Implementation of Improvement Measures for the Refusal % reduction in Distribution Centers of a Peruvian Brewing Company

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Abstract

The order's delivery process of this Peruvian brewery generates many rejected orders and, therefore, cost overruns, for which the present work aims to make an analysis of the main problems, such as product quality, truck loading errors and non-payment of clients; and propose improvement actions to reduce refusals, operating and transportation costs. In addition, the purpose of the research is to demonstrate the profitability of the proposed improvements, both establishing a prepaid service and implementing RFIDs for inventory control, based on the current situation of the company and its logistics network, and analyze how these improvements affect the main KPI refusal percentage. On the other hand, the methodology has followed the IMRAD structure, and tools such as Input Analyzer and the Monte Carlo Method were utilized. The main findings of the research explain that the refusal % was reduced from 2.28% to 1.83%, and the benefit / cost of the proposed improvement actions has a value of 1.83, indicating that for every dollar invested, there is a benefit of 1.83 dollars. This proposal, shows that these actions are effective and feasible, maintaining the service level and reducing the costs previously mentioned.

Keywords
Refusal, Logistics, Improvement, RFID, Prepayment

1. Introduction

The company is a beer production enterprise that sells drinking consumer goods such as beer, carbonated drinks, water, energizers, etc. As of now, this company holds more than 95% of the beer market share and it is constantly increasing. That is why it has 5 production plants and more than 100 distribution centers where the products are sent to be distributed in the different regions throughout Peru. In addition, there are 5 main distribution centers located within the same premises of each plant that have their own distribution networks, which have been located according to geographical convenience. From these centers, orders are distributed nationwide in trucks, thus achieving coverage of demand at the country level. The company relies on taking customer orders through an online application to be able to schedule their shipments. Likewise, it has processes that primarily include the production of beverages and their due shipments to the distribution centers to later transfer them to customers. Within this chain, the goods produced are boxed and distributed by trucks to previously specified distribution centers. Boxes of 12 and 6 units are used for the customer's order presentations. During these activities, refusals may occur along the process. Refusals are orders (classified as Not Delivered) for beverages that have not been delivered as planned or that have been delivered incorrectly due to logistical, customer, or sales reasons.

The company has agreed to share their organizational and historical data for research purposes in this investigation, which means that every numeric data collected is reliable and true. According to historical data of 2022, 6.44% of the orders are refusals due to poor quality presentation, and this percentage is higher than the one obtained in 2021 which is 6.13%. This problem involves having dented products, broken tags, ripped tags, between others, caused by wrong product manipulation by workers. This poor quality presentation is visually determined the workers' observations. Likewise, 3.86% of the orders are rejected due to a product truck loading error, obtaining an amount of 19,042 boxes rejected by customers. This percentage has increased in comparison with the year 2021, where these rejections happened in 3.42% of the orders. This is caused by controlling incorrectly the traceability and the identification of products, which makes them be loaded, by workers, into the wrong trucks with different destinations from the desired ones. Since past years, the company has had to deliver orders to final customers at an increasing rate because of the

market expansion and due to the Covid-19 pandemic, which brought more sales opportunities and more refusal appearances during the whole delivery process given the larger amounts of orders. Currently, about 3% of these are classified as refusals due to incorrect delivery for various problems, which exceed 18,000 monthly orders. In this aspect, refusals due to logistic reasons occupy 15% in volume of the total number of rejected orders. Within this logistics field, there are refusals due to poor quality presentation and truck loading errors that exceed approximately 10% in volume of the total number of orders rejected in the period. Likewise, the refusal percentage attributed to the customers field is 45% of the total volume of rejected orders in the period. This generates, consequently, the greatest amount of order refusals, which transform into lost resources of the company. The refusals have had negative effects on the monthly costs for the company because since January 2022, they have generated cost overruns. The current refusals percentage is 3.2%, which is much higher than the budget of 2.62%.

The purpose of this research is to improve the processes involved in the provision and truck loading of product orders and to propose a more efficient model for the current digital customer ordering platform. The aim is to achieve greater efficacy during the product loading process so that they coincide with the orders placed, thus achieving a reduction of refusals which will be measured through the indicator of the percentage of rejected orders.

1.1. Objectives

This research intends to analyze the current situation of the company's order refusals to identify factors of improvement on the customer and logistics fields. Based on this, this study will propose improvement actions on the current processes to reduce the order refusal percentage and will analyze their quantitative effects as a result.

