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Operation Management Techniques & Applications in Bangladeshi Industry

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Abstract

In developed countries, most of the industries use appropriate operation management techniques in production system. This is quite obvious that they posses high technology, skilled resources, and adequate raw materials. Unfortunately, Bangladesh has lack of high technology production plants and skilled manpower. Applying operation management techniques to improve production performance and limited resource and manpower utilization is one of the core techniques to overcome such issues. Previously, many attempts have been made to apply improvement techniques in various manufacturing industries. Under these circumstances, choosing the suitable operation management methods is quite important. In this paper, different operation techniques like, forecasting, inventory management techniques, aggregate planning, scheduling, CRP, MRP, ERP, time study, method study, work study and linear programming methods with applications in different manufacturing organizations are discussed. Findings suggest that forecasting techniques have been applied more frequently in recent times compare to twenty years ago. But forecasting accuracy has not improved much. The goal of aggregate planning is to achieve effective production planning with strategic decision and applications wherever, the effectiveness of using inventory management and scheduling is more important to run an optimal production system. All of these techniques can be used to improve production processes and can be benefited by using effectively and efficiently. Therefore, an attempt has been made to discuss appropriate use of operation management techniques and their applications in Bangladeshi industry.

Keywords: *Forecasting, Scheduling, Inventory management, Time study, Aggregate planning.*

1. Introduction

The economic environment of our country is very poor because of our industries have limited resources, raw materials, energy and technology. Moreover we have lack of knowledge on process improvement techniques, operation management techniques i.e., forecasting, inventory management, aggregate planning, MRP, CRP, scheduling, time study etc. whichare very necessary for effective productivity, increased efficiency. Many of our industries such as Garments, Textile, Automobile, chemical, Cement industries can boost up our economy and industrial sectors by applying these techniques. If manufacturing companies can potentially apply and get benefitted by these techniques, our industrial as well as service sectors will definitely have great impact on our economy as well as all over the world.

2. Background& Methodology

It has observed from previous statistics that Bangladeshi industries had changed a huge amount of its production capabilities compare to 20 years ago. Bangladesh has great opportunities to develop in industrial sector because of her sufficient amount of natural resources, available land and cheap labor. The key objective of this paper is to discuss the operation management techniques to industrial and related personnel in Bangladeshi industries. The major concern of this paper is to find suitable techniques for recent production problems and others activities of production system.We demonstrate the application of various techniques approach that how the use of operation management techniques could increase smoothproduction and profit line with optimum cost. This paper consists of some

necessary techniques, their purposes, scopes and opportunities in respect to our Bangladeshi industries. Information and data are collected from native source like,Meghna cement industry, Akiz Group, Navana Battery Ltd, BRAC Aarong, Epyllion Group etc. Beside the Industry sources, foreign journals and books are usedto solve some problems with examples.

3. Operation Management Techniques, scopes & applications

Operation management is a vast area in Industrial and Production Engineering where a large number of operation management techniques are used. This section will describe the nature and scope of operation management techniques and will present the issues of competition, strategy and productivity.

Forecasting

Forecast is an estimate of a production system that will happen in future. Forecasting is the process of estimating future demand in terms of the finance, timing, quantity, quality, and location for the desired products and service. An essential aspect of managing any organization is planning for the future. Organizations employ forecasting techniques to determine future inventory, costs, capacities, and interest rate changes.

Oppertunities & scopes

Forecasting is the powerful technique of making statements about future planning on production whose actual outcomes (typically) have not yet been observed. But it possible to meet the demand forecast. Some reputed industries applied this technique for future prediction. The key in forecasting nowadays is to understand the different forecasting methods and their relative merits and so be able to choose which method to apply. Defining a problem, products sales for a manufacturing company over the last 10 weeks are shown in Table 1, analyzed the data to see that linear trend equation is followed here. Calculation has followed trend line equation as well as predicted sales for 11 and 12 weeks.

