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Identification and Reduction of waste of Finished Goods inventory level by applying lean techniques in the warehouse

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Abstract- *The present dissertation work was carried out at Xyz Company. The work was based on decreasing the inventory carried by the company in form of finished goods. Previously the inventory level of 37% of sales on the month was maintained for a part named 301 from line 1 in the hub 3production hub. After analysis we find the various wastes that are present in the system and try to reduce the wastes in form of production and in form of waiting using techniques such as Simulation and Forecasting. Once we had forecasted demand and optimized replenishment time we find that the resulting simulation has a lesser inventory fluctuation and has reduced down from 37% to 27%.*

Keywords- *Inventory level, simulation, forecasting, exponential smoothening, Replenishment cycle*

I. INTRODUCTION

The aim of the paper is to decrease the current inventory level in form of finished goods. The company has five major Hubs of production .The project is being carried out at hub 3 production ,in this hub 3 there are three different lines namely line 1 ,line2, line3. The work carried out is for a product 301 which belongs to line one in the hub 3 production lines. The hub 3 has five parts each of the parts goes through the following process as shown in fig

Figure 1.Overall process

The overall inventory maintained for product 301,302,303,304 and 305 are to be brought down to 25 % of sales, it has to be analysed if it can be done by studying the factors that are responsible for the pilling up of inventory. The demand for the product is basically a pull system where the forecast for every 3 months is sent to the company and then the procurement for raw material is accordingly.

The analysis is done for demand, sales and for inventory level maintained and then we conclude the relation between there factors, once we find the relationships we try to decrease the waste present in the system.

II. LITERATURE REVIEW

The problem defined is basically based on inventory level issue and how to reduce it as mentioned in the textbook on inventory management written by *Robert A. Russell , TimothyL. Urban*

The inventory-staggering problem is a multi-item inventory problem in which replenishment cycles are scheduled or offset in order to minimize the maximum inventory level over a given planning horizon. We incorporate symmetry-breaking constraints in a mixed-integer programming model to determine optimal and near-optimal solutions. Local-search heuristics and evolutionary polishing heuristics are also presented to achieve effective and efficient solutions. We examine extensions of the problem that include a continuous-time framework as well as the effect of stochastic demand.[1]

From the above literature we can see how scheduling is one of the most important factors in inventory level management, as we know in just in time system we have to keep a minimum inventory and this can only be done by

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decreasing the replenishment time. Hence we take this literature to know the basic fundamentals of Just in time system and replenishment time and its relation with demand and sales.
Also based on a literature review, Mertens (2015b) developed several solution directions in order to reduce the amount of waste. Literature shows that rearranging supplier properties in terms of reducing lead times and/or review periods and breaking up the case pack size are opportunities to reduce outdating. Moreover, taking into account information on the inventory levels in the stores is hardly investigated for perishables in a distribution inventory system[2.], the paper explains the simulation of product in warehouse so that replenishment cycle can be found.

III. ANALYSIS

3.1 Analysis of Demand Inventory and Sales in current system

For the analysis part we are using a software called MINITAB to plot the graphs and relations .First the data of sales, demand and inventory from the year 2013 was collected in month wise. The values of demand and sales was compared to check if it was consistent and accurate the following graphs were plotted and it was found to be that the relation between the sales and demand was quite accurate and there was no much difference.

