

**Implementation of an inventory control system in the snack company****Implementación de un sistema de control de inventarios en la empresa de botanas**

ACOSTA-GONZÁLEZ-Yanid†, DELGADO-GÓMEZ Gilberto, ESTRADA-NAVARRETE Jorge and DE LUNA-CARDONA, Emmanuel

*Universidad Tecnológica de Aguascalientes*

ID 1<sup>st</sup> Author: Yanid, Acosta-González / ORC ID: 0000-0001-9112-7872, Researcher ID Thomson: S-5620-2018, CVU CONAHCYT ID: 449264

ID 1<sup>st</sup> Co-author: Gilberto, Delgado-Gómez / ORC ID: 0000-0001-5213-9432, CVU CONAHCYT ID: 998195

ID 2<sup>nd</sup> Co-author: Jorge Estrada Navarrete / ORC ID: 0000-0001-6641-9363, CVU CONAHCYT ID: 478494

ID 3<sup>rd</sup> Co-author Emmanuel de Luna Cardona/ ORC ID: 0000-0009-6747217X

DOI: 10.35429/JTIP.2023.16.7.10.18

Received March 30, 2022; Accepted June 30, 2022

**Abstract**

This engineering research consists of improving the control of inputs and outputs from the warehouse; Optimize the operations that are carried out to streamline the flow of the process towards production, using equipment (Racks, pallets, among others) and content that provides added value to generate a continuous flow within the company. These improvements will make it possible to devise a control system in the warehouse area that allows the user to carry out a verification of what enters and leaves the warehouse. In such a way, that it constantly reflects the fluctuating needs of the consumer. This will allow the company to better position itself in the market, translating this into an increase in sales and optimization of its resources (raw material and finished product).

**Inventory system, Continuous improvement, Work measurement, ABC inventory**

**Resumen**

Esta investigación de ingeniería consiste en mejorar el control de entradas y salidas del almacén; optimizar las operaciones que se llevan a cabo para agilizar el flujo del proceso hacia la producción, utilizando equipos (Racks, tarimas, entre otros) y contenido que aporte valor agregado para generar un flujo continuo interno dentro de la empresa. Ésta mejora permitirá idear un sistema de control en el área de almacén que permita así al usuario llevar una verificación de lo que entra y sale del almacén, de tal forma, que éste refleje constantemente las necesidades fluctuantes del consumidor. Lo anterior le permitirá a la empresa posicionarse mejor en el mercado, traduciéndose esto en un aumento en las ventas y una optimización de sus recursos (Materia prima y producto terminado).

**Sistema de inventario, Mejora continua, Medición del trabajo, Inventario ABC**

**Citation:** ACOSTA-GONZÁLEZ-Yanid. DELGADO-GÓMEZ Gilberto, ESTRADA-NAVARRETE Jorge and DE LUNA-CARDONA, Emmanuel. Implementation of an inventory control system in the snack company. Journal of Technologies in Industrial Processes. 2023. 7-16: 10-18

† Researcher contributing as first author.

## Introduction

The project was developed in a company dedicated to the sale of snacks, located in the municipality of Jesús María, Ags.; it has 20 workers, including two managerial positions.

This project arises from the need to improve the delivery times of the orders and the conservation of the good condition of the product, for it was defined the control of inputs and outputs as well as specific measures related to waste and product shortages. The activity is carried out in the warehouse area where there is a product packaging area (see Figure 1).



**Figure 1** Botanas Macías Warehouse

Source: Own elaboration with information from the company Botanas Macías

It is feasible to develop an inventory control system because it has a time of 15 weeks since it is intended to improve delivery times and the conservation of the good condition of the product. It will allow the worker to have a better control of the inputs and outputs in the warehouse. In such a way that it reflects the fluctuating needs of the consumer.

## Description of the Problem

The company has been operating for five years without methodologies for the management and improvement of its results.

Given that the company intends to position itself in the market, improving compliance and the quality of its services to its customers, this project was proposed.

The first approach consisted of a Genba tour in its facilities, in which observations were made and workers were consulted.

Genba: "the real place" and refers to the act of directly seeing what happens (Melo, 2020).

