PRODUCT POSITIONING OPTIMIZATION USING THE ABC METHOD

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Abstract. Due to the high levels of competitiveness, companies have searched for market differentiation by promoting innovations, reducing prices, improving quality, increasing productivity and efficiency, etc. Logistics, in this context, plays an important and decisive role in the maintenance of current customers and gain of new customers and prominence in the market. The heating/cooling issue of the sales is common in some seasons, and depends on the world economic situation, climate change or holidays. This paper proposes a warehouse automation scenario that aims at minimizing logistic costs and level of stocks, enabling the warehouse flow monitoring. It allows the company to improve its performance in handling finished product stocks. By verifying the sales quantity for previous periods it is possible to obtain the relationship between the seasonality of each finished product. Based on these data we can create an ABC Curve, based on Pareto´s Principle, that facilitates studies of a better allocation of the products in stocks by rearranging the warehouse, creating an order of priority of the company's portfolio and deleting unnecessary displacements through the best routes of the AGV´s (Automated Guided Vehicles). Therefore it is possible to obtain a lean warehouse that operates with minimum safety inventories, as the need for marketing in certain times of the year has been. This handling of stock of finished products enables the proposed reduction in logistic costs and consequently, a substantial competitive edge. To complement the work, the proposed optimization was applied to a middle-sized business in the region of Sao Paulo, for better analysis and understanding of the impact generated by the seasonal demand on the warehouse. This case allowed observing high logistic costs in the company, highlighting the needs of the proposed optimization. In conclusion, the project can be considered of great importance to improve the conditions and storage methods.

Keywords: *seasonal demand,, inteligent warehouses optimization*

1. INTRODUCTION

According to the Council of Logistic Management (1986), logistics can be defined as the “process of planning, implementing, and controlling the efficiency, the flow and storage of goods, services and related information from the point of origin to the point of consumption to conform to customers requirements”.

In this context, logistics is a factor used as strategy for an optimization. According to Bowersox and Closs (2007), it represents a source of competitive advantage due to its integrated management. In this way, companies seek competitive advantage as a means of keeping or gaining highlight in the business market, due to the dynamism of the global market economy..

To obtain this competitive advantage, companies are using integrated information systems in order to automate their production processes using technologies, such as Electronic Data Interchange (EDI), Warehouse Management System (WMS), Barcode Technology and Vendor Managed Inventor (VMI). These logistical systems support the control of information flow in the company. Specifically, the Warehouse Management System (WMS) streamlines the information flow in a warehouse, improving the storage operability and promoting the process optimization through an efficient management of information and resources. WMS allows the company to take the maximum advantage of this activity. The vast majority of companies depends on this system to standardize work procedures and stimulate the best logistic practice (Werc, 2003).

In a free enterprise environment, companies compete to achieve customers so that they can find a more favorable position in the business market, in relation to their competitors. Therefore, they consciously chose a competitive strategy among the alternative paths and actions to fulfill (Porter, 1986). It is common to listen to the competitive strategies of the companies, in which some compete for prices and other for marketing.

Global market conditions promote an increasing interest in integrating strategic, tactical and operational decision making in order to achieve enterprise wide optimization (Rodriguez, 2010). An important number of remarkable researches supports this idea (Grossmann, 2005; Varma, *et al*., 2007). Models and methods have been developed to solve enterprise optimization problems from different points of view (Sarker and Diponegoro, 2009; Sousa, *et al*., 2008; You and Grossmann, 2008).

Warehouses are an essential component of any supply chain. Their major roles include buffering the material flow along the supply chain to accommodate variability caused by factors, such as product seasonality and/or batching in production and transportation; consolidation of products from various suppliers for combined delivery to customers and value-added-processing, such as kitting, pricing, labeling, and product customization (Gu, 2005).

Some studies have considered only the items fixed position inside the storage system and investigating the best route to attend solicitations of service orders (Klimm *et al*. 2007; Olmi, 2008; Ravizza, 2010; , Vivaldini *et al.*, 2009, Vivaldini *et al.*, 2010). These studies have shown the need of a comprehensive and continuous research in this area. Recent researches have shown that operations optimization in warehouse related to resources represents a great improvement in the company's logistics procedures (Baker and Canessa, 2009; Gu *et al*, 2007; Mountz, 2010; Zhanga and Laib, 2010).

