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Increasing the service level index through implementing Lean Warehousing tools in a trading household equipment company

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Abstract*– The commercial sector represents a fundamental part of Peru's economy and has been growing exponentially in recent years. However, like any other sector, it is affected by various challenges that affect customer satisfaction, the impact of which has a direct effect on sales. Therefore, in this case study, a set of tools such as the 5S methodology, Kaizen and standardized work were defined, which will focus on the optimization of this indicator and the solution of its root causes. Likewise, the improvements were validated through a pilot test and the use of Arena software. The results obtained were positive, since there was a time reduction in the search for tools from 8 minutes to 4 minutes, and the cycle time decreased from 15 minutes to 10 minutes. The material shortage rate improved from 29% to 10% and finally the efficiency was maximized from 48.41% to 64%. All these results generated an increase from 87% to 94% in the main indicator, which is the service level. This research proposes a new model combining Lean Warehousing, Kaizen, 5S and Standard work applied in a kitchen commercialization company, which would help other companies in the same sector to optimize the picking and packing processes and increase the service level. It should be noted that there are not many case studies using these methodologies, so the aim is to disseminate and validate these methodologies in a new scenario.

Keywords*-- 5S, Standardized Work, Kaizen, Service level, household equipment, Trading company.

I. Introduction

The commercial sector is one of the main sectors that provide the greatest contribution to the Peruvian economy, representing 9.8% of the national GDP [1] and 24.7% of the economically active population (EAP) [2]. Moreover, in the first half of this year it achieved an increase of 2.85% [3]. Many companies nowadays tend to focus mainly on product quality or competitive pricing to differentiate themselves from competitors, however, another way for a company to remain competitive in the market is by maintaining a high service level [4]. In the present article, the company studied has an average of 87% service level, however, this indicator should exceed 94% [5]. According to the research, the main causes would be lack of material, delay in locating tools, low efficiency in picking, packing and packaging times. For example, in a trading company, a low service level was identified as a problem, due to the lack of material, disorder in the work area and delays in picking and packing, which after applying methodologies of process standardization and time management, managed to reduce this indicator [6]. There are several success stories of Lean Warehouse implementation, however, many of them are focused on the manufacturing sector. Therefore, this research work seeks to disseminate the use of Lean Warehouse in a new scenario that is the commercial sector, which would contribute to the optimization of the processes of the aforementioned sector. Under this premise, a model based on the 5S, work standardization tools and Kaizen was developed to increase the service level. This scientific article is divided into six sections: introduction, state-of-the-art, contribution, validation, discussion and conclusion.

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II. Literature Review

A. Lean Warehouse in the commercial sector

This tool requires a persistent, sustainable, technical and weighted progress of the warehousing process with the help of the workers. Lean Warehousing is based on reducing waste or excess in the supply chain to give value to the customer by generating utility in place and time [7]. This tool is focused on making an effective and adequate ordering of products. It seeks to reduce activities that do not generate value to warehouse operations and to recognize the causes of excesses. From another perspective, Lean Warehouse has been used for many years to optimize a company's internal logistics. Likewise, several components such as competitiveness, globalization and the more limited life cycle of the item requires companies to implement more economical and efficient manufacturing techniques [8]. Accepting the use of the Lean tool means that the elements encompassed by this tool are respected, both in commercialization and in all the procedures that are executed in the company, likewise, the use of Lean Warehousing is precisely for the processes that are areas that are more likely to originate waste or scrap. In addition, applying this tool in the warehousing area is an assured improvement in the organization's procedures and in the performance of the warehouse and the entire company [9].

B. Kaizen in the commercial sector

This methodology is very important, because it seeks to improve the results of a procedure through a series of actions. A case study shows that to continuously progress in the sustainable growth of a company, the Kaizen tool is implemented, and it was found that by applying this methodology the statistical impacts of the workers positively

affect their commitment, mentality, and interaction, thus having better decision making and the tasks to be prioritized [10]. From another point of view, another case study performed an analysis and applied Kaizen methodology in a restaurant addressing several challenges in different operational procedures, which impair and influence customer satisfaction and company performance. This tool helped a lot to reduce delays, customer complaints, reprocesses and extra costs, in addition to other operational challenges. A 70% reduction in the problems encountered was achieved thanks to the implementation of Kaizen [11]. This philosophy is an efficient and reliable improvement tool, it helps companies to quickly identify opportunities and inefficiencies. After implementing this methodology in a case study in India, it was shown that Kaizen was able to decrease the amount of inventory held, decrease cycle time and lead time, increase productivity, eliminate rework, and significantly improve product quality [12].