Through this activity, we learned about the general problems in the warehouse area and basically the slowness to deliver the product to the shipment, as well as the waste of the product because there is no sequence of supply, packaging and delivery.

With the purpose of identifying the areas of opportunity in the mentioned areas in conjunction with the operators, from the 5W2H tool helped within what fits to identify what should be done, and question the objective raised, so that the action can be carried out, determine those responsible, to execute it and verify the location, duration, form and action in which it should be carried out, to be able to make an analysis of the cost of this with the PDCA cycle being able to act to planning and reality (Mercês Oliveira, 2021).

- What: What are the inputs and outputs of the process?
- Who: Who are the people involved in the processes? Who provides input to the processes? Who are the "customers" of the process?
- Where: Where does the work take place? Are all the necessary materials and equipment on site?
- When: Are all process inputs and information available when needed? Are lead times high or low?
- Why: What value does this process bring to the customer?

A record of the answers of each operator and the observations seen during the tour was taken, reaching the conclusion that currently there is not adequate equipment to organize the warehouse (racks, shelves, among others), this causes that once the raw material is received from suppliers, This causes delays (see Figure 2) at the moment of delivering the product to the clients and there is no control of the inputs and outputs of both raw material and finished product; Considering that these are perishable products, this makes it difficult to comply with delivery times and leads to waste (MECALUX, 2021).

**Name of the process:** Compliance with the material requested by production.

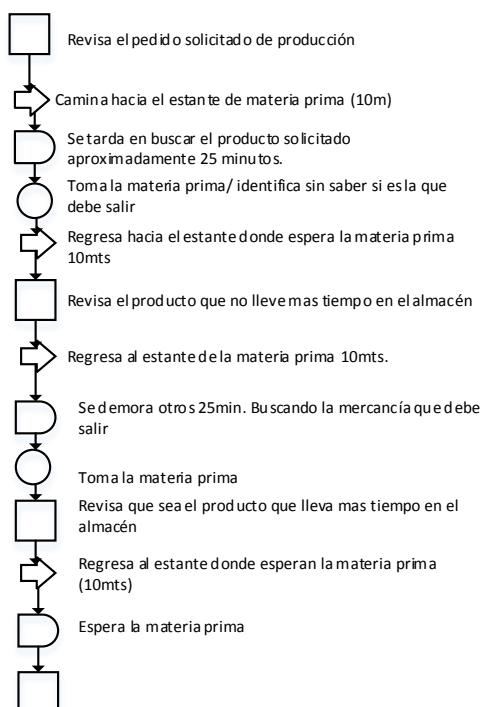
**Area:** Warehouse of the company Botanas Macías.

**Starts:** Warehouse receiving rack

**Ends:** Warehouse receiving rack

**Done by:** Emmanuel De Luna Cardona.

**Date:** 02/21/2022

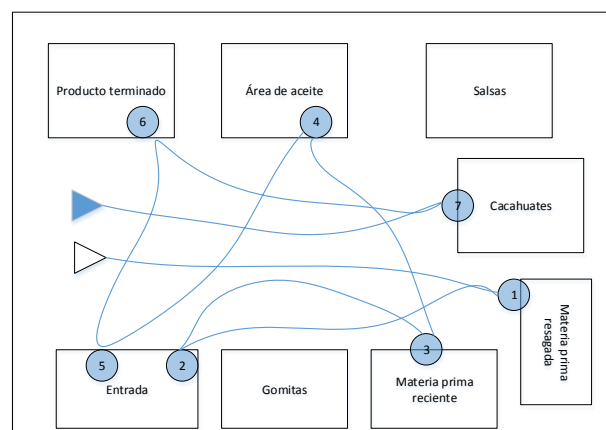


Resumen de Actividades	
Simbología	Cantidad
○	2
□	4
➡	4
⌒	3

**Figure 2** Process Flow Diagram

Source: Prepared by the company with information from Botanas Macías

A spaghetti diagram was made as a visual aid of all the routes that are made when raw material and finished product are requested to the warehouse manager. It was represented as it is in the actuality without making the established improvements where you can see the delays and all the dead times that are inside the warehouse (See Figure 3).



