Cost to Store: An important factor to evaluate margin on the product- A case related to the retail industry

AKSHAT SHAH [1]

[1] Symbiosis Institute of Operations Management, Nashik, Symbiosis International (Deemed University), Pune, India

ABSTRACT

With increasing visibility and complexity in supply chain resulted in high-velocity operations which will lead the best practices in supply chain management. Various business process integration is the heart of supply chain management. As we know that there are 3 key issues that every business has, Maximum customer service, limiting inventory investment and Maintaining high operating efficiencies. It is important to keep dynamic balancing among the above 3 issues. When we see this issues in the context of the retail industry, the company wants to increase the variety in the stores to get the high customer service but high variety leads into higher inventory level in the warehouse and more capital investment in the inventory will reduce the margin on the product by spending more money on holding. Simultaneously high variety increase the production complexity and reduce the efficiency which resulted in the high cost of goods sold and low margin. By maintaining the dynamic balancing between the company of this issue can reduce its cost of goods sold and increase margin or give a discount to stay price competitive in the market.

In any retail industry, Major part of the cost of goods sold is churned by the inventory holding cost. (Cost to store). Generally, it is assumed to be 15% to 20% of the product cost without any calculation. But for increasing market competitiveness a firm should have to keep their eye on the inventory holding cost of each SKU.

The objective of this paper is to prepare total cost to store model by finding cost components of inventory holding. where the manufacturing cost per unit is defined but due to sales variability, Cost of holding is different, so, with the example of a retail industry where lot size is not same in supply as well as demand-side and inventory carrying days are also different for each SKUs (depends on the sales trend), The methodology for calculating carrying cost is defined.

Keywords

Warehousing, Inventory, Holding Cost, Retail, Cost, Cost Accounting, Operations, Profitability, Supply Chain Management, Logistics, Cost to store, Sales

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Introduction

A supply chain is defined (Christopher, 1998)as "the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer." (Ballou, 2004) defined supply chain as "All the activities which are associated with the flow of information, material and money from the source to the end user. (Mohd javaid, 2012) stated that supply chain is a method of creating products for end-user which include the stockholders like raw material suppliers, Manufacturing units, warehouses, transporters, distributors, retailers and customer. So, the definition of the supply chain can be varying from company to company but the basic concepts remain same like it does not depends on the number companies involved in the single supply chain but it involves a number of functions involved in the supply chain.

The individual company or organization can control their supply chain by vertical or horizontal integration with their supplier and customer. This level of integration determines the visibility, accessibility and controllability throughout their supply chain partners.

(Lapinskaitė, 2014) used total cost approach as supply chain cost which includes the cost of raw material, cost of labour, cost of freight and cost of inventory. They described, how each cost affects the financial metrics like EBITDA, GROSS Margin, TURNOVER, working capital and return of capital employed with the example of Holger Clasen GmbH & Co. KG.

As of now, multi-channel retail frameworks have gotten expanding interest. Somewhat because of developing on the web business that fills in as a second channel for some, organizations, offering channel explicit price has become a Common type of revenue management. Optimum control policies to be optimal in the presence of multiple channels hence the cost of inventory holding is important factor needs to be included in the inventory control policy.(Schneider & Klabjan, 2013)

So the model defined in the following subjections will help the organization to keep track on holding cost of each SKU, and further they can divide that cost to multiple channels, Multiple storage location and

multiple brands as well. Which is useful for the retail industry.

Literature review

Supply chain function incorporated supplier, logistic and customer while logistic function includes material management and distribution. Supply chain cost function is a linear function with the objective of maximization value and minimizes the task which incurred cost. (Lapinskaitė & Kuckailytė, 2014).Proper cost determination is significant in the implementation of proficient inventory control frameworks. As the years progressed, a few strategies have been created to decide an ideal or near-ideal stock arrangement and the techniques are continually being refined. (Dawid Lahutta, 2014) provided the framework of cost to serve as a costing method to analyze the customer profitability using the case study of the food industry. where fixed cost, Variable cost, Financial cost, warehousing cost and transportation cost was taken as the main function for cost calculation, and compare it with the customer revenue generation stream to analyze the profitability of the customer under each category of product sales and proved that the lower Inventory cost reduces the cost to serve and increase profitability.

Any product cost is a combination of Raw material cost, manufacturing cost, warehousing cost, Sales and distribution cost. several models have been developed to find the product cost but the objective of these models is to reduce the product cost and deliver maximum value to the customer.

Supply chain cost involves the cost from order processing, purchasing, inventory carrying cost and distribution cost(Pettersson & Segerstedt, 2013).(Fleisch & Tellkamp, 2005)identified factors for supply chain cost in the retail industry which are process quality, theft and unsaleable affect inventory inaccuracy, Eliminating inventory accuracy can reduce the supply chain cost.

