Optimization Proposal for Supply Management Implementing Supply Chain Management and Lean Warehousing in an Alcoholic Beverage Marketing Company of The Retail Sector

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Abstract

Nowadays, change is the only constant variable. Therefore, business enterprises should focus more attention on them supply chains. The main contribution of this paper is to show the relation between Lean Warehousing and Supply Chain Management since one is inside the other and they complement each other very well to produce results in the retail sector. In the course of the research, the raised hypothesis was proved since the presented results show a better behavior in a 38.36%, compared to the initial scenario. The results of this research show that retail sector companies must perform appropriate management of their inventories, establish a forecasted demand, and have appropriate warehouse spaces. It was possible to decrease their operations time in a 29.59% and have better management of their resources in a 27.50%. The main objective of this paper is to prove that due to the implementation of engineering techniques in the supply processes that involve warehousing, planning, and inventories, and the subsequent decrease of inefficiency, an alcoholic beverage marketing company optimized its operation in said areas. This research applied a mixed methodology, using direct observation and a discrete event simulation software to optimize complex scenarios (Arena).

Keywords
Supply Chain, Retail sector, Warehouse environment, Marketing of alcoholic beverages.

1. Introduction
Supply chain management must archive total efficiency in all stages of the logistic cycle, such as production, support services, expedition, distribution, purchases, reception, warehousing, and inventory. For that, the planning, supply, warehousing, and distribution processes must be optimized (Garay 2017).

Additionally, the retail sector offers multiple products to its clients, thus it needs significant support from its providers to be able to deliver repositions according to the demand (Tarigan et al. 2021). Its performance is measured based on the attainment of objectives and goals in a set time period (Tarigan et al. 2021). At the same time, this performance measures the company's competitiveness in the sector, which is determined by the price and quality of the product, the services offered by the company, and the location of the retail company (Petljak et al. 2018).

To become more competitive, especially in the retail sector, the supply chain activities must be executed, because when doing so the company's performance is clearly better in comparison with its competitors. To execute the supply chain activities on retail sector companies, factors such as information technology, inventory, production, location, and transportation are crucial since these factors set the supply direction (Vu et al. 2020).

Carrying out supply chain management allows the retailer to improve its performance since it links the provider with the customer (Tarigan et al. 2021). Supply chain strategies are really important for a retail sector company, considering they link the high-level strategy of the organization with its activities such as purchases, planning, and production

planning. Furthermore, logistics is a fundamental part of supporting retail companies to rationalize their distribution, infrastructure, and make more efficient use of their resources (Ramos et al. 2020).

However, retail companies showcase shortcomings such as inventory record inaccuracy, which creates a low operational performance. Therefore, it is necessary to identify the sales and inventory management processes that will help with inventory record inaccuracy to optimize its operational performance (Shabani et al. 2021). For this reason, the company can show a decrease in profit and generate more expenses in the purchase of goods, due to the fact that not having determined the product stocks inside the warehouse creates unnecessary purchases or insufficient stocks quantities (Michael Heaviside et al. 2020).

Another shortcoming in retail companies is the lack of planning. Retail companies must be able to plan their merchandise availability to balance the demand with current stock. Accumulation or lack of merchandise should be avoided. This happens when a retail sector does not have the tools to guarantee the estimated purchase of its merchandise (Michael Heaviside et al. 2020).

Moreover, the warehouse is a factor to take into consideration, since it is considered as one of the main elements inside the supply chain. Warehouses participate in most commercial processes of retail companies, such as planning, purchases, and distribution (Y. Prasetyawan and N. G. Ibrahim 2020). It is well known that the operative model of a warehouse can have a significant economic impact due to its prevalence in the supply chains (Ramos et al. 2020).

Finally, in regards to the logistic factor, the picking and packing operations are considered one of the most important problems in logistics and arise in many industrial engineering applications. Logistics in this context is defined as the process of efficiently planning and controlling the flow and warehousing of merchandise from production until customer consumption to fulfilling their requirements (Al-Khazraji et al. 2020).