**Figure 3** Spaghetti Diagram

Source: Own elaboration with information from the company Botanas Macías

**General objective**

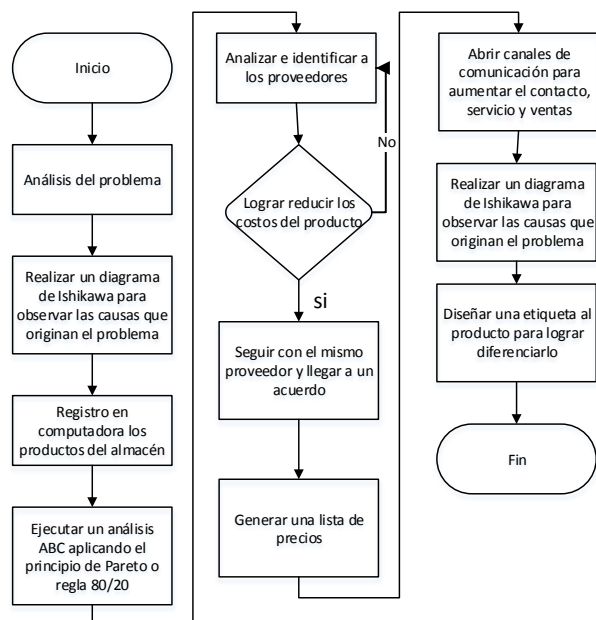
To reduce by 50% the preparation time of a standard batch of product for shipment.

**Methodology**

The methodology to be applied is QC-STORY based on the Deming Circle to carry out the implementation of the project. The Deming Cycle (PDCA) is composed of four stages, so that, at the end of the last one, the first one begins again. This allows the activity to be evaluated again and again periodically incorporating new improvements. The four stages are as follows: Plan, Do, Check and Act (Eurofins Environment Testing Spain, 2023).

The stages on which the project will be based are as follows:

1. **Plan.** Identify the situation of the company with the help of a scatter diagram to see how far out of range the data obtained after having performed a process timeline (See Figure 4.).



**Figure 4** Flowchart for the application of the Kaizen methodology

To do. Perform a Cause-Effect diagram (Ishikawa) in order to observe and analyze the different causes that originate the problem and arrive at the root cause and be able to establish the necessary measures and actions to control the warehouse.

1. Verify. Classify the products in the warehouse with the help of an ABC analysis in order to identify all the most important items we have in the warehouse.
2. Act. Check sheets will be used to have a control and evidence of the improvements in the warehouse control system and once approved by the manager, they will be implemented.

## Development

### 1. Plan

The identification of the problem and the objective are exposed at the beginning of this document, so we go directly to the next steps of the methodology.

### Analysis of the current situation

We started with the stage of a time study with a stopwatch in the process of orders (30 pieces) to the customer that are made during an average day, in order to have a control of the situation in which the company is.

"The study of methods is the technique par excellence to minimize the amount of work, eliminate unnecessary movements and substitute methods. The measurement of work in turn, serves to investigate, minimize and eliminate unproductive time, that is, the time during which no added value is generated (Salazar Lopez, 2019).

The customer cyclically places orders on a specific day of the week, and this information serves the operator to prepare the order one day prior to the scheduled delivery date and avoid waiting times.

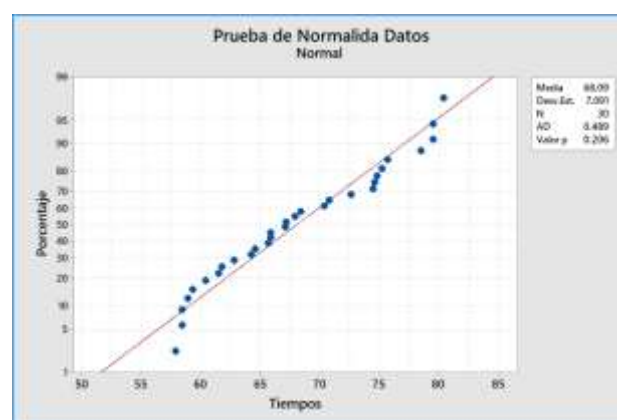
The average time for order preparation is 68.09 minutes; this time is considered as the cycle time of the order preparation activity; it should be noted that the objective is to reduce 50% of the time (see Table 1).

