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Distribution Management in a Peruvian Wholesale SME by minimizing Product Returns: A Case Study

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Abstract - Small and medium-sized companies seek to improve and innovate in all their different processes, since there is more competition, and they all seek to be leaders in the sector in which they operate. However, a problem that involves the entire distribution chain, as well as the profitability of the business, is the return of merchandise. The main objective of this research study was to propose an improvement proposal in distribution management to enhance the number of returns in a wholesale company for the traditional channel using the SMED, Lean Six Sigma and Demand Forecasting. The secondary objectives of this implementation were to analyse and understand the root causes of this problem to address it in the best possible way using diagnostic tools such as the Pareto Diagram and Value Stream Mapping. Likewise, to quantify and measure the impact of this indicator within the company through indicators and statements of economic results. These results were only possible thanks to the implementation of the tools in the company's operations through simulations using Arena and Streamline software, giving us a reduction of 2.47% of distribution time on transport routes, as well as 19% of improvement in sales revenues thanks to the decrease of product returns. Thus, to conclude in a macro study of the economic impact of the project through sensitivity analysis using the MS Excel Risk tool, which detailed a 78.2% success rate to the investment.

Keywords- SMED, Lean Six Sigma, Forecasting, Product Return, Distribution

I. INTRODUCTION

Wholesale distribution is established with channel flows linking buyers and sellers on a global scale because its activities and logistics have made it possible for transactions to take place across international borders [1]. Thus, the sector has a growth rate of 6.42% in the last five years worldwide. In 2021 alone, it generated a total of 67 million dollars. Such is its importance, that its internal problems affect the operation within the entire supply chain, highlighting its relationship with the other agents in the chain and the rate of returns they handle on the products shipped [2]. In reference to traditional channel, specialized Latin American retail markets have a greater preference for these and resist the entry of modern retailing channels. The causes can be summarized in the perception that consumers have of modern channels, describing them as "storage" areas, shopping habits, and the social condition of the population, which limits their economic resources, among others [3]. This is not alien to the peruvian market, since 73.8% of consumer products distribution market is concentrated in the traditional channel.

The object of study is a peruvian distribution company responsible for marketing and distribution of staple products to traditional sector, mostly grocery stores and bakeries. The company has 19,000 sales points distributed in the northern Lima area. The company's distribution is divided among 45 salespeople who receive a total of approximately 30 orders each. Each salesperson registers his or her orders in the computer system until the end of the sales schedule. Subsequently, the scheduling area maps the orders registered by salesmen to assign the distribution zones to each carrier, in addition to other necessary documents and invoicing. These orders are received by the warehouse area who, after checking the condition of the goods, then sends them to the transport teams.

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II. STATE OF THE ART

Product returns is a problem that affects directly affect distributors, generating economic losses, fluctuations in inventories and difficulties in coordinating flows [4]. Proper management of information among the members of the chain is key to avoid unnecessary returns [5]. Difficulty in estimating demand affects key performance indicators, such as the rate of returns [6]. Strategies such as having multiple sales channels and direct attention to customers and retailers by distributors have been shown to reduce these rates [7]. Wholesale-retail pricing is influenced by retail chain decisions, generating value differences [8]. Returns are related to storage costs and profitability, with policies addressing omnichannel returns management and customer service being necessary [9].

1. Lean Six Sigma

Such a methodology that combines the principles of Lean Manufacturing and Six Sigma to improve the performance of processes. Based on five phases: 1. Define: define the problem or opportunity for improvement. 2. Measure: measure the current state of the process. 3. Analyze: analyze the root causes of the problem. 4. Improve: implement the necessary improvements. 5. Control: monitor the results of the improvements [10]. Distribution companies can utilize Lean

Six Sigma to streamline order preparation processes, leading to significant reductions in preparation times. This can be achieved by identifying and eliminating non-value-adding activities that contribute to inefficiencies. Additionally, standardizing processes and implementing quality control measures can enhance order delivery accuracy, ensuring that shipments reach their intended destinations promptly and correctly [11].

