SUDAN UNVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF GRADUATE STUDIES

Planning Production and Inventory by Using Material Requirements Planning System

Case Study: Wafrapharma Laboratories, Khartoum, Sudan

تخطيط الإنتاج والمخزون بإستخدام نظام تخطيط المواد

دراسة حالة: معامل وفرفارما، الخرطوم، السودان

A thesis submitted to the College of graduate studies in partial fulfillment of the requirements for the degree of M.Sc. in mechanical engineering (Production)

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الآيـــــــة

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿ قُلْ هُوَ ٱللَّهُ أَحَدٌ (1) ٱللَّهُ ٱلصَّمَدُ (2) لَمْ يَلِدْ
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صدق الله العظيم

سورة الإخلاص

Dedication

To my Parent with much love

To my Brother and Sister

For their inspiration and encouragement with much gratitude

an affections that I can't well put down here.

Acknowledgements

I would like to thank my Supervisor for his professional advice

and assistance **Ustaz.Widatallah Alamin** *served as a mentor*

and directed me along the traveled path and he surrendered

many valuable days revising my work.

My friend ***AbdAlrhmanAbaas*** *He always seemed to know*

when to encourage me to work on this research or do

something interesting. Full thanks to my wife ***Heba*** *best*

flower in my life.

MY brothers and sisters were great friends, and for all in Wafrapharma laboratories.

Abstract

Competition pressures are forcing manufacturing companies to continuously seek new ways to manage their production capabilities more effectively in order to meet the demands of the market. In addition, to fulfillment of consumer needs and faster delivery times require efficient manufacturing controls and planning to ensure that productivity is maintained, stocks are minimized and resources are optimized.

Part of management's drive in an organization is to ensure future sustainability. This involves the introduction and ongoing investment into advanced computerized information systems that can assist management across core production functions. This includes inventory control, order management, production scheduling and financial management and the cross-linking thereof. One such system that supports these activities is MRP.

This research aims at illustrating how production is planned with the material requirements planning MRP as this system includes benefits and multiple objectives. Also, it is an attempt to apply this system on wafrapharma laboratories industrial firm. The context of this company was studied before and after the implementation of MRP. The guidelines for successful system implementation are the level of MRP usage in the company, the problems encountered, and the resulting benefits. Some of the findings indicate that the MRP system reduces inventories, improves deliveries, and achieves better planning and control. This study concluded that the MRP system allows the firm to plan at a strategic level by identifying the manufacturing and sales plans of products.

المستخلص

الضغوط التنافسية تجبر الشركات الصناعية إلى البحث باستمرار عن طرق جديدة لإدارة قدراتها الإنتاجية على نحو أكثر فعالية من أجل تلبية متطلبات السوق وتلبية احتياجات المستهلكين ومواعيد التسليم الأسرع تتطلب ضوابط فعالة للتصنيع والتخطيط لضمان الحفاظ على الإنتاجية، وتقليل المخزونات وتحسين الموارد.

جزء من دافع الإدارة في المنظمة هو ضمان الاستدامة في المستقبل . وهذا ينطوي على إدخال وإستمرار الاستثمار في نظم المعلومات المحوسبة المتقدمة التي يمكن أن تساعد الإدارة عبر وظائف الإنتاج الأساسية. ويشمل ذلك مراقبة المخزون، جدولة الإنتاج والإدارة المالية، والربط المتبادل بينهما. ومن بين هذه النظم التي تدعم هذه الأنشطة تخطيط إحتياجات المواد (MRP).

ويهدف هذا البحث إلى توضيح كيفية التخطيط للإنتاج مع متطلبات تخطيط احتياجات المواد (MRP) حيث يتضمن هذا النظام فوائد وأهدافا متعددة. كما أنها محاولة لتطبيق هذا النظام على مختبرات وافرمارما الصناعية، درسنا سياق هذه الشركة قبل وبعد تنفيذ (MRP). المبادئ التوجيهية لتنفيذ النظام الناجح هي مستوى استخدام (MRP) في الشركة، والمشاكل التي واجهتها، والفوائد الناتجة. وتشير بعض النتائج إلى أن نظام (MRP) يقلل المخزونات ويحسن التسليم ويحقق تخطيطا وتحكم أفضل في الإنتاج والمخزون.وخلصت هذه الدراسة إلى أن نظام (MRP) يسمح للشركة بالتخطيط على المستوى الاستراتيجي من خلال تحديد خطط التصنيع والمبيعات للمنتجات.

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Chapter One

Introduction

1.1 General Introduction:

The current century witnessed remarkable development in all its fields. The most important of these was the technological development of information, the complexity of processes, and the change in the business environment. Thus, the need for companies to develop sophisticated information systems to meet their growing needs and requirements of their customers and increase profitability and achieve the competitive advantages.

The material requirements planning (MRP) system was introduced at the beginning of 1960 in the United States as a computerized method for planning the process of obtaining materials, controlling production, placing orders and reducing inventory to the minimum to achieve competitive advantage in the modern industrial environment.

It is considered one of the most recent intellectual and applied trends in the fields of production and inventory. It is a new and alternative approach to production planning systems and traditional stocks such as production batch models, economic demand quantity and demand reuse point. These systems are characterized by many shortcomings due to unrealistic assumptions based on demand volume and rates use and ignore the influence of environmental factors and variables on production planning and operations.

The concept and philosophy of the material needs planning system is an information system that organizes efforts to obtain the right materials in a timely manner or in other words provide all the production process requirements that are specified for the products listed in the main production schedule in a timely manner (These may be basic raw materials or non-finished products). This system was a major revolution in its early days. It introduced computers and organized planning in the production process.

1.2 Problem Statement:

The research problem involved the inventory control on wafrapharma laboratories industrial firm.

1.3 Research Objectives:

The primary research objective is to establish a Material Requirement Planning (MRP) system within wafrapharma laboratories industrial firm.

1.4 Importance of the study:

Planning and control of material requirements is the essence of production systems. Due to the high importance of materials and the high proportion of total production costs, planning and control is the basis for successful operations management in achieving its objectives by increasing efficiency of resource utilization or reducing inventory and improving customer service through delivery on time and reduce delays.

1.5 Research Scope:

The research aimed to determine the need for a MRP system at wafrapharma laboratories industrial firm. The scope of this study was limited to wafrapharma laboratories industrial firm and only included data from this organization.

1.6 Research Methodology:

This research depends on descriptive and analytical methods to enable the description and simplification of the subject to reach the objectives of this study and know its various aspects and analyze its dimensions. A case-study approach was followed, with wafrapharma pharmaceutical laboratories as the case study organization.

Excel is used as computer software for design and implementation of Material Requirements planning within wafrapharma pharmaceutical laboratories is selected as case study.

1.7 Research layout:

In this section a brief description of the contents of the research chapters are presented as following:

Chapter one: Gives a generic description of MRP and states the problem of the research, objective, Importance of the study, methodology and general search layouts. Chapter two: The Theoretical Framework of MRP, Inventory Management and Previous Studies. Chapter three: Research Methodology, Research approach, Sample and data gathering, Procedures and limitations. Chapter four: Results and Discussions. Chapter Five: A conclusion presented in addition to recommendations.

Chapter Two

The Theoretical Framework and Previous Studies

2.1 Preface:

Inventory Management, also called Inventory control, is a company's efforts to comprehend the minimal cost and levels of inventory held in which they can still meet demand. Many balancing acts must be constantly addressed and monitored within inventory management. For companies such as wafrapharma pharmaceutical laboratories, thousands of parts' inventory levels must be maintained, but depending on how often the part is used these inventory levels differ. A tool many firms use to gauge their proficiency at allotting inventory levels is the inventory turnover ratio. The inventory turnover ratio is equal to sales divided by inventory and it represents the amount of times inventory is sold and replaced over a given period of time. [1] While many companies strive to reduce inventory turnover ratios, they must not sacrifice service and lead times in order to do so. Not enough inventory results in back ordering, while too much inventory can result in getting caught with obsolete goods and large expenses.

One of the most important aspects to inventory management is purchase planning and raw material management. The first decision within this is deciding how long the inventory will last Depending on the raw material and the type of inventory management system, purchase planning can be done on a number of different scales; weekly, biweekly, monthly, tri-monthly, etc. For industries with fluctuating demand, planning and material ordering must be done much more rapidly. The next decision of choosing the level of inventory per order will depend on how often a company receives material shipments. The level of raw material inventory must be adequate to meet the production plan. [2]

Over the years inventory management has made many strides, and today there are many different methods to managing a company's inventory, such as MRP or JIT. Because demand, product and type differ so much industry-to-industry, a method that is best for one company to reduce inventory while increasing service may not be ideal for another company in a different industry.

While each system's methods on reaching optimal inventory levels differ, they are all built upon the foundation of constant inventory monitoring and improving, as well as the recording and analysis of past inventory levels compared to business success and units produced/ shipped.

Material Requirements Planning (MRP) started in the late 1960s. The technique was applied first to mobile and airplane industry. As the technique became well known, many large and small businesses adopted MRP method in order to increase their productivity and decrease the production cost.

Material requirement planning (MRP) is a key element in managing resources in a manufacturing environment. MRP systems were developed to help companies manage dependent demand inventory and schedule replenishment orders. MRP systems have proven to be beneficial to many companies.

Information technology plays a major role in designing and implementing (MRP) systems and processes as it provides information about manufacturing needs (linked with customer demand) as well as information about inventory levels. MRP techniques focus on optimizing inventory. MRP techniques are used to explode bills of material, to calculate net material requirements and plan future production.

2.2 Types of Inventories:

Employing the generic definition of inventory, a large spectrum of situations can be structured as inventory management problems. These include the following:

1. Raw materials inventory as input to manufacturing system.
2. Bought-out-parts (BOP) inventory which directly go to the assembly of product as it is.
3. Work-in-progress (WIP) or work-in-process inventory or pipeline inventory.
4. Finished goods inventory for supporting the distribution to the customers.
5. Maintenance, repair, and operating (MRO) supplies. These include spare parts, indirect materials, and all other sundry items required for production/service systems.

It may be noted that the basic definition of inventory being a "usable but idle resource" remains valid irrespective of the type of inventory being managed.

2.3 Types of Inventory Management Systems:

Why do companies invest so much in finding the perfect inventory management system?

Inventory is one of the biggest assets in most companies. When inventory turns increase, so does the companies bottom-line. Since most companies' missions are to generate the greatest profit, managing inventory vital part in the success of the company. [3]

All methods of inventory management are designed to accomplish the one goal of having the lowest total cost and the highest service (or product) level possible. Something companies tend not to reach equal balance and instead prefer to lean towards one side or the other.

There is no universal method that works perfectly for every company. There are two basic types of inventory systems, continuous and periodic, with a numerous variety of methods on each system. Each company must find the method that works within their operations and adapt it to work perfectly for them. Even after finding a method that works, a company must be up to date with research and new methods that could better improve their system. [3]

2.3.1 Minimum Stock Levels (perpetual system):

The most basic method that companies use to manage inventory is by using minimum stock levels, a type of continuous inventory system. This method, also referred to as the perpetual system, is an independent system that orders a certain amount on a set schedule. New stock gets ordered once an existing stock has reached a certain level, or a minimum level that is normally set by the company. [9] Though this is one of the simplest ways for a company to managed inventory, there are no special benefits that come with using it.