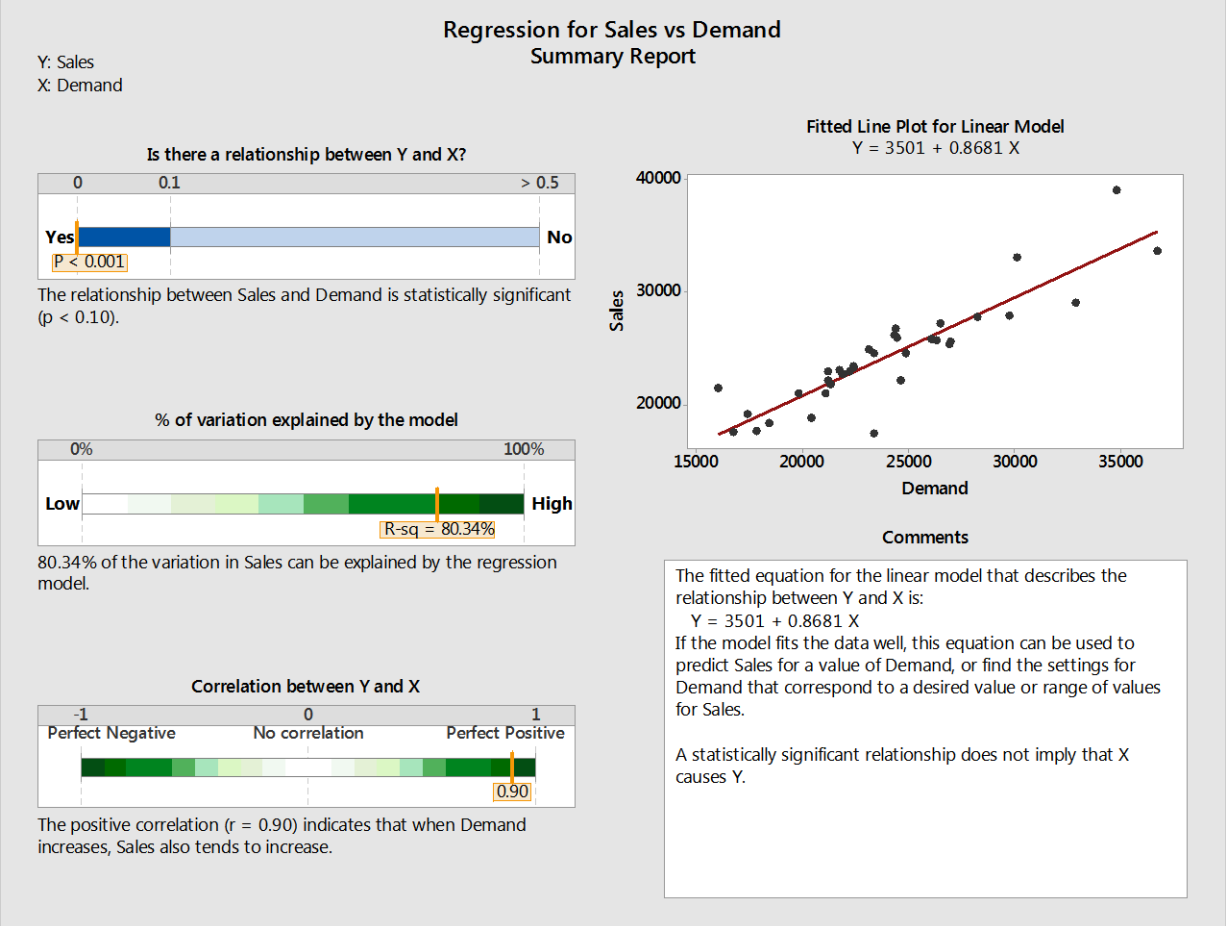

Figure 2.Regression for Demand and sales

Now that we know that there exists a relation between the sales and demand we take one of the values and compare it with inventory as to know if there is a relation between sales and inventory and as we compare the value of sales to that of inventory we got the following plot.