2. SMED

Single Minute Exchange of Die method is a time-saving technique that reduces changeover times by optimizing internal and external activities. It is currently being used in distribution and logistics [12]. The application of SMED in distribution is very effective for reducing preparation and delivery times. For example, in a distribution company, SMED can be used to reduce the changeover time between loading different products onto a truck. This would allow the company to load more products in the same amount of time, which could improve efficiency and productivity [13].

3. Forecasting

Demand forecasting is a tool that estimates the future sales of a product. It is essential for production planning, distribution, and marketing. There are various methods used for, including qualitative techniques such as market research, expert opinions, and quantitative approaches like time series analysis, regression analysis, and econometric modeling [14]. In distribution, it helps to determine the quantity of products to transport to each point of sale to meet demand. Accurate demand forecasting is crucial for optimizing inventory levels, managing logistics, and ensuring efficient supply chain operations [15].

TABLE I
COMPARATIVE MATRIX OF COMPONENTS VS STATE OF THE ART

Scientific Articles	Causes or Objectives		
	Increase and adequate Safety Stock	**Reduce bad order taking**	**Reducing time to point of sale**
Elisa, K., & Anggita, P (2020)		5S	SMED
Gupta, A., & Singh, R. (2020)		Lean Six Sigma	
Boulaksil, Y., Fransoo, J., & Blanco, E. (2022)	Demand forecasting		
Patel, K., & Shah, A. (2021)		Lean Six Sigma	SMED
Dominguez, R., Cannella, S., & Framinan, J (2019)	Demand forecasting	Lean Manufacturing	
Proposal	**Demand forecasting**	**Lean Six Sigma**	**SMED**

III. CONTRIBUTION

A model has been designed to decrease the rejection rate in a company, something that uses tools such as Lean Six Sigma, SMED and Demand Forecasting to address the fundamental reasons identified in the problem analysis. Its goal is to improve the efficiency and profitability of the company. This model is divided into three stages with their respective inputs and outputs, as shown in the figure below. The stages are derived from an analysis of the MSE's current situation and the search for a solution to the problem.

The company's current situation is that the percentage of returns has a significant presence in the inventory stock once the daily distribution day is over. The company studied calculates this indicator as follows: It collects all the number of vouchers issued when salespeople receive a sale. This voucher represents the total order of a single point of sale, i.e., this voucher contains all the products which the store or warehouse requested as supplies to be shipped. This resulted in a percentage of returned vouchers out of the total invoiced of 6.4% on average during 2022.

These returns are a problem because of two things: first, such undelivered merchandise returns to the initial point of distribution without having generated any profitability, plus it means higher storage costs. Second, the existence of a technical gap with the wholesale sector in which the company participates, since the competition in terms of merchandise distributors in traditional points of sale has a lower return than that of the distributor studied. In the study conducted by Onofre & Márquez [16], research was conducted on the marketing of wholesale distribution to the traditional channel of a staple product. One of the data collected from the study is that the average rejection rate in distribution is approximately 3.90%. This value is sufficient to establish a target limit on which to prioritize the solution of this problem.

A. Model Components

Phase 0: Diagnosis

In the first stage, the model evaluates the company's current indicators to identify the problem. It uses tools such as VSM, Pareto Diagram, Ishikawa, 5 Whys and problem tree to analyse the root causes of the problem. For example, and after doing a hierarchization of the main causes of rejections in our object of study by means of the Pareto diagram, it was possible to identify the three main reasons for the problem: 32.89% covers the management of order taking, 28.76% the time on the transport route and 16.94% caused by the condition of the goods at the time they arrive in the truck to the customers at the time of distribution.

Indicators are developed for the variations until the proposed objective is reached. In the second stage, tools to mitigate the causes are identified and implemented in four specific phases. As results, the problem is minimized, and the indicators proposed in the input are evaluated to verify the effectiveness of the tools. In addition, an analysis of the tools to

be used in the solution was carried out, compiling bibliographic sources that highlight the use of Lean tools.

