INVENTORY MANAGEMENT OF METAL SHEETS IN SHEET METAL INDUSTRY

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Abstract : Inventory management plays an important and strategic role in today's competitive and uncertain environment. Inventories of material are kept by companies in order to full-fill customer's demand on time. Large amount of holding cost is associated with the inventory of materials. Effective management of inventory helps company to reduce unwanted inventories and keep the overall cost of inventory at optimum level. This study found certain problems related to inventory such as capital locked up due to accumulation of dead inventories, no arrangements of safety stocks, unvarying control policies for all the inventory items and high inventory cost. This paper conduct ABC analysis, combined XYZ-FSN analysis and calculates Economic Order Quantity and safety stock for managing metal sheets of different thickness in company X.

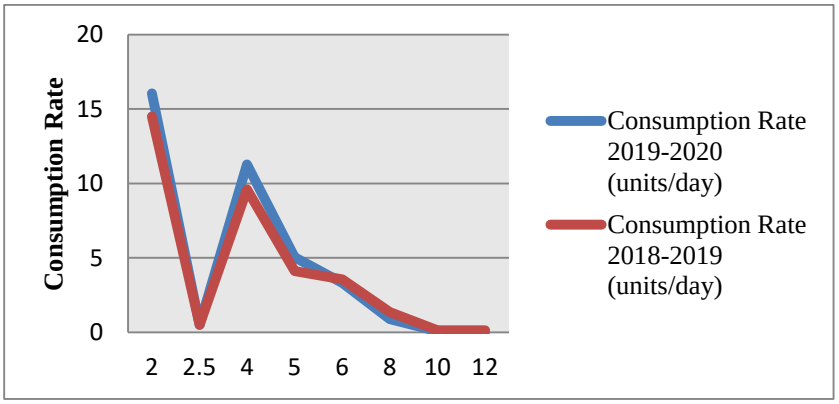
IndexTerms **– Inventory Management, ABC Analysis, Combined XYZ-FSN Analysis, Economic Order Quantity, Safety Stock.**

I. INTRODUCTION

Inventory is defined as the stock of finished goods, raw material and all the materials which are held for the purpose of later utilization for production of goods [1]. Inventory Management is defined as the systematic approach of planning, decision making, organizing and controlling the inventory items so that cost associated with buying and storing the inventory items is minimum or optimal. Inventory management is important for the successful operation of most companies [2]. Metal sheets of different thickness are used as a raw material in sheet metal industries. Inventory of metal sheets help company to full-fill customer orders on time. Inventory of these metal sheets constitutes high holding cost. The work of efficient inventory management department is to find when to order and how much to order so that customers order can be full-fill on time and situation of overstock and under-stock can be minimized. Efficient inventory system helps companies to do optimum use of their working capital .Provision of safety stock helps company to minimize stock out situations. Safety stock is the amount of material to be kept to absorb unpredictability in demand. Safety stock protects company from tradeoffs due to unanticipated and random demand for the goods [3]. Economic Order Quantity is the quantity at which holding and ordering costs are equal. Economic Order Quantity technique helps company to reduce ordering cost and holding cost thus overall cost of inventory reduces [4].Selective control is the variation in method of control from one item to another [5]. Varying control over inventory items helps company to focus more on important inventory items rather than less important items. Selective control techniques help the company to decide different control policies for different items.

II. PROBLEM STATEMENT

This research found certain problems in company X related to inventory management. The problems are unvarying control policies, accumulation of dead inventories, capital locked up due to accumulation of dead inventories, high holding cost and no provision of safety stock. The aim of this paper is to perform ABC analysis so that varying control policies can be implemented to different thicknesses of metal sheets. This study also performs combine XYZ- FSN analysis to find non –moving items having high stock value so that problem of accumulation of dead inventory can be minimized and locked up capital can be released. This paper also calculates EOQ and safety stock so that total cost of inventory can be reduced and problem of under stocking can be avoided respectively.



Graph 1: Consumption rate comparison

The above graph shows that consumption rate of some items decreases in year 2019-2020 as compared to 2018-2019. The decrease in consumption rate of some items is a reason behind the overstocking and accumulation of dead inventories.

III. RESEARCH METHODOLOGY

3.1 Data Requires

In this step we find all the data require to perform various selective control techniques and to calculate EOQ, safety stock, reorder level and average inventory. The data requires are as follows:-

1. Annual usage
2. Annual stock value
3. Cost of one sheet
4. Lead time
5. Ordering cost
6. I=Inventory holding cost as a percentage of average inventory investment

3.2 Data Collected

In this step all the data listed are collected from primary and secondary sources of company X inventory department.

Table 1: Annual consumption, stock value, cost and lead time related data.

