Operations Planning & Control at Ross Product Division

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Abstract— Ross products which belongs to a division of Abbott, is one of the leaders in the U.S market in the field of pediatric nutritionals and is considered to be one of the world's leading developers in adult nutritionals. The vision of Ross products is to be the worldwide leader in providing excellent services to their customers. This firm mainly focuses on four products. The firms collapse was due to the poor forecasting models used and also due to the fact that they were not able to meet their demand at the specified time. Other main factor for their drawback is due to the high work in progress (WIP), long cycle times and poor machine utilization times resulting in high cost. The firm was not able to uphold the number of customers they had due to the increase in cost and gradually over the years the firm kept losing its customers. In order to increase their demands the firm decided to concentrate on important criteria's like reducing the cost of their products, bringing down the number of cycle times and moreover reducing the high (WIP). Moreover, the firm has to focus more on forecasting. A proper forecasting model needs to be implemented to their four major products which will lead to burgeoning of their demands in the future. Simulation test by Arena software was carried out by introducing a model which is used to analyze a plant processing for four sub-products. For routing purposes there are four stations used namely Workstations one to four. The objective of this project is to reduce the overall cost which would be spent on buying new machines and bringing down the under time cost. Furthermore, the most important factor is to complete the job within the stipulated time period and minimize the number of machines used. Process Analyzer was used to obtain the optimum solution.

Index Terms— Cycle Times, Forecasting, Nutritionals, Process Analyzer, Scheduling, Simulation, Work In Progress.

1 Introduction

Our main objective is to perform a detail study on the Ross products with regards to its manufacturing process in various areas such as:

Forecasting – Due to current stock level of the company's products which were insufficient to meet the upcoming demands of the customers, ultimately, resulted in drastic decrease of the profits. This in turn led to customer dissatisfaction and decline of profits.

Production & Utilization – The inefficiency of the firm in predicting the accurate forecasting models and the ignorance of forecasting the demand at the right time lead to their downfall. The utilization of production machines was indeed inadequate.

Inventory –Higher work in progress leads to higher inventory and higher cycle-time. By determining the root cause of the increase in (WIP) we would gradually decrease the average cycle-time and inventory cost.

Scheduling – Scheduling is considered to be a significant factor in assigning jobs and recourses to various employees and placing them in proper shifts. It was due to the improper scheduling of the firm in the areas like not placing the employees at the correct slots and inefficient methodology used for scheduling products resulted in off-putting effect on their overall performance.

2 Ross New STRATEGY

Ross is planning to revise their production and planning strategy by hiring part time engineers to collect, analyze data and identify the best method for forecasting the demand, planning the production based on Bill of Materials (BOM).

2.1 Step One (Data Collection)

The cost information of products and sub-products are collected as shown below on table 1:

Table 1: Cost Information of Products

	Product 1	Product 2	Product 3	Product 4
Regular cost ($/unit)	87	45	35	76
Holding ($/unit/week)	14	10	9	13
Backorder ($/unit/week)	43	28	20	18
Regular Workforce	2	5	5	5
Regular production/worker	20	20	20	30
Under-time Cost	$20/unit			
Hiring Cost	$2,000/worker			
Firing Cost	$1,000/worker			
Constrains	No overtime or subcontracting, holding cost based on ending inventory and beginning inventory is zero			

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Table 2: Cost Information of Sub-Products

	Sub-Product 1	Sub-Product 2	Sub-Product 3	Sub-Product 4
Regular Cost($/unit)	23	22	12	9
Under-time cost	$2/min			
Buy M/c Cost	$2,500/machine			
Resale M/c Cost	$1,250/machine			
Constrains	No overtime or subcontracting allowed, Holding cost based on ending inventory			

2.2 Step Two

2.2.1 Forecasting

Forecasting is the method of predicting the company's future sales demand. There are various approaches used in determining the demand forecast namely,

- Qualitative approach
- Quantitative approach

If the company has a better understanding of the demand, it can prove to be more significant and competitive in the worldwide market. The supplier needs to have the right amount of stock and this can be done only when there is enough knowledge of fluctuation of demand in the future. There is also a possibility of decrease in sales, when there insufficient supply of goods due to the underestimation of demand in the future. On the other hand when the demand is overestimated, this can lead to excess storage of stock resulting in financial drain. The method that we used to build the forecasting models is as follows:

