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SMART INVENTORY MANAGEMENT SYSTEM FOR WOODWORKING INDUSTRY

[1]PRAJAPATI P. ADHAU, [2]Dr. R. S. Dalu

[1]Post Graduate student, [2]Professor

Mechanical Engineering, Department

Government College of Engineering, Amravati

Abstract : This research paper is written to suggest a slightly new and more efficient approach to the inventory management system i.e. to have an Intelligent and Smart inventory management system which can be accessed from the cloud. Before moving forward, let us know a little about what is an Inventory. Inventory is an idle stock of physical goods that contain economic value and are held in various forms by an organization. Inventories are held in various forms, it can be a stock awaiting packing, processing, transformation, use, or sale at a future point of time. Any organization which is into production, trading, sales, and service of a product will necessarily hold inventories to aid in future consumption and sale.

***Index Term*: Inventory Management System, Inventory Control, EOQ, ABC, FSN, SDE analysis**

1. INTRODUCTION

Inventory management is the process of ordering, handling, storing, and using a company's non-capitalized assets - AKA its inventory. For some businesses, this involves raw materials and components, while others may only deal with finished stock items ready for sale. Either way, inventory management all comes down to balance - having the right amount of stock, in the right place, at the right time. Inventory management is a challenging problem area in supply chain management. Companies need to have inventories in warehouses in order to fulfill customer demand, meanwhile, these inventories have holding costs and this is a frozen fund that can be lost. Therefore, the task of inventory management is to find the number of inventories that will fulfill the demand, avoiding overstocks.

This paper presents a case study for the woodworking factory on inventory management. It is proposed to use inventory management in order to decrease stock levels and to apply an agent system for the automation of inventory management processes. An inventory management system (IMS) use case for a woodworking factory has been used while analyzing the data and suggesting a novel solution approach. This system can be used to store the details of the inventory based on the sale details, generate sale and inventory reports periodically, etc. this is one integrated system that contains both the user component(used by salespersons, sales managers inventory managers) and the admin component (used by the administrators for performing admin level function such as adding a new item to the inventory), etc.

The woodworking factory needs robust functionality for managing the logistics facilities for optimal inventory management processes. Support for inventory management helps in recording and tracking materials on the basis of both quantity and value. Woodworking Warehouse inventory management functions cover internal warehouse movements and storage. Using this, one can reduce costs for warehousing, transportation, order fulfillment, and material handling while improving customer service.

2. ECONOMIC ORDER QUANTITY

Economic order quantity (EOQ) is the ideal order quantity a company should purchase to minimize inventory costs such as holding costs, shortage costs, and order costs. This production-scheduling model was developed in 1913 by Ford W. Harris and

has been refined over time. The goal of the EOQ formula is to identify the optimal number of product units to order. If achieved, a company can minimize its costs for buying, delivering, and storing units. The EOQ formula can be modified to determine different production levels or order intervals, and corporations with large supply chains and high variable costs use an algorithm in their computer software to determine EOQ.

EOQ is an important cash flow tool. The formula can help a company control the amount of cash tied up in the inventory balance. For many companies, inventory is its largest asset other than its human resources, and these businesses must carry sufficient inventory to meet the needs of customers. If EOQ can help minimize the level of inventory, the cash savings can be used for some other business purpose or investment.

The EOQ formula determines a company's inventory reorder point. When inventory falls to a certain level, the EOQ formula, if applied to business processes, triggers the need to place an order for more units. By determining a reorder point, the business avoids running out of inventory and can continue to fill customer orders. If the company runs out of inventory, there is a shortage cost, which is the revenue lost because the company has insufficient inventory to fill an order. An inventory shortage may also mean the company loses the customer or the client will order less in the future.

The formula assumes that demand, ordering, and holding costs all remain constant. Economic order quantity (EOQ) is a formula for how much inventory a company should purchase with a set of variables like total costs of production, demand rate and other factors. The formula identifies the greatest number of units in order to minimize buying, holding and other costs.

This formula shows exactly how much inventory a company should order to reduce holding and other costs.

