

## STUDENT PAPER SUBMISSION FORM

### Title of Submission

Warehouse Management System as an Option for Inventory Management.

---

---

**Author(s)** Please list all authors followed by their permanent e-mail address

(1) Carlos Alberto Duarte Cervantes [cervantescar36@hotmail.com](mailto:cervantescar36@hotmail.com)

(2) Stephany Prado Tapia [fanny\\_prado@hotmail.com](mailto:fanny_prado@hotmail.com)

(3) Jonathan Elí Ruíz Concha [jdw\\_ixoye@hotmail.com](mailto:jdw_ixoye@hotmail.com)

### Primary Author Name

Carlos Alberto Duarte Cervantes

### E-mail

[cervantescar36@hotmail.com](mailto:cervantescar36@hotmail.com)

### Educational Institution

Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Estado de México.

### APICS Terra Grande - Heartland District Chapter Affiliation

ITESM-CEM. Mexico City Student Chapter.

Paper Title: "Warehouse Management System as an option for Inventory Management."

Authors:

- Carlos Alberto Duarte Cervantes
- Stephany Prado Tapia
- Jonathan Elí Ruiz Concha

University Affiliation: Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Estado de México.

All the authors are currently full-time undergraduate students in Industrial and Systems Engineering at Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Estado de México.

Supporting local APICS Chapter: ITESM-CEM Mexico City Student Chapter.

Submission Classification: Full-time Undergraduate

## ABSTRACT

As the result of new technologies, increased competition and other market dynamics, maximizing the efficiency of today's supply chain operations is getting more difficult and complex day by day.

This paper examines the warehouse management system as an option for inventory management, comparing it with traditional techniques for inventory management.

## OVERVIEW OF INVENTORY MANAGEMENT

All organizations have some type of inventory planning and control system. Nowadays, inventory is one of the most expensive assets of many companies, representing as much as 40% of total invested capital (3). This is the reason why a good inventory management has become a crucial decision in companies. A good inventory management system can reduce total costs in a company, but in the other hand this means to invest in this system. The crucial task is to balance between inventory investment and customer service.

## LITERATURE REVIEW

Inventory includes all goods and materials that are used in the distribution and manufacturing process. Raw materials, subassemblies and finished products are part of the inventory. It involves capital, space use, it expires, it can be stolen and sometimes lost. For all this reasons, sometimes inventory is seen as a "passive";

but also inventory can be used as a buffer to prevent from stopping the manufacturing process, in this case inventory is seen as an “active”.

### Functional Classification of Inventories

The primary function of inventory is as buffer and separator. Buffer between demand fluctuations and production capacity, between final assembly requirements and components availability; and it breaks the demand from the immediate dependence in the supply.

The functional classification of inventories is made based in the special use of inventory in each situation (2):

- Anticipation Inventories. These types of inventories allow the company to answer an emergency in the demand or an insufficient offer, for anticipated.
- Batch Size Inventories. In many cases it is inefficient to produce or buy articles at the same rate as they are consumed. The batch size inventories search the biggest saves in the production or buys, producing or buying at an intermittent rate in a quantity (batch size) enough to satisfy the relatively stable demand during a certain period.
- Fluctuation Inventories. Fluctuation on demand and offer are unavoidable. This type of inventories are stored to satisfy the highest fluctuation on finished articles demand; in the same way it is stored to absorb the variations on raw materials requirements, components and production inputs. The final goal of this inventory is to allow the company to offer its service to its customers when the service demand is higher than the mean

or when the inventory supply is longer than usual. This type of inventory is also known as *Safety Stock*, *Buffer Inventory* or *Reserve Inventory*.

- In transit Inventories. Not always the stages in the manufacturing process are physically together. In fact, usually some components are made in one location and are sent to other city, state or country to finish its assembly. Articles in movement from one stage to another are named *in transit inventories*, and include all the articles shipped from the finished products warehouse to the customers; it also includes the products that a company ship from one facility to another.

## Inventory Costs

It exist 4 types of costs related with the inventory management (4):

1. Preparation Costs. They include the costs of all the activities that need the creation of a production or buy order. They include the cost for making the order, prepare the specifications, register the order, monitoring the order, processing the bills and prepare the payment.
2. Maintenance Costs. Are all the costs for the simple fact that an article is in inventory. It includes the costs of invested capital, costs of spoilage, obsolescence, stealing, insurances and taxes. It also includes the storage costs caused by handling, security and space.
3. Lack of inventory Costs. 2 possible scenarios can happen: delayed orders and non-delayed orders. In the first the customer waits to receive the product; in the second one the customer doesn't wait and the order is lost.