C. 5S in the commercial sector

The 5S tool is defined as the application of 5 steps used to improve performance, increase efficiency, and promote continuous improvement in the organization [13]. The 5S tool is described in 5 Japanese words, Seiri, Seiton, Seison, Seiketsu and Shitsuke, these steps are simple to implement, and are based on managing the elements of a certain area of work [14]. The case study of a trading company in which the main problem is the high rate of order returns with 41% that after the implementation of the 5S tool decreased to 12.10%. The implementation of the 5S in this company, first of all, the total number of items in the warehouse was counted, and the number of unnecessary items was identified through the use of red cards. Once the use of the cards was completed, they were recorded in order to calculate and check the measures for improvement actions. Finally, order and cleanliness were instilled to be able to maintain an adequate workspace [6]. In another case study, the application of 5S resulted in a 22% decrease in the distance traveled and the optimization of picking, packing and dispatching processes. It is also suggested that 5S can be applied to any company since it seeks to optimize logistics processes [15].

D. Standardization of work in the commercial sector

The standardization tool can be defined as the determination of an order sequence to establish the criteria of the procedures to be performed by the worker to increase the efficiency of performing the work [16]. For example, in a trading company presents as a problem the high percentage of non-productive times, the non-standardization of workers' tasks and the obsolete replenishment. It is proposed to modify the replenishment system and improve the times in the picking process. As a result, stock breakage was reduced by 17% and non-production time was reduced by 2 hours per day, and the number of workers was reduced from 14 to 11 [17]. In another case study of a company in the commercial sector, the objective is to implement a continuous improvement model, which seeks to improve processes in the warehouse, thus reducing labor overheads and high picking and storage times. One of the tools used in this case study is the standardization of work, which had the impact of an increase of 26.7% in picking productivity and 33.8% in warehouse productivity [18]. Another case study regarding the application of the work standardization tool was in a retail industry that aims to reduce the percentage of returns due to errors and returns for damaged products. The implementation of this tool consisted of reviewing the procedures of the functions of the workers to evaluate if the way they are working is the correct one. As a result, after the implementation, the indicators of returns due to error were reduced by 1% and returns due to damage by 5% [19].

III. CONTRIBUTION

A. Model Basis

Currently, several marketing companies in the country have a low service level compared to the commercial sector, due to which the profitability of the company is not very favourable, and no progress is seen in terms of competitiveness. Following this problem, research has been carried out on different methods, types and tools to eliminate these strategic obstacles. In Table 1 we can see the articles that details their models based in the obstacles that we want to improved. This has been the result of an exhaustive review of the literature on success cases with the application of Lean tools, identifying the common causes that our case study has with those found in the literature.

TABLA I
COMPARISON MATRIX OF THE CAUSES OF THIS RESEARCH VS. THE STATE OF THE ART

Causes / References	Lack of knowledge of the process on the part of workers	Lack of packaging material	Clutter in the warehouse	Lack of labeling of racks and shelves
[14]			5S	5S
[12]		Kaizen		
[19]	Standardized Work			
[10]		Kaizen		
[13]			5S	5S
[20]			5S	5S
[16]	Standardized Work			
[21]		Kaizen		
[17]	Standardized Work			
Proposed Tools	**Standardized Work**	**Kaizen**	**5S**	

B. Model Components

The proposed model consists of 3 phases: (1) Problem Analysis, (2) Improvement proposal y (3) Model Validation.

1) Phase 1: Problem Analysis

This first phase consists of the activities that were carried out before implementing the proposed model.

To recognize the problems encountered in the research, an in-depth study of the current context must be made beforehand, and a VSM diagram of the company must be drawn to know the procedure in more detail, with the purpose of identifying the waste and specifying the efficiency of each process. In order to calculate the KPI's that confirm the identified problem, the actual demand data, the number of orders delivered on time, the number of orders delivered complete and orders that do not present failures are used. Likewise, a problem tree diagram must be elaborated to discover the root causes of the problem found, in the same way, a deep study must be done to identify the best tools and techniques necessary for its respective resolution. And later, by means of a Pareto, the problems to be solved with the highest priority will be determined.

Likewise, the work standardization technique is implemented, which focuses on establishing a consecutive structure of the processes to be carried out by the worker. Standardization is a method that makes it possible to homogenize criteria with all employees, and also to expressly establish the: What, How, Where, Why, When and Who. This system consists of 3 components:

1. The Takt Time, which is to have the cycle time simultaneously with the average time.

2. The Work Sequence, focused on the consecutive order of operations performed by a multifunctional worker.

3. The types of inventories in procedure (Standard Work-In-Process) focusing on reducing the amount of wastage in the processes.

The third and last tool to implement is Kaizen. This methodology is a technique of Japanese origin, where kai means change and zen means good. This tool perceives failures as potential flows, since, when they are found, they make it possible to show where and how to improve. For the execution of this philosophy, 2 steps are carried out. The first step is to gather all the information, at this point it is necessary to first analyse what should be done, then to see if it is possible to execute what has been proposed and, finally, to prepare everything according to the decisions that have been taken to improve the problem found. And the second step is to do and evaluate what will be done to improve the indicator.