As we can see from the above figure that the relation between sales and demand can be put into a straight line equation (Y=3501+0.8681X), also as we can see that the variation explained is about 80.34 % that means that 80.34%of change in demand can be explained to be having a relation with the increase in sales, also the figure shows that correlation between sales and demand are having a value of 0.9 positive value which means that demand increases as sales value increases.
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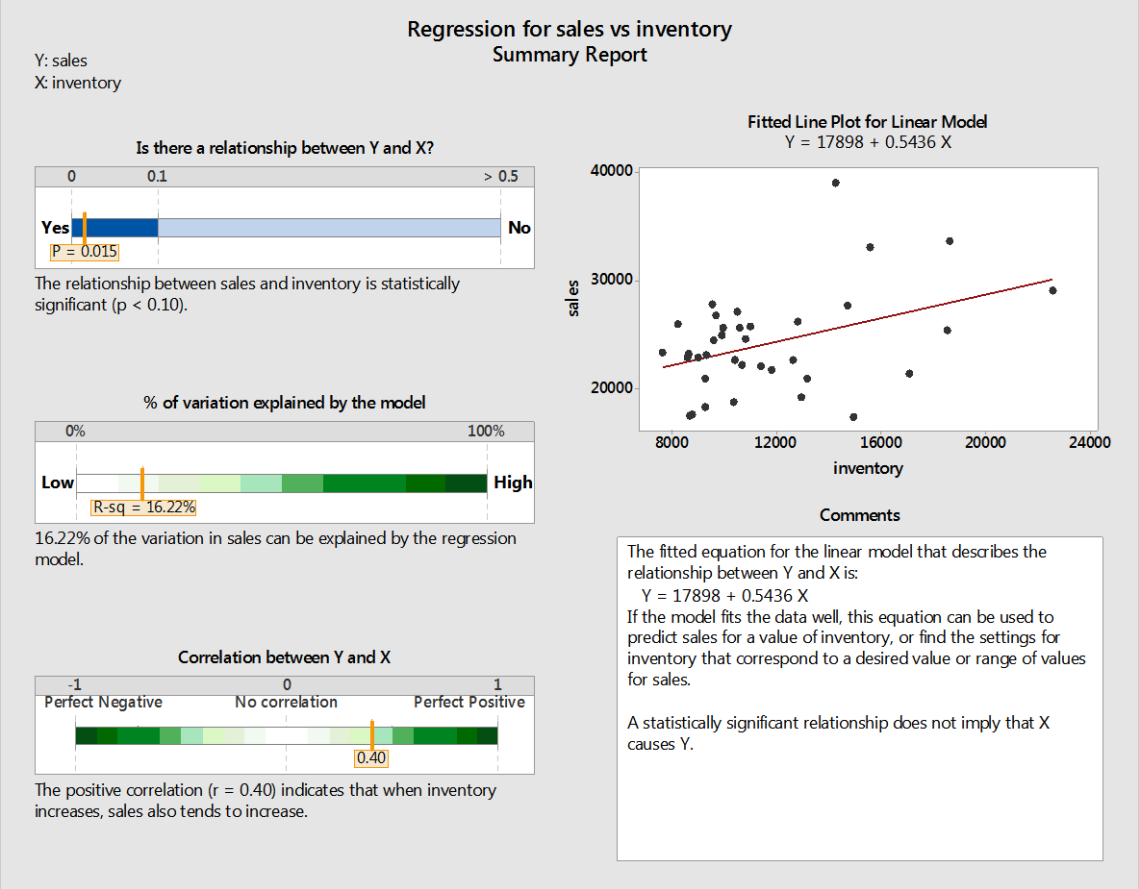

Figure 3.Regression for Sales and inventory

We take the data of inventory in hand sales and as we know that we have to maintain an inventory of 25% of sales we take that as a target value then the following plot was plotted.

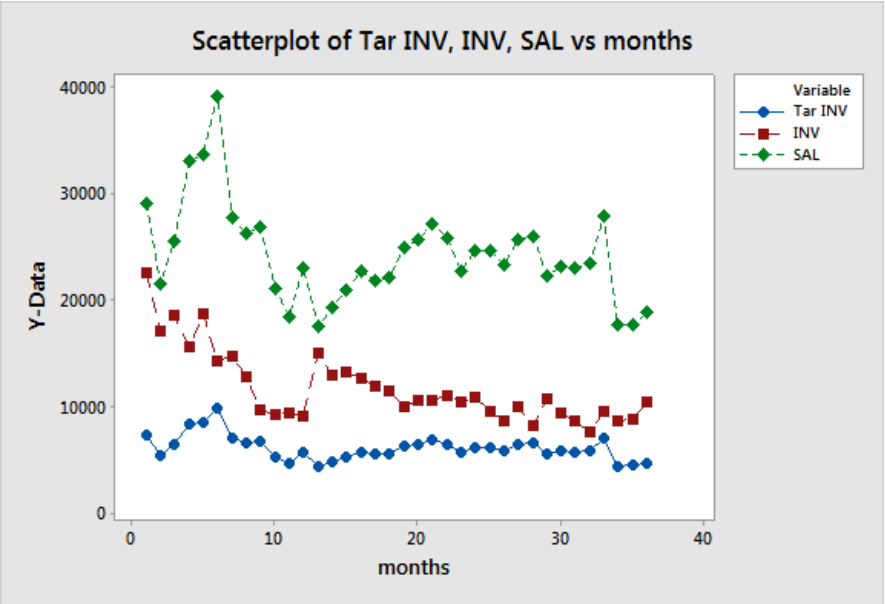

Figure 4.Scatter plot of inventory sales and target inventory

Now we plot a matrix plot that explains the relation between sales value on the particular month and how much inventory was maintained on that month then we find that there is a lot of variation on each sales value to the no of inventory, so it can be concluded that there are particular factors that influence the value of inventory even when the sales were constant now we analyze the possible wastes that can be present in the system as to find the cause of variation