The costs in the first scenario include the extra hours of work to follow the delayed order; meanwhile in the second scenario the costs are simply the lost sale.

4. Capacity related costs. These costs are related with the expansion or contraction of the production capacity, as a result of the medium or long term planning. They include the hire and training of new workers, the buys of new equipment, and the payment of extra hours among others.

### Inventory decisions

Inventory decisions are related with planning capacity decisions, with planning structures at long, medium and short terms, with “do” and “control” phases in the operations management. There are a lot of variables that affect inventory, such as: facilities size and capacity, type of process, distribution methods, among others. Because of the interaction of all this variables, inventory management involves the principles, concepts and techniques to decide what and how much to order, when it is needed, when to order the buy or the production and how and where to store it. Decisions at any of these levels need to be related to decisions in other levels (they need to be integrated) and need to support the objectives of the organization by the defining and getting the desired levels of customer service and the achievement of the investment objectives in inventory.

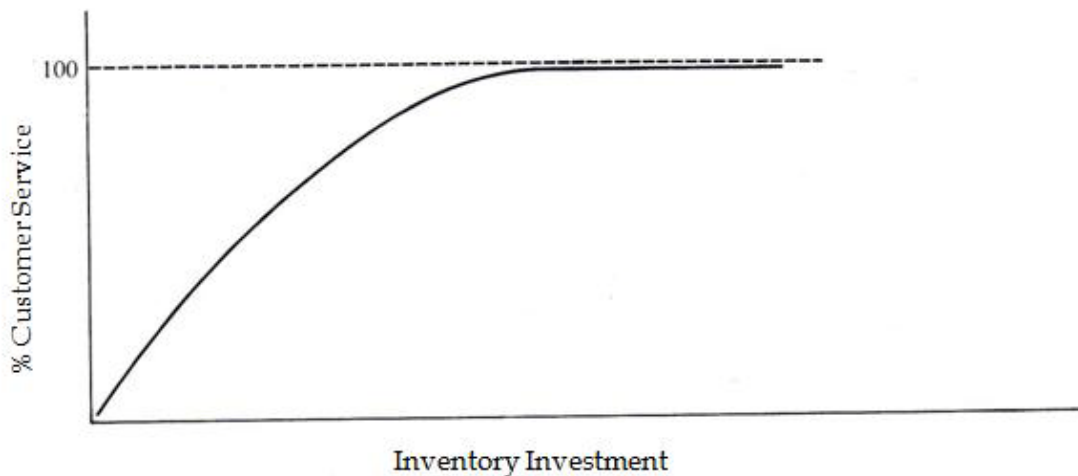
### Customer Service

This term is used to describe the availability of articles when the customer needs them. A good inventory system can improve the customer service. Generally the

customer service has an exponential interrelation with the inventory investment (2), as it is shown in the following graphic.

FIGURE 1

Customer Service vs. Inventory Investment



### Inventory Management Systems

In an operational environment, inventory management is made by the use of a group of procedures that are known as inventory management systems. An inventory management system covers a set of decisions, rules and guidelines for several situations in the inventory. Uses the data processing capacity to determine the nature of the different situations as they arise in the planning horizon. Using the information that describes the decision variables, the system will automatically make the decision on the basis of explicit models of some situations. In other situations, less structured, the system will show important information so that a human can make the decision.

## Inventory Distribution Management

The objective of the inventory distribution management is to have an inventory in the right place, at the right time and at a reasonable cost. In other words, to achieve a desired customer service level at a specified cost or below this.

The management systems for the inventory distribution management can be classified in two (2):

1. Pull systems. In this type of system, the warehouse determines its requirements and the factory orders; it “pulls” inventory to the warehouse. This type of system does not consider other local warehouse needs, neither the available inventory in the main warehouse or the factory production plan. The local warehouse controls the order system.
2. Push systems. In this type of system, the forecasted requirements for all the warehouses are added up for period, and the planned production and available inventory are allocated to the warehouses. Inventory is “pushed” inside the warehouses. This type of system considers all the projected requirements from all the warehouses, the available inventory in local warehouses and in the main warehouse and the in-transit inventories. The main warehouse controls the order system.

