

# **EVOLUTION OF MRP-TYPE SYSTEMS**

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## 7. MANUFACTURING RESOURCE PLANNING AND ENTERPRISE RESOURCE PLANNING SYSTEMS: AN OVERVIEW

### 7.1 EVOLUTION STAGES OF MRP-TYPE SYSTEMS

Material Requirements Planning (MRP), combined with computer technology gave the most adequate successful computerized production requirement system.

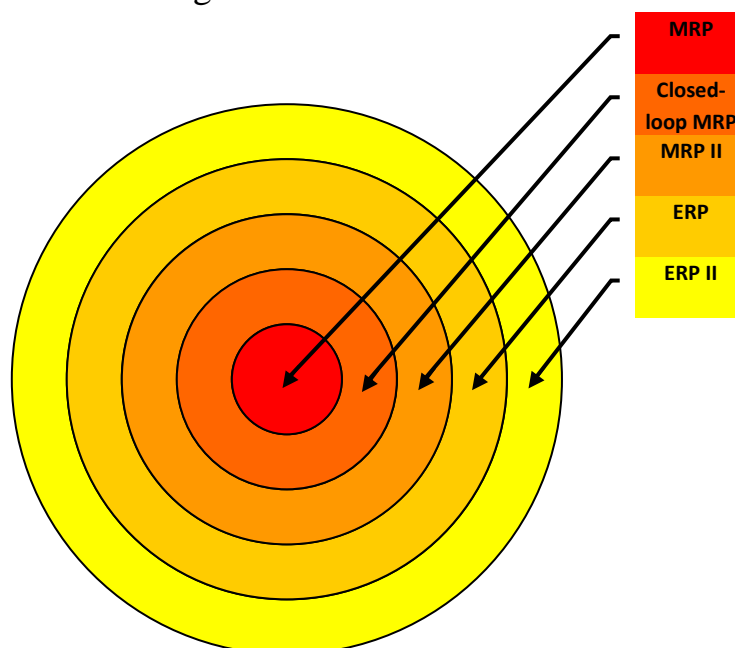
No doubt, production requirements techniques always need a lot more due to the competition in businesses and the growing requirements of manufacturing systems. Thus, MRP systems are developed with the time to be capable to cover these growing requirements.

As a result, this led to generate a series of MRP-type systems through the following five evolution stages:-

1. Evolution stage I: Material Requirements Planning (MRP).
2. Evolution stage II: Closed- loop MRP.
3. Evolution stage III: Manufacturing Resource Planning (MRP II).
4. Evolution stage IV: Enterprise Resource Planning (ERP).
5. Evolution stage V: Enterprise Resource Planning Extended (ERP II).

Practically, MRP is still in use as the core (central module) in all of MRP-type systems and the other modules in all of these systems are built around this core. The stages of MRP-type systems evolution can be represented as shown in *Figure (7.1)*.

In this chapter these systems and their developments are explained consequently according to their evolution stages.



**Figure (7.1)** The Evolution Stages of MRP-type Systems

### 7.1.1- Evolution Stage I: Material Requirements Planning

Material Requirements Planning system is primarily designed to handle ordering and scheduling of dependent demand inventories in terms of raw materials, component parts... etc. But ordering and scheduling of assembled products is not an easy process, it needs to maintain track of the enormous number of inventories, and to differentiate between "*dependent*" and "*independent*" demand.

#### Benefits of MRP

MRP users reported many benefits among these:-

1. Reduction in inventory.
2. Improved customer service.
3. Quicker response to changes in demand and in the MPS.
4. Reduce set-up and product changeover costs.
5. Better machine utilization.
6. Increased sales and reduction in sales price.

#### Limitations of MRP

It is great that MRP is a super power computerized tool offering its users the benefits listed hereabove, but they faced the following limitations in Practice:-

1. It assumed the infinite capacity is available, and that suppliers always delivered correctly and at time. It caused the MRP processor to generate schedules and requirements that could not be accomplished by the factory.
2. It is an "*open-loop*" system that sent plans to purchasing and production personnel but could not receive feedback. As a result, adjustment could not be made to plans in order to keep the schedules valid.
3. It generates valid schedules in the sense that they follow logically from the demand. But practically after planned orders are launched, some of planning factors may be changed.
4. When any change in demand fed to the system, it became "*nervous*" and causes an excessive amount of re-planning.