Table 1. Forecasting data

Week(x)	Demand (y)	x*y	x^2
1	700	700	1
2	724	1448	4
3	720	2160	9
4	728	2912	16
5	740	3700	25
6	742	4452	36
7	758	5306	49
8	750	6000	64
9	770	6930	81
10	775	7750	100
∑x=55	∑y=7407	∑xy=41358	$\sum x^2$=385

Following the above values, a and b values have been calculated using following equations:

$$b = \frac{n(\sum xy)-(\sum x)(\sum y)}{n\sum x^2-(\sum x)^2} = \frac{10(41358)-55(7407)}{10(385)-55(55)} = 7.51$$

$$a = \frac{\sum y - b\sum x}{n} = \frac{7407-7.51(55)}{10} = 699.40$$

Following regression forecasting while the line equation is Y = a + b*x where, y=dependent variable, x=independent variable, a=intercept,b= the slope of the data line. For this problem, the regression line: y_x = 699.40 + 7.51*x. Now calculating the forecasted value of 11 and 12 periods,
F_{11}=699.40 + 7.51(11) =782.01
F_{12}=699.40 + 7.51(12)=789.52

Following different forecasting techniques, we can calculate future demand, lead time and quality of different product. This can be benefitted to increase productivity, scheduling, planning and production capacity estimation.

Aggregate production plan

Aggregate planning is an operational activity that does an aggregate plan for the production process in advance time to gain idea for management as to what quantity of materials and other resources are to be procured. For this reason, the total cost of operations of the organization is kept within budget over that period. It also determines the quantity and timing of resources that are required to match immediate periodic demand for all products. The aggregate planning usually helps to fulfill future demand by introducing modifications in the work force levels, overtime, vacation schedules, labor level, inventory levels, subcontracting, overtime, under time, and planned backlogs. Different strategies and techniques are used to balance the productivity. For example, the trial and error charting and graphic technique is easy to understand this technique that is also convenient to use and involves costing out various aggregate planning alternatives and selecting the optimum one for the production capacity.

Table 2. Summary of cost of alternating plan

Cost category	Pure chase strategy	Pure level strategy	Mixed strategy (mixed strategy work force=chase strategy work force)
Regular production	$340,296	$361,500	$347,147
Overtime production	$10,132	-	$9,600
Subcontracted production	$91,200	-	$73,960
Under time	$16,656	-	-
Inventory holding/ shortage	-	-	$11,420
Hiring / firing	$29,350	$1,514	$29,350
Total cost	$472,534	$560,453	$471,459

Scopes and Opportunity

Now a day, aggregate planning is significantly used in Garments, textile Industries, ceramics industry where Labor, Inventory levels, Overtime work, Subcontracting and Other controllable variables are utilized effectively. Various Automobile Industries i.e.,Aftab Automobiles Limited,Navana Group etc. usually apply pure strategies of aggregate planning. Companies can be benefitted by utilizing their capacity effectively (labor, plant, equipment etc.) through aggregate production plan.

Master production schedule

A master production schedule (MPS) is a plan for individual commodities to produce in each time period such as production, staffing, inventory.It is usually linked to production and manufacturing where the plan indicates when and how much of each product will be demanded.

Table 3. Customer order and MPS

Period	1	2	3	4
Customer orders	80	50	30	10

Period	(A) Inventory from previous period	(B) Requirements	(C=A-B) net inventory before MPS	MPS	(MPS+C) projected inventory
1	0	80	(80)	100	20
2	20	70	(50)	100	50
3	50	70	(20)	100	80
4	80	70	10	0	10

Starting Inventory =0	1	2	3	4
Forecast	70	70	70	70
Customer orders	80	50	30	10
Projected on-hand	20	50	80	10
MPS	100	100	100	0
ATP	20	50	60	0

This plan quantifies significant processes, parts, and other resources in order to optimize production cost, to identify bottlenecks, and to anticipate needs and completed goods. Since an MPS drives factory production activities, the accuracy and viability of using this technique dramatically affect profitability of the organization.