2. Literature Review

According to the research of Chen et al. (2013) about a supply chain with a control headquarters, a central distribution center, local distribution centers and small stores, there have been challenges in terms of long times of waiting between the members of the supply chain. After implementing improvements that reduced times and operating costs the result was a reduction of the total transfer time in local distribution centers of 19% after having eliminated waste within the chain. Furthermore, according to Natanaree (2014), warehouse procedures are difficult to carry out and this increases with a greater number of products, therefore, activities need to be carried out efficiently and an updated technology is capable of generate profits in these centers.

On the other hand, the Engineering Method is a systematic critical examination of the existing and projected methodology used to carry out a job or operation. It has wide applications in industries, its essence allows adaptation to any type of workstation and/or work methodology used (Salazar 2019). Therefore, it is common to implement this technique in both manufacturing and service companies (Espinal et al. 2012). For logistics processes, Engineering Methods technique can be used for the design of jobs and flows of materials and products (Correa et al. 2012).

On the other hand, inventory management can be a complex operation for those responsible for storage and stock control. As Hamidi et al. (2010) mentioned, the use of technological tools allows direct contact between managers and inventories, and automatically records, identifies, and warns the user about the inventory's condition. Logistics management needs inventory management to perform its activities and meanwhile, a successful logistics system could help to improve warehouse environment and operational activities. (Oluwaseyi et al. 2017).

The construction of warehouses and distribution centers must be able to carry out processes of entry, distribution, operations, and dispatch in a way that achieves efficiency. According to the research by Liu et al. (2019) the model of their warehouses in Yonghui contemplates these activities to achieve significant economic benefits, which allowed them to achieve a reduction in storage costs, greater efficiency and give a better image of the company.

The research made by Cañas and Correa (2013) explains the benefits of implementing advance payments in an automotive service, which can be transferred to any other process, such as of selling orders. The results indicate that it is necessary to protect the value of the products and services offered by the company to protect its value. Based on the paper made by Saygin (2006) the use of technology such as RFIDs in warehouses, instead of manual processes, could increase the service level up to around 95%, The system serves the purposes of identification, monitoring, authentication (Nambiar 2009) The use of sensors and RFIDs are more practical compared to the traditional model. It is convenient to take stock using RFIDs because inventory handling costs and inventory losses are reduced, and it increases flexibility against the market and increases competitiveness. (Liu et al. 2019). The profits of a company can

be increased with the use of RFIDs, since it optimizes the techniques to be used to promote, select, classify, among other things, the company's products, which improves efficiency and reduces operating, commercial and financial costs. (Yahia 2010). There is a significant relationship between the digital transformation of a supply chain and the improvement of the operational performance of its company. (Sukhotu 2021). Investing and implementing emerging technologies will create a sustained competitive advantage for companies. (Agrawal and Narain 2018).

3. Methods

The research to be developed has a pre-experimental design with a quantitative approach that consists of a methodology built by a diagnosis with relevant data, a modeling of the current situation, presentation of the improvement proposal, modeling of the situations with improvements, and a comparative analysis. Mainly, the investigation will focus on refusals generated by loading errors and poor quality presentation, and the non-payment of orders by customers.

3.1. Diagnosis

The dimensions that manipulated to propose improvements are the loading method and the digital order taking. During the loading method, products with inappropriate presentation quality and products that are not part of the correct orders are loaded to the trucks for later delivery. On the other hand, the actual order-taking process currently allows customers to schedule online orders to be fulfilled. However, there are many cases that, upon receiving the products, the corresponding payments are not made by customers, and the orders are considered rejected.

The population on which the research will be based will include distribution centers in the regions consisting of North-East, Center-South and Lima, from which real data can be obtained. These DCs belong to the brewing company in question and are the ones that distribute the orders of finished products to the final customers. It is important to emphasize that order taking includes the reception of these by the sales area, which are then processed by the logistics planning area, who finally manage all daily orders. On the other hand, the analysis' time period will be the first 20 weeks of 2022, given that the results will be more recent and reliable, due to the great variability of the demand and external problems that have occurred in these months.

3.2. Current Situation Modelling

RFM The company makes an inventory count of the available stocks that are ready to be sold. With this information, the stocks are programmed in the digital system so customers can view the available products. After that, orders are placed on an internet platform called BEES, where customers make the order according to the quantity of products they want. Then, the company makes the programming of the time window, according to the availability given by the customers. These validations allow the confirmation of the products that will be loaded into the trucks for the needed routes to the warehouse destination. This is the point where the manual picking process of the products is initiated an where they are put into boxes according to the customer's orders. Pallets are used to pile up the boxes in a way that they are stable enough to be moved with a pallet-transporter. The products are then loaded into the respective trucks for further dispatch to the programmed route and then the orders are finally delivered to the clients' destinations.

