

## Feasibility Analysis for Sorter Modification

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**ABSTRACT:** To expand the storage and distribution capacity, it is necessary to make the processes efficient with quality and safety of the packages to guarantee and maintain the expected level of acceptance and/or the attraction of new clients, based on research and manipulating parameters in the Sorter. In order to find the most useful point, carrying out random quantitative tests on the machine, conducting interviews with the personnel who are in contact and with the operators, the aim is to have a result of 70,000 packages per day, although for this it is necessary to add feeding lines, labeling stations and Leverage 100% of existing equipment as streamlining warehousing and distribution processes is so pressing.

**KEYWORDS**—Sorter, PLC, KVA, Paquetes.

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### I. INTRODUCTION

Due to population growth, supply, demand and, above all, competition, companies are forced to reduce their costs and increase the quality of their products.

In addition to considering a quality service as the main tool for attracting customers who seek not only to satisfy the need to purchase a product, but also to feel cared for and convinced that the purchase of their product exceeds needs or expectations, generating a climate of comfort.

It always seeks to be the best option, not only in quality and price, but also in service, generating comfort and acquiring the confidence of the customer who, as an expert, will realize that we have the products they require.

But to achieve this, it is necessary to have first-rate logistics that allows us to face the new challenges that arise, for which innovation and continuous improvement are required. For this reason, there is a need to expand storage and distribution capacities to reach the level that the client expects of us.

### II. PRESENTATION

Within a storage system as a set of processes whose purpose is to maintain and preserve the products in stock in optimal conditions for their disposal when they stop becoming products to be needs requested by customers.

A machine that makes an automatic selection used for the distribution of merchandise that works quickly and applies volumes to carry Softline (small packages) has been since its creation a system of easy adaptation and popularity for logistics where the main characteristic is the speed and efficiency avoiding errors and above all helping to reduce times to meet established deadlines for companies that are dedicated to the classification and preparation of orders in this way to comply with the process.

The system of classifying packages is very important, making them automatically and for this the "Sorter" (Classification System) is used, in which to do logistics, knowledge of this technological tool is important in order to deliver complete and reliable, although it is a relatively new tool, it has to be studied in greater depth due to the issue of improving efficiency.

### III. FACTORS

Competitiveness

The most important part that we must take into account to obtain the benefits of a Sorter is the efficiency of the orders or products and, above all, the particular indicators of each operation. With this system, more routes, distribution channels, reduction of times, are obtained. Cost reduction and flexibility without

leaving aside that includes automated and computer systems that make the operation optimal to provide visibility in terms of information instantly and with this, competitiveness is substantially increased.

#### Error reduction

One of the reasons why Sorters are considered highly important is to justify a good classification, especially in reducing errors, since the Sorter can classify up to 300 packages per minute, this can increase depending on the degree of need. of the operation, this is extremely necessary, above all to attend to all those customers who demand a large number of packages, boxes or products that must be delivered on time, in the correct manner and above all without errors, since the service and quality and above all by not having so many manual processes that can mistreat the merchandise are very important considerations in a distribution center.

It can also be used in reverse logistics when the packages were not delivered and storage or return to suppliers is required, in addition to considering that for the admission or entry of suppliers it turns out to be much faster.

#### Versatility

It is essential to carry out a good selection of Sorter considering effective consulting, engineering and implementation to carry out endless benefits. To select the Sorter that best suits the possibilities, it is necessary to carefully consider analysis of industrial, mechanical, electrical engineering and systems that guarantee the entire operation. This will lead us to classify in different ways, be it orders, routes, types, etc. Another good thing is that it can be used as an order assortment or shipping area assortment item.

This is guided through software, sensors, motors, belts, and electrical and electronic controls that help transport package loads of various kinds to the interior and exterior of a distribution center in a precise and controlled manner [1].

Although there is no clear information on the creation of the first automatic classification system, there are those who assure that it comes from the Netherlands, they are among the main pioneering companies of worldwide renown, it is possible to mention Daifuku, Dematic and Vanderlande.

