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An adaptive Approach to Investigation Evaluation of Incorporated Material Set Optimum Re-Order Point

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Abstract:

In a manufacturing company inventory cost is a significant part of expenses. Therefore reordering point (ROP) of the items must be optimum to reduce its carrying cost. In this present work, Investigations have made about the inventory control and R O P in a magnum steel manufacturing plant in Banmore (M.P) to find the optimum ROP by applying ved and xyz analysis. Mathematical modeling is done with the help of Mat lab software.

Keywords :Re-Order Point (R.O.P.), inventory carrying cost (I.C.C.), VED analysis, XYZ analysis and Mat lab R2011b .*

1.Introduction

In a manufacturing Plant some items are vital from production point of view but inventory cost of these parts is very high. It's not Feasible to keep more safety stock for these kinds of items but unavailability of these items can stop the manufacturing operation of that plant. Now-a-days, business environment is highly uncertain which affects the lead time of the procurement of the items and we have to keep the safety stock of such items. It can include that the company should achieve the balance among the safety stock they have to keep on hand and cost of carrying inventory. In this work an effort has made to find out the optimum value of Re-Order Point (R.O.P).

2.Literature Review

A kanban technique attracted many researchers since it was first brought to light by Monden (1983). Heoriginally summarized the Toyota approach for determining the appropriate number of kanbans at a workstation. It is applied recently in supply chain systems to efficiently manage the flow of materials. Rees et al. (1987) extended the Toyota approach to fluctuating product-mix problem by using the next periods forecast demand and the last periods observed lead times. Co and Sharafali (1997) considered the over-planning factor in Toyota_s formula for computing the number of kanbans for several production inventory control models.

Altiok and Ranjan (1995) studied a multi-stage pull system that dealt with production inventory system. Martand Telsang(2004) describes the concept of Selective control which means variations in method of control from item to item based on selective basis. The criterion used for the purpose may be cost of the item, criticality, lead-time, consumption, procurement difficulties, or something else. Various classifications are employed to render selective treatment to different types of material, each classification emphasizes on a particular aspect. The ved analysis represents classification of items based on critically. The analysis classifies the items into three groups called Vital, Essential and Desirable. The xyz analysis is based on value of the stock on hand (i.e. inventory investment) items whose inventory values are high are called X items while those whose inventory values are low are called Z items. And Y items are those, which have moderate inventory stocks.

3.Data Collection

We have visited steel company when the manufacture leaf plate for spring and TMT bar 8mm , 10mm ,12mm, 16mm, 20mm, 25mm diameter. In for inventory they store more than 1000 items in store which are long used for production leaf plate and TMT bar.

Name of the Item	Annual Require meant (S)	Ordering Cost in Rs. (Cp)	Unit Cost in Rs. (Cu)	% of Average Inventory Investment nt (I)	Lead Time (In Days) (LT)	Cons ump ion rate (CR)	Nature of the Item	Source of the supply	Way of the transport rotation
1	758	60	70	4.1661	15	540	Buyer’s	National	Truck
2	1300	110	420	1.19841	7	1200	Buyer’s	National	Truck
3	1800	120	310	2.1505	7	1500	commercial	Foreign	Ship
4	2800	10	1200	3.4722	7	2400	Standard	Local	Truck
5	432	10	567	1.2563	15	220	commercial	Local	Train
6	8887	155	477	1.6543	18	6896	commercial	Local	Truck
7	1209	120	5675	1.1904	20	750	commercial	Local	Train
8	900	60	760	0.02024	7	650	commercial	Local	Ship
9	1800	190	609	0.3547	15	1500	commercial	Local	Truck
10	1300	90	200	0.0416	7	1200	commercial	Local	Train
11	432	40	357	1.0147	15	250	commercial	Local	Train
12	32	10	865	0.8064	20	200	commercial	Local	Train
13	2100	120	410	0.0135	7	1800	Standard	Local	Train
14	1300	20	320	4.7691	15	900	commercial	Local	Truck
15	120	10	780	1.8769	15	65	Standard	Local	Truck
16	650	10	120	0.3347	15	20	Standard	Local	Truck
17	13	20	320	2.6041	7	12	Standard	National	Truck
18	1843	150	1400	0.2145	18	1500	commercial	National	Truck
19	1300	25	450	0.2541	20	1200	commercial	Local	Truck
20	13	980	8000	0.3698	15	12	commercial	Local	Truck
21	130	30	160	0.5208	7	120	commercial	Local	Train
22	932	40	1500	0.3333	15	600	Buyer’s	Local	Truck
23	9583	665	900	0.1851	18	7986	Buyer’s	Local	Train
24	9983	720	354	0.1721	15	7876	commercial	Local	Truck
25	2341	120	764	4.7691	15	1800	commercial	Local	Truck
26	13	120	2065	1.8769	18	12	Buyer’s	Local	Train
27	1600	440	266	0.3347	20	1200	commercial	Local	Truck
28	500	620	987	0.5834	15	320	Buyer’s	Local	Truck
29	840	40	560	0.0248	7	720	commercial	National	Train
30	450	349	432	1.8763	20	320	commercial	Local	Truck
31	1200	125	675	0.0045	18	900	commercial	Local	Truck
32	8760	980	236	2.7734	15	76674	commercial	Local	Truck
33	12	40	346	1.8473	18	9	Buyer’s	National	Truck
34	390	60	1500	0.0185	7	360	Standard	National	Truck
35	130	720	220	0.0765	15	65	commercial	Foreign	Truck
36	186	120	50	1.2584	18	120	Buyer’s	Local	Truck
37	154	450	90	2.5	20	90	Buyer’s	Local	Train