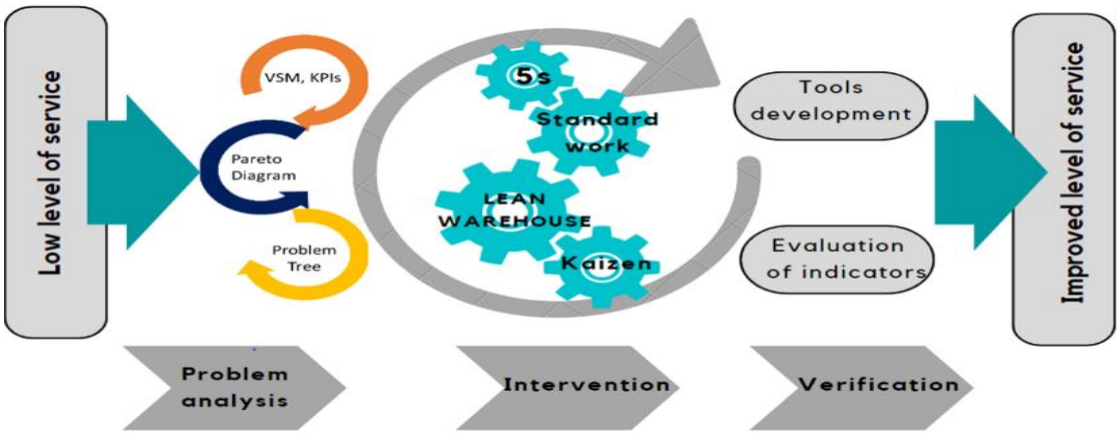

Fig. 1: Proposed model. Adapted from [10], [12], [19].

2) Phase 2: Improvement proposal

In this next phase, the selected tools are developed to be applied in the improvement format. As a first technique we have the application of the 5S, with the purpose of having cleaner, better structured, more orderly, but, above all, more active work areas. This methodology is based on the following principles:

Seiri: Identify and classify what is useful and what is not and discard unnecessary waste.

Seiton: Order what is needed so that it is in an easily accessible area.

Seiso: Continuously clean work areas and instruments.

Seiketsu: Maintain high levels of cleanliness and orderliness.

Shitsuke: Adapt to new company measures and be precise in implementation.

3) Phase 3: Model Validation

In this last phase, it will be analyzed and verified whether the objectives set are being met after the application of the indicators to ensure the progress of the model of progress and continuous improvement. For the implementation of the 5S system to last in the company, an audit model will be applied, which will be carried out before and after its development, where it will be verified if the activities outlined are being carried out. After the KPIs that ensure the implementation of the applied tools have been calculated, they will be compared with the behavior prior to the practice to demonstrate the impact produced by the new format. Fig. 1 below shows the proposed model for the company and Fig. 2 shows the flow diagram of the proposed model.

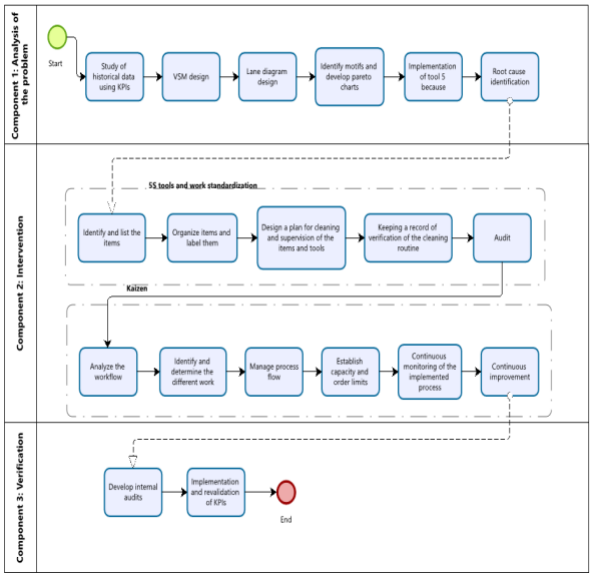

Fig. 2 Flowchart of the proposed model.

C. Model Indicators

The following indicators will be used to determine the impact after the implementation of the proposed model.

