

The Conversion Cycle: Review of Material Requirements Planning (MRP)

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Abstract. The purpose of this paper is to determine the planning of raw material requirements using MRP (Material Requirements Planning). The analysis method uses descriptive analysis by performing the MRP stages which are carried out, among others: Making Bill of Materials, Making product structures, Forecasting: quadratic method, cyclical method, linear regression, MPS (Master Planning Schedule), Creating production schemes, Creating Product Structures, Planning Raw Materials, Master production scheduling, Calculation of raw material requirements using the Lot For Lot (LFL) method, Least Unit Cost (LUC) method. Secondary data taken in the company is data on sales and raw materials. Planning for raw materials requires forecasting the next month's sales using the cyclical method. The results of the calculation of raw material planning obtained a monthly production forecast of 7 units of product with an average order time of 3 months. With MRP, companies can better control inventory and delivery times of raw materials, ensuring that materials can arrive at roughly the exact time they are needed in the production process. In addition, by using the MRP method inventory costs are reduced, because with the MRP method a company can control inventory so that there is no excess inventory and delays in delivery of goods.

Keywords: Conversion Cycle; Material Requirements Planning

1 Introduction

Entering the current era of 4.0, the economy is progressing very rapidly and competition among economic actors is also getting tighter. The ability to absorb and use technology in an effort to improve company performance must continue to be improved in order to produce good quality products that are able to compete in the market. Production is the company's core activity which is the main activity. The company's production activities are required to produce quality products and in accordance with consumer desires. To start production, the company requires raw materials to be processed into products that have added value with the best quality. In order for the production system to run on time according to the specified schedule, the company must plan raw materials for a smooth production process. Good management of the production process is needed so that production activities can run smoothly, stable, and better for achieving optimal results. Inventory is a very important subject in the company. If the company lacks material inventory (out of stock) it will result in

obstacles in the production process, which will result in a shortage of merchandise inventory and can lead to customer disappointment. In addition to inventory management, which determines how much inventory there should be, a balance of production factors is also needed to support the smooth running of production activities. The production factors include 5M, namely material (material), machine (machine), method (method), money (capital), and man (human resources). The five factors of production must complement each other and cannot work alone [1].

One of the factors that become the main ingredient in the production process is material, which requires good management so as not to hamper the production process. Therefore, planning for raw material requirements is very important and needs to be considered because the production process is very dependent on the availability of raw materials so that the process continues to run smoothly. In this case the planning of raw material, material requirements must be aligned with all elements of the company such as available capital, conditions of production machines, state of human resources, orders received, and other elements. PT. ABS Raya Rubber Works is engaged in the production of tires, with a fairly high production level and a fairly short order period. So, raw material planning is indispensable necessary to ensure the smooth production process. Uncertainty about demand affects the procurement of raw materials, at PT. ABS Raya Rubber Works often ignores the problem of procuring these raw materials. It can be seen in the limited warehouse conditions and often excess raw materials, resulting in a buildup of raw materials, delays in the procurement of raw materials because there is no schedule for purchasing raw materials. This without realizing the company will cause losses, both in the form of material damage if it is stored for too long and cause problems with costs that should be minimized. All planning activities for raw material requirements at PT. ABS Raya Rubber Works must be determined to improve the company's performance, for that it is determined the planning of raw material requirements using MRP (Material Requirements Planning) which is a leading science in Production Planning and Control [2].

2 Literature Review

2.1 The Operating Cycle Concept

A process in an operating system is a program that is being executed, it is the smallest unit of work that individually has resources scheduled by the operating system. Initially the process is run sequentially or sequentially, a process will be executed until it is finished and then move to the next process. Sequential systems have the disadvantage of low user level or processor utility. Executed processes have five states consisting of: New:

- a) The formation of a process Running
- b) Instructions that are being executed Waiting
- c) The process of waiting for some event to occur Ready
- d) Waiting to be streamed to the processor (processor) Terminated
- e) The process has finished executing [3].

The purpose of the production process is to increase efficiency and effectiveness in product design assignments, supplier interactions, employee management, and customer relations. Production cycle: a series of business activities and related information processing operations that are continuously associated with the manufacture of products.