2.3.2 Just In Time (JIT):

One of the most widely used systems of inventory management is the Just in Time (JIT) method. This method looks to deliver the exact needed quantity of inventory to the production floor just in time for when it is needed. The JIT method is highly dependent on the ability of the company and the suppliers to deliver on time. If the company and suppliers were not reliable, this method would never work. It is also inefficient if the supplier is not located close to the manufacturing facility since the method is so dependent on scheduling.

2.3.3 Economic Order Quantity (EOQ):

The Economic Order Quantity, or EOQ model, attempts to find the balance between too much and too little inventory by looking for the optimal quantity that will deliver the lowest cost of carrying inventory. Since a fixed quantity is being ordered when the inventory reaches a specific level, the EOQ model is known as a continuous inventory system. A lot of information is needed to use this formula causing it to become a complex method and it can often become unusable. To be successful using EOQ, a company needs to know the usage of units, ordering cost in $/order, annual carrying cost, unit cost in $ and order unit quantity.

Without each of these values, the EOQ method is unable to be used. There are assumptions to the model including constant demand, no shortages, constant lead-time and instantaneous order receipts.

A graphical representation of EOQ is seen in Fig.(2.1) the optimal point is when the holding cost equals the ordering cost. The EOQ is where the lowest cost to the company can be found. If holding costs are lower than the EOQ, the ordering costs are higher and the bottom line is also higher, and vice versa.

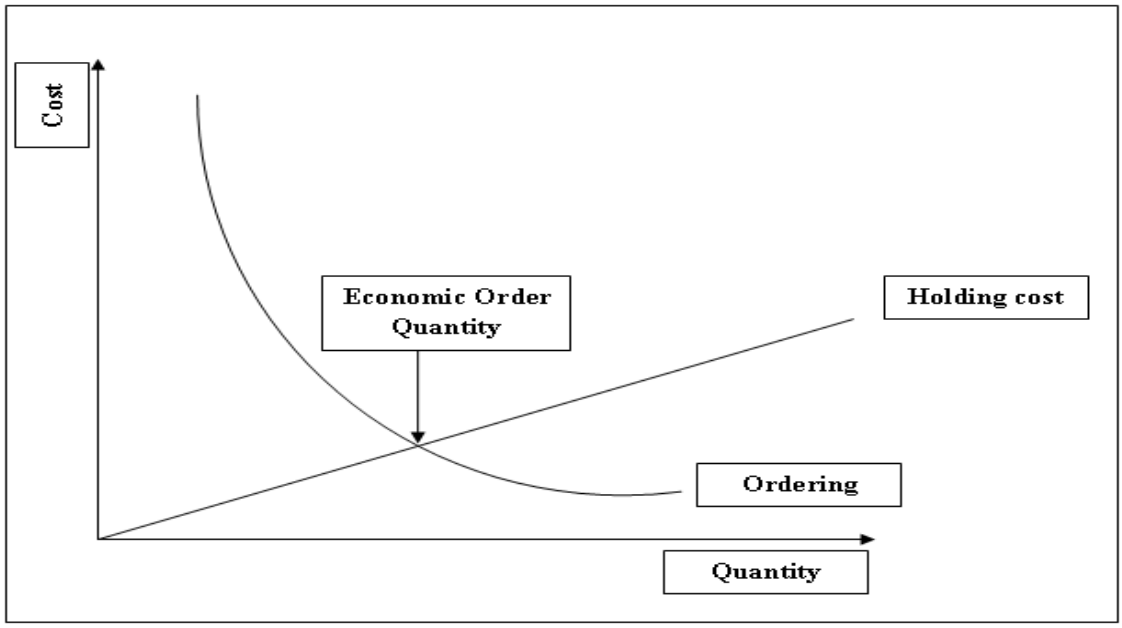


Fig. (2.1) Economic Order Quantity

Fig. (2.2) shows the most basic EOQ model. Graphed is the level of inventory in relation to time. The horizontal line on the graph is the reorder point or quantity. Once the inventory depletes to that point, a new order is placed. As the order is being filled, the rest of the inventory is depleted up until the new order quantity is ready.

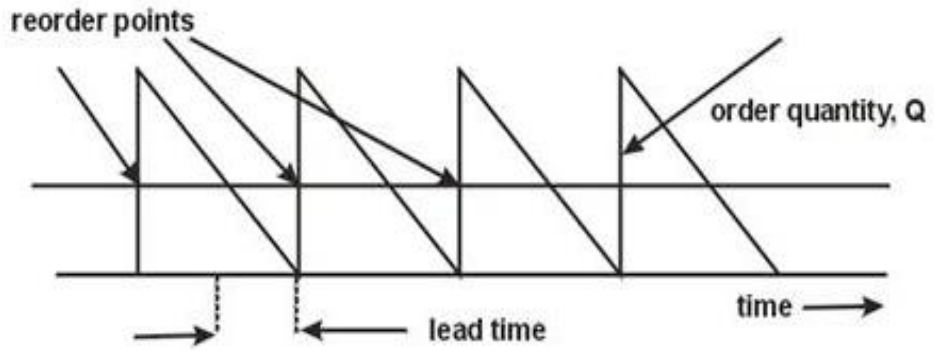


Fig. (2.2) Simple Deterministic Inventory Model Based on Fixed Demand Lead Time

2.3.4 Safety Stock (SS):

Safety stock is another common way companies manage their inventory. Companies utilize this by keeping an extra amount of inventory that is carried on top of the normal quantity. This is called the safety stock and it is used as a buffer against uncertainty with situations including supplier performance issues, long lead times and material uncertainty. Finding the perfect safety stock level is difficult due to complex formula that is used to calculate it. For companies on a tight budget, using this method can cause financial harm due to the potential holding cost associated with extra inventory. [3]

It is common for companies to carry a large amount of safety stock for seasonal or cyclical demand. Many companies that see an increase in demand during the holiday season use this method often. By producing and holding inventory during the holiday off-season, they are able to meet the demand during the busy time, but keep their production at the same level all year.

Companies will also look to purchase large quantities of inventory to save money causing them to then have excess inventory. They must be careful in doing this that the cost of holding this inventory does not exceed the amount they are saving in purchasing the large quantity.

2.3.5 Last in First Out (LIFO) and First in First Out (FIFO):

The best way to explain the method of (LIFO) would be to think of items on a shelf. The unsold items would be pushed to the back in order to make room for newer items. (FIFO) is a method that is similar and usually compared with (LIFO). This method is one that is commonly seen in grocery stores. Restocking the selves involves taking the items already there and pushing them to the front while stocking the new items behind the older ones.

Both of these methods take different characteristics when talking about the value of inventory and calculating profit on inventory. This is because companies can have different types of products. They can have those that are one-time only where once they are sold, they are gone, or they can have items that they restock when inventory gets low. It is these types of product where LIFO and FIFO come into play when determining the value. It is the companies' choice on which method to pick to improve their profit/loss statement.

2.3.6 Vendor Managed Inventory (VMI):

One way to manage inventory and optimize the use of a supply chain is through Vendor Managed Inventory (VMI). With access to the distributor's inventory data, this method is able to generate purchase orders along the supply chain. Normally when a distributor needs a product, they place an order with a manufacturer. With the VMI model, the manufacturer instead receives the distributors' sales and stock level data, and creates the order. With VMI, the

manufacturer instead of the distributor generates orders. Fig.(2.3) gives a visual representation of the method.

As portrayed, all the information goes through the manufacturer (factory) and orders are generated to the customer locations and warehouses based on that.

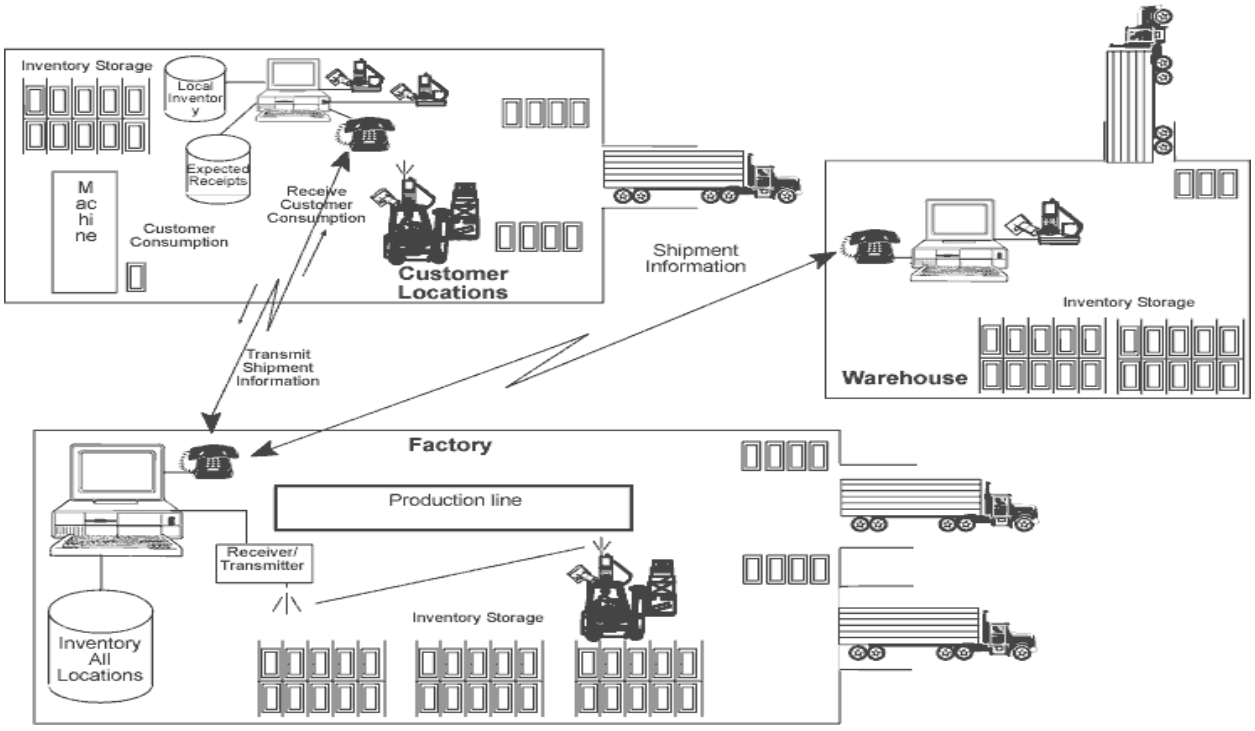


Fig. (2.3) Map of Vendor Managed Inventory System

2.3.7 ABC Method:

The ABC method of inventory management focuses on categorizing items in terms of their importance to the company. This method is also known as the Pareto Principle which states that 20% of inventory comes from 80% of the overall volume. More simply, a small percent of your products make up the major of your inventory. Items are given rankings to determine this small percent. Higher value items, usually the higher dollar items, are given an 'A' will those least important to the company are given a 'C'. Companies would give items with an 'A' ranking more attention when looking at inventory, such

as when ordering is needed. There is a lot of work associated with method since the inventory must be analyzed frequently to stay up to date and successful. [3] Figure (2.4) shows an example of a graphical representation of the ABC method. It can be seen on this graph that 20% of the total items account for just over 80% of the total company usage.