Given the mentioned deficient factors in retail companies and taking into consideration that this paper is based on a retail company dedicated to the marketing of alcoholic beverages, the following research question is raised: Is it possible that the retail company can appropriately operate with the implementation of engineering techniques in its supply chain processes? With that, the following specific problems are raised: Is it possible to determine the factors that cause deficiencies in the supply chain processes? what engineering tools or techniques are the most adequate to implement in these processes? and how much efficiency improves in the retail company with the implementation of the engineering techniques in the supply chain processes? For that reason, this study raises the following hypothesis: If the alcoholic beverage marketing company of the retail sector implements engineering techniques in its supply chain processes, it will optimize its efficiency.

1.1 Objectives

The main area of the supply chain on marketing companies is their inventories because thanks to inventories companies can obtain economic benefits that can translate into profits or losses. Thus, it is of great importance that the company has appropriate control of its inventories. To archive appropriate inventory management, which is a transversal activity to the supply chain, strategies must be implemented for its appropriate management and, above all, to avoid consequences, such as a low level of service, bullwhip effect, and costs increases (Salas-Navarro et al. 2017).

Planning is another point to be considered by marketing companies, which refers to supply chain management. Supply chain management is the alignment of operational activities with the factors that intervene with the supply chain and that the company must be able to properly manage (Jonsson and Holmström 2016).

In regards to warehousing, the activities involved in this process must be optimal to reduce possible inefficiencies and create reliability in terms of costs for the company and, in consequence, be able to fulfill the client's requirements (Dotoli et al. 2015). Additionally, in regards to backrooms, where warehousing activities are developed, meaning, the warehouse, it allows the retail sector to react to the product's demand. Activities like picking, delivery of units, products transformation, merchandise returned to providers, among others, develop in this space. In addition to that, backrooms impact the whole supply chain. It mitigates the capacity pressure, by allowing the stocks to transfer in a downstream way to the stores, creates wider delivery windows, and is crucial at the moment of making management

and transportation costs decisions, which is reduced because it provides better storage spaces that help to avoid multiple daily deliveries from the distribution centers (Pires et al. 2017).

Taking into consideration these three aspects, the objective of this paper is to show the appropriate operation of an alcoholic beverage marketing company by decreasing inefficiency and implementing engineering techniques in its supply chain processes that involve the three factors aforementioned. With this purpose, a diagnosis will be prepared to evidence the causes that create deficiencies in the inventory, management, and warehousing processes of the supply chain at the alcoholic beverage marketing company. In this way, if the retail sector can identify the roots of operational inefficiency, it will prepare better to respond to changes in business contexts (Shabani et al. 2021). Having identified these causes, the following objective is to determine what engineering tools are the most adequate to implement in these processes and, therefore, observe in what measure inefficiency decreases in the company due to the implementation of engineering techniques in said processes.

2. Literature Review

The motivation for this research emanates from the fact that the retail sector considers that problems related to the inventory record are the norm, not the exception of operations at store level (Chuang and Oliva 2015). Additionally, the different processes of these complex entities can create inventory record inaccuracy or the processes can be affected by it (Shabani et al. 2021).

A proposal to optimize inventory record inaccuracy is the implementation of a variant of the NDEA that is a mathematical programming method that makes a data envelopment analysis to find the inaccuracies in the inputs and outputs, as well as calculating the efficiency of decision-making units that work combined with an adjusted inventory record inaccuracy measurement method (Shabani et al. 2021).

The research detailed above is based on a fashion retail company. The obtained numeric results show that the improvement of inventory record inaccuracy is important for inefficient retail companies (Shabani et al. 2021).

