Lean Service management model to reduce canceled orders in a fast-food company

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Abstract*– The restaurant subsector is of great importance in the country's economy, generating a contribution of 2.8% of the national GDP. However, based on the research carried out, some problems that afflict the industry were identified, being the high rates of canceled orders the main problem that affects the study company. This problem results in customer dissatisfaction, so it is vitally important to reduce the causes that generate the cancellation of the client's orders. In relation to the above, the case study presents a high rate of returns surpassing the sector by 13.46% negatively impacting the profitability of the company. Therefore, a model based on the PDCA cycle was used, implementing Lean, BPM and FEFO Inventory Management tools with the aim of reducing canceled orders in the company. The implementation of these tools was carried out in different stages, taking as baseline the following indicators: percentage of overdue supplies, distance traveled, occupancy rate and level of satisfaction. At the end of the implementation, the % of cancelled orders was reduced by 9.7% and the percentage of overdue supplies decreased to 7.71%. In this way the distances traveled were reduced to 2255.6 meters improving the gross margin of the company. The result will be used as a reference and example for future implementations to the rest of the companies in the sector.

Keywords—Canceled orders, Fast-food, FEFO, layout redesign, Operator Balance Chart, PDCA cycle

I. INTRODUCTION

Over the past three years, the restaurant-services sector maintained a growth trend, increasing at rates of 3% to 5% per year [1]. However, in 2020, the appearance of the COVID-19 pandemic had a negative impact on the industry, resulting in a sharp decline in revenues. In the case of Peru, the restaurant sub-sector decreased by 21.17% because of the restriction in capacity according to the departmental alert level. The services sector represents 80% of Peru's tertiary sector GDP, where 57.99% corresponds to the economic activity of restaurants [2]. This sector has been increasing over the years, so competitiveness has become its greatest strategic weapon, where companies seek to reduce processes and operating time to maximize profits and minimize production costs and expenses. However, customer dissatisfaction based on the service provided to them has generated different complaints to companies. Seventy-six percent of these complaints are related to poor service quality, including late deliveries, complaints about the condition of the food, complaints about operations, etc., resulting in reprocessing and cancellation of orders placed [3].

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Restaurants and especially fast-food establishments work with "rush" sales which require a quick response with respect to orders; therefore, the consumers become more sensitive to wait time and are more likely to become impatient in an on-demand context than in a traditional operations context. This, in turn, results in a higher intention to cancel, becoming the main problem plaguing most fast- food companies [4].

In the fast-food industry, consumer returns and cancellations are order changes that result mostly from poor order processing. When consumers cancel product orders, usually the product is already being prepared or has already been delivered to the customer, therefore, consumer cancellations significantly affect operations and incur significant operating costs [5].

Some multinational companies such as McDonald's, Burger King and Xibei, in China, have promoted the adaptation of different solution methodologies to the activities of their restaurants to mitigate frequent problems. In the case of McDonald's, they applied the Lean concept and inventory management to increase their productivity and improve the quality of their inputs [6], being the standardization of work, Kanban model and FEFO system the most used. In this way, the food oxidation process was reduced to a minimum and productivity increased. The second success story is Burger King, where an analysis was carried out using a value map and process flow diagrams, with the aim of identifying the changes that were generated, to eliminate them from the process. The company achieved the optimization of its flows and the elimination of interferences in its process, greatly reducing the order delivery time [7]. In the case of Xibei, a Chinese restaurant, they adopted the lean philosophy within their customer service management, with the objective of achieving the delivery of their order in the shortest time and providing their customers with an unparalleled experience [8].

The objective, of this study, is to examine the factors that influence consumer cancellation behavior in different fast-food centers. Most of the previous studies [9], [5], on consumer cancellation focused on service industries, such as airlines, hotels, and healthcare, where they designed algorithm to predict consumer cancellations. However, there is limited information in the literature regarding order cancellation in the restaurant service industry. In this study, we focus on a fast-food service platform in an on-demand context, where we will analyze the reasons for consumer cancellation, specifically, we will

examine how waiting times and low quality for different operational processes affect consumer cancellation. Due to this, this research aims to disseminate and extend the integration of Lean tools and PDCA cycle in a different scenario, thus incorporating a solid management model in the restaurant subsector, with the purpose of contributing to the growth and competitiveness of the different companies in the sector and thus improving customer satisfaction. This research presents an improvement proposal that seeks to reduce the rate of cancelled orders through the combination of the Facility Layout Design (FLD) and Line Balance tools, which will allow us to redesign the workstations and level the workload at the stations, respectively. In addition, FEFO inventory management will be applied to achieve maximum quality of all perishable inputs. Finally, through the application of Business Process Management (BPM), processes will be modeled, implemented and executed automatically in order to achieve customer satisfaction with the correct fulfillment of delivered orders [10], [11].

