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INDUSTRY 4.0 IN DISTRIBUTION CENTERS AT PANELCO

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Abstract: In recent years, the production and distribution chains of various companies have witnessed the emergence of a number of connected technologies (Nieblas, 2018). The relationship between these new technologies and factory machinery better known as Industry 4.0 has paved the way for increasingly linking production processes and changing the way finished products are moved, stored and distributed. Thus, today, Distribution Centers have become an important component in the supply chain infrastructure of companies and are increasingly treated as a strategic facility capable of providing a competitive advantage for the organization. The implementation of Industry 4.0 technologies in Distribution Centers will drive a change in them, ranging from the reconfiguration of their workforces for management, analysis, security and data handling (Nieblas, 2018). Likewise, it will also provide indicators that facilitate the location and storage of products, based on rotation levels, so that the most important items or those that are most in demand are located in areas that optimize movements of enlistment, picking, transportation, among others.
Keywords: industry, distribution, technology

INTRODUCTION

Today, **Distribution Centers (cedis)** have become an important component in the supply chain infrastructure of companies and are increasingly treated as a strategic facility capable of providing a competitive advantage for the organization (Nieblas, 2018).

The implementation of **Industry 4.0 Technologies** in distribution centers will drive a change in them, ranging from the reconfiguration of their workforces for management, analysis, security and data handling (Nieblas, 2018).

It is crucial for organizational leaders to proactively assess the impact of distribution trends and the potential benefits of utilizing Industry 4.0 technologies, as this can enable them to more effectively plan how they will achieve their future goals in a marketplace that will be changing rapidly over the next decade.

Technological advances have the potential to transform Distribution Centers in several significant ways: making them more flexible, efficient, competitive and becoming a structural element in the manufacturing and distribution value chain (2021).

The concept of Industry 4.0 emerged with the German government at the 2011 Hannover Fair, where it is called the set of actions aimed at achieving the so-called "Smart Factory", as well as the digital transformation of industry through the acquisition of industrial process data (Vessi, 2021).

The transition to smarter, more flexible systems and advanced technologies inherent in Industry 4.0 also requires change within the organization itself. While automation technologies can be configured to match business objectives, the company may need to restructure to maximize the benefits of automation.

I. First Industrial Revolution

Labor was replaced by machines, bringing as a consequence a change from a rural economy based on agriculture to a model of industrial economy, resulting in an increase of capital never seen before (Vessi, 2021).

II. Second Industrial Revolution

The division of tasks took place and due to the use of electric power, long working days were allowed.

III. Third Industrial Revolution

Based on the development of digital technology with the use of computers and the development of the internet that allows interconnectivity between devices using electronics and information technology for automated production (Vessi, 2021).

With the computer, we can manage, analyze, store millions of data, execute computer programs or automate mechanical

processes, which is why it is a fundamental tool for the human being of the 21st century.

IV. Fourth Industrial Revolution

Processes are connected through the Internet of Things or Industrial Internet of Things, which means that everything is connected through private networks or the Internet to send or receive data to facilitate their visualization and interaction without the need for human intervention. Using data analysis as the main link to implement the necessary technologies for process automation (Vessi, 2021).

THE NEED TO ADJUST TIMES

The customer's shopping experience depends directly on adjusting logistics to the timing at different stages, from receipt of the order to its final destination (Inside, 2020). To adjust to deliveries, we must adapt to Industry 4.0. The first step is to know our lead time and apply Lean Manufacturing (based on the elimination of those activities that do not add value to the process or to the customer), for the simplification and optimization of processes and resources through the implementation of different standardized methods (Inside, 2020).

METHODOLOGY

What the market currently offers are five key technologies for the digitization and automation of logistics processes:

- Warehouse Management Systems (WMS).

Warehouse management systems or WMSs use software to collect all important data in one place, making it easier for us to analyze data to improve our facilities. A WMS can be linked to any other intelligent system and can be accessed remotely, allowing us to plan future actions, generate reports or access inventory (2021, 2 November).

- Industrial Internet of Things and Big Data.

- Devices are the foundation of all intelligent systems. In these environments, the connected technician can monitor equipment status, optimize inventory control, help management plan work schedules and improve customer satisfaction, just to name a few possible applications (2021, 2 November).