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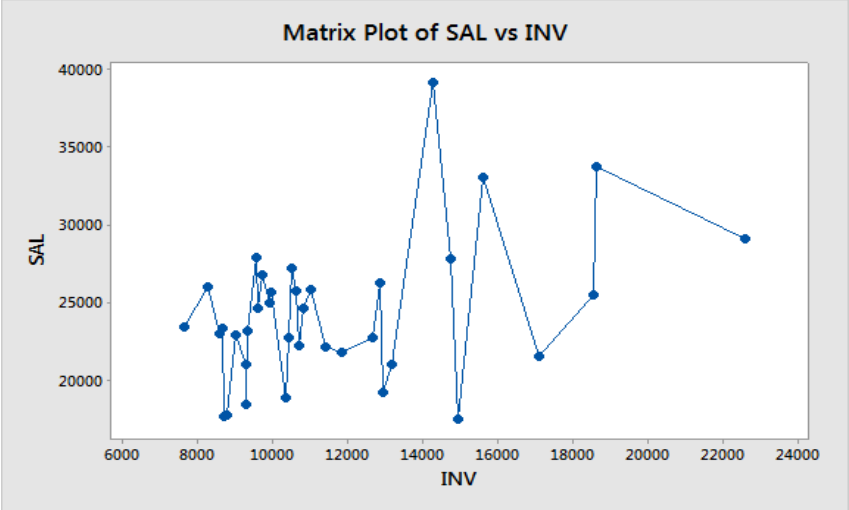

Figure 5.Matrix plot of sales and inventory

Analyzing the Wastes Present in the system ,The type of waste that we have taken that effect the system were found to be the following :-

- Transportation
- Overproduction
- Waiting

3.2 Waste reduction in form of Transportation

The no of products that is on transportation depends on sales of the product and the level of inventory that has to be maintained, and as our paper intention is to lower the inventory level,as sales is expected to increase we could see that there will be a sufficient percentage of goods that will be in transit and which can be worked upon in future as to schedule accordingly.
Hence we can conclude that as we cannot decrease the days by transport it is considered to be an unavoidable loss.

3.3 Waste in form of over production

As to find the current state we apply simulation on excel sheet for the current warehouse so that we calculate the total inventory that is present in warehouse and the existing inventory level. we split the table into 6 different columns namely Cycle count, Day count, Beginning inventory , Demand ,Ending inventory, Quantity Production ,Days until Finished Goods arrives. The following results were found for product no 01 when it was simulated to certain days.

Table 1

cycle count	day count	beginning inventory	Demand	Ending inventory	quantity produced	Days until FG arrives
1	1	1665	0	1665		
	2	1665	0	1665		
	3	1665	0	1665		
	4	1665	0	1665		
	5	1665	196	1469		
	6	1469	200	1269		
	7	1269	204	1065		
	8	1065	204	861	739	1
2	1	861	104	1496		0
	2	1496	224	1272	794	0
3	1	1272	0	2066	569	0
4	1	2066	208	2427	195	0

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5	1	2427	220	2402		
	2	2402	228	2174		
	3	2174	224	1950		
	4	1950	108	1842		
	5	1842	212	1630		
	6	1630	0	1630	214	0
6	1	1630	208	1636		1
	2	1636	216	1420	1114	0
7	1	1420	220	2314		1
	2	2314	0	2314		
	3	2314	0	2314		
	4	2314	0	2314		
	5	2314	0	2314	143	2
8	1	2314	240	2217	793	1
	2	2217	212	2798		0
	3	2798	220	2578		
	4	2578	220	2358		
	5	2358	228	2130		
	6	2130	236	1894		1
	7	1894		1894	157	0
9	1	1894		2051		
	2	2051	0	2051		
	3	2051	244	1807		
	4	1807	236	1571		
	5	1571	244	1327		
	6	1327	236	1091		
	7	1091	236	855	1039	2
10	1	855	0	1894	389	1
11	1	1894	0	2283		0
	2	2283	0	2283		
	3	2283	0	2283		
	4	2283	0	2283		
	5	2283	0	2283		
	6	2283	244	2039		
	7	2039	236	1803		
	8	1803	0	1803		
	9	1803	244	1559		
	10	1559	240	1319		
	11	1319	240	1079		
	12	1079	244	835	657	2