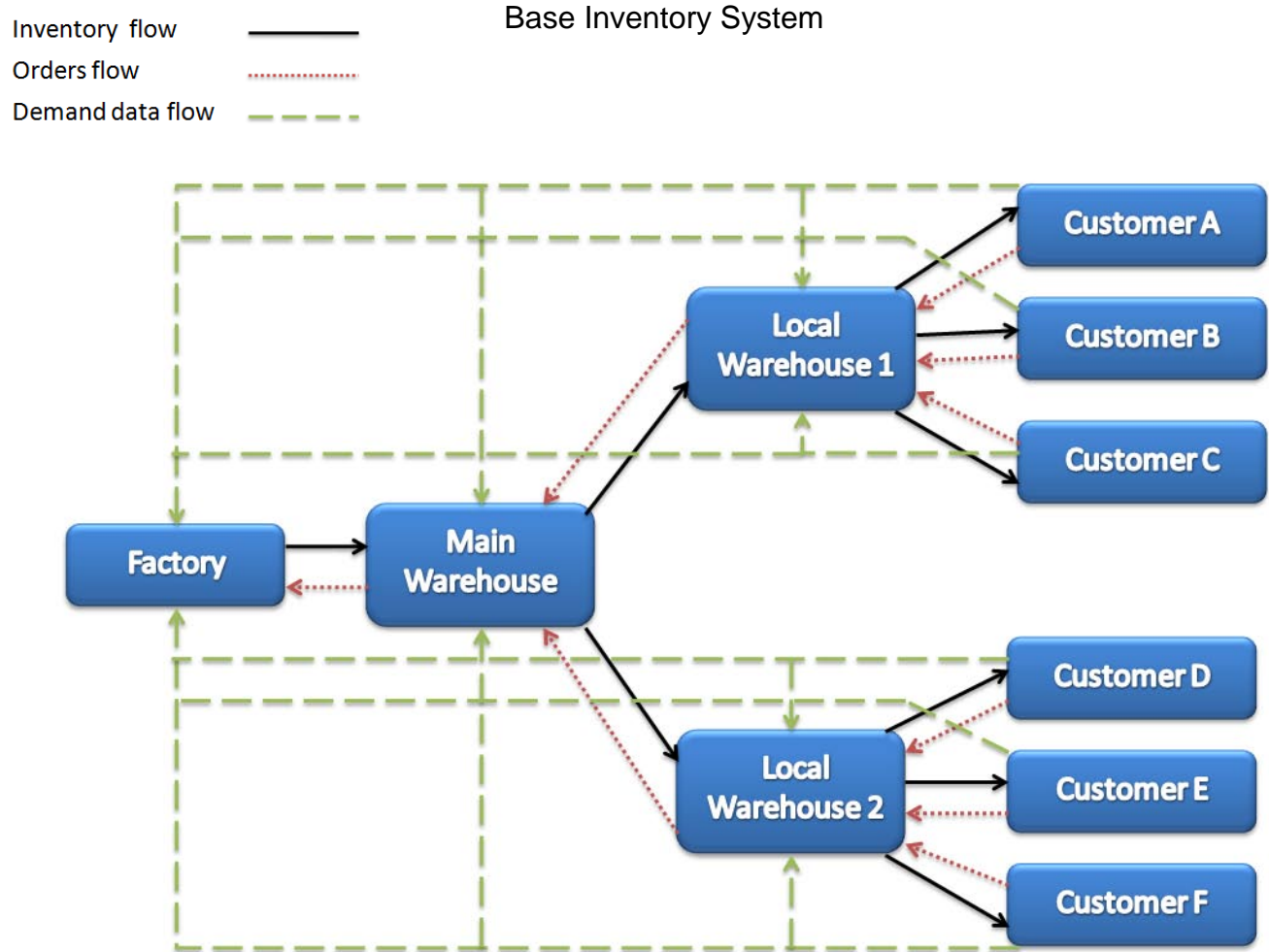
## Inventory Control for the Pull Systems

- Order Point System. In this type of system the local warehouse orders to the main warehouse when the inventory quantity gets at the order point. This system can result in a very erratic demand in the main warehouse. It

requires a large safety stock in the main warehouse plus the safety stocks in the local warehouses.