### 7.1.2- Evolution Stage II: Closed-loop MRP

MRP was initially developed without any capacity checks or input from other departments. Thus, the production plan often was not believable to anyone outside of production function. "*Closed-loop MRP*" is an enhancement that includes capacity checks. Which are used interactively with the master production schedule and the component production plans (from MRP), to generate feasible schedules.

Closed-loop MRP made feedback possible by including schedule, rescheduling actions and "*Shop Floor Control*" (SFC), thus it "*closed the loop*" to overcome the fundamental weakness of "*open-loop MRP*".

### **7.1.3- Evolution Stage III: Manufacturing Resource Planning**

Manufacturing Resource Planning (MRP II) is essentially extended form of closed-loop MRP that also includes strategic planning processes, "*business planning*", and a number of other business functions such as human resources planning, profit calculations and cash flow analysis.

Obviously, the initial intent for MRP II was to plan and monitor all resources of a manufacturing organization; manufacturing, marketing, finance, and engineering, through a closed-loop system generating financial figures. The second important intent of MRP II concept was that it "*simulates*" the manufacturing system.

Practically, both above involved in new MRP II systems which represent a companywide system.

#### **The Structure of MRP II**

The technical differences between closed-loop MRP and MRP II are small compared to the real significant functional difference. *Figure (7.2)* shows the schematic diagram of MRP II.

Practically, MRP II requires several additions to the inputs of the system, the key one is bill of materials. MRP II requires extending the bill of materials to include all the details of the resources needed to produce one unit of product. Those included are mainly; labor, machinery, tools, space and materials. In fact it will be a "*Bill of Resources*" (BOR), which can be used by MRP II to project shortages at specific times, giving departments advance notice of required remedial action, like need to hire or train labor, need for support resources.

MRP II can keep track of machine loads and whether there is a need for more machines or subcontractors, or not. Also MRP II treats cash flow almost like materials. The system calculates the cost of all planned order releases and creating a cash flow forecast. This includes payments to suppliers, wages, power and all other costs associated with production. The additional functions of MRP II, means it includes extra modules to those included in closed-loop MRP. The extra modules generate extra feedback loops.