Similarly was carried out for two more months, We see that there is a huge difference in the reorder cycle in cycle 11 it is high about 12 days but various other cycles the values are as low as 1day. Thus we can say that the system basically does not have a standard re order point.

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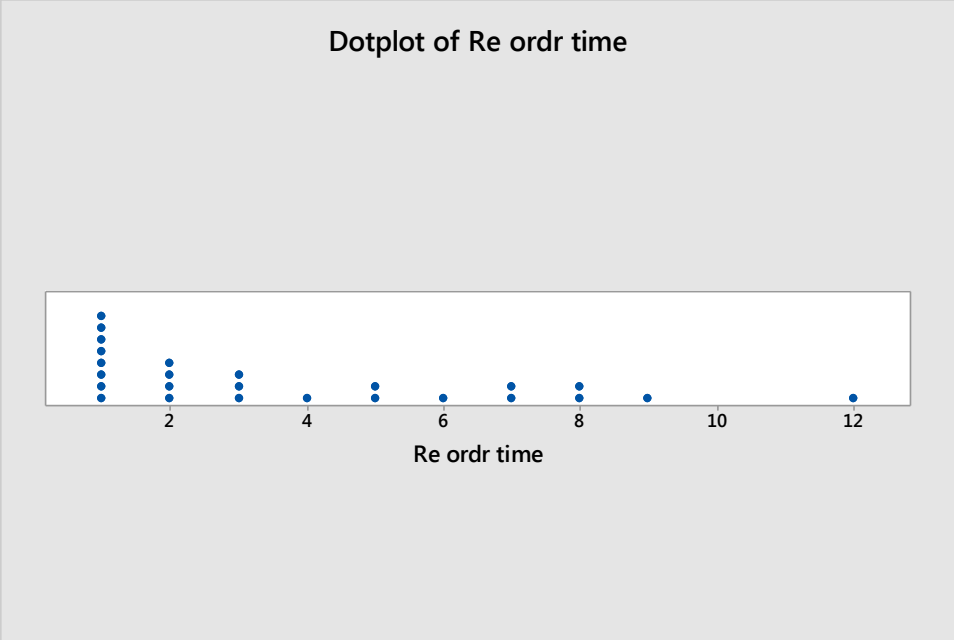

Fig:- Dot plot for reorder time

3.4 Waste Reduction in form of Waiting

The waste in form of waiting of finished goods in the warehouse is mainly caused because of fluctuation in demand. The demand changes over a period of time exponentially to know the behavior of it we had plot the graph of demand against time monthly and now to get a better understanding of data we do exponential smoothening on the demand data, now to do an exponential smoothening data of three years demand was collected for every month .We take alpha to be a value of 0.4 to make the problem acceptable in real life situation, the following is for the total data but as we see that in simulation we have considered only product 01 ,hence we also plot the smoothening of product 01 and it was found that the expected value of demand for the month after exponential smoothening was found to be around 4059 products of finished goods.