- **Periodic Review System.** In this type of system the status of the inventory in the local warehouse is determined at regular periods, and the local warehouse orders the required quantity to have the inventory at the determined level (maximum). In this type of system, the safety stock in the main warehouse has to be larger than the order point system, due to the fluctuations in the demand in the cycle and in the lead time.
- **Double Order Point System.** This system provides additional information to the main warehouse. The local warehouse reports when its inventory is equal to the traditional order point plus the normal demand during the manufacturing lead time. This allows the main warehouse to check its position at inventory, relative to the anticipated orders of the local warehouses and take appropriate actions.
- **Base Inventory System.** In this type of system, an inventory level for each article is set periodically. All facilities that store inventory are informed of the sales weekly or daily, so that the local warehouse, the main warehouse and the factory know the client demand trends; with this the system reduces the “whip effect” throughout the supply chain, and the factory and main warehouse can plan on the basis of the real client demand. As the supplying of the local warehouses is done on the basis of client demand and available inventory, this system adds some characteristics of the “push” systems. The following diagram explains this type of system:

FIGURE 2



### Inventory Control for the Push Systems

- Distribution Requirements Planning (DRP). DRP joins the production planning with the distribution planning to determine the total requirements in the same flow point according to the Master Production Schedule (MPS). When the MPS articles are not the final product, they can be seen as if they were the first distribution stage. DRP projects the requirements for the local warehouses and creates planned orders in the main warehouse, avoiding delayed orders. DRP is based in the future requirements instead of past

sales, and it keeps a large part of the safety stock in the main warehouse instead of keeping it in the local warehouse.

#### Literature Review Conclusion

Collectively, the literature demonstrates that inventory is all goods and materials that are used in the distribution and manufacturing process. Its main functions are: as buffer between demand fluctuations and production capacity, and as separator, breaking the demand from the immediate dependence in the supply. Companies must consider the 4 types of inventories explained (Anticipation, batch size, fluctuation and in transit inventories) and the costs related to them (Preparing, maintenance, lack of inventory and capacity related costs) to define the inventory management system to be used in the company. The company also needs to define a desired customer level service, which is going to affect directly the Inventory Distribution Management System, considering the inventory investment allowed by the Administration. Nowadays, as the customer expectations are higher, companies need to offer a higher level of service to its customers; this has result in mixed Inventory Distribution Systems, with both “pull” and “push” characteristics; with the final objective of obtaining an integrated supply chain, from local warehouses to the factory. An option for those companies, who want to offer a higher level of service to its customers, who control large amount of materials in their inventories and want a more integrated supply chain, is a Warehouse Management System. This option has several benefits and decreases the complexity of the Inventory Management System and the Inventory Distribution System, as it will be described in the next section.

## WAREHOUSE MANAGEMENT SYSTEM (WMS)

A warehouse management system, aims to control the movement and storage of materials within a warehouse. It is also associated with the process of transactions, shipping, receiving, putting away and picking. Warehouse Management monitors the progress of products through the warehouse. It involves the physical warehouse infrastructure, tracking systems, and communication between product stations.

This system is software that works down the basic logic of using a combination of item, location, quantity, unit of measure, and order information to determine where to stock, where to pick, and in what sequence to perform these operations.

Using WMS:

- It will reduce inventory.
- It will reduce labor costs.
- It will increase customer service.
- It will increase inventory accuracy.

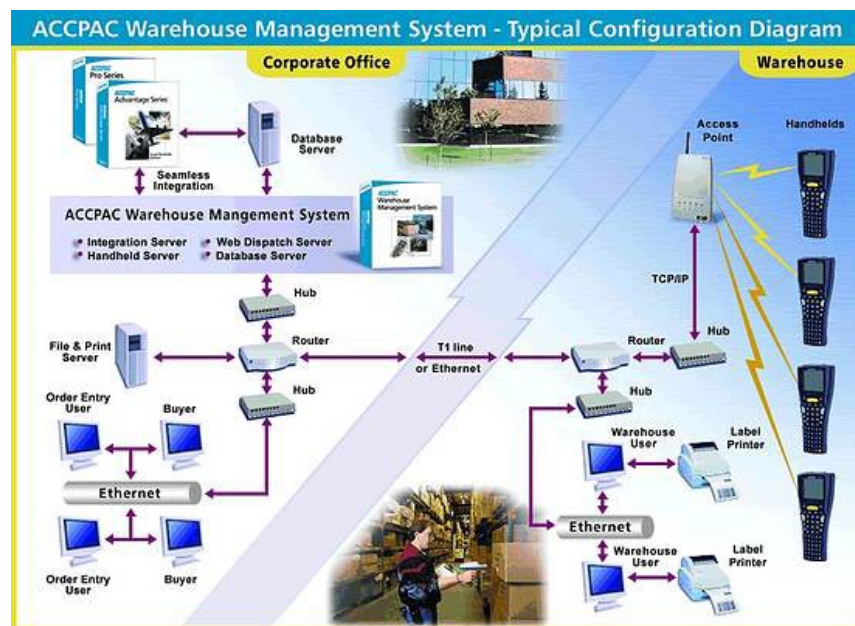
These points can be noticed in such a way that because it is software, you require less people for operating it than the labor saved on the warehouse floor. It is so effective in searching, looking and picking the item that it reduces the cycle times of doing those things manually bringing greater ability to service the customer.

