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Model to Increase the Level of Service Using the 5S Tools, Work Standardization, SLP and Demand Forecasting in a Peruvian Quick Commerce SME

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Abstract. The digital sales market has grown significantly in recent years, especially during the global pandemic. Quick commerce companies have gained popularity due to their ability to provide quality products at the customer's doorstep in a short amount of time. To remain competitive in this industry, companies must maintain their delivery time and provide excellent service. This study aims to optimize the processes of a quick commerce company by applying four selected tools. The goal is to complete the highest number of orders within the first 15 minutes of placing an order. The proposed model includes demand forecasting, systematic layout planning, 5's, and work standardization, resulting in an 18.6% increase in the service level. This model can be replicated by other companies in the industry and serve as a basis for further research.

Keywords: quick commerce, 5S, work standardization, SLP, demand forecasting

1. Introduction

Quick Commerce (q-commerce) is considered a type of e-commerce in which order delivery takes place in extremely short intervals, ranging from 10 to 15 minutes [1]. While cost savings is a priority in traditional e-commerce models, q-commerce focuses on speed and quality [2]. According to Euromonitor, global sales made through e-commerce have increased by 83% from 2019 to 2022, turning over 3.6 trillion USD in the past year [3]. On the other hand, according to a recent report published by Coresight Research [4], 47% of U.S. consumers project that they will do their household grocery shopping online in the next 12 months. In Peru, sales through e-commerce channels increased by 21.8% in 2021, representing approximately PEN 12,290 million [3]. According to the Peruvian Chamber of E-Commerce [5], among the main categories that presented the highest sales growth in 2021 was "App delivery", with 233%. Likewise, e-commerce contributed approximately 5.75% of GDP in 2018, which reflects the importance of this industry for the country's economy [6]. As these companies publicly offer a delivery time of 10 to 15 minutes as part of their value proposition, it is necessary to deliver on this promise in order to build customer loyalty to the brand.

Currently, among the most influential factors for consumer purchase decisions in the e-commerce industry are delivery time [7] and product availability [8]. According to Zhou et al. [9], picking time accounts for more than 50% of the total operational time, which also means 55% of the total cost of warehouse operations. On the other hand, authors such as Marques et al. [10] state that the fulfillment rate or level of service provided by companies in this sector depends directly on the Out of Stock (OOS) rate. The above mentioned indicates that companies in this sector have processes to improve and new engineering solutions to this problem are needed.

In this context, there is a need to analyze each of the activities of a quick commerce company's process, from order acceptance to delivery, in order to identify where the problem arises. For this purpose, a company that reflects the problems described above was chosen, identifying those that directly affect the level of service. These can be summarized in three: poor order in the company's warehouses, lack of standard procedures, and inadequate demand planning. In this sense, to solve the described problems, an action plan will be developed to improve the current situation using the 5S tools, Work Standardization, Systematic Layout Planning, and

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Demand Forecasting. These methodologies were selected based on the success cases found in the literature reviewed.

Although logistics problems have been addressed in the e-commerce sector, there is very little research that addresses it from a q-commerce company since it is a sector that has emerged recently. In this case, the application of improvement processes in micro-hubs is different from that of regular warehouses, which is why the need for this research arises.

2. State of the Art

2.1. 5S

The main objective of the 5S tool is to achieve long-term changes with the collaboration of workers [11]to improve the physical work environment through cleanliness maintenance and training [12]. Safety is an important factor in the quality standards of this industry since it sells food and convenience products. Therefore, a culture of cleanliness, order and safety in workstations should be considered an essential element [13], [14]. This methodology follows five steps: classify, order, clean, standardize, and maintain [11]. Authors such as Linh et al. [15] have demonstrated that this technique has brought several benefits such as the elimination of non-value-generating processes, increased process effectiveness, and improved worker performance since simplifying operations reduces the time spent on unnecessary activities like searching for inputs. In a case study developed in Peru, the use of the 5S tool in the company´s warehouses reduced product delivery delays by 28% [16]. Siva et al. [17] showed that tools like 5S can help eliminate process inefficiencies in a service company. Their process showed a reduction in cycle time from 221,400 seconds to 7,920 seconds, which, in turn, increased the time spent on value-added operations.