In regards to appropriate inventory management, there is a proposal that comprises a series of logistics steps, which allows measuring integration and collaboration levels in the supply chain. These are: definition of integration and collaboration politics, collaborative planning, integration of key and critical processes, performance measurement, and drafting of action plans (Salas-Navarro et al. 2017). This methodology was applied in companies of the wood and furniture sector. However, many of these companies manually managed their inventories, which interfered negatively in the optimization of processes, management, forecasting, and resupplying. Results showed that the processes integration and collaboration in inventory management is low because there is a lack of process planning, lack of information flow in real-time, and lack of knowledge about the inventories levels among the actors of each stage of the supply chain (Salas-Navarro et al. 2017).

In regards to planning, to facilitate marketing retail activities, a system that uses a forecasting method that helps to estimate quantitatively the minimum stock to be ready for the future using data obtained in the past is required. According to these data, order quantity and order points methods are designed (Michael Heaviside et al. 2020). The methods used were forecasting, economic order quantity, and order points (Michael Heaviside et al. 2020).

The system of determining of minimum stock was applied in a retail company of spare parts shops and motorbikes, based on data obtained in the past about spare parts pieces. By applying this method, the forecast of the necessary stock for two articles for 3 and 4 months ahead was identified, as well as a possible safety stock and other relevant stock data (Michael Heaviside et al. 2020).

Retail businesses are no longer considered only as passive receptors of products, now they are product supply controllers according to the customer demand. Therefore, retail businesses control, organize and manage the supply chain from production until consumption (Fernie et al. 2010).

For this reason, the handling unit, which is the minimum unit quantity sent to a store that is put on a shelf inside the retail company and has a strong impact in picking operations, is relevant for this research (Ramos et al. 2020). In the distribution center, the handling unit is the minimum quantity to send to retail stores and has a great impact on picking

operations (Ramos et al. 2020). For that, the "shelf" is a key resource of the retail supply chain and its space must be able to store diverse products and brands inside the warehouse (Hübner and Schaal 2017).

For the previous case, an analytical cost model was developed. The pattern has many costs components divided into three important categories: "Handling costs at the distribution center, handling costs at the store, and inventory costs at both locations." (Ramos et al. 2020).

Three types of scenarios were assessed for a Portuguese food warehouse. First, it was found that in the current scenario the total cost was heavily influenced by the handling cost in the distribution center that, at the same time, was intertwined with the picking activity (and inherent cost). Second, in the optimistic scenario, the most significant cost element is the handling cost at the store, having the shelf stacking cost the higher impact. Finally, in the conservative scenario, the inventory cost in the store and the handling cost at the store are the most relevant (Ramos et al. 2020).

Regarding warehousing, the Lean Warehousing tool is well known. This tool is used to identify and eliminate wastes in a warehouse. When implemented, it can cut on turnaround time concerning merchandise and, consequentially, increase the use of warehouse resources (Bashir et al. 2020). It is known that Lean Warehousing is used inside warehouses through the combination of lean tools, such as 5s, Value Stream Mapping, Gemba, Fifo, Fefo, System Layout Planning, among others (Bonilla-Ramirez et al. 2019).

A case study that seeks to decrease the product return rate in a distribution center applied the Lean Warehousing tool. For this, they used four lean tools, which are: 5s methodology, system layout planning, the Minimum - Maximum provisioning model, and the FEFO system. These tools will develop in three stages that the case study formulates: to create stability, to create flow, and make it flow (Bonilla-Ramirez et al. 2019). As a result, there was a 12.45% to 5.5% decrease in rejected products due to the implementation of Lean Warehousing. Furthermore, the picking operation was reduced from five hours to three hours and there was a decrease in the percentage of unfulfilled orders because of lack of stock from 28.64% to 22% (Bonilla-Ramirez et al. 2019).

3. Methods

This is a correlational explanatory research (Hernández et al. 2014), because there is a relation between the retail sector and the supply chain, giving that supply chain management shapes the performance of the retail sector (Gorane and Kant 2016).

