Systematic Layout Planning: A Research on the Third Party Logistics of a Peruvian Company

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Abstract. Logistics operators face various problems, the most common being the inadequate distribution of the operations yard. This is reflected in international logistics indexes, in which Peru ranks as one of the last countries. The company studied herein presents a problem of high reprocessing levels in the operations yard, which affects the level of service offered to customers. This study proposes the application of industrial engineering tools, such as systematic layout planning, to reduce reprocessing, increase profits. The proposed tool has been validated via simulation using the Arena software.

Keywords: Systems engineering · 3PL · Systematic layout planning · Simulation

1 Introduction

Outsourcing processes, such as packaging, distribution, storage, and inventory control, have increased the contribution of logistics operators to the supply chains of different organizations worldwide; this is because outsourcing services may reduce logistics time and cost. Logistics operators, mainly third party logistics (3PLs), play an extremely important role in the supply chain of companies or organizations [1]. Therefore, it is considered an important research topic because without operators anticipated success rates would not be achieved.

In 2015, such companies generated great benefits for the logistics of various companies worldwide by reducing inventory and fixed logistics costs by 5%, and 15%, respectively [1]. To this end, the company and the suppliers must be aligned to work with a high level of confidence that ensures order fulfillment. In addition, to better manage the supply chain, companies must automate their inventory management. Currently, only 12% companies are automated.

This study proposes the application of the systematic layout planning (SLP) tool [2] to reduce high reprocessing levels for logistics operators. The proposed improvement process comprises four stages: diagnostics, proposal preparation and design, implementation, and validation.

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2 State of the Art

Several studies are available in the literature concerning the design or redesign of company areas using SLP owing to its easy application in small and medium enterprises that improves the flow of materials and labor. To apply the SLP steps, the authors identify the company's management strategy [3] and activities [4], the restrictions of the operations yard and the type of materials [5] and the time and the travel distances inside the area because the space used represents a cost for the company [6].

The distribution proposal must provide a safe work environment [7] because activities such as picking require a hard physical effort when performing the action of repeatedly placing and removing the boxes on the pallets, especially if the pallets are not find in a correct height for the operators [8].

Due to the complex activities that take place in the operations yards, it is difficult to implement the distribution proposal to evaluate the efficiency and accessibility [9] and then propose changes. Therefore, the authors propose using technology through software simulations to more accurately assess the impact of the proposal [10].

3 Methods

The method used herein comprises four steps: initial analysis, innovative technical proposal, final analysis, and results, as shown in Fig. 1.

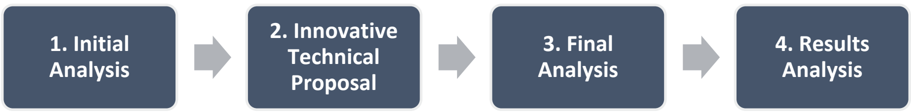

Fig. 1. Proposed method.

The above mentioned steps can be described as follows.

First, an initial analysis of the company is conducted to evaluate its current conditions. This analysis is performed through visits to the company, wherein the flow of operational processes is identified together with any potential problems. Subsequently, a prioritization matrix is created to determine the main problem in the operations area. Next, an Ishikawa Diagram is used to identify the root causes of the said problem. Post identification, tools to mitigate or eradicate these problems are proposed. In this study, the proposed tool is SLP and the research indicators are cycle time and the distance traveled.

Second, an innovative solution is proposed. This proposal begins with the collection of information relevant to the development under consideration. Then, we assess load flows and resources used for its movement inside the operations yard using a relational table and diagram to identify proximity requirements among areas located in the operations yard. In addition, the workload and income for each province is assessed using the P-Q and ABC diagram. Subsequently, different physical distribution proposals are developed for the operations yard. In all proposals, the proximity of the areas according to movements, workload, and percentage of income must be prioritized. After, the proposals are evaluated to select the proposal that provides the best flow of materials.

Third, results obtained post tool application are evaluated. In this stage, the proposed indicators are assessed via an Arena simulation, considering the improvement in employee performance and physical changes in area distribution. However, evaluating the reduction of the number of reprocesses post tool application is very important as this is the problem to be solved.

Finally, the results are analyzed using a semaphore table to compare initial results against the results obtained through the simulation.

4 Results

4.1 Initial Results

To obtain the current situation of logistics operators, continuous visits and meetings were conducted with the company's general manager and operations staff. In this manner, we were able to identify the sequence of activities and existing problems affecting the performance of the employees. Following this, current problems were listed and a prioritization matrix was created to determine the main problem. Based on the matrix, high reprocessing levels were deemed the main problem. Subsequently, causes were assessed through a problem tree, and the following reprocessing issues were identified: deliveries to the wrong destination, incomplete order deliveries, and order deliveries in poor condition. The root cause for all these reprocesses was determined to be inadequate area distribution in the operations yard.

Defining improper physical layout as one of the root causes, the following indicators were defined: the travel time and distance of an employee when mobilizing loads. To this end, the time taken and distance traveled between the areas involved in the operational processes were measured.

4.2 Innovative Technical Contribution

This study focuses on the development of the application of SLP to increase operations productivity and ensure the safety of the load and employees throughout the working day. This impacts the problem as errors may be avoided when locating loads; in addition, excessive handling of loads is reduced, which can cause physical damage to loads and errors when locating boxes in the storage area. Here in, SLP was developed in seven stages, as shown in Fig. 2.