A. Service level: This indicator identifies the number of orders served with respect to the total number of orders. The initial value of the service level is 87% and the objective is to increase the service level percentage to 94% [22].

$$\%\ Level\ of\ servicie = \frac{Orders\ fulfilled}{Total\ number\ of\ orders} \times 100$$

B. Efficiency: This indicator identifies the percentage of orders dispatched over the company's actual capacity to carry out this process. The initial efficiency value is 88.41% and the objective is to increase the percentage to 96%. [23].

$$Efficiency = \frac{Number\ of\ orders\ dispatched}{Real\ dipatch\ capacity} \times 100$$

C. Total search time: This indicator represents the total time used to locate the tools required to perform an activity. The initial value is 8 minutes, and the objective is to reduce it by 30%.

$$Total\ search\ time = \frac{Average\ search\ time}{Total\ time\ available\ for\ work}$$

D. Cycle time: this indicator identifies the total time it will take to complete the activities of each activity. The initial value of the cycle time is 15 minutes. It is intended to be reduced by at least 10%.

$$Cycle\ time = \frac{sum\ of\ the\ observerd\ time}{Number\ of\ cycles\ observed}$$

E. Material shortfall: This indicator identifies the percentage of material that would be missing in the warehouse. The initial value is 29%, which is to be reduced by 50%.

$$Material\ Shortfall = \frac{Number\ of\ orders}{total\ material\ available} \times 100$$

IV. Validation

A. Validation scenario

In order to demonstrate the effectiveness of the improvement proposals, it was carried out in two ways, through a pilot plan and the use of Arena software for the simulation of the system. For the pilot plan it was necessary to perform an initial audit and for the simulation it is proposed the design of the current and the improved process, to determine areas of improvement. Both the pilot plan and the simulation were carried out in a kitchen commercialization company, being the picking and packing areas the ones considered for the implementation of the proposed improvements.

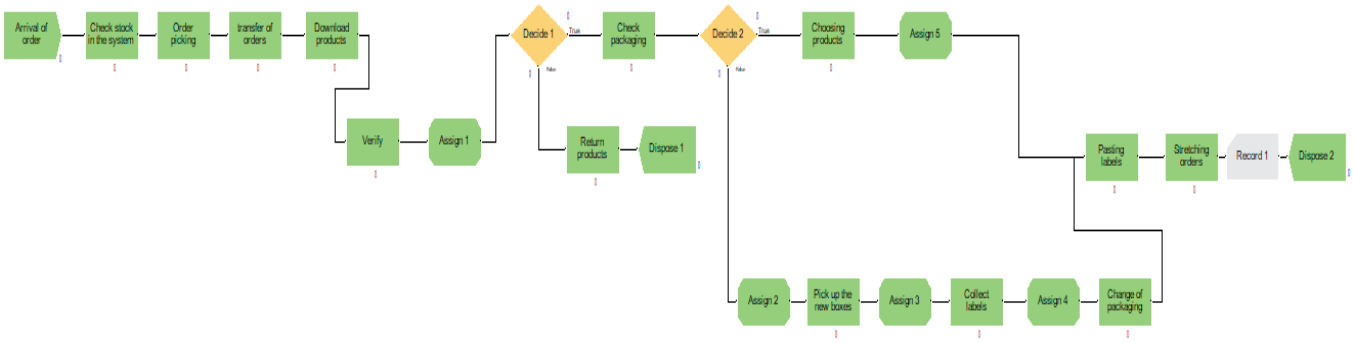

Fig. 3: Graphical representation of the current system

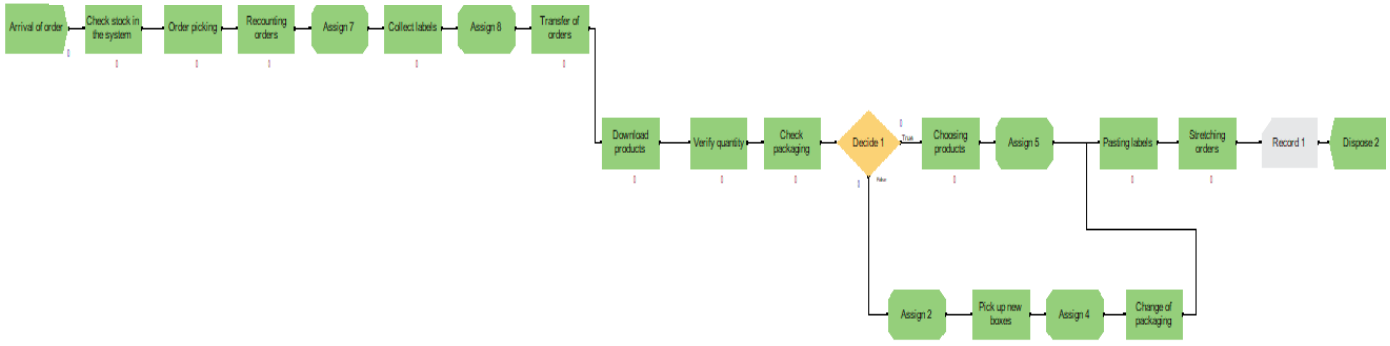

Fig. 4: Improved system graphical representation

B. Initial diagnosis

The company studied is in charge of the commercialization of kitchens, from the unloading of the products to their distribution. The initial diagnosis showed that the company's main problem is a low service level, which is 87%, 7% below the ideal and representing an economic loss of S/1,324,458 either due to fines or reprocessing. There are three causes of this problem, which are late orders, failed orders and incomplete orders, the first being the main cause (68%). This is also due to delays in the picking area and delays in locating products. The root causes of the first cause are the workers' lack of knowledge of the process (63%) and the lack of packaging material (37%). The root causes of the second cause are the disorder of the warehouse (55%) and the labelling of racks and shelves.