Table 3: Forecasting Methods for each Product

Product	Method
Product 1	Moving Average
Product 2	Seasonal Model With Trend Adjustment
Product 3	Linear Regression
Product 4	Exponential Smoothing

2.2.2 Production Planning

The major concerns of production planning are to reduce the work in progress, determine the forecasting methods which are optimal and efficient, and finding the bottlenecks. When a firm is able to use their resources in an efficient way it means, that, they are performing well in their production planning department. A company plans its production either in long term, medium term or short term. Production planning in long term mainly focuses on increasing the capacity after various decisions taken by the firm. In case of medium term the company mainly focuses on hiring or firing employees and making adjustments in increasing inventory.

The evaluation of products is carried out using two different production plans to minimize cost and time:

- **Level Policy** – Constant production rate throughout the year
- **Chase Policy** – Producing exactly what is required

In our project we have made use of Material Requirements Planning (MRP) for all the products and sub-products based on the BOM (Bill OF Materials) to produce the forecasted demands.

2.2.3 Capacity Planning

Capacity planning is defined as process in which a company is able to withstand the required demand by having the necessary stock or inventory in hand at the right time. The main goal of capacity planning is to maximize the capacity of the company in terms of increase in efficiency and profitability and minimize the discrepancy such as factor affecting the capacity planning namely ability of the workers, number of workers, production and suppliers. Aggregate planning is one of the popular methods of capacity planning it's responsible for matching the demand with the supply of goods thereby maintaining a tremendous production rates without backlogs.

2.2.4 Scheduling

Scheduling is crucial to the production planning process because by performing scheduling properly a company can improve its efficiency and reduce its cost while maximizing its productivity.

3 Data Analysis & Results

Table 4: Demand Data

History Horizon	Product 1	Product 2	Product 3	Product 4
1	53	232	28	120
2	53	52	45	140
3	48	162	83	146
4	44	62	63	144
5	42	266	71	140
6	50	56	72	156
7	48	186	68	155
8	43	66	85	160
9	46	310	116	165
10	52	64	122	150
11	50	200	126	156
12	47	84	128	165
13	44	325	138	160
14	46	77	152	165
15	48	235	162	170
16	50	88	166	176
17	48	365	178	180
18	44	82	180	186
19	46	265	198	191
20	45	99	208	197

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21	Forecasting Periods
22	
23	
24	
25	

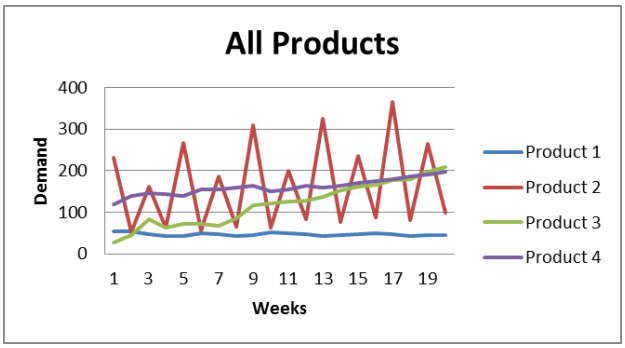

Figure 1: Historical Data for All Products

3.1 Forecasting

The first 10 weeks were used to forecast, and the recent 10 weeks were used to validate the forecast for the next 5 weeks.

Table 5: Forecast Summary

Period	Product 1	Product 2	Product 3	Product 4
21	46.8	387.20	203.90	202.25
22	46.8	85.08	212.20	207.62
23	46.8	274.25	220.50	212.99
24	46.8	103.13	228.79	218.36
25	46.8	411.83	237.09	223.73

