.C., a significance of 0.000 (<0.05) was found through the T-Student test; the assessment before (pre-test) the implementation showed 83% efficiency, while 94% was achieved after the implementation, an increase of 11%. Therefore, the null hypothesis was rejected, and the alternative hypothesis was accepted. From these results, it can be inferred that efficiency in delivering orders on time improved in relation to the lead times agreed with the customer, thus confirming that the implementation of Lean Logistics increased the efficiency of the distribution area of the company Inversiones Karmont S.A.C. These findings coincide with those of Espejo (2017), who, through the implementation of Lean Logistics, managed to increase efficiency in delivering orders on time from 70% to 93%, achieving a variation of 23%, while also optimizing delivery lead times from 5 days to 3 days, in effect improving the institutional image by reducing late order deliveries.

For the second specific objective, i.e., to determine to what extent the implementation of Lean Logistics increases the effectiveness of the distribution area of the company Inversiones Karmont S.A.C., a significance of 0.000 (<0.05) was found through the T-Student test. In the pre-analysis, an effectiveness of 73% was obtained, while a result of 92% was achieved after the implementation, an increase of 19%. Therefore, the null hypothesis was rejected, and the alternative hypothesis was accepted. From these results, it can be inferred that effectiveness in delivering conforming orders improved in terms of quality and specific requirements requested by the customer, thus confirming that the implementation of Lean Logistics increased the effectiveness of the distribution area of the company Inversiones Karmont S.A.C. These promising results coincide with what was stated by Espejo [24]; through the implementation of Lean Logistics, the effectiveness of the logistics area was improved, with the delivery of conforming orders going from 49.65% to 90.10%, an increase of 40.45%. Additionally, it achieved customer loyalty from retail chains and increased sales volume after implementation.

5. Conclusions

The implementation of Lean Logistics significantly increased the productivity of the distribution area of Inversiones Karmont Company, from 71% to 87%, and clearly reduced the flow time of the order from entry to final delivery to the customer.

The implementation of Lean Logistics significantly increased the efficiency of the distribution area of Inversiones Karmont Company, from 82% to 94%, effectively optimizing the lead time to 3 days.

The implementation of Lean Logistics significantly increased the effectiveness of the distribution area of Inversiones Karmont Company, from 73% to 92%, by fulfilling orders delivered in accordance with requirements.

Through the implementation of Lean Logistics, the Value Added Index (VAI) increased from 70% to 77%, with activities that do not add value ("wastes") being eliminated, thus achieving greater process flow.

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