The present research was structured as follows: in section II, the literature review was developed. Sections III and IV propose the definition of the research contribution and develop the validation of the proposal, respectively. In section V, the discussion is detailed and finally, in section VI, the conclusions of the research article are drawn.

II. LITERATURE REVIEW

A. *Cancellation of orders in the service sector*

According to previous studies, the price and speed of service are the ideal complements for adequate operational efficiency [14]. These criteria are arranged to increase satisfaction levels according to the customer experience, which contributes to generate economic benefits in companies [11] [12]. Since it generates a loyalty and increase of consumers [15].

Likewise, other authors point out that within the fast-food industry there is a dissatisfied trend that confronts the behavior of the diner, which generates a decrease in profits and poor service [13] [16].

In agreement with the above, other authors point out that the return of orders can occur in several industries of the service sector such as airlines, health care, hotels, education, among others. Such is the case in a study conducted in an airline company, in which an optimal revenue management system was designed to reduce flight cancellations generated by customers [17]. Likewise, another similar case occurred in a hospital company, in which an algorithm was generated to predict service cancellation [22]. Similarly, in another study, customer behavior modeling was performed to verify the reasons for cancelled orders in a cab and travel company [18].

In accordance with the above, several studies address the results of customer cancellation in the service sector since research in this area focuses on consumer behavior. In the context of fast-food companies, there is limited information in reference to order cancellation. Therefore, the present research focuses on this understudied subsector.

B. *Application of Lean tools in the service sector.*

Globally, many manufacturing companies have adopted the Lean culture and now the Lean movement is spreading to service industries. Similarly, a review of the literature has shown that, although there are no standards and methodologies for its use in services, applying Lean to the sector can yield positive results, economic and financial growth, as well as improve the behavior of workers [13, 14, 19].

In terms of research, the first case of success identified consists in the reduction of changes in the process under study, including unnecessary routes and high inventory rates, which is mitigated with the construction of a present and future VSM [20]. Another case was carried out in an electrical services company, in the study it was possible to reduce employee utilization by up to 31.6% and average times by up to 3.92 days [21]. Similarly, in another case, productivity was increased by up to 30% and WIP was reduced by 70% in an IT services company [22].

Another Lean Service tool used is the Facility layout design (FLD), which helps in the distribution of workstations, machines, equipment, among others [23]. The study generated a decrease in their workflow of 0.94% and a decrease in the distances traveled of 6.58%. Another study obtained a reduction in its material flow displacement from 122,037.84 meters to 73,711 meters per month, which indicates a reduction of 40% [20].

On the other hand, other studies use the Operator Balance Chart (OBC) as another technique of the Lean approach, which consists of assigning tasks to workstations to improve the production line, mainly in manufacturing companies. Also, the tool aims to reduce the number of workstations and thus reduce cycle times, increase line efficiency, reduce costs and more [25].

C. *Application of GMP in fast-food or similar processes.*

Business Process Management is a basic tool for companies, since managers focus mainly on implementing general processes and aligning them with the organizational strategy, strategic objectives, and the creation of activities. Adding added value for customers. [26]. Therefore, this tool focuses on the analysis, design, development, and implementation of all business processes, including interaction, control, and optimization.

There are several studies that analyze the various improvements that the BPM approach can bring to companies

in terms of cost, quality, speed, and service. In one of these studies, the authors [27] reported that business process modeling allowed them to plan flows and share knowledge among all process users. In addition, this assignment allowed them to train new collaborators, as the BPM tool provided them with complete information to better understand the workflow within the company.

For their part, the authors [28] noted that BPM helped them to ensure higher productivity and better turnover in the company studied; it also allows them to eliminate invaluable tasks and identify areas for improvement through process analysis, which helps to reduce lead times and time to market by synchronizing the process. As a result, employee productivity improved by 23% and, as a result, the company's revenue increased by approximately 47%.

D. FEFO and ABC multi-criteria analysis in fast-food or similar processes

The FEFO and ABC multi-criteria analysis tools help in inventory management since the combination of both techniques allows order within inventories. In this sense, the first expiration, first out (FEFO) method is prioritized in warehouses with perishable products with short expiration dates because it is an inventory management technique that prioritizes the distribution of the products closest to their expiration date. With this system, you can avoid the situation where materials in stock have expiration dates [29].

The case study shows that performing a combination of FEFO techniques and ABC multi-criteria analysis can reduce the percentage of obsolete products from 19% to 2% and improve inventory reliability from 75% to 95%. All this had an impact on the drop in profits, which fell from 14.1% to 7% [Isidro]. Another author conducted an exploratory study based on surveys and the impact of COVID-19 in the food and beverage industry in Bangladesh. Where the main strategy is to implement the FEFO method, as this is the main strategy to decrease the risk of product shelf life. Conversely, by reducing the product shelf-life risk, this strategy can also reduce the ROI losses of the business [30].