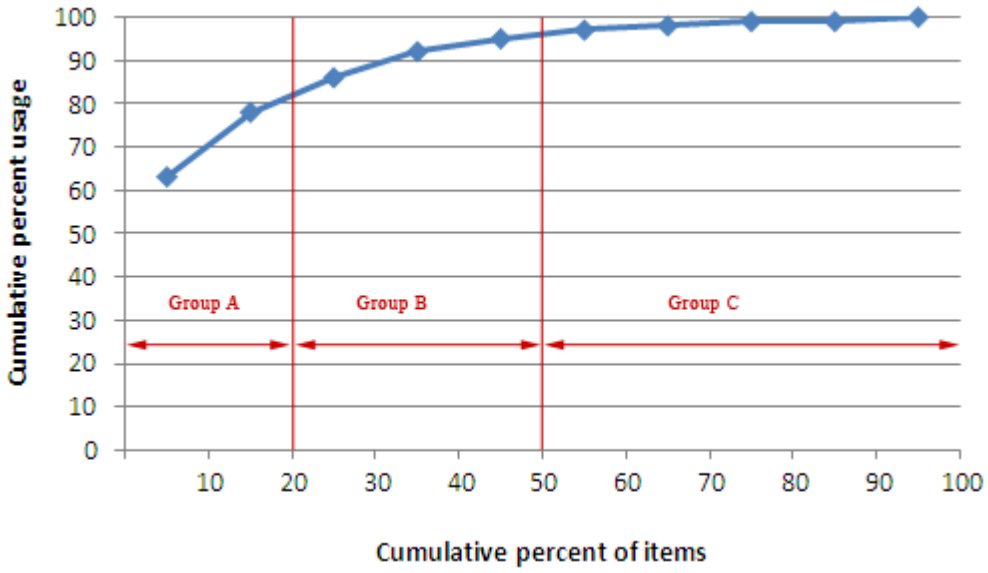


Fig.(2.4): Graphical Representation of ABC Method

By using this method, companies are able to focus on the products that need the attention. Time spent on the less important products can be used to concentrate on those higher value products that in the long run will help in managing the inventory.

2.3.8 Material Requirements Planning (MRP):

This method of inventory control helps to streamline business processes and control order processing. It is a push system that has a sort of backwards system of scheduling. MRP is a computerized ordering and scheduling system that is ideal for the manufacturing and fabrication industries since it uses data generated from the company, like the BOM, to project what material will be needed in the future, how much and exactly when. The system keeps track of

the parts that the production is dependent on and analyzes it to perfect the production schedules. The benefits of MRP are that it is able to track the effects of many different variables throughout production. Though it does have a great deal of benefits and can greatly improve the productivity of a company, it is still a system that takes some time to implement. It takes large amounts of data for it to work properly so for a new company with very little information about lead times, usage and productivity, this system is not ideal. Figure (2.5) is a basic flowchart depicting MRP system.

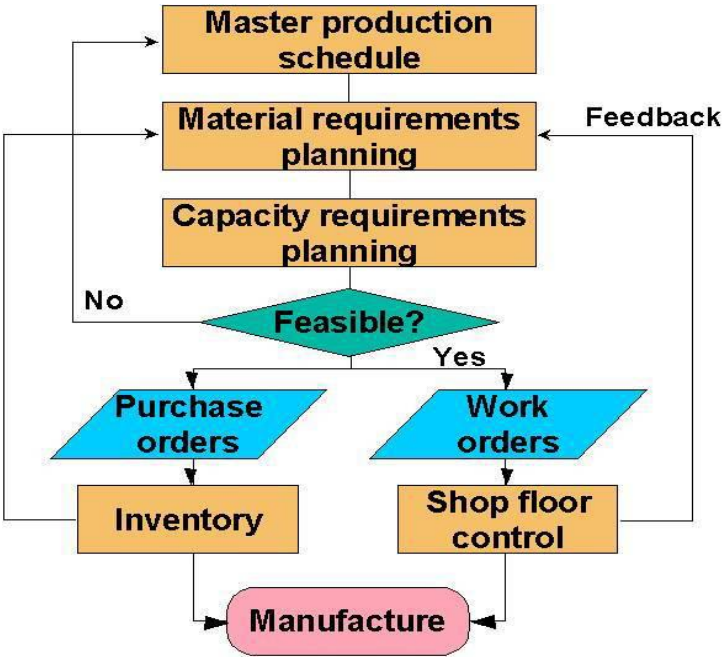


Fig.(2.5) Flow of a MRP system

2.4 Definition of MRP System:

Material Requirements Planning (MRP) is a dependent demand technique that uses bill-of material, inventory, expected receipts, and a master production schedule to determine material requirement. It is concerned with both production scheduling and inventory control. It is a material control system that attempts to keep adequate inventory levels to assure that required materials are available when needed. [4]

Material Requirements Planning (MRP) is a computer-based production planning and inventory control system. It is a production planning process that starts from the demand for finished products and plans the production step by step of subassemblies and parts. It is software based production planning and inventory control system used to manage manufacturing processes. [5]

Materials Requirement Planning (MRP) is a scheduling procedure for production processes that have several levels of production. Given information describing the production requirements of the several finished goods of the system, the structure of the production system, the current inventories for each operation and the lot sizing procedure for each operation, MRP determines a schedule for the operations and raw material purchases. [6]

Material requirement planning (MRP) is a tool for estimating the material requirements of components of different types which produce final assembly of finished equipment. When the demand for finished product is known through forecasting, the demand for sub-assemblies and components that go into the making of the sub-assemblies can be calculated with accuracy by the MRP approach. [1]

MRP is a computer-based system designed to organize the timing and ordering of the dependent demand products. The demand for the raw material and components of the final product are calculated by using the demand for the final product and it is determined how much and in what quantity to order from these components and raw material, considering the production and lead times and counting back from the delivery time of the product. Thus, the demand for the final product is used to calculate the demand for the components in lower levels. This process is divided into planning periods and the production and assembly functions are organized, resulting in lower inventory levels along with ensuring the timely deliveries of the final product. [2]

A key question to a MRP process is the number of times a company replenishes (or turns around) inventory within a year. There are accounts of inventory annual turnover ratios of greater than 100, mainly reported by Japanese companies. One can readily realize that the a high inventory ratio is likely to be conducive to lowering production cost since less capital is tied up to unused inventory.

MRP systems use four pieces of information to determine what material should be ordered and when (see also Fig. 2-1 and Fig. 2-2):

1. The master production schedule includes quantities of products to be produced at a given time priod.
2. Bill of materials, which lists exactly the parts or materials required to make each product.
3. Production cycle times and material needs at each stage of the production cycle time.
4. Supplier lead times.

The master schedule and bill of materials indicate what materials should be ordered; the master schedule, production cycle times and supplier lead times then jointly determine when orders should be placed.

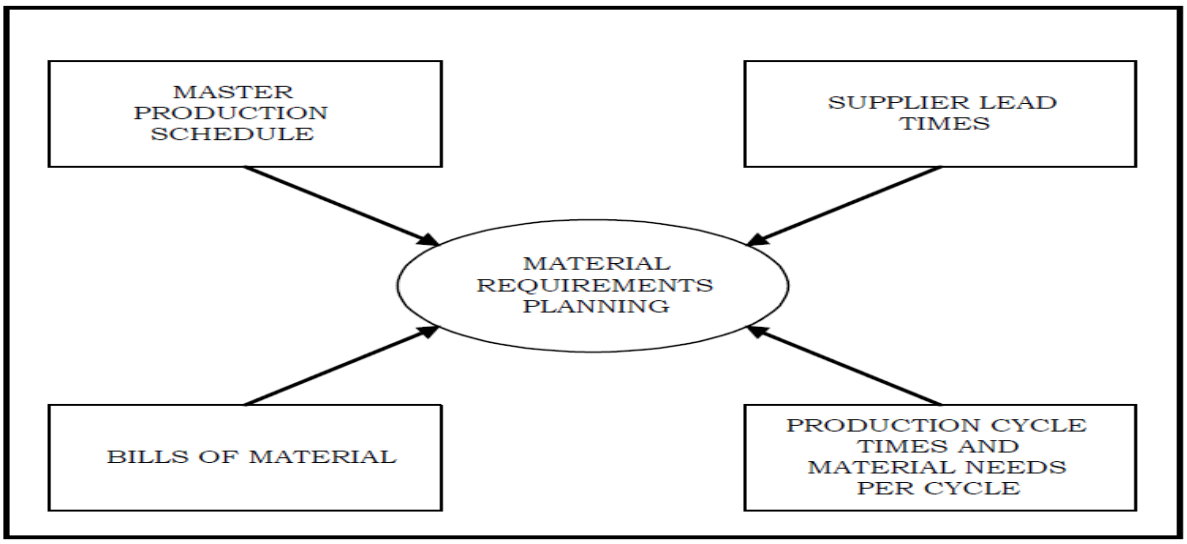


Fig. (2.6) MRP in context with production management processes

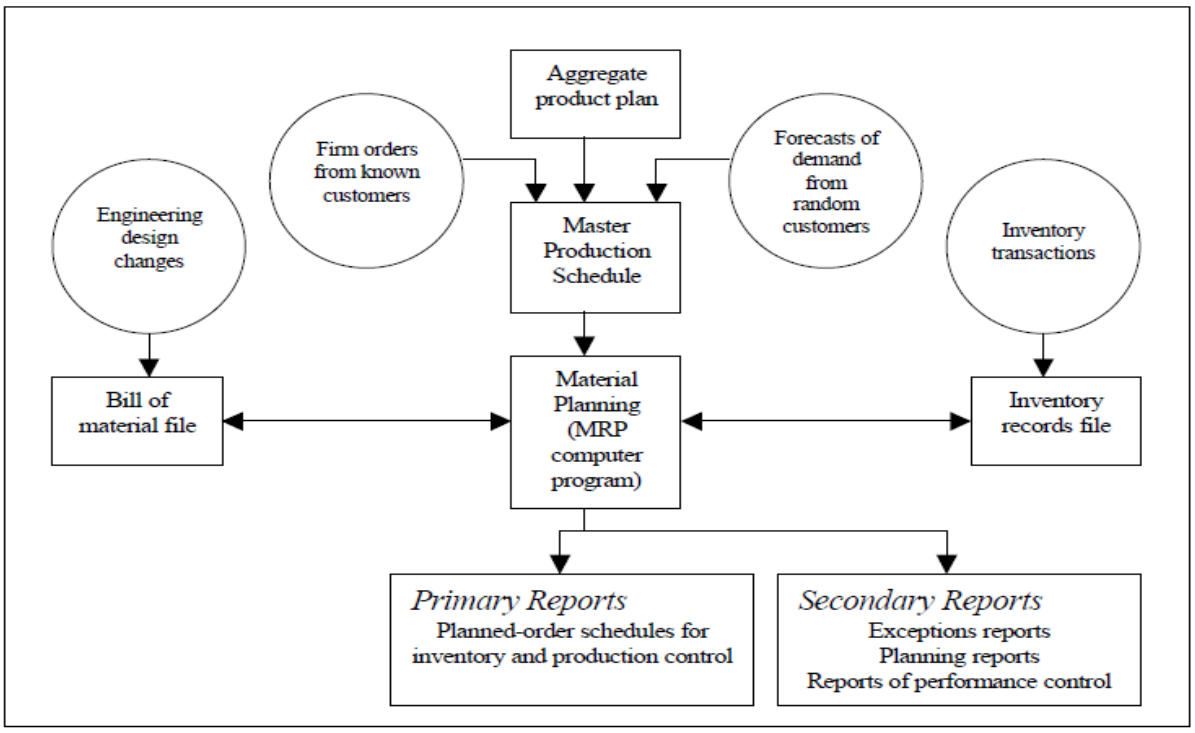


Fig (2.7). Overall View of the Inputs to a Standard Material Requirements Program and the Reports Generated by the Program