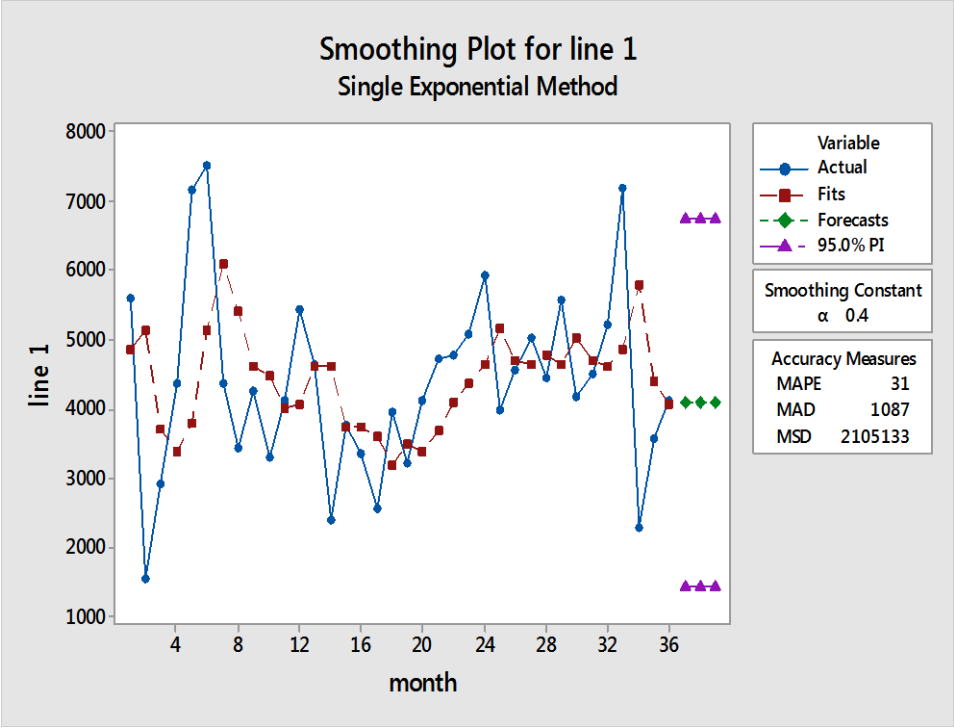

Fig- Exponential Smoothening for line 1 at alpha=0.4

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IV. RESULTS and CONCLUSIONS

The important results were drawn from the Analysis of the problem and were found to be the following:

1. The Demand is forecasted and we have found that it was quite an accurate value with alpha =0.4 which reduced the time which the product had to wait in the warehouse as there is a forecast hence lesser inventories would be carried.

2.The Waste in form of overproduction is stopped by standardising the re order time of finished goods.
The replenishment time was having high variation and was fluctuating around a high value from One to twelve.
Once we use the demand that is forecasted and we simulate the results for inventory in the warehouse there was a decrease in the fluctuation of inventory level. The fig shows the variation before we make the replenishment time constant.