Typical MPS's are created by software with user tweaking.A typical MPS example is shown in Table 3. The forecast for each period is 70 units. The starting inventory is zero. The MPS rule is to schedule production if the projected inventory on hand is negative. The production lot size is 100 units.

Scopes and Opportunity

MPS is a business process design tool to balance and supply and in our country usually textile and clothing industries are benefitted by this technique. Demand management, material requirement planning, plant scheduling, supplier scheduling, financial planning activities are managed by this scheduling process. AbulKhair Group, Advanced Chemical Industries (ACI) etc. industry applying this to control their optimum production rate and productivity.

Time study

Time study is a work measurement technique for recording the time of performing a certain specific job or its element carried out under specific condition. Devices for example, stop watch ,taco meter, electronic timer are required for time study along with different other documents like, observation sheet ,observation board, job order or labor reporting data. Normally the cycle time is calculated for a certain work or task for further calculation of standard work time. An example is shown here.

Table 4. Normal and standard time calculation

Element No.	Cycle Time (min)				Avg. Cycle Time	Performance Rating	Normal Time
1	1.5	1.5	1.3	1.4	1.425	110%	1.568
2	2.6	2.7	2.4	2.6	2.575	110%	3.325
3	3.3	3.2	3.4	3.4	3.325	110%	3.658
4	1.2	1.2	1.1	1.2	1.175	110%	1.175
5	0.51	0.51	0.52	0.40	0.505	110%	0.555

PFD Allowance =15%
Normal time for the cycle = 1.568+3.325+3.658+1.175+0.555 = 9.531
Standard time = (9.531 + (0.15*9.531)) = 10.484 min

Opportunities of time study

Time study can eliminate insignificant task and nonproductive activities. It combines the sequence and layout of production and has been increased machine effectiveness. Scheduling and planning are properly maintained to determine the effective time. For that purposes reduces all type of timing waste, waiting time, processing waste, machine downtime. Time study can eventually increase performance or productivity that reduces all process waste or bottlenecks throughout the production. Batch or mass type production process normally follow the time study technique and can be benefitted.

Capacity Requirement Planning (CRP)

Capacity requirement planning is the process of determining the short term capacity requirements from MRP output. It is the process to give some necessary information to organizations on when planned order released, the current shop load, routing information job time and load report each work center. When variances are projected, the organization manager remedies such as alternating routing, changing or eliminating work size. CRP is the powerful technique that control plant capacity, changing demand, level production schedule; manage scheduling conflictsof an industry.

Table 5. CRP data for three departments

Process characteristics	Department		
	Grid casting	Pasting	Filling
Working hours per day	8	8	8
Processing time per battery, min	15	10	20
Average daily downtime, min	80	90	40
Average daily setup time, min	16	30	8
Defective time,%	6	4	9

Features and Benefits

CRP is the procedure that determines in detail the amount of labor and machinery resources required to accomplish the tasks of an operationplan. This tool is currently used widely in garment and textile industry. Beside that, food and beverage industry such as, Fu-Wang Group, Akiz Group of Industries and Automobile industry are also utilizing this technique to determine the amount of labors, number of equipment, machine efficiency, and production rate. Considering an example,Navana Battery Ltd. has signed a contract with Grameen Shakti for the delivery of 300 parts per year.Each battery is processed in three departments respectively grid casting, pasting, and filling shown in Table 5. The company operates 300days/yr.

Determination ofefficiency, (E) for each of the production stage,

Grid stage: $E_1 = 1 - \frac{DT-ST}{D} = 1 - \frac{80+16}{60*8} = 0.80$
Pasting stage: $E_2 = 1 - \frac{DT-ST}{D} = 1 - \frac{90+30}{60*8} = 0.75$
Filling stage: $E_1 = 1 - \frac{DT-ST}{D} = 1 - \frac{40+8}{60*8} = 0.90$