2.5 The scope of MRP in manufacturing:

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. A few examples are given below:

1. If a company purchases insufficient quantities of an item used in manufacturing, or the wrong item, they may be unable to meet contracts to supply products by the agreed date.

2. If a company purchases excessive quantities of an item, money is being wasted - the excess quantity ties up cash while it remains as stock and may never even be used at all. This is a particularly severe problem for food manufacturers and companies with very short product life cycles. However, some purchased items will have a minimum quantity that must be met, therefore, purchasing excess is necessary.
3. Beginning production of an order at the wrong time can cause customer deadlines to be missed.

2.6 Classes of MRP user/companies:

Material Requirements Planning (MRP) systems fall into four categories often identified as ABCD, in terms of use and organizational implementation.

1. Class A represents full implementation of MRP. MRP system is tied up with company's financial system and includes capacity planning, shop floor dispatching, and vendor scheduling as well as links with human resource planning. There exists continuous monitoring of performance and inventory records and master production schedules are accurate.
2. Class B represents a less than full implementation. MRP system is confined in the manufacturing area; however, it encompasses master production scheduling.
3. Class C represents a classical MRP approach in which the system is confined to management of inventories.
4. Class D represents a data processing application of MRP. System is used for keeping track of data rather than as decision-making tool.

2.7 Types of firms / organizations that MRP can be applied:

MRP is being used in a variety of industries with a job-shop environment (meaning that a number of products are made in batches using the same

productive equipment). The list in table 2-1 includes process industries, but the processes mentioned are confined to job runs that alternate output product and do not include continuous process such as petroleum or steel. MRP is most valuable to companies involved in assembly operations and least valuable to those in fabrication. [5]

Table.(2.1) Industry Applications and Expected Benefits of MRP

Industry Type	**Examples**	**Expected Benefits**
Assemble-to-stock	Combines multiple component parts into a finished product, which is then stocked in inventory to satisfy customer demand. Examples: watches, tools, appliances.	High
Fabricate-to-stock	Items are manufactured by machine rather than assembled from parts. These are standard stock items carried in anticipation of customer demand. Examples: piston rings, electrical switches.	Low
Assemble-to-order	A final assembly is made from standard options that the customer chooses. Examples: trucks, generators, motors.	High
Fabricate-to-order	Items manufactured by machine to customer order. These are generally industrial orders. Examples: bearings, gears, fasteners.	Low
Manufacture-to-order	Items fabricated or assembled completely to customer machine tools. Examples: turbine generators, heavy machine tools.	High
Process	Industries such as foundries, rubber and plastics, specialty paper, chemicals, paint, drug, food processors.	Medium

MRP does not work well in companies in companies that produce a low number of units annually. Especially for companies producing complex expensive products requiring advanced research and design, experience has shown that lead times tend to be too long and too uncertain, and the product configuration too complex for MRP to handle. Such companies need the control features that network-scheduling techniques offer.

2.8 Conditions for implementation MRP:

Several requirements have to be met, in order to given an MRP implementation project a chance of success:

1. Availability of a computer based manufacturing system is a must. Although it is possible to obtain material requirements plan manually, it would be impossible to keep it up to date because of the highly dynamic nature of manufacturing environments.
2. A feasible master production schedule must be drawn up, or else the accumulated planned orders of components might “bump” into the resource restrictions and become infeasible.
3. The bill of materials (BOM) should be accurate. It is essential to update them promptly to reflect any engineering changes brought to the product. If a component part is omitted from the bill of material it will never be ordered by the system.
4. Inventory records should be a precise representation of reality, or else the netting process and the generation of planned orders become meaningless.
5. Lead times for all inventory items should be known and given to the MRP system.
6. Shop floor discipline is necessary to ensure that orders are processed in conformity with the established priorities. Otherwise, the lead times passed to MRP will not materialize.

2.9 Implementation Procedure of MRP:

2.9.1 Steps / Phases of a MRP project:

The material requirements planning portion of manufacturing activities interacts with the master schedule, bill of materials file, inventory records file, and the output reports.

2.9.2 Inputs to a Standard MRP Program:

1. Demand for Products: Product demand for end items stems from two main reasons. The first is known customers who have placed specific orders, such as those generated by sales personnel, or from inter department transactions. The second source is forecast demand. Demand from known customers and demand forecast are combined and become the input to the master production schedule.
2. Bill of Materials File: The bill of Materials file contains the complete product description, listing materials, parts, and components but also the sequence in which the product is created. The BOM file is often called the product structure file or product tree because it shows how a product is put together. It contains the information to identify each item and the quantity used per unit of the item of which it is a part.
3. Inventory Records File: Inventory records file under a computerized system can be quite lengthy. Each item in inventory is carried as a separate file and the range of details carried about an item is almost limitless. The MRP program accesses the status segment of the file according to specific time periods. These files are accessed as needed during the program run.

2.9.3 MRP Computer Program:

The MRP program works as follows:

1. A list of end items needed by time periods is specified by the master production schedule.
2. A description of the materials and parts needed to make each item is specified in the bill of materials file.
3. The number of units of each item and material currently on hand and on order are contained in the inventory file.
4. The MRP program "works" on the inventory file. In addition, it continuously refers to the bill of materials file to compute quantities of each item needed.
5. The number of units of each item required is then corrected for on hand amounts, and the net requirement is "offset" to allow for the lead time needed to obtain the material.

2.9.4 Output Reports:

Primary Reports: Primary reports are the main or normal reports used for the inventory and production control. These reports consist of:

1. Planned orders to be released at a future time.
2. Order release notices to execute the planned orders.
3. Changes in due dates of open orders due to rescheduling.
4. Cancellations or suspensions of open orders due to cancellation or suspension of orders on the master production schedule.
5. Inventory status data.

Secondary Reports: Additional reports, which are optional under the MRP system, fall in to three main categories:

1. Planning reports to be used, for example, in forecasting inventory and specifying requirements over some future time horizon.
2. Performance reports for purposes of pointing out inactive items and determining the agreement between actual and programmed item lead times and between actual and programmed quantity usage and costs.
3. Exceptions reports that point out serious discrepancies, such as errors, out of range situations, late or overdue orders, excessive scrap, or nonexistent parts.

2.9.5 Partial techniques and tools included in each step:

In order to achieve successful results from the use of a MRP system, many variables (e.g. demand of orders) must be taken into consideration and thorough examination. Statistical tools and forecasting techniques are necessary to predict the unknown demand. In addition to these, many more techniques are used, which are borrowed from the fields of:

1. Production management.
2. Control of production.
3. Warehouse management.

2.10 MRP Processing:

MRP processing takes the end-item requirements specified by the master schedule and "explodes" them into time-phased requirements for assemblies, parts and raw materials using the bill of materials offset by lead times. The determination of the net requirements is the core of MRP processing.

Gross requirements are the total expected demands for an item or raw material during each time period. These quantities are derived from the master production schedule or the planned-order releases of their immediate "parents". Scheduled receipts are open orders (orders that have been placed) and are

scheduled to arrive from vendors or elsewhere in the pipeline by the beginning of a period. Projected on hand are the expected amounts of inventory that will be on hand at the beginning of each time period: scheduled receipts plus available inventory from last period.

Net requirements are the actual amount needed in each time period. In addition to subtracting projected inventory on hand from gross requirements, net requirements are sometimes adjusted to include safety stock and an allowance for waste. Planned-order receipts are the quantities expected to be received by the beginning of the period. Under lot-for-lot ordering (lot size = 1), this quantity will equal net requirements. Under lot-size ordering, the order size must be in multiples of the lot size, thus this may exceed net requirements.

Any excess is added to available inventory in the next time period. Planned order releases are the planned amount to order in each time period; equal planned order receipts offset by lead times. This amount generates gross requirements at the next level in the assembly or production chain. When an order is executed, it is removed from "planned-order releases" and entered under "scheduled receipts". As time passes, the plans need to be updated and revised to reflect the moving horizon overtime since old orders will have been completed while new orders enter; also there may have been some changes in quantities, delays, missed deliveries, and so on.

Orlicky (1975) suggested that MRP records could be updated using either the regenerative system (approach that updates MRP records periodically) or net-change system (approach that updates MRP records continuously).[6]

The parameters of the MRP system are one of the most important activities for the perfect functioning of the system. In addition to basic information about the product structure and the process of lead time or provider, one should take into consideration some reality and circumstances of companies environment.

As an example, can be mentioned a supplier whose deliveries not always are on time. In this case, normally the safety stock option can be adopted, and this parameter should be included on the system.

Based on this, Correa et al. (2007) state that some basic parameters are essential for MRP operation: [5]

1. Product Structure: is the specification of the quantity of each item that make up each product, known as Bill of Materials (BOM).
2. Depended Demand Items: these are those items that make up the finished product, whose purchase depends on the customer orders.
3. Independent Demand Items: under this category are consumer items that are part of the production process as an input, and are not raw materials, stored on the basis of consumption history.
4. Repleshnment Lead Time: the time spent between placing the order and receiving the material.
5. Production run time: also named as cycle time, is the time spent from the beginning to the end of an finished good production.
6. Production batch size: is the amount of certain item to be manufactured in order to optimize the process.
7. Replacement batch size: is the quantity of a particular item that is acquired each time also, with a view also on cost optimization.
8. Minimum stock: is the minimum amount that must be kept in stock, either raw materials or finished product.
9. Maximum stock: the highest level of materials that can be kept stocked.