Every day, manufacturing and distribution operations must sort large amounts of inventory into cartons, other boxes, shipping containers, bags, or padded envelopes. As service level agreements become more demanding, the pressure to perform on or above expectations increases. This reality, coupled with higher order volumes, shorter processing times, and increased operating costs, is driving the need for automated sorting becoming increasingly popular around the world [2].

### **IV. THERE ARE SEVERAL TYPES OF CLASSIFIERS**

**CROSSBELT SORTER** The Sorter Cross Belt is a piece of equipment that offers the greatest range in the industry. It has the functionality of connecting to courier and parcel centers, also to CEDIS where the characteristics of the product to be handled are very varied by various industries such as textiles, footwear industry, airports, etc.

The **TILT TRAY SORTER** is an automated system that provides high selection capacity, this means an easy deposit of the products for their destination. It is a type of Sorter with special characteristics for difficult products, this system consists of classifiers in the form of bidirectional scales that allow sending Packages on Both Sides of the Conveyor Offering a simple solution that supports fast-paced environments, Tilt Pan Sorters provide high-speed sorting for even the most difficult-to-transport products. This sorting technology can move a variety of product shapes, sizes and materials, including soft goods like plastic bags.

**SHOES SORTER OR SORTER DE TACONES** for the multifunctionality of handling packages and a great capacity for intralogistics processes in the market.

The equipment as a whole is driven by a motor unit that pulls the slats on which the diverters called "shoes" slide and are activated from the software of the equipment itself. This is the Sorter that has the most advantages after the hidden system that it uses for its deviation through the slats. It is quite friendly regarding the handling of the packages, it is more expensive, but with this tool you have a greater confidence in the operations at the same time that it provides a higher range.

The mechanism is controlled by a mechanical system driven by pneumatic and electric motors and drivers, the sizes and weights of the packages that it can handle are very varied and if efficiency is sought it can maintain a high speed, it must have a controller that with the Intelligence is provided for its operation, it helps to maintain a correct application to cover the requirements and demands and the information and required orders can be coordinated.

A Sorter allows you to separate a load of products depending on the requirement of the exit order of either stores or private recipients in small or individual ones, the advantage is that it can be ordered and thus distribute a unit of 100 single product pieces in one unit and 100 multi-product pieces, that is to say that at the

entrance we will have products from a supplier or brand and at the exit we will have a mix of suppliers or brands. And since there is an increasing variety of classifiable products, it becomes a very useful tool.

Once the variety of products that can be classified from small, large, light and heavy is known, the solutions are equally varied and adjustable to the different needs of each owner. In addition, manufacturers require different shapes or types of Sorter depending on the size of the space, transportation requirements, location, space design, mix of different types of Sorter, and above all focused on the route it carries out.

### **V. SIMILAR MECHANISMS**

The basic principle of all conveyors is the same, it consists of a table made up of bands or rollers that move units or packages in a certain direction or to another new conveyor and depending on the distance it will be where the units or packages are intended to remain, these can be motorized or mechanical and these can end in pallets, pallets or containers that are exchanged when they are full or direct the conveyor to another and not only to containers since they can be for the operator to remove the packages or that a transport unit can be filled of any size.

However, at the moment of carrying out the most appropriate design using the different techniques used, the most recommendable to use in a Sorter system are the means to divert the merchandise and move them from the main one to the branches.

Whatever the choice of the technique used, the simplicity of solutions at a low price and functionality is sought in relation to other alternatives.

### **VI. CAPABILITIES**

The equipment installed "System of Draw" has a distribution capacity for one hundred and ten packages per minute according to the technical data sheet. To confirm said data, ten-second samplings were carried out, projecting to one minute and verifying the veracity of said data.