2.2. Work standardization

The concept of standardization should not only be analysed in manufacturing companies but also in service companies. Many companies consider implementing the tool in their processes due to the impact it has on increasing efficiency and productivity. In a case study conducted in the United States, it was determined that the lack of process standardization was one of the most important causes in the inventory management problem of a food warehouse [18]. According to Puvanasvaran et al. [19], the tool reduces cycle time by eliminating or modifying non-standardized processes. Authors such as Nallusamy and Saravanan [20] sought to reduce the cycle time of their processes to make them more efficient. After implementing the tool, the cycle time decreased by 350 seconds. Likewise, Mor et al. [21] applied Work Standardization in an Indian company with the aim of implementing a detailed sequence of procedures in its processes. With the tool, the productivity of the studied company increased by 6.5% and the cycle time was reduced by 31.6 seconds. On the other hand, Silva-Campusano et al. [22] sought to reduce the return rate and cycle time in a Peruvian poultry company. Thanks to the combination of the Work Standardization and 5S tools, they managed to reduce the return rate from 8.99% to 4.95%. In a peruvian shoe company, the authors Laura-Ulloa et al. [23] managed to increase the OTIF by 44.48% and reduce the cycle time by 27.27% by applying this tool.

2.3. Systematic layout planning

SLP has been widely used in small and medium-sized enterprises, as well as in various production and service systems, to propose a new workplace design. Its primary purpose of this tool is to optimize the layout of personnel and materials for increased efficiency and effectiveness [24]. In a footwear Peruvian company, it was identified that the main problem was order delivery. After implementing the SLP tool, the results obtained nor only impact the order delivery, achieving 100% compliance, but also increase production capacity, decrease defective products by 3%, and increase productivity by 8% [25]. On the other hand, authors such as Leon-Enrique et al. [26] increased the productivity of the unloading and storage processes by 40%, as well as a 60% increase in net margin. Likewise, authors such as Potadar and Kadam [27] mention that with the SLP method, the new plant layout significantly reduced the distance of material flow and the cost of piece movements. In this research, it was possible to observe in the results a decrease in costs by 11.63%. According to a study by Suhardini et al. [28] the implementation of this tool increased production capacity by 37.5% and reduced material handling costs by 10.98%

2.4. Demand forecasting

Demand forecasting is a management tool that aims at planning the possible need for the product to ensure its availability over time [29]. In the e-commerce sector, demand is difficult to predict since it depends on various factors such as discounts on the platform, seasonality and availability [30], [31]. Likewise, authors such as Tanaka and Sagawa [32] state that in this sector demand tends to be highly variable due to price competitiveness, since it is easier for customers to compare prices through an e-commerce platform than in a physical store format. It is important to make an accurate demand forecast in order to properly calculate the safety stock of the product and reduce stock outs [33]. Hsieh [34], aimed to predict demand more accurately by comparing different methods and choosing the one that was closest to the actual sales volume as the most accurate. In another case study developed in Japan, a demand forecast considering frequent price changes of an e-commerce company was conducted [32]. With those results, an inventory management model was proposed that allowed the company to avoid both stockouts and overstocking.

3. Proposed Model

After conducting an analysis of the current situation of the company, where the main causes of the identified problem were known, a search for tools that could contribute to the improvement of the service level was carried out. Fig. 1 shows in a dynamic way the composition of each of the phases of the innovative model in a new and growing industry such as quick commerce. In this diagram, the input problem to be solved is shown, which is the low service level, as well as the outputs that will be obtained if the improvement proposal is carried out, where the main one is the improvement of the service level and secondly, the reduction of the picking times and the reduction of the Out of Stock ratio.