The applied methodology has is mixed since it combines characteristics of qualitative and quantitative approaches. In regards to the qualitative methodology, observation of the studied sector will be performed to identify the factors that will be studied (Hernández et al. 2014). In regards to the quantitative methodology, numeric data collection obtained from the alcoholic beverage marketing company will be used, as well as mathematical models to get results with the Arena simulation program (Hernández et al. 2014).

To start with the methodology, papers of different specializations like Operation Management, Logistics, Warehousing, and Supply Chain Management were reviewed. The papers were assessed and the most relevant for this research were selected (Arana-Solares et al. 2012).

The diagnosis and the subsequent analysis of the current situation were developed (Sablón-Cossío et al. 2021). Afterward, the problem was defined (Correa et al. 2012) and a strategy /action proposal to have a better performance in the industry was formulated (Sablón-Cossío et al. 2021). Thus, Lean Warehousing techniques are used as a useful tool to insert good and efficient practices in the company (Bonilla-Ramirez et al. 2019). In addition, it is desired to present a coherent and integrated vision of the efforts presented in logistics (Issaoui et al. 2021); for which, Supply Chain Management will be applied.

The data was collected in two ways. For this research, primary information sources (interviews and observed experience) and secondary information sources (current documents and reports about warehouse management) (Correa et al. 2012), among other documents will be used.

Lean Warehousing will be used because it allows implementing improvements, as well as making an initial diagnosis of the company's current situation using the Value Stream Mapping tools that come with it, which will make it possible

to see the current status of the company. In the long-term, the main goal is to archive the optimization of the processes in supply chain management, of the business field, and Lean Warehousing allows being more specific in the management of the company's procedures in the warehousing area, which affects the end consumer.

Discrete simulation is used as a quantitative tool to develop a reproduction of the processes through a computer model to facilitate the evaluation of layout or optimization scenarios. This tool provides a representation of activities and resources having into account uncertain circumstances. Additionally, this tool makes experimentation possible and allows evaluating alternatives from a quantitative approach, without falling in high costs or altering productivity (Correa et al. 2012).

This model can be applied by different companies in the same market. Regarding the target audience, this paper is intended for educators, students, researchers, and businessmen that want to understand or deepen in discrete simulation culture applied to warehouse management (Correa et al. 2012).

To explore the Arena model, a double simulation will perform, each one with a different scenario.

The research problem was brought up through the obvious consequences in the company, which were indicators that the company didn't have a correct management of its processes. For this reason, the implementation of Supply Chain Management and Lean Warehousing was raised as aforementioned. Both techniques are focused on tackling the causes of the problem.

Supply chain incorporates a group of processes that support product supply, processing, and distribution. Thus, is more suitable that all organizations that operate in one or more processes of the supply chain are aligned with the competitiveness that depends on the supply chain environment. Hence, the most competitive organizations will be those in which supply chains adjust to change faster and are more flexible (Issaoui et al. 2021).

This research's greatest limitation is that is it based on the direct monitoring of a company during a particular time period. The achieved results are considered general. Thus, in different conditions, these concepts may not be the most fitted for optimization (Pérez et al. 2021).

4. Data Collection

This case study is based on a Peruvian alcoholic beverage retail company, which presents inefficiency problems in its supply chain processes due to different causes that will be explained further on.

For this reason, this paper seeks to optimize said processes with the implementation of engineering techniques and, by consequence, increase efficiency, since this is produced through the decrease of marketing, inventory, logistics, and transportation expenses through all the business partners (García and Jaramillo 2012).

According to the diagnosis, the causes that lead to the presented problem are: the lack of a demand forecasting method, which creates an excess or deficit of merchandise; the lack of proper purchase planning; the warehousing area does not have an appropriate order; delays in picking and packing processes; and the inventories are outdated, due to the lack of periodic control. Hereunder, is shown an extract of the current situation of the inventories in the following table 1.