When increasing accuracy and efficiencies in the receiving process the level of safety stock may be reduced and with it the level of stock in excess, having an impact in the costs that it generates.

Another important point is that WMS takes advantage of the technologies of radio frequencies and bar codes for delivering a system of administration to all the stores. It also allows multiple orders to be prepared at the same time.

FIGURE 3

Interaction of WMS with their components



This system is designed for being efficiently and for optimizing the daily activities that are held in a warehouse while, at the same time, it reduces the costs of maintenance and inventory, integrating the processes of purchase and accomplishment of requests. Almost, 100 % of the precision in orders is improved

creating an efficiently control of inventory in business, running the part of the warehouse practically without the use of paper.

### Material And Resources Control System (MARC) WMS

In this paper we are focusing on the WMS named MARC, a WMS software by MARC Global. This software manages all the distribution, fulfillment, transportation and unique value-added services activities across the enterprise. This software has unparalleled configuration capabilities to vertical-specific roadmaps for multiple industries. It is ideal for companies that view their supply chain as having strategic importance and as an essential asset for providing them with a competitive advantage.

It manages the inventory flow inside a warehouse and integrates all warehouse functions in one single system (Inbound and Outbound). It uses barcodes to identify and trace all movements, being a process that is directed via radiofrequency units (RF).

The form in which it interfaces is:

1. Automated interfaces feed and flow out of MARC to a host ERP system.
2. MARC sends tasks to the RF terminal units.
3. MARC receives and performs tasks through the computers and RF terminals.

The main benefits by using MARC WMS are (5):

- Inventory visibility and accuracy improved to near 100%
- 100% product traceability
- Improve management control and reporting
- Improved customer service
- Increased workforce productivity
- Improved space utilization
- Throughput velocity increased
- Improved delivery time
- Picking times reduced for quicker order fulfillment
- Reduced picking errors

The next flowcharts were given to us by Mars Mexico, a group formed by Effem Enterprises (Pedigree, Perfect Fit and Whiskas), Mars Inc (Milky Way, Snickers and M&M's), Lucas World (Lucas candies and Skwinkles), Uncle Ben's and Wrigley's (Wrigley's Bubblegum, Orbit & life savers). These flowcharts show how MARC works. This system is used in the Mars warehouses located in Queretaro, Monterrey and Guadalajara. It is also used in other countries, such as: Russia, Brazil, Europe and United States. For example, the figures 4 and 5 show us the procedures to have an effective inbound process. These processes help MARS to reduce the time to stock, pick and inventory the products, because the products are ordered through a coordinate system and MARC use FEFO (First Expiration First Out) to avoid that products expire inside the warehouses.