Media	68.09
Medium	67.15
Mode	65.9
Standard Deviation	7.09

**Table 1** Order preparation times.

Source: Own elaboration with information from the company Botanas Macías.

The average time to place it is 68.09 minutes. Taking into account that the problem is to reduce 50% of the time generated by the delays, it can be established that the objective is outside the specification limits as can be seen in the image (See Graph 1).



**Graph 1** Normality test

Source: Own elaboration with information from the company Botanas Macías; Own elaboration with information from the company Botanas Macías



The purpose of the Ishikawa Diagram is to make a graphical representation that allows to visualize the causes that explain the problem identified with the Gemba path and the process flow diagram because it brings better results and to ask the why of each cause. At this point the five whys technique will be used to discover the root cause of the problem.

As can be seen in the cause-effect diagram, all the causes that generate the lack of organization in the warehouse are found within the machinery, labor and method, all are focused on the absence of equipment in that area, therefore the operators do not perform their activities efficiently, causing these delays in the warehouse (See Figure 6).



Figure 6 Ishikawa diagram of the lack of organization in the Warehouse area

Source: Own elaboration with information from the company Botanas Macías

ABC analysis for inventory classification

The ABC analysis helps to prioritize performance and resources in the items that are important for the company.

A items: These refer to the most important items (the most sold or most urgent). The ones that provide the most revenue and have the highest profit margin (See Table 2).

ID	Producto	Cantidad	Costo Unitario	Costo Total	Beneficio Total	Margen
ID100	Cueritos	105020	\$ 25	\$ 2,63,000.00	\$ 793,000	39.0%
F0205	Hard White	9402	\$ 22	\$ 206,844.00	\$ 999,844	49.0%
ID101	Fried	476	\$ 315	\$ 149,940.00	\$ 1,149,784	56.0%
K0300	Pistache	390	\$ 260	\$ 101,400.00	\$ 1,251,184	61.0%
2.07E+13	Confío chok	590	\$ 90	\$ 53,100.00	\$ 1,304,284	63.0%
3.07E+13	Gummy Fruit	1040	\$ 50	\$ 52,000.00	\$ 1,356,284	66.0%
3.07E+13	Gummy Bear	832	\$ 56	\$ 46,592.00	\$ 1,402,876	68.0%
k0302	Striped Carrot	1872	\$ 24	\$ 44,928.00	\$ 1,447,804	70.0%
7.50E+12	Dove	104	\$ 360	\$ 37,440.00	\$ 1,485,244	72.0%
3.07E+13	Gummy Worm	624	\$ 56	\$ 34,944.00	\$ 1,520,188	74.0%
IA101	Pork trunk	416	\$ 70	\$ 29,120.00	\$ 1,549,308	75.0%
F0101	Choco Strawberry	396	\$ 70	\$ 27,720.00	\$ 1,577,028	77.0%
C0003	Pork rinds	260	\$ 100	\$ 26,000.00	\$ 1,603,028	78.0%
C0001	Pork ear	364	\$ 70	\$ 25,480.00	\$ 1,628,508	79.0%
				\$ 1,628,508.00		

Table 2 Products A Source: Prepared by the company with information from Botanas Macías

Type B products: These are those of lesser importance or secondary use, i.e., all products that are for resale (see Table 3).

Table 3 Products B Source: Own elaboration with information from the company Botanas Macías

Type C items: These are unimportant items. Therefore, having them in the warehouse often costs more money than the benefit they provide because they are perishable products (see Table 4).