Thickness (mm)	Annual Usage (Units)	Stock Value (Rs)	Cost (Rs/unit)	Ordering Cost (Rs/order)	Holding Cost (I=30%)	Lead Time (Days)	Total Cost Without EOQ (Rs)
2	5856	235990.1	2451.59	11963.76	0.3	6	323021.51
2.5	180	9070.51	3064.36	459.65	0.3	6	12410.61
4	4116	331715.3	4902.68	16816.19	0.3	6	454037.17
5	1836	184949.7	6128.22	9376.18	0.3	6	253156.81
6	1212	146496.9	7354.26	7427.8	0.3	6	200550.64
8	324	52262.52	9805.35	2647.44	0.3	6	71480.95
10	24	4780.21	12256.94	245.14	0.3	6	6618.76
12	12	2941.61	14708.03	147.08	0.3	6	3971.16

3.3 Data Analysis and Calculation

In this step of research methodology we analysis the collected data to perform various analysis and find out following:-

- Economic Order Quantity (EOQ) = √ ((2 x ordering cost x annual demand)/(I x cost per unit))
- Total annual ordering cost = (annual demand x ordering cost)/ordering quantity)
- Total annual holding cost = (I x unit cost x ordering quantity)/2)
- Total annual cost = total ordering cost + total holding cost
- Safety stock= lead time x (annual consumption/365)

ABC Analysis

ABC analysis is based on Pareto principle [6]. It uses annual usage value criteria to classify the items of inventory. In ABC analysis, A category include items which constitute 70-80% of total inventory investment. B and C category include items which constitute 10-15% and 5-10% of total inventory investment.

Steps require for ABC analysis:-

1. List the sheets of different thickness for ABC analysis.
2. Determine annual usage value in rupees by multiplying annual usage value in units with unit cost.
3. Arrange the listed items in descending order of their annual usage value in rupees.
4. Find the percentage of annual usage value of item by dividing usage value of item by total usage value of all items and also find cumulative percentage annual usage value.
5. Find the percentage item value of item by dividing item value of item by total item value and also find the cumulative percentage item value.
6. Classify items into different categories based on the cut-off values.

Table 2: ABC Analysis.

Thickness (mm)	Annual Usage (Rs)	Percentage Annual Usage	Cumulative % Annual Usage	Cumulative % Item Value	Category
4	20179430.88	34.26	34.26	12.5	A
2	14356511.04	24.37	58.63	25	A
5	11251411.92	19.1	77.74	37.5	A
6	8913363.12	15.13	92.87	50	B
8	3176933.4	5.39	98.26	62.5	C
2.5	551584.8	0.94	99.2	75	C
10	294166.56	0.5	99.7	87.5	C
12	176496.36	0.3	100	100	C
Total	58899898.08				

XYZ Analysis

XYZ analysis used to classify the items into X, Y and Z categories based on the stock value (inventory investment) criteria [5]. In XYZ analysis X category includes items having high stock value. Y and Z category include items having medium and low stock values respectively.

Steps require for XYZ analysis:-

1. List the sheets of different thickness for XYZ analysis.

2. Determine annual stock value by multiplying present stock units with unit price.
3. Arrange the listed items in descending order of their annual stock value.
4. Find the percentage values of annual stock value of item by dividing stock value of item by total stock value of all items and also find cumulative percentage annual stock value.
5. Find the percentage item value of item by dividing item value of item by total item value and also find the cumulative percentage item value.
6. Classify items into different categories based on the cut-off values.

Table 3: XYZ Analysis

Thickness (mm)	Stock Value (Rs)	% Stock Value	Cumulative % Stock Value	Cumulative % Item Value	Category
4	331715.33	34.26	34.26	12.5	X
2	235990.05	24.37	58.63	25	X
5	184949.68	19.1	77.74	37.5	X
6	146496.86	15.13	92.87	50	Y
8	52262.52	5.4	98.27	62.5	Z
2.5	9070.51	0.94	99.2	75	Z
10	4780.21	0.49	99.7	87.5	Z
12	2941.61	0.3	100	100	Z
Total	968206.77				

FSN Analysis

. FSN analysis classifies item based on the consumption figures [7]. It categorizes the items into three categories i.e. fast, slow and non- moving.

Steps require for FSN analysis:-

1. List the sheets of different thickness for FSN analysis.
2. Determine consumption rate of item by dividing annual demand of item by 365 days.
3. Arrange the listed items in descending order of their consumption rate.
4. Find the percentage of consumption rate of item by dividing consumption rate of item by total consumption rate of all items and also find cumulative percentage consumption rate.
5. Find the percentage item value of item by dividing item value of item by total item value and also find the cumulative percentage item value.
6. Classify items into different categories based on the cut-off values

Table 4: FSN Analysis

Thickness (mm)	Usage Rate (unit/day)	Percentage Usage Rate	Cumulative % Usage Rate	Cumulative % Item Value	Category
2	16.04	43.19	43.19	12.5	F
4	11.28	30.35	73.54	25	F
5	5.03	13.54	87.08	37.5	S
6	3.32	8.94	96.02	50	N
8	0.89	2.39	98.41	62.5	N
2.5	0.49	1.33	99.73	75	N
10	0.07	0.18	99.91	87.5	N
12	0.03	0.09	100	100	N
Total	37.15				

Combined XYZ-FSN Analysis

In industry all the items have different consumption rate some have high consumption rate while others have low. FSN helps us to identify items which are fast moving, slow moving and which are non-moving. Combined XYZ-FSN analysis helps the company to classify items into NX, NY and NZ categories, these categories represent non moving items which accounts for bulk of slow moving or non-moving stock value. This combined analysis helps company to take decision of discard or disposal regarding non-moving items [8]. The strategy for items in NX category is that items in this category must be discard off immediately at optimum price. The strategy for items in NY category is that items in this category must be discard off as early as possible and the strategy for items in NZ category is that items in this category must be discard off as early as possible even low prices are getting for their disposal [9].