3.3. Improvement Measures Presentation

The improvements to be proposed to the company's actual situation will be based on Ishikawa's analysis of root causes of the refusals due to truck loading errors and poor quality presentation, and the non-payment by customers. Truck loading errors refer to products being loaded to the incorrect trucks with incorrect destinations. Poor quality presentation involves having dented products, broken tags, ripped tags, etc. Non-payment by customers mean that the clients, for various reasons and problems, don't end up paying for the orders. The main findings are stated below.

For the first dimension, there was found that there is not a great use of technology in terms of a system of traceability of products; there are a lot of manual physical processes where products could be handled wrongly; the products are fragile (plastic tags, fragile metal cans, carton boxes, etc.) and the workers need to be quick during product handling, which increases the risk of being rough during the picking process. The presentation quality of products is checked only with visual inspection, so there are products that are not quality-fit and are still loaded to the trucks. Some of these quality issues are scratches, ripped off plastic tags, dented cans, between others.

For the second dimension, there was found that the causes associated with the non-payment of orders come mainly from the digital system used to register and take the orders, given that the problems include orders that are issued

erroneously, duplicated or not complete. Also, there is no way or actual method to pay for orders before they are confirmed, so it may happen that, at the time of delivery, these are not paid by customers. The company's policy allows this type of operation, and it does not provide guarantees for the payment of orders once they products are delivered to the destination.

3.4. Proposed Situation Modelling

The techniques to be used for the investigation will be important for data collection and to be able to make further analysis of the situations that will be generated. These include techniques such as observation of historical data and modelling, both of which involve the use of instruments. For the evaluation of the proposals to be implemented, for each of the 2 types of refusal problems, the factors will be weighted out followed by a Weighted Criteria Matrix where the comparison of solutions is evidenced to identify the one with the highest score with respect to the important factors. Observation will serve mainly to identify quantitative data on the number of orders, refusals, among others. On the other hand, the Monte Carlo analysis uses Microsoft Excel as an instrument to generate results. This is a method that considers a variety of random iterations to reflect average results of different data that will be used to evaluate the proposed model and its viability as an improvement over the current situation. In order find two statistical distributions of random variables, the Input Analyzer extension of the Arena program will be used in the model. Likewise, a description of the new model and the main benefits obtained with the changes will be presented.

3.5. Comparative Analysis

Based on the proposal that will be presented, an analysis of the current and new situation will be made. Main changes, implications and main benefits that arise from what is proposed will be contemplated. About the main changes, there will be an analysis of the additional processes to be carried out that add value, the creation and substitution of the affected activities will ensure a lower level of refusals. The most important results will be compared, in terms of the impact in the refusal percentage indicator and in the volume of hectoliters and orders.

4. Results and Discussion

4.1. Solution for Refusals by Loading Errors and Poor Quality Presentation

Regarding the refusals due to loading errors and poor quality, a weighting of factors was done to evaluate the best proposal to be able to control and carry out traceability of the products. The factors considered (from A to E respectively) are cost, utilization complexity, reading velocity, energy necessity and data storage capacity. Three proposals will be considered.

The first option is the use of RFID technology that uses a reader equipment that emits electromagnetic waves to load the labels and thus be able to receive the information. The labels are attached to the product as stickers, they can be in several units per dollar if the volume is large and they do not require their own power. The readers can identify multiple labels at once. The second option is the bar code system, which involves a reading device that identifies a black and white bar code. It identifies only one product at a time, but this makes the reading much more precise. They are also cheap and bought in large volume. It works with a short reading range with a maximum of 4.5 meters. The labels are attached as stickers or can be printed and do not require power. The third option is the use of the WIFI Tags system, which is a more advanced and complex technology than others, so it also costs much more. They are active labels that provide data and information in real time about goods and work through the internet. Batteries are used as power sources to be able to always function. It requires an appropriate installation environment for its operation.