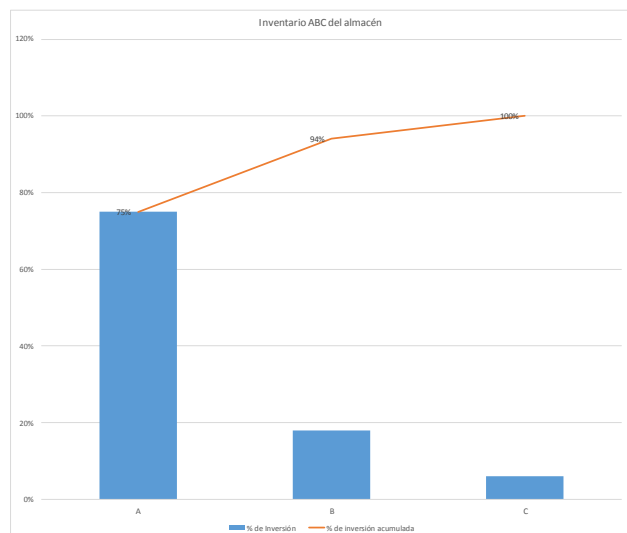
Table 4 Products C. Source: Prepared by the company with information from Botanas Macías

Once the ABC analysis had been carried out, in which all the products in the warehouse were identified, the necessary calculations were made to have a record in numbers of what is in the warehouse (see Table 5).

ZONA	N° ELEMENTOS	% ARTICULOS	% ACUMULADOS	% INVERSION	% INV. ACUMULADO
0-80%	A	15	34%	34%	75%
80%-95%	B	17	39%	75%	94%
95%-100%	C	12	27%	100%	100%
Total	44	100%	100%	100%	

Table 5 Item warehouse calculations Source: Prepared by the company with information from Botanas Macías

The following Pareto Chart 2 shows the percentages of investment invested in the warehouse, which helps to see which products will be standardized first and, once this is done, the performance of the products and the reduction of the delays that currently exist can be seen.



**Graph 2** Pareto Diagram

Source: Prepared by the company with information from Botanas Macías.

This diagram shows that starting with type A products, which are the most frequently ordered and sold products per day, we can achieve our proposed objectives.

In Zone "A" there are 15 items which represent 34% and are responsible for 75% of the investment.

In Zone "B" there are 17 items which represent 39% of the total number of items and are responsible for 18% of the investment.

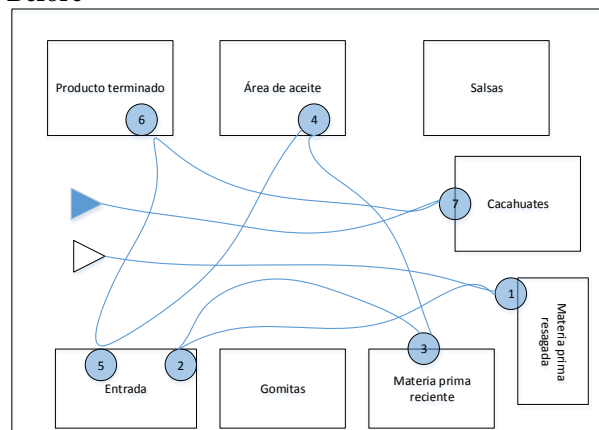
In Zone "C" there are 12 items which represent 27% and are responsible for 6% of the company's investment.

**Results and conclusions**

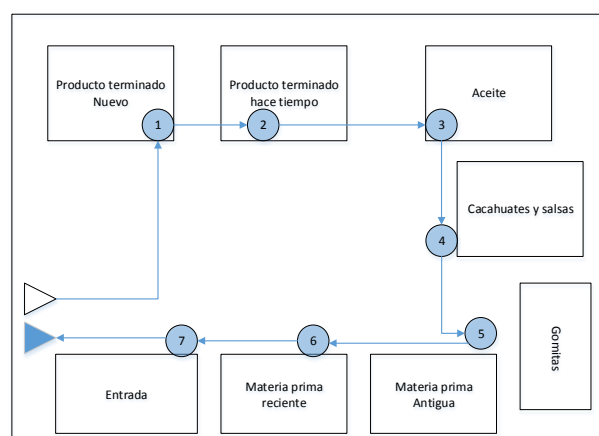
We began to organize all the products (raw materials, peanuts, sauces, fried foods, gummies, among others) that are in the warehouse, giving priority to the products that were classified in section "A" according to the ABC analysis and consequently to products "B and C".