FIGURE 4

Warehouse inbound process: Receiving “to be” process

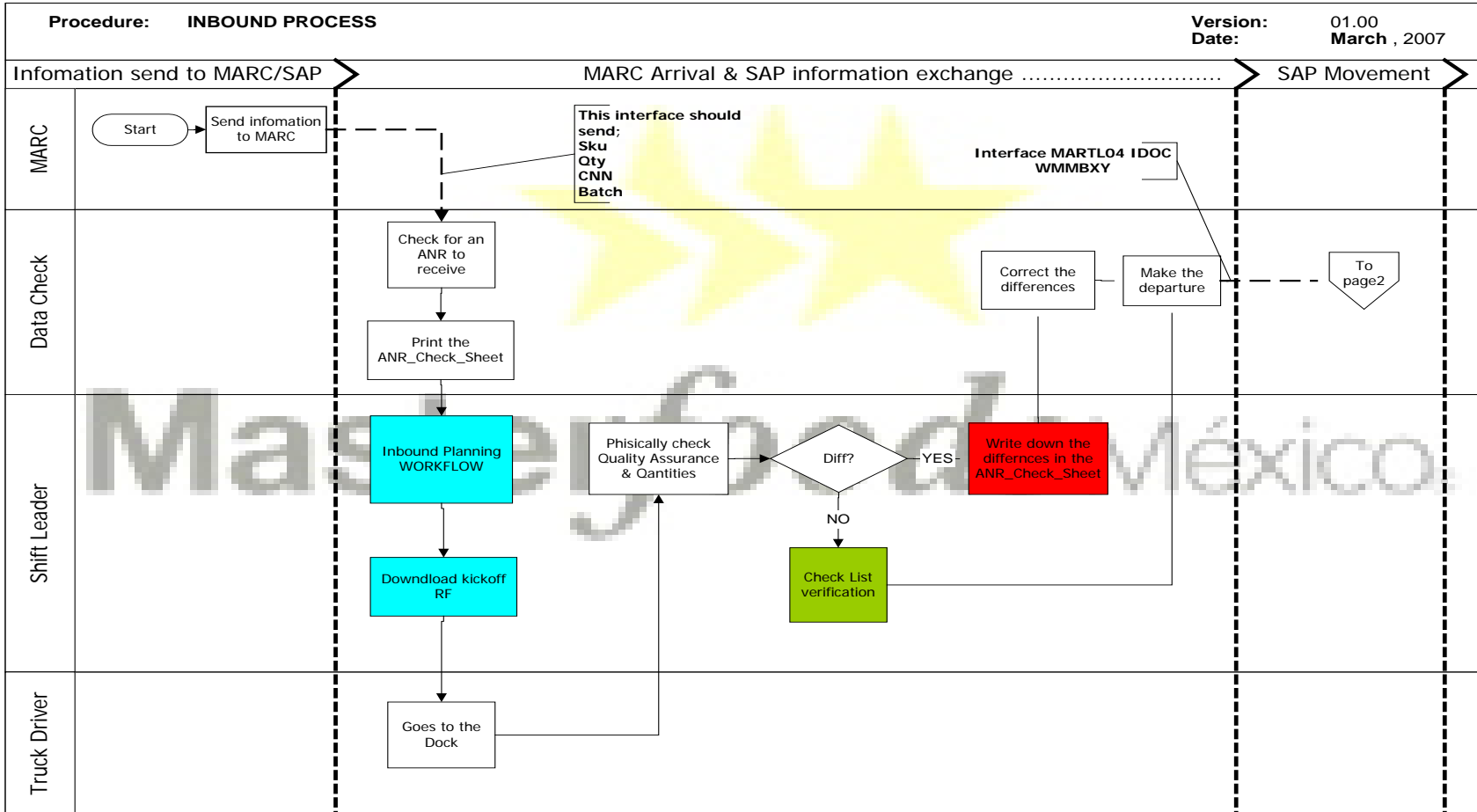


FIGURE 5

Warehouse inbound process: Receiving “to be” process (continue)

