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ARRANGEMENT OF MULTIPRODUCTS APPLYING THE CHAOTIC WAREHOUSE

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Abstract: The article shown corresponds to the analysis and study of chaotic warehouses applied to a practical case. It corresponds to the result of an investigation carried out in a multi-product warehouse of an automotive industry supplier. The objective was to establish the rules of distribution and placement of the products using a tool according to the problem. Once the investigation was completed, a reduction in downtime per hour/week was obtained in two of the initial processes. The storage and location allocation policies propose a system for optimal use of spaces in said area, to avoid implications that affect the management and flow of materials. It is worth mentioning that the proposed system can be applied in warehouses that have size and/or space restrictions in the storage area, as well as different brands, production characteristics and physical specifications for which establishing warehouses under the traditional management concept Allocation without slack leads to material losses, parts without registration, use of storage areas with non-corresponding material, inventory errors, etc.
KEYWORDS: Multi products, randomness, warehouse.

INTRODUCTION

It is necessary to start from the concept of storage, which is considered as the operational subprocess concerning the storage and conservation of products with minimal risks for the product, people and company, through the best use of the physical space of the warehouse.

This optimization of spaces aims to facilitate the development of activities and for this, the zoning of the warehouse is necessary. The warehouse can be divided into the following areas:

- Reception and control: which corresponds to the assigned area where the entry process is planned.

- Storage: is the selection and grouping of merchandise in the designated area.
- Order preparation: it is the manipulation of the products that are placed in the corresponding areas to be prepared for your request.
- Departure and verification: corresponds to the activities necessary for the final shipment of the goods.
- Office: is the area intended for auxiliary jobs for warehouse operations.

On the other hand, it is worth mentioning that the products are classified according to sales volume, to establish differential service levels that are applied in a probabilistic demand inventory system, which increases the value obtained with the sales forecast by as many standard deviations. as those that correspond to the probability related to the desired service level for each category, which can be read in "Purchasing and inventory management based on Holt-Winters forecasts and service level differentiation by ABC classification." (Marin, Garcia, & Gomez, 2013)

It can be noted that randomness does not appear within this type of rules, because uncertainty can hardly be handled in operational processes, because these cause human errors or incorrect decisions. In order to obtain positive results with this way of managing information, it involves making randomness evident to establish decision standards for any situation.

Therefore, any system that uses randomness must use robust software and the senses are activated to detect problems in the area, create solutions for different problems and standardize decision making.

This makes the problem more complex to understand and solve. And it is in this scenario that a form of control and administration of randomness is exposed, focused on establishing limits for each scenario, that is, that the operator of that area knows and carries out standard activities, but is also provided with friendly information, the which helps design the storage and assortment process of materials, impacting not only the best use of space but also search time.

AUTOMATED IDENTIFICATION SYSTEMS

Automated Identification Systems (AIS), almost always in the form of a barcode, allow for quick and accurate identification of items. When automated identification systems are combined with effective management information systems, operations managers know the quantity and location of each unit. This information is used with human operators or automated storage and retrieval systems to load units anywhere in the warehouse, at random. Precise inventory quantities and locations require potential utilization of the entire facility because space does not need to be reserved for certain stock keeping units (SKUs) or part families.

Figure 1 shows the tasks of computerized random storage systems.

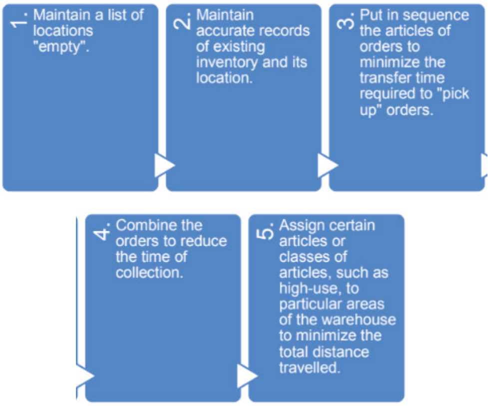

Figure 1. Tasks of Computerized Storage Systems.