Phase 1: Management in order taking

Once the problem of returns in the vouchers has been identified, a second collection of information is estimated, this time by discriminating the rejected vouchers by reasons for rejection. These reasons are collected according to what is registered in the system, so they are feasibility collections according to the digitations of the sales forces. With the data obtained for 2022, it was decided to create a statistical control chart of the total number of returned receipts according to the reasons related to the order management. Thus, as a first approach to sellers, it was decided to make a model on the main objectives of scheduled training, being this the tool by which sellers will have access to information on the groups of items and their types of packages at the time of typing, as well as the dynamics to choose to communicate with the sales force.

The improvement opportunity for the order management of the salespeople is the constant feedback on the use of the application, but above all on the information necessary for the typing of certain groups of items. Thus, as a first approach to sellers, it was decided to make a model on the main objectives of scheduled training, being this the tool by which sellers will have access to information on the groups of items and their types of packages at the time of typing, as well as the dynamics to choose to communicate with the sellers, It is intended to be a tool for continuous use according to the results of rejections that are obtained in the future.

Phase 2: Distribution process time

For the implementation of the SMED methodology, the activities that are performed in the company's process must be specified: from the collection of orders by salespeople to the dispatch of products to the points of sale by carriers. To classify the activities, it was determined that the internal activities are all those that are fundamental and necessary to add value and continue with an adequate synergy in the value process. On the other hand, external activities were identified as activities that do not add value directly to the company's main process and can be performed in a secondary manner. For example, the activity of transporting products to the loading area is identified as an external activity, since different operators perform this activity. Also, it can be performed while other activities are being executed.

A statistical graph was made with the times taken with respect to the activities. With this, it was obtained that 48% of the time used within the value process are internal activities. Apart from that, 52% of the time is spent on external activities. Three activities and its possible solutions have been identified as:

1. Opportunity for improvement by zoning the digitized orders, the proposal involves a dynamic distribution, allowing to manually adjust the zones of the operating system. This speeds up delivery times by modifying the carriers' routes. It is suggested to integrate an operator to program these zones according to the updated information from the transport manager.
2. Sending requirements to warehouse, highlighting the opportunity to improve through forecasts that allow sending requirements in advance, organizing a previous list for a more efficient preparation.
3. Loading of products onto trucks, identifying the opportunity to improve the pre-organization of the items to be loaded. This measure will reduce search time and minimize loading errors.

Phase 3: Distribution process time

Since the product catalog is large, we chose to collect the 50 products with the highest turnover and value in the warehouse, since they will have the greatest impact on demand forecasting. It should be clarified that the company's data were only obtained in terms of the number of dollars sold per receipt and not by inventory.

Once the commercial history was obtained, the best statistical model to implement is chosen. Moving Average, Simple Exponential Smoothing, Double Exponential Smoothing (Holt Model), Triple Exponential Smoothing (Holt-Winters Model), Triple Exponential Smoothing (Holt-Winters Model) with 2020 – 2021-year clearance, due to pandemic shock as a unique event, are the studied models. According to the indicators, the last model is the most effective one since it yields a lower MAPE error percentage than the others, as well as a higher correlation coefficient.

When Holt-Winters Model method is selected, it is applied to forecast future demand, adjusting parameters, and iterating to improve accuracy. The accuracy of the forecast is evaluated using metrics such as average absolute error or mean absolute percentage error, compared to actual data.

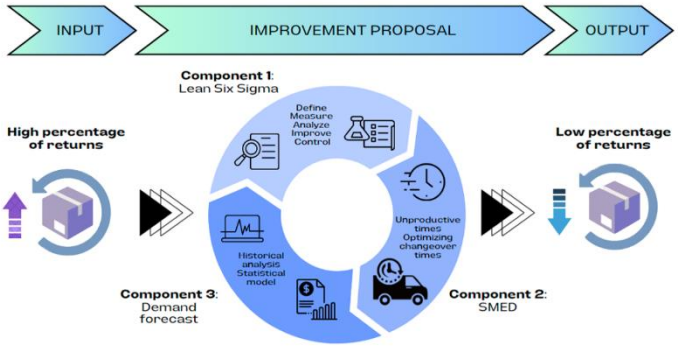

Fig. 1: Proposed Improvement Model

B. Model indicators

A. Return ratio: measure of the ratio of returned orders to the total number of orders issued in a period. It is indicated in percent units.

$$Return\ ratio = \frac{Total\ number\ of\ returned\ orders}{Total\ number\ of\ orders}$$