Table 1. Extract of the database of the inventories

Products	Boxes (average)
Whisky OLD TIMES Blended Red Bottle 750ml	150
Coctel Zhumir Pink Watermelon 700ml	200 - 250
Rum Pomalca X 1 Lt. 3 years reserve	100
Gin BEEFEATER Pink Bottle 750ml	No data
Pisco TABERNERO Acholado La Botija Bottle 700ml	35
Rum Captain Morgan 750 ML	15
Rum APPLETON SPECIAL Dorado Bottle 1L	No data

Caribbean Caribbean Golden Rum 2002 700ml	No data
Aguardiente Don Tomas 750 cc	No stock
Wine Tacama Rosé Semi Seco 750 Ml	40
Enrique Mendoza Santa Rosa Reserve 2016 750ml	No stock
Sparking RICCADONNA Asti Bottle 750ml	25
Wine SANTIAGO QUEIROLO Borgoña Bottle 375ml	150 -160
Pisco VIEJO TONEL Mosto Verde Bottle 500ml	No data

Furthermore, we can see the current map of the company in the following figure (2); which lacks shelves and an appropriate order for merchandise. The boxes are stacked one upon the other in towers, but they do not have a standardized order. Additionally, the map (see Figure 1) shows there is limited access to the area due to the excess of accumulated merchandise, part of it should discharge.

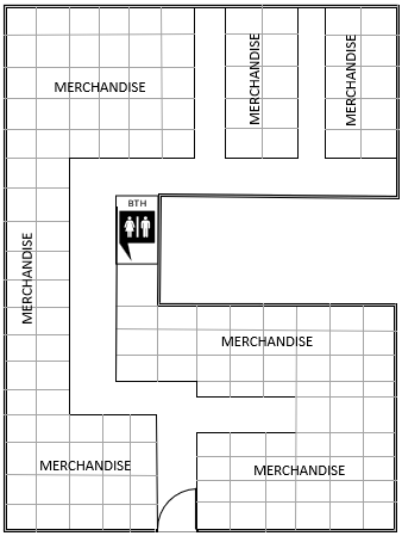

Figure 1. Current map of the warehouse

To delve into the picking and packing problems, Value Stream Mapping, a Lean Warehousing tool, was used. This allows the diagnosis of critical points in picking and packing operations, this will be shown in figure 2