Next, we can see a before and after view of the routes that are made, visually we can see an order and better organization of the warehouse in which a better distribution of the area is observed, as well as a visual organization and with fewer routes within the same, reducing delays and search times, thus reducing the time of placing orders by almost 50% (See Table 6).

**Before**



**After**



**Figure 6** Spaghetti diagram before and after improvement.

Source: Prepared by the company with information from Botanas Macías

He took 30 times again, after having made the improvement of 33.08 min. having the products identified and avoiding searching for each one of them thanks to the implementation and standardization of the warehouse (See Table 6).

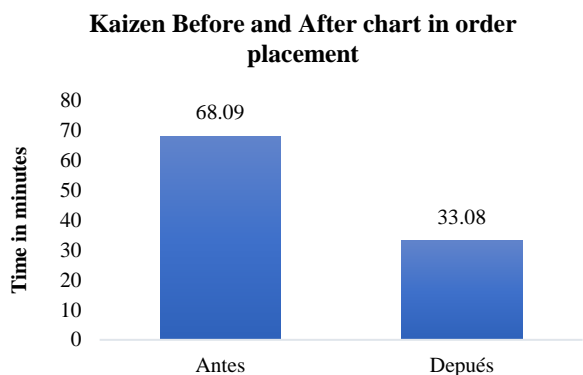
<b>MEDIA</b>	33.084
<b>MEDIUM</b>	33.7
<b>FASHION</b>	30.5

**Table 6** Time taken after standardization

Source: Own elaboration with information from the company Botanas Macías

A series of calculations were made where it is observed in a quantifiable way the decrease in time when placing orders taking into account that the average time to place each order was 68.09 minutes, once the implementation and standardization of the area is done it is 33.08 minutes, which translates as an improvement of 52% less time than what it took previously.

With this we can see that the objective of the project was achieved, since 48.58% of time was reduced when carrying out each of the orders (See Table 9) located in the annexes. In the following bar graph we can see the improvement in percentage of the decrease in time that is now made to perform each of the orders in the warehouse area (See Graph 3).



**Graphic 3** Before and after the improvement of cycle times when placing each of the daily orders (Secretaría del Trabajo y Previsión Social, 1999)Source: Own elaboration with information from Botanas Macias.

The products were ordered with the implementation of warehouse equipment and furniture (racks, pallets, shelves, among others) that the company purchased in order to better optimize resources and eliminate delays in these areas (See Figure 7, Figure 8, Figure 9, Figure 10).

Kaizen 1		
<b>Site:</b> Warehouse	<b>Purpose:</b> To assign a specific area for each product in the warehouse.	<b>Date:</b> 15/03/2022 2
<b>Previously</b>	<b>Then</b>	
		
<b>Problem</b>	<b>Result</b>	
All the frying and the hardboard were in disarray and together with the boxes of raw material.	With the determination of an assigned area for frying and hard products, sections were designed to place such product and achieve a greater optimization of the assigned area.	



**Figure 7** Kaizen 1

In the warehouse there was no identification of the old product with the new one, as well as a separation by type of product (See Figure 9).

Kaizen 2		
<b>Site:</b> Warehouse	<b>Objective:</b> To organize the potato to keep control of the product in stock.	<b>Date:</b> 3/03/2022
<b>Before</b>	<b>After</b>	
		
<b>Problem</b>	<b>Result</b>	
The potato is not in the right place and there is no control of the material in stock at the moment.	All the potatoes are in the place that was determined so that both visually and with the record kept by the person in charge it is easy to locate the product and have control over it.	

**Figure 8** Kaizen 2

The product offered by the company had been mixed up and a shelf had to be purchased for this classification and to have a better control of it (See Figure 10).

Kaizen 3		
<b>Site:</b> Warehouse	<b>Objective:</b> To organize the frying and classify it depending on the type of frying.	<b>Date:</b> 03/25/2022
<b>Before</b>	<b>After</b>	
		
<b>Problem</b>	<b>Result</b>	
All the fried food was disorganized and mixed up, which caused a waste of time when looking for the type of fried food requested.	The frying was organized in the racks by type and shape of frying so that no time is wasted looking for the product requested and the search time is optimized.	