B. Mape: is an indicator of Demand Forecasting performance that measures the size of the (absolute) error in percentage terms.

$$MAPE = \frac{1}{n} \times \sum \left| \frac{actual\ value - forecast\ value}{actual\ value} \right|$$

n= number of iterations

C. Holt-Winters Exponential Smoothing: This indicator is a seasonal method that comprises the forecast equation in order to make possibles future results.

$$F_{(i+k)} = (L_i + k + B_i) \times S_{(i+k-m)}$$

$F_{(i+k)}$= forecast at step
$(L_i + k + B_i)$= estimated level at step
$S_{(i+k-m)}$= estimated seasonal variation of period length

IV. VALIDATION

Arena Simulation Software tool was selected to export the results of time improvement. Since it is directly related to our components proposed in the previous chapter, and as previously mentioned, the improvement proposal focuses on two processes of the total product cycle, in this case, order processing, in which the Lean Six Sigma tool will be used, and order processing and preparation, SMED tool will be used to reduce downtime. On the other hand, the Streamline tool will be used to simulate demand behavior, which is the last component of our proposed improvement plan.

For the first scope to be developed will start from the order registration, until the end of the distribution and dispatch stage, in this time span between the two stages is where the impact of the SMED and Six Sigma tool will be seen. In the current system there is no improvement and classification in the activities within the loading area, that is why the use of the SMED tool is proposed to improve the time of the subprocesses. As shown in the process diagram, the process is mapped considering the entities, activities and variables that influence and will be part of the solution and any internal modifications. For example, the operator, which after the improvement would no longer oversee sending requirements, or the zoning, which would change from being automatic to being operated manually by a programmer.

For the validation of Arena, the model is performed by comparing the outputs of the model with those of the current system calculated. The cycle time obtained by the arena model is 93.82 min average, having a minimum difference. Therefore, the simulated model is validated. As it is observed in the improved situation the system time has reduced from 93.82 min to 85.77 min, having a significant improvement of the model besides approaching the reached objective of 83.7 min.

On the other hand, to make the accurate forecast, it is necessary to collect the historical data of the sales made since 2019 to find the suitable statistical model, for this we have the following. The aggregate demand between all months and years since January 2019, disaggregated among the 50 products with the highest turnover is the input in Streamline.

TABLE 2
SALES ORDERS FORECASTING BY MONTH

Year	Month	Sales Forecasting
2023	January	$ 1,074,866.31
2023	February	$ 975,935.83
2023	March	$ 1,155,080.21
2023	April	$ 1,109,625.67
2023	May	$ 1,106,951.87
2023	June	$ 1,072,192.51
2023	July	$ 1,016,042.78
2023	August	$ 1,155,080.21
2023	September	$ 1,109,625.67
2023	October	$ 1,106,951.87
2023	November	$ 1,072,192.51
2023	December	$ 1,072,192.51

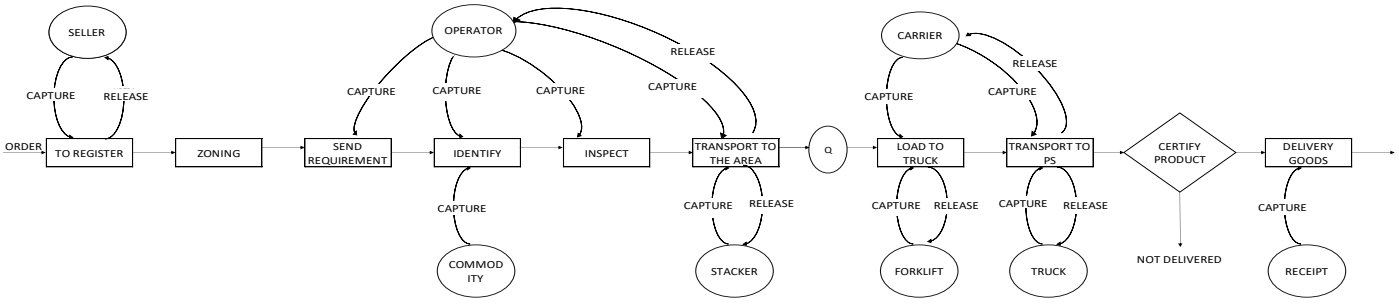

Fig. 2: System activity graph

TABLE 3
2023 IMPROVED SYSTEM OUTPUTS

Identifier	Average	Standard deviation	0.950 C.I. Half Midth	Minium Value	Maximum Value	Number of Obs.
System time	85,7	5,69	2,35	81,9	99,2	90