The operational optimization is achieved by designating the item position inside the warehouse to reduce distances traveled during all the moving process. On the other hand, some products need efficient distribution not only for economical reasons, but also for those related to security (CSCMP, 2010). The effects of infrastructure on the general conditions of the economic efficiency are quite obvious. The availability of an appropriate infrastructure maximizes gains of efficiency to the productive system, as well as the increase in added value, reducing the input cost per unit.

This paper presents a method that assures a correct positioning of stocked products, guaranteeing a great material handling based on seasonal demand and, consequently, reducing logistics costs. In order to do so, a company partner in São Paulo State provided real data of its Warehouse Management System (WMS), and the seasonality was raised.

The article is organized as follows: In a section 1 introduces the subject; Section 2 shortly contextualizes the seasonal demand and logistic costs; Section 3, describes the ABC Method; Section 4 presents a description of the company where the study was applied and the results; Finally section 5, presents the conclusions and the main contributions.

2. SEASONAL DEMAND

Demand forecast is the main subsidy of the production planning. It provides information about the future demand of products so that production can be planned in advance, allowing productive resource to be available in appropriate quantity, moment and quality. Seasonality is a characteristic frequently caused by climatic variations, holidays and other factors. Therefore, procedures are used to assess the seasonality and forecasting methods that consider the effect of seasonal fluctuations on the demand, because the more information about demand behavior of one product, the more accurate the stock (Queiroz and Cavalheiro 2003).

The data to calculate the seasonal demand can be obtained through a marketing research, or data collection of sales in previous periods.

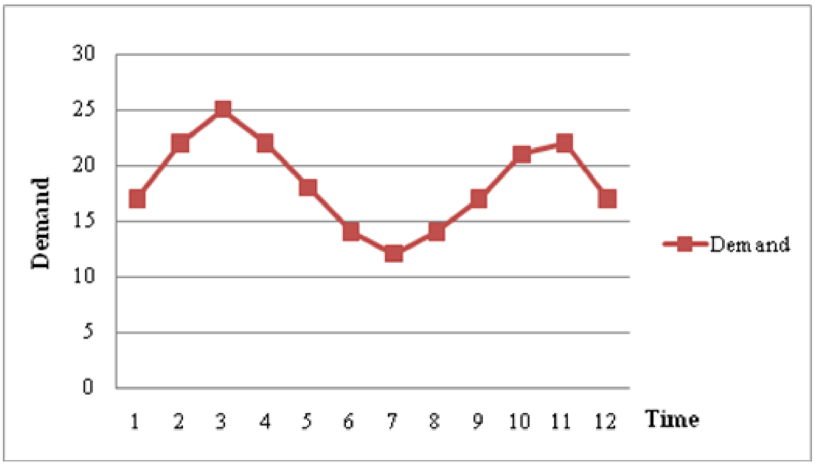

Figure 1. Seasonal demand
Adapted from Chen and Chang (2007)

According to Wallis and Thomas (1971), seasonality can be defined as a set of systematic, but not necessarily regular movements or fluctuations in a period equal to or shorter than one year. Which occurs in a time series. However, seasonality is the result of economic, social and institutional natural causes. There are two main interests in the adjustment of time series to seasonal variation: the proper study of seasonality and the removal of seasonality from the series in order to study it afterwards in its other aspects. In this last, the idea that the existence of seasonal variations affects the recognition and interpretation of important non-seasonal variations in one series is implicit (Pino *et al*, 1994).

2.1. Demand Forecast

According to Ballou (2007), the planning and control of the logistic activity depend on accurate estimates of the services and volume products to be processed by supply chain. Those estimates usually occur in the form of planning and demand forecast to production planning and control (PPC). Dias (1993) considers that every study about stock is ruled by the demand forecast. According to the author, the demand forecast should always be considered the most likely results hypothesis to define which products, how many of this products and when this products will be required by customers. The demand forecast is characterized by

- The starting point for inventory planning;
- The efficiency of the adopted methods;
- The number of hypotheses used in the reasoning.