Random storage systems can increase facility utilization and decrease labor costs, but require accurate records. (Render Barry, 2014)

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Multi-product warehouses are known in the automotive industry, due to the different designs of automobiles and the needs of assembly plants, both in their chemical and structural composition, shape, additional components, etc., which translates into a huge list of different products required from each Tier supplier (general automotive industry term), this means that the supplier, at the same time, will require a similar list of products from the following links of components and raw materials.

Randomness is not isolated or contrary to traditional systems, but traditional ABC systems use a rigid process, which is why they do not allow randomness to appear in decision making, which can cause problems in a multi-product warehouse. following, to mention a few:

- Empty spaces in the warehouse, which are waiting for assigned material.
- Potential loss of material.
- Slow reaction to changes in demand.
- Incorrect material handling.
- Warehouse use by 60%, but with material without registration because it does not have an assigned place.

This is because the way of dividing the warehouse according to the characteristics of the product and its demand for an enormous amount of different types of product turns material handling into an almost impossible activity, due to the demand for detail in the analysis. to assign locations to each of them.

CHAOTIC WAREHOUSE

It corresponds to a volumetric optimization parameter of any Platform, where the definition of the storage spaces must be governed by the criterion of varied use, that is, the versatility of the positions must be achieved, without maintaining fixed locations. (Movint, 2011)

In a chaotic warehouse you can find very different products grouped in the same place. In addition, there are multiple forms and strategies related to the warehouse in logistics, since it is one of the most important parts of a company and to which a large part of the financing will be allocated. Among all the existing warehouse organization systems, today we will talk about chaotic warehouse storage or management, a type of warehouse organization that is currently booming. (Traenseop, 2023)

Managing a chaotic warehouse allows the warehouse manager to have full control of the stored material, its exact location, relocations of materials, as well as entry and exit of merchandise. It consists of a control of the warehouse in its distribution of aisles, number of shelves and heights, which allows controlling each cell of the warehouse intended to store merchandise in order to quickly locate the necessary material at all times, knowing if any shelf is empty and needs be filled or if any material has to be relocated within the same warehouse. This tool allows quick access to the necessary material at all times, locating it through its specific location. (Solutions, 2017)

It must be noted that the warehouse can be designed at medium capacity. Taking into account what was mentioned previously, experience shows that in no case will stocks be available in the warehouse at their maximum level. When some references have maximum inventory levels, others will be at low levels, others will be at medium levels, etc. This way, it is possible to design warehouses taking into account the average stock level available in them.

Consequently, it is obvious that the use of the physical space of the warehouse is, in this case, much more adjusted to the logistical reality of the company.

However, due to the fact that products can constantly vary in location within the warehouse, it seems logical that their controls could be more complex than in the case of fixed-space organized storage.

Therefore, in the case of chaotic or free space storage, it is normally necessary to have computer support that is capable of managing the location and guaranteeing control of the products in the warehouse. (Inza, 2013)

APPLICATION CASE

The high performance demanded by the automotive industry is based on five axes:

1. The Quality Operating System.
2. Systems Capacity.
3. Continuous Performance.
4. Customer Satisfaction.
5. Continuous Improvement.

That is why, to be competitive in the face of the demands of the assemblers, the processes of the members of the supply chain have the objective of reducing waste and process costs.

Internal warehouses are a common site in Tier1, Tier2 and Tier3 (Tier1 are those that sell directly to the assemblers and the assemblers themselves, Tier2 are the suppliers of Tier1 and Tier3 are suppliers of Tier2.), because They are created to store by-products and the multiple manufacturing processes that the products of the automotive industry need. Unfortunately, these types of areas are not taken into account as a primary part of the material flow, but this is a big mistake because internal warehouses They are the ones that control the takt time quoted by the client, therefore, the input and output of materials in said warehouses must be considered of vital importance to comply with the five axes mentioned previously and to be able to obtain the necessary requirements established by International Automotive. Task Force (IATF) to be recognized as an automotive supplier.

Due to all of the above, there was a need to optimize the operation and costs generated by establishing a traditional administration in an internal warehouse of multiple products, which does not have sufficient capacity to completely store the current customer demand.

Based on the above, it is intended to use the Chaotic Warehouse tool as the main link in the administration of said warehouse, with the objective of using 100% capacity.