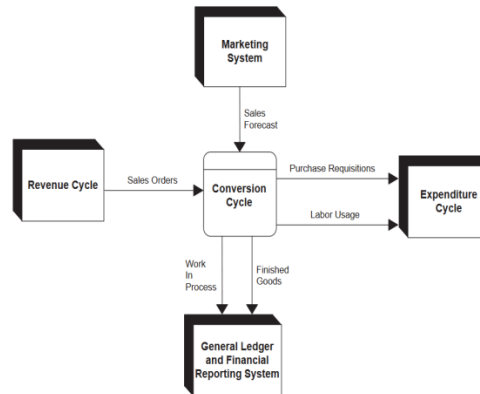


Fig. 1. The Conversion Cycle
Source : Render (2019)

Notice how a production cycle information system integrates both operational and financial data from many sources. The engineering department is responsible for developing product specifications. The engineering department also accesses general ledgers and inventory files for information on sales forecasts and customer orders. The production planning department uses this information plus data on current inventory levels to develop a master production schedule and create new records in the production order file to authorize the production of certain items [4]. When processes enter the system, they are placed in the job queue. This queue consists of all processes in the system. Processes that live in main memory and are ready and waiting to execute are stored in a list called the ready queue [5]. The third step in the production cycle is the actual manufacture of the product. Computer-integrated manufacturing (CIM): a manufacturing approach in which many manufacturing processes are executed and monitored with computerized equipment, partly through the use of robots and the collection of real-time data from manufacturing activities [6]. This is the most common method of production and is used to manufacture products such as automobiles, household appliances, canned goods, automotive tires, and textbooks. The discussion in this chapter is based on a batch processing environment.

2.2 Planning and Controlling Production

Production planning and control can be defined as the process of planning and controlling the flow of materials in, flowing and exiting the production or operating system so that market demand can be met with the right amount, the right delivery time, and minimum production costs. From the definition above, the work contained in the planning and control of production can be broadly distinguished into two interrelated things, namely production planning and production control [7]. Production planning and control is the process of planning and controlling the flow of materials, flowing and exiting the production/operating system so that market demand can be met with the right amount, the right time, and minimum production costs [8]. Production planning is determining or setting organizational goals, and the strategies, project policies, program procedures, methods, systems, budgets and standards needed to achieve their goals [9].

2.3 Material Requirement Planning (MRP)

The right method to do this is Material Requirement Planning (MRP), because it has the benefit of "being used for planning and controlling items (components) that depend on items at a higher level." [10]. MRP will be very helpful if expected in planning the needs of raw materials in the demand of each component depending on the number of final products produced. MRP is a related demand technique that uses a list of material needs, supplies, estimated receipts, and production schedules to determine material needs [11]. Material needs planning (MRP) is a logistics procedure, rules and technique of computing record keeping designed to translate MPS (Master Scheduling) into clean needs for all items. Master planning schedule or production master schedule is a statement of what end products (end items) will be produced in the form of amount and time (when). The function of MPS is [12]:

- a) Schedule the production and purchase of materials for products/items. MPS states when, the number and due date of products must be ordered.
- b) Make input data planning material needs. MPS is spelled out by using a bill of materials to determine the number of material component and assembly needs so that MPS can be met.
- c) As a basis for determining the needs of resources, such as labor, machine clocks, or energy through calculations of rough capacity planning. Since MPS is expressed in product units, capacity planning can be done in more detail.
- d) As a basis for determining the promise of delivery of products to consumers. By allocating the number of product units in scheduling, then control the number of products that cannot be known so that the making of appointments can be estimated more accurately.

There are several understandings of the Material Needs Plan or it can be called Material Requirement Planning (MRP), among others are as follows:

- a) Material Requirement Planning (MRP) is the purchase of goods needed, planned according to the need to make goods [13].
- b) Material Requirement Planning (MRP) is a computerized system of all materials needed in the conversion process of a company, both manufacture business and service business [14].

There are four characteristics that characterize the material requirements plan, namely [15]:

- a) Able to determine the need at the right time. The intent is to determine exactly "when" a work should be completed or "when" the material should be available to meet the demand for the final product planned on the production master schedule.
- b) Form a minimal requirement for each item. With the known need for the finished product, the MRP can precisely determine the scheduling system (based on priority) to meet all the minimum needs of each component item.
- c) Determine the implementation of the booking plan. The intention is to give an indication of when a booking or cancellation of a booking must be made, either a booking obtained from outside or made by yourself.
- d) Determine rescheduling or cancellation of a planned schedule. If the existing capacity is not able to fulfill the scheduled order at the desired time, then the MRP can give an indication to carry out a scheduling plan by determining realistic order priorities.

Each particular system has some limitations, so there are always things that affect the level of difficulty after the system is operated. Five MRP factors that affect the difficulty level of MRP are [16] : (a) Product Structure, (b) Size Lot, (c) Different lead time, (d) Changes to the final product in a plan, (e) Components are general.

3 Methodology

This research method uses qualitative descriptive [17] methods by review articles related to the conversion cycle: review of material requirements planning (MRP). There are plans after the data obtained will be processed from the following methods : (a) Product Structure Creation, (b) *Bill Of Material*, (c) Forecasting. Then the data is analyzed using MRP in its processing using the Lot For Lot method, this simple technique method is used for items that require a fairly expensive storage cost to minimize the cost of storage. Least Unit Cost method, a method that relies on the smallest unit cost can minimize costs because it prioritizes the period of ordering the smallest cost.