2.11 Benefits of MRP:

1. Reduction in inventory. MRP mainly affects raw materials, purchased components, and work in-process inventories. Users claim a 30 to 50% reduction in work-in-process.

2. Improved customer service. Some MRP proponents claim that late orders are reduced 90%.
3. Quicker response to changes in demand and in the master schedule
4. Greater productivity. Claims are that productivity can be increased by 5 to 30% through MRP.
5. Labor requirements are reduced correspondingly.
6. Reduced setup and product changeover costs.
7. Better machine utilization.
8. Increased sales and reductions in sales price. These are also claimed as MRP benefits by some users.

2.12 Previous Studies:

Material Requirement Planning Systems Development by James F. Cox and Stephen J. Clark (1977) in their article Material Procurement for Effective Production Management viewed that Materials Management is more a dependent demand management. Information relating to the market demand will help to procure sufficient materials which leads to materials requirement planning.[7] Reviewing the research in Material Management taking place in the United States, Smith and Jagetia (1978) in their article Inventory Control System started that 50.00 % of the savings were achieved by single inventory control system, which reduced 20.00% of annual inventory investment. The American Management Association started that the adoption of one scientific inventory control technique, namely the economic lot size in place of purchase as judgment bas is was responsible for reduction in total inventory investment by 20.00% to 30.00% without sacrificing customer service. Similarly, Gopalkrishnan and Sandilya (1978) Standardization Techniques for Materials Management observed that some of the leading firms in England reduced their number of inventory items by 40.00% and the American firms by 55.00% through the application of standardization technique. [6]

Datta(1978) in his article Mastering Materials A case Study of Paper Industry that "Materials Management is an essential activity of an enterprise for the procurement and use of materials distinctly separated from the process of procurement and use of human skills from labourers for the ultimate development to attain some predetermined objectives. " in his article author29 examined the importance of managing materials to paper industry by studying the case of Altanta Paper Mills. [2]

Gopalakrishna and sundareshan (1979)explained that the integrated materials planning, purchasing and procurement planning, inventory control, stores custody and operation and salvage and disposal. According to them, if functional responsibilities were kept independent from each other, they led to conflict of interest resulting in inventory buildup and therefore integration in turn, would result in greater coordination and better control. Further, while discussing the materials management in the background of Indian conditions, the authors listed seventy-six indices to evaluate materials management planning and forecasting efficiency, inventory and stores, standardization, codification and value analysis, transportation analysis, transportation and distribution and twenty-five questions that become useful in any enquiry on materials management.

Computerized materials requirement planning in manufacturing companies in Malaysia by Mohd. Ezani and Mat Hassan (1991) in their empherical study presented the usage of computerized Materials Requirement Planning System in Malaysia manufacturing companies. Authors concluded in their article by stating that the contemporary practices have been practiced by Malaysian manufacturing companies. [6]

Chapter Three

Research Methodology

3.1 Preface:

This project was aimed to assist wafrapharma laboratories industrial firm in improving their inventory management system and production with meeting their goals.

The sections that follow describe the research approach followed, sampling, methods employed for data gathering, data handling and data analysis, reliability and validity and limitations of the research.

3.2 Research approach:

This study followed a case-study approach. wafrapharma laboratories industrial firm, served as case study organization.

The benefits of a case-study approach are argued by various researchers. Bourque and Clark (1992) postulated that a case study approach provides a single unit of analysis from which first-hand insight is gained into a particular phenomenon. Similarly Hussey and Hussey (1997) state that studying real-life situations can be an advantage as it provides a medium for gaining insight into the complexity of particular and unique phenomena experienced by a case-study organization, allowing the researcher to recognize issues to be considered and developing directions for change - a process that can be referred to as 'unfolding'. Furthermore Garbers (1996) is of the opinion that case-studies provide options for in-depth descriptions and explanations of specific phenomenon within the context of reality, environment and meaning. [7]

In choosing a case-study approach, the most important aspects relating to operations management was able to gain an understanding and the need for an effective material requirements planning system, both quantitative and qualitative inventory management methods have been examined in the case analysis. Quantitative methods employ mathematical models to manage

inventory, while qualitative methods use conceptual ideas from supply chain management to reduce inventory. It is expected to arrive at a deep understanding of how inventory management is done, and what factors influence efficiency and effectiveness of inventory management to reduce cost, improve service, and enhance competitive advantage, and linking research findings to existing literature with the aim of furthering knowledge development.

3.3 Sample and data gathering

The data used in this study were collected by interviewing warehouse managers and procurement managers who are involved in inventory management. Other data are collected by studying company documentation, such as production schedules, inventory reports, and production reports.

3.4 Procedures:

First, the annual reports of sample firm were collected and developed a profile of the inventory management style of the company I have chosen.

Second, the related staff and managers about the details of inventory management were interviewed.

Third, the data from inventory lists, production schedules and so forth was collected. The representative period and group of data to analyze was collected.

3.5 Basic flowchart depicting an MRP system:

The system calculates net requirements for all the requirement quantities that are to be planned. The system thereby compares available warehouse stock or the scheduled receipts from Purchasing and Production. In the case of a material shortage, that is, if the available stock (including firmed receipts) is smaller than the quantity required, the system creates procurement proposals.

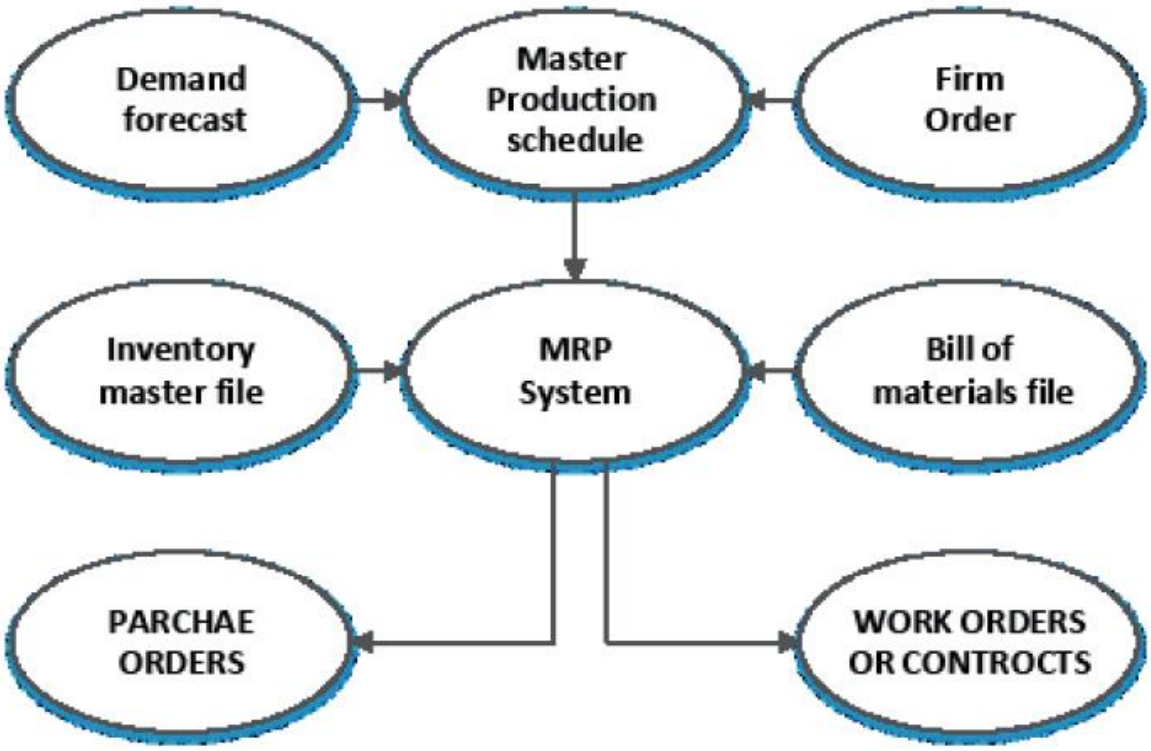


Fig. (3.1) flowchart depicting an MRP system

3.5.1 Establish Master Production Schedule (MPS):

In this point the master production schedule (MPS) was established of wafrapharma laboratories industrial firm for the year 2017, which describes when each product is scheduled to be manufactured; MPS procedure consolidates the independent demands of forecasts and customer orders to determine the requirements of the end products in each time bucket in the planning horizon. After netting the on-hand and on-order inventory, and offsetting the lead-time, the production schedule of the end products, MPS, is determined. MPS is then fed into the MRP procedure to determine the requirements raw materials. Table 4-1 shows master production schedule of wafrapharma laboratories industrial firm for the year 2017.

Table (3.1) Master Production Schedule

YEAR-2017	Waframic	Wafrazole	Wafrapect	Wafrastin
JAN	-	-	60,000	60,000
FEB	-	150,000		-
MAR	-	150,000		-
APR	100,000	75,000	-	-
MAY	200,000	-	-	-
JUNE	150,000	37,500	-	-
JULY				
AUG				
SEPT				
OCT				
NOV				
DEC				
Total	450,000	412,500	60,000	60,000

3.5.2 Establish Bill of Materials (BOM):

In this point the bill of materials was established, which lists exactly the parts or materials required to make products Wafrazole, Waframic, Wafrapect and Wafrastin .It gives information about the products structure. Shows bill of materials per batch of products under study in tables (3.2), (3.3), (3.4) and (3.5) below:

Table (3.2) Bill of materials of product Wafrazole

Sr.no	Component Description	Unit	Qty
1	Metronidazole Benzoate	kg	48.250
2	Sucrose	kg	300.0
3	Soudium Citrate Dihydrate	kg	3.0
4	Citric Acid Monohydrate	kg	0.75
5	Methyl Paraben	kg	0.825
6	Propyl Paraben	kg	0.10
7	Saccharin Sodium	kg	1.875
8	Xanthan Gum	kg	3.75
9	Polysorbate 80	kg	0.75

10	Glycerin	kg	37.5
11	Sorbitol (70% soiution)	kg	48.75
12	Propylene Glycol	kg	7.5
13	Mixed Fruit flavor	kg	1.5
14	Caps	Pcs.	7,500
15	Carton 24*24*24	Pcs.	150
16	Bottles 125 ml	Pcs.	7,500
17	Printer Hot	Pcs.	1

Note: Bach Wafrazole = 7,500 Bottles

Table (3.3) Bill of materials of product Waframic

Sr.no	Component Description	Unit	Qty
1	LableWafrazole	Pcs.	7,500
2	Mefenamic Acid	kg	7.5
3	Sucrose	kg	450
4	Soudium Benzoate	kg	1.5
5	Saccharine Sodium	kg	0.75
6	Glycerin	kg	75.0
7	Sorbitol 70% Solution	kg	75.0
8	Xanthan Gum	kg	1.5
9	Microcrystalline Cellulose	kg	3.0
10	Polysorbate 80	kg	0.75
11	Citric acid	kg	1.275
12	Banana flavor	kg	0.5
13	Strawberry flavor	kg	1.0
14	Caps	kg	10,000.0
15	LableWaframic	kg	10,000.0
16	Carton 23*23*23	kg	200.0
17	Bottles 100 ml	kg	10,000.0
18	Printer Hot	kg	1.0