DEVELOPMENT AND IMPLEMENTATION OF THE OPTIMIZATION MODEL

The internal warehouse is located between two areas, which are the beginning of the manufacturing process. The first area is transformation, which is responsible for changing the raw material and creating the product. The second adds the main characteristic to the product, which is why these two processes are vital and irreplaceable, in addition to controlling the takt time and the output of the finished product that will be used by the client.

The first area produces around 250 families of products, each with different characteristics, which become around 800-900 items or products that will be processed by the next area, each with different demands, divided according to their demand. weekly and its group proportion as follows: High Runner 50%, Medium Runner 30% and Low Runner 20%, likewise the difficulty of the environment and the changing demand in customer orders must be added. That is why managing a warehouse with these characteristics is almost

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impossible if it is done through traditional ABC.

According to the analysis of the two areas, the second area maintains a downtime of 8K-9K hours/week, with the main cause of this downtime being "Non-Supply" at 86%, which is caused by the handling. so complex of the warehouse. An in-depth study using genchi genbutsu, a VSM, and a Cause and Effect analysis, showed an occupancy of between 50%-60% during the week. In addition to that, the statistics show unregistered material waiting to be placed in the warehouse. Senior management questions the use of the warehouse, because there is material without registration outside the corresponding storage area, but with an occupancy of less than 60% of its capacity.

These two realities are contradictory because there is empty space in the warehouse, but it cannot be used, there is material without being able to be registered or stored because there is not enough space or empty assigned area to be able to place it.

The management obliges the warehouse and those in charge to generate the registration and entry of materials in any available space without taking into account the established rules. The administration decides to apply the chaotic warehouse or random storage tool which uses a precise record of the locations, both used and empty, at the same time of visual location of the areas, FIFO rule and the assignment of material to the first empty location that is found, use of barcodes or scanners, but all this managed by robust and friendly software that the operators themselves can understand, understand and use in a simple way. Information is generated to be able to analyze and change the management of the warehouse, therefore the decision to use the chaotic warehouse is concluded. To do this, it is necessary to use software that helps locate the products.

The implementation was carried out as follows:

- An ABC and/or Pareto analysis was carried out in order to identify the materials with the highest and lowest turnover in the warehouse.
- Product families with similar characteristics and destinations were assigned and identified. (Note important the new target variable added to the analysis)
- Maximum and minimum values were established for each product family according to the weekly average demand or orders.
- Records of the safety inventory levels and re-order point of each product were generated.
- The specific areas for each family were located and delimited, ordering them in descending order.
- The relevant layout was carried out according to the previous analyzes and the corresponding physical areas were identified.
- Software was developed and implemented to identify labels or barcodes of each product.
- A control of material inputs and outputs was developed respecting FIFO.
- Random storage rules in the area were established.

Figure 2 shows the difference between managing the warehouse through the ABC methodology vs the Chaotic Warehouse tool. The first with detailed storage without slack, placing in each location a product with specific characteristics, but without having room for increases or changes in demand, the second stores products with similar characteristics, in this case with equal destinations or lines, with ease of being able to store the material in a specific area, without restricting it to a single location, as long as the locations are empty and are intended for that type of product. The image shows, for example, products A1, A2, …. A12 each located in a specific location, in an ABC Warehouse, however in the other type of warehouse, all products with the letter A can use any location as long as it has the letter A as identification, as shown in figure 2.

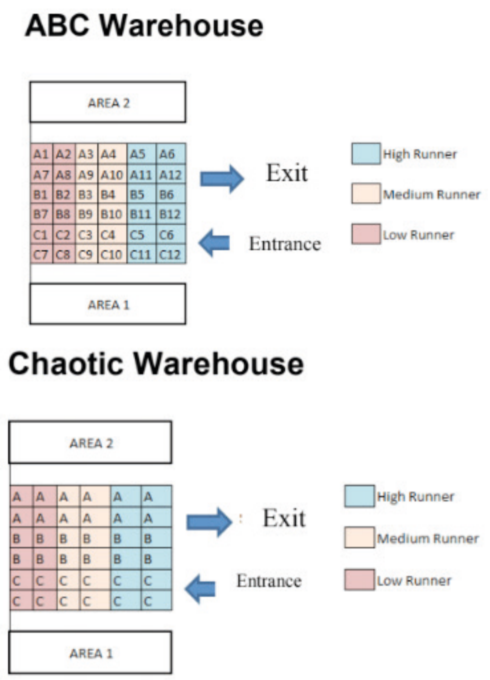

Figure 2 ABC Warehouse vs Chaotic Warehouse

To control the randomness, a standard layout was defined that would show the specific locations for each product according to an ABC analysis, so that after the end of production or when the lines are setup, those products that are out of their place, are taken back to the places established in the layout.