(Bolaños-Zúñiga & Vidal-Holguin, 2020) used Monte-Carlo simulation to analyses item by item inventory control strategy considering stochastic lead times. They also formulate non-linear mixed-integer optimization model using the objective function of minimizing total costs of warehousing.

Inventory carrying cost includes operating cost like a utility, rent, labour, damage, product obsolesces. It is counted over a period of time, Generally, one year(Chopra, S.; Meindl, 2007) while (Azzi et al., 2014) divided warehouse cost into five subsequent costs which are Evident cost, Semi evident Cost, Hidden cost, Investment cost, and operation cost. They found inventory Carrying cost under two major scenarios where a company uses a manual warehouse system and a company uses the ASRS system, hence proven the cost structure for both the scenario using multiple case study.

(Bokor & Markovits-Somogyi, 2015) stated that it is important to acquire dependable and exact data about the structure of the estimations to accomplish an effective distribution of resources inside the logistic of the organization. Conventional ways to deal with computations may not be adequate to accomplish this objective on account of unpredictable and heterogeneous logistics service.

(Rajhans, 2018)described mathematical approach to for calculating inventory carrying cost. He denied the assumption of taking inventory carrying cost as a percentage of procurement cost and further, he listed down the different cost incurred in the warehouse under two verticals, Fixed cost and, Variable costs. In the end, he found E.O.Q(Economic order quantity) based on total inventory cost. While (Lahutta & Wroński, 2014)found inventory holding cost using activity-based costing, where activities were defined and the cost associated with that activity is divided per product as the percentage of utilization of activities.(Kucera, 2019) also used activity-based costing where variable indirect cost are allocated based on the relative performance basis and fixed indirect cost allocated as relative time consumption basis to calculate logistic cost and warehousing cost of the automobile industry.

(Berling, 2008) presented the model for the cost associated with holding inventory based on a general macroeconomic framework. Furthermore, it has provided activity-based costing by identifying key cost activities and its cost driver for the determination of inventory Carrying cost per unit per time. Where units were decided based on the E.O.Q and time was decided for performing an activity.

inventory carrying cost is directly proportional to the Inventory holding days means high inventory ageing tends to increase the Carrying cost of that product and drained profit margin(Albertson, 2008). he illustrated this with the hypothetical example of automobile showroom by comparing two cars profit margin, one was 60 days in the showroom and one was just in time. while (Tony Noland, 2011) used inventory turns as a key factor for calculating inventory Carrying cost in automobile showrooms.

Inventory carrying cost is also dependent on the replenishment cycles and demand rate. (Friedman, 1982) described optimal replenishment schedule considering liner carrying cost and demand rate,

Exponential demand function and discounted carrying cost.

In the retail industry where the backroom inventories are responsible for the higher inventory cost and create operational complexity. (Eroglu et al., 2018) derived pack and half rule (which suggests that the shelf space allocated for a product should be at least 50% larger than the case pack quantity in which the product is delivered) to eliminate backroom inventories in retail operations. The drivers like product depth, product width, demand elasticity, case pack quantity, and inventory carrying cost significantly influence the effect of the pack-and-a-half rule on a retailer's profits.

So, based on the research on the calculation of inventory holding cost associated with the product depends on the size of the product (Case pack), Number of costs occurred for the specific time, Space utilization, Unit holding days and nature of the demand. Using this primary research, a simple model to calculate inventory holding cost with the retail case study is developed in the following subjections.

Research Methodology

After the factors defined by the study of the research papers, the next step was to identify those factors which are affecting the most while calculating inventory holding cost and find out the methodology to calculate the cost using these factors. The detail questionnaires were circulated to the manager, warehouse controllers and manager during a two months internship at the company.

A few sources were utilized to get the information, for example, an internal organization's ERP framework for inventory transactional data and verifiable Excel tables and Factual information prepared by Warehouse controller.

4.1 In-Depth Interviews

The objective of individual meetings is to get significant data and experience-based information from every respondent. Meetings were made during two months of internship at the organization. Data was gathered through short meetings on every day's communication or exceptional meeting in the specific case; the gathering was made with Supply chain manager, warehouse controller, Master data manager, Warehouse managers and executives.

4.2 Observation

Observation technique was utilized on similar bases in depth meetings. The observation was also derived from the available data.

