Management model based on Lean, S&OP and SLP to increase the service level in a MSE in the brewery sector

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***Abstract*— This article is developed in a warehouse of a trading company belonging to the beer industry, which plays an essential role in the supply chain, since it favors delivery times and reduces financial losses in the warehouse, which allows offering better services and increase profits. In order to have an optimal handling of the products within the warehouse, it is necessary to have a greater efficiency in the fulfillment of orders. Therefore, in this case, the implementation of the Systematic Layout Planning and Sales and Operations Planning methodology has been chosen, accompanied by Lean and 5S tools, with the aim of optimizing the level of service and maximizing storage efficiency. The results of this model show the current situation of the company, which is 84.34% of the service level and increases by 96.65%, which is due to the implementation of the 5S, S&OP, SLP and Standardized work.**

***Keywords*—Systematic Layout Planning, 5S, Sales and operations planning, service level, brewery sector**

I. INTRODUCTION

The beer marketing sector is constantly undergoing global changes over time. This sector, like other industries, has been affected by the COVID-19 pandemic, causing great economic losses for companies in this sector. In this context, companies have had to opt for e-commerce through online channels that allow them to obtain higher profits. This change has generated several challenges in the logistics chain of brewing companies. In the study of the Ministry of Transport and Communications [1], it is stated that there is a percentage of perfect orders in the brewing sector of 65.5%; while according to a study of the real time of the supply chain mentions that the standard indicator of Service Level should be 98%, considering as a metric the average of the sector [2]. These factors result in a low level of service provided to customers.

The problem identified is due to various deficiencies such as lack of qualified personnel, manual processes without the use of technology, delays in the preparation of orders due to lack of technology and automation, lack of standardization of processes, lack of training processes, lack of availability of transportation, delays in picking up and delivery of products, among others. These factors together result in poor company efficiency and customer dissatisfaction, which negatively impacts the company's profitability. Regarding other similar cases, Nguyen Thi Ha [3] in Hanoi elaborated a study of the Heineken company where an on-time delivery indicator of 91% was presented. Likewise, Igwe et al [4] presented a case of delivery time improvement of 4 beer distributors in South South, Nigeria, which presented an average on-time delivery indicator of 84%. On the other hand, Meuns [22] presented a case of a Dutch brewing company that had a percentage of complete deliveries of only 79.25%. All these events demonstrate the low level of service offered by brewing companies, so it is important to continue presenting new solutions to this problem.

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In this sense, the beer marketing sector needs to be more efficient in fulfilling its orders. Therefore, a case study has been chosen to show the limited delivery capacity due to different operational deficiencies. The causes of the problems identified are incomplete deliveries (quantity), late deliveries (time) and damaged deliveries (quality), which generate monetary losses of 5% of the operating costs of the case study. In this context, an improvement model has been developed combining the tools of the Lean methodology (5S and Work Standardization), Systematic Layout Planning (SLP) and Sales and Operations Planning (S&OP). It should be noted that, although there is research in the beverage industry that proposes improvements in the logistics chain. However, fewer studies focus on the brewing sector in Peru.

Furthermore, there are few studies with micro and small companies in the beer marketing sector regarding the implementation of engineering techniques and methodologies in the same case in the search for process improvement or optimization. For this reason, the need for this research arises. This scientific article is divided into five parts which are: Introduction, State of the Art, Contribution, Validation and Conclusions.

II. STATE OF ART

The articles indexed and selected in the state of the art were classified according to the tools used by different authors to optimize the service level of warehouses. The classifications are presented in the case studies as follows:

A. *Lean Tools*

Lean implementation depends on the application of appropriate tools and techniques, as well as top management decisions and worker interactions. According to Kumar et al [5], after implementation, the entire system and processes of the organization should be reviewed to take advantage of opportunities for continuous improvement. Regarding the work standardization tool, Dzubakova and Koptak [6], Fazinga et al. [7] seek to reduce the cycle time of the processes, since part of the work sequence was not standardized and had to be defined by the teams autonomously. On the other hand, Azucena et al. [8], Somasundaram [9] propose the use of 5S to identify the critical control and hygiene points and the appropriate measures for a correct solution were determined through this tool.

