Optimization of Material Requirements Planning (Case Study: Oil Companies of ETKA Organization)

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Abstract: Material Requirements Planning is a commonly accepted approach for replenishment planning in major companies. Material requirement planning systems help manufactures determine precisely when and how much material to purchase and process based upon a time-phased analysis of sales orders, production orders, current inventory and forecasts. Purpose this paper is Optimization of Material Requirements Planning in Oil Companies of ETKA Organization. Other objectives of this paper are: To minimize excess material needed in store, Prevent shortages of raw materials, Timely delivery of products to sell in accordance with market demand, Reduce and minimize production stoppages, Prevent immediate purchases, Reduce costs and ultimately increase profits.
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1. Introduction

MRP was formed as an approach of production planning and management. Orlicky (1975) introduced this system in a help book in 1975. The introduced MRP was the first version of MRP system, named as Materials Requirements Planning (MRP I). Later, several MRP systems were extended into other versions including Manufacturing Resources Planning (MRP II) and Enterprise Resources Planning (ERP) (Browne et al., 1996). Material requirement planning systems help manufactures determine precisely when and how much material to purchase and process based upon a time-phased analysis of sales orders, production orders, current inventory and forecasts. They ensure that firms will always have sufficient inventory to meet production demands, but not more than necessary at any given time.MRP will even schedule purchase orders and/or production orders for Just-in-time receipt. The MPS can also include product forecasts, which may be calculated automatically using data from sales or production history. In manufacturing environments with complex product structures and multiple production stages, material requirements planning (MRP) systems are the most commonly used for production planning and material supply decision making.

Van Donselaar and Gubbels (2002) compare MRP and line requirements planning (LRP) for planning orders. Their research basically focuses on minimizing the system inventory and system nervousness. They also discuss and propose LRP technique to achieve their goals. Many authors (Baker, 1993; Thomas and McClain, 1993; Silver et al. 1998) have presented lot-sizing models for multistage MRP systems. However, these have been simpler than the model now. In MRP systems, the master production schedule (MPS) represents a plan for the production of all end-items over a given planning horizon. It specifies how much of each end-item will be produced in each planning period, so that future component production requirements and materials purchases can be calculated using MRP component- explosion logic. As such, the MPS has to be feasible so that components can be produced within the capacity available in each time period.

Material Requirements Planning (MRP) is a commonly accepted approach for replenishment planning in major companies. The MRP-based software tools are accepted readily. Most industrial decision makers are familiar with their use. The practical aspect of MRP lies in the fact that this is based on comprehensible rules, and provides cognitive support, as well as a powerful information system for decision making. Some instructive presentations of this approach can be found in Baker (1993), Zipkin (2000), Tempelmeier (2006), Dolgui and Proth (2010) and Graves (2011). Nevertheless, MRP is based on the supposition that both demand and lead time are deterministic. However, most production systems are stochastic.

2. Research background

Yenisey (2006) applied a flow-network model and solved a linear programming method for MRP problems that minimized the total cost of the MRP system. Mula et al. (2006) provided a new linear programming model for medium-term production planning in a capacity-constrained MRP with a multiproduct, multilevel, and multi period production system. Their proposed model comprised three fuzzy sub models with flexibility in the objective function, market demand, and capacity of resources. Wilhelm and Som (1998) present an inventory control approach for an assembly system with several types of components. Their model focuses on a single finished product inventory, so the interdependence between inventory levels of different components is once again neglected. Axsäter (2005) considers a multi level assembly system where operation times are independent random variables. The objective is to choose starting times (release dates) for different operations in order to minimize the sum of the expected holding and backlogging costs. The paper (Louly and Dolgui, 2002) considers the case of the objective function minimizing the sum of average holding and backlogging costs. While Louly et al. (2008) study the case when backlogging cost is replaced with a service level constraint. The obtained models for optimal planned lead times represent generalizations of the discrete Newsboy model. Kanet and Sridharan (1998) examined late delivery of raw materials, variations in process lead-times, interoperation move times and queue waiting times in MRP controlled manufacturing environment. To model such environment, they represented demand by inter-arrival time rather than defined from the master production schedule.

Kumar (1989) studies a single period model (one assembly batch) for a multi-component assembly system with stochastic component lead times and a fixed assembly due date and quantity. The problem is to determine the timing of each component order so that the total cost composed of the component holding and product tardiness costs is minimized. Chauhan et al. (2009), presents an interesting single-period model. Their approach considers a punctual fixed demand for one finished product. Multiple types of components are needed to assembly this product. The objective is to determine the ordering time for each component such as to minimize the sum of expected holding and backlogging costs.