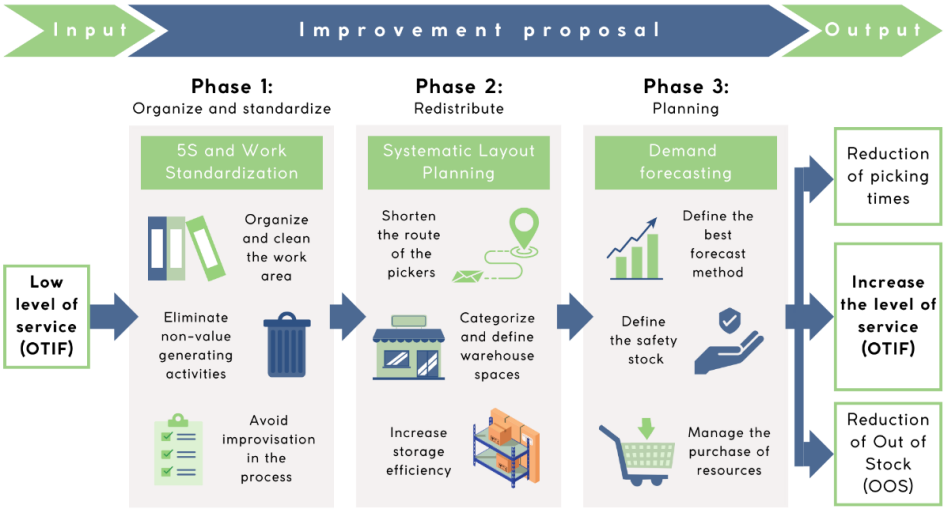

Fig. 1: Proposed model construct

3.1. Phase 1: Organize and standardize

The first phase is composed by the 5S tools and Work Standardization. This stage consists of cleaning the workstation and eliminating all unnecessary objects from the workstation, as well as establishing work sequences and guidelines for the picking process. First, the Area Managers will be informed about the 5S model and its benefits. Then, the aisles of the warehouse will be labeled and arranged for a better understanding of the space. In this way, the chances of a picker getting confused or lost inside the warehouse will be minimal, since the aisles and requested products will be easy to identify.

In parallel, the way in which the operators should do the activity of scanning the products and packing the entire order will be established. First, an analysis of the current working method of the pickers will be made, measuring the times to determine the initial situation. Knowing this, the activities that do not generate value were eliminated. Therefore, a graphic manual was created for the pickers, where the sequence of activities of the process is defined. To verify the compliance of these two lean manufacturing tools, a weekly audit will be carried out through visual control of the workstation. Also, the impact of the implementations on the main

problem will be analyzed by performing a time measurement in the picking process and a simulation on the improved process.

3.2. Phase 2: Redistribute

In the second phase, the Systematic Layout Planning tool will be applied. In this stage, one of the largest warehouses will be taken as a model to see the distribution and classification of the products in it. For this, it was necessary to visit the hub and to have a plan of the space. An ABC analysis will be performed taking sales by category as a distribution criterion. The optimal situation is to have the products with the highest rotation close to the dispatch area to make this activity as fast as possible. To validate the results obtained by the improvement, a time measurement will be made before and after the improvement proposal, which will be introduced in the simulation mentioned above.

3.3. Phase 3: Planning

Finally, in phase 3, demand forecasting will be applied. For this research, it was decided to perform the forecasting test only for the Fresh Food category, since the company handles a very large number of SKUs to analyze the demand of each one of them. The test was conducted using six different time series forecasting methods to determine which one is most accurate for the category and industry. The objective of this tool is to achieve the minimum error in the projection of the demand in order to elaborate a purchasing plan that will allow the company to reduce its Out of Stock ratio.

Once the results of the simulation and testing of different forecasting methods have been obtained, a comparative table of the initial situation and the results of the improvement proposal will be made.

4. Validation

4.1. Initial diagnosis

As mentioned above, the main problem faced by companies in the quick commerce industry is the promise to deliver complete orders in the shortest possible time. Currently, the percentage of orders delivered within the first 15 minutes, that is, the service level or OTIF 15, was on average 64.4%. According to the literature, a company in the quick commerce industry must have a service level between 97% and 99% to be considered optimal [8]. This being said, it can be seen that, compared to the industry standard, the company has a significantly low level of service, being 32.6% the technical gap. In addition, the VSM tool was used to determine the current average cycle time, which turned out to be 20.35 minutes per order, a time that not only does not comply with the company's value proposition but also turns out to be too high for the type of sector to which the company belongs [1]. It was also analyzed the OOS indicator for each category, where it was found that the category with the highest percentage was Fresh Food, with 9.66%. Knowing this, a calculation of the annual economic loss of the company was made, which amounts to a value of 5,285,634 USD and represents 31.79% of total sales. Fig. 2 specifies the reasons and causes of the company's main problems and the tools that will solve each of them.

