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A Method Study on Implementation of Material Requirement Planning (MRP-I) in Sample Bicycle Manufacturing Industry

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Abstract:- Scheduling is the process that refers to establishing the timing and use of resources involved in various operations within the organization. It relates to efficient use of equipment and facility, human resources and materials. The problems faced due to absence of scheduling in an organization are staff turnover, employee availability, covering of unusual periods of activity and so on. This paper highlights the problems an organization faces due to absence or low quality scheduling and how to overcome these. Michael J Brusco has subsequently developed a new heuristic based search on the simulated annealing algorithm, which was to generate integer personnel schedules in continuously operating organizations. The baseline of any business is to achieve profitability and scheduling has major impact on company's profitability. The gaps in scheduling are chaos in operations, loss of credibility, inefficient workflows and increased costs. The main aim of this work is to nullify the gaps using scheduling tools and techniques and also to improve the revenue of the organization. The data used for this analysis are primary data which were collected through interviews and surveys. This analysis will help in identifying the next level schedule in an organization. This analysis will help in taking scheduling in an organization to next level.

Keywords:- *Staff Turnover, Annealing Algorithm and Gaps.*

I. INTRODUCTION

Scheduling is the process of arranging, controlling and optimizing the work and workloads in a production process. It pertains to establish both the time and use of resources within an organization. Under the operations function namely manufacturing and services, scheduling relates to use of equipment and facilities, the scheduling of human activities, and receipt of materials. Allocation of the above parameters along with the inventory management using forward and backward scheduling is done here. The supervision of non-capitalized assets and stock items is major part in operations which is handled by inventory management. Inventory management includes controlling and overseeing of ordering inventory, storage of inventory and controlling the amount of product ready for sale. So we focus on inventory management which assists in managing inventory increase efficiency and productivity in operations.

The inventory management is analyzed using Material Requirement Planning also known as MRP-I. It is a system used for calculating the various materials and components required for manufacturing a product. It consists of three phases namely: taking inventory of the materials and components on hand, identifying additional ones are needed and then scheduling their production or purchase. It refers to the basic calculations used to determine component requirement from end product manufacturing.

II. EXISTING PROBLEMS

A. Excess Inventory

Excess inventory occurs when inaccurate orders are made which leads to storage problems and also prevents from offering better products to customers.

B. Failure to Keep Track of Stock

Tracking inventory with infrequent checks or using manual process is not enough to manage the supply chain. Failing to keep close track of stock movement causes accounting errors, resulting in added costs for the organization.

C. Difficulty in Identifying Demand Patterns

Changing demand can also be one of the biggest challenges of SMBs, especially with ever-increasing and changing product portfolios.

D. Low Product Turnover

Failure in tracking demand leads to a reduced product turnover due to fall in demand. Lower turnover leads to excess inventory that result in requirement for bigger space in warehouse and increase in capital.

III. PURPOSE OF ANALYSIS

This analysis is used to determine the quantity, components and sub components requirement to keep priorities updated for the production process through Material Requirement Planning.

A. Scheduling & Planning

The main objective of this analysis is to ensure planning of all manufacturing processes, this scheduling of different job works or part production or purchase will minimize or remove any kind of idle time for machine and workers.

B. Inventory Management

Ensure the availability materials at the moment's notice. This eliminates the need for manual processing and it is also able to carry out material orders with ease.

C. Maintaining Priorities

It is used to keep priorities updated and valid. MRP System is used to respond to the changes taking place in the daily environment, to reorganize priorities and also to keep plans current and viable.

D. Determine the Quantity and Timing of Material Requirements

MRP is used to determine what to order, how much to order, when to order and when to schedule delivery.

E. Cost Reduction

In correlation with inventory management, cost is reduced significantly through a steady flow of inventory, holding and reduced untimely delivery cost and ultimately brining more revenue into the operation.

F. Production Optimization

Material flow throughout the supply chain, equipment and employees are able to work at a much faster and efficient rate.

IV. MRP-I SYSTEM

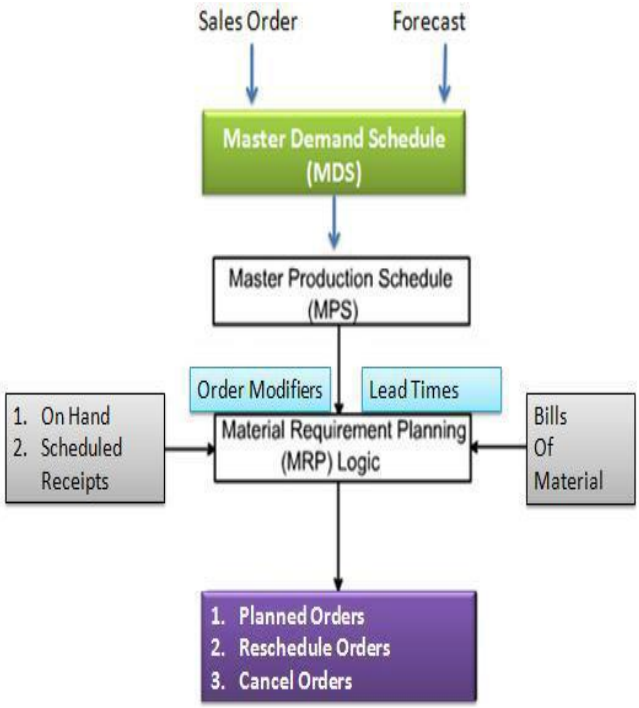

Fig 1:- MRP-I Systematic Diagram

A. Bill of Material

MRP systems are dependent on identifying the components, their interrelationships and the accurate quantities for production planning. Bill of Material is necessary for the system to be effective. MRP systems ensure that the Bill of Material is correct.