C. Simulation of improvement proposal

In order to demonstrate and validate the improvement proposals implemented, the simulation was carried out in the Arena software, so the design of the current process and the improved process was performed. Then, the development of the scope of the system, the input variables, the data sample size and finally the calculation of replications and the system outputs will be considered. To develop the simulation of the logistic procedure, time was taken from the arrival of the truck with the goods to the dispatch and respective invoicing to the customer. To develop the calculation of the optimal replicas of the simulation procedure, a sample of 30 replications was chosen. This simulation is show below. Fig. 3 represents the initial situation.

The proposed new model aims to increase the service level a kitchen trading company using tools such as Lean Warehousing, Kaizen, 5S and Standard work, and can also be used in other companies that are similar or that have problems such as lack of packaging material, low efficiency, disorder of the warehouse and high picking and packing times. A new model was designed in Arena software for the improved process, in which all the proposed tools were developed, as shown in Fig. 4.

D. Application of the proposed model in the case

1. Implementation of the 5S

Seiri (Classify): The first phase consists first of knowing the necessary elements by means of two types of tools, which are a checklist and color cards. With respect to the checklist, the tools that are found in the warehouse will be defined as cleaning elements, EPPS, tools, from which we will proceed to classify between the necessary elements that are those that are used to carry out routine activities within the studied area, likewise the unnecessary elements were identified as elements that are broken, elements that do not belong to the warehouse area and tools that are not constantly used. Therefore, the use of red cards will be used to classify the actions to be carried out. The purpose is that workers should be aware of which tools should

be present in the work area, so it will be easier to visually identify unnecessary and infrequently used tools.

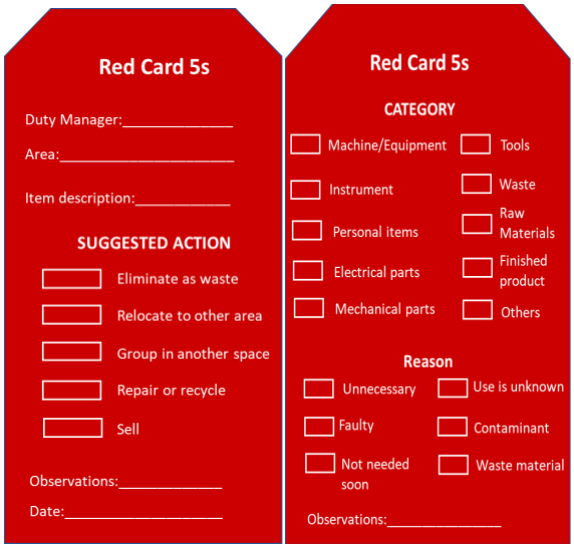

Fig. 5: Red card design

From Fig. 5 it can be seen that the card will allow sorting the items according to category (equipment, waste, personal items, tool, electrical parts, mechanical parts, instrument, finished product, others), and will also allow marking the suggested action for each item found (repair or recycle, sell, relocate, dispose) and also to know the reason for each item (unnecessary, defective, unknown use, contaminant, unusable waste material and not needed soon).

Fig. 6 shows the elements before being classified and Fig. 7 shows the elements that are already classified after applying the first phase of the 5S tool.

Fig. 6: Elements before sorting

Fig. 7: Elements after sorting

Seiton (Sort): In the sorting phase, we can see pallets and boxes out of place. In the same way, the signage in the warehouse is not respected, and elements can be seen outside the yellow line. Other elements that are in the wrong place are the boxes, which can be seen under the racks. In addition, there are shelves, cluttered with boxes and other elements that should not be in the work area.

It is proposed to implement the classification of tools according to their frequency of use, and posters or signs will be placed so that workers can be guided. Regarding the classification of materials and tools, these will be located according to their frequency of use. Fig. 8 shows the elements before being ordered.

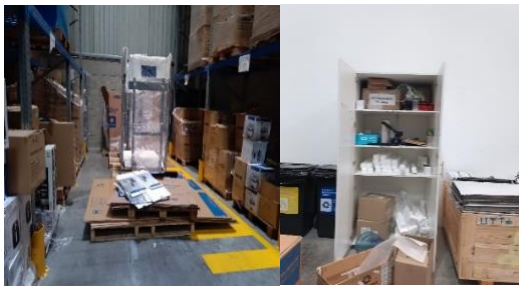

Fig. 8: Elements before being ordered

Fig. 9 shows the elements that are already ordered after applying the second phase of the 5S tool.

