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[Cruz* *et al.*, 6(7): July, 2017]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

# PROPOSAL TO IMPROVE THE PRODUCTION PROCESS OF A PLASTIC CONTAINER MANUFACTURING COMPANY

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**DOI**: 10.5281/zenodo.834559

## ABSTRACT

In Mexico, the plastic industry has been developed to innovate and compete in the regional, national and global context. This sector has been a key player in national economic development. Its contribution has helped boost sectors that are now strategic for the country, such as automotive, food, electrical and electronics, medical devices, agriculture, as well as construction and housing, among others.
This article presents an automation proposal for plastic containers manufacturing company. After an analysis, it was identified different actions to improve the productivity during the process. This actions were classified for it short, medium and large implementation time. Finally, the objective of the proposal is improved a key process because this action represents the plant develop and increase the company utility.

**KEYWORDS**: automation, manufacturing, processes, plastic container, production, utility.

## I. INTRODUCTION

In Mexico, the plastic industry has been developed to innovate and compete in the regional, national and global context. This sector has been a key player in national economic development. Its contribution has helped boost sectors that are now strategic for the country, such as automotive, food, electrical and electronics, medical devices, agriculture, as well as construction and housing, among others.
The plastics industry is made up of the petrochemicals industry, which manufactures resins and additives and the plastics manufacturing sector, which provides inputs to 59 branches of the country's economic activity. Plastic products are widely used in the manufacturing industry (mainly in the automotive industry), in the manufacture of electrical, electronic and household appliances, as well as in the manufacture of pharmaceuticals, among others.
The plastic industry is one of the most dynamic of the economy, since in 2015 it represented 2.5% of Gross Domestic Manufacturing and registered a growth rate of 4.4%; In terms of employment represented 4.6% of the manufacturer and during the period 2013-2015 generated 3,780 new jobs.
The Ministry of Economy reports that the plastic industry is one of the most dynamic in the economy, since in 2015 it represented 2.5% of the gross domestic product and registered a growth rate of 4.4%; In terms of employment represented 4.6% of the manufacturer and during the period 2013-2015 generated 3,780 new jobs. Likewise, the market value of the plastic industry exceeds 23.4 billion dollars in Mexico.
Therefore, it is important to keep competitive the industries dedicated to the production of plastic through the improvements and optimization of their processes; this can be achieved through an analysis of their processes and thus determine the best short, medium and long term technological strategy to implement.
This paper presents a proposal for the improvement of a key process selected from a plastic container manufacturing company; we proceed to the analysis of the structure of the company to determine what kind of automation technology can be implemented.

## II. METHODOLOGY

**Company description**

The company under analysis is engaged in the production of plastic container for different companies, in addition to selling custom packaging wholesale.
This company produces four different types of plastic containers:

- Type A: Consists of 9 different sizes of containers.
- Type B: Consists of 3 different sizes of containers.
- Type C: Only one container is handled, there are no other types of size as it is not needed.

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- Type D: Special order according to the customer, the company orders the mold and the sample to the customer, they are only engaged in the production and once finished the product and the requested lot, the molds are returned.

In addition to producing plastic packaging, the company is also engaged in the collection of packaging for recycling and use as raw material. The recycled plastic is mixed with the virgin plastic to produce a package, reducing costs and ensuring quality to the customer.

**Plant layout**

The plant is distributed in three different zones:

- Warehouse-Mills. In the warehouse, three types of pieces are deposited: the mold needed by the machines to create new containers, the raw material (recycled and virgin plastic) and the finished product; Stored in batches and randomly placed to be ready for quick sale. In this area are also placed two plastic mills used to grind the pieces of recycled plastic.
- Manufacturing area. In this area, the main machines are placed: The extrusion-blow machine that produces the containers and the injection machine that manufactures the caps and in case it needs some extra complement. Also in this area is the compressor that supplies compressed air to the machines.
- Storage and handling of recycled material. In this area, the recycled material is collected, cut, washed and dried; later it passes to the mills located inside the warehouse.

