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Application of Lean Tools and Inventory Policies in a Mass Consumer Distribution Company in Peru

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Abstract. The distribution sector accounts for a significant portion of Peru's GDP. Due to the necessity to cut costs and stay competitive, SMEs in this field have been driven to enhance their processes by adding approaches that assist them in achieving this goal. With this challenge in mind, it was decided to present an improvement model that combines Lean approaches with inventory policies in order to reduce the number of orders returned by a distribution SME, so increasing the utility of the product. The results of this model show the current situation of the company, which is 13 percent of returned orders, a reduction to 8% of returns, a 38.5 percent improvement by reducing the number of returns, which is due to the implementation of the 5S methodology, Poka-Yoke, SLP, and a multicriteria ABC model for inventories, which is due to the implementation of the 5S methodology, Poka-Yoke, SLP, and a multicriteria ABC model for inventories.

Keywords: Returns, SLP, 5S, Poka-Yoke, ABC multicriteria

1. Introduction

Currently in Peru, micro and small companies contribute approximately 40% of the Gross Domestic Product. Trade and distribution represent 10.7% of the national GDP. Likewise, it is also shown that SMEs generate 47% of employment in Latin America, this being the most important characteristic of businesses of this type. These data show the weight and importance of this sector at a national and global level. According to the data registered by the INEI (2021), the commerce sector has registered a decrease of 0.85% compared to the previous year, which has caused a decrease in the sector's profits and an urgent need to reduce costs. In the statistical data bank of the INEI, it is recorded that, in the Apurímac region, there are twenty-one distribution companies of beverages (beers and soft drinks) currently [11], evidencing the importance of these in the economy and in the jobs they generate in their region.

At a global level, consulting the literature, there are different investigations on the same identified problem, which indicates that it is a recurring problem in various parts of the world. For example, in a distribution company located in Italy, it has been identified that the main problem is also order returns, this due to product damage, bad labeling, late deliveries, etc. This meant that the expected profit on the part of the company never reached the projected one, a problem that was considerably reduced after the application of various time management and process standardization methodologies. [14]. Another clear example is a beverage packaging and distribution company whose main problem was the return of orders. They focused the solution on the use of those mentioned previously and focused on the standardization of processes to obtain fast and effective results [4]. To finish with the examples, a company in the distributor commercial sector proposed an improvement by applying the 5s and suggesting that the next companies that apply it diversify the methods to enhance this improvement. It is from this conclusion that different methods of improvement in the processes and implementation of the 5s have been implemented in the present work, concluding with satisfactory results, exceeding expectations, and demonstrating that the correct implementation of the methodology in companies in full growth is of vital importance for its correct operation.

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Under this context, the research is based on a medium-sized company, dedicated to the distribution of beverages, so that it is our case to study and apply the methodologies and proposals raised, The main problem of this company is the return of orders (19% of return on average) mainly due to product damage caused in storage processes. Given this, it is necessary that the commercial sector, especially the small group that is dedicated solely to the distribution of products, standardize its processes and identify these problems from the beginning, or if possible, even before the implementation of the processes and renewing them. continuously to keep up with changes in the sector and customer needs. Given the identified problem and the causes of the problem, the implementation of useful methodologies and their correct implementation are proposed. The proposed methodologies are 5S, process standardization, Poka-Yoke, and the establishment of security and storage policies within the company's processes. The "5S", of Japanese origin, represents the name of five actions: Separate, Clean, Order, Standardize and self-discipline, which, applied as a group in productive, service and educational organizations produce transcendent achievements [10].

This presented scientific article is divided into seven parts described below:

Introduction, which is the present summary of the research project. The state of the art, which is the description of the terminology that describes the project or under which we have been guided and which was consulted through various bibliographic sources cited at the end of the document for its correct validity. In the contribution, the proposal to contribute to the literature is described, based on various consultations to various sources of information and the same information obtained from the company studied, focusing on various methodologies and innovating in some processes. Results / Validation, where the effectiveness of the proposals presented and the results obtained will be verified. Discussion, where we compare what is observed and applied in the research with the literature sources consulted and, finally, conclusions, where the main and most outstanding points to be highlighted from the research are summarized.

2. State of the Art

2.1. Poka-Yoke

A Poka-Yoke is a Japanese gadget that literally means "error-proof." The goal of this approach to process design is to remove or avoid errors, whether human or automated. This technique can also be used to aid in the discovery of mistakes. [1]. The initial step in selecting the best quality control technique is to select the right inspection system, followed by the proper function, and finally, the appropriate contact, fixed value, or PY movement step method. The authors have presented a classification structure for PY service and recovery options. The framework can assist service administrators in error detection during or before the service process [13]. By implementing this tool for the elimination of errors and has a significant impact on the performance of operations in such a way that the number of returns for quality observations is reduced, important gains are obtained from an economic point of view [3].