**Figure 1.** Sampling

Partida	Muestreo (10 s)	Proyección (1 min)
Muestreo 1	19 paquetes	114 paquetes
Muestreo 2	21 paquetes	126 paquetes
Muestreo 3	22 paquetes	132 paquetes
Muestreo 4	20 paquetes	120 paquetes
Muestreo 5	19 paquetes	114 paquetes

Source: Theauthors, 2023

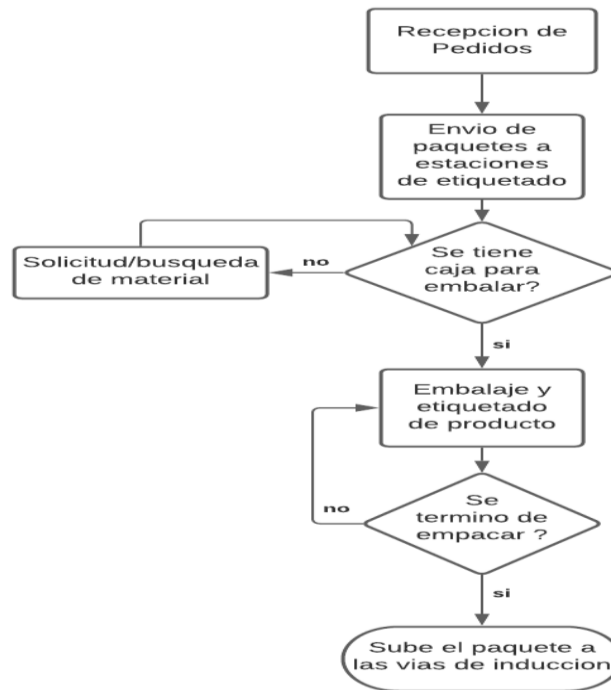
The line, under current conditions (Transport at the entrance and exit of the Sorter) has a production capacity of forty-nine thousand one hundred and forty packages in a period of 21 hours, if the aforementioned capacity is exceeded or there is not enough personnel. in the exits to evacuate the bays, this will have problems in operation.

The work plan estimates a production of seventy thousand packages per day, thirty thousand packages from Warehouse 1 and forty thousand packages that are expected to be processed on site, giving the sum of the mentioned total.

Regarding the load capacity of the system, according to the manufacturer's specifications in the technical data sheet we have that, we can support a load of up to 74Kg/m.

In the control of the system of the boards located on one side of the Sorter vision tunnel we can find the part of force and control. The control is divided into 2 boards, in the first we can find an Allen Bradley brand PLC, Controllogix 5583E model, with an Ethernet protocol communication card, a 16 digital input card, a 16 Digital Output card, a of 16 Analog Inputs and one of 16 Analog Outputs; It also has space to add different cards.

Figure 2. Flouchart



Source: The authors, 2023

### VII. SYSTEM LIMITATIONS

The equipment has 4 feeding paths. The side conveyors correspond to a distance of 56 and 63 m. While the central conveyors have a distance of 96 and 98 m. With these data we can calculate a minimum of 91 packets queued in the sidebands and 157 packets in the central transports.

Regarding the output of the system, we have 18 bays, currently 3 assigned to messaging, 1 to error and 14 to different destinations. These have a passage of 57 cm for the transit of the package, which will generate a jam with the blue containers, in addition to the fact that currently, the packages are usually stuck due to this.

Figure3. Inductionways

VÍAS DE INDUCCIÓN	
LATERAL DERECHA	63 m
LATERAL IZQUIERDA	56 m
CENTRAL DERECHA	98 m
CENTRAL IZQUIERDA	96 m

Source: The authors, 2023

Ecuation 1. For KVAc calculation

$$kVA_{(3\phi)} = \frac{\sqrt{3} \times V_{L-L} \times I_{AC}}{1000}$$

Source: The authors, 2023

IAC=Electric current in Amps

VL-L=Line-Line Voltage.

Based on this formula, we calculate 423 KVA of use with respect to the capacity of the transformer, being 42.3% of its capacity.

To estimate the load, we count the current consumption with respect to the additional equipment, which corresponds to 24 motors, along the inputs and the expansion of the Sorter, the quantities and powers can be seen in the following table.