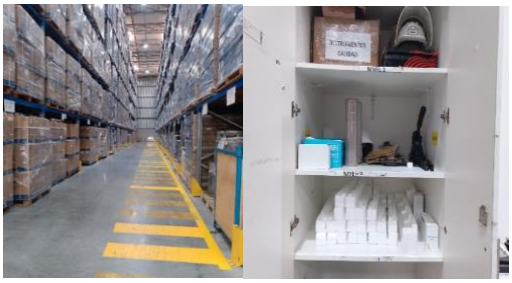

Fig. 9: Elements after being ordered

Seiso (Clean): The sources of dirt and places that were difficult to access for cleaning were identified and a cleaning plan was drawn up. It is also proposed to install garbage garbage cans that will be segmented by color, with green representing recyclable materials, yellow representing plastics and metals, blue for garbage classified as paper and cardboard, and finally, the black garbage can for general waste that has not been sorted. This classification of waste will allow for better recycling management.

Likewise, in order to carry out the cleaning of the studied area, it is proposed the elaboration of a calendar, in this way it will be possible to detail the activities that will be carried out in each week and will have a better execution of the implementation. The proposed cleaning schedule to be implemented in the company will be presented below. The Fig. 10 shows the proposed schedule for the cleaning plan.

AREA	TASK	Duty manager:											
		CLEANING PLANNING											
		WEEK											
		Monday		Tuesday		Wednesday		Thursday		Friday		Saturday	
		TURN 1	TURN 2	TURN 1	TURN 2	TURN 1	TURN 2	TURN 1	TURN 2	TURN 1	TURN 2	TURN 1	TURN 2
		7:30 - 8:10	19:00 - 19:40	7:30 - 8:10	19:00 - 19:40	7:30 - 8:10	19:00 - 19:40	7:30 - 8:10	19:00 - 19:40	7:30 - 8:10	19:00 - 19:40	7:30 - 8:10	19:00 - 19
Picking and packing zone	Clean passageway												
	Clean and dry floor												
	Unobstructed transit zone												
	Tools in place												
	Cleaning of tools used												
	Materials ordered												
	Disposal of accumulated garbage												

Fig. 10: Proposed schedule for the cleanup plan

Seiketsu (Standardize): The implementation of spreadsheets was carried out, in which the times will be recorded, in addition to the use of information boards and the constant follow-up after the implementation. On the other hand, the implementation of a 5S methodology compliance checklist was proposed. In this checklist, a company employee can be delegated to perform the function of controlling and supervising. It is proposed that these reviews should be carried out at least twice per shift and these verifications will be carried out in the areas of the warehouse studied, such as the picking area and the packing area.

5s Compliance Checklist						
Inspection data			Areas of the company			
Date	Hour	Duty Manager	Picking area		Packing area	
			1° review	2° review	1° review	2° review
Criteria to be reviewed						
Employee attendance list						
The work areas present only materials and tools necessary for the and tools necessary for the process						
The operator complies with the established established cleaning and tidiness policies						
Work areas are used for the specific development of specific development of the activities						
The tools are in order and clean and clean						
Operators are aware of the location of location of the necessary tools, materials						
Time is recorded in the packing and packing process packing and packing						

Fig. 11: 5S compliance checklist

From Fig. 11, it will be possible to follow the level of compliance with the above proposals for each "S" that are part of the 5S methodology. In addition, it will allow to take the necessary measures to be implemented or to reward the workers for the effort they have made in implementing the new measures.

Shitsuke (Discipline): This phase of the process is very important, since it will be possible to determine whether the application of the 5S methodology has been executed correctly and whether it can last over time. Therefore, through the application of the first 4s it was possible to determine that the areas studied were disorderly and that the tools used were not within reach, so that the workers were late in doing their work. In addition, it could be determined that some workers did not have enough motivation to actively carry out the proposed implementations and other workers forgot or did not know how to carry out the proposed improvements. Therefore, in this case study, this phase will focus primarily on two aspects: workers will be grouped and reminded of the importance of the implementation of 5S, and a space will be designated in which posters will be placed to visually assist in the application of 5S. Fig. 12 shows the Panel with posters of the 5S methodology.

Fig. 12: 5S methodology poster pane

Fig. 13 shows the picking and packing areas much cleaner and tidier after having applied the 5S methodology.

Fig. 13: Pilot 5S fully implemented

Fig. 14 shows the results of the initial and final audit after the implementation of the pilot.

Fig. 14: Results of the 5S assessment

At the end of the application of the 5S methodology, the result is a 59% increase in the final audit, which is a significant increase compared to the initial audit.