Table 1. Weighted Criteria Matrix 1

	RFID		Bar Code		WIFI Tags	
Factor Weight	Qualification	Score	Qualification	Score	Qualification	Score
A 0.1	3	0.3	4	0.4	1	0.1
B 0.3	4	1.2	3	0.9	3	0.9
C 0.2	3	0.6	2	0.4	3	0.6
D 0.1	4	0.4	4	0.4	1	0.1
E 0.3	2	0.6	2	0.6	3	0.9
Final Score		3.1		2.7		2.6

The different options were evaluated with a logistics expert from the company with a score range between 4 and 1 for the very good, good, regular and bad criteria. The implementation of the RFID system for the Distribution Centers was chosen. The use of RFIDs within the process will be used to identify and have technological traceability within the distribution centers and inventories. The reasons for this proposal derive from the greater precision and technological control of products through labels for reading by RFID scanners with data stored in databases. Thus, the use of this technology helps to identify the products that enter the trucks and are distributed to contribute to the correct loading of the products and to identify their batch in case they are damaged in a more efficient, fast and precise way.

As for the more technical characteristics, the system consists of RFID readers that are small machines, which are handled with one hand, that emit electromagnetic waves towards the labels that are stuck on the products. In this way, an electrical charge is induced in the labels that will cause the signal to return to the reader with the information contained. This proposal implies the installation of the RFID system with UHF (Ultra High Frequency) labels that are attached to the boxes of the products, which contain information about what product there is, how many there are, the batch and the order to which it belongs. The operators of the DCs will be able to register the exits and entrances of products with the readers quickly and thus the products would be correctly assigned. More than 100 labels can be scanned simultaneously without the need for line of sight, automating the process that would have required more time and resources and would be subject to more human error (Peak Technologies, 2019).

4.2. Solution for Refusals by Loading Errors and Poor Quality Presentation

Regarding the refusals due to non-payments by customers, a weighting of factors was done to evaluate the best proposal to be able to reduce this indicator. The factors considered (from A to D respectively) are cost, implementation easiness, efficacy and infrastructure necessity. Three proposals will be considered.

For the implementation of prepayment, this implies the need to pay before accepting the customer's order, in order to ensure the correct delivery of the products on the agreed day. On the other hand, the cost of this solution is very low, and its ease of implementation is very good, since it would be enough to add that option to the application. This option would be applied to customers with frequent non-payment recidivism, and they will be communicated that the company has cost overruns for these refusals, so this will be the new policy. The second option includes the use of calls to customers before starting the order delivery process. However, this situation still allows customers to cancel their orders without penalty. The cost of the current situation is high, since large cost overruns are generated by rejected orders. In terms of its effectiveness, this is rated as regular, since rejected orders can be further reduced. The third option is the increase in credit, which would imply granting customers a greater amount of credit so that they can make their purchases, in a regulated manner, as long as they are frequent customers and have no history of cancellations. In terms of cost, this would be very low, and it would be easy to implement. However, it would not be as efficient as the other options since customers could still cancel their orders.

Table 2. Weighted Criteria Matrix 2

	Prepayment		Postpayment		Increase in credit	
Factor Weight	Qualification	Score	Qualification	Score	Qualification	Score
A 0.33	3	1	2	0.67	3	1
5B 0.17	4	0.67	4	0.67	3	0.9
C 0.17	4	0.67	2	0.33	2	0.33
D 0.33	4	1.33	4	1.33	4	1.33
Final Score		3.67		3		3.17

Using the same criteria as in the previous case, we determine that the main solution for this issue is a better design of the virtual platform for taking orders, the most important feature being the operation of virtual prepayment of orders generated before their registration is completed, this being only applicable to repeat customers. Thus, the number of orders delivered to customers rejected for non-payment would be reduced, since the total payment would be made previously. In addition, the company’s policy will also need to be more flexible to allow these changes in the operation in order to obtain benefits.

4.3. Parameters and model data

All amounts used in the model are in hectoliters (beverage unit). The statistical parameters that have been used come from the company's historical data on a weekly basis about the volume in hectoliters planned to be delivered (demand) and the volume in hectoliters not delivered (refusals). Using the Input Analyzer extension of the Arena program, it was possible to find the random variable distribution for both statistical parameters mentioned above. They are Demand (DEM)=149000+125000*Beta (1.6;0.702) and Initial Refusals (RI)=Triangular (3430;5380;7330).