Figure 1 shows the plant layout of the company with its respective dimensions.

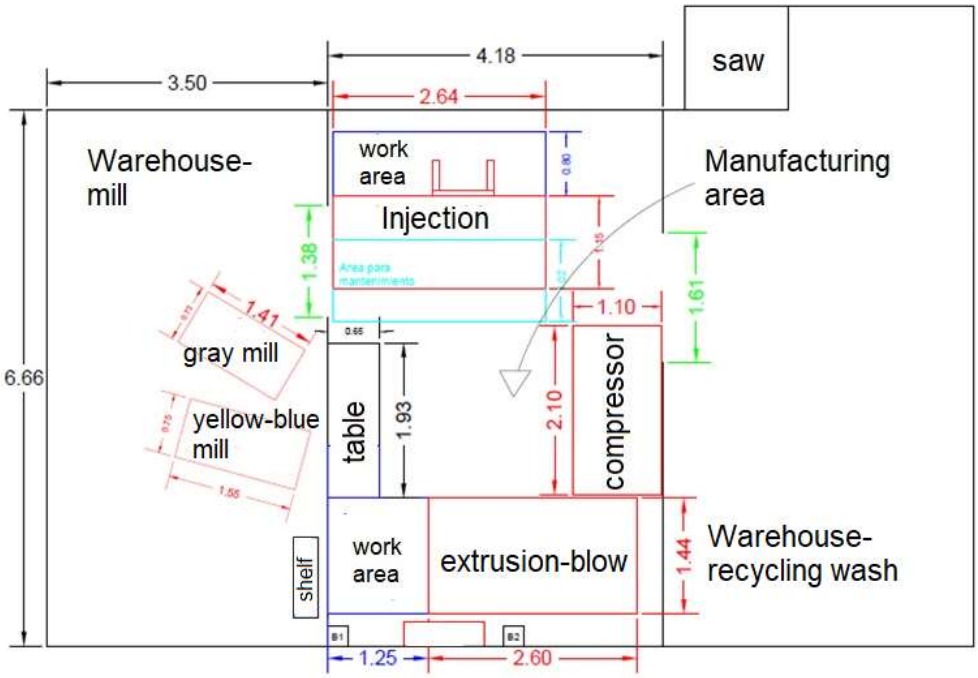


***Figure 1. Plant layout***

**Competitive strategies**

Two competitive strategies were identified in the enterprise:

1. Product innovation: the company is concerned about continuous improvement, which is why they have constantly implemented improvements or generated new products. An example is the use of a handle in its products to improve the grip and transport. Another example is that there is a plan to introduce a new product to the market in less than 2 years, since they detected with a market study the need for this, in addition to that they conducted a technical study in order to achieve the capacity for their production.
2. Customer focus: The company has honesty as one of the values that characterizes it and this together with the good communication they maintain with their customers has generated that they always return. The company knows the value that the client has so he takes care of their relationship with them and always tries to satisfy their expectations and within their possibilities to overcome them.

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**Process description**

The product is conformed by the plastic container, the covers and some extra complement in case of requesting it. The process starts, once you have the molds, in the extraction-blow machine and in the injection machine, both machines work in parallel. They expect a warm-up time of 3 hours to reach the temperature sufficient to melt the plastic. Subsequently the machines are fed with processed material (percentage mix of virgin and recycled material).

The extrusion-blow machine is responsible for the manufacture of the containers. The process of feeding the machinery is done manually, the operator cuts the material, presses the mold, waits for the compressed air to blow, after a few seconds, opens, removes the part and begins the process again. The injection machine is responsible for the manufacture of caps and accessories.

Once the containers leave the extrusion-blow machine, a time is allowed to cool the pieces and then the surplus is cut for reuse.

Finally, the containers are assembled with the lids and placed in bags for storage. Figure 2 shows the flow diagram of the selected key process.