In another study, a lack of FEFO inventory control was identified for products stored in FMCG companies, so that after implementing the tool, the rate of non-fulfillment of orders due to expiration was improved, which was reduced by up to 20% [31]. Therefore, the duration of logistics operations and environmental conditions along the supply chain must be considered in decisions along fragile supply chains [32].

III. INNOVATIVE PROPOSAL

A. Model Rationale

The proposed model is developed based on continuous improvement through the PDCA cycle and the implementation of the tools used in the Lean Service methodology, such as FLD and OBC, FEFO System and the BPM tool. The purpose of the model is to achieve a redesign of the work areas, level the workloads and generate improvements in the production process, hoping to improve delivery times and increase the quality of orders. This model is based on the format proposed by the authors [33], [34], which were adapted to the requirements of the company, whose objective is to reduce the cancellation of the company's orders, reducing bottlenecks in cycle times and, therefore, increasing production capacity.

Based on the literature reviewed, it has been possible to identify the different benefits of the application of the tools under study in the restaurant subsector. In the case of the Lean methodology, it allows eliminating waste, improving the experience of customers and employees. Several authors [27]-[29] agree that the Lean method gives positive results because it is systematic, both in the investigation of the problem and in the solution.

In addition, the authors [21], [30] emphasize the importance of studying methods to apply simpler and more efficient methods in the process of food companies, to reduce the time required to perform different jobs, as well as to conserve the most adequate resources to produce products.

In the case of the FEFO system, the authors [31], [32] agree that it is an inventory management technique that makes the storage of inputs flow, demanding their maximum quality. The benefit of this type of system is the increase in the margin that allows the products to move more, generating an increase in the number of orders in the company.

On the other hand, the BPM tool aims to design, implement, analyze and continuously improve the processes of a goal-oriented organization. [26]. Because of this, our model seeks to apply this tool as the last phase with the objective of having a continuous control and analysis based on data, allowing us a comparison of the target processes with the real ones, and with this establish average values and possible deviations.

Table 1 shows the comparative matrix of the studies that contribute to the research.

TABLE I
COMPARATIVE MATRIX OF SELED LITERATURE

Reference	Tools	Results
[23, 25]	Operator Balance Chart (OBC), Standardization of process, DMAIC	Reduced cycle time for new orders to 15 minutes/order.
[23]	Facility Layout Design (FLD), Systematic Layout Planning (SLP), Spaghetti Diagram	43% reduction in distances covered.
[29, 30, 31]	FEFO, 5S, Diseño Warehouse	50% reduction in transportation and inventory handling activities.
[26, 27]	BPM, Standardization of work, Methods study	57% reduction in delivery time.

B. Proposed model

It is important to mention that there are several case studies on the application of Lean methodology in the fast-food industry, as is the case of authors [14], [35], [36] among others. However, studies on the PDCA cycle in this sector are not very frequent; on the contrary, it is more used in similar sectors or other industries. This is the case of the author [37], who presented a study on the application of the PDCA cycle to analyze and solve problems of excess sauce losses in a process that produces frozen foods in a food industry in southern Brazil. Another case is the study of the author [38] where the value of the PDCA cycle to standardize nursing management in an intensive care unit (ICU) for patients with severe coronavirus 2019 (COVID-19) disease was evaluated.

On the other hand, there are studies that have attempted to merge the Lean Six Sigma and PDCA tools with the purpose of improving the apparel processes in a textile industry, this is the case of the author [39]. One of the conclusions of this study is that Lean tools are perfectly applicable with the PDCA cycle since it allows industries to continuously improve and control each step of the Deming cycle. Also, this study demonstrates that their fusion is possible since they share the same objective, which is to ensure the quality of products to generate value to customers with continuous improvement.

Despite this, there are few articles that present the feasibility of merging the Lean and PDCA cycle systems into one, specifically in the fast-food industry. In this research, it is suggested that future studies determine practical applications that support the idea that Lean and the PDCA cycle can coexist. Because of this, the present study can provide tools for further research on the topic, having as its main purpose to explore the relationship between Lean tools and the PDCA cycle, and to characterize such relationships in the fast-food industry. The objective is to seek cooperation between these two systems and not to duplicate efforts on the way to improve quality and efficiency while ensuring customer satisfaction.

For this study, a diagnosis was carried out in a Peruvian fast food chain company, whose main problem was the high rate of cancelled orders. As a result, it was possible to identify the root causes of this problem, which correspond to: Unnecessary travel (25%), poor distribution of workload (21%), inefficient method in the packaging process (11%) and high rate of expired supplies (17%).