**Figure 9** Kaizen 3

The Kaizen that was also performed was the organization of the arrival and departure of products and that the worker can more easily identify the product that has already been in the warehouse for some time with the one that has just entered (See Figure 10).

Kaizen 4		
<b>Site:</b> Warehouse	<b>Objective:</b> To separate and place the boxes of raw materials and sauces for a better location and management of the product.	<b>Date:</b> 03/25/2022
<b>Before</b>		<b>After</b>
		
<b>Problem</b>		<b>Result</b>
Las cajas de la salsa se encuentran juntas con las frituras y no se tiene una clara visión del tipo de salsa que es.		Se organizaron las cajas de manera que se dejó a la vista del operario el tipo y contenido de salsa que contiene.

Figure 10 Kaizen 4

### Recommendations

Quality standards were established in conjunction with the company to maintain a balance of cleanliness, order and standardization. Over time, this will forge self-discipline in the operators and all the company's personnel in accordance with NOM-04-STPS-1999. This standard applies throughout the national territory and applies to all work centers that by nature of their processes use machinery and work equipment.

### Quality policies

The correct execution of activities. The company must let all its personnel know that any activity concerning the company will be carried out by means of objective processes and management, previously marked in the company.

- Encourage the work spirit from the leaders to the workers.

- To elaborate a study to analyze the potential risk generated by the machinery and equipment in which an inventory of all the factors and dangerous conditions that affect the health of the worker (Employer) must be made.
- Train workers for the safe operation of machinery and equipment, as well as the tools they use to develop their activity (Worker).
- Comply with the measures indicated in the Specific Safety and Hygiene Program for the Operation and Maintenance of Machinery and Equipment (Worker).
- Keep the work area clean and tidy.

### Acknowledgement

We would like to thank Botanas Macías for their support in improving the inventory control system.

### References

- Eurofins Environment Testing Spain . (10 de 08 de 2023). *El ciclo Deming: en qué consiste y cómo ayuda en la gestión y mejora de procesos*. Obtenido de ¿Qué es el ciclo Deming? : <https://www.eurofins-environment.es/es/el-ciclo-deming-que-consiste-y-como-ayuda-gestion-procesos/>
- M., A. (17 de 10 de 2018). *Círculo de Deming*. Recuperado el 18 de 05 de 2021, de <https://empresas.infoempleo.com/hrtrends/circulo-de-deming>
- Machado Miranda, E., Nuela Sevilla, S. E., López-López, A. P., & Mosquera Guanoluisa, D. L. (26 de 01 de 2020). Evaluación niveles de iluminación en interiores y cálculo para instalaciones de alumbrado. *KnE Engineering/VI congreso Internacional de la Ciencia, Tecnología e Innovación*, 5(2), 13-36. doi:<https://doi.org/10.18502/keg.v5i2.6215>
- MECALUX. (04 de 02 de 2021). *Los 10 problemas logísticos más comunes en un almacén*. Obtenido de <https://www.mecalux.com.mx/blog/problemas-logisticos>



Melo, S. (28 de 08 de 2020). *¿Por qué y cómo realizar un Gemba walk?* Obtenido de <https://datascope.io/es/blog/porque-y-como-realizar-una-caminata-gemba/#:~:text=Es%20un%20recorrido%20para%20observar,realmente%20sucede%20en%20tu%20negocio.>

Mercês Oliveira, T. (2021). O CICLO PDCA E O 5W2H: AS FERRAMENTAS ADMINISTRATIVAS. *Revista Valore*, 1-15. Recuperado el 06 de 06 de 2022, de <https://revistavalore.emnuvens.com.br/valore/article/view/1089/842>

Quiroa, M. (9 de NOV de 2020). *Economiapedia*. Recuperado el 20 de Mayo de 2021, de <https://economipedia.com/definiciones/ciclo-de-deming.html>

Salazar López , B. (25 de 06 de 2019). *Estudio de tiempos*. Obtenido de *¿Qué es el estudio de tiempos?*: <https://ingenieriaindustrialonline.com/estudio-de-tiempos/que-es-el-estudio-de-tiempos/>

Secretaría del Trabajo y Previsión Social. (1999). NOM-04-STPS-1999. México.