4.4. Controlled Variables

Table 3. Controlled Variables List

Controlled Variables	Description	Value
Non-payment Reason		
% SD (Non-payment Percentage)	Average Non-payment Refusal % from the total Refusals (historical data)	20.33 %
% PP (Prepayment Percentage)	Representation of the client recidivism % to have prepayment imposed (Authors' decision)	70.00 %
Truck Loading Error Reason		
% EC (Loading Error Percentage)	Average Loading Error Refusal % from the total Refusals (historical data)	1.67 %
% PCI (Inventory Control Percentage)	Percentage of products to have traceability after the picking process. (Natanaree 2014 investigation result)	100 %
% IEC (Load Error Imprecision)	RFID imprecision during truck loading. (Buckel & Thiesse 2013 investigation result)	1.22 %
Poor Quality Presentation Reason		
% MC (Poor Quality Presentation Percentage)	Average Poor Quality Presentation Refusal % from the total Refusals (historical data)	2.14 %
% TAP (Saved Time Percentage)	Saved time % during order preparations. (Chen et al. 2013 investigation result)	60 %

4.5. Non-Controlled Variables

Table 4. Non-Controlled Variables List

Non-controlled variables	Formula	Description
Non-payment Reason		
SDE (Non-payment Estimation)	SDE = %SD*RI	Actual refusals (hl) due to non-payments.
VPP (Prepayment Volume)	VPP = %PP*SDE	Number of hl to go through be prepayment.
SDN (Non-payment New)	SDN = SDE-VPP	New refusals (hl) due to non-payments after the proposal.
Truck Loading Error Reason		
ECE (Loading Error Estimation)	ECE = %EC*RI	Actual refusals (hl) due to loading errors.
ECN (Loading Error New)	ECN = ECE-(%PCI-%IE)*ECE	New refusals (hl) due to loading errors after the proposal.
Poor Quality Presentation Reason		
MCE (Poor Quality Presentation Estimation)	MCE = %MC*RI	Actual refusals (hl) due to poor quality presentation.
MCN (Poor Quality Presentation New)	MCN = MCE-%TAP*MCE	New refusals (hl) due to poor quality presentation after the proposal.

4.6. Monte Carlo Method Results

Using random Excel values (Aleatorio 1 and Aleatorio 2 in Figure 1), the 2 distributions previously mentioned and the Controlled Variables, the Monte Carlo method was employed for 10,000 observations in order to get a more reliable result on the refusal reduction percentage and volume indicator. For this, the Demand distribution and the Initial Refusals distribution were fed with Excel's random number generator (Aleatorio 1 and Aleatorio 2), as shown

in columns 2 and 3 in Figure 1. The variables mentioned previously were then calculated using their respective formulas, as shown in Table 4 and using the historical data as shown in Table 3. All of these calculations finally led into the results on the volume quantity of beverages that had a refusal reduction, which then transforms into the final refusal % obtained after implementing the improvements stated. After doing the entire Monte Carlo analysis, the graph obtained is shown in Figure 2, where it is evidenced that the most common refusal reduction, in an annual scale, belongs to the range between 48.43 and 49.53 kilohectoliters (volume unit that represents 100,000 times the number of liters).

Table 5. Results List

Result	**Formula**	**Value**	**Description**
% RTE (Total Refusal Estimation)	% RTE = 100*RI/DEM	2.28 %	Actual total refusal percentage.
% RSDN (Non-Payment Refusal New)	% RSDN = SDN*100/RI	6.10 % (previous value was 20.33%)	New refusal % due to non-payment after the proposal.
% RECN (Loading Error Refusal New)	% RECN = ECN*100/RI	0.02 % (previous value was 1.67%)	New refusal % due to loading errors after the proposal.
% RMCN (Poor Quality Presentation New)	% RMCN = MCN*100/RI	0.86 % (previous value was 2.14%)	New refusal % due to poor quality presentation after the proposal.
RR (Reduced Refusals)	RR = (SDE-SDN)+(ECE-ECN)+(MCE-MCN)	922.60 hl	Number of refusals (hl) reduced after the proposal.
% RTN (Total Refusals New)	% RTN = (RI-RR)/DEM	1.89 %	New refusal % after the proposal.

The results presented show that the level of total refusals of the company with the presented proposals was effectively reduced. On average, it was possible to reduce 992.60 hl of weekly refusals, which means that this indicator went from having 2.28% to 1.89%. This represents a decrease of 17.11% of total refusals per week. The following figures show the results obtained.