Considering the diagnosis indicated in the previous paragraph, the Lean-PDCA model has been developed (see Figure 1) to reduce the high rates of cancelled orders and their impact on the company.

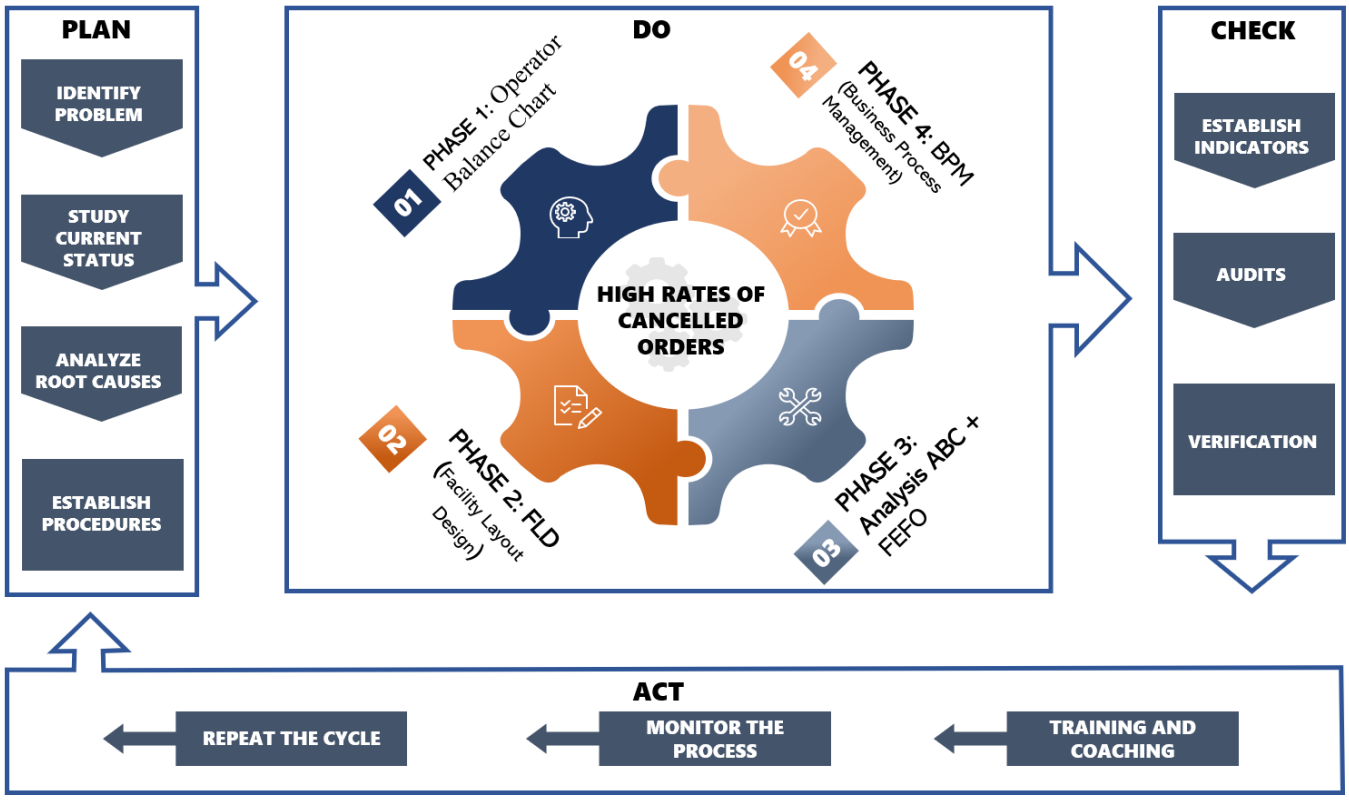

Figure 1. Proposed Model adapted from [14], [22], [35], [36], [37], [38], [39]

The contribution of this proposed model is to implement and validate the Lean-PDCA methodology in a new scenario, whose information of the tools that contain them is limited and little studied in the literature of the fast-food subsector, and in this way set a precedent that will be used as a case study to help reduce the rates of cancelled orders in the production chain of the different fast-food companies, through improvement opportunities.

Therefore, it is essential to highlight the new project model, which integrates the FLD, Line Balance, FEFO and BPM tools in a PDCA continuous improvement cycle that allows contributing with scientific evidence in the sector, and thus optimizing, dynamizing and regulating the production cycle of fast-food companies, reducing the number of cancelled orders, and achieving an increase in the profitability of the companies. Likewise, the proposed model aims to disseminate and validate the application of the Lean-BPM methodology in a PDCA improvement cycle in one of the most influential industries of the service sector such as fast-food restaurants, which contains little literature of case studies with quantitative results in the sector.