V. DISCUSSION

Once the validations of two components within the project were performed, we proceeded to compare the objectives with the results shown, this time focusing on the performance of the project to determine how much it varied from what was established in the theory, as follows. In this sense, and focusing on the first problem, meanwhile it can be estimated that the improvement time in a project whose objective was the optimization of transportation in pre-established areas was optimistic thanks to the ease and freedom of elaboration of roadmaps of the carriers with respect to the company's plan, i.e., their interest could be aligned with the Lean strategy from the beginning [17].

However, it is also affirmed that such improvement was going to result depending on the facilities that each area of the operations had, as well as that the roadmaps could be influenced by decisions of the distributor [18]. In this sense, it is understandable why, despite approaching the indicator objective, the performance remained 2% of the optimum, because it is very complicated to relate the Lean strategy to the transportation area, which in our object of study is outsourced. This is the reason why the solution is focused on improving distribution and not so much on routing.

In addition, other people stated that inventory forecasting is achievable according to business objectives and is somewhat easy to achieve according to statistical model standards [19]. This is the reason that the performance on most of the objectives turned out to be positive according to the coefficient of determination R^2, thanks to the Streamline system that determines a model more attached to the statistical relationship.

It is also found that the gross result of the implementation of the project is 215 thousand dollars, which is equivalent to a surplus in the company's cash. The project is low-cost, so it does not require debt to finance it. Likewise, the economic indicators are also positive, COK, NPV and IRR are managed under sustainable project standards, and the payback period is defined in less than one calendar year. A sensitivity analysis was also performed using @Risk in MS Excel, giving 78.2% of success rate of performance in our improvements.

VI. CONCLUSIONS

To mitigate problems of product returns in distribution, Lean methodology was used as the main approach, making use of both the DMAIC methodology and SMED technique for the optimization of internal processes and the agile resolution of activities susceptible to adjustments in pursuit of a more efficient overall process aligned with business objectives, as well as Demand Forecasting thus reducing the incidence of stock shortages at the time of delivery. All these were articulated with the primary objective of enriching the customer's experience, giving 18.89% improvement in shipping time.

MEASUREMENT OF THE IMPROVEMENT PROJECT								
Problem	**Aim**	**Improved**	**Performance**	**Cause**	**Indicator**	**Aim**	**Improved**	**Performance**
Time on transport routes	83.7 min	85.77 min	-2.47%	Poorly distributed areas of orders in routings	Distribución time	14.5 min	14.72 min	-1.52%
				Sending requirements to warehouse	Shipping time	0.9 min	0.73 min	18.89%
				Delay in queue of products in the loading area	Loading time	31.5 min	33.94 min	-7.75%
Condition of goods	$11,832.52	$ 14,063.29	-19%	Difference of forecast with actual sales	MAPE	15.64	18.97	-21.29%
				Variance of the statistical model with the historical one	Determination coefficient R^2	0.94	0.82	12.77%

Fig. 3: Measurement of improvement results

The results obtained show a significant impact on the optimization of delivery times, reduction of product supply failures and greater efficiency in inventory management. Such as a reduction to 18.97 MPAPE, this comprehensive implementation of Lean methodologies and specific tools has not only improved customer satisfaction but has also laid the foundation for a more efficient and economically viable distribution process for the company. The strategic approach adopted has proven to be fundamental in achieving effective and profitable distribution, highlighting the importance of the application of structured methods and specialized tools at the business level.

Optimization in an operational distribution structure always considers time as a priority unit to be improved. However, customer satisfaction is of equal or greater importance if the problem to be studied is due to a consequence of a malpractice in the sales and delivery process. The results are an indication that distribution is not only an activity within the process, but a service itself that can be improved from the reception of the order.

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