In addition, Capcha-Huamali, E. et al. [10], Coronel & Huamani [11] incorporated Lean principles to obtain an efficient warehouse design with better operational performance, thus improving their service level.

B. Sales and Operations Planning (S&OP)

Nemati et al. [12], Pereira et al. [13] stated that the importance of applying the Sales and Operations Planning (S&OP) tool lies in integrating sales, production, distribution and purchasing planning, jointly and simultaneously with the goal of improving company and customer benefits Similarly, Nemati et al. [12], Dreyer et al. [14], Dittfeld et al. [15] argued that with a demand-centric Sales and Operations Planning (S&OP) design, it is possible to manage demand risks to ensure high levels of customer service by synchronizing customer demand with supply capacity, aligned with a business strategy in a cost-effective manner.

C. Systematic Layout Planning (SLP)

The Systematic Layout Planning (SLP) tool allows efficient use of resources, organization of work areas and equipment; Montalvo et al. [16], Hu and Chuang, [17] assert that if there is a bad process and design of the warehouses, it can affect the delivery time of orders, and there is a high probability of choosing the wrong order, which affects greatly the efficiency of delivery. Zunic et al. [18], Liu et al. [19] propose to analyze the general design of the plants and their logistic relationships. In both cases it is suggested to carry out a redesign to shorten the working distance. Montalvo et al. [16], Vargas and Ulloa [20] have shown that a model can be proposed that uses several improvement tools, such as Kanban, TQM and 5S to adapt together with the SLP, in such a way that it allows showing a comprehensive solution, increasing the productivity of workers.

III. CONTRIBUTION

A. Model Basis

The value proposal provided by this research work was developed using the tools evaluated in the State of the Art for the integrated model. This approach was developed to solve the main problem of the study, which aims to increase the level of service in MSEs in the brewing sector. In this sense, Sales and Operations Planning (S&OP) is found in the literature as one of the most required planning techniques for the identified problem, as well as Systematic Layout Planning (SLP) as another of the proposals to be implemented in this study. In addition, there are the Lean tools: 5S and Standardization of work as fundamental mechanisms for the organization of work. The following comparative matrix (Table 1) shows the main causes or objectives of the problem and the most relevant items.

TABLE I
COMPARATIVE MATRIX OF OBJECTIVES VS STATE OF ART

Scientific articles	**Objectives**		
	Demand Management	**Warehouse Management and design**	**Process Improvement**
Nemati, Y., Madhoshi, M., & Ghadikolaei, A. S. [12]	Sales and Operations Planning (S&OP)		
Montalvo-Soto, J., Astorga-Bejarano, C., Salas-Castro, R., Macassi-Jauregui, I., & Cardenas-Rengifo, L. [16]		Systematic Layout Planning (SLP)	
López-Barrantes, C., & Torero-Toche, C. [20]		Systematic Layout Planning (SLP) and 5S	5S
Somasundaram, R., Sundharesalingam, P., Vidhya Priya, P., & Renuka, P. [9]		5S	5S
Džubáková, M., & Kopták, M. [6]			Standardization of wok
Proposal	Sales and Operations Planning (S&OP)	Systematic Layout Planning (SLP) and 5S	5S and Standardization of work

B. Proposed Model

The proposed model is developed based on the following tools: Sales and Operations Planning (S&OP), Systematic Layout Planning (SLP) and the Lean tools: 5S and Standardization of Work. These techniques will be applied in the implementation and control component; and will be applied in different phases, in order to satisfy the customer's needs, through a high effectiveness in the service level.

C. Model Components

The proposed model is developed through 3 components, as shown in Fig. 1.

1) Component 1: Diagnosis of Current Situation

This component analyzes and diagnoses the current situation. It also seeks to identify the existing technical gap and its main causes.

Next, the most critical process in the logistics chain was identified in order to detect the main problem. By means of a Pareto diagram, the evaluation of the possible reasons was carried out in order to know their importance or relevance.