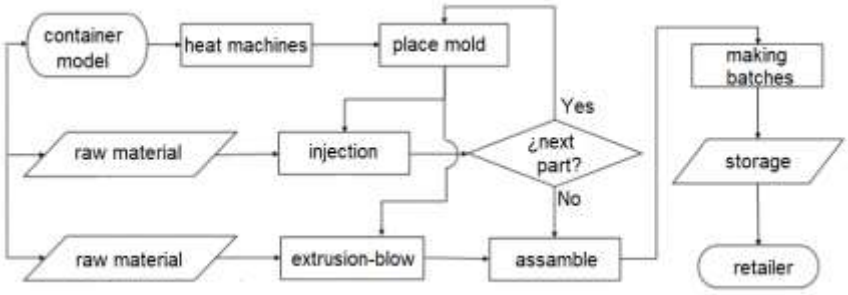


***Figure 2. Process diagram***

**Key process**

The extrusion-blowing machine as well as the injection machine have as key parameters the preparation time, which includes mold placement and heating the time to extract the surplus product material elaborated, which improving these two factors will allow a reduction in the production time.

In addition to this, it has been identified that the distribution of machines and other parts of the plant is not optimal, so that by making some modifications in the positions of these could take better advantage of the spaces and decrease times of movement of pieces.

Another problem is the order in the warehouse, currently there is no inventory system or warehouse control, which causes dead times and sometimes loss of materials.

## III. RESULTS AND DISCUSSION

**Proposal**

According to the problems identified, the following changes are proposed:

1. Short term: use of barcode labels to improve warehouse control and a new plant layout to reduce transportation time.
2. In the medium-long term: update of the machinery suitable for the production processes.
3. Long-term: use of conveyor belts to carry the parts from the machines to the assembly point.

Automating the operation of the machines and the transportation of the parts, and reorganizing its plant distribution, the company can improve its services and the quality of its products, having even more possibilities to enter new markets. In addition to achieving an increase in productivity resulting in economic benefits. By implementing all these changes in the plant, the results regarding the flexibility of the process were in machines, material handling operation and product.

**Implementation plan**

In the short term, the implementation of two measures is proposed, the first is a new distribution of plant in the company, moving the machines and workspaces, to reduce the transportation times of the material of both the raw material and the finished product, Of the machines to the warehouse. The proposal is observed in Figure 3, where only the storage-laundering recycling and the saw remain.

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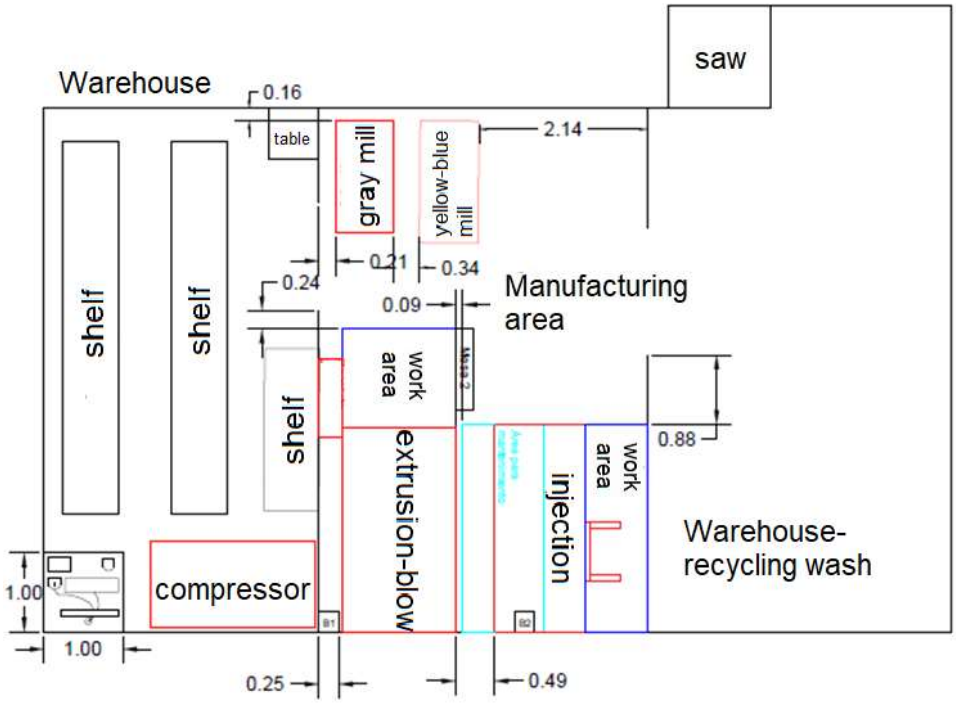