Stage 1: In this stage, the dimensions of the area corresponding to each zone of the operations yard and the distance between them was measured. In addition, information necessary to develop the P-Q and ABC analyses. Next, we defined the three columns in the middle of the operations yard and the electrical connections that hinder the modification of office locations in this area were identified as restrictions.

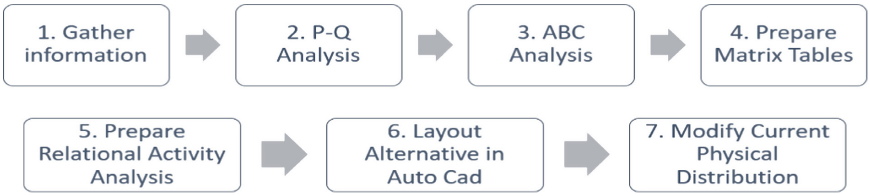

Fig. 2. Systematic layout planning stages.

Stage 2: In the second stage, destinations were evaluated according to the amount of volumetric space. This evaluation was performed through P-Q Analysis, as shown in Fig. 3.

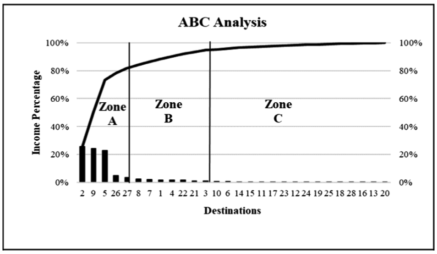

Fig. 3. P-Q analysis

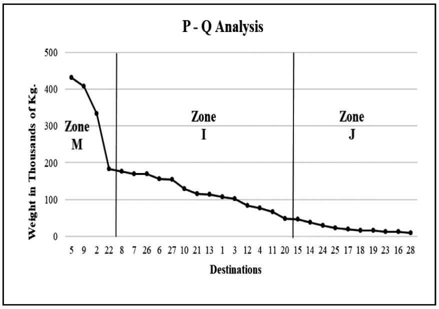

Fig. 4. ABC analysis

Stage 3: In the third stage, the destinations were evaluated via ABC analysis according to the percentage of income that they contributed to the company during the year 2017. Figure 4 shows the corresponding ABC diagram.

Based on the P-Q and ABC analysis, it is concluded that destinations 2, 5, and 9 must be prioritized when relocating the areas as they are destinations with the highest monthly load movement and represent 73.18% of the total income received by the company.

Stage 4: We evaluated current efforts and compared them against the effort that would be made when redistributing the area layout according to the analysis using matrix tables that related load weights and the distance traveled between areas. Based on this analysis, the effort being made currently is 18,266.80 kg/m. By implementing the proposed improvements, the efforts will be reduced to 14,165 kg/m.

Stage 5: In the fifth stage, relational activity analysis was conducted using the relational activities table and diagram. Based on this analysis, the direct proximity between the parking lot and the packing area and that between the pick-up and boarding area and the printing table were deemed crucial. However, the short distance between the packing area and the following areas—pick-up and boarding area, printing table, and destinations 2, 5, and 9—are also absolutely required.

Stage 6: In this new distribution, the locations of destinations 2, 5, and 9 were prioritized as they were locations storing the largest cargo to be moved to provinces. For the same reason, the storage area was increased. In contrast, certain destinations were grouped into a single area as they did not require the space they had owing to the small amount of cargo stored in them. Furthermore, the reverse logistics area was relocated outside the operations yard because it did not add value to the processes performed therein.

Stage 7: In the final stage, areas were redistributed via a simulation using the Arena software, and, in this manner, practical results were obtained for comparison against the expected theoretical results; the comparison validated the application of the SLP tool.

5 Results Analysis

After applying the SLP tool, the results were analyzed according to the proposed indicators. Figure 5 presents a semaphore table that shows the indicators of the number of reprocesses, cycle time, and distance traveled for orders addressed to significant destinations. The current value, projected value, and the value obtained from the simulation are all presented.

Indicator	Unit	Semaphore			Current Value	Expected Value	Obtained Value
		Red	Yellow	Green			
Number of reprocesses	%	> 15	15 - 6	≤ 5	9.13	5.00	7.00
Cycle times	Minutes	≥ 140	139 - 110	< 110	138.74	107.29	120.46
Distance traveled	Meters	> 100	100 - 50	≤ 50	87.50	50	39

Fig. 5. Control indicators

The main indicator of the success of this project is the amount of reprocessing as it is the main problem of the company. As observed in Fig. 5, a 5% reduction was estimated. However, the value obtained is 7% because the modifications were simulated, which generates variations in the results.

For the second indicator, at the beginning of the project, cycle times were expected to decrease to 107.29 min. However, they were reduced to 120.46 min. Furthermore, as regards the distance traveled in the operations yard, a 50-m reduction was expected, and, through the results of the simulation, distances were reduced to 39 m.

6 Conclusions

Plant distribution is a common problem in small companies and even in some large companies. However, the SLP tool may contribute to an optimal redistribution of company areas. Therefore, this study shows the changes made in the physical distribution of an operations yard for a logistics operator applying SLP, focusing on improving the operations area's performance and preventing operation errors that generate reprocessing.

Regarding the main objective of the research project, the company's reprocessing level was reduced to 7%. In addition, the simulation of the current and proposed operations yard was compared, revealing that the time was reduced to 18.28 min. Similarly, the distance traveled was reduced by 39 m.

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