**Figure4.** Table of Loads

MOTOR	POTENCIA (HP)	CARGA	U
Entrada 5			
M1	2	2.46	Amp
M2	1	1.23	Amp
M3	1	1.23	Amp
M4	2		Amp
M5	1.5	1.8	Amp
M6	2	2.46	Amp
M7	3/4	1.2	Amp
Entrada 6			
M8	2	2.46	Amp
M9	1	1.23	Amp
M10	1	1.23	Amp
M11	2	2.46	Amp
M12	1.5	1.8	Amp
M13	2	2.46	Amp
M14	3/4	1.2	Amp
SORTER			
M15	2	2.46	Amp
M16	2	2.46	Amp
M17	2	2.46	Amp
M18	2	2.46	Amp
M19	15	24.6	Amp
M20	2	2.46	Amp
M21	2	2.46	Amp
M22	3	4.92	Amp
M23	2	2.46	Amp

M24	2	2.46	Amp
	GRAN TOTAL	72.42	Amp
	CARGA TOTAL	57.88	KVA

Source: The authors, 2023

Multiplying this value by 1.15 (15% as a safety factor) gives us a total of 66.5 KVA.

The average consumption will be 66.5 KVA, adding to the load supported by the transformer in Zone 2 we will have a total of 489.5 KVA giving 48.95% of the transformer capacity.

Regarding the transformer, we have a consumption of 368.30 KVA, which is 36.3%; Assuming that we connect the additional transports to this transformer, we would have a consumption of 434.8 KVA, being 43.48% of the capacity of the Zone 1 transformer.

### VIII. PRODUCTION

In the first quarter of the year, a production record was prepared by the operators. Using this information for the analysis, we can see that, in the month of March, we found the largest number of products, with a total of 236,428 packages sorted by the system, which gives an average of 7880 packages per day and, in turn, 788 packages every two hours (average). Based on these data we can say that the Sorter is working at less than 10% of capacity.

With the current composition, the Sorter is capable of processing 49,560 packages in a 21-hour shift, based on data provided by site personnel.

