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IMPLEMENTATION OF COST OPTIMIZATION TOOLS: A CASE STUDY

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Abstract - In today's competitive environment for growth and sustainability, organizations need to adopt scientific approach and cost optimization tools for managing business. This paper explores the applications of cost optimization tools in reducing costs and improving profitability in businesses. A case study of an agro implements manufacturing plants is presented. It includes the implementation of various techniques such as forecasting, Economic Order Quantity (EOQ), ABC analysis and Assembly line balancing. The methodology used in the case study involve collecting and analyzing data manually or using software systems whenever possible, and testing different scenarios to identify the most effective solutions. The findings suggest that cost optimization strategies can lead to significant cost savings and improved profitability. This paper highlights the importance and need of cost optimization tools in improving business processes and productivity.

Key Words: – Inventory management, Forecasting, Assembly line, Cost optimization.

1. INTRODUCTION

In today's rapidly changing market, businesses across various industries are increasingly relying on cost optimization tools to reduce expenses while maintaining quality. These tools can be applied to procurement, inventory management, manpower planning, and production processes, etc. Cost optimization tools are particularly useful for businesses facing tight profit margins or facing high competition, as they enable them to remain competitive while achieving profitability. This paper explores the application of cost optimization strategies and tools, highlighting the importance of data-driven decision-making and continuous improvement to achieve operational excellence and improve profitability. This paper presents the application of the four cost optimization tools niz. Demand forecasting, EOQ, ABC Analysis and Assembly line balancing to an agro- implement manufacturing plant. The objectives of this study were as follows: to analyze inventory, to predict the demand for a product, and to improve line efficiency

2. CASE STUDY

2.1 Introduction to Industry

The industry selected for the case study is founded in 1986. It is situated in MIDC, Amravati (MH.). It is medium scale industry with ISO 9001:2015 certification. The company had technical collaboration with leading manufacturer FALC S.R.L. a globally renowned Italian agricultural mechanization company in 2013. The annual turnover is about 36 crore and number of employees is around 147. The industry manufactures various agro-implements. The product selected for this Case Study is a 'Rotavator' shown in figure 1, which is a type of agricultural machinery that is used to prepare soil for planting by breaking up and tilling the soil.

The industry is in process of enhancing productivity through optimum utilization of resources and planned applications of Cost Optimization tools (COT).

Fig -1: Rear View of Rotavator

3. COST OPTIMIZATION TOOLS

3.1 Forecasting

The Annual Sales value of Rotavator for last six years is shown in Table 1. Exponential Smoothing, Moving Average method and Regression Method of forecasting has been selected for forecasting future demand. Table 2 shows the forecast by three methods with their accuracy.

Table -1: Annual Sales of Rotavator

Year	Sales (Units)
2017	2600
2018	2132
2019	1591
2020	3051
2021	3042
2022	3345

Table -2: Comparison of Forecasting Methods

Forecasting Method	Forecasted Demand (Units)	Error %	Accuracy
Exponential Smoothing Method	2845	22%	Low
Moving Average Method	3146	16%	Moderate
Regression Method	3418	14%	High

By comparison of three forecasting method, regression method has least error and recommended as the best method. It can be used to forecast next 5 years sales. The forecasted demand for next 5 year of rotavator using regression method with linear regression equation Y=226.1X +1835.3 is shown in table 3. Figure 2 shows the graph of Annual Demand Forecasting of Rotavator for next 5 year.

Table -3: Annual Demand Forecasting of Rotavator for next 5 year

Year	Forecasted Demand (Units)
2023	3418
2024	3644
2025	3871
2026	4097
2027	4323

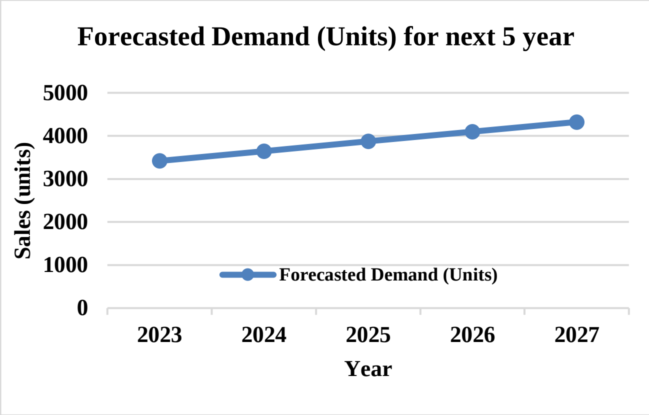

Figure -2: Annual Demand Forecasting of Rotavator for next 5 year.