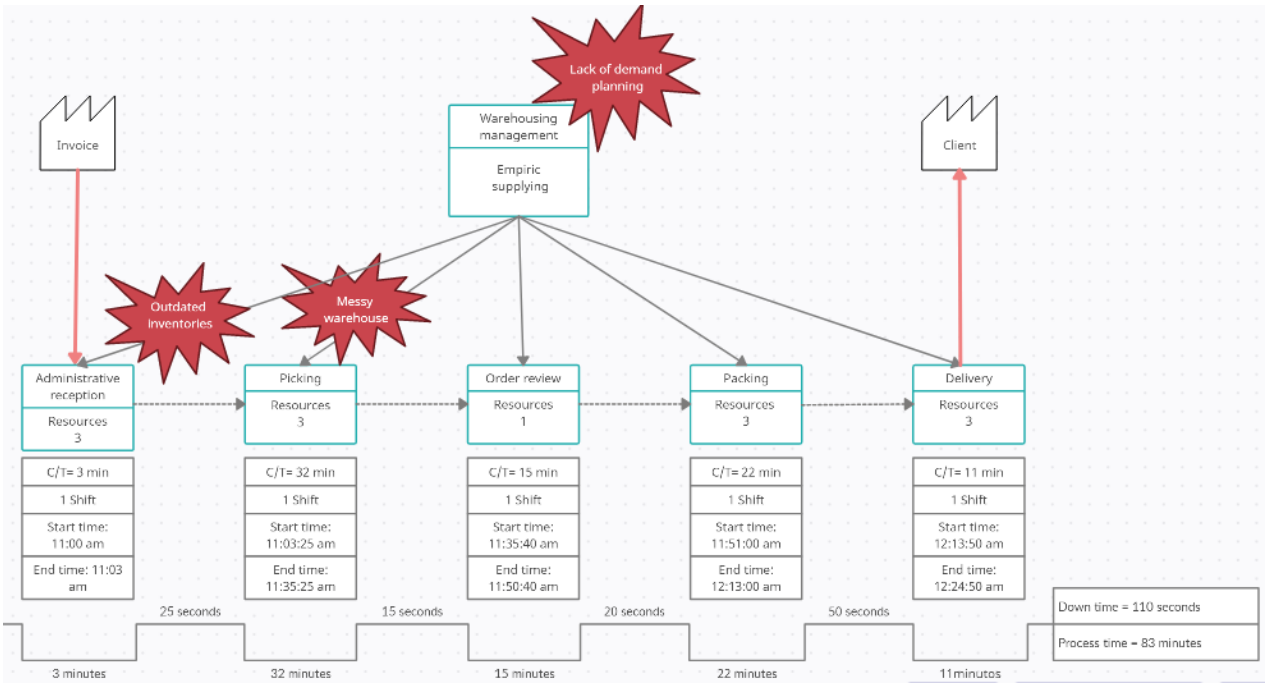

Figure 2. Stream Mapping of the process

The research problem has the consequences for the company like low financial performance; in other words, a decrease in profit and client dissatisfaction due to out-of-time deliveries, and lack of expected quality and quantity. These consequences will be shown through the data in table 2 and figure 3 respectively.

Table 2. Financial performance of the company by month

	Dec -20	**Jan.-21**	**Feb.-21**	**Mar-21**	**Apr-21**	**May-21**
Financial performance (%)	12.76%	7.22%	4.78%	4.92%	9.44%	10.20%

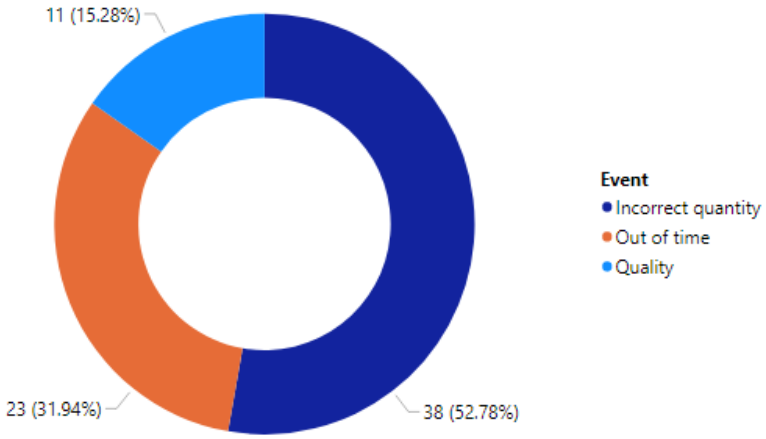

Figure 3. Dissatisfied clients because of mentioned problems

5. Results and Discussion

The engineering tools applied, as aforementioned, are Supply Chain Management (SCM) and Lean Warehousing. The proposed solutions seek to attack the causes of the problem. The strategy plan followed in the paper can be seen in figure 4