The bill of materials explains what, how, and where to buy the required materials, and also includes instructions for how to assemble the product from the various parts ordered. All manufacturers who are building products, regardless of their industry, always get started by creating a bill of materials.

This is because the bill of material pulls together all sorts of product information that it has on several disciplines such as design and engineering, document control, operations, manufacturing, purchasing and contract manufacturer will consume data contained within the BOM record to get the job done right. In fact, engineers and manufactures of industry rely so heavily on special subsets called the engineering bill of materials (EBOM) and the manufacturing bill of materials (MBOM). Business activities like parts sourcing, outsourcing and manufacturing are the main needs for executing BOM and so it is important to create a BOM that is well organized, correct and up-to-date.

B. Master Production Schedule

It specifies the quantities and times when products are needed and thereby dictates when all the contributory production activities should happen. The master production schedule also commonly referred to as the MPS is effectively the plan that the company develops for production, staffing, inventory, etc.

It has variety inputs of such as data, e.g. forecast demand, production costs, inventory costs, etc and as output a production plan detailing amounts to be produced, staffing levels, etc for each of a number of time periods.

This production plan,

- Operates at an aggregate level.
- It is cost driven and attempts to meet the specified requirements at minimum cost.

V. ANALYSIS AND INTERPRETATION

We conducted this analysis in bicycle manufacturing industry. The below data is obtained from one of the leading bicycle manufacturing company in India. Based on that data's we performed our analysis with the aid of tool like MRP-I. We solved out the listed problems that helps by means of minimizing the cost of production and time, maximizing inventory utilization.

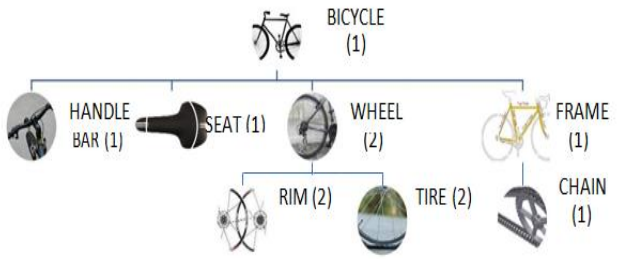

Fig 2:- Product Structure

Parts	Order Quantity (Units)	Lead Time (Month)	Inventory on Hand (Units)
BICYCLE	3276	1	4277
HANDLE BAR	6760	1	3892
SEAT	6687	1	4042
WHEEL	8089	2	10,852
RIM	15,107	2	5874
TIRE	15,928	2	1036
FRAME	3276	1	2275
CHAIN	3433	2	4032

Table 1:- Bill of Material

A. Bicycle

Inventory on Hand = 3276 units, Order Quantity = 4277 units, Lead Time = 1 month, Pre Order: Order place on December (previous year) of 4277 units, to be delivered in 1st month (January).

Month	January	February	March	April	May	June
Demand	6259	4166	4043	-	5259	4216
Receipt	4277	4277	4277	-	4277	4277
Inventory on Hand	3276	1304	1415	1649	1649	667
Planned Order Release	4277	4277	-	4277	4277	-
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	-	4259	4166	-	4166	-
Receipt	-	4277	4277	-	4277	-
Inventory on Hand	728	728	746	857	857	968
Planned Order Release	4277	4277	-	4277	-	-

Fig 3:- MRP Calculation of Bicycle

B. Handle bar

Inventory on Hand = 6760 units, Order Quantity = 3892 units, Lead Time = 1 month, Pre Order: None

Month	January	February	March	April	May	June
Demand	4277	4277	-	4277	4277	-
Receipt	-	3892	-	3892	3892	-
Inventory on Hand	6760	2483	2098	1713	1328	1328
Planned Order Release	3892	-	3892	3892	-	3892
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	4277	4277	-	4277	-	-
Receipt	3892	3892	-	3892	-	-
Inventory on Hand	1328	943	558	558	173	173
Planned Order Release	3892	-	3892	-	-	-

Fig 4:- MRP Calculation of Handle Bar

C. Seat

Inventory on Hand = 6687 units, Order Quantity = 4042 units, Lead Time = 1 month, Pre Order: None

Month	January	February	March	April	May	June
DEMAND	4277	4277	-	4277	4277	-
RECEIPT	-	4042	-	4042	4042	-
Inventory on Hand	6687	2410	2175	2175	1940	1940
Planned Order Release	4042	-	4042	4042	-	4042
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	4277	4277	-	4277	-	-
Receipt	4042	4042	-	4042	-	-
Inventory on Hand	1940	1705	1705	1705	1470	1470
Planned Order Release	4042	-	4042	-	-	-

Fig 5:- MRP Calculation of Seat

D. Wheel (2)

Inventory on Hand = 10,852 units, Order Quantity = 8059 units, Lead Time = 2 month

Pre Order: Order place on December (previous year) of 8089 units, to be delivered in 2nd month (February).