Observacion	Aleatorio 1	Aleatorio 2	DEM	RI	SDE	VPP	SDN	ECE	ECN	MCE	MCN	RR	RTN	RTE
1	0.971884063	0.548602575	273539.53	5477.20	1113.51	779.46	334.05	91.47	1.12	117.21	46.8848099	940.14	1.66%	2.00%
2	0.067814516	0.041904029	179077.11	3994.52	812.09	568.46	243.63	66.71	0.81	85.48	34.1930708	685.64	1.85%	2.23%
3	0.708362773	0.179892765	260614.68	4599.65	935.11	654.58	280.53	76.81	0.94	98.43	39.3730163	789.51	1.46%	1.76%
4	0.493527443	0.338043128	242963.68	5033.38	1023.29	716.30	306.99	84.06	1.03	107.71	43.0857076	863.96	1.72%	2.07%
5	0.972611955	0.010802261	273556.44	3716.62	755.59	528.91	226.68	62.07	0.76	79.54	31.8142698	637.94	1.13%	1.36%
6	0.263333121	0.863574484	215872.24	6311.41	1283.11	898.18	384.93	105.40	1.29	135.06	54.0257097	1083.33	2.42%	2.92%
7	0.49809976	0.304820778	243405.68	4952.55	1006.85	704.80	302.06	82.71	1.01	105.98	42.3938379	850.09	1.69%	2.03%
8	0.396480719	0.07798726	232795.87	4200.13	853.89	597.72	256.17	70.14	0.86	89.88	35.9530733	720.94	1.49%	1.80%
9	0.047507369	0.684556308	173234.11	5781.15	1175.31	822.71	352.59	96.55	1.18	123.72	49.4866082	992.31	2.76%	3.34%
10	0.662966494	0.678525034	257391.43	5766.41	1172.31	820.62	351.69	96.30	1.17	123.40	49.3604602	989.78	1.86%	2.24%
11	0.476152394	0.005607317	241255.13	3636.50	739.30	517.51	221.79	60.73	0.74	77.82	31.1284689	624.19	1.25%	1.51%

Figure 1. Monte Carlo Method in Excel for the first 11 observations out of 10,000

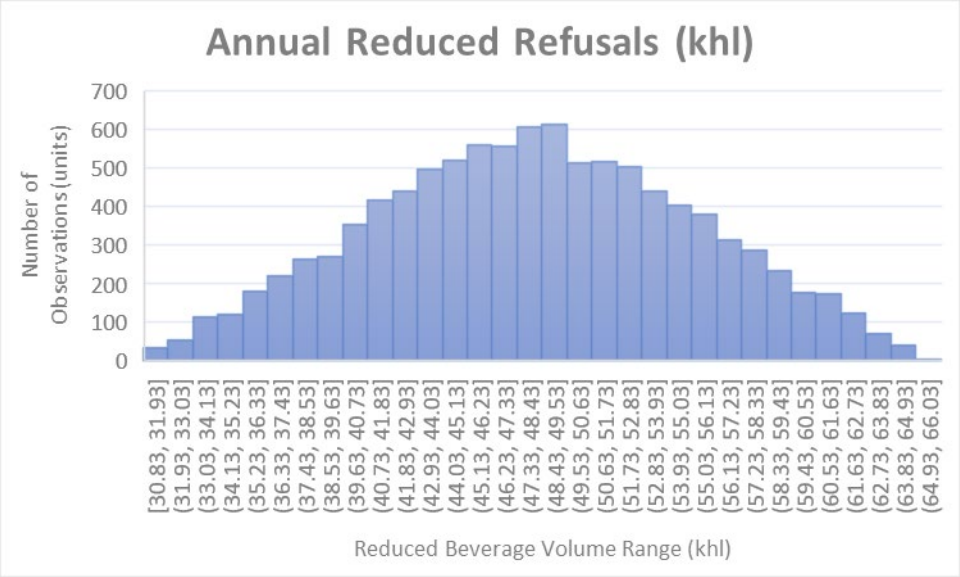

Figure 2. Reduced Refusal Histogram in kilohectoliters

4.7. Economic Results

The implementation of the proposed improvements has as its main objective the reduction of refusals since these mean the non-delivery of the products to the clients, whether for reasons of the company, the clients, or others. However, the viability must be evaluated economically and if benefits are generated greater than the costs.

The benefits derived from the implementation of an RFID system are not only limited to the greater and traceability of products when loading them to trucks, but also, being a technological system, there are also time efficiencies, fewer errors and less operating costs. On the prepayment side, fewer shipments of products that would not be paid are made, so transportation costs are saved and there is now the opportunity to deliver orders that definitely would be paid.

About the transport operation, the current data is the following. There is an average cost of 9.93 soles/km, trip of 42 km/truck and number of 700 trucks/day, which result in 42*9.93*700=291,000 soles/day. On the other side, according to Table 5, out of the 2.28% of the actual refusal %, there is a % saving of 14.23% for the non-payment reason, 1.65% for the loading error reason and 1.28% for the poor quality presentation reason, where RFID is only involved in these last 2 values. This means that there is a 2.28%*(14.23+1.65+1.28)%=0.39% saving of transport costs. Combining these results and considering 6 working days per week, 4.33 weeks per month and 12 months per year, there is an annual transport saving of 291,000*0.39%*6*4.33*12=356,142.40 soles/year (equivalent to 89,035.60 dollars/year).