4.3 Identified components of inventory holding cost from research papers and personal interview

Table 1-Cost identification

		Cost Components	(Rajhans, 2018)	(Kucera, 2019)	(Azzi et al., 2014)	(Lapinskaitė & Kuckailytė, 2014)	(La Londe & Lambert, 1977)
Fixed cost	Inventory cost	Capital cost	✓			✓	✓
	Warehouse cost	Initial cost of Maintenance equipment	✓				✓
		Initial cost of handling equipment	☐	✓		✓	✓
		initial cost of storage equipment	✓				
		Rent paid per month					✓
		Insurance premium paid per month for the area	✓		✓		✓
	Labor cost	Total monthly salary paid	✓	✓	✓	✓	✓
Variable cost	Inventory Cost	Monthly Shrinkage cost			✓	✓	
		Repackaging/Unpackaging cost	✓	✓	✓		
		Damage cost			✓	✓	
		Space utilization cost		✓	✓		✓
	Warehouse cost	Monthly Electricity bill	✓	✓	✓		✓
		Monthly Maintenance cost					✓

		IT/ITES service rent			✓		
		Fuel cost		✓	✓		✓
	Labor cost	Contract labor cost (Security, Housekeeping etc.)	✓		✓	✓	✓

4.4 Inputs

The input requires for deriving the unit inventory holding cost.

1) Capital cost Blocked
   Or
   Monthly rent paid for the land
2) Insurance premium paid for the area
3) Insurance premium paid for damage/obsolesce and against any natural disaster
4) Capital invested in storage equipment
5) Approx. life of storage equipment
6) Capital cost for maintenance equipment
7) Life of maintenance equipment
8) Monthly maintenance cost
9) Monthly average Electricity bill
10) Monthly average Fuel cost
11) Total salary paid
12) Total capacity of the warehouse (In pallets)

SKU wise data

1) Case pack of each SKU- Number of units packed in one carton box
2) Pack size- Number of cartons can be placed on one pallet
3) Shrinkage/relocation/obsolescence/damage /packing and unpacking/rejection costs per SKU
4) Inventory transaction data for Inward and outward date of Unit SKU

4.5 Derivation of formula: -

Let,

S = total salary given to the employee of the warehouse including contractual labour and permanent employee

c_l = capital cost invested for land

c_s = Capital invested in storage equipment

c_m = Capital invested for Maintenance equipment

L_S = Life of storage equipment (In months)

L_m = Life of maintenance equipment (in months)

ip_1 = Insurance premium for area

ip_2 = insurance premium paid for damage/obsolesce and against any natural disaster

e = electricity bill per month

f = fuel cost per month

b = Breakdown maintenance cost per month

r_1= rent paid to the landlord

r_2= Other rental service costs like IT/ITES

I_o = Interest paid for loan/ Opportunity cost

G1= Monthly damage cost per SKU

G2 = Re-packaging and labelling cost

G3 = Inventory Shrinkage cost per SKU

K = total capacity of the warehouse

D = month days/Year days- depends on the time of total cost calculation

$Q_1, Q_2, Q_3, \ldots, Q_n$ = Quantity available under each bucket

$n_1, n_2, n_3, \ldots, n_m$ = Minimum holding days for each bucket

p = pack size of SKU

x = pallet key of SKU

λ= per day holding cost

1.5.1 Cost Calculation

1.5.1.1 Fixed Cost(α)

$$\alpha = s + (c_s/L_S) + (c_m/L_m) + ip_1 + ip_2 + (r_1 \text{ OR } I_o \text{ OR } (c_s * \text{Interest rate})) + r_2$$

1.5.1.2 Variable cost(β)

$$\beta = e + f + b$$

1.5.1.3 Dedicated SKU cost (γ)

$$\gamma = G1 + G2 + G3$$

1.5.2 Total Warehouse Cost (C_w)

$$C_w = \alpha + \beta$$

$$C_w = s + (c_s/L_S) + (c_m/L_m) + ip_1 + ip_2 + (r_1 \text{ OR } I_o \text{ OR } (c_s * \text{Interest rate})) + r_2 + e + f + b$$

1.5.3 Per day Per Pallet Holding cost

$$\text{Per day Per Pallet Holding cost}(\lambda) = \frac{\text{Total warehouse cost}}{\text{Month days} * \text{capacity of the warehouse}}$$

$$\text{Per day Per Pallet Holding cost}(\lambda) = \frac{Cw}{D * K}$$

1.5.4 Total holding cost per SKU

$$\text{Total holding cost per SKU} = \sum_{n=0}^{n} \left(\frac{(\text{Quantity} * \text{Minimum Holding days} * \text{Per day per pallet holding cost})}{(\text{Pack size} * \text{Pallet Position})} + G1 + G2 + G3 \right)$$

$$\text{Total holding cost per SKU} = \frac{(Q_1n_1+Q_2n_2+Q_3n_3+\ldots+Q_nn_m)^* \lambda}{p^*x} + G_1+G_2+G$$

$$\text{Total holding cost per SKU} = \sum_{i=1}^{n}\sum_{j=1}^{m}\left(\left(\frac{Qinj * \lambda}{(p * x)}\right)\right) + G1 + G2 + G3$$