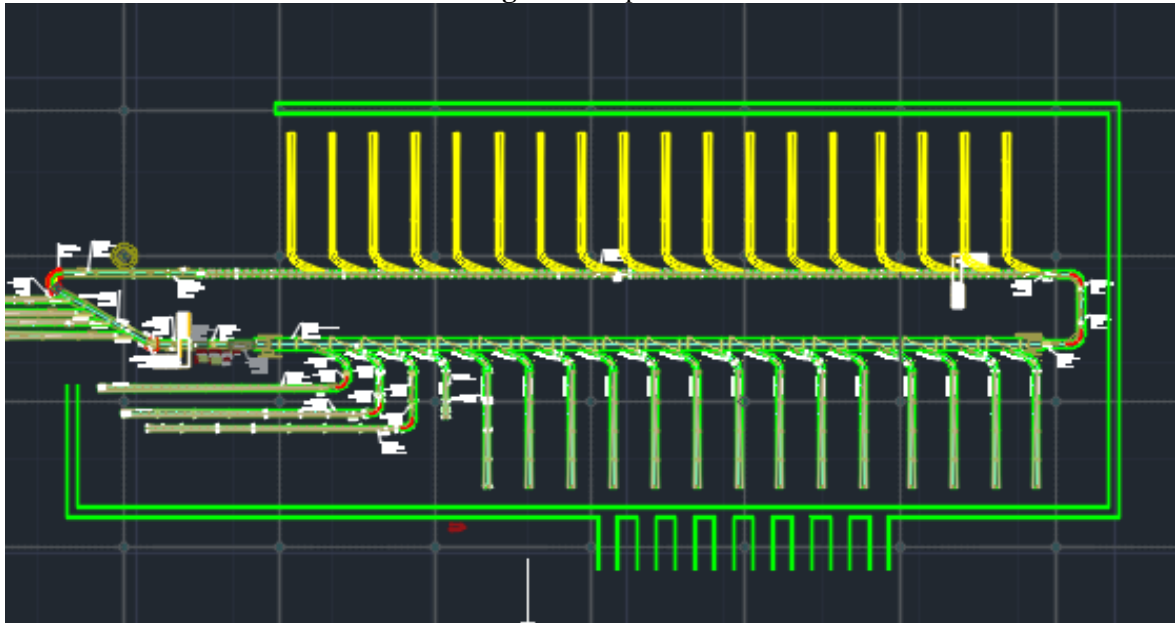
### IX. PROBLEM STATEMENT

The objective is to be able to reach a production of 70 thousand packages per day; To achieve the objective, it is necessary to make an addition to the feeding transports, corresponding to 2 lines, one of 68 m and the other of 74 m (cyan lines in the upper part of image X), in addition to making 100% use of the equipment existing, speaking of the labeling stations, which have a capacity of 20 packages per hour (PW, 18 stations) and 50 packages per hour (SL, 40 stations), giving a production of 49,560 packages per day; In the additional lines, 4 direct package induction stations will be established, these will have the capacity to introduce 31,500 packages to the Sorter, thus giving a total of 81,060 packages per day (21 hrs).

This modification implies relocating equipment in addition to adding new conveyors to lengthen the line, enough to avoid accumulation and free transit of our package, a mezzanine must also be placed to be able to use the space inside the Sorter; In addition to this, we must bear in mind the need to develop an independent control, which can coexist harmoniously with the current one.

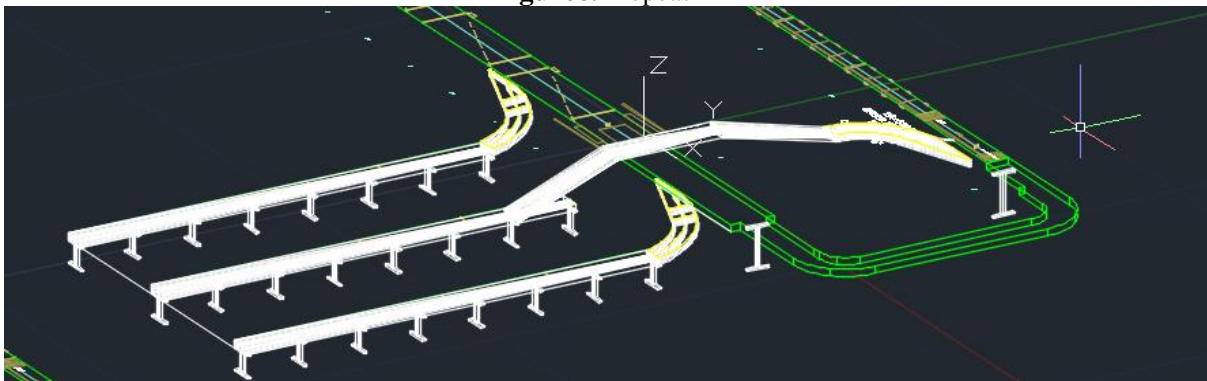
In the final part of the Sorter we must modify the exits, changing the descents for larger ones, with this we intend to eliminate the jams caused by the measurements of the packages, which do not allow free transit in these curves. Speaking of personnel, we need to have a minimum of one person in each bay, so that they are exclusively in charge of clearing the packages, avoiding congestion in transport, once the assigned personnel have a substantial number on the pallets, they will proceed to be taken to the center of the post-draw area, with the help of a skid or forklift, where the packages will be located at the final destinations (if necessary).

**Figure5.** Proposal 1



Source: Theauthors, 2023

**Figure6.** Proposal 2



Source: Theauthors, 2023

Due to the fact that the merchandise generates a greater distance and that the descents are very far from the exit platforms, another proposal is made with a 60 cm bridge so that the packages pass freely, leaving the recirculation area available as a buffer.