2.2. Systematic Layout Planning (SLP)

Systematic design planning was chosen since it is a simple methodology to implement. Furthermore, its techniques include layout design criteria that have been applied in both academia and industry in recent decades. One of the most critical decisions an operations manager may make is the layout of the facility. This decision currently has a medium and long-term impact on businesses, particularly in the services industry. Poor process and design can lead to operational inefficiencies and customer loss [18].

2.3. 5S and preventive maintenance

This tool and this philosophy are generally applicable to all medium-sized companies in full growth and in the case of beverage distribution companies it is a good opportunity for its application, based on several success stories, Willison [20] used the 5S tool as part of the Lean initiative in warehouse and delivery facilities of distribution companies in India. Operating processes, tool organization, cleaning schedules, and material handling all underwent adjustments. In a case study, it's important to show how 5S practices can help a business accomplish its goals of improved performance and continual development. They carried out a 5-year audit, an action plan for each of the 5 through activities, sort, order, clean, standardize and maintain

discipline. This tool generates benefits, such as improving the quality of products or services, in the work environment, reducing costs, increasing efficiency, reducing waste, etc. [7].

An improvement of productivity indicators must be carried out, keeping the entire production system within the global indicators of team effectiveness, proposing implementation pillars, so that organizations are more productive [8]. The results with the implementation of "5S", improved the time of search and preparation of products. The time it takes to find a product has been decreased from 30 minutes to 5 minutes. This time difference brought a saving of 7% to the company. The result was the reduction of failed products, thereby increasing the overall efficiency of the equipment and achieving the highest productivity. The 7% increase in the global indicators of effectiveness was achieved after the implementation of preventive maintenance within a month of these activities.

2.4. ABC multicriteria

It is impractical to expect every product to receive equal attention in a company with a large inventory. Managers/administrators should classify these products in order to develop suitable control levels and policies for each class of inventory based on its relative importance, so that management efforts and expenses are commensurate to it. The traditional approach is to categorize items into three groups A, B, and C, descending, according to a single criterion related to the annual value invested in the assets. However, there is a need to consider more criteria for the inventory classification [9].

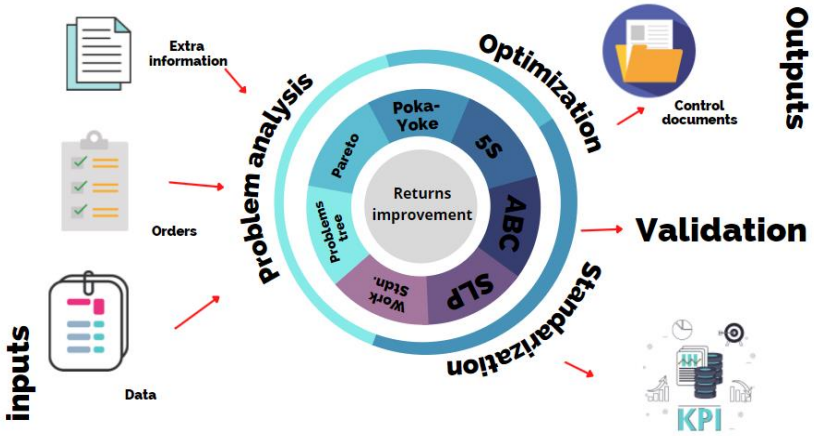

Fig. 1: Proposed model

3. Contribution

3.1. Model Basis

The warehouse and inventory management area is an important component within the value chain and impacts competitiveness and efficiency in different organizations. It faces constant changes and new challenges, which is why it must be in constant learning and implement changes at a strategic level. This article presents an implementation proposal based on the literature of different Lean Logistics and Warehouse Management models and tools to ensure a decrease in the level of order returns.

3.2. Proposed Model

The main objective of the analysis of the case study is to reduce the level of order returns, as this is well above the expected level. This will occur through the implementation of a model with 4 stages applying different improvement tools. This was designed thinking about what the research needs, applying different instruments, which have different benefits when applied, bringing different advantages by not having been used all together in the past. This implies having optimal results from each tool and thus encompassing all possible contributions. The first stage consists of the analysis of the problem using tools such as the lane diagram, indicator analysis, Pareto and problem tree. For the improvement development stage, the 5S and SLP are implemented to provide a standard in the company's working methods. Then the ABC multicriteria and Poka-Yoke model is applied to optimize the warehouse area. Finally, the validation stage is completed, in which it is evaluated utilizing a simulation and analysis of KPIs.