The main basis of the model is the PDCA methodology, which has a cyclical nature, ensuring continuous attention to quality improvement. The purpose of this model is to execute the Lean tools, FEFO system and BPM in the second stage (DO), where a full-scale execution is carried out. The Plan, Verify and Act stages complement all the phases necessary for the perfect cyclical operation of this model. Likewise, the model considers as one of the important aspects to provide new ways to facilitate communication between areas, such as the improvement of their strategies and the time spent in each of their processes.

The first component of the model is Plan, in which the improvement activities are identified, in which the problem to be studied is chosen, then a previous analysis of the current situation of the company is carried out. Subsequently, an in-depth analysis is carried out using tools such as cursographs, Time Taking, among others. Accordingly, the root causes are established, and procedures are established in accordance with the previous literature research that is carried out.

The second component of the model is Do, where the phases that will help improve or mitigate the root causes found in the main problem are developed. Each of the phases of this component is made up of tools, which were distributed based on the order of application:

- Phase 1: Line balancing
- Phase 2: FLD
- Phase 3: ABC and FEFO analysis
- Phase 4: BPM

In this component, the tools selected are designed to mitigate the root causes identified, which directly affect the problem of order cancellations.

The third component of the model is Check, where a test period is performed to validate its correct functioning. If the improvement does not meet the initial expectations, it will be necessary to modify it to align it with the planned objectives. The fourth and final component of the model is Act, which begins at the end of the test period. The results must be studied and compared with the performance of the activities before improvements can be made.

Finally, the objective of the application of the model, which includes the tools in a PDCA cycle, is to make cyclical improvements with the initiation of each of the components of the model.

C. Design of the proposed model

Figure 2 shows the detail of the model proposed in the research work. in the research work:

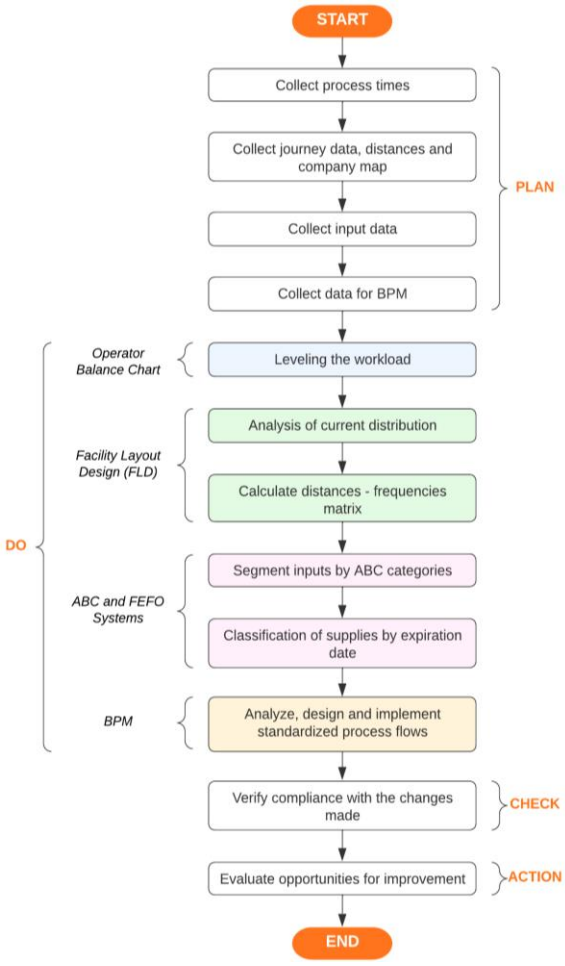

Figure 2. Phases of the proposal

The figure above shows the detail of the steps and/or activities to be followed sequentially for the implementation of the proposed model, starting with the first component Plan where those points of improvement are identified.

Then follows the Do component, which contains the development of the tools (Line Balance, FLD, FEFO, BPM) specific for each identified cause, FEFO, BPM) specific for each identified cause, then the Verify component is executed, where the compliance and results are analyzed after the implementation and finally the last component Act is developed, where the generated changes are established, which will be established in the company.

Being a PDCA cycle, the stages of each component are repeated in certain periods, providing a constant improvement in the company.

D. Indicators

In the last step, the evaluation is performed based on the indicators that were established in the planning. In the case study, the evaluation of the indicators is carried out at the beginning of the research, where the results are obtained before the implementation and at the end of the validation, where we will obtain the results of the current situation of the proposal. The indicators to be considered are 5, which are defined in the table II.