***Figure 3. Proposed layout for the company***

The second measure to be implemented in the short term is to order the warehouse. It is proposed to place shelves to store tools, raw material, product in process and finished product, thus helping the rapid identification of the material. The proposal is complemented by a system of labeling of bar codes for a better control of inventories and logistics of the products.

For the management of the warehouse in addition to the implementation of the labels, the use of a wireless barcode reader is suggested. This will allow easy identification of the contents of the lots by reading their labels, without the tying of cables that could hinder the work of identifying the products.

It is necessary to mention that it will be necessary to install a computer in the work area with the program for bar code reading and the database.

Implementing the short-term plan, there would be improvements in some indicators such as:

Reduction of time: material and personnel transportation time is reduced by better plant distribution.

Increase in productivity: due to the reduction of time it will be possible to produce more pieces per work shift.

Control of inventories: there will be better control of inventories due to the implementation of the labeling system, so that the number of units per piece in stock as well as its location in the warehouse will be known.

Cost reduction: Increasing productivity reduces production costs.

In the medium-long term it is proposed to carry out a study of times and movements to expedite the transportation and handling of material considering the space that is available and the space allocated for each machine in the area.

Once this is done, we propose to implement the upgrade of the suitable machinery to improve the production processes. For the extrusion-blow machine, the acquisition must be a machine of high speed of operation, pneumatic and hydraulic control controlled by means of the integration of a PLC. For the injection machine, the acquisition must be a machine with servomotors and the inclusion of a PLC, to be able to operate manually, semiautomatic and automatically as required.

The long-term measure includes the search for a larger structural surface where the new machinery is placed, and the production processes can be streamlined with the help of the mentioned machines and the implementation of conveyor belts to handle materials.

Implementing the medium and long term plans can impact the following indicators:

Reduction of time: Reduction of machine preparation and feeding times by using automatic equipment, as well as reducing the transport time of material with conveyor belts.

Increase in productivity: due to the reduction of time it will be possible to produce more pieces per work shift.

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Waste reduction: Automatic machinery is designed to take advantage of almost 100% of the material with which it feeds.
Reduction of direct costs: when implementing automatic machinery, the labor needs are more specific and in smaller quantity, thus reducing the direct costs related to labor.
Increase in profits: increasing productivity and reducing costs, directly increase the profits of the company.

## IV. CONCLUSION

Every automation proposal requires an analysis of the manufacturing structure, strategies and production procedures of the manufacturing company, because if there is any inconsistency, the proposed solution will not have the expected impact on the company's indicators.
A proposal was made based on the needs identified in the plastic packaging production plant. These were classified in the short, medium and long term according to the cost of investment and the urgency to cover those needs.
The central proposal is the update of the technology used to meet the current needs of the production process with improvements in the agility of work operations and less losses of raw material. This with the vision of obtaining a long-term flexible manufacturing cell with a set of electromechanical components, which work in a coordinated way for the achievement of a product, allowing serial production of the same.
Finally, the intention is to obtain a manufacturing system with a more productive and agile process that satisfies the requirements of the clients and offers them a final product with higher quality, besides providing substantial profits for the investors.

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## CITE AN ARTICLE

**B., Cruz Jimenez, Contreras Rivero J., Montañez Rufino M, and Peon Escalante R. "PROPOSAL TO IMPROVE THE PRODUCTION PROCESS OF A PLASTIC CONTAINER MANUFACTURING COMPANY." *INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY* 6.7 (2017): 838-47. Web. 25 July 2017.**