Note: Bach Waframic = 10,000 Bottles

Table (3.4) Bill of materials of product Wafrapect

Sr.no	Component Description	Unit	Qty
1	Diphenhydramine HCL	kg	1.620
2	Ammonium Chloride	kg	15.780
3	Menthol	kg	0.120
4	Tri-Sodium Citrate	kg	6
5	Sucrose	kg	450
6	Citric Acid	kg	0.96
7	Glycerin	kg	36
8	Orange oil flavor	kg	0.660
9	Lemon flavor	kg	0.660
10	Methyl Paraben	kg	0.048
11	Propyl Paraben	kg	0.120
12	Chocolate Brown color	kg	0.150
13	Caps	Pcs.	6,000
14	LableWafrapect	Pcs.	6,000
15	Carton 24*24*24	Pcs.	120
16	Bottles 125 ml	Pcs.	6,000
17	Printer Hot	Pcs.	1

Note: Bach Wafrapect = 6,000 Bottles

Table (3.5) Bill of materials of product Wafrastin

Sr.no	Component Description	Unit	Qty
1	Chloropheneramine Malate	kg	0.240
2	Methyl Paraben	kg	1.08
3	Propyl Paraben	kg	0.120
4	Sucrose	kg	240
5	Glycerin	kg	30
6	Cherry flavour	kg	0.03
7	Caps	Pcs.	6,000
8	LableWafrastin	Pcs.	6,000
9	Carton 24*24*24	Pcs.	120
10	Bottles 125 ml	Pcs.	6,000
11	Printer Hot	Pcs.	1.0

Note: Bach Wafrastin = 6,000 Bottles

3.5.3 Establishing Inventory Status File:

The inventory status file provides information on the identification and quantity of items in stock.

Table (3.6) Inventory status file

Sr.No	RAW MATERIAL NAME	Unit	Starting Inventory
1	Metronidazole Benzoate	kg	1,598.00
2	Mefenamic Acid	kg	2,973.00
3	Diphenhydramine HCL	kg	21.50
4	Ammonium Chloride	kg	28.80
5	Menthol	kg	2.00
6	Tri-SodiumCitrate	kg	275.00
7	Chloropheneramine Malate	kg	16.50
8	Methyl Paraben	kg	38.30
9	Propyl Paraben	kg	55.50
10	Saccharin Sodium	kg	254.60
11	Xanthan Gum	kg	323.15
12	Polysorbate 80	kg	110.90
13	Glycerin	kg	3,112.00
14	Sorbitol (70% soiution)	kg	3,198.00
15	Propylene Glycol	kg	703.00
16	Microcrystalline Cellulose	kg	1,045.00
17	Citric acid	kg	963.00
18	Soudium Benzoate	kg	64.00
19	Soudium Citrate Dihydrate	kg	977.00
20	Mixed Fruit flavor	kg	88.00
21	Banana flavor	kg	129.00
22	Strawberry flavor	kg	62.00
23	Lemon flavor	kg	88.00
24	Orange oil flavor	kg	32.80
25	Cherry flavour	kg	1.45
26	Chocolate Brown color	kg	9.58

27	Sucrose	kg	907.00
28	Caps	kg	200,000.00
29	Printer Hot	each	74.00
30	Bottles 100 ml	each	560,000.00
31	Bottles 125 ml	each	480,000.00
32	LableWafrazole	each	40,000.00
33	LableWaframic	each	68,000.00
34	LableWafrapect	each	43,000.00
35	LableWafrastin	each	35,000.00
36	Carton 23*23*23	each	2,350.00
37	Carton 24*24*24	each	3,400.00

3.6 Running the MRP Program:

The MRP program explodes the item requirements according to the BOM file, level by level, in conjunction with the inventory records file. A released data for the net requirements orders offset to an earlier time period to account for the lead-time.

The above data has been entered into MRP Software system (In next chapter) to output reports.

3.7 Limitations:

The research aimed to determine the need for a MRP system at wafrapharma laboratories industrial firm. The scope of this study was limited to wafrapharma laboratories industrial firm and only included data from this organization.

Chapter Four

Results and Discussions

4.1 General description of Wafrapharma Laboratories:

Wafrapharma Laboratories is a governmental company. The sole shareholder of the company is the National Treasury of Promotion of Medical Services. It is a completely self-determined company with a board of directors and executive staff which execute the implementation of developmental policies with delegation of power and free hand to run the factory on economical basis.

Wafrapharma was established by the Medical Crops in 1982 with license (D) under drugs and poison act (SUDAN), also it was incorporated under the Sudanese Companies Act to produce pharmaceuticals for people Armed Forces and their faceless taking a great part in the programme of medical insurance. It also participates in the welfare of Sudanese society through a reasonable amount of products sold in the market. In 1999 the factory was belonged to the National Treasury for Promotion of Medical Services by a presidential decree. Table (4.1) shows list of products on Wafrapharma under study.

Table (4.1) Wafrapharma list of products.

No	Item	Generic name
Liquid Syrup		
1	Wafrazol 200mg/5ml susp.	Metronidazole benzoate
2	Waframic 50mg/5ml susp.	Mefenamic acid
3	Wafrapect syrup	Diphenhydramine , Ammonium chloride
4	Wafrastin syrup	Chlorphneramine maleate

4.2 Suppliers of Raw Materials:

1. China
2. India
3. S. Korea
4. Germany

5. UAE
6. Local Market

4.3 Implement MRP Program on Wafrapharma:

The Excel-Based MRP system has the following features:

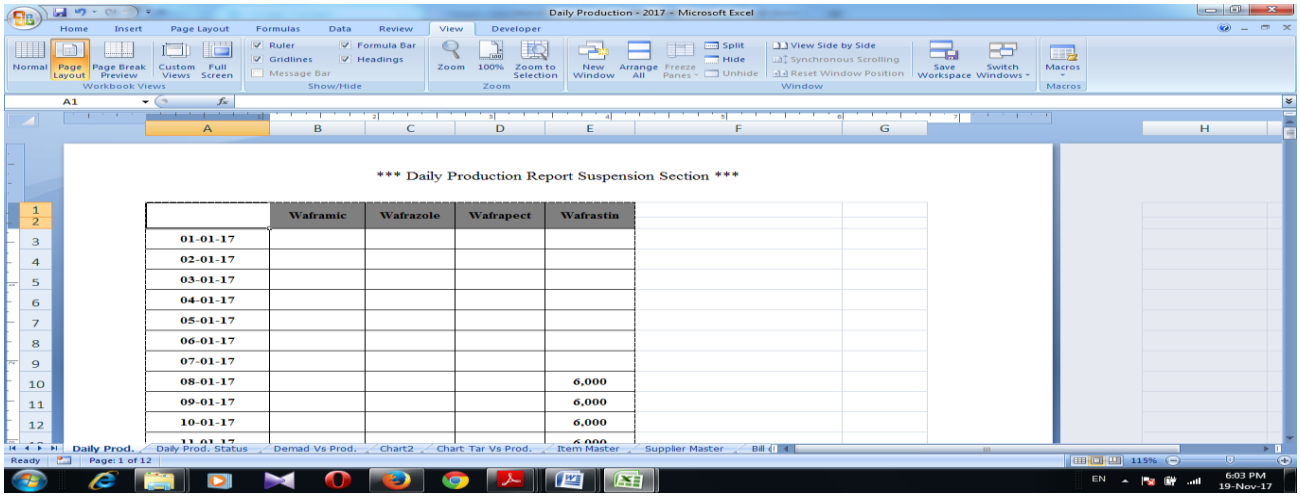
1. Demand is generated by a make-to-inventory finite schedule, but may also be from another source
2. A single level Bill of Material structure.
3. Inventory of raw material and components is allocated to the earliest scheduled product first, and will be dynamically re-allocated as the schedule changes.
4. A purchase action report identifies purchase orders which must be placed or chased to meet the schedule.

4.3.1 Overview of steps:

1. Enter Products in **Master Production Schedule** sheet.
2. Enter Raw Materials in **Raw Materials** sheet.
3. Enter Bill of Materials in **BOM** sheet.
4. Enter orders in **Orders** sheet after checking availability.
5. View Current raw material stock in **Raw Materials** sheet

4.3.2 Steps in Details:

1. Enter daily production quantity from any type of product in ***Daily Production Sheet*** fig. (4.1). In this screen you enter the daily production quantity of each product.

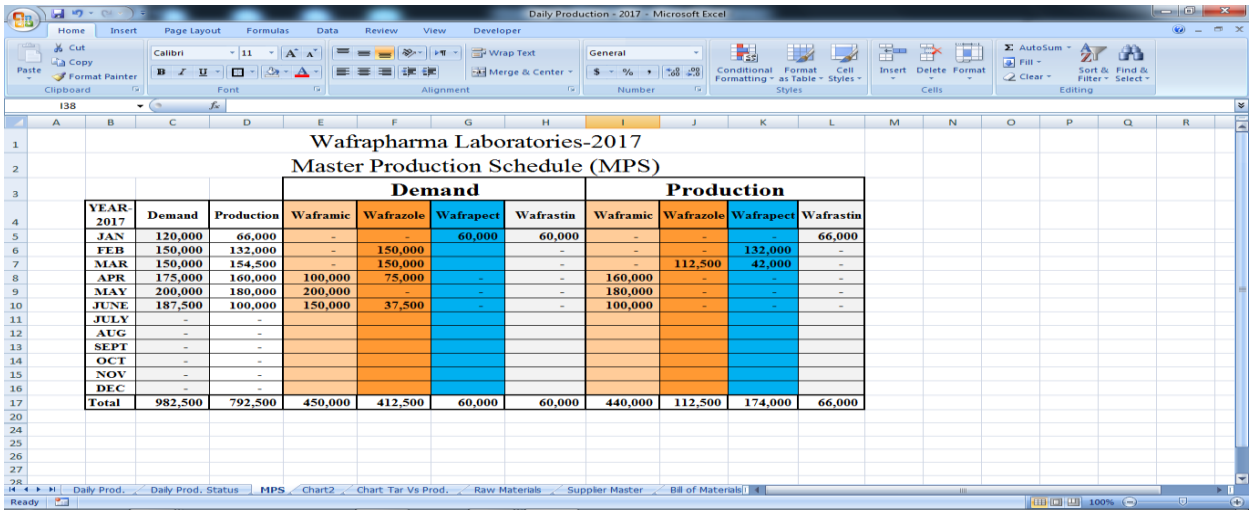


*** Daily Production Report Suspension Section ***

	Waframic	Wafrazole	Wafrapect	Wafrastin
01-01-17				
02-01-17				
03-01-17				
04-01-17				
05-01-17				
06-01-17				
07-01-17				
08-01-17				6,000
09-01-17				6,000
10-01-17				6,000

Fig (4.1) Daily Production Sheet

2. Enter Annual Demand for all products in Master Production Schedule (MPS) Sheet fig (4.2). This screen describes when each product is scheduled to be manufactured and quantities.