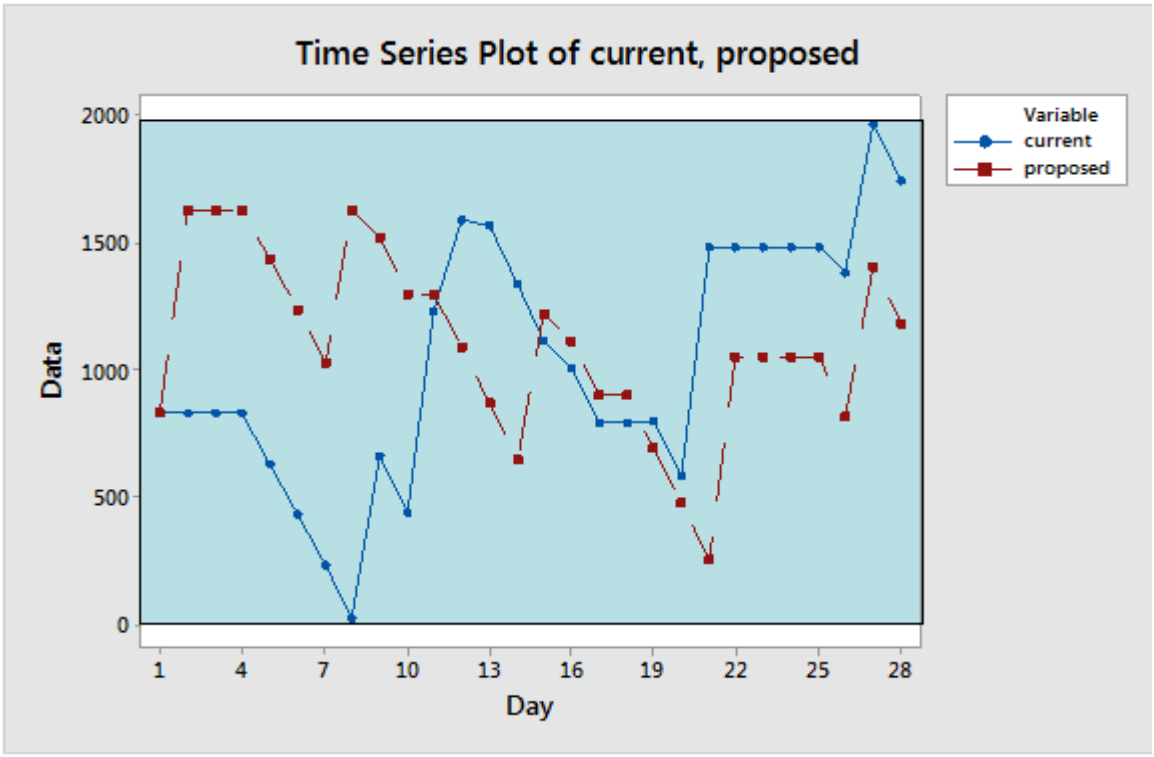

Fig- Variation in inventory levels without constant replenishment cycle

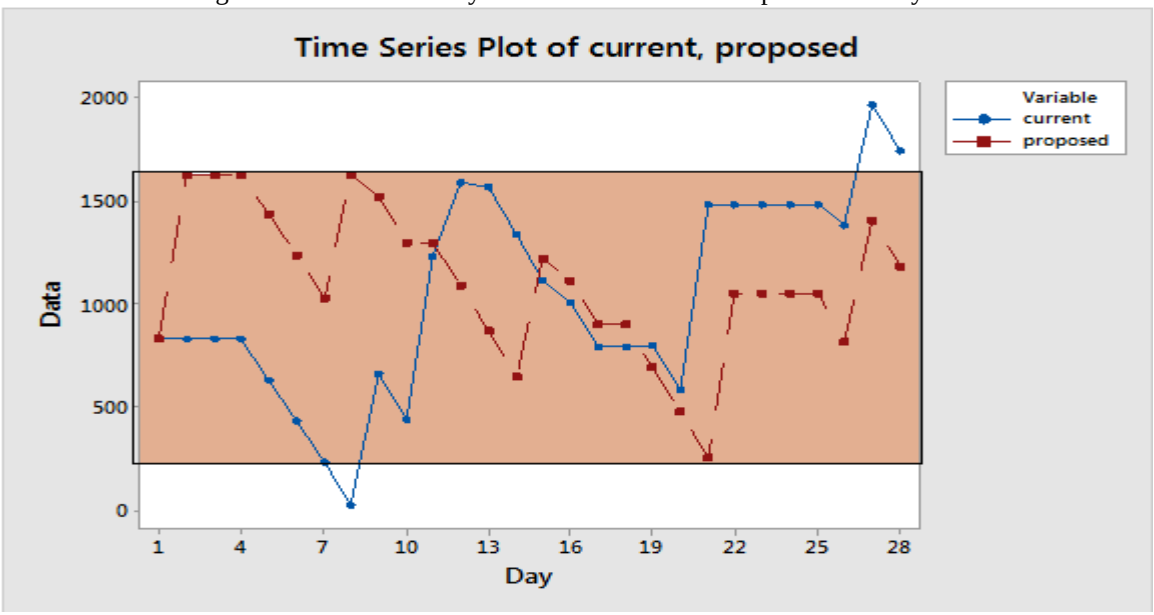

Fig- Variation in inventory levels with constant replenishment cycle

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From the above results as we have seen the fluctuation of inventory has decreased when we have a constant replenishment time or we can say that by reducing replenishment time of finished goods in the production we can reduce the current level of inventory which was 37% in the beginning can be bought down up to 27% for the product 301.

REFERENCES

[1.] The textbook on inventory management written by Robert A. Russell , TimothyL. Urban

[2.] Text book of Applied Statistics and Probability for Engineers by Douglas C. Montgomery, George C. Runger.

[3.] Waste Reduction in a Distribution Inventory System by Reconsidering Policies in the Central Warehouse. by P.A.J. Mertens

[4.] Silver, E., Pyke, D., & Peterson, R. (1998). Inventory management and production planning and scheduling. Chichester: Wiley.

[5.] Naylor, T., & Finger, J. (1967). Verification of Computer Simulation. Management Science, 14, B92-B101.

[6.] Law,a.m.,&w.D.Kelton, Simulation Modeling and analysis TATA Mc Graw Hill 2007

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