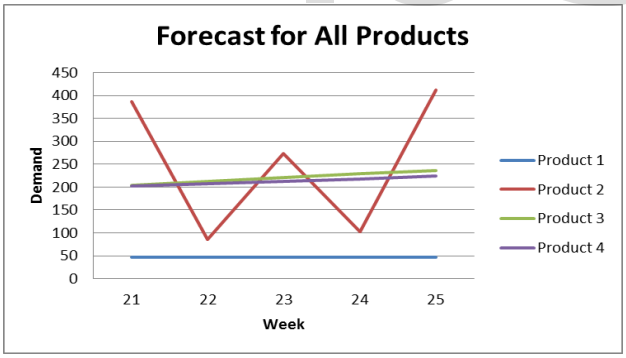

Figure 2: Forecast Summary

3.2 Production Planning

Level Policy and Chase Policy were used for our calculations:

Table 6: Production Plan for each Product

	Product 1	Product 2	Product 3	Product 4
Level Plan Cost	$23,745	$79,415	$55,331	$96,342
Chase Plan Cost	$23,745	$159,025	$53,775	$96,040
Best Plan	Level or Chase	Level	Chase	Chase

Table 7: Production for the next 5 weeks

	Weeks					Plan
	21	22	23	24	25	
Product 1	47	47	47	47	47	Level Plan
Product 2	253	253	253	253	253	Level Plan
Product 3	204	213	221	229	238	Chase Plan
Product 4	202	208	213	218	224	Chase Plan

3.3 Capacity Planning

After calculating the MPS for each sub-product we started calculating the Capacity:

Table 8: Time Available in every Station

	Time Available (In Next 5 Weeks)				
Station	21	22	23	24	25
1	2194	2194	2194	2194	2194
2	2215	2215	2215	2215	2215
3	2194	2194	2194	2194	2194
4	2215	2215	2215	2215	2215

Table 9: # of Machines Required in every Station

	Number of Machines Required				
Station	21	22	23	24	25
1	20	12	18	15	15
2	21	10	18	12	13
3	18	11	16	13	12
4	21	10	18	14	13

Table 10: # of M/C to Buy and Sell per week

	Number Of Machine Difference ('+' = buy, '-' = sell)				
Station	21	22	23	24	25
1	15	-8	6	-3	0
2	11	-11	8	-6	1
3	13	-7	5	-3	-1
4	11	-11	8	-4	-1
Total Required	50	0	27	0	1
Total Excess	0	37	0	16	-2

Table 11: Total Cost of Machines

	Total Cost				
	21	22	23	24	25
Buy Machine Cost	125000	0	67500	0	2500

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Resale Machine Cost	0	46250	0	20000	2500
Cost For Each Week	$125,000	$46,250	$67,500	$20,000	$5,000
Total Cost	$263,750				

3.4 Scheduling

We add more machines to minimize the total finish time and bring it below 40 hours. Using Process Analyzer Tool we changed the batch size and machine count to minimize the total processing time in order to minimize the total cost. The least utilized machines are removed to bring the total cost down.

3.4.1 Process Analyzer Output

Table 12: Process Analyzer Output

Scenario	# of machines				Batch 1	Batch 2	Batch 3	Batch 4
	M/C 1	M/C 2	M/C 3	M/C 4				
1	20	21	18	21	10	10	5	5
2	13	16	22	15	12	1	1	31
3	13	16	22	15	12	1	10	12
4	12	13	17	12	12	1	10	10

Total Cost for each scenario is as follow:

Table 13: Total Cost for each Scenario

Scenario	Total Processing Time	Buy Machine Cost	Under Time Cost	Total Cost
1	Over 40 hours	---	---	---
2	29.05	90,000	87,481.2	**$177,481**
3	33.22	90,000	58,576.82	**$ 148,577**
4	35.03	80,000	20,503	**$100,503**

Cycle times for each scenario are as follow:

Table 14: Cycle-times for each scenario

Cycle Time (min)				Avg. Cycle-Time (min)
P1	**P2**	**P3**	**P4**	

1237.1	1021.23	1115.35	1750.34	**1281.005**
1423.72	1139.31	1141.46	1734.22	**1359.67**
1508.62	1368.43	1186.37	1973.05	**1509.118**

4 Conclusion

After the analysis and calculation, scenario four reflects the best result in terms of cost efficacy. On the other hand, scenario one will result in a shorter cycle-time but higher cost. The managers at Ross have to decide what will yield a higher customer satisfaction and will keep the company profitable.