2.1 Components of the EOQ Formula

D: Annual Quantity Demanded
Q: Volume per Order
S: Ordering Cost (Fixed Cost)
C: Unit Cost (Variable Cost)
H: Holding Cost (Variable Cost)
i: Carrying Cost (Interest Rate)

2.2 Applying the EOQ formula

Let’s take 2 different cases and apply the EOQ formula to it. But before applying the formula, we need to get all the variables required for it.

Case 1:

Product name - Two Door Wardrobe (Chocolate Shade)

Product Cost - INR 10,000 /-

Sheet Required -

PB BSL Belford Oak (E1 Interior Suede) - 1.83m x 2.44m x 18mm

Cost of the Sheets -

PB BSL Belford Oak (E1 Interior Suede) - INR 2500 /-

Total Sheets Required for 1 Unit –

PB BSL Belford Oak (E1 Interior Suede) - 2.7 Sheets (~ 12.180 Square Meters)

Economic order quantity formula

The following formula is used to determine the economic order quantity (EOQ):

$$EOQ = \sqrt{\frac{2 \times D \times Co}{Ch}}$$

Where,

- D = Demand per year
- Co = Cost per order
- Ch = Cost of holding per unit of inventory

Case 2:

After applying the EOQ to the raw data of the items in inventory, the results were promising.

Item Name - Valigny Oak

Item Price (S) - 2798

Quantity Required Per Year (D) - 104

Holding Cost (H) - 2652

Yearly Orders Before EOQ were - **3**

Now, the formula for EOQ is **EOQ = SQRT((2*D*S)/H)**

= SQRT((2*104*2798)/2652)

= 15

Yearly Orders After EOQ are - **7**

2.3 Where and How was the money saved ?

As we placed 7 orders instead of 3, the order quantity decreased, which led to liquid cash saving. Please take a look at below calculations

Decreased Order Cost

Order Cost Before EOQ -

= ROUND((Qty Required Per Year/3) * Price)

= ROUND((104/3) * 2798)

= 96,998

Order Cost After EOQ -

= ROUND((Qty Required Per Year/7) * Price)

= ROUND((104/7) * 2798)

= 41,570

Total Liquid Cash Saved due to EOQ

= 96998 - 41570

= 55,428

Here, we can see that liquid cash of 55,428 was saved. The total amount of money that was saved after applying the EOQ formula is **41,75,676** yearly. This is a very big amount. The contribution in saving this amount was of the Holding Costs, Labor Costs etc.

3. ABC Analysis

ABC approach is a managerial technique of determining the degree of control to be exercised over various items of inventories. This is done by analyzing the stock-usage patterns by money value of importance.

ABC analysis is based on “Pareto’s Law of Cause and Effect” which states that only 20% of the activity causes 80% of the effect. This 20/80 rule is very useful in business.

It suggests ‘keep an eye on this 20% and you will cover 80% of the effect’. When this rule is applied to inventory items, it is known as ABC analysis.

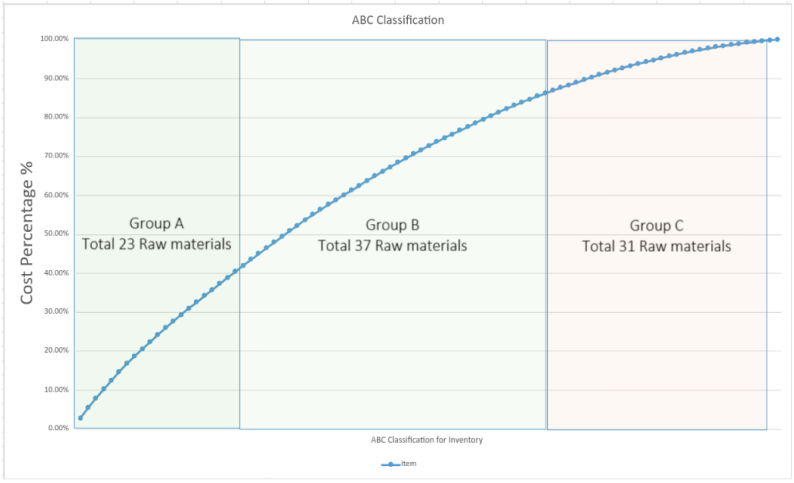
This technique splits goods into three categories to identify items that have a heavy impact on overall inventory cost.