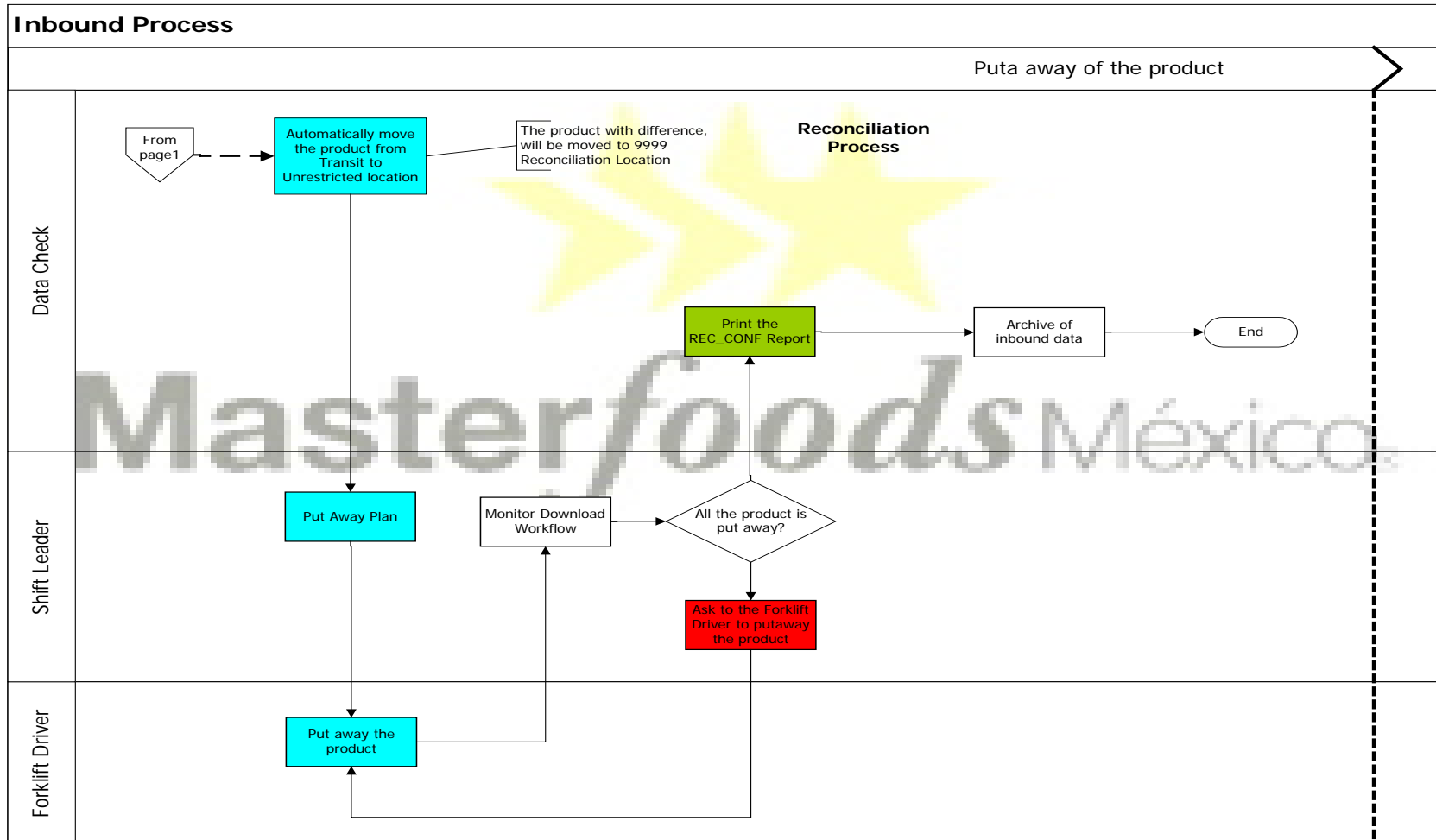
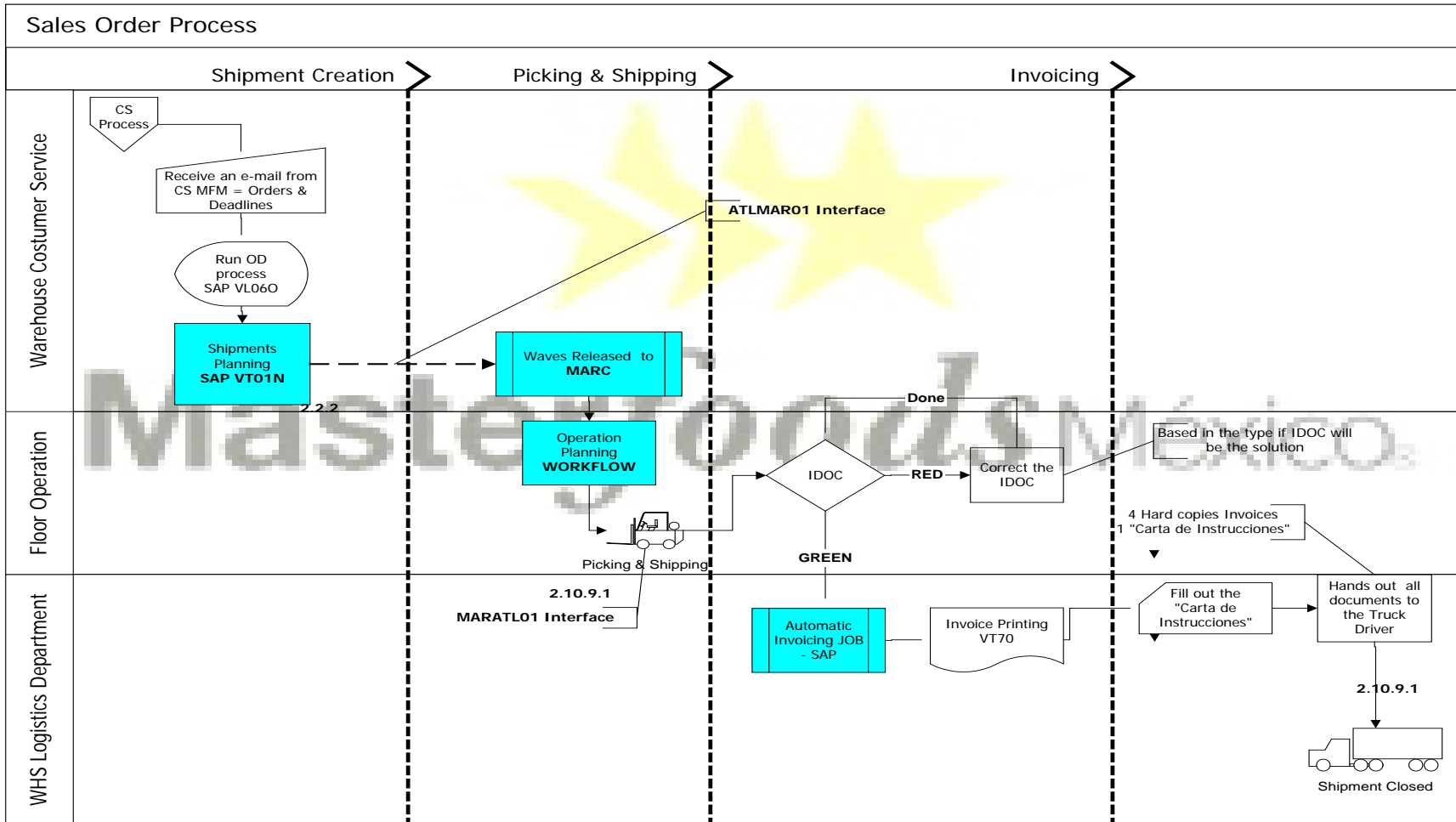