Van Donselaar and Gubbels (2002) compare MRP and line requirements planning (LRP) for planning orders. Their research basically focuses on minimizing the system inventory and system nervousness. They also discuss and propose LRP technique to achieve their goals. Minifie and Davies (1990) developed a dynamic MRP controlled manufacturing system simulation model to study the interaction effects of demand and supply uncertainties. These uncertainties were modelled in terms of changes in lot-size, timing, planned orders and policy fence on several system performance measures, namely late deliveries, number of set-ups, ending inventory levels, component shortages and number of exception reports. Billington et al. (1983) suggest a mathematical programming approach for scheduling capacity constrained MRP systems. They propose a discrete-time, mixed-integer linear programming formulation. In order to reduce the number of variables, and thus the problem size, they introduce the idea of product structure compression.

3. Materials Requirements Planning for Company No. 1

Materials Requirements Planning for Company No. 1 as shown in Table 1.

Table 1. Materials Requirements Planning for Company No. 1

The total number of sheets required for the supply of tins	1296041
The total number of cartons required for production of Various products	1721009
The total number of Bottles required for production of Oil 810 gr	2469136
The total number of Bottles required for production of Oil 900 gr	3888889
The total number of Bottles required for production of Oil 2700 gr	1703704
The amount of granules required for production of Bottles	434604983 (gr)

Table 1 show that in Company No. 1 the total number of sheets required for the supply of tins is 1296041; the total number of cartons required for production of various products is 1721009, the total number of Bottles required for production of Oil 810 gr is 2469136, the total number of Bottles required for production of Oil 900 gr is 3888889, The total number of Bottles required for production of Oil 2700 gr is 1703704 and The amount of granules required for production of Bottles is 434604983 (gr).

4. Materials Requirements Planning for Company No. 2

Materials Requirements Planning for Company No. 2 as shown in Table 2.

Table 2 show that in Company No. 2 the total number of sheets required for the supply of tins is 984550; the total number of cartons required for production of various products is 1351930, the total number of Bottles required for production of Oil 810 gr is 2592593, the total number of Bottles required for production of Oil 900 gr is 2222223, The total number of Bottles required for production of Oil 2700 gr is 1333334 and The amount of granules required for production of Bottles is 333185305 (gr).

Table 2. Materials Requirements Planning for Company No. 2

The total number of sheets required for the supply of tins	984550
The total number of cartons required for production of Various products	1351930
The total number of Bottles required for production of Oil 810 gr	2592593
The total number of Bottles required for production of Oil 900 gr	2222223
The total number of Bottles required for production of Oil 2700 gr	1333334
The amount of granules required for production of Bottles	333185305 (gr)

5. Materials Requirements Planning for Ghanjeh Company

Materials Requirements Planning for Ghanjeh Company as shown in Table 3.

Table 3. Materials Requirements Planning for Ghanjeh Company

The total number of cartons required for production of Various products	668724
The total number of Bottles required for production of Oil 810 gr	7407408
The total number of Bottles required for production of Oil 900 gr	617284
The amount of granules required for production of Bottles	305555580 (gr)

Table 3 show that in Ghanjeh Company the total number of cartons required for production of various products is 668724, the total number of Bottles required for production of Oil 810 gr is 7407408, the total number of Bottles required for production of Oil 900 gr is 617284 and The amount of granules required for production of Bottles is 305555580 (gr).

6. Conclusion

The basic function of MRP system includes inventory control, bill of material processing and elementary scheduling. MRP helps organizations to maintain low inventory levels. It is used to plan manufacturing, purchasing and delivering activities. "Manufacturing organizations, whatever their products, face the same daily practical problem - that customers want products to be available in a shorter time than it takes to make them. This means that some level of planning is required." Companies need to control the types and quantities of materials they purchase, plan which products are to be produced and in what quantities and ensure that they are able to meet current and future customer demand, all at the lowest possible cost. Making a bad decision in any of these areas will make the company lose money. Purpose this paper was Optimization of Material Requirements Planning in Oil Companies of ETKA Organization. The results of this paper are: To minimize excess material needed in store, Prevent shortages of raw materials, Timely delivery of products to sell in accordance with market demand, Reduce and minimize production stoppages, Prevent immediate purchases, Reduce costs and ultimately increase profits. First problem with MRP systems **-** the integrity of the data. If there are any errors in the inventory data, the bill of materials data, or the master production schedule, then the output data will also be incorrect. Data integrity is also affected by inaccurate cycle count adjustments, mistakes in receiving input and shipping output, scrap not reported, waste, damage, box count errors, supplier container count errors, production reporting errors, and system issues Second problem - systems is the requirement that the user specify how long it will take for a factory to make a product from its component parts (assuming they are all available). Additionally, the system design also assumes that this "lead time" in manufacturing will be the same each time the item is made, without regard to quantity being made, or other items being made simultaneously in the factory.

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