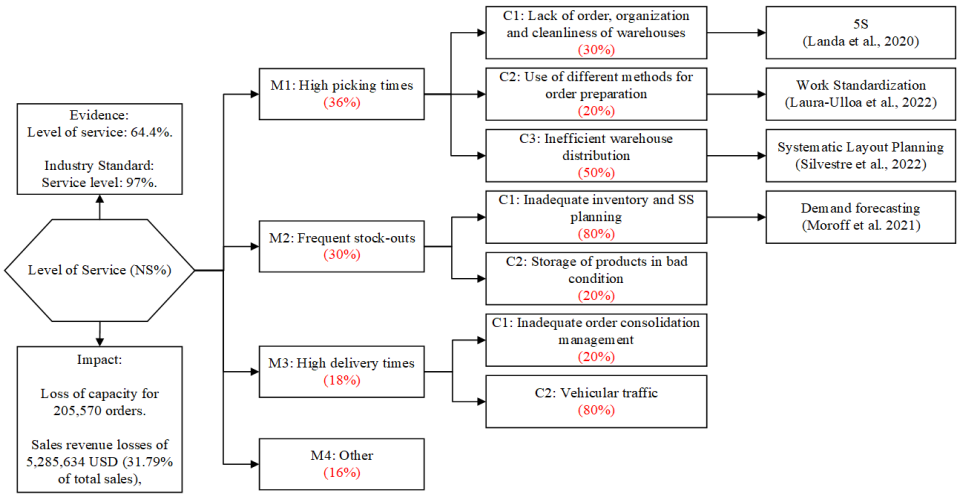

Fig. 2: Problem tree

4.2. Validation of the improvement proposal compared to the initial diagnosis

To validate each component of the model, it was necessary to perform a diagnosis of the initial situation of each of the factors that would be impacted by the tools. First of all, an initial audit of the 5S tool was carried out, from which an initial compliance level of 79% was obtained. On the other hand, the current methodologies for performing scanning and packaging activities were analyzed. Currently, there are two different methods for this part of the process where some operators perform them separately and others simultaneously. As for the diagnosis for the application of the SLP tool, we took the transfer times from the support table to each shelf, which will represent the selection times by category. On the other hand, for the diagnosis of the current demand forecast, the demand forecast calculated with the current method was compared with the real demand, which resulted in a MAPE indicator of 16.72%.

4.3. Simulation of the improvement proposal

Demand forecasting tests for the Fresh Food category were performed with six different methods using Microsoft Excel software. These included simple moving average, weighted moving average, simple exponential smoothing, Holt, Holt-Winters, and linear regression. It is important to mention that the sales data of the category for the last 37 weeks were used for the tests. Following this, the mean absolute percentage error of each forecast was calculated to determine which methods were the most accurate compared to the real demand. In this way, the Holt-Winters method was the most appropriate to estimate the demand for this category. Finally, the model chosen was again validated by projecting the demand from week 38 to week 42 to prove that it is better than the one currently used.

On the other hand, a time simulation was carried out using Arena software to determine whether the proposed model would reduce picking times and increase the company's service level as a consequence. In this section, we detailed the parameters of the simulation, such as the scale of the system, the input variables, the calculation of the sample size, the entities or elements of the system, and the restrictions and periods applicable to the simulator. Fig. 3 shows the simulation of the improvement proposal.