2. Standard work:

The sequential order of the activities to be performed was determined, which would increase efficiency and reduce the time required to perform the work. Therefore, it is proposed to classify the current process into VA (function that adds value), NVAN (function that does not add value, but is nevertheless necessary for the process) and NVA (function that does not add value). Once the activities have been classified, improvements will be proposed for the activities classified as NVA, which will reduce time. Two opportunities for improvement were identified in the order picking and packing processes: The posting and verification of the order quantity and the movement of the operator to the materials warehouse. To this end, the implementation of a routing sheet was proposed, which will indicate the quantities required according to the customer's order, as well as that the operator, when preparing the order, performs the physical and system count before moving the products to the packaging area. On the other hand, another of the proposed improvements is to implement baskets in order to collect the materials required for packaging in a single transfer of the operator and thus reduce time. After implementing these improvements, the initial process eliminated 4 activities that did not add value and the percentage of these activities decreased from 43% to 24%, and the activities that add value increased from 33% to 47%. Consequently, the cycle time was reduced from 15 to 10 minutes, which represents a decrease of 33%. Fig. 15 shows the roadmap implemented.

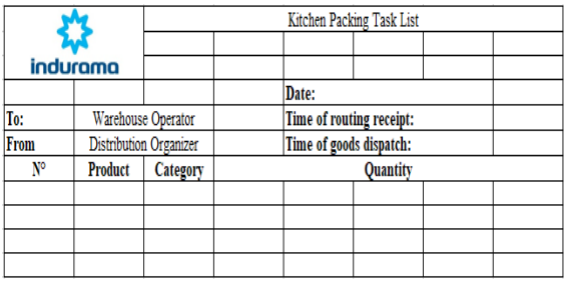

Fig 15: Road map

Fig. 16 is an example of the sequential order that the employees need to follow

Fig 16: Application of the Standard Work

3. Kaizen:

Standardization of the order delivery procedure is carried out, which will allow employees to know when material is missing and order it in advance, without having that dead time or delay due to not having the complete packaging material. The following steps were implemented: Performance in current time of the materials, measure the performance of the supplier's leads times, performance in current time of the materials out of contract, measure delivery times due to unforeseen events and count the materials that have arrived in poor condition or do not have the required documentation. After implementing the improvement proposals, the lack of materials in the company was reduced by 11%. By having a better order and giving suppliers access to information on the rotation of materials, they can supply the company at the required time.

D. Results of validation

After implementing the improvements, the following results were obtained, as shown in Table II.

TABLE II
RESULTS OF THE INDICATORS WITH THEIR TOOL RESPECTIVE

Tool / Objective	Indicators	As is	To be	Improved
General Objective	Service level Index	87%	96%	10% ▲
5S	Tool search time (min)	8	4	50% ▼
	5S Audit	5.4	8.6	59% ▲
Standardized work	Efficiency	88.41%	96%	9% ▲
	Cycle time (min)	15	10	33% ▼
Kaizen	Lack of materials	29%	10%	11% ▼

First, the implementation of the 5S methodology reduced the time spent searching for tools by 50% and increased the percentage of the initial audit by 59%. All these improvements are reflected in the organization of the picking and packing areas. Second, we were able to reduce the cycle time by 33%, which is the time it takes an operator to perform his work per unit, it is important to mention that these improvements were made in the picking and packing area. Moreover, the implementation of standardized work allowed us to increase worker efficiency by 9%. Finally, the Kaizen methodology was implemented, which allowed an 11% improvement in the materials shortage indicator.

Once applied, all these tools that are part of Lean Warehousing and Kaizen, it was possible to reduce the main indicator, which is the service level, from 87% to 96%, which implies a 10% improvement.

V. DISCUSSION

A) News scenarios vs results

At this point 3 scenarios are proposed, in order to make a comparison of the current simulation of the first month with the following 3 months. In scenario one, the results obtained in the

initial simulation will be used, then for scenario two, the data obtained in the second simulation will be used, and finally, for scenario three, the data from the previous simulation will be used. In this way, there will be scenarios from the current situation to the month four simulation.

1) First scenario: In this first scenario, Arena Software is used again to perform a simulation for a second month with the application of the improvements presented above, of the Lean Warehousing methodology.

TABLE III
INDICATORS OF PREVIOUS VS. IMPROVED PROJECT

Indicators	***Current Situation***	***Improved Situation***	**Scenario 1**
Tool search time (min)	8	4	3.3
5S Audit	5.4	8.6	9.1
Efficiency	88.41%	96%	97.45%
Cycle time (min)	15	10	9
Lack of materials	29%	10%	8.70%
Service level Index	87%	96%	96.5%

As shown in the Table III, the tool search time decreased to 3.3 minutes. On the other hand, the 5S audit increased from 8.6 to 9.1 and the efficiency increased to 97.45%. Also, cycle time decreased to 9 minute and material shortage decreased to 8.70%. Service level increased to 96.5%.

2) Second scenario: Arena Software is used again to simulate this second scenario. In this case, the comparison will be between the results obtained in scenario 1 and scenario 2.