TABLE II
INDICATORS PROPOSED

INDICATOR	DESCRIPTION
Percentage of cancelled orders (PD)	Refers to the percentage of cancelled orders, which includes total cancelled orders over total daily sales. In addition, several studies analyzed propose that a reduction of up to 5.24% can be generated [14] [15] [17].
Percentage of distance traveled (D)	This refers to the distance traveled when making a dish. Several studies analyzed propose that a reduction of up to 29.91% can be generated [23].
Occupancy rate (TO)	It refers to the occupancy of the effective hours of the operators in reference to the work areas. Several studies analyzed indicate that an occupancy rate of less than 15% should be achieved [24] [25].
Percentage of expired supplies (IV)	These are the expired products that remain in the warehouse and are thrown away. Several studies analyzed indicate that the percentage of expired inputs should be less than 8.87% [29][31].
Satisfaction level Net Promoter Score (NPS)	In reference to compliance with customer standards. Several studies analyzed establish that the level of satisfaction should be higher than 80% [26][27].

Where, the formula for the indicators is as follows PD in (1), D in (2), TO in (3), IV in (4) and NPS in (5).

$$PD = \frac{Pedidos\ devueltos}{Total\ de\ pedidos\ vendidos} \times 100\% \quad (1)$$

$$D = \frac{Distancia\ recorrida\ nuevo\ distribución}{Distancia\ recorrida\ en\ el\ caso\ en\ estudio} \times 100\% \quad (2)$$

$$TO = \frac{Tiempo\ de\ ciclo\ del\ proceso}{Tack\ Time} \times 100\% \quad (3)$$

$$IV = \frac{Kg\ de\ insumos\ vencidos}{Kg\ de\ insumos\ comprados} \times 100\% \quad (4)$$

$$NPS = \%Promotores - \%Detractores \quad (5)$$

IV. VALIDATION

Based on the implementation, this segment refers to the validation of the proposed model, which is divided into four sections: (1) description of the scenario, (2) initial diagnosis and (3) application of the model in the case study and (4) results.

4.1. Description of the scenario

To validate the model proposed in the research, a pilot plan and the use of the simulation method were chosen. The pilot plan method was carried out with the implementation of one of the components using a combination of the ABC multi-criteria analysis and the FEFO method, which mitigates the high rates of expired inputs.

As a second method, the Arena simulator was used to reduce unnecessary runs, reduce unproductive times, and level the workload in the conditioning station.

4.2. Initial diagnosis

The company under study has a percentage of cancelled orders of 18.7% in contrast to the sector, which is 5.24%. Likewise, the economic impact was calculated with the sum of *food cost + hh cost + opportunity cost*, representing a 24.7% loss of the total turnover in the period from July 2019 to August 2021.

Consequently, the company currently has a distance traveled of 3021.2 meters between workstations, an occupancy rate % of 46.8%, an expired supplies % of 14.26% and a satisfaction level of 42.6%.

4.3. Application of the Model in the Case Study

This section explains the details of the simulation model to verify and validate the results generated in the literature review.

First, the application of the pilot plan carried out in the company is described.

4.3.1. Pilot plan: FEFO and ABC analysis

This pilot plan consisted of keeping a control based on the expiration date of each of the most important inputs in the preparation process, previously identified with an ABC analysis.

This process began with the development of a macro design that allows the operator to generate a record of the inputs

and outputs of each input, in addition to which various user-level manuals were created, which were delivered and explained in the various training sessions for the personnel in charge. Finally, the pilot plan was executed, where the display cards were printed and completed with the information of each input previously recorded in the macro. The stickers were then affixed to the packaging of the inputs and stored in the respective order.

Table 3 shows what was implemented in the FEFO pilot for the storage of the company's inputs:

TABLE III
SUMMARY OF PILOT PLAN ACTIVITIES

1. Preparation of registration/macro document

ABC CLASSIFICATION	ESTIMATED COST SHARE %	QUANTITY OF PRODUCTS
A	80,0%	8
B	95,0%	7
C	100,0%	8

Selection of most important inputs (Group A)