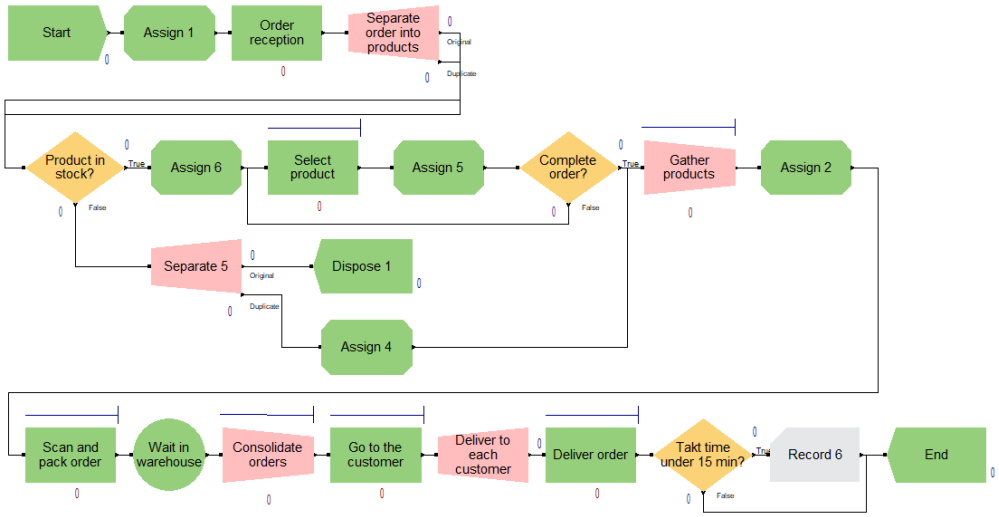

Fig. 3: Simulation of the improvement proposal

Fig. 5 shows the contrast between indicators in the initial diagnosis and the results obtained from the demand forecasting test and the simulation of the lean tools

MEASUREMENT OF THE IMPROVEMENT PROJECT								
PROBLEM	**CURRENT**	**OBJECTIVE**	**IMPROVE**	**CAUSE**	**INDICATOR**	**CURRENT**	**OBJECTIVE**	**IMPROVE**
Level of Service (OTIF 15)	**64.40%**	**97%**	**83%**	Delay in process cycle time	Picking time	7.24 min	2.3 min	1.29 min
					Scanning and packing time	2.88 min	0.6 min	0.45 min
					Selection time	4.36 min	1.7 min	1.02 min
				Low demand forecast accuracy	MAPE %	30%	5%	9%
				High levels of stock-outs	OOS	9.66%	<7.5%	3%

Fig. 3: Simulation of the improvement proposal

5. Discussion

The proposed model based on the increase in the level of service offered by the quick commerce company using lean manufacturing and demand forecasting tools can be applied in other industries with similar problems to those detected in this research: lack of organization of the work area, lack of standardization in the processes, lack of an adequate demand forecasting and inventory management model, and inefficient location of products in the warehouse. The results of the model are presented in Fig. 5.

When analyzing the results obtained, the main indicator with the highest value in this study is the level of service, where we can see an increase of 18.6% compared to the current situation. This result shows that the tools used have decreased the time it takes to complete an order and 83% of the orders are within the standard of 15 minutes [1]. The time in the picking process decreased considerably thanks to the 5s, work standardization, and SLP tools. The three tools identified waste in the process and it was possible to propose an improvement that would increase efficiency and decrease the cycle time [23]. Finally, with the demand forecasting method, one of the main problems of the company, the high level of stock-outs, was attacked. According to the different methods used, the one with the lowest percentage of error was chosen, which was suitable for the type of industry of this company. Finally, it was possible to simulate that with the proposed method, the percentage of stock failures in the Fresh Food category would decrease by 6%. For future research, it is recommended to have as much historical data as possible in order to make forecasts more accurate. That said, the four tools used in the improvement proposal helped increase the quick commerce company's service level by a meaningful percentage, although not enough to reach the industry standard.

6. Conclusion

The objective of the research was to improve the level of service in the attention of a company in the quick commerce sector since it was identified, based on the industry standard, the importance of time in the customer experience. With the application of the different tools mentioned above, the objective of improving the level of service, which was initially at 64.4% and increased to 83%, was achieved.

It became evident that one of the main problems in the company was the inadequate demand forecasting method used in the company. After testing different forecasting methods, the Holt-Winters method was determined to be the most appropriate for the industry, reducing the MAPE by 21% according to the final validation. As a result, the purchasing plan obtained a reduction of the Out of Stock indicator from 9.66% to 3%, being this value within the expected range. Finally, with the implementation of the 5S tools, work standardization, and SLP, picking time was reduced from 7.24 minutes to only 1.29 minutes, that is to say, by approximately 82%. That said, it was possible to prove that the proposed model is effective in achieving an increase in the company's service level.

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