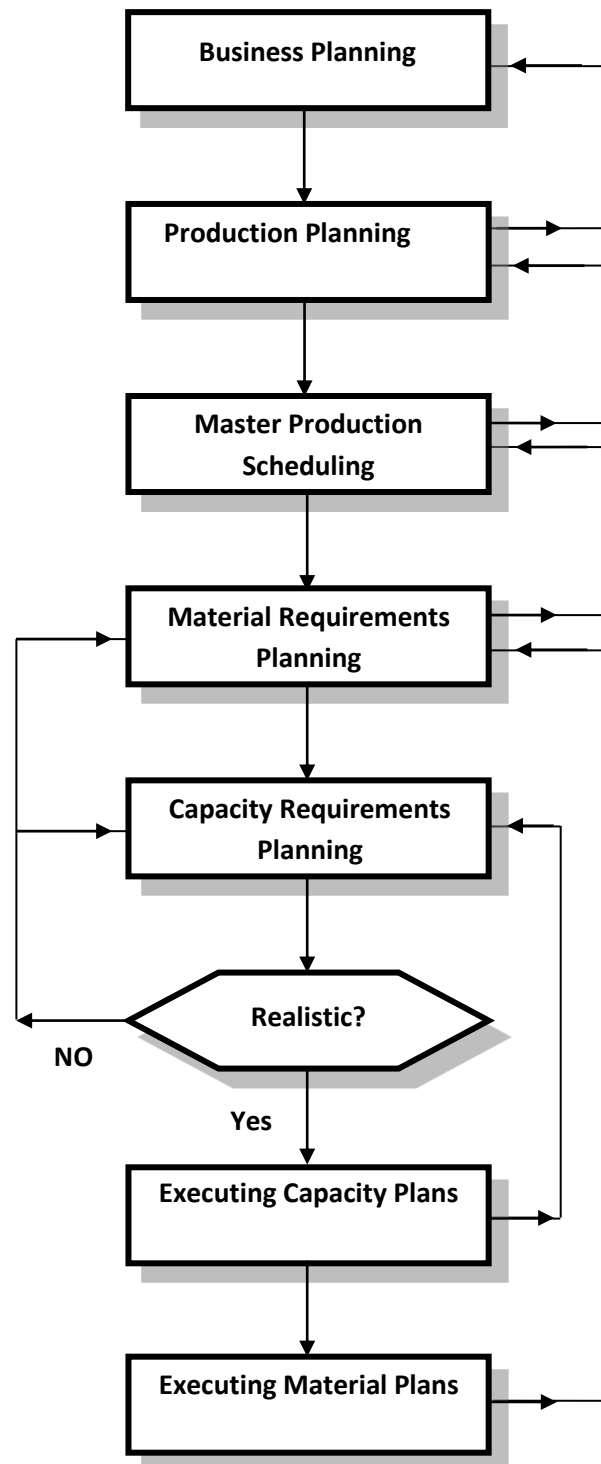


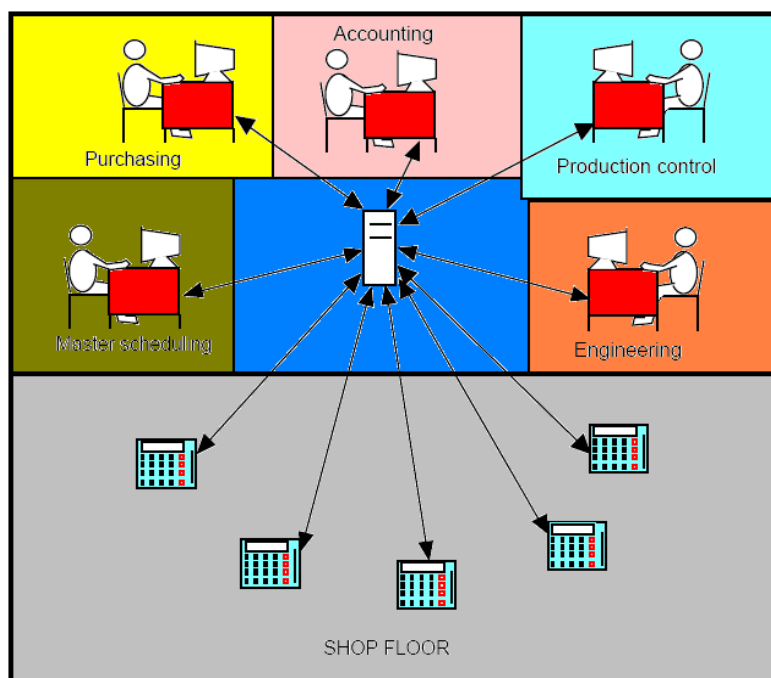
Figure (7.2) Schematic Diagram of MRP II

## Characteristics of MRP II

The characteristics of MRP II can be described as follows:-

1. The operating and financial system is one and the same. They use the same transactions, they use the same numbers. The financial figures are merely extensions of the operating numbers.
2. It has a "what if" capability, since a good system is a simulation of reality, it can be used to simulate what would happen if various policy decisions were implemented. This facility can be carried out at master production scheduling stage.
3. It is a whole company system now, involving every facet of the business because the things that MRP II is concerned with (sales, production, inventories schedules, cash flow...etc) are the very fundamentals of planning and controlling a manufacturing or distribution business.

These characteristics mean that MRP II effectively builds a computer-based planning model of the organization and gives it an opportunity to use single database, which is accessed and used by the whole company according to individual functional requirements. This enables the various departments of the organization, to effectively share information and communicate with each other. *Figure (7.3)* shows how the different departments connected to a single database, which means that the changes are available to everyone on the system as soon as they are made, and everyone has access to the same data. The terminals on the shop floor provide a feedback loop that updates the files on the status of work in process.



**Figure (7.3)** Different Departments Connected to a Single Database

MRP II allows everyone in the company (marketing staff, production, accounting .....etc) to work with the same "game plan", using the same valid numbers to run the business, and is capable of simulation to plan and test alternative strategies.