2. Preparation of registration/macro document

OTTO GRILL — DATE TODAY: 15/4/2022 — FEFO INVENTORY MANAGEMENT

CODE	Article	Supplier	Purchase date	Expiration date	State	Price	Assigned card
10000123	Lettuce	"Verduras Manuel"	1/4/2022	3/4/2022	Conform	S/ 1,20	
10000145	Tomato	"Verduras Manuel"	1/4/2022	3/4/2022	Conform	S/ 3,00	
10000216	Steak	Avinka	3/4/2022	4/4/2022	Conform	S/ 4,80	
10000987	Carrot	"Verduras Manuel"	1/4/2022	4/4/2022	Conform	S/ 2,00	
10000321	Beet	"Verduras Manuel"	1/4/2022	5/4/2022	Conform	S/ 4,00	
10000433	Rice	Alicorp	5/4/2022	5/4/2023	Conform	S/ 168,0	
10000987	Potato	Alicorp	5/4/2022	6/4/2022	Conform	S/ 3,50	
10000111	Chuleta criolla x 120 gr	Supensa	2/4/2022	3/4/2022	Conform	S/ 2,20	
10000134	Flank steak	Supensa	3/4/2022	4/4/2022	Conform	S/ 4,50	
10000103	Quadril	Supensa	3/4/2022	4/4/2022	Conform	S/ 8,25	
10000180	Leg fillet (Chicken)	Avinka	3/4/2022	5/4/2022	Conform	S/ 1,60	
10000122	Hot-dog	Supensa	2/4/2022	2/5/2022	Conform	S/ 6,00	
10000133	Egg	Supensa	2/4/2022	16/4/2022	Conform	S/ 80,00	

FEFO Inventory Registration System

Labeling and storage of supplies

Use of traffic light cards based on expiration date

Secondly, with the help of ARENA software, the implementation of the remaining tools was simulated: FLD, Line Balance and Business Process Management.

4.3.2. Simulation of tools

The simulation method is described, in which the design of the current system of the processes involved in the elaboration of orders was generated daily. These were carried out in cash register, preparation, conditioning, and dispatch. The process starts with the arrival of customers and then the order is placed at the cash register, where the first-time measurement is made; this time corresponds to the time it takes the cashier to take the customer's order, i.e., the total time from the time the customer arrives at the cash register and is served until the order ticket is delivered.

After that, the order preparation process begins, where the employees oversee cooking the inputs required to assemble the order, here the second time measurement is generated, which corresponds to the preparation time, where the sum of the preparation of the complements (rice, salad, etc.) with the sum of the time it takes to fry the meats on the grill and the requested complements is considered. This process is currently the bottleneck of the entire service flow.

Once the inputs are cooked, we proceed to the preparation of the dish, where we consider the time, it takes the employee to assemble the dish, that is, the incorporation of each previously cooked input to the dish ready for delivery to the customer. After that, a conditional validation is performed to check if the dish contains any type of complement, in case it does, the order goes to the complements section to be incorporated. If it is not required to incorporate any complement, the order is sent directly to the exit of the process; that is to say, to the final delivery to the client.

After the description of the current system, the improved simulation model is made, by which, firstly, the number of resources in the conditioning process is balanced, whose station has an overload of work, with this it is validated, and results are obtained based on the line Balance tool. Secondly, the canner, washer and salad topping stations were redistributed to reduce the distance between them, using the FLD tool as the basis for this improvement. Finally, the stations involved in the conditioning process were arranged to improve the work method through the application of the BPM tool.

4.4. Results

The following table shows the results of the model indicators, which were obtained after the implementation of the pilot and the simulation of the tools. The table shows the comparison of the current situation with the results of the implementation of the model, whose values were favorable within the ranges obtained in the literature. Table IV shows the details of the results obtained:

TABLA IV
COMPARATIVE INDICATORS - BEFORE AND AFTER

Indicator	Before	After	Results (Improvement)
Percentage of expired supplies	14.26	**7.71**	115.0%
Distance traveled	3021.2	**2255,6**	106.5%
Occupancy rate	46.08	**16.8**	89.3%
Net Promoter Score (NPS)	42.6	**75.6**	94.5%

After the application of the proposed model, an improvement of 72% was obtained in the percentage of cancelled orders of the orders in the company under study, since the aim is to have a lower percentage range of 5.24% of cancelled orders. In this way, the final index would go from 18.7% to 5.24% in the cancellation of orders, achieving the margin that the sector defines as the maximum in the fast-food industry.

V. DISCUSSION

5.1. New potential scenarios

Based on the simulation, it was possible to validate the effectiveness of the proposed improvement proposal to reduce the rates of cancelled orders, the delay in the delivery of orders and the increase in the quality of inputs.

As a result, it can be concluded that the results of the results of the research were satisfactory. satisfactory. However, to demonstrate the reliability and however, to demonstrate the reliability and accuracy of these results, the implementation of this optimization in other scenarios will be analyzed. of this optimization in other scenarios will be analyzed. For this analysis scenarios with similar processes and product characteristics and characteristics of similar products will be considered: confectionery and drugs.

5.1.1. Confectionery

This sector has expiration dates like those of the inputs in the case study (vegetables, meats) since this line manufactures its products with perishable inputs that have a short shelf life and has a high percentage of expired inputs of 13.78% in 2021. It is also important to mention that the indicators of order cancellations and percentage of expired supplies are key for this sector. key for this sector.