Category A is your most valuable product that contributes the most to overall profit.

Category B is the products that fall in between the most and least valuable.

Category C is for small transactions that are vital for overall profit but don’t matter much individually. We did study on the Raw materials data of a woodworking factory. Same as all the industries, there were changes in trends of the woodworking industry too. So there was a shift in least sold and most sold products.

ABC



The graph was plotted using real data from the inventory of the woodworking factory.

3.1 Example Calculation

Item Name - Belford Oak

Item Price - 7462

Quantity Required Per Year - 120

Total Amount Required

= 7462 * 120

= 89,5440

By a formula which is not disclosed by the woodworking factory due to business confidentiality purposes, the percentage or margin saved on this particular item was **1%**, which brings us to a total saving of **8,954** annually.

Using the ABC analysis, it was possible to make changes in order to be placed and thus, money was saved due to proper utilization of the results from ABC Analysis. Total amount of Money Saved is **8,02,066** for 1 year.

4. FSN Analysis

FSN stands for fast-moving, slow-moving and non-moving items. Essentially, this segments inventory into three classifications. It looks at quantity, consumption rate and how often the item is issued and used.

Fast-moving items are items in your inventory stock that are issued or used frequently. When it comes to slow-moving items, these ones are issued or used for a specific period of time. Lastly, non-moving items are not issued or used at all over a certain time frame.

Fast-moving inventory, as the name suggests, comprises the stock that moves quickly and needs to be replenished very often. Generally, the stock that lies in this category has an inventory turnover ratio of more than 3 and constitutes around 10-15% of the total inventory.

Slow-moving inventory is the inventory that crawls slowly through the supply chain and has an inventory turnover ratio between 1-3. It is generally 30-35% of the total stock.

The inventory that rarely moves with the inventory turnover ratio below 1 and makes 60-65% of the total stock is called the Non-moving inventory.

We also did the study of the raw materials in the woodworking factory and got the following data -

4.1 Example Calculation

Item Name - Linewood

For performing FSN analysis, we must have the following data pertaining to each inventory item:

Name - Linewood

Turnover ratio = ?

The annual demand of a particular item = 73

The unit price of each material = 4741

Annual usage of each item = ?

Cumulative annual usage of a particular item = ?

The turnover ratio can be computed using this formula:

Turnover Ratio = Annual Demand/Average Inventory

Turnover Ratio = 73 / 7

Turnover Ratio = 10.43

After that, lets calculate Annual usage of item

Annual Usage of item = Annual Demand of item x Unit Price of item

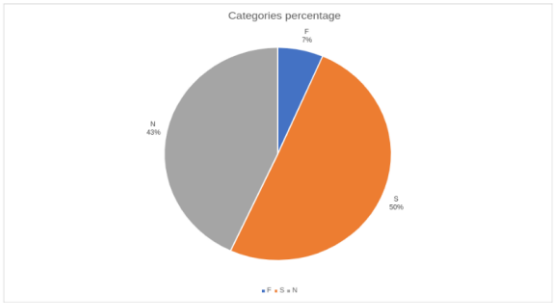
Annual Usage of item = 73 x 4741

Annual Usage of item = 346093

Percentage Annual Usage = 1.10%

Cumulative Annual Usage = 1.10

FSN



5. SDE Analysis Approach

This analysis classifies inventory on three different levels, based on the availability of items.

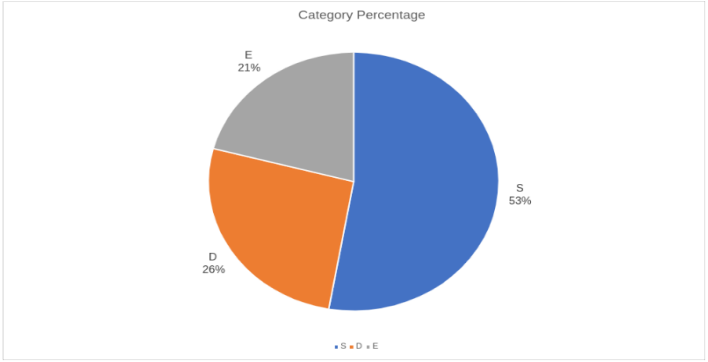
S – scarce, refers to generally imported items that require longer lead times and often are in short supply. For example, imports of goods are subject to government stringent regulations and ultimately slows down the procurement process.