Ballou (2007), states and forecasting in logistics includes factors of spatial and time nature, also including the extension of variability and the degree of randomness. This happens because logistics professionals need to know where and when the demand will occur, so they can plan the warehouse location, determine the inventory turn along the supply chain and geographically allocate the transport resources.

According to Bowersox and Closs (1996), the demand forecast is divided by location, quantity of products and period of time and its purpose is to plan logistics operations. To develop an integrated process of demand forecast, all possible sources of information as well as their users characteristics should be considered.

2.2. Logistic Costs

Logistic costs in a company of the manufacturing sector can be divided into packing, data processing, logistics management, transport, storage and stock in the following proportions.

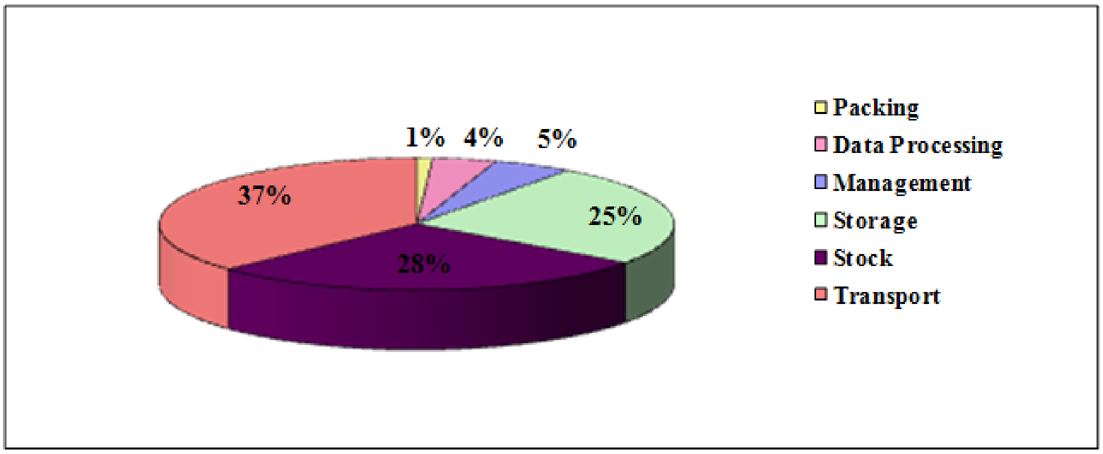

Figure 2. Logistic costs
Adapted from Neto (2010)

The analysis of the graph leads to the conclusion that an optimization in stock and storage is necessary, because both totaled 53% of the logistical costs. Given that stock represents investment, in other words, finished products and storage encompasses all the physical structure.

Slack *et al.* (2002) define stock as an accumulation of manufactured or non-manufactured material goods.It exists to compensate the oscillations of the demand and to efficiently supplement this necessity. Ballou (1992) proposes the use of the ABC Curve, in which the tables of products are classified according to the sale level.

There are several forms to reduce this portion of logistic cost, such as reduction of warehouse area to operate with minimum stock or inventory policy (Just in Time, FIFO e LIFO) (Slack *et al.*, 2002) and/or optimization of positioning of the stocked products.

The integration between the correct positioning of finished products and the automatic routing system for Automatic Guided Vehicles (AGVs) will reach the cost optimization in material handling, as well as the costs concerning the maintenance of equipment. In addition, the optimization of finished products positioning is supported by several authors, because it rearranges the layout of the storage. This modification achieves a better flow in the warehouse, reduction of routes to be traveled between loading and shipping area of the product and decrease of the response time between operations.

3. ABC METHOD

The ABC Method has been largely applied in the literature. It enables to reduce the total distances of goods movement in the warehouse. The technique shows a great efficiency and has some similarities with the Pareto's Principle. Once the items have been prioritized, a modified Pareto' s Principle (commonly referred to as the "80/20 rule") is used to stratify the parts into categories. Typically three categories are used: "A", "B", and "C", hence the name "ABC Method".