5.1.2. Medicines

This sector has longer expiration dates than those of the case study, since this sector defines expiration dates longer than 1 year, which generates a greater gap to be able to control the type of storage of each product. Likewise, it has a high percentage of expired products, 21.9%, since it does not implement inventory systems that help to improve the ordering of incoming and outgoing products. In this case, the expired products indicator is the key for analysis and improvement.

5.2. Analysis of results

5.2.1. Economic Analysis

The feasibility of the project was evaluated by analyzing profitability indicators such as NPV and IRR. With respect to the research, it should be noted that it is aimed at generating an improvement in the packaging and supply process with the objective of reducing the number of returned orders.

TABLA V
FINANCIAL PROFITABILITY INDICATORS

INDICATORS	
COK_{anual}	10.32%
VAN	S/. 243,089
TIR	263%
B/C	2.23
PRI	0.41 trimesters

5.2.2. Environmental Analysis

Currently, one of the main objectives of companies is to reduce the negative impacts caused to the environment when carrying out activities in the industrial or service sector. Therefore, in this project it is important to generate an evaluation in which the activities that generate contamination in the water, air or soil of the planet can be defined.

Based on the above and the proposed improvement of the project, which involves a redistribution of its work areas and the processes that are executed in the main area of the company. The proposed modifications generate environmental impacts; therefore, an environmental evaluation was carried out using the Leopold matrix.

The results of the matrix were favorable, since -23 points were obtained based on the total. This result implies the sum of the 4 processes involved after the implementation of the proposed model.

5.2.3. Social Analysis

Some of the social impacts that impact the project will be detailed below using the London Benchmarking Group (LBG) methodology, which is a model that helps in the evaluation of new projects. This methodology helps to define how, why, what and where the contributions will be generated. It also defines the post-implementation achievements and impacts. implementation and impacts.

Figure 3. London Benchmarking Group Methodology

5.2.4. Future work

Once the present research is finished, it is proposed to expand the limits of each knowledge acquired in the stages of the project and to continue generating contributions to the different industries that seek to reduce the rate of cancellation of their orders or services, providing their customers with a fast and improved quality of service. improvement in the quality of their service.

- To investigate and expand the knowledge of the tools in other areas different from the restaurant subsector. That is, study, validate and promote the implementation of the Lean-BPM model in other industries.

- Investigate the compatibility and integration of the Lean-PDCA methodology with other engineering tools, such as 3D simulation programs, that can be applied to redesign production plants.

- Investigate, propose, and validate the possible implementation of Lean-PDCA to solve other significant problems in the service sector with respect to of the service sector with respect to process improvement.

VI. CONCLUSIONS

Currently, the restaurant subsector represents 57.99% of Peru's GDP, which is an important percentage of the country's economy; however, there are limited studies that contribute to the literature based on tools that help improve the profitability of restaurants. tools that help improve the profitability of companies in this sector. companies in this sector.

The sectorial analysis of the company under study was generated, as well as the contrast of the problem of high rates of cancelled orders in the sector vs. the company. Likewise, the basis of the tools selected under the Lean model was defined: Line Balance, FLD, FEFO and the BPM tool.

The reasons and root causes that originate the cancellation of orders in the company were identified. Likewise, a gap of 13.26% and an economic impact of S/361,303 was identified, which represents 24.7% of the total turnover loss. The first reason corresponded to the delay in the delivery of orders (57%), the root causes of which were: unnecessary trips (25%), poor distribution of workload (21%) and inefficient work methods in the packaging process (11%). The second reason the second reason corresponds to low quality (17%). The second reason corresponds to low quality (17%), where the main root cause was identified as the high rate of expired inputs.

We were able to generate a model design that aims to reduce the inefficient processes in the different areas of the company. inefficient processes in the different areas that require a methodology to optimize a methodology for the optimization, streamlining and regularization of the regularization of the company's production cycle. For this reason, it was decided to build a model that consists of 4 components, which follows the Deming cycle of which follows the Deming cycle of continuous improvement. Within the main component, four phases were identified, corresponding to the tools to be that correspond to the tools to be used.

The implementation of the pilot plan based on the FEFO inventory management system tool and the simulation of the implementation of the F.L.D, Line Balance and Business Process Management tools were carried out. As because of this, a reduction in the rate of cancelled orders was as it was reduced from 18.7% to 9.7%, a reduction of 51.9%. reduction of 51.9%.

The key indicators for reducing order cancellations were the percentage of overdue supplies and the level of satisfaction. In the first of these, after the implementation of the FEFO pilot program, a reduction of 115% was achieved to the current percentage value. Customer satisfaction was also increased to 75.6%, higher than the minimum required by the company (>70%).

The analysis of the other impacts determined that the project has a positive impact on the environment, contributes to society with an increase in the skills of the personnel and allows them to be at the forefront of technological innovation.

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