FIGURE 6

Warehouse outbound process: Sales order "to be" process



## CONCLUSION

Nowadays, in order to be a competitive company they must seek ways to reduce costs, to increase productivity and to integrate their supply chain without leaving the customer service aside. An important way of doing this in a company is throughout their inventories. A good Inventory Distribution Management System with a good Warehouse Management System can save up to 40% of the total costs of a company (3).

A perfect solution to actual companies, who want to offer a higher level of service to its customers, who control large amount of materials in their inventories and want a more integrated supply chain, is a Warehouse Management System. A WMS can help a company to reduce inventory costs greatly, maintain an accurate inventory control throughout the factory and warehouses, increase the customer service and avoid all the complex mathematical operations that an Inventory Distribution Management System implies.

A WMS like MARC manages the inventory flow inside a warehouse and integrates all warehouse functions in one single system that helps to improve management control and reporting, improved space utilization and reduced picking errors. As this system takes advantage of the technologies of radio frequencies and bar codes MARC also helps to increase the throughput velocity, increased workforce productivity and improved delivery time.

Finally a WMS would allow companies to manage efficiently their inventories, resulting in a reduction of inventories management costs and in an increase of customer service; moreover, it would also be a very good support in the decision-making of inventory policies.

## REFERENCES

### MLA Reference Style

- (1) Coulter, J. and Shepherd, A. Inventory Credit – An approach to developing agricultural markets. Rome: FAO, 1995
- (2) Fogarty, D., Blackstone, J., and Hoffman, T. Administración de la producción e inventarios. Mexico: CECSA, 2004.
- (3) Heizer, J. and Render, B. Operations Management. Upper Saddle River, N.J.: Pearson/Prentice Hall, 2004.
- (4) Sipper, D. and Bulfin, R. Planeación y control de la producción. México: McGraw Hill, 2005.
- (5) <<http://www.redprairie.com>>. Retrieved April 24<sup>th</sup>, 2009.