Finally, an Issue tree was developed to synthesize the main problem, the economic impact, the evidence, the

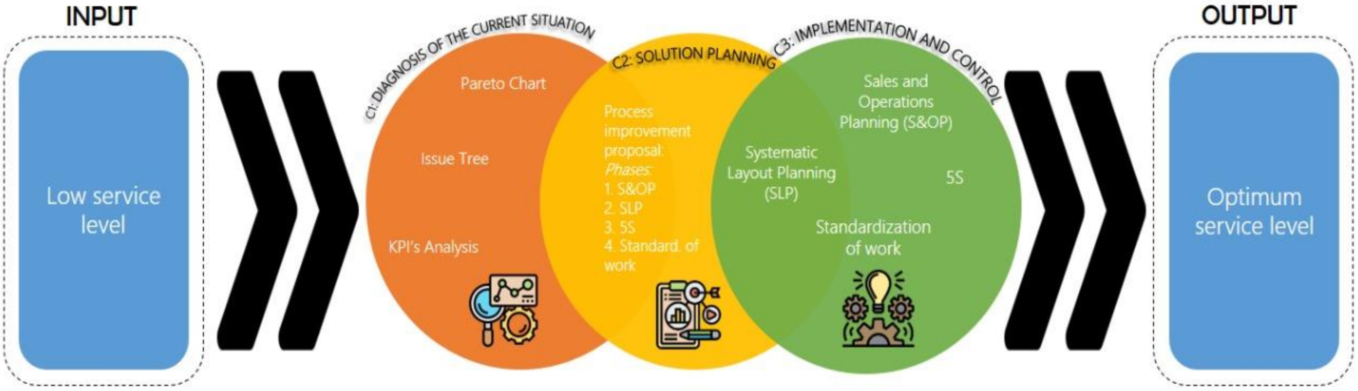

Fig. 1 Proposed model

reasons and the root causes. This tool allows a more complete analysis of the techniques and tools that can be implemented to mitigate the main problem.

2) Component 2: Solution Planning

The management model is developed to improve the level of service. This is used under an improvement proposal that will be composed of four phases, in each phase a different tool is implemented. In the first phase, the Sales and Operations Planning (S&OP) will be used to optimize the merchandise purchase planning. In this way, the aim is to reduce the suspension of sales due to insufficient products in the warehouse.

In the second phase, Systematic Layout Planning (SLP) is developed to verify the current state of the plant, as well as to identify the needs of the warehouse areas, in order to subsequently propose improvements for a new optimal distribution.

In the third phase, the 5S tool is developed to optimize the state of the work environment by having a clean, orderly and organized workplace. This mechanism is key to avoid wasting time and unnecessary movements in the warehouse, as well as motivating employees to work in the best conditions.

The last phase is composed of the Lean: Standardized Work tool, whose objective is to propose an efficient work method that reduces variability and the time required to perform tasks, obtaining better results by offering a level of quality that meets the customer's expectations.

3) Component 3: Implementation and Control

Finally, the implementation and control component is based on the application of each of the phases proposed in component 2, in order to subsequently compare the indicators evaluated at the beginning with the indicators obtained at the end of the implementation. The data obtained will be evaluated in a simulation software and the results and impacts of the tools and techniques applied will be studied.

D. Indicators of the proposed model

For this research, the following indicators will be used to evaluate progress and verify the improvements obtained.

- Service level: percentage of orders that the company can fill within a given period.

The goal is to increase the company's service level by 9%.

- Damage free orders: percentage of orders that the company has delivered without damage or breakdowns.

$$Damage\ free\ orders = \frac{N°\ orders\ without\ damage}{N°\ total\ orders}\ x\ 100$$

The goal is to increase the company's damage-free orders percentage by 10%.

- On-time deliveries: percentage of orders that the company has delivered on time.

$$On\ time\ deliveries = \frac{N°\ orders\ arrived\ on\ time}{N°\ total\ orders}\ x\ 100$$

The goal is to increase the company's on-time order percentage by 1%.

- Fulfillment accuracy rate: refers to the fact that the order arrives without shortages and in good condition to the customer.

$$Fulfillment\ accuracy\ rate = \frac{N° accurately\ filled\ orders}{N°\ total\ orders}\ x\ 100$$

The goal is to increase the company's fulfillment accuracy rate by 3%.

IV. Validation

1) Initial diagnosis

The development of the simulation plan for each of the tools proposed is carried out in a beer marketing MSE in order to test the results of the proposal in a real scenario. In the following case study, the company has reached an average service level of 84%, when the industry standard is 98%.