D – difficult, refers to items that are often available domestically but are difficult items to procure. For example, items that generally come from far cities or where reliable suppliers are difficult to find. The general rule of thumb for this classification is if the inventory stock requires more than a fortnight to be available, but less than six months lead time it should be classed as difficult.

E – easy, refers to items which are freely available, that are often procured quickly and locally, relatively hassle-free.

After doing the research on all the data from woodworking factory, we got the following graph -

SDE



6. Comparison between ABC, FSN & SDE

If we compare the ABC vs FSN vs SDE, we can say that ABC analysis prioritizes the orders and affects the order quantity too. FSN gives us an insight of when to place the order, which means, if an item is more fast moving, then the orders must keep flowing, because the demand of that item is also continuous. On the other hand, the SDE allows us to know more about the availability of the item. So if an item is easily available, we can place the order a couple days if not hours before, but if the item is scarce, then the order needs to be placed asap.

A.B.C. (Always Better Control) method is of immense use. Under this method materials are classified into three categories in accordance with their respective values. Group 'A' constitutes costly items which may be only 10 to 20% of the total items but account for about 50% of the total value of the stores.

A greater degree of control is exercised to preserve these items. Group 'B' consists of items which constitute 20 to 30% of the store items and represent about 30% of the total value of stores. A reasonable degree of care may be taken in order to control these items. In the last category i.e. group 'Q' about 70 to 80% of the items is covered costing about 20% of the total value. This can be referred to as the residuary category. A routine type of care may be taken in the case of the third category. This method is also known as 'stock control according to value method', 'selective value approach' and 'proportional parts value approach'. If this method is applied with care, it ensures considerable reduction in the storage expenses and it is also greatly helpful in preserving costly items.

Now coming to FSN Analysis, the categorization is made on the basis of consumption and the average stay of materials in the inventory store. The higher the stay of an item in the inventory, the slower would be the movement of such material. Such classification is also influenced by the nature of materials and managerial discretion.

Fast-moving = This is that category of inventory items that are placed nearer to the store issue point so that they are easily accessible whenever the need arises. The stock of these materials is reviewed frequently for the placement of fresh orders.

Slow-moving = It represents that category of inventory items that are stored a little far and the stock is reviewed periodically for any obsolescence. These may be shifted to the Non-moving category.

Non-moving = It represents that category of inventory items that are kept for disposal. These material items are reported to the management and an appropriate provision for loss may be created.

That was all about FSN, now about SDE analysis, One of the main benefits of conducting an SDE analysis is future planning. Since it highlights which products might be trickier to acquire than others, it can kick-start your procurement process. This allows a business owner to prepare the warehouse and organize plans with other suppliers when they can get this process underway. It is a simple system that can provide guidelines and a quick snapshot of what's going on and what needs to be ordered.

7. Suggested Approach

There are various approaches in Inventory management apart from EOQ model, but to be precise and save wastage and money, there is a strong need of having a system in place which has all the features in it like inventory updation, material in and out of inventory, stock updates etc. So an intelligent system with the help of data science or machine learning can lead the way to a business with more and more profits while having less and less wastage of money, time and resources.

8. Conclusion

Based on the research results there remain some obstacles and problems related to the management and inventory control at the Carefine woodworks. In the planning phase and procurement of goods, managers are faced with the frequent occurrence of supplies running out prior to new procurement being conducted, which is not in accordance with the objectives of goods, namely that goods managers are expected to seek supplies in sufficient condition.Out of all the approaches we applied on the data, EOQ was the best in saving money and giving a clarity on what to order and how much to order. Thus, If a digital system is implemented which has the data of all the inventory, we can apply machine learning and other things to it to increase the

intelligence of the system such that, there will be very less need of human intervention in ordering, and planning for the inventory items. We can also do the reports section to the same.

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