According to Askin and Standridge (1993), the method is defined as the products are divided in to three classes (A, B, C) according to the index of movement. The items with a great index are classified in to class A and allocated in positions near the entry door and/or exit of merchandise; those that have an intermediate index of movement are classified in to class B and allocated in positions with distances; finally the items classified in class C are those that have the smaller necessity of movement. Therefore, class C is allocated in the positions with higher distances to the port of entry and output of the merchandise.

In purchasing, the basic ABC analysis is used to identify which segments represent most of the spent in a given category or portfolio. Most of the time, few segments in a portfolio constitute the largest part of the total spent.

The classic ABC method consists in ordering the allocation of stock in to three groups according to the demand value or annual consumption value. The allocation order is determined by multiplying these groups by the price or cost per unit.

Martins and Laugeni (2002) defined three groups, as follows

- Class A: constituted by few items (until 10% or 20% of the items), shows a high value of accumulated consumption (from 50% to 80% in general).
- Class B: constituted by a medium number of items (20% to 30% in general), shows a value of accumulated consumption around 20% to 30%.
- Class C: constituted by a large number of items (above 50%), shows a low value of accumulated consumption (5% to 10%).

With this classification, the company obtains a list of products responsible for the higher part of its billing, as seen in Figure 3. Moreover, products with higher output must specifically stay near the shipping area.

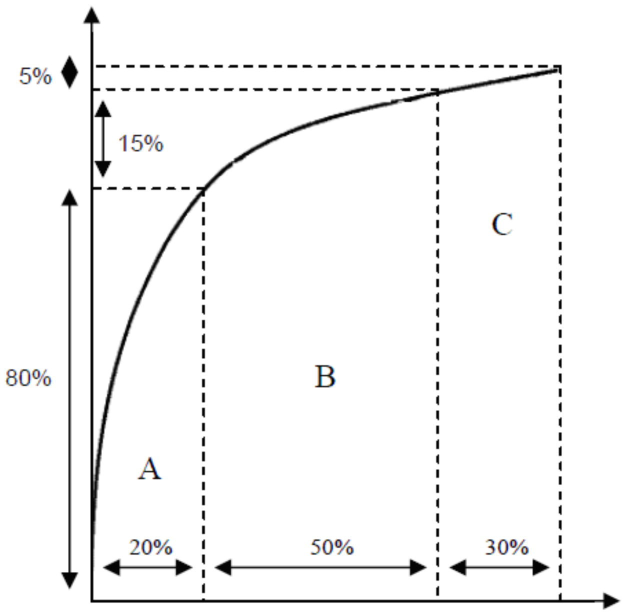

Figure 3. Pareto´s law or 80/20 Rule
Adapted from Christopher (2007)

A proposal for costs reduction in the warehouse movement is the arrangement of the storage spaces with an aisle decreasing the distance to the other aisle (Askin and Standridge, 1993). In addition, the study of Roodbergen and Koster (2001) shows that the use of an aisle may significantly reduce the distances traveled for situations in which routing techniques to collect and move merchandise within the warehouse are employed.

Based on the ideas of literature in this area, we have concluded that the correct storage space adequacy and analysis of the seasonal demand of portfolio are the main factors to obtain the storage system optimization.

4. RESULTS

The ABC Method was applied to a distributor of a medium-sized company located in São Paulo State whose main economic activity is the manufacturing of food products for cats and dogs. The company has a portfolio that varies according to breed, size and age of the animal, totalizing of 146 SKUs (Stock Keeping Units). By monthly analyzing the demand, we have concluded that 80% of sales are intended for dog and 20% for cats.

The graphs below show the results of the products classification according to the method proposed by Pareto.

Table 1. Parameters of the ABC Curve for the distributor company.

