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Analysis of Inventory Control Techniques and Study of Non Conventional Parameters

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***Abstract*— This paper aims to review the basic principles of inventory control and reduction in material handling costs by discussing traditional techniques and parameters which influence them. It aims to define the relationship between production and distribution and the use of technology to serve this relationship better. It also aims elucidate various flaws in the typical techniques and provides solutions to the same. It introduces RFID technology as a realistic technical tool which can help serve the supply chain more efficiently, with better balancing of resources and by acting as a continuous source of information. It also outlines the importance of customer feedback on the sales and reputation of the company and its goods. With better visibility in a supply chain, several positive changes can be brought which can redefine the operations and investments involved.**

Keywords*— Inventory; Control; Sorting; Techniques; Rfid; Customer; Satisfaction;

I. INTRODUCTION

With globalization, the world has observed a growth in almost all spheres of life- population, technology and industry. With the growing competition and the rising unpredictability of the demands, the pressure of designing a supply chain as such to maximize cost effectiveness has risen exponentially. With uncalled and unpredicted demands, there comes an additional pressure on inventory. A well balanced firm is one which has struck a perfect balance between its production and its sales, thus causing no undue expenditure. For the same, one of the major factors is the balance and control of the inventory. Inventory simply refers to the stocking of goods for the purpose of distribution and sales. Inventory plays a significant role in deciding the company's investment and operational costs. Since the concept of "Just in Time" manufacturing cannot be applied everywhere, it is practical and convenient to store to finished goods until it is ready for shipping. The biggest question that now arises is, "How much to store?" and "Where to store? [1].To understand this let us first understand the basics of inventory control.

Inventory control refers to the planned approach for determining what to order, when to order and how much to order so that the costs associated with buying and storing are optimal without stalling the production and interrupting the sales [1]. To answer these questions, the various levels in an inventory that have to be considered are as follows:

- Re-ordering Level- This is also known as the ordering limit. It lies somewhere between the maximum level and minimum level of storage. This quantity is such that it represents the quantity sufficient to meet the demands of consumers until new produce is made available. It is used to refer as to when a order should be placed.
- Maximum Level- As the name suggests it is that level above which the stock should reach or it the level above which no more investments in stocking of goods or goods is required. It ensures the losses due to obsolescence, theft, deterioration of materials etc are minimized.
- Minimum Level- It is the minimum level of stock necessary to ensure that the sales do not stop due to lack of goods. It is the lowest level of inventory necessary for continuous and smooth operation of the production chain.
- Average Stock Level- It simply is the average of the maximum stock level and the minimum stock level, i.e., ½(Maximum stock+ Minimum stock).
- Danger Level- The danger level is that level under the stock must never fall in any condition. It lies a little below the minimum stock level and in any case it does occur, the company must try to bring up the produce instantaneously.
- Economic Order Quantity (EOQ)- On considering the various costs such as order carrying costs, holding costs and ordering costs, the optimum order quantity obtained per order is called the economic order quantity. This quantity finds a balance between the two major costs- Procurement cost and carrying cost. When the material is ordered frequently in small lots, the procurement cost incurred increase. When larger lots are ordered, the order carrying costs increase. Since these two costs counteract each other, the balance is achieved at a specific point known to be the EOQ. It is directly proportional to the demand of the product, its reordering cost and inversely related to the carrying cost.

II. TRADITIONAL SORTING PRACTISES

Every business philosophy, Supply Chain Management (SCM), Lean Manufacturing and others work to minimize the costs involved. This reduction is best done by the adopting a policy which reduces logistics costs and handle the inventory better. When the inventory share in the company's assets is from 15% to a quarter of a cent of total assets and costs associated with inventory holding are from 10 to 20% of the total cost, inventories represent a significant source of financial savings [2]. Thus for a better management of inventory, the items are usually grouped and stacked in order of their significance, costing, speed of movement and some others. Depending on which parameter is of the highest priority, we have the following as the most prominent types of sorting techniques:

A. *ABC Analysis*

All the materials cannot be given the same attention and some minor overlooking could prove costly. To correct this human error and for the sake of practicality, a company needs to divide the goods in an order of their significance. ABC analysis which is primarily based on the Pareto Principle, which states that "Majority of the problems are caused due to a minority of the total factors in the ratio of 80:20 respectively" This we can simply interpret this as, not all factors weigh equally on a system and for this reason, it would be advisable for a form to sort their inventory according to the impact that item serves upon the parameter under study.