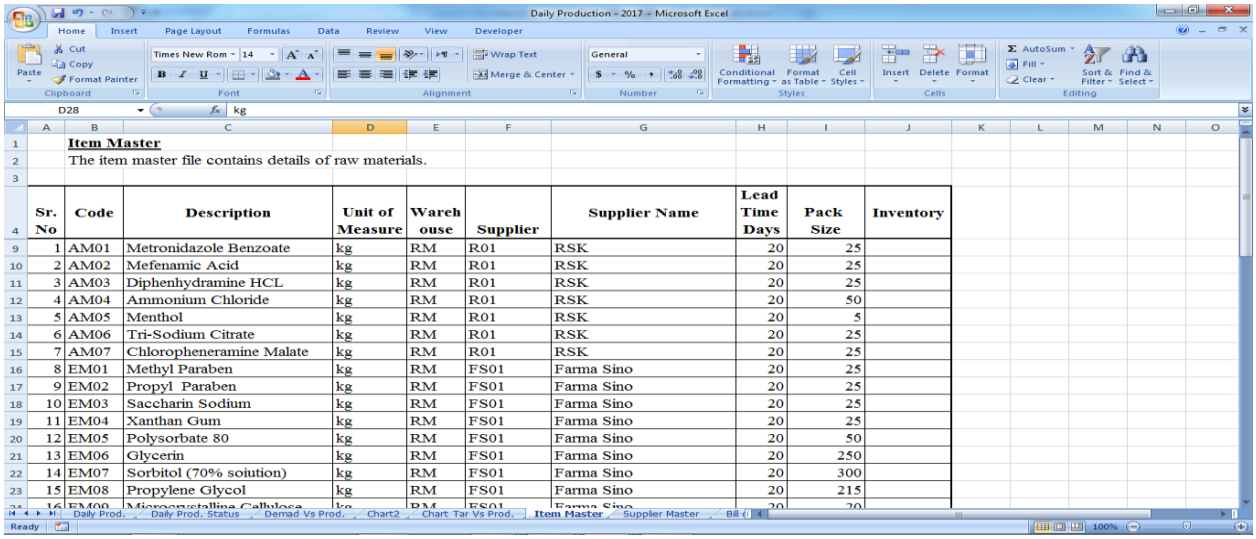
Wafrapharma Laboratories-2017

Master Production Schedule (MPS)

			Demand				Production			
YEAR-2017	Demand	Production	Waframic	Wafrazole	Wafrapect	Wafrastin	Waframic	Wafrazole	Wafrapect	Wafrastin
JAN	120,000	66,000	-	-	60,000	60,000	-	-	-	66,000
FEB	150,000	132,000	-	150,000		-	-	-	132,000	-
MAR	150,000	154,500	-	150,000		-	-	112,500	42,000	-
APR	175,000	160,000	100,000	75,000	-	-	160,000	-	-	-
MAY	200,000	180,000	200,000	-	-	-	180,000	-	-	-
JUNE	187,500	100,000	150,000	37,500	-	-	100,000	-	-	-
JULY	-	-								
AUG	-	-								
SEPT	-	-								
OCT	-	-								
NOV	-	-								
DEC	-	-								
Total	982,500	792,500	450,000	412,500	60,000	60,000	440,000	112,500	174,000	66,000

Fig (4.2) Master Production Schedule (MPS)

3. Enter list of raw materials use in the ***Raw Materials*** Sheet fig (4.3). This screen describe code, unit of measure, warehouse, supplier, lead time and pack size for each raw materials used in products Wafrazole, Waframic, Wafrapect and Wafrastin.



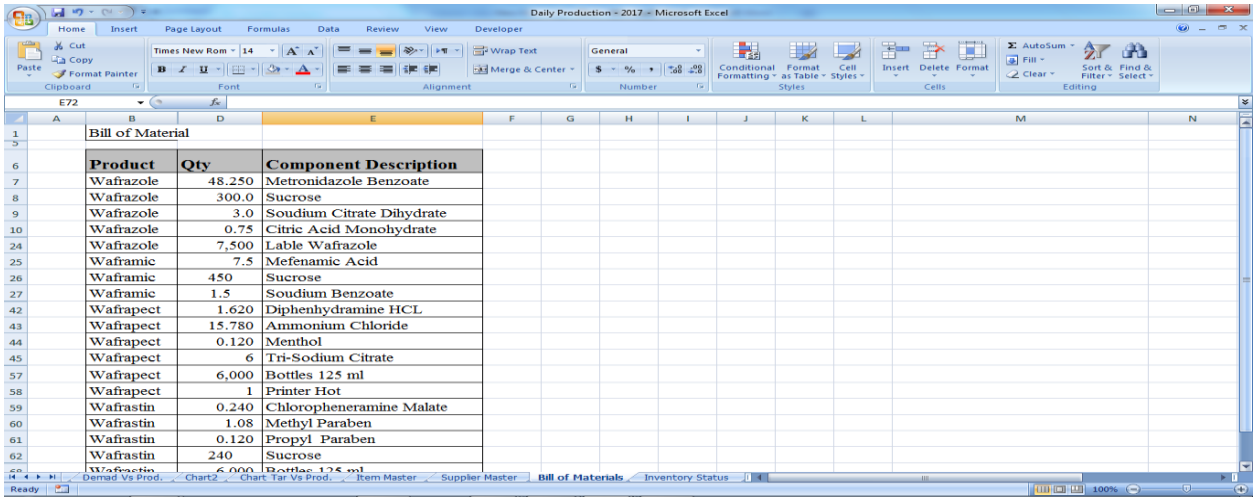
Item Master

The item master file contains details of raw materials.

Sr. No	Code	Description	Unit of Measure	Warehouse	Supplier	Supplier Name	Lead Time Days	Pack Size	Inventory
1	AM01	Metronidazole Benzoate	kg	RM	R01	RSK	20	25	
2	AM02	Mefenamic Acid	kg	RM	R01	RSK	20	25	
3	AM03	Diphenhydramine HCL	kg	RM	R01	RSK	20	25	
4	AM04	Ammonium Chloride	kg	RM	R01	RSK	20	50	
5	AM05	Menthol	kg	RM	R01	RSK	20	5	
6	AM06	Tri-Sodium Citrate	kg	RM	R01	RSK	20	25	
7	AM07	Chloropheneramine Malate	kg	RM	R01	RSK	20	25	
8	EM01	Methyl Paraben	kg	RM	FS01	Farma Sino	20	25	
9	EM02	Propyl Paraben	kg	RM	FS01	Farma Sino	20	25	
10	EM03	Saccharin Sodium	kg	RM	FS01	Farma Sino	20	25	
11	EM04	Xanthan Gum	kg	RM	FS01	Farma Sino	20	25	
12	EM05	Polysorbate 80	kg	RM	FS01	Farma Sino	20	50	
13	EM06	Glycerin	kg	RM	FS01	Farma Sino	20	250	
14	EM07	Sorbitol (70% soiution)	kg	RM	FS01	Farma Sino	20	300	
15	EM08	Propylene Glycol	kg	RM	FS01	Farma Sino	20	215	

Fig (4.3) Raw Materials Sheet

4. Enter Bill of Materials (BOM) in ***BOM*** sheet fig (4.4). This screen lists exactly the parts or materials required to make products Wafrazole, Waframic, Wafrapect and Wafrastin.



Bill of Material

Product	Qty	Component Description
Wafrazole	48.250	Metronidazole Benzoate
Wafrazole	300.0	Sucrose
Wafrazole	3.0	Soudium Citrate Dihydrate
Wafrazole	0.75	Citric Acid Monohydrate
Wafrazole	7,500	Lable Wafrazole
Waframic	7.5	Mefenamic Acid
Waframic	450	Sucrose
Waframic	1.5	Soudium Benzoate
Wafrapect	1.620	Diphenhydramine HCL
Wafrapect	15.780	Ammonium Chloride
Wafrapect	0.120	Menthol
Wafrapect	6	Tri-Sodium Citrate
Wafrapect	6,000	Bottles 125 ml
Wafrapect	1	Printer Hot
Wafrastin	0.240	Chloropheneramine Malate
Wafrastin	1.08	Methyl Paraben
Wafrastin	0.120	Propyl Paraben
Wafrastin	240	Sucrose

Fig (4.4) Bill of Materials (BOM) sheet

5. Display Inventory Status in ***Inventory Status*** sheet fig (4.5). This screen shows the following:

a. Starting Inventory: Displays the current stock level of each raw material in beginning of the year 2017.

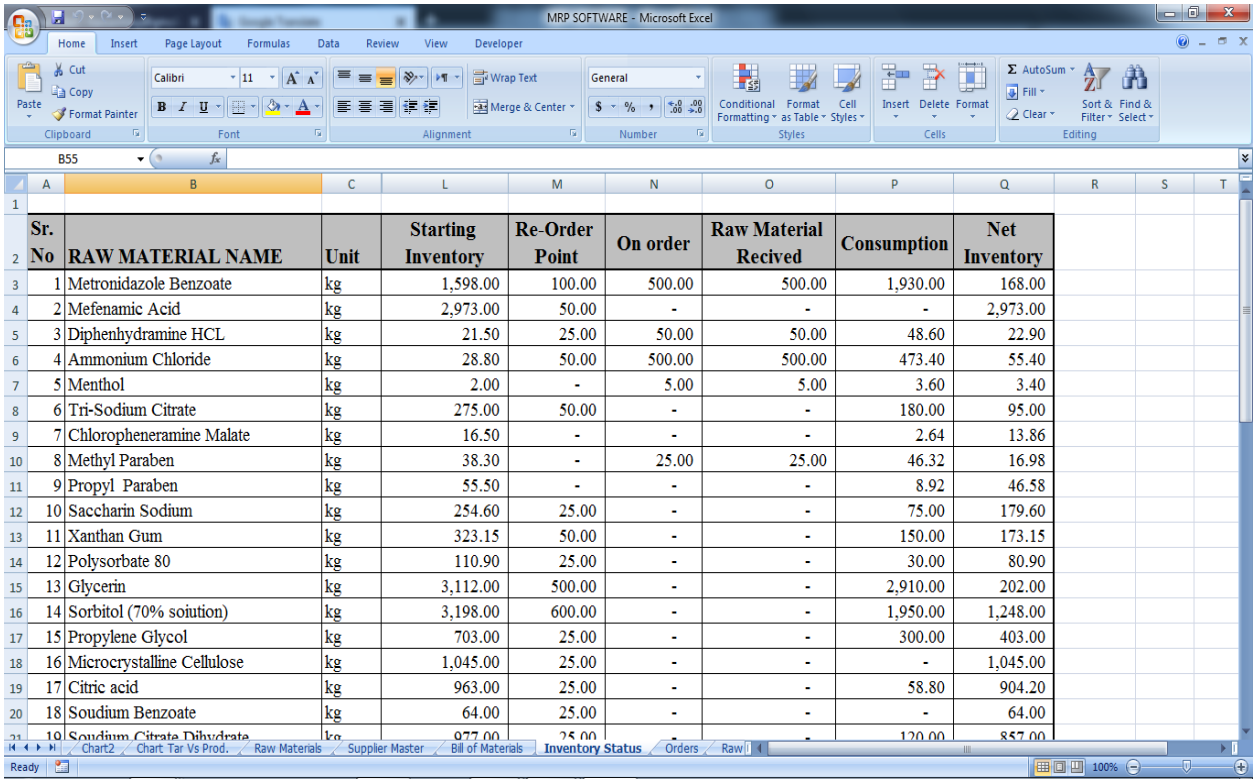
b. Re-Order Point: Displays re-order points for each raw material.

c. On order: Displays name and quantity of each raw material.

d. Raw Material Received: Displays quantity of each raw material received.

e. Consumption: Displays quantity of each raw material used in production.

f. Net Inventory = Starting Inventory + Raw Material Received – Consumption.