CONCLUSION

The two ABC systems and the Chaotic are not contrary or antagonistic, on the contrary, they can interact very well together, obtaining the best from each of them and reducing their weak points; For example: too much randomness can generate a lack of control throughout the system, and on the other hand, so much control can generate too many rigid rules, causing the system to not be able to visualize or control unexpected changes.

Storage systems must use software to facilitate the registration of entries and exits as well as define specific areas or locations for each product or family. Mark them or generate visual aids for user-friendly understanding. Furthermore, the layout is an important tool because it illustrates the work and the summary of the decisions made previously, meets the objective of synthesizing the tool and facilitates the understanding of the established indications or rules.

It is important to point out the complexity of establishing a chaotic warehouse or random storage tool in an active environment where they are governed by a takt time and idle time is measured. The tool is powerful but the mentality of the human resource is what controls and manages it, which is why it is necessary to define and convince operators of the importance of this tool, in addition to understanding it. Training is essential at this point, as well as the creation and use of manuals along with aids that reduce the complexity of the process.

It is clear that the implementation of this mentality and way of working resulted in chaos, due to the previously generated taboos, the radical change and the uncertainty of establishing and maintaining a new, unknown way of handling material. Training and continuous improvement start from operators, supervisors and administrators, and are generated in a visual and friendly way.

FMEA and 8D's tools are used to standardize the process, in addition to eradicating failures in the new process.

With the implementation of the project, downtime was reduced by 1K-1.5K average hours per week, resulting in increased productivity in area 2 as a result of reducing operators' leisure due to lack of material; The activities of the warehouse managers were also reduced, at the same time the search for material within the warehouse was facilitated, in addition the use of the warehouse increased between 80-90%, with all the material registered, the time of the process of entry/ exit to the warehouse.

REFERENCES

Anas M. Atieh*, H. K.-a. (2015). **Performance improvement of inventory management system processes by an automated warehouse management system**. 48th CIRP Conference on MANUFACTURING SYSTEMS - CIRP CMS 2015.

Ander Errasti, C. C. (2010). **Estado del arte y retos para la mejora de sistemas de preparación en almacenes-Estudio Delphi**. Dirección y Organización, Núm. 40, Abril 2010.

Inza, A. U. (2013). **Manual Básico de Logística Integral**. Madrid, España: Diaz De Santos.

Ilona Jacyna-Gołdaa, M. I. (2017). **The Multi-criteria Decision Support in Choosing the Efficient Location of Warehouses in the Logistic Network**. 10th International Scientific Conference Transbaltica 2017: Transportation Science and Technology.

Krajewski, L. (2013). **Administración de Operaciones Procesos y Cadena de Suministro**. Mexico: PEARSON.

Marin, J. A., Garcia, J. A., & Gomez, O. D. (2013). **Gestión de compras e inventarios a partir de pronósticos Holt-Winters y diferenciación de nivel de servicio por clasificación ABC**. Scientia et Technica.

R. Dekker1, M. d. (2004). **Improving Order-Picking Response Time at Ankor's Warehouse**. Interfaces.

R. Dekker1, M. d. (2002). **Quick response practices at the warehouse of Ankor**. ERIM REPORT SERIES RESEARCH IN MANAGEMENT ERS-2002-19-LIS.

Render Barry, H. J. (2014). **Principios de Administración de Operaciones.** Mexico: PEARSON.

Richard L. Francis, L. F. (1992). **Facility Layout and Location: An Analytical Approach**. Prentice Hall.

Stephen C. Graves, W. H. (1977). **Storage-Retrieval Interleaving in Automatic Warehousing Systems**. Management Science.