3.3. Model Components

The following table presents the proposed model components supported by the literature review and their different phases:

TABLE I. COMPARISON MATRIX OF THE PROPOSAL COMPONENTS VS. THE STATE OF THE ART

Components	***Errors within operations***	***Environmental damage***	***Supply management***	***Standardization of processes***
Palominos et al., (2019)				SLP
Costa et al., (2018)		5S		5S
Zárate, L. G. E., & Lozada, M. Á. R. (2020).			ABC Model	
Alejandra et al., (2018)	Poka-Yoke			
Herrera et al., (2019)				Standardized work
Proposal	**Poka-Yoke**	**5S**	**ABC Model**	**SLP, 5S and standardized work**

The following section will describe the components of the model:

A. Problem Analysis

The current situation will be analyzed, where information of the usual operations will be collected to have an analysis based on the process mapping that will be developed with a lane diagram tool. In addition, scientific articles with similar problems in the operations area will be reviewed to determine the vest tools for diagnosis, improvement, and validation.

B. Process stabilization

Phase 2 is made up of the SLP and 5S analysis tools. This phase aims to identify the main problems of the processes, to propose medium- and long-term objectives for the improvement of the delivered product quality and to organize the workspaces.

C. Storage and dispatch optimization with ABC and Poka-Yoke

Component 3 consists of the implementation of the ABC multicriteria tool. Once the processes are stabilized, the aim is to reduce the time of the operations by optimum distribution of the stored products. With the Poka-Yoke tool the number of errors during the process of dispatch will be reduced, decreasing the number of reprocesses and client observations, also decreasing the time of the verification steps.

D. Model Validation

Finally, the ARENA simulator will be used to visualize the results of the implementation of the solution model. The indicators before and after the development of the proposed model are shown.

3.4. Model Indicators

To prove the effectiveness of improvements it is necessary to measure them through indicators.

A. Delivery fulfilment on time: allows to calculate the percentage of deliveries that were delivered in the time established with the client.

   Objective: to increase compliance level by 33%.

$$DF = \frac{Total\ orders\ delivered\ on\ time\ in\ the\ month}{Total\ orders\ delivered\ in\ the\ month} x100$$

   Interpretation: measures the % of products delivered within the time stablished with the client.

B. Damaged products: allows to calculate the percentage of products that have been damaged within the warehouse or in transport to the customer due to the lack of standardization of processes.

Objective: to reduce the number of damaged products by at least 50%.

$$DP = \frac{Total\ number\ of\ damaged\ products}{Total\ products\ in\ stock}\ x\ 100$$

Interpretation: measures the % of products damaged due to failures within the warehouse and transport.

C. Average order picking time: allows to calculate the average time in minutes that operators take to prepare orders.

Objective: to reduce order preparation time by 40%.

$$APT = \frac{Total\ time\ spent\ picking}{Total\ number\ of\ orders\ attended}$$

Interpretation: measures the average time spent to prepare an order.

D. Returned orders: allows to calculate the percentage of orders returned by the client due to nonconformities.

Objective: to reduce returns to a minimum of 5%.

$$RO = \frac{Total\ rejected\ orders}{Total\ number\ of\ orders\ attended}$$

Interpretation: measures the percentage of rejection of orders delivered.

4. Validation

4.1. Initial Diagnosis

The current case shows a technical gap in post service between the company studied and the sector, where the aim is to reduce the percentage of returns to get closer to the sector average. Currently, the company studied has a 13% of total returns during the year 2020, whereas the sector average is 5%. To decrease this indicator and consequently increase the utility of the company, the main causes of this problem in the sector are addressed: (a) defaulting on the quantity of products in the orders, (b) observations on the quality of delivery of the products, and (c) poor delivery of orders on time. The results of the model applied in the company under the case of study will be shown below, where different indicators were evaluated for measurement and evaluation.

4.2. Validation Design and Comparison with the Initial Diagnosis

For the application of this model and its validation, a simulation will be used to compare the current situation of the company under study with the ideal situation after going through the 4 components of the model. Within the first component, the current situation is analyzed, and information is gathered through a literature review and an analysis of key performance indicators (KPI's), thus finding the main problems and causes of returns in the sector, mapping everything in a lane diagram. For component 2 a Systematic Layout Planning (SLP) is used in order to propose a viable rearrangement of the current warehouse distribution to increase both productivity and efficiency. This is achieved using a Diagram of Activity Relationship. 5S is used to improve the order of the work and the place through qualifications. Finally, for process optimization an ABC multicriteria model and a Poka-Yoke are used in component 3 to decrease the returns by at least 5%.