Name of the Item	Annual Require meant (S)	Ordering Cost in Rs. (Cp)	Unit Cost in Rs. (Cu)	% of Average Inventory Investment nt (I)	Lead Time (In Days) (LT)	Cons ump ion rate (CR)	Nature of the Item	Source of the supply	Way of the transport rotation
39	1287	120	420	1.1904	15	650	commercial	Local	Train
40	7878	225	500	1.2563	15	4657	Buyer's	Local	Truck
41	543	250	900	0.5875	15	320	Buyer's	Local	Train
42	1200	125	150	0.0345	15	650	commercial	Local	Truck
43	4569	760	120	1.8763	15	3544	Buyer's	Local	Truck
44	9876	900	540	0.0045	15	7986	Buyer's	National	Train
45	987	1024	190	2.7734	20	650	commercial	Local	Truck
46	900	50	1045	1.8473	15	650	commercial	Local	Truck
47	1876	40	80	1.0084	15	1200	Buyer's	Local	Truck
48	1578	25	620	0.0765	15	750	Standard	National	Truck
49	2500	125	567	0.1721	18	1800	commercial	National	Truck
50	1300	20	165	0.0505	7	1200	Standard	Local	Ship

Table1: Data Collected from electrical department magnum Steel manufacturing plant in Banmore (m.p) India

2.Methodology

For this Work we have investigated data from VED analysis and then xyz analysis. By applying both VEDand XYZ analysis we can find out such items which are very critical and important from research point of view. So, methodology is applied on these 5 items. For finding out the optimum R.O.P. electrical department magnum Steel manufacturing plant in Banmore (m.p) India shown in table1. On all the items we applied firstly we use the regression modeling with the help of Mat Lab software.

2.1.VED Analysis

Here we 'V' is consider for 'Vital', 'E' is for 'Essential' and 'D' is for 'Desirable'. The result of this analysis will be helpful in converging our focus on the 'Vital items', for which the level of inventory control required would be tighter than the parts.

For VED analysis we consider following factors, which affects the R.O.P. of items in the plant:

- Ordering cost(OC) (as per unit)
- Lead Time (LT)(in Year)
- Nature Of Item
- Source Of Supply

- Way Of Transportation

After finding out the factors which affects the R.O.P., we give them weight age according to their importance for R.O.P. For weight age of factors we draw a table as follow

S.r NO.	Factors	First Degree	Second Degree	Third Degree
1	Ordering coast(5)	OC<100 (5)	100<OC<1000 (10)	OC>1000 (15)
2	Lead Time(20)	LT <2 (20)	2<LT<4 (40)	LT>4 (60)
3	Nature of item (20)	Buyer's Design (20)	Commercial (40)	Standard (60)
4	Source of Supply (25)	Local (25)	National (50)	Foreign (75)
5	Way of Transportation (30)	Truck (30)	Train (60)	Ship (90)_

Table 2: Factors Considered For VED Analysis With The Plan For Weight Age & Point