About the labour costs in the DCs, the current data is the following. There is an average warehouse worker salary of 1,050 soles/month, 53 DCs nationwide, 7 workers that would be benefited by RFIDs and 60% saved time (Chen et al. 2013), and considering 12 months per year, there is 1,050*53*7*60%*12=2,804,760 soles/year saved in labour costs.

On the other hand, the listed proposals also carry out costs. The costs derived from the implementation of the proposals include the implementation of the RFID system with the equipment, components, among other elements listed below. According to Chen et al. (2013), in their research on a consumer products company, the implementation of the RFID system involving PCs, readers, labels, software, training, among others, amounts to a $33,000 cost per distribution center divided over 5 years. Likewise, the cost of 200,000 dollars for the implementation of the system for the central operation offices must be included, which is also divided by 5 years. Considering 53 DCs and an exchange rate of 4 soles/dollar, there is a (200,000+53*33,000)*4/5=1,559,200 soles/year (equivalent to 380,800 dollars/year). This means that the RFID benefit/cost ratio is (2,804,760+60,868)/1,559,200=1.84.

For the implementation of prepayment, there is a single cost for the redesign of the virtual application for taking orders and a variable commission of 50 Peruvian cents for each order made of any amount. The prepayment implementation cost considers a change of the actual digital platform of order registrations. This operation has a cost of 7,000 dollars.

With an exchange rate of 4 soles/dollar, this unique payment would cost 7,000*4=28,000 soles. On the other side, there will be variable costs that consist of 50 Peruvian cents/order. Using the historical data, there are 543,876 orders/week, and considering 52 weeks/year, 100 Peruvian cents/sol, there will be 50*543,876*52/100=141,407.93 soles/year. This means that the annual prepayment implementation cost is 28,000+141,407.93=169,407.93 soles/year (equivalent to 42,351.98 dollars/year).

In summary, the proposals will obtain savings in transport and labour costs that sum a total of 356,142.40+2,804,760=3,160,902.40 soles/year (equivalent to 790,225.60 dollars/year). As a counterpart, the total costs of the proposals include the RFID implementation, the platform digital change and the variable costs for each registered order. These costs sum a total of 1,559,200+28,000+141,407.93=1,728,607.93 soles/year (432,151.98 dollars/year). Finally, the proposals result in a total profitable margin of 3,160,902.40-1,728,607.93=1,432,294.47 soles/year (equivalent to 358,073.62 dollars/year), which transform into a benefit/cost ratio of 3,160,902.40/1,728,607.93=1.83.

Given the results, it is evident that it is feasible to implement both proposals to reduce the company's refusals, which would generate better customer service and produce efficiencies in transportation and DCs operations. Given all the improvements, an annual benefit of 1,432,294.47 soles/year would be obtained by the company and this money could be used for other activities or invest in new ways of generating savings for the company. In total, for every sol invested, 1.83 soles would be obtained as savings, and this is very beneficial. As a summary, it is confirmed and shown that the proposals are economically viable given that the 3 refusal reasons worked on are capable of being reduced with investment in assets and changes in the company's policies, which were also capable of generating operation savings.

4.8. General Discussion

The results obtained previously show that, effectively, the proposals to be implemented in the processes will achieve a reduction in the company's % refusal indicator. On average, a reduction of 922.60 hl is forecast on a weekly basis because it is going from having 2.28% to 1.89% of refusals, which means a decrease of 17.11% in that amount. In this way, the company would no longer be sending or planning weekly deliveries of 922.60 hl to consumers who would not receive the product for the reasons of the study, which are refusals due to poor quality presentation, loading error or customer non-payment. Regarding the economic results, it was possible to find a total annual saving of 3,160,902.40 soles and a total annual cost of 1,728,607.93 soles, which generates a benefit of 1,432,294.47 soles per year and a benefit-cost ratio of 1.83.

It can be evidenced that a reduction in refusals was obtained, which derives from greater control over inventories and greater operability. This is complemented by the results of the research by Liu et al. (2019), which shows that RFIDs generate benefits by using automated equipment that analyzes several stocks at the same time to reduce errors of counting and operating time and improve the flow of communication between centers. Likewise, in their study of warehouses, they indicate that the change from the traditional method to one with more technology such as RFIDs improves warehouse management by reducing costs in the management of these centers, inventory losses, achieving time savings and even greater productivity. flexibility compared to the market.