Date	
Initial	04/01/2010
Final	01/31/2011

Class A	
% Items	20.0%
% Value	79.56%
Items in Stock	880
Value (R$)	187468.67

Class B	
% Items	30.0%
% Value	15.3%
Items in Stock	1321
Value (R$)	36051.67

Class C	
% Items	50.0%
% Value	5.14%
Items in Stock	2201
Value (R$)	12111.47

Total	
% Items	100.0%
% Value	100.0%
Items in Stock	4402
Value (R$)	235631.81

Table 2. Classification of the products according the ABC method.

Ranking	**Product Code**	**Annual Demand**	**Annual Average Value (Unitary - R$)**	**Total Annual Value (R$)**	**% of Total**	**% Accumulative of Total Value**	**Class**
1°	76	497	88.71	44083.95	0.378	0.378	A
2°	48	139	128.98	17934.67	0.154	0.532	A
3°	41	125	82.70	10088.56	0.087	0.619	A
4°	12	104	91.70	9483.42	0.081	0.700	A
5°	31	88	93.41	8251.08	0.071	0.771	A
6°	97	56	131.87	7386.00	0.063	0.834	A
7°	14	43	139.83	6004.55	0.052	0.886	A
8°	108	535	8.88	4749.56	0.041	0.926	A
9°	123	73	61.10	4460.79	0.038	0.965	A
10°	101	148	27.79	4112.31	0.035	1.000	A

For the formulation of a graph of ABC Curve, two parameters were established (Table 3).

Table 3. ABC Curve Coordinates.

Coordinates of the Class Division					
A		**B**		**C**	
X	Y	X	Y	X	Y
0	0	880	187468.67	2201	223520.34
880	187468.67	2201	223520.34	4402	235631.81

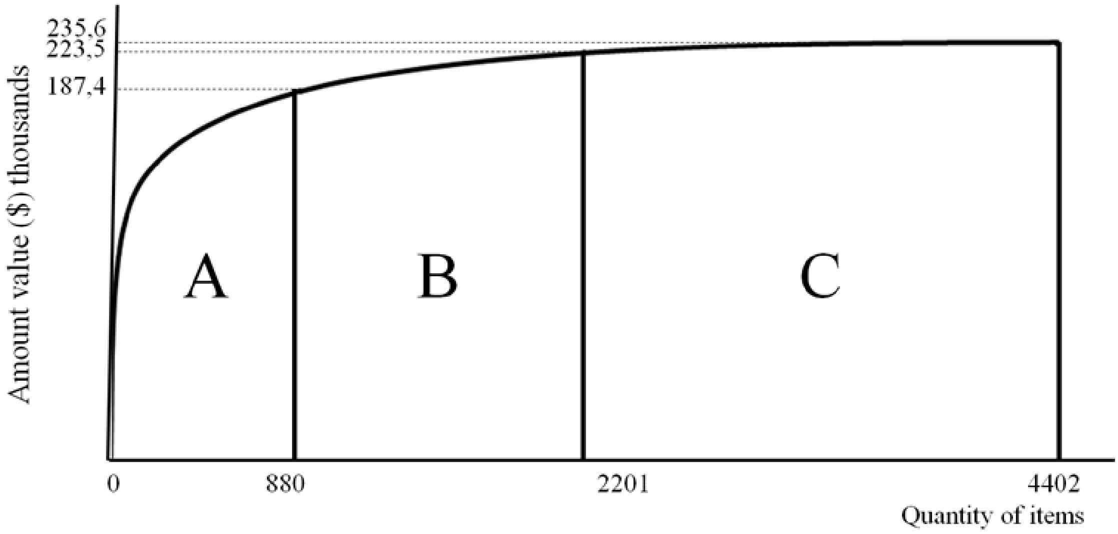

Figure 4. ABC Curve

In the previous arrangement the products were not ordered by priority sales, but allocated in numerical order according to their codes, as shows in Figure 5a. Therefore some items were classified by the ABC Method, as class A had to be dispersed in the warehouse.