3.2. Inventory Management

It had been observed that the excess raw material inventory was the problem being faced by the company. The overstocking of inventory leads to increased inventory costs, which can be detrimental to the company's bottomline. To address this issue, two inventory management techniques: Economic Order Quantity (EOQ) and ABC Analysis have been applied. By using EOQ, the company can ensure that they are ordering the optimal amount of raw material to meet demand while minimizing inventory costs.

A) EOQ:

The values of ordering cost, holding cost and annual demand has been taken from the industry. The EOQ value is calculated for six materials of the Rotavator using standard formula. The values are given in Table 4.

Table -4: Calculated EOQ for material of Rotavator

Sr. No.	Material (Rotavator)	Ordering Cost in Rs (S) (per order)	Holding Cost in Rs (H) (per unit)	Annual Demand (D) (kg)	EOQ (Q) (kg)
1	Seamless RoundPipe	100.80	1.9	22000	1528
2	MS - Flat	57.40	1.04	20000	1486
3	MS - Round Bar	69.10	1.28	4000	657
4	MS - Sheet	70.50	1.3	40000	2083
5	ERW Pipe Round	70.90	1.31	6400	832
6	ERW Pipe Square	70.90	1.31	11000	1091

Table 5 shows the comparison of actual and proposed value of quantity per order and number of orders per year.

Table -5: Comparison of EOQ and No. Of Orders with existing values

Sr. No.	Material (Rotavator)	Actual Order Quantity (kg)	EOQ (kg) (Approx.)	Actual Orders per Year	Calculated Orders as per EOQ
1	Seamless Pipe Round	1833	1528	12	14
2	MS - Flat	1667	1486	12	13
3	MS - Round Bar	1000	657	4	6
4	MS - Sheet	3333	2083	15	19
5	ERW Pipe Round	1066	832	6	8
6	ERW Pipe Square	1886	1091	7	10

The observation of table 5 shows that for all six materials the number of orders per year needs to be increased.

B) ABC Analysis

Table 6 shows Annual raw material consumption, cost per unit and Annual Consumption cost for all material of Rotavator. Sort the items into groups A, B, and C as per the process of ABC analysis. 'A' items are the top-priority items with the highest consumption value, 'B' items are important but have a lower consumption value, and 'C' items are the lowest priority. Table 6 and table 7 shows the categorization of materials according to ABC Analysis.

Table -6: Annual Raw Material Consumption

Sr.	Material	Annual Consumption (kg)	Cost per unit (Rs./kg)	Annual Cost (Rs) Lakhs
1	MS Sheet	40000	65.3	26.12
2	Seamless pipe(Round)	22000	95	20.9
3	ERW Pipe (Round)	6400	65.75	4.20
4	ERW Pipe (Square)	13200	65.75	8.68
5	MS Round Bar	4000	64	2.56
6	MS Flat	20000	52.5	10.5

Table -7: Material categorized according to ABC Analysis

Material	Annual Cost (In Rs)	Cumulative Annual Cost (In Rs)	% of Inventory Value	Cumulative %	Weightage	Category
MS Sheet	2612000	2612000	35.80	35.80	78.83%	A
Seamless pipe (Round)	2090000	4702000	28.64	64.44		
MS Flat	1050000	5752000	14.39	78.83		
ERW Pipe (Square)	867900	6619900	11.89	90.73	17.66%	B
ERW Pipe (Round)	420800	7040700	5.77	96.49		
MS Round Bar	256000	7296700	3.51	100.00	3.51%	C

As per the ABC Analysis : 'A' category of items includes MS Sheet, Seamless pipe round and MS Flat; 'B' category of item consists of ERW pipe (Square) and ERW pipe (Round), and 'C' category of items consist of MS Round bar.

3.3 Assembly Line Balancing

Presently, the assembly of Rotavator is carried out in manual mode with discrete operations. It is seen that the material handling has a noticeable time share which directly affect the production rate. Assembly line is proposed to improve the productivity of this process. Existing Operational Sequence of Rotavator consist of the tasks as shown in table 8.