ABC analysis (Pareto principle) groups the items into 3 categories, namely A, B and C. This categorization is done on the basis of how much the item impacts a set parameter. The items covered in the A category are those which correspond to the highest turnover and their storage stocks are kept minimum. These goods can take a longer time to order but correspond to the highest percentage in terms of costs and are thus kept in low volumes. The next category is the B category. The items in this category represent a moderate and a moderate storage costs. They are maintained in optimum quantities and have a lesser impact on the turnover percentage than the items in the A category. Finally, in the C category, we have the maximum quantity of goods. These goods have the highest stock levels though they have least impact on turnover and the costs.

Thus to summarize the ABC analysis, the items are sorted in groups of three depending upon the impact they cause. Type A items have the least inventory and maximum impact, Type B have a moderate quantity corresponding to a moderate impact and lastly Type C have the largest inventory yet the smallest cost. Thus maximum attention is paid to type A items followed by B and then C.

B. *XYZ Analysis*

XYZ analysis is another technique adopted to sort out goods. The basis of this technique is to sort the goods according to the pattern of the demand or consumption. Along with ABC analysis, this practice forms the basic frame for any inventory control and aids in optimization. XYZ analysis also has 3 categories:

- Group items X- These are those items whose demand can be forecasted easily. These goods are said to have a stationary demand pattern.
- Group items Y- These are goods with a variable demand and their demand might vary seasonally. Hence their forecasting is not completely accurate but moderately accurate.
- Group items Z- These are goods with a sporadic demand and forecasting with special methods needs to be applied here.

  Thus we can obtain a division of items according the forecasting capability and the demand of the item.

C. *Inventory Turnover Analysis*

The goal of the inventory control technique is to separate out the slow moving inventories and the obsolete inventories from a particular supply chain. The items are segregated according to their rate of movement in and out of the inventory every year. Under this classification, we have a few types:

- Fast moving inventory- The target is to keep the stocks of such goods high.
- Middle moving inventory- The target is to keep a moderate level of stock and gradually to change them into a fast moving inventory.
- Slow moving inventory- The target is to keep these stocks minimalistic yet increase their turnover to increase optimization.
- Non moving inventory- The target is to eliminate such inventories and thus reduce the undue loss caused by it.

D. *Statistical Analysis*

If not analyzed by the above methods, the next most common ad historical method is the statistical method. This method involves the study and analysis of the previous sales and distribution cycles. The consumption over the years is studied. It consists in the processing of complex time series of storage inputs, consumption and inventories of material items [3]. Because of the exclusion / confirmation of seasonality, it is appropriate to choose a time horizon within 1-2 years. The goal of this step is to evaluate the actual item consumption and some basic statistical parameters: average, standard deviation, trend or seasonality [4]. The process involves statistically determining a demand and then based on that demand, we find the basic parameters for the set up of the inventory (safety stock, minimum stock level etc). Followed by the determination of the basic parameters, we move onto the replenishment processes and the design of the conceptual model which includes working on parameters such as delivery times, management of daily supplies and other. The last step includes the comparison of real time model against the conceptual model formed. Various other real times factors such as changing order costs, new services, coverage level and others are included and finally the best suited model is adopted.

III. INCLUSION OF TECHNOLOGY- RFID TECHNOLOGY AS NEWER METHOD.

The biggest drawback of any system working on any of the above principles is the fact that the above systems do not provide for any source of information visibility. This is because the data accounted for at every step is forwarded ahead in a cyclic form and any miscalculation can cause havoc. Thus, the basic and simplistic techniques for inventory handling are no longer predominant. If a charge sheet or an Excel sheet is passed around for inventory data, several obvious factors can cause the flow of incorrect information. Firstly, as stated earlier any miscalculation would be passed ahead for the remaining calculations which would cause a difference in the calculated result and the actual result. Since the inventory helps decide the demand and the demand decides the costs, a big difference will be caused by a small human error. Apart from this, when large inventories are handled by sheets, the workers responsible for the inventory will not be able to circulate the information around. This again will cause a disturbance in the cycle. Due to the lack of sufficient control, thefts and misdemeanor can step in causing an unhealthy work environment.

Since all these issues provide the solution for more information; clarity into the demands and better flow of information at every stage will lead to better management. How can we ensure a better flow? By the use of ever growing technology, life has been made easier. By continuously updating information provided in the real time will give a more accurate insight into the events and eventually lead to a better planning and control. The inclusion of technology for the ease of controlling inventories is popularizing and Radio Frequency Identification (RFID) is a popular enabler for the same. RFID integrated with sensors is also gaining demand since it can read information from a distance thereby increasing the number of points that serve as sources of information. This would increase the speed at which information is received and updated. This proves to be more beneficial than a typical barcode system which does not have this unique feature. Bar-coding is tool used for creating visibility, innovation and control. Another electronic tool being developed for applications is the Electronic Product Code (EPC) which like the other tools would aid in the development of a source of information, knowledge and solutions to tackle the problems of the supply chains. Tajima (2007) claims that this method of inventory handling will help realize process automation, solutions for information that requires processing which will in turn create visible and innovative environment and cause a change in organizational and supply chain practices. According to Chao (2007), we are currently at the beginning of integration of RFID into business workflows and supply chains of companies.