- Collaborative robots.

These robotic devices optimize operations and increase productivity without the need to modify the entire facility's current processes (2021, 2 November).

1. Autonomous mobile robots and AGV systems

Automated mobile robots (AMR) and automated guided vehicles eliminate the human element, enabling them to carry out their tasks autonomously (2021, 2 November).

- Verification systems for merchandise and packaging condition.

These systems make it possible to check that the materials inside the package match the linked order and help to quickly manage any anomalies, as well as to reintegrate the items into available stock with the possibility of incorporating them into preparations in progress (2021, 2 November).

DESIGN CRITERIA (METHODOLOGY AND SOFTWARE FOR RESULTS ANALYSIS)

Panelco S.A. is a company in charge of the commercialization of five families of construction products such as: flat steel, steel, pipes, structural steel and roofing.

Taking this company as a reference, the development of the inventory management system application will be carried out through office automation tools such as Microsoft Access and Excel, as well as surveys and interviews with the company's management and administrative level, as well as with the operators located in the warehouse.

The delimitation of the project is defined in a period of 3 months where we seek to demonstrate the impact that Industry 4.0 has had on the organizational, strategic and efficient scope in 1 distribution center covering the entire organization.

RESULTS

The general manager reports that for 10 years inventory adjustments have been made and no measures have been taken in this regard, which generates administrative wear and tear and an increase in logistics costs; these adjustments made to the inventory balances in the system are to be able to invoice or dispatch goods.

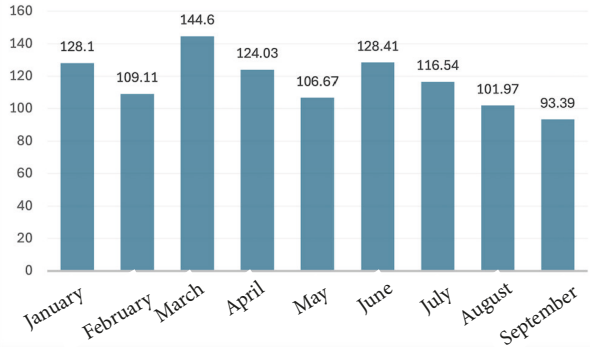
There is a latent risk of occupational accidents to which the company's operators and suppliers are exposed due to the products that protrude into the common corridors; walking over the product also causes damage to the materials.

ANALYSIS OF RESULTS

Supplier certification	
Target	Control the quality of suppliers
Periodicity	Monthly
Formula	$\frac{proveedores\ certificados}{total\ de\ proveedores}$
Unit of measure	Percentage
Goal	25%

Table 1. Supplier certification

Source: own elaboration.



Purchase volume	
Target	To know the relationship between purchase volume and sales volume.
Periodicity	Monthly
Formula	$\frac{vallor\ de\ las\ compras}{total\ de\ las\ ventas}$
Unit of measure	Percentage
Goal	95%
Graph	

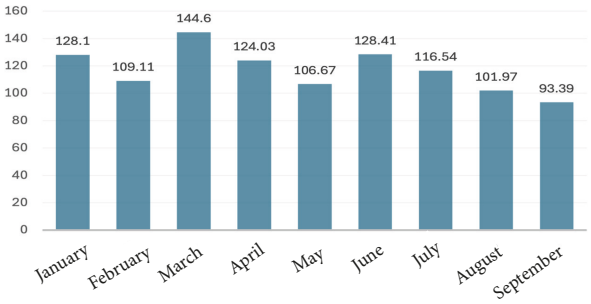


Table 3. Orders delivered complete

Source: own elaboration.

CONCLUSIONS

The implementation of the system makes it possible to provide indicators that facilitate the location and storage of products, based on rotation levels, so that the most important items or those that are in greatest demand are located in areas that optimize movements of preparation, collection, transportation, among others.

It should be noted that inventory management is a fundamental tool for organizations today, because, with the implementation of techniques, technological processes, and others, inventory levels can be determined, as well as their reorder point, facilitating the processes in the supply chain, and establishing in a standardized and technical way the policies of safety stock, quantity to order, to meet the needs and satisfy the demand, making companies competitive in the market.