TABLE IV
INDICATORS OF PREVIOUS VS. IMPROVED PROJECT

Indicators	***Current Situation***	***Improved Situation***	**Scenario 2**
Tool search time (min)	8	4	3
5S Audit	5.4	8.6	9.3
Efficiency	88.41%	96%	98%
Cycle time (min)	15	10	8
Lack of materials	29%	10%	8.10%
Service level Index	87%	96%	97%

As can be seen in the Table IV, the tool search time was reduced to 3 minutes. On the other hand, the 5S audit compared to the previous scenario only increased by 0.2 and the efficiency increased a little to 98%. In addition, the cycle time was reduced to 8 minutes and the lack of materials decreased to 8.10%. Service level increased to 97%.

3) Third scenario: Finally, in this scenario, the data collected in the previous scenarios is used to simulate the fourth month of improvement application.

TABLE V
INDICATORS OF PREVIOUS VS. IMPROVED PROJECT

Indicators	***Current Situation***	***Improved Situation***	**Scenario 3**
Tool search time (min)	8	4	2.3
5S Audit	5.4	8.6	10
Efficiency	88.41%	96%	99%
Cycle time (min)	15	10	7
Lack of materials	29%	10%	6.90%
Service level Index	87%	96%	98.5%

As can be seen in the Table V, for the third scenario the tool search time was reduced to 3 minutes. In addition, the 5S audit increased to 10, while the efficiency was 99% again. Also, cycle time decreased to 7 minutes and material shortage decreased to 6.90%. Again, positive figures are obtained for this simulation. Service level increased to 98.5%.

B) Analysis of results

For this point, the indicators previously achieved in the three scenarios are handled. For this purpose, the Table VI shown below was executed, in which the percentage difference between the three scenarios and the actual situation of the company will be evaluated, in order to clearly recognize how much progress was found.

TABLE VI
DIFFERENCE OF THE DIFFERENT SCENARIOS

	Difference		
Indicators	**Scenario 1**	**Scenario 2**	**Scenario 3**
Tool search time (min)	-4.7	-5	-5.7
5S Audit	3.7	3.9	4.6
Efficiency	9.04%	9.59%	10.59%
Cycle time (min)	-6	-7	-8
Lack of materials	-20.30%	-20.90%	-22.10%
Service level Index	9.5%	10%	11.5%

According to the results in the table above, it can be seen that as the months go by, after the application of progress, the indicators continue to be positive. The tool search time has a gradual but noticeable reduction, likewise, the cycle time decreases up to 53.33% and the percentage of missing materials has a clear reduction of up to 22.10% less. On the other hand, in the 5S audit and efficiency it is clearly seen how these indicators increased over the real situation. Service level increased by up to 11.5%.

C) Future works

- It should be made clear that the simulation and scenarios have a restriction, due to the fact that when executed in the Arena software, they depend on the characteristics of each company, since some variations can be found regarding results.
- It is preferable to validate the development of the model with different scenarios, using different types of kitchens, since the results of the cycle time could vary depending on the circumstance such as the customer's requirement, how the packaging is or the quantity.
- When developing the proposed model, the areas that interact with the main procedure to be interceded must be taken into account. This is essential, because the root causes of the procedure to be intervened may originate in another area.
- It is advisable to train all workers who are involved in the main procedure and in order to carry out the proper development of improvements and to have a continuation and persistence of effective results, employees must be committed and accustomed to a training of continuous progress.

VI. CONCLUSIONS

At the end of this research, it can be concluded that the implementation of the Lean Warehousing methodology achieves a significant improvement in the warehouse management of a trading company. Through the results, a great progress can be observed with respect to the indicators and objectives of the company.

On the other hand, we can conclude that by reviewing the literature and the Lean Warehousing tool to carry out the study, it was possible to have a theoretical support to implement the improvement proposal, since research was found where this methodology was applied with its respective tools, and it was feasible to optimize the storage indicators of several companies.

By using engineering tools such as the lane diagram and Value Stream Mapping, it was possible to determine the main problem in the company, which is the low service level. Likewise, by using the Ishikawa diagram, the tool of the five because the root causes were diagnosed, which are the lack of materials, the disorder in the warehouse, the lack of knowledge of the process by the workers and the lack of labelling of racks and shelves.

In conclusion, the correct implementation of the 5S methodology and the standardized work in the picking and packing areas achieved a reduction in tool search time, a reduction in cycle time and an increase in efficiency. In summary, tool search time and cycle time were reduced by 50% and 33%, respectively, in addition to a 9% increase in efficiency.

Also, with the application of this method, it was possible to relate the cause of the problem with its respective solution through a model that proposes several guidelines to follow through a distribution of improved tasks. By implementing tools such as the 5S, Kaizen and Standardized Work of the Lean Warehousing method, it was possible to apply a proposal that makes it possible to solve the problems found in the company.

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