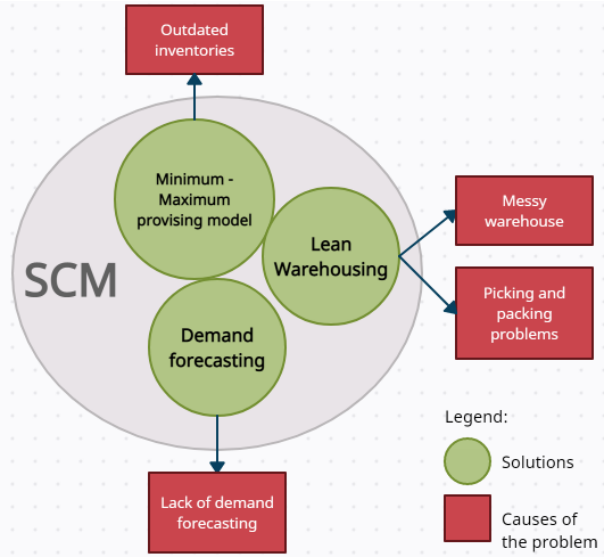

Figure 4. Graphic representation of the causes and solutions

To resolve the outdated inventories, the Minimum - Maximum provisioning model will be implemented, since the demand of the customers is variable and the capacity of the warehouse was not appropriate for large quantities of safety stock (Bonilla-Ramirez et al. 2019).

When implementing the Minimum - Maximum model, the annual sale record must be considered, since this information will be use to get exact data for the supply formulas. Similarly, the type A products of the ABC analysis, as well as the Kraljic matrix should be the main focus for the development of the model. The implementation of this model seeks to reduce the number of times the company does not have stock to serve and satisfy the customers' orders (Bonilla-Ramirez et al. 2019). This model allows tracking all the merchandise and updating the inventories.

To resolve the mess in the warehouse a Lean Warehousing tool was implemented. This is the system layout planning (SLP). For its development, it was required data about the stock on the warehouse, such as specific quantities, locations, and routes of the products. In the begging, the warehouse's initial distribution didn't count with any plan from the company for the location of products. This caused an increase in the picking and packing time, as well as in the workload of the warehouse workers. After that, a redistribution of the products was developed based on an ABC analysis, to identify the products that have the most sales (Bonilla-Ramirez et al. 2019). The storage area was reorganized, which allowed creating a fluid route of the operations at the moment of performing them. The restroom was removed to preserve the safety and health conditions in the warehouse. The result can be seen in figure 5.

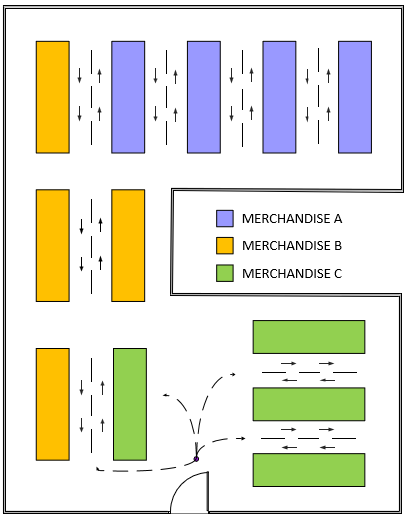

Figure 5. Redesigned map of the warehouse

For problems presented in picking and packing a simulation of the client's reception and delivery of orders process was performed on Arena, which included the following operations: order reception, picking, review, packing, and product delivery. The simulation can be seen in the following figure 6.