After carrying out an exhaustive analysis to identify the main deficiencies in the logistics chain, it was identified that the most critical process is the packing process. Based on the main problem, an analysis of reasons was carried out using a

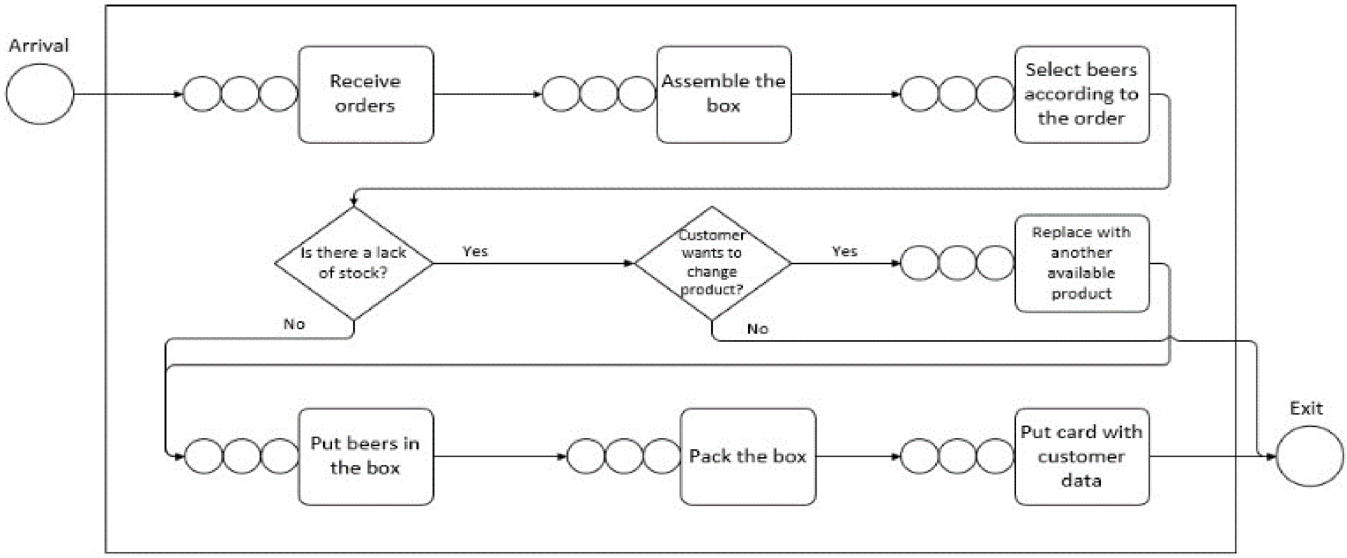

Fig. 2 Representation of the improved system

Pareto diagram, the main causes were incomplete deliveries (53.33%), damaged deliveries (40%) and late deliveries (6.67%).

2) Design of the validation 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 MSE with its ideal situation after going through the 3 components of the model presented above. 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. For component 2, a solution planning using Sales & Operation Planning (S&OP) tools is used to improve the level of beer replenishment. Likewise, the application of Systematic Layout Planning (SLP) was proposed to elaborate a feasible reorganization of the current warehouse layout by means of an Activity Relationship Diagram. On the other hand, the 5S tool is used to improve the work order and the place through qualifications. Finally, work standardization is used for process optimization. In component 3, these tools will be applied in a simulation, as shown in Fig. 2 and the results will be monitored with the proposed indicators, as shown in Table 2.

TABLE II
INDICATORS TABLE

Indicators	Current	Expectation
% Service level	84.34%	98%
% Stock shortage	22.1%	1%
Cycle time	472 sec	430 sec

3) Proposed Validation Design

The implementation of the model has been developed with a simulation of the Arena software during a period of one month. Two simulations were conducted, the first with the current state of the process and the second with the optimized process with all the proposed improvements. For that period, it was possible to increase the service level from 84.34% to 96.65%, which represents a positive increase in the sales and distribution plan.