IV. RESULTS AND DISCUSSION

4.1 Result of ABC, XYZ and FSN ANALYSIS

Table 5: Result of ABC, XYZ and FSN Analysis.

Thickness (mm)	ABC Analysis	XYZ Analysis	FSN Analysis
4	A	X	F
2	A	X	F
5	A	X	S
6	B	Y	N
8	C	Z	N
2.5	C	Z	N
10	C	Z	N
12	C	Z	N

4.2 Control Policies for Different Thickness of Metal Sheets

Table 6: Control Policies for Different Thickness of Metal Sheets.

Categories	A (4mm,2mm and5mm)	B (6mm)	C (2.5mm, 8mm, 10mm and 12mm)
Degree of control	Tight control	Moderate degree of control	Low degree of control
Safety stock	Low	Medium	High
Ordered quantity	EOQ	EOQ	EOQ
Lead time	Constant efforts to reduce lead time	Moderate efforts to reduce lead time	Minimum efforts to reduce lead time
Ordering procedure	Frequently ordered	Less frequently ordered	Ordering in bulk

4.3 Result of Combined XYZ-FSN ANALYSIS

Table 7: Result of Combined XYZ-FSN Analysis.

Combined XYZ-FSN Analysis			
Category	F	S	N
X	4mm and 2mm	5mm	-
Y	-	-	6mm
Z	-	-	2.5mm, 8mm, 10mm and 12mm

Table 7 shows the result of combined XYZ-FSN analysis. It shows that 4mm and 2mm falls in XF category and 5mm in XS category respectively. It also shows that 10mm.12mm, 8mm and 2.5 mm thickness of metal sheets fall in NZ category and 6mm thickness falls in NY category, these thicknesses of metal sheets represent non-moving items having bulk of non moving locked stock. 10mm.12mm, 8mm and 2.5 mm thickness of metal sheets must be discarded as early as possible even low prices are getting for their discard. 6mm thickness also must be discarded as early as possible. Discard of these non moving items helps the company to free amount which is locked up by these non-moving items.

4.4 Result of EOQ, Total Cost and Safety Stock

Table 8: Result of EOQ, Total Cost and Safety Stock

Thickness. (mm)	EOQ (units)	Annual Holding Cost (Rs)	Annual Ordering Cost (Rs)	Total Annual Cost (Rs)	Safety Stock (Units)
2	436.48	160510.5	160510.86	321021.36	96.26
2.5	13.41	6166.72	6167.04	12333.76	2.96
4	306.78	225613.24	225612.52	451225.76	67.66
5	136.847	125794.28	125794.99	251589.27	30.18
6	90.337	99654.27	99654.56	199308.83	19.92
8	24.15	35519.88	35518.45	71038.33	5.33
10	1.78	3289.15	3288.63	6577.78	0.39
12	0.89	1972.35	1974.23	3946.58	0.2

4.5 Comparison of Total Cost When Ordering Quantity is Equal to EOQ and When Ordering Quantity is Equal to Present Ordering Quantity

Table 9: Comparison of Total Cost

Thickness (mm)	Total Cost without EOQ (Rs)	Total Cost with EOQ (Rs)	Change in Total Cost (Rs)
2	323021.51	321021.36	2000.15
2.5	12410.61	12333.76	76.85
4	454037.17	451225.76	2811.41
5	253156.81	251589.27	1567.54
6	200500.64	199308.83	1241.81
8	71480.95	71038.33	442.62
10	6618.76	6577.78	40.98
12	3971.16	3946.58	24.58

V. CONCLUSIONS

This research uses ABC analysis which helps company to decide different control policies for different thickness of metal sheets. Variation in control policies helps inventory management department to focus more on important inventory items. Combined XYZ-FSN analysis helps company to identify non-moving items having high non-moving stock value. It is found that 2.5mm, 6mm, 8mm, 10mm and 12mm represent the non-moving items having high stock value, these items must be disposed as early as possible. In this research it is found that ordering quantity equal to Economic Order Quantity balance holding and ordering cost which decreases total cost by an average of 1025.74 Rs of each thickness of metal sheet. Ordering quantity equal to Economic Order Quantity helps company to optimize its total cost of inventory. Having safety stock helps the company to avoid the situations of stock out.

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