MRP II software vendors kept adding modules, to stay ahead of computers. A finite scheduling module, capable of incorporating capacity constraints into the planning mix is frequently available in some MRP II packages.

In reality, many systems have been developed and sold by many software and consulting firms. Efforts continued in MRP II systems along the lines of modification by adding and/or improving the existing modules.

### **Benefits of MRP II**

Most of the companies that implement MRP II successfully have realized many significant benefits. In the narrow sense, the chief benefit of MRP II is its ability to generate valid schedules and keep them that way. A valid schedule has different benefits for the entire company, including the following.

1. It improves on-time completions. Industry calls this improving customer service, and on-time completion is one good way to measure it. MRPII companies typically achieve 95% or more on-time completion.
2. It cuts inventories. With MRP II, inventories can be reduced at the same time a customer service is improved. Stocks are cut because parts are not ordered if not needed to meet requirement for parent items. Typically gains are 20 to 35 %.
3. It provides data (future orders) for planning work center capacity requirements. This benefit is attainable because the basic MRP is enhanced by a capacity requirements planning.
4. It improves direct-labor productivity. There is less lost time and overtime because of shortages and less need to wait time due to stopping one job to set-up for a "shortage-list job" or "hot job". Reduction in lost time tends to be from 5 to 10% in fabrication and from 25 to 40% in assembly. Overtime cuts are greater, on the order of 50 to 90%.
5. It improves productivity of support staff. Purchasing can spend time saving money and selecting good suppliers. Materials management can maintain valid records and better plan inventory needs. Production control can keep priorities up-to-date. Supervisors can better plan capacity and assign jobs. In some cases, fewer support staff are needed.
6. It facilitates closing the loop with total business planning. That includes planning capacity and cash flow, which is the chief purpose and benefit of MRPII.

### 7.1.4- Evolution Stage IV: Enterprise Resource Planning

The term Enterprise Resource Planning (ERP) was coined in 1990's to describe the latest developments in resource planning. In the light of the increasingly complex requirements of a global manufacturing environment, ERP introduced among other things, extensive multi-site management and communications functionality to the realm of resource planning.

However, there is a tendency within the operations management field to consider ERP as a natural extension of MRP II. ERP systems expand the concept of MRP II, and the key difference between MRP II and ERP is that while MRP II has traditionally focused on the planning and scheduling of internal resources, ERP strives to plan and schedule supplier resources as well, based on the dynamic customer demands and schedules. The modular functionality commonly found in ERP system includes enhanced functionality of all of the modules of MRP II systems, as well as "*Electronic Data Interchange*" (EDI), Engineering change control, Project Management and control, and service control. The typical ERP system can be called as an umbrella system.

Practically, among the most important attributes of ERP is its ability to; automate and integrate an organization's business processes, share common data and practices across the entire enterprise and produce and access information in a real-time environment.

#### Characteristics of ERP system

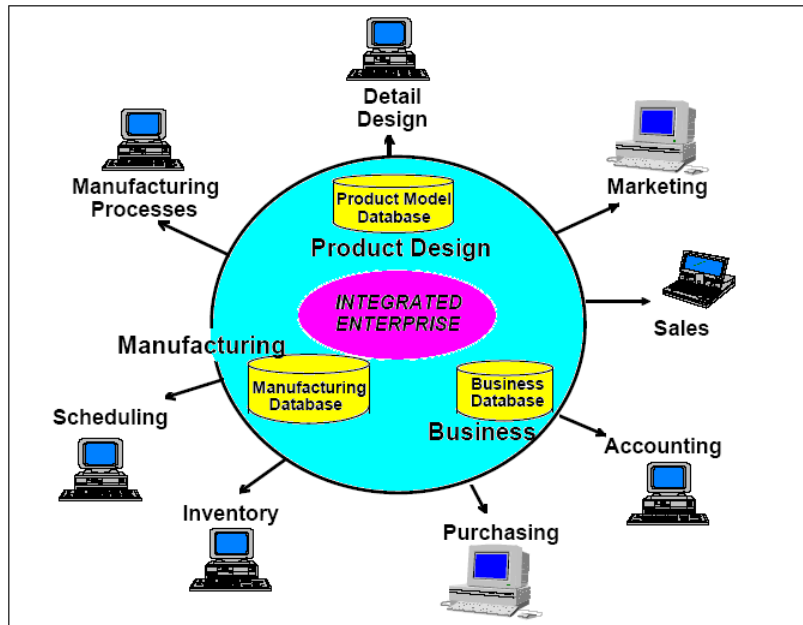
ERP systems have the following characteristics:-