IV. BETTER INFORMATION LEADING TO SATISFIED CUSTOMERS

According to retail historian, Robert Spector, a finance deciding factor for retailers is that they have a good and controlled inventory system. Not having a good inventory system, retailers or suppliers will not be able to forecast demands with any kind of accuracy which would in turn result running out of stock frequently (Levinson, 2005). Customer satisfaction is crucial because it serves as the best way to understand what a company should target in the market. It provides an insight into what should be their policies and services to ensure a streak of success from happy clients.

Satisfaction can be subjectively defined from person to person. For some clients, satisfaction would mean on time delivery while to others it could be easy returns or heavy discounts. However, as the seller one must take into considerations all the possible definitions of customer satisfaction. This is because a certain company's loyalty and product repurchase comes from achieving a good and consistent customer satisfaction. The measurement of customer satisfaction cannot be exact since this science is highly subjective. It is crucial to establish a link between customer satisfaction and the calculated results since customer satisfaction is not a measurable quantity by nature, it requires sampling and statistical analysis. Additionally there is a gap between expectations and actual performance perceptions when qualitatively measuring customer satisfaction

Customer satisfaction is also important because it has an impact on the reputation of the company and its market image. A study conducted showed a five percent increase in loyalty can enhance profitability by 25 to 85 percent (Cacioappo, 2000). Similarly, other studies have suggested and proved that on average, four percent of the customers tend to be dissatisfied or complain about the product or service involved and at times both as well, and such dissatisfied customer would probably tell nine other people a bad review, while a satisfied customer would tell five people about the goodness of the company (Cacioappo). This reference draws the importance to another theory of the perfect order. Edward Marien, from the University of Wisconsin defines perfect order as that order when a customer finds the right product at an appropriate destination in good condition with the proper documentation and at the least cost. The need for perfect order rooted the needs for tools which can assist this process.

While understanding the customers' needs there must be a clarity of what is required and how much is required. Surveys and statistical analysis should be done using modern tools of analysis based on technology. Technology is important for the proper flow of information. Any miscommunication can lead to change in standards and priorities which help a firm rate and set their goals. Once again, technology which would be more reliable than manual gathering of knowledge would serve as a quicker and less erroneous tool. However, the biggest question to be asked is that "How does the collection of this information play a role in the working of an organization and its customers?"

The surveys and statistical studies are crucial for the interpretation of the demand. This theoretical demand plays a direct role in the inventory and the costs associated with it. If the company can provide goods on time and in the best quality at the best price then it would gain favors in terms of customer satisfaction. This would in turn lead to a positive impression of the company in the market causing an increase in customers. However, if any insufficiency in terms of quantity or quality are realized, the reputation of the company would be tarnished. Thus customer satisfaction would in turn help determine the futuristic demand and the inventory needed for the same. These miscalculations can cause heavy losses and thus must be carefully examined.

V. CONCLUSION

This paper provides us with a few concepts that one can work with to create an ideal inventory model for the future. We must understand the basic existing concepts and principles that are used in the designing of these current inventory models. Once we understand their pros and cons, we can start working on parameters that can strengthen the cons and determine ways to minimize the costs incurred in the pros.

The importance of inventory control in a company is vital. Any shortages or the excess of production can lead to a success or a failure of a firm or the product. For the same, if more reliable methods which would accurately give out the number or the counts rather than a mismanaged manual system, control over an inventory would be more convenient. Sensor technology, RFID technology and bar-coding are some techniques that are being used and continuous research to

improve these devices is simultaneously on. Receiving information at every stage is crucial for the planning and implementation of the next, thereby providing a better control over the inventory and its flow.

However the most crucial step lies in integrating a system such that it suits the type of production perfectly and uses the technology to its best benefit. For better management, the deciding authorities must understand their product, the market for it and then determine that business policy that will enhance its efficiency. Whether the policy of "Just in Time" or simply demands by forecasting can be used to finalize the production, is the decision of the authorities. This decision will then pave way for the type of technology that can be used. This technology would then be used for a continuous flow of knowledge and through factors like customer satisfaction, better sales and profits can be acquired. The times have changed and the gap of real time and theoretical time can be reduced with proper planning and technology and that provides for the basis of this paper.

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