Being the best generated proposal, it is proposed with a total budget of \$26,753,459.00

## X. FACTIBILITY

Logistics is carried out from a National Center, it is distributed to several Regional Centers, due to the complexity and quantity of various products, there is a need for redistribution that, apart from being expensive, delays delivery times that can denigrate the good image that customers have of the company.

The difference between a National Center and a Regional Center lies in the complexity of the processes, size of boxes, number of boxes, road access and Regional Centers of other providers.

The similarity is that each one has a reception, storage, distribution, restocking and shipping area.

Each national center after having received, accommodated, distributed, replenished and sent to the regional centers so that they in turn do the same to get the boxes to the different stores to be exposed to customers and these are consumed.

Regarding the technical study, the proposal is made to eliminate from each regional center those redistribution processes, which in this case are 5 Jalisco, Guanajuato, Michoacán, Guerrero and Veracruz, with the purpose of taking the boxes to the 18 different stores from the National Center.

Methodological framework for the development of this study the following methods were used:

Observation processes based on the behavior of the Sorter to know how the operation of the personnel releases jams, accommodates boxes by lowering.

Investigate process by asking operators about experiences of successful processes and manual mistakes that could affect performance. In parameters issued by the software that the Sorter uses to know times, quantities and performance.

Market study, Offers solutions to the end customer with high quality and service Customer profile: For the logistics of first-level distribution companies, it focuses on TOP, Medium and high-income customers since it offers a wide range of products and brands national and international focusing on the consumer trend.

The current process for getting the merchandise to the stores is through distribution from a national center to the regional centers to carry out a receipt process where the pieces that entered are counted and checked against the manifest of origin in addition to carrying out a decantation that guides serves to guide the different areas selecting and separating the product.

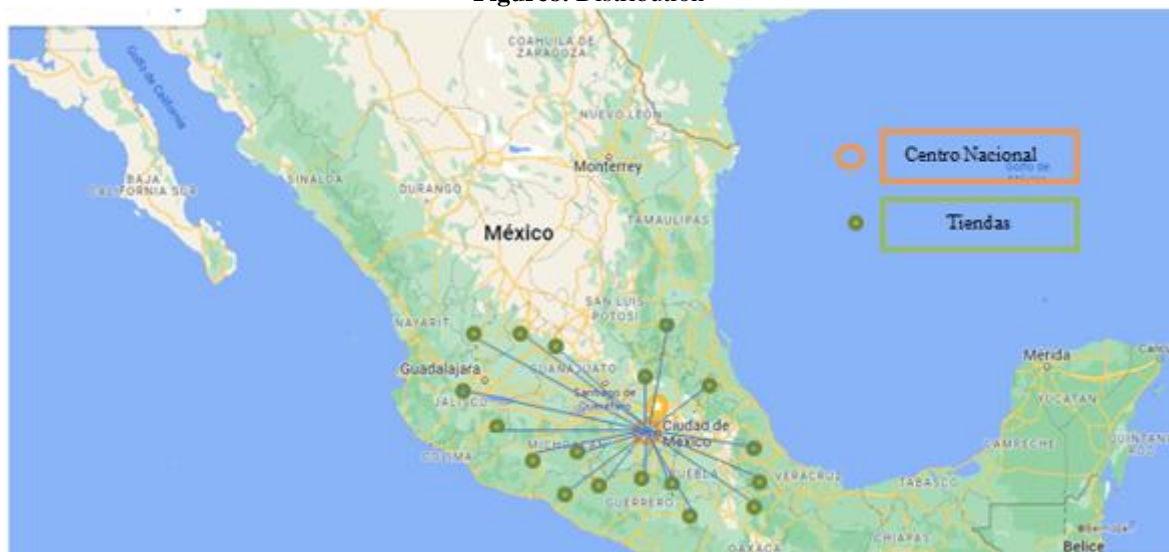
Figure7. Location



Source: Theauthors, 2023

After having separated the packages, a record is made in the database, it is accommodated on pallets and it is lined up on the departure platform towards the stores with the support of another manifest.