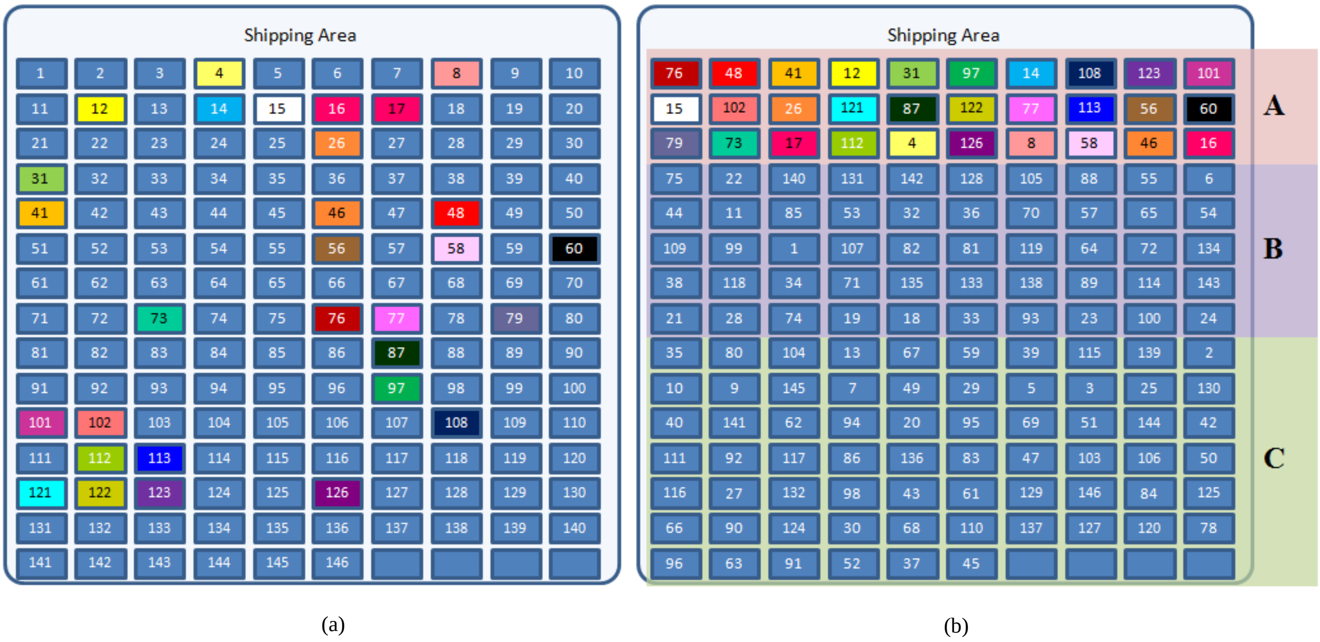

Figure 5. Availability of the items in the storage: (a) prior to the optimization and (b) after optimization

Figure 5b, shows the application of the optimization, in other words, products classified according to the ABC Method. The product of class A are near the dispatch area for a better perception of the rearrangement; colors are assigned to the items.

This rearrangement based on Method allowed a better allocation of the items and reduced the distances traveled between the product and shipping area, since the products belonging to Class A showed a higher demand.

5. CONCLUSIONS

This work has shown the application of an already consagrated tool in literature to prove that small rearrangements in the positioning of finished products reduce a great portion of the logistics costs and optimize the goods movement in a warehouse. The article relates the positioning optimization of the stocked products to the reduction of the logistics costs.

With the positioning optimization of the stocked products, it was possible to achieve an appropriate physical arrangement and a relevant layout, allowing the three-dimensional use of the warehouse in the most efficient possible manner and providing a great drive of materials and access to any SKU for quick and easy and security.

The layout optimizations related to the improvement of the goods movement and efficient storage reduced costs and value-added for the storage activity. When consistently monitored by professionals of logistics, the indicators presented will provide information that allows effectively evaluating the efficiency of the moving process and materials storage.

The application of the positioning optimization speeded the storage process, because detected the priorities in certain times of the year, enabling the company to function with minimum security stocks. The new industrial rearrangement reduced the logistic costs increasing considerably the competitive advantage in the business market.

It was possible to improve the allocation of the finished products in the warehouse, as well as toreduce the storage space and operate with the minimum stock through the seasonal demand survey.

6. ACKNOWLEDGEMENTS

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