4 Result and Discussion

In this section will be analyzed and discussed about the application of MRP in the planning of raw materials in the company. During this time the company does not use the MRP method in planning raw material needs. The company buys or provides raw materials taking into account orders and supplies in the warehouse. The raw material ordering plan is done by calculating the raw material needs of the order that is determined minus the inventory in the warehouse. Ordering raw materials is not good without an early booking schedule. This can result in:

- a) Delays in delivery of raw materials resulting in shortages of supplies
- b) Delay in delivery of finished goods on the buyer's side
- c) There can be an oversupply of raw materials (over stock) that will cause extra costs.

Inputs or inputs used in the calculation of raw materials and raw material schedules include: Master Production Schedule, Bill Of Material, inventory data, and ordering lead time of each component or final production. In its application, the material requirement planning (MRP) method considers the grace period of ordering and the production process of a component. Until when components must be ordered or manufactured can be determined. MRP requires informational data or components as seen in the example image below:

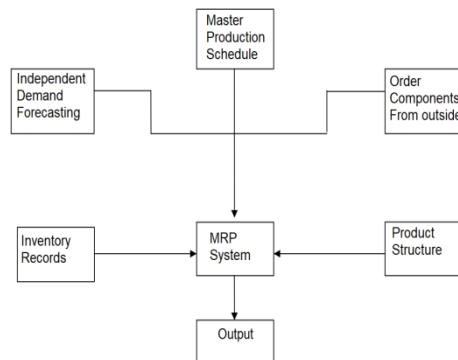


Fig. 2. MRP system

Source : Agrawal, A., Minis, I., & Nagi, R. (2000)

In determining the Master Production Scheduling information is needed regarding the quantity to be produced for some time to come through production planning determined based on product forecasting or orders from consumers, taking into account the production capacity.

In addition to MPS, the MRP method also requires inventory data, both finished goods as well as components and a list of components (Bill of Materials) of a product that will be produced. From the MRP process, information about the number of components or the time of ordering or production of these components will be obtained.

Three main components or inputs of the MRP system:

- a) Master Production Schedule (MPS), MPS is the main product schedule i.e. data that provides information about the schedule of the finished products that must be produced to meet the demand that has been predicted..
- b) Inventory Status Reqord, inventory records are accurate information data and availability of finished goods and components. This data includes the identification number of each component, the number of goods in the warehouse, the amount to be allocated, the minimum inventory level, the components being ordered and the arrival time and procurement period for each component.
- c) Bill of Material, the Bill of Materials is data that contains about the structure of a product that details the components of sub assembling (types, quantities, and specifications) the relationship of an item and its components are shown in a product structure in rank. The final product is referred to as level zero, while the next component is referred to as level one, two, and so on as in the figure below:

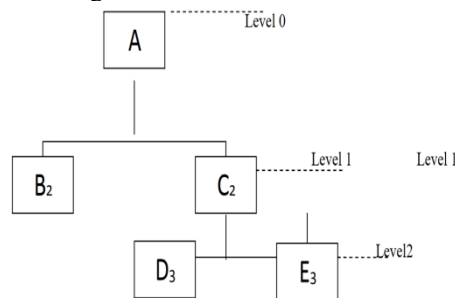


Fig. 3. Product Structure Diagram
Source : Melnyk. et.al (2001)

The relationship between an item and its components is addressed in a product structure in a ranking manner. The final product is referred to as level 0, while the next component is referred to as level 1, 2 and so on. Leveling is used to calculate MRP (material requirement planning) using the POM for windows computer application. The numbers in parentheses indicate the number of components to make one unit of component at its upper level. BOM is a list of the number of components, mixtures of materials, and raw materials needed to make a product [18].

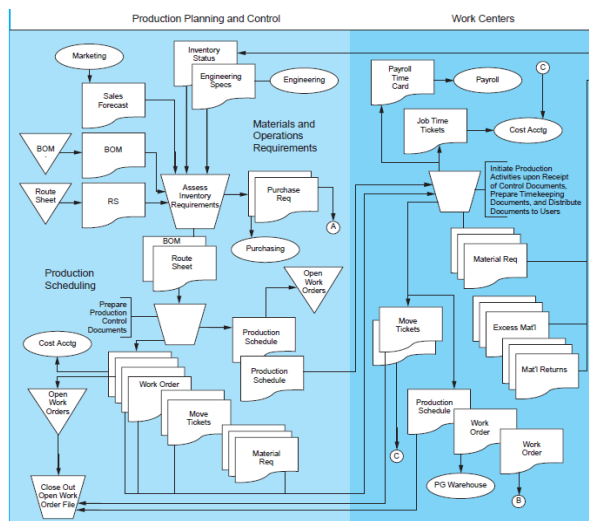


Fig. 4. Cost Accounting Procedures
Source : Rossi, et.al (2017)

- The step in the production cycle is cost accounting. Its aims are:
- Providing information for planning, controlling, and evaluating the performance of production operations.
 - Provide accurate cost data about products for use in pricing and product mix decisions.
 - Collects and processes information used to calculate inventory values and cost of goods sold that appears in the company's financial statements.