Points	Classification
<150	Desirable(D)
150to 175	Essential(E)
>175	Vital(V)

Table 3

On The Basis Of This Table We Categorized All The Items Into V Or E Or D As Shown In Table 3;

Name of Item	Ordering cost (A)	Lead Time (B)	Nature of Item (C)	Source of Supply(D)	Way of Transportation (G)	Total (A+B+C+D+G)	Category (V/E/D)
1	5	20	20	50	30	125	D
2	10	40	40	50	30	170	V
3	15	20	20	75	90	220	V
4	10	60	60	25	30	185	V
5	5	20	20	25	60	130	D
6	10	40	40	25	30	155	E
7	10	60	60	25	60	215	V
8	5	40	40	25	90	200	V

Name of Item	Ordering cost (A)	Lead Time (B)	Nature of Item (C)	Source of Supply(D)	Way of Transportation (G)	Total (A+B+C+D+G)	Category (V/E/D)
9	10	20	20	25	30	105	D
10	10	60	60	25	60	215	V
11	5	20	20	25	60	130	D
12	5	60	20	25	60	170	E
13	10	40	60	25	60	195	V
14	5	20	40	25	30	120	D
15	5	20	60	25	30	140	D
16	5	20	60	25	30	140	D
17	5	40	60	50	30	185	V
18	10	40	40	50	30	170	E
19	5	60	40	25	30	160	E
20	10	20	40	25	30	125	D
21	10	60	40	25	60	195	V
22	5	20	20	25	30	100	D
23	10	40	20	25	60	155	E
24	10	20	40	25	30	125	D
25	10	20	40	25	30	125	D
26	10	40	20	25	60	155	E
27	10	60	40	25	30	165	E
28	10	20	20	25	30	105	E
29	15	20	40	50	60	185	V
30	10	60	40	25	30	165	E
31	10	40	40	25	30	145	D
32	10	20	40	25	30	125	D
33	5	40	20	50	30	145	D
34	10	60	60	50	30	210	V
35	10	20	40	75	30	175	E
36	10	40	20	25	30	125	D
37	10	60	20	25	60	155	E
38	10	20	60	25	30	135	D
39	10	20	40	25	60	155	E
40	10	20	20	25	30	105	D
41	10	20	20	25	30	105	D
42	10	20	40	25	30	125	D
43	10	20	20	25	30	105	D
44	10	20	20	25	60	135	D
45	15	60	40	25	30	170	E
46	5	20	40	25	30	120	D
47	5	20	20	25	30	100	D
48	5	20	60	50	30	165	E
49	5	40	40	50	30	165	E
50	5	20	60	25	90	200	V

Table 4:Categorization Of Items Into V/E/D

2.2.XYZ Analysis

After ved analysis we will switch over to xyz analysis. For this analysis we consider I.C.C. for categorization of items into X or Y or Z. Here we consider X for higher I.C.C., Y for medium I.C.C. and Z for lower I.C.C. as shown in Table .

The following formula of Economic Order Quantity (EOQ) and Inventory carrying Cost (I.C.C.) is used for all 12 items selected for xyz analysis.

EOQ = $\sqrt{(2S * C_P / C_U * I)}$

I.C.C. = (EOQ/2) * C_U * I

Here S = Annual requirements of items (nos.)

C_P = Ordering cost (as per unit)

C_U = Manufacturing cost or Unit cost (Rs. Per Unit)

I = Inventory Investment

Factors considered for xyz analysis and Categorization

Categorization of items into X/Y/Z

Parameters	**Category**		
	X	**Y**	**Z**
Inventory Carrying Coast(I.C.C)	I.C.C>200	200>I.C.C>100	ICC<100

Table 5

Sr.NO.	**Name of item**	**V/E/D**	**Category X/Y/Z**
A	2	V	X
B	3	V	X
C	4	V	X
D	7	V	Z
E	8	V	Z
F	10	V	Z
G	13	V	Z
H	17	V	X
I	21	V	X
J	29	V	Y
K	34	V	Z
L	50	V	Z

Table 6: Combined Results Of VED& XYZ Analysis

Categorization of item into XYZ
Using the table we made a nine point matrix. In this matrix. We distribute the entire items category into the combination of V/E/D and XYZ
Nine point matrix

	X	Y	Z
V	A B C H I	J	D E F G K L
E	6 12 18 19 23 26 27 28 35 37 39 45		
D	1 5 9 16 20 22 24 2531 32 33 36 38 39 40 41 42 43 44 46 47		

Table 7

By this table , we find out 5 items a=A B C H I that comes into category of X and V so these 5 items are very critical from research point of view so we applied methodology on these 5 items only.