TABLE II. INDICATORS RESULT

Indicators	Current	Expectation
Returns (%)	13%	5%
5S auditory (%)	60%	85%
Time searching tools (min)	35	12.5
Transfer to the dispatch area (min/order)	8.6	5
Picking time (min/order)	15	10
Daily errors	22	10
Orders handled per day	32	37

4.3. Improvement-Proposal Validation

The implementation of the model has developed thanks to a simulation of the Arena program to corroborate its efficiency. Two simulations were carried out, the first with the current state of the process and the second with the process optimized after all the improvements.

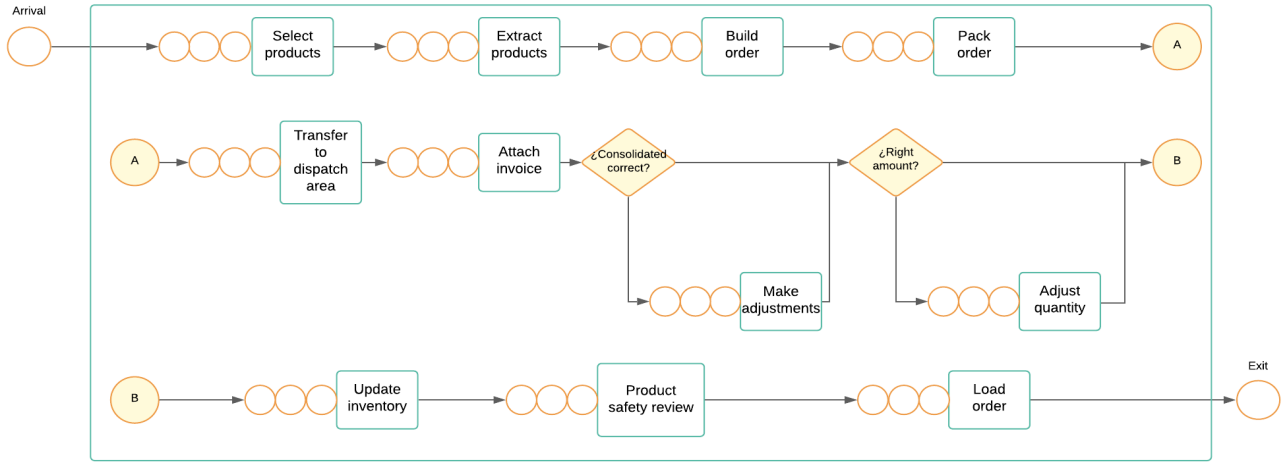

Fig. 2: Representation of the improved system

In the second simulation, the time of the processes were reduced due to the implementation of the 5S tool, reducing the time thanks to the order and cleanliness, and SLP was also used to reduce the transfer time from one workstation to another. And in continuity, the ABC multicriteria model was applied to rearrange the warehouse according to the most important products. Finally, a Poka-Yoke tool was implemented to reduce the errors and, consequently, reduce the time fixing them. The above-mentioned actions were implemented, and the result obtained is shown in Table III where a comparison of the current and actual situation is made.

TABLE II. INDICATORS RESULT

Indicators	Current	Improved
Returns (%)	13%	8%
5S auditory (%)	60%	80%
Time searching tools (min)	35	12.5
Transfer to the dispatch area (min/order)	8.6	2
Picking time (min/order)	15	7.5
Daily errors	22	4
Orders handled per day	32	40

Thanks to the data obtained, it was possible to see a 38.5% improvement in reducing the returns, which validates the implementation of the Lean model with inventory policies and demonstrates how all the indicators that its application improved.

5. Conclusions

The standardized process reduced the storage and distribution process by up to half the time, with the help of manuals and a periodic review of the tasks performed by each warehouse operator. In addition, the number of returns for defective or poor-quality products was reduced by 5%, and this translates into an increase in the level of on-time delivery.

Lean picking, a model that eliminates waste activities, reorders products, improves the process, and includes the planning and control dashboard. This document shows that the above can be applied successfully in the picking operation of a beverage warehouse. Results include a reduction in the time of search of orders, an increase in the acceptance of products and higher production in less time.

The assumption that there is resistance among them for the new implementations proposed is false. During the development of the research, it was possible to recognize the high willingness of the warehouse and transport operators to know more about the new improvement methods presented. With correct and understandable dissemination and support by the company's staff, it can be concluded that the application of the tools is beneficial within the organization.

Within the continuous improvement system, vitally important lean tools were implemented so that the development of the research can take place. These tools helped provide a detailed overview, achieving a better understanding and directly impacting productivity, safety, and delivery time.

This study could be used as a basis to have as a preliminary guide in cases of other sectors in which also work with an SME. Further investigation requires an analysis of the variables that must be considered for the application of the mentioned methodologies. Each industrial, having its peculiarities, implementing an integrated system requires an exhaustive evaluation of the models.

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