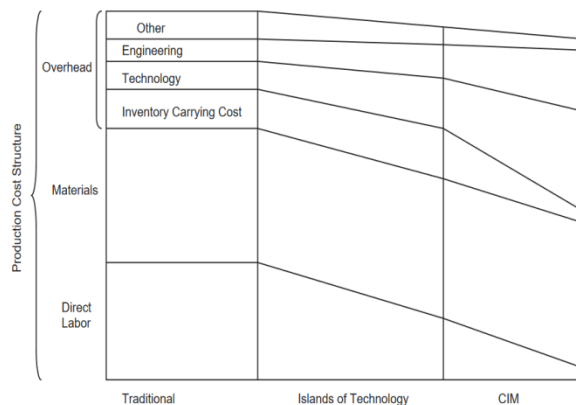


Fig. 5. Changes in Cost Structure between Different Manufacturing Environmen
Source : Hendra Kusuma (2001)

Standard cost data for management reporting are historic in nature. Data lag behind the actual manufacturing activities on the assumption that control can be applied after the fact to correct errors. In a lean setting, however, shop floor managers need immediate information about abnormal deviations. They must know in real time about a machine breakdown or a robot out of control. After-the-fact information is too late to

be useful. Accounting data use dollars as a standard unit of measure for comparing disparate items being evaluated. Decisions pertaining to the functionality of a product or process, improving product quality, and shortening delivery time are, however, not necessarily well served by financial information produced through standard cost techniques. Indeed, attempts to force such data into a common financial measure may distort the problem and promote bad decisions.

5 Results and Discussions

The conversion cycle consists of both physical and information activities related to manufacturing products for sale. The context-level data flow diagram (DFD) the central role of the conversion cycle and its interactions with other business cycles. Production is triggered by customer orders from the revenue cycle and/or by sales forecasts from marketing. These inputs are used to set a production target and prepare a production plan, which drives production activities. Purchase requisitions for the raw materials needed to meet production objectives are sent to the purchases procedures (expenditure cycle), which prepares purchase orders for vendors. Labor used in production is transmitted to the payroll system (expenditure cycle) for payroll processing. Manufacturing costs associated with intermediate work-in-process and finished goods are sent to the general ledger and financial reporting system.

Overall, MRP provides positive results and is very helpful in the ongoing production process. Through the help of MRP the company can find out the company can know when the production process can be done, when and how many raw materials should be held and when production can be completed. By making and implementing MRP product constraints get some solutions to problems arising due to the unplanned procurement of raw materials needed. Actually with MRP all the time can be planned well ranging from ordering raw materials, production process, to packaging and ready to be handed over to consumers. With punctuality, of course, it will increase consumer satisfaction. With the creation of MPS in the MRP, of course, the company can find out how many products are needed and when the right time to order or buy. Supported by raw materials chocolate bars and extracts do not cause shipping costs so that the message is very low, then the JIT system is suitable to be implemented in the product.

With the application of MRP-the company can find out how many raw materials are in the market, so that it can know the clean needs of raw materials, the creation of waiting times is usually due to the stock of chocolate bar suppliers do not meet our order needs. If the supplier for that time is unable to meet the needs the company can switch to another chocolate bar supplier at a higher price. Punctuality is important because it affects consumer satisfaction. In determining the Master Production Schedule (MPS) is based on production order data received by the company, taking into account the production capacity or process capabilities of the company, so that it will be determined how much will be produced and when the implementation time. In the input company that can be used as a basis to determine MPS is in the form of orders from buyers (buyers), received by the marketing section.

From the marketing section information about this order will be submitted to the PPIC (Product Planning and Inventory Control) section. This section will make a production plan, when and how many products will be produced and design the product according to the buyer's wishes. Regarding when and how many products will be produced, of course, requires consideration of the company's process capabilities or each part of the processing. With regards to the products to be raised in the study, the company received an order from one of

the buyers of 20,000 products all produced 7 days in February. The product has never been produced before. In the list of components will be listed the various components used to produce a product, with the number each to make 20,000 products. The company in compiling a list of components based on the characteristics of the shape of the product desired by the buyer.

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