In addition, thanks to the Sales and Operations Planning (S&OP) tool, it was possible to reduce the percentage of beer out-of-stocks from 22.1% to 1.24%. Of the three brands selected for the simulation model (Heineken, Damm and Kuntsmann), only Damm had a stockout. This could be achieved by reducing the replenishment period from 14 to 9 days and modifying the quantity of beers to be replenished for each brand.

Moreover, thanks to the 5S tools, SLP and work standardization, the cycle time has been reduced from 472 to 426 seconds. The activity that has had the greatest impact is beer selection, since the optimized model considers covering a shorter distance, and there is adequate signage to identify each brand of beer, facilitating the process.

TABLE III
CURRENT SIMULATION VS IMPROVED SITUATION

Indicators	Current	Improvement
% Service level	84.34%	96.65%
% Stock shortage	22.1%	1.24%
Cycle time	472 sec	426 sec

As shown in Table 3, The data obtained showed an improvement of 12.61% in the level of service, which, because of the application of the tools, improved the packing process.

4) Results comparison

For the development of this chapter, three scenarios are proposed in which a comparison of the current simulation of the first month is made with the following three months. For the first scenario, the results obtained in the simulation of the second month will be used; for the second scenario, the data obtained by simulating the third month will be used; and finally, the third scenario will be carried out with the data obtained by simulating the fourth month. In this way, scenarios will be obtained from the current situation to the fourth month of simulation. In table 4, a comparative analysis based on 3 scenarios is shown.

TABLE IV
SCENARIO COMPARISON

Indicators	Current	Improvement	S1	S2	S3
% Service level	84.34%	96.65%	96.64%	96.25%	95.99%
% Stock shortage	22.1%	1.24%	7.74%	14.83%	17.27%
Cycle time	472 sec	426 sec	427 sec	428 sec	428 sec

Comparing the results of the three proposed scenarios, we can see that, in the three months of simulation, after the improved situation, the indicators continue to decline. In the different months, the level of service decreases slightly, the percentage of stock breaks increases with the passing of the months, so it would be recommended to modify the number of units to be replenished in the Damm brand beer. Also, the cycle time increases between 1 and 2 seconds approximately, so it is inconsequential. It is necessary and important to monitor the indicators, to prevent them from continuing to decline and to continue improving over time.

5) Future improvement analysis

It is necessary to determine that the validation and the scenarios have certain limitations, since they were carried out with the Arena software version 16.10. This means that, depending on the characteristics and category of each company, there may be some variations in terms of results.

Likewise, it is recommended to validate the implementation of the model with different scenarios, using different brands of beers. This is because the amount of replenishment of beers is variable depending on the type of beer.

It should be clarified that, in this case study, the data from the intervened company was taken during a recovery period from the Coronavirus pandemic. Therefore, factors such as reduced demand and other problems that this situation entails can affect the input and output flows seen in the simulation.

CONCLUSIONS

In summary, with the implementation of the Sales and Operations Planning (S&OP) tool and the Systematic Layout Planning (SLP) methodology, with the help of the Lean, Standardization of Work and 5S tools, favorable results were obtained that met the pre-established expectations. It was also noted that the service level increased from 84.34% to 96.95%, significantly approaching the target of 98%. This growth means that the warehouse has significantly increased the number of orders it can successfully fulfill. This optimization meets an increase of more than 10%. On the other hand, the service level can be further improved in a warehouse with similar characteristics to the case presented, achieving approximately 99.85% service level.

Regarding the other indicators, the percentage of stock shortage was significantly optimized, reducing from 22.21% to 1.24%. This change was reflected in the implementation of the Sales and Operations Planning tool, reducing the replenishment period from 14 to 9 days, modifying the number of beers to be replenished for each brand and improving inventory turnover. On the other hand, the process cycle time was also improved with the decrease from 472 to 426 seconds with the help of the SLP, 5S and Standardization of Work tools. This time savings facilitates the processing of more orders, as well as improving productivity and process efficiency.

On the other hand, all the results obtained were due to the simulation in Arena that originated based on the entities, attributes and variables. It was concluded that all the tools could be simulated, based on the current and proposed model. In addition, it can be specified that the redistribution of the warehouse had a positive impact for the company, as well as the improvement of the replenishment and the cut of time of activities of the process. It should be noted that the order of the implementation phases is necessary and important since the success of the proposal would not be achieved without it.

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