Figure8. Distribution



Source: Theauthors, 2023



This seeks to reduce the 5 Regional Centers of which 3 are rented and 2 are owned.

**Financial Study**

With the Costs, the aim is to reduce the costs of operation and distribution of merchandise as well as the touches that, as already mentioned, are a time delay and can cause loss.

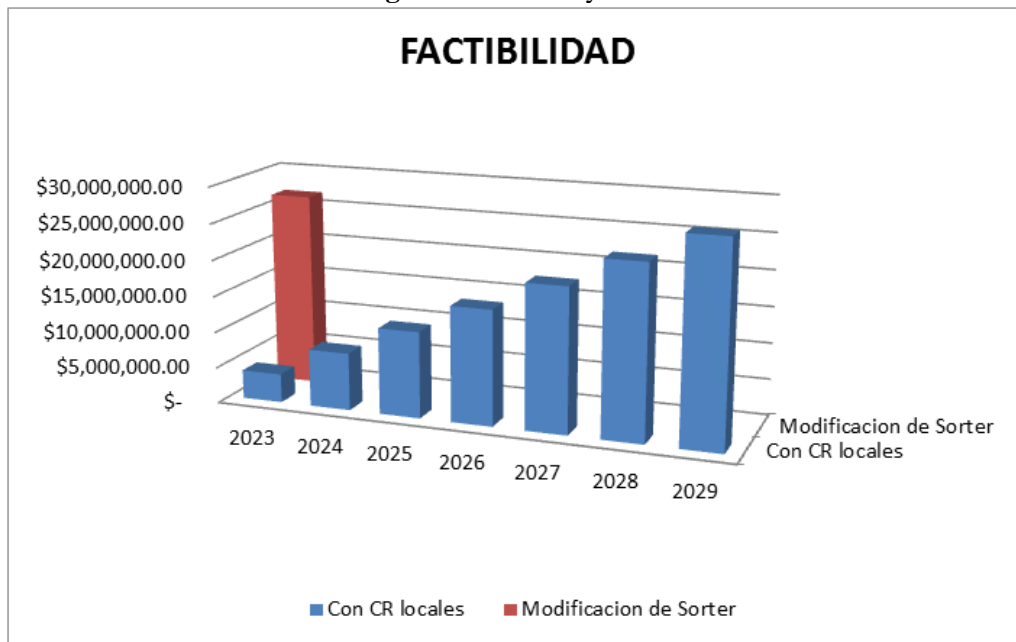
Due to the fact that the operation in each Regional Center is different, the area occupied by the distribution to the store also varies in space, so the % of occupancy is referred to the area in m2 of each one of the 5 warehouses destined to the shipment to stores.

**Figure9.** Costs

	Costo Total	% Ocupación Área de Envíos	Costo mensual
<b>Renta de la nave</b>	\$ 16,637,000.00	13%	\$ 2,162,810.00
<b>Gastos Operativos</b>	\$ 2,165,000.00	30%	\$ 649,500.00
<b>Salarios</b>	\$ 5,671,225.00	16%	\$ 907,396.00
<b>Mantenimiento</b>	\$ 1,342,784.00	19%	\$ 255,128.96
<b>Total</b>	\$ 25,816,009.00		\$ 3,974,834.96

Source: The authors, 2023

**Figure10.** Factibility Chart



Source: Theauthors, 2023

**XI. CONCLUSIONS**

It is of the utmost importance to mention that developing this type of machine has revolutionized the market in such an urgent way within the logistics world that it allows speeding up processes that previously became extremely long and tedious, thus making it possible to reduce the time spent, giving way to guarantee cycles. clean handling and classification of cargo achieved great efficiency and above all customer satisfaction that is more demanding with their requirements every day without distinguishing between types of items to manage where we could even generate several options to suit the customer.

The expense considered in the modification of the Sorter to carry out the transfers of the boxes from the National Center to the stores is feasible from year 7

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