Compared to the article by Cañas, T. and Correa, V. (2013), the selection of customers to whom to apply the prepayment differs in terms of the main reason. In the cited article, the customers were selected based on their purchase intent, however, in this research article, there are two selection criteria. In the first place, customers are classified by the status of "repeat offender" or "non-repeat offender", and they are the first to whom the prepayment is applied. Later, repeat offender customers are separated according to the average volume of orders they make, with those who consolidate a greater volume being eligible for prepayment.

On the other hand, the percentage of clients selected to have prepayment applied differs somewhat between both articles: 64% in Cañas, T. and Correa, V. (2013) and 70% in this research article. This is due to the method of customer selection mentioned above.

This research has used historical data of the company to locate the amounts of demand and refusals that have been had and has been complemented with information from other research articles. In this way, the results that have been obtained must be precise because they are all based on reality. However, the data sources are different, and it could happen that they do not exactly represent the situation that would take place in the company. Likewise, this research

has used the information collected by the company to forecast average results using the Monte Carlo method, which ensures greater reliability because it makes 10,000 runs of the model. This is an additional limitation because it all starts from the theory and conditions that we have presented. If one wanted to obtain more exact and demonstrable results, it would be necessary to physically implement the proposed proposals and carry out studies of the new physical processes.

On the other hand, there was also the limitation of not being able to measure the reaction to change by the company's collaborators, in the face of changes in the processes, nor was it possible to evaluate their capacity in the use of the technologies that are being proposed. These are also part of the limitations that could in some degree affect the results on the % of predicted refusals. We recommend that studies that have the facility to evaluate these criteria take it into account.

Comparing based on the research by Xiao et al. (2017), the values used in this research with the results of their study are similar, because they found a reduction in the time used by operators over time in distribution centers of 65% after implementing the RFID system. This value is contrasted with that used in the present investigation, which is (Chen et al. (2013) which is 60%, which shows a similarity in the amounts. It should be noted that RFID system costs based on their research in China, so the value for Peru could differ.

Likewise, in comparison with the research of Chen et al. (2013), they highlight in their study that the accuracy with the reading of RFIDs is 99.5%, which is similar to 98.78%, which was used in the present investigation. However, when working with large volume quantities of products, this difference in accuracy could mean considerable variance in inventory recording. It should be noted that they used lean manufacturing, which are techniques that help eliminate waste of time, inventory, materials, among others, and this would contribute positively to any distribution center. They also found that the use of cross-docking as a distribution and storage strategy further favors operating times.

The results obtained show a benefit-cost ratio of 1.83 in total for the 2 improvements implemented. On the side of RFIDs specifically, this ratio is 1.84, and it is contrasted with the value obtained by Tsai & Huang (2012), who achieved a ratio of 2.5 for their system in their study with RFIDs. This complements the viability of this improvement and its positive effect on cost savings. This study deals with a port in Taiwan with container trade of more than 1 million annually to achieve greater container security, eliminate manual inspections and reduce fees.

5. Conclusions and Future Research

The company effectively has the capacity to reduce the refusals % due to non-payment by customers, loading errors and poor quality, which generates a better rate of orders delivered correctly and generates efficiencies in transportation and distribution centers. There is a total positive benefit-cost ratio of 1.83, so the proposals are viable and beneficial. The flexibility in policies must be aligned with the objectives and planning of the company. It is necessary to analyze the client portfolio and formulate strategies for the different segments to ensure profitability.

Some differences with other investigations include the SKU numbers of the companies, since in this case there are not as many codes as in others. Also, some involve supply chains with ocean shipments of products. On the other hand, the investigations are assimilated to the studies of companies with high turnover products, especially in the warehouse areas, and because the sources of efficiency are focused on eliminating the waste of operating time, resources, and unnecessary transfers, which are converted into costs.

The novelty of this research was the focus on a problem not so commonly analyzed, which represents refusals, which cause less customer service and money losses from various sources. The 3 specific reasons investigated, and the improvements not only fulfilled the main objective of reducing rejects, but also show a correlation with efficiency in distribution centers. Likewise, the Monte Carlo Method was used to foresee probabilistic cases that model reality. It is recommended to expand this research with analysis of physical operations and time studies in the different distribution centers to further reduce times, routes and further automate processes. Inefficiencies due to waste of time, products and operations were eliminated. For this reason, the implementation of lean manufacturing techniques, analysis of routes and increase of technology in DCs for other operations would surely generate lower costs.

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