Month	January	February	March	April	May	June
Demand	8554	8554	-	8554	8554	-
Receipt	-	8089	-	-	8089	-
Inventory on Hand	10,852	10,852	10,387	10,387	1833	1833
Planned Order Release	-	-	8089	-	8089	8089
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	8554	8554	-	8554	-	-
Receipt	8089	8089	-	8089	-	-
Inventory on Hand	1833	1368	903	903	438	438
Planned Order Release	-	8089	-	-	-	-

Fig 6:- MRP Calculation of Wheel

E. Rim (2)

Inventory on Hand = 5874 units, Order Quantity = 15,107 units, Lead Time = 2 month, Pre Order: None

Month	January	February	March	April	May	June
Demand	-	-	16,178	-	16,178	16,178
Receipt	-	-	15,107	-	15,107	15,107
Inventory on Hand	5874	5874	5874	4803	4803	3732
Planned Order Release	15,107	-	15,107	15,107	-	15,107
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	-	16,178	-	-	-	-
Receipt	-	15,107	-	-	-	-
Inventory on Hand	2661	2661	1590	1590	1590	1590
Planned Order Release	-	-	-	-	-	-

Fig:- 7 MRP Calculation of Rim

F. Tire (2)

Inventory on Hand = 1136 units, Order Quantity = 15928 units, Lead Time = 2 month, Pre Order: None

Month	January	February	March	April	May	June
Demand	-	-	16,178	-	16,178	16,178
Receipt	-	-	15,928	-	15,928	15,928
Inventory on Hand	1136	1136	1136	886	886	636
Planned Order Release	15,928	-	15,928	15,928	-	15,928
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	-	16,178	-	-	-	-
Receipt	-	15,928	-	-	-	-
Inventory on Hand	386	386	136	136	136	136
Planned Order Release	-	-	-	-	-	-

Fig 8:- MRP Calculation of Tire

G. Frame

Inventory on Hand = 2275 units, Order Quantity = 3276 units, Lead Time = 1 month, Pre Order: None

Month	January	February	March	April	May	June
Demand	4277	4277	-	4277	4277	-
Receipt	-	3276	-	3276	6552	-
Inventory on Hand	2275	1274	1274	273	2548	2548
Planned Order Release	3276	-	3276	6552	-	3276
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	4277	4277	-	4277	-	-
Receipt	3276	3276	-	6552	-	-
Inventory on Hand	1547	546	546	2801	2801	2801
Planned Order Release	3276	-	6552	-	-	-

Fig 9:- MRP Calculation of Frame

H. Chain

Inventory on Hand = 4032 units, Order Quantity = 3433 units, Lead Time = 2 month, Pre Order: None

Month	January	February	March	April	May	June
Demand	3276	-	3276	6552	-	3276
Receipt	-	-	3433	6866	-	3433
Inventory on Hand	4032	756	756	913	1227	1227
Planned Order Release	3433	6866	-	3433	3433	-
Month	**July**	**August**	**September**	**October**	**November**	**December**
Demand	3276	-	6552	-	-	-
Receipt	3433	-	6866	-	-	-
Inventory on Hand	1384	1541	1541	1855	1855	1855
Planned Order Release	6866	-	-	-	-	-

Fig 10:- MRP Calculation of Chain

I. Observation

December								
November								
October	↘							
September		↘	↘				↘	
August				↘				
July	↘	↘	↘				↘	↘
June	↘	↘	↘	↘	↘	↘	↘	
May				↘				↘
April	↘	↘	↘		↘	↘	↘	↘
March	↘	↘	↘	↘	↘	↘	↘	
February								↘
January	↘	↘	↘		↘	↘	↘	↘
order quant	3276	6760	6687	8089	15107	15928	3276	3433
Parts	BICYCLE	HANDLE BAR	SEAT	WHEEL	RIM	TIRE	FRAME	CHAIN

Fig 11:- Observation table (which month, what to order and how much to order)

VI. CONCLUSION

Using MRP-I calculation the inventory scheduling is calculated and planned on what quantity must be ordered every month based on the availability of material in hand and requirement. This calculation will help to increase the profitability of company by means of decreasing the capital cost in production of bicycles. It helps to maintain the safety stock level for the purpose of round the clock productions. This schedule planning method helps to place the order of sub components and manage inventory effectively. It can also be used to manage the inventory cost and purchasing cost effectively. This will also help in making a better decision in manufacturing of bicycles.

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