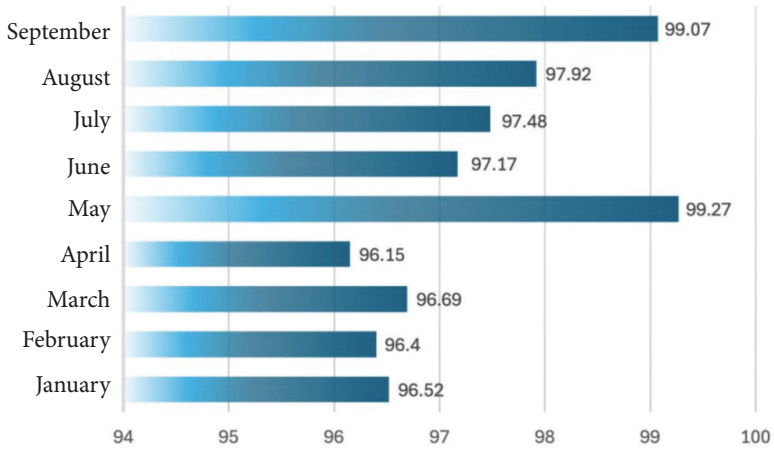
Deliveries perfectly received		
Target	To know the effectiveness of final deliveries in terms of compliance, quality and documentation.	
Periodicity	Monthly	
Formula	1 -	*pedidos rechazados/ total ordenes de compra recibidas*
Unit of measure	Percentage	
Goal	95%	
Graph		

Table 2. Deliveries perfectly received

Source: own elaboration.

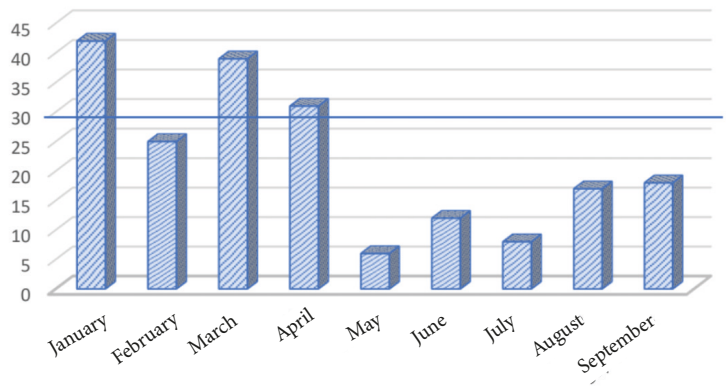
Merchandise turnover	
Target	Control the number of times total inventory is converted to cash, as well as the amounts in CEDI.
Periodicity	Monthly
Formula	$\frac{ventas\ acumuladas}{inventario\ proomedioo}$
Unit of measure	Number of times
Goal	30
Graph	

Table 4. Merchandise turnover.

Source: own elaboration.

REFERENCES

I. (2021, 2 noviembre). 5 soluciones imprescindibles en un almacén inteligente. [R]evolución artificial. Recuperado 10 de noviembre de 2021, de https://blog.infaimon.com/almacenes-inteligentes-la-nueva-tecnologia-que-rompe-moldes/

II. Inside, C. (2020, 23 noviembre). *Los 4 principales problemas en la Industria 4.0, que ponen en jaque la logística de las empresas*. Inside Logistics. https://www.insidelogistics.com/los-4-principales-problemas-en-la-industria-4-0-que-ponen-en-jaque-la-logistica-de-las-empresas/

III. Nieblas, M. (2018, 23 mayo). *La Industria 4.0 y los Centros de Distribución*. Deloitte México. Recuperado 12 de noviembre de 2021, de https://www2.deloitte.com/mx/es/pages/manufacturing/articles/centros-de-distribucion.html?icid=wn_centros-de-distribucion

IV. Vessi, N. (2021, 11 febrero). *Qué es Industria 4.0 y sus antecedentes*. InnoAdap Technology. Recuperado 15 de octubre de 2021, de https://innoadap.com/que-es-industria-4-0-y-sus-antecedentes/