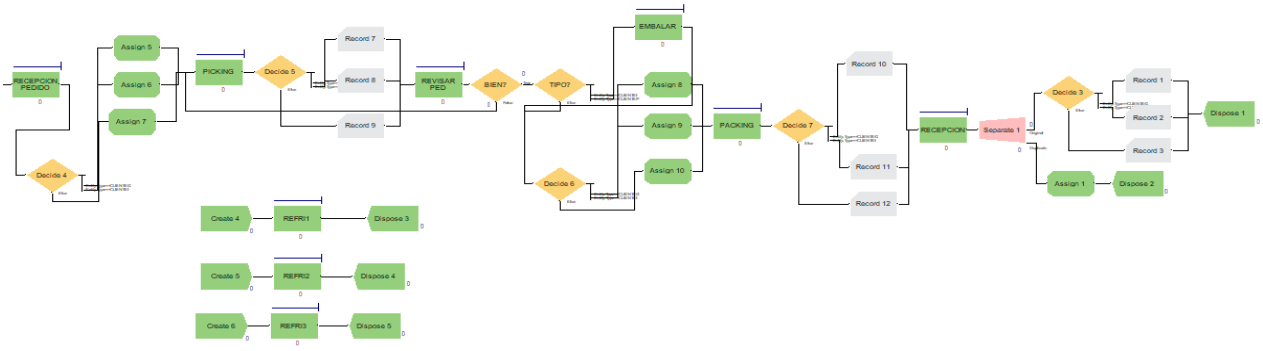

Figure 6. Simulation of the process before optimization

A double simulation was performed, one before implementing optimizations and the other with optimizations implemented. To evaluate the probability distribution, the activities of each process were tracked during the simulation. The Kolmogorov Smirnov tests were held using a p-value of 0.05. Once the statistical analysis of the goodness of fit for the variables was performed, the appropriate distribution for the picking and packing activities can be obtained. These results adjust to a logarithmic uniform distribution (p-value 0.10). For the times of the other activities the same distribution was used. This shows that the data is viable to use in the simulation model to find a solution to the picking and packing problems (Correa et al. 2012).

The results produced in both scenarios are shown in the following table 3. Please note that the indicators cover three types of orders: small, medium, and big.

Table 3. Measure indicators by the simulation

Indicator	Unit	Before	After	% of optimization
Number of bottles by type of order				
Small order	Invoice	8	11	37.50%
Medium order	Invoice	3	9	200.00%

Big order	Invoice	3	5	66.67%
Time spent on PICKING by type of order				
Small order	Minutes	14.2	6.7	52.82%
Medium order	Minutes	47.1	45.5	3.40%
Big order	Minutes	35.5	10.7	69.86%
Time spent on PACKING by type of order				
Small order	Minutes	9.8	9	8.16%
Medium order	Minutes	22.3	15.5	30.49%
Big order	Minutes	34.3	22.6	34.11%
Percentage of processed orders by type of order				
Small order	%	62.50%	45%	17.50%
Medium order	%	67%	40%	27.00%
Big order	%	67%	44%	23.00%
Average wait time	Minutes	3.2	2.8	12.50%
Percentage of use of resources				
Employee A	%	9.80%	12.10%	2.30%
Employee B	%	39.90%	51.40%	11.50%
Employee C	%	23.40%	92.10%	68.70%

When comparing the process of the initial simulation and the optimized scenario, it can be concluded that the appropriate layout has more entities assisted, fewer reprocessed orders, more utilization of resources, and less operation times in our processes of interest. The proposed solution makes it possible to optimize the picking and packing processes and could potentially positively impact the satisfaction of the client's needs and the efficiency of resources and warehousing of products (Correa et al. 2012).

To address lack of demand, working with an associative forecast model was proposed. This model takes into account one or multiple variables related to the quantity that wants to be forecast. Once the variables are obtained, a statistical model was developed that shows the future behavior of the elements of interest is prepared (Heizer and Render 2009).

6. Conclusion

This paper shows that through the implementation of engineering techniques, such as Supply Chain Management and Lean Warehousing tools in the supply chain processes of an alcoholic beverage retail company optimizations can be quantified. Additionally, the studied company's resources can be better exploited bringing a series of benefits, such as the decrease in costs and expenses, an appropriate type of demand forecasting, and a method to update inventories that adjust to the company's requirements. This paper is focused on one of the causes of our research problem, which is the delays in picking and packing processes. To tackle this, the Value Stream Mapping lean tool was used to make a deeper diagnosis that allows us to have more details of the process. After that, this data was run through the Arena simulation program and, afterward, the corresponding optimizations using the system layout planning (SLP) lean tool were proposed. As more businesses enter the supply chain of the retail sector market, is more necessary to perform extensive studies about the problems in the supply chain processes and its causes to get solutions through engineering tools. For future research, the reliability rate of the simulation that comprises the optimization techniques could be improved by using other tools that come as a complement of Arena, like Output Analyzer, in which each researcher can determine the reliability percentage that they wish to get on the results. This tool also allows producing statistical analysis based on the simulation results.

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