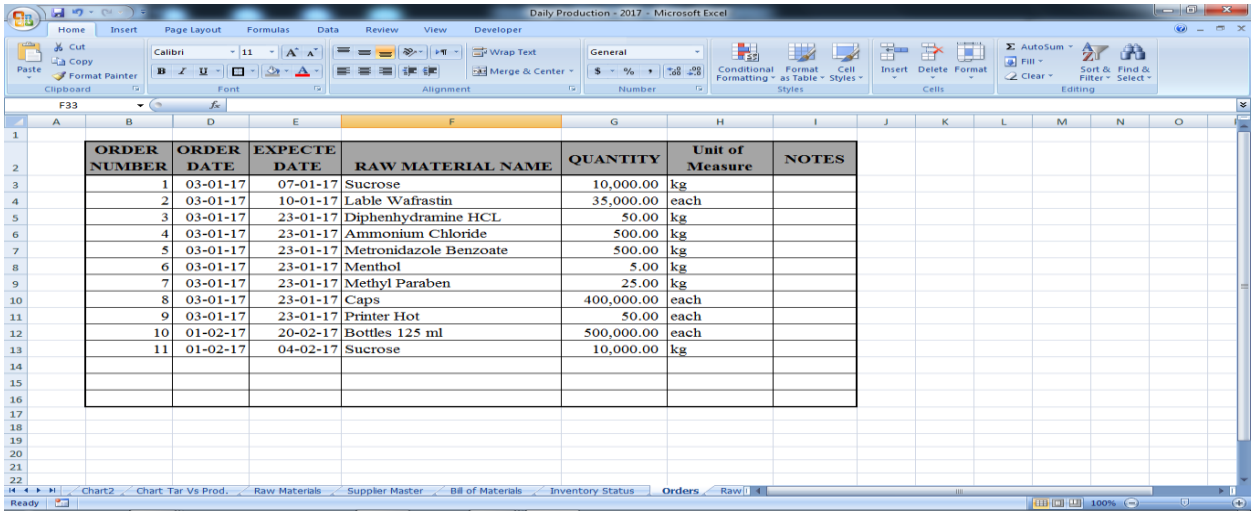


Sr. No	RAW MATERIAL NAME	Unit	Starting Inventory	Re-Order Point	On order	Raw Material Recived	Consumption	Net Inventory
1	Metronidazole Benzoate	kg	1,598.00	100.00	500.00	500.00	1,930.00	168.00
2	Mefenamic Acid	kg	2,973.00	50.00	-	-	-	2,973.00
3	Diphenhydramine HCL	kg	21.50	25.00	50.00	50.00	48.60	22.90
4	Ammonium Chloride	kg	28.80	50.00	500.00	500.00	473.40	55.40
5	Menthol	kg	2.00	-	5.00	5.00	3.60	3.40
6	Tri-Sodium Citrate	kg	275.00	50.00	-	-	180.00	95.00
7	Chloropheneramine Malate	kg	16.50	-	-	-	2.64	13.86
8	Methyl Paraben	kg	38.30	-	25.00	25.00	46.32	16.98
9	Propyl Paraben	kg	55.50	-	-	-	8.92	46.58
10	Saccharin Sodium	kg	254.60	25.00	-	-	75.00	179.60
11	Xanthan Gum	kg	323.15	50.00	-	-	150.00	173.15
12	Polysorbate 80	kg	110.90	25.00	-	-	30.00	80.90
13	Glycerin	kg	3,112.00	500.00	-	-	2,910.00	202.00
14	Sorbitol (70% soiution)	kg	3,198.00	600.00	-	-	1,950.00	1,248.00
15	Propylene Glycol	kg	703.00	25.00	-	-	300.00	403.00
16	Microcrystalline Cellulose	kg	1,045.00	25.00	-	-	-	1,045.00
17	Citric acid	kg	963.00	25.00	-	-	58.80	904.20
18	Soudium Benzoate	kg	64.00	25.00	-	-	-	64.00
19	Soudium Citrate Dihydrate	kg	977.00	25.00	-	-	120.00	857.00

Fig (4.5) Inventory Status sheet

6. Display primary reports in ***Orders*** sheet fig (4.6).This screen shows the following:

6.1 Order Date: Date when the order is placed.
6.3Expected Date: Date when the inventory is impacted.
6.3 Raw Material Name: Enter name of items on the order.
6.4 Quantity: Enter quantity of items on the order.



ORDER NUMBER	ORDER DATE	EXPECTE DATE	RAW MATERIAL NAME	QUANTITY	Unit of Measure	NOTES
1	03-01-17	07-01-17	Sucrose	10,000.00	kg	
2	03-01-17	10-01-17	Lable Wafrastin	35,000.00	each	
3	03-01-17	23-01-17	Diphenhydramine HCL	50.00	kg	
4	03-01-17	23-01-17	Ammonium Chloride	500.00	kg	
5	03-01-17	23-01-17	Metronidazole Benzoate	500.00	kg	
6	03-01-17	23-01-17	Menthol	5.00	kg	
7	03-01-17	23-01-17	Methyl Paraben	25.00	kg	
8	03-01-17	23-01-17	Caps	400,000.00	each	
9	03-01-17	23-01-17	Printer Hot	50.00	each	
10	01-02-17	20-02-17	Bottles 125 ml	500,000.00	each	
11	01-02-17	04-02-17	Sucrose	10,000.00	kg	

Fig (4.6) Orders sheet

7. Display primary reports in graphic fig (4.7).

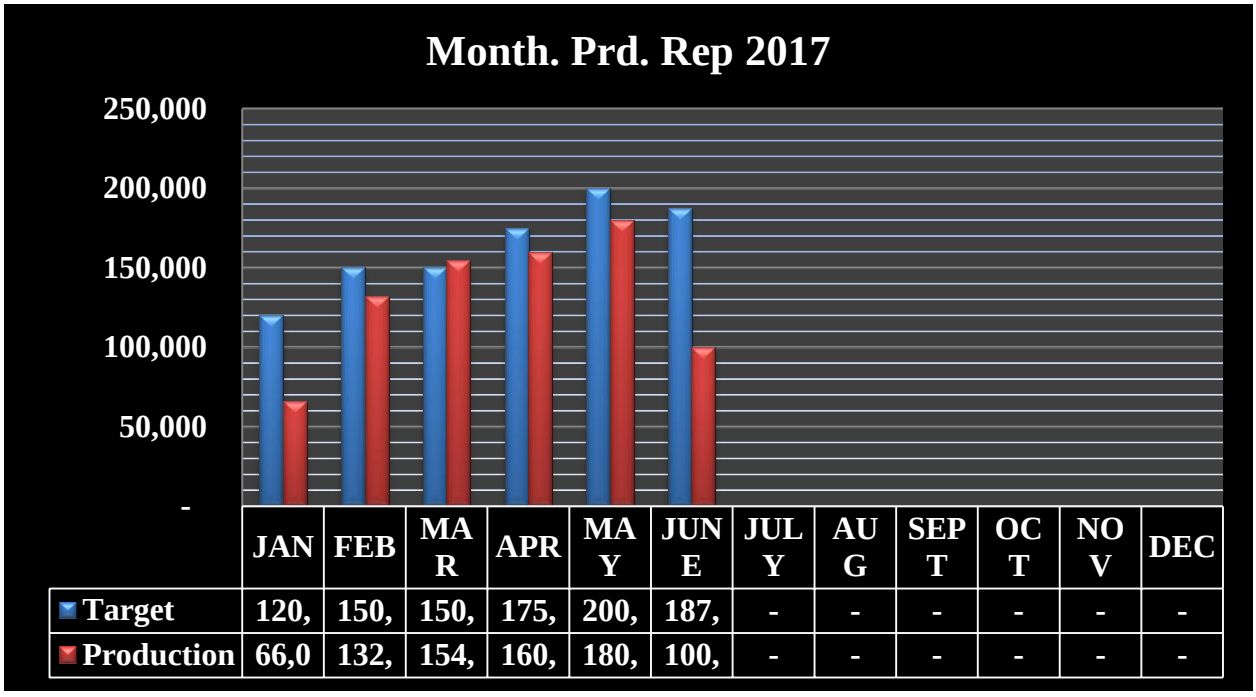


Fig (4.7) primary reports in graphic

8. Display secondary reports in ***Daily Production Status*** sheet Table (4.1).This screen shows quantity of the target production of each product and the quantity actually produced from each product and the percentage of execution.

Table (4.1) Daily Production Status sheet

Year-2017	Waframic	Wafrazole	Wafrapect	Wafrastin	Total
Target	450,000	412,500	60,000	60,000	982,500
Production	440,000	112,500	174,000	66,000	792500
Target Achieved%	98%	27%	290%	110%	81%

9. Display Comparison Production (20016~2017) in ***Comparison Production*** sheet table (4.2). This screen shows a comparison between the production of 2016 and 2017 for each product.

Table (4.2) Comparison Production Sheet

Year	Waframic	Wafrazole	Wafrapect	Wafrastin	Total
2016	400,000	150,000	36,000	-	586,000
2017	440,000	112,500	174,000	60,000	786,500

Chapter Five

Conclusions and Recommendations

5.1 Conclusions:

At the end of this research the following can be concluded:-

1. The result of MRP applications in wafrapharma laboratories industrial firm is create direct relationship and link between production management and stores.

2. The result of MRP applications in wafrapharma laboratories industrial firm is avoiding raw material expiration.

3. The result of MRP applications in wafrapharma laboratories industrial firm is calculation the amount and type of material required in the production of the final product and scheduling purchasing and manufacturing orders.

4. The result of MRP applications in wafrapharma laboratories industrial firm is to provide the demanded quantities on demanded times and avoiding storage.

5.2 Recommendations:

From this research of got some recommendations represented in:

1. Establish prerequisite data base to provide the essential inputs for this system.
2. Develop a program to qualify employees to apply the MRP system in the firm.
3. Implement MRP system on all production divisions in wafrapharma laboratories industrial firm.

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