2.3. Calculation For Re-Order Point(R.O.P)

the following steps for For calculation of R.O.P we consider all 5 items

For item A :

Annual consumption = 1200

EOQ = 36.7570

Lead time = 7 days =7/365 =0.0191 year

As 1200 consumed in 1 year so as the 36.7570 will consume in 0.0306 year but lead time of the items is 0.0191 year so the re-order of items a should be at least 0.057 year before so, appropriate re-order point of items ‘a’ is 0.0306-0.0191 =0.0115 year

Some calculation is applied for items B, C, H, I,

- For item B: ROP= 0.0173 year
- For item C: ROP= 0.4597 year
- For item H: ROP= 0.1523 year
- For item I: ROP= 0.0228 year

2.4. Modeling Of Parameters

To generalize the results, the modeling of input parameters (consumption rate, lead time, & unit cost) and re-order point (R.O.P) is done using regression modeling and mat lab software R2011b

The parameters under consideration are

1) Consumption Rate (C.R)

2) Lead time (L.T)

3) Unit cost (U.C)

The re-order point is a function of C.R., L.T., and U.C so we can take R.O.P.as

In (R.P) = C1 in (C.R) + C2 in (L.T)+ C3 in (U.C)

Where C1, C2, C3 are constant which are to be determined by regression modeling and using MATLAB software.

The output parameter re-orders point and input parameters are converted from actual absolute values to natural logarithms. For regression analysis the natural logarithms of re-order point is taken as single output parameter [Y] where as natural logarithms of C.R =[X1]

In (R.P.) = $C_{1,}$ C_2, C_3 are constants which are to be determined by regressing Modeling and using MATLAB software. The output parameter Re-order point and input parameter are converted from actual absolute valves to natural logarithms. For regression analysis, the natural logarithms of Re-order point is taken as single output parameter[Y] whereas natural logarithms of C.R. = [X_1], DELL

L.T. =[X_2],U.C. =[X_3] has been taken as input parameters X = [X_1 X_2 X_3].

The following steps were followed and MATLAB is used

- Consider the output parameter natural logarithms of Re-order point (R.P.) [Y] and input parameter [X].
- X'= Transpose of [X] was determined.
- X' Transpose of [X]was multiplied with [X] to get the product[X'*X].
- The inverse of product [X'*X] = $[X'*X]^{-1}$ was obtained.
- X' transpose of [X] was multiplied with Re-order point (R.P.) [y] to get for product [X'*Y].
- Step 4$[X'*X]^{-1}$ was multiplied with step 5 [X'*Y] to obtained the product of $[X'*X]^{-1}$ and [X'*Y].

- The final matrices found in the form of :

β_1

β_2

$\beta =\ \ \beta_3$

Finally, after the completion of program and the valves of constants found as follows:

- $C_1 = \beta_1$
- $C_2 = \beta_2$
- $C_3 = \beta_3$

From Regression Modeling we find out the values of 'β' shown as follows:

B = - 0.9474 0.2706 - 0.7543 5.3323

From this result we get

- β = 5.3323
- β = -0.9473
- β = 0.2706
- β = -0.7543

the values of constants obtained are :

- C_1 β = 5.3323
- C_2 β = -0.9474
- C_3 β = 0.2706
- C_4 β = -0.7543

Substituting these value then equation of R.O.P becomes

$$R.O.P. = (C.R)^{-0.9474} (U.C)^{0.2706} (L.T)^{-0.7543}$$

3.Conclusion

The basic aim of this research was to develop a 'Nine point competitive matrix for pull system' which will incorporate XYZ & VED analysis with, Kanban system, so as to optimize the inventory & reducing the number of stock out. In line with that, a competitive matrix has been developed.

Inventory carrying cost is a vital part of economic analysis. It varies with no. of items and its re-order point by mathematically modeling we find out that R.O.P. of every item directly proportional to its consumption rate, lead time , inventory investment and unit cost.

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