Determination of production rate (P) per stage,

Final demand, $P_{g.3}$=300 units/ yr.
Filling stage: $P_3 = \frac{Pg.3}{1-P}$ = 300/ (1-0.09) =329.67≈330 units
Pasting stage: $P_2 = \frac{Pg.2}{1-P}$ = 330/ (1-0.04) =343.75≈344 units
Grid stage: $P_1 = \frac{Pg.1}{1-P}$ = 344/ (1-0.06) =365.95≈366 units

Determination of equipment requirement(N):

Grid stage: $N_1 = \frac{T1}{60} * \frac{P1}{D*E1} = \frac{15*366}{60*8*.80}$ =14.3≈15 m/c
Pasting stage: $N_2 = \frac{T2}{60} * \frac{P2}{D*E2} = \frac{10*344}{60*8*0.75}$ =9.55≈10 m/c
Filling stage: $N_3 = \frac{T3}{60} * \frac{P3}{D*E3} = \frac{20*330}{60*8*0.90}$ =15.30≈16 m/c

Inventory Management

An inventory is a stock or store of goods. Manufacturing firm uses inventory management techniques to store raw materials, purchased parts, finished goods, machines, tools, and other supplies. Conventional inventory management follows different tools such as, ABC Analysis, EOQ, EPQ, Discount quantity, safety sock to determine the inventory costs that more important for every industry.

Scopes and Opportunity

Inventory management is an important technique of determining the quantity of products has stored, order cycle, length of order cycle, number of orders per years and annual total cost. It also determines the inventory cost and save a huge amount of money. For example, as a local distributor for automobile company expected to sell approximately 9,600 steel-belted radial tires of a certain size and tread design next year. Annual carrying cost is $16 per tire, ordering cost is $ 75. The distributor operates 288 days a year.

So, economic order quantity, $Q = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2(9600)75}{16}}$ =300 tires
Where H= Holding cost, S= Ordering cost, Q= Ordering quantity.

Then, number of order cycle: $D/Q = \frac{9600\ tires}{300\ tires}$ =32, Length of the order cycle = Q/D =300/9600=$\frac{1}{32}$ *288 =9 works day.
Total cost = holding cost + ordering cost= $(\frac{Q}{2})$*H + $(\frac{D}{Q})$ *S= (300/2)*16 + (9600/300)*75= 2400+2400=$4800.

4. Results & Discussions

The above discussion implies that a large number of manufacturing industries follow different operations management techniques and tools. The tools can improve productivity, efficiency and performance of the production and operation of the industry. An overview of different operation management techniques related to different manufacturing sectors and areas are listed in Table 6.

Table 6. Potential operation management techniques related to manufacturing sectors

Manufacturing sectors	Operation Management Techniques
1. Jute,cotton, textile and leather industries I. Cotton textile II. Jute textile III. Garments IV. Leather	a. Forecasting b. Aggregate production planning c. Inventory management
2.Manufacturing of food, beverage and tobacco industries. I. Tea and Sugar II. Soft drink III. Tobacco IV. Vegetable oil and soya-bean V. Flour milling.	a. Time study b. Method study c. Work study d. Supply chain management
3. Chemical, fertilizer, petroleum and rubber industries. I. Fertilizer II. Pharmaceuticals III. Insecticides IV. Paint and varnish V. Matches VI. Petroleum VII. Rubber footwear.	a. Linear Programming. b. Inventory Management. c. Transportation model.
4. Non metallic industry I. Glass industry II. Ceramics industry III. Cement industry	a. Material Requirement Planning. b. Forecasting.
5. Metallic industry I. Auto-mobile industry II. Furniture industry	a. Capacity Requirement Planning. b. Forecasting. c. Master Production Schedule(MPS)

5. Limitations &conclusion

Appropriate application and of different operation management techniques has become a major challenge in competitive industrial sectors. Although we have available human resources, we are running behind because of scarcity of skilled and technical human skill. From top management to worker, we have lack of knowledge on operation management techniques, improvement skills. It is recommended that to achieve the best possible output from operation management techniques; technical skill, human skill and conceptual skill must be employed in production and operation in manufacturing industry. By this, Bangladeshi industry can increased their productivity and efficiency.

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