Table -8: Existing Scenario in Industry

Sr. No.	Tasks	Transportation time (min)	Time taken by worker (min)	Precedence
1	Place the rotor on a trolley andclear the holes	0.67	1	
2	Fixing the G.S plate along withprotective cap	1.33	3	1
3	Fixing the O.S plate along withprotective cap	1.33	3	1
4	Place main frame on trolley and attach to GS and OSplate	1	3.5	2,3
5	Fixing 3P hitch/ top hitch	1	1.83	4
6	Fixing the bottom clamp	0.84	1.67	4
7	Fixing the bottom gear on GSplate	0.5	1.5	2
8	Tight the lock nuts	0.5	2.16	3
9	Fixing the gear box	2.33	3.16	6
10	Attach Reinforced shaft	1	3	9
11	Fixing the shafts with help of topclamps	0.5	1.84	9,10

12	Fixed the top gear on GS plate	0.5	1.34	11
13	Fixing the gear box cover	4	7	12
14	Fixing bonnet to main frame andattach bonnet patch to plates for safety	1.5	1.84	13
15	Feed the oil to the gear box	0.67	3.5	14
16	Test the rotavator	0.67	13	15
	Total Time (mins)	**18**	**52.50**	**70.50**

In this existing scenario, 16 operations are required to prepare a complete assembly. Time required for transportation is about 18 minutes and the activity time is about 52.50 minutes. The total time is about 70.50 minutes for assembly. On the basis of Assembly line balancing principles, the following 3 models have been proposed with change in operational sequence, and minimizing transportation time.

- The distance between the workstation and inventory racks is consider to be minimum as per distance travelled, as consider transportation time.
- The crane is also provided for material handling of heavy parts which will be shared between the stations.
- Organize a proper operational sequence with the help of software which reduces the idle time.
- The base column of crane or kitting trolley accommodates the different tools like nuts/bolts.

Comparative Analysis of Proposed Models

With the use of Flexible Line Balancing software, the different parameters have been calculated. The Table 9 shows the calculated values and the comparative analysis of all 3 proposed models:

Table -9: Comparative analysis of proposed models

Parameters	Model 1	Model 2	Model 3
Workstation	3	3	3
Maximum Workstation Time	20 min 30 sec	20 min 10sec	19 min 20 sec
Idle Time	3 min	3 min 20 sec	1 min
Efficiency	93.2%	94%	99.1%

In the first proposed model, the number of workstations is 3 and the maximum workstation time is seen as 20 minutes 30 seconds. The idle time and line efficiency is 3 minutes and 93.2 % respectively.

In the second proposed model, the number of workstations is 3 and the maximum workstation time is 20 minutes 10 seconds. The idle time and line efficiency is seenas 3 minutes 20 seconds and 94 % respectively.

In the third proposed model, the number of workstations is 3 and the maximum workstation time is 10 minutes 20 seconds. This model has same operational sequence as per existing system. The idle time and line efficiency is seen as 1 minutes and 99.1 % respectively and task times are equally distributed. Out of the three models, Model No.3 has highest efficiency (Table 9).

The production rate per day and per month is calculated for existing and proposed model no 3:

Assuming, the total available time per day is taken as 465 mins and working days per month is 25 days.

Production rate (Existing system) $= \frac{465\ min}{70.5\ min} =$ 7 units/day, so the monthly production rate is 175 units/month.

Production rate (Proposed model 3) $= \frac{465\ min}{57.17\ min} =$ 9 units/day,

so the monthly production rate is 225 units/month.

Table -10: Comparative Analysis

Parameter	Existing System	Proposed Model 3
Production Rate	175 units/month	225 units/month
No. of Workers	5	3
Line Efficiency	-	99.1%
Cycle Time	70.5 min	57.17 min

The table 10 shows that implementation of proposed model 3 increases production rate from 7 to 9 units/day while number of workers reduces from 5 to 3. The line efficiency of proposed model 3 is 99.1 % and cycle time reduces from 70.5 to 57.17 minutes**.**

4. CONCLUSION

The case study reveals that the application of the cost optimization tools like Forecasting, EOQ, ABC Analysis and Assembly line balancing are beneficial for the growth and progress of the industry. It helps the industry to optimally plan the resources, to reduce the unnecessary activity, to avoid the excess storage of inventory, to control the inventory of high cost items, to properly utilize of manpower etc. Thereby, reduces the various costs and enhances the productivity.

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