1.5.5 Unit Holding cost

$$\text{Unit Holding cost} = \frac{\text{Total holding cost}}{\text{Available inventory of SKU}}$$

$$\text{Unit Holding cost} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{m}\left(\left(\frac{Qinj * \lambda}{(p * x)}\right)\right) + G1 + G2 + G3}{\sum Q}$$

Case study

XYZ retail ltd is a manufacturer of textile products like bedsheets, covers, bath towels etc. The company operated warehousing facility which is located in the mumbai. The total amount paid for operating that warehouse on lease and the rent is 25 Lac per month. The company have more than 5000 SKUs stored in the warehouse. Each SKU arrived in different lot and at different time at warehouse which is being stored to the designated location. And when customer order arrives the units of SKUs were loaded on the basis of FIFO manner(Older units send first)

Key information-:

- Company is paying 25 lac ₹. per month to the land owner as a rent. All other fixed cost was calculated and consolidated as 10 Lac ₹. Per month.
- The variable cost which includes electricity, fuel and breakdown maintance cost is sum up at 11 Lac per month
- The capacity of warehouse is 7000 pallets.
- Each pallet have differenet number of units which is depend on the size of product and pack key of the product
- The lot size of manufacturing and selling is not identical
- The manufacturing lot size is also not same. It varies based on the market behavior.
- There is no damaged and shrikage in the product.

For the simplicity purpose the calculation is shown for 2 SKU only but this can be replicated on as many SKU as the anayst want.

The detail of SKU are given below

Table 2-SKU data

SKU Number	Arrival date	Quantity	Pack key	Pallet Position
BL1001	16/8/2020	500	50	6
BL1001	29/7/2020	320	50	6
BL1001	14/8/2020	160	50	6
RS2001	22/8/2020	740	30	8
RS2001	4/8/2020	960	30	8
RS2001	25/7/2020	1000	30	8

Suppose the the order arrived for SKU BL1001 and RS2001 on the date 29/8/2020 and the quantity is 980, 2700 respectively.

So based on the storage days of each lot of each SKU we can find the average amount spent on the each unit of each SKU as described below.

Table 3- SKU data 2

SKU Number	Arrival date	Quantity	Pack key	Number of days in warehouse (Order Date-Arrival date)

BL1001	16/8/2020	500	50	13.00
BL1001	29/7/2020	320	50	31.00
BL1001	14/8/2020	160	50	15.00
RS2001	22/8/2020	740	30	7.00
RS2001	4/8/2020	960	30	25.00
RS2001	25/7/2020	1000	30	35.00

Total holding cost= Fixed cost+ variable cost
Total holding cost = 4600000

$$\text{Per day per pallet holding cost} = \frac{4600000\ ₹}{30.5 * 7000}$$

Per day per pallet holding cost = 21.54 ₹ per pallet

$$\text{Total holding cost(BL1001)} = \frac{((500 * 13) + (320 * 31) + (160 * 15)) * 21.54₹}{(50 * 6)}$$

$$\text{Total holding cost(BL1001)} = 1351.28\ ₹$$

$$\text{Unit Holding cost} = \frac{1351.28}{980}$$

$$\text{Unit Holding cost(BL1001)} = 1.37\ ₹$$

$$\text{Unit holding cost(RS2001)} = \frac{((740 * 7) + (960 * 25) + (1000 * 35)) * 21.54₹}{(30 * 6) * 2700}$$

$$\text{Unit Holding cost(RS2001)} = 2.84\ ₹$$

In most of the cases the carrying cost is taken as a percentage of material cost or manufacturing cost but inventory carrying cost is also depends on the number of holding days because increasing holding day resulted into higher carrying cost as well as risk of product obsolesces, damaged and theft is also increased. Higher holding cost decrease the margin on the product as well

Conclusion

Cost to store is an important factor to identify the inward and outward flow of the material as well as it helps the manager to take a decision on the discounting and promotion and identify the true value of margin on a unit of the product. Cost to store is used as a feedback mechanism to the production planning in order to maintain the current or desired balance of income and expenses. Using this carrying cost analysis, the manager can negotiate with the customer to ensure that they can cover a portion of inventory cost or manager could set down terms that determine the span that stock stays in their storage, or force conveying charges for putting away stock for expanded timeframes.

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