1. ERP systems are packaged software designed for a "*client/server*" environment.
2. ERP systems integrate the majority of a business's process.
3. ERP systems process a large majority of an organization's transactions.
4. ERP systems use an enterprise-wide database that typically stores each piece of data once.
5. ERP systems allow access to the data at real time

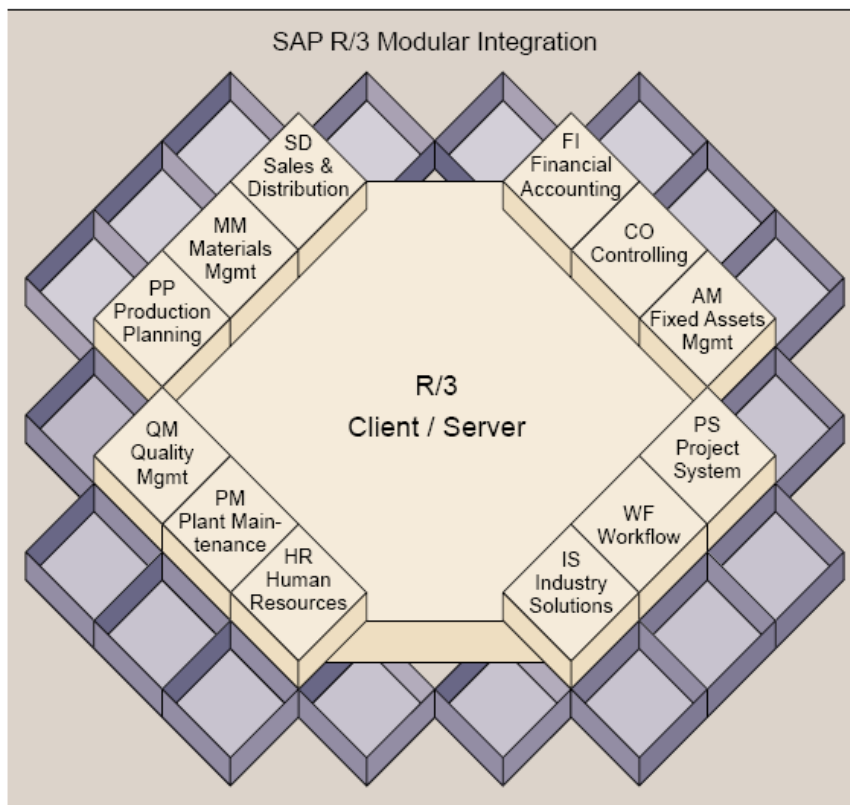
However, client/server environment means that users have personal computers with functional modules of ERP system on their desks, while the large database is kept centrally. Client/server system can be expanded reasonably easily at low cost. This computer network system has the ability to link data from different server types. The information access linkages also connect database from different server types. In addition client/server system can also link servers in distant locations. ERP use "*Local Area Network*" (LAN) technology to local servers and "*Wide Area Network*" (WAN) technology to wide distance locations. *Figure (7.4)* shows an Enterprise client/server



model. The popularity of ERP systems started to soar when SAP, a German based company, released its next generation software known as R/3. ERP systems may include a wide range of functionality. The components of such systems are often referred to as modules *Figure (7.5)* shows the integration of the different modules of SAP's R/3 system, that includes the following modules



**Figure (7.4)** The Enterprise Client/ Server Model



**Figure (7.5)** Modules of SAP R/3 system

### 7.1.5- Evolution Stage V: Enterprise Resource Planning Extended

Enterprise Resource Planning Extended (ERP II) is the last generation of MRP-type systems. It is a development or an extension of ERP systems. The new systems included extra modules which gave ERP II systems the following characteristics:-

1. Integrated systems that cover the firm's entire value by transition from an internal view of the firm to business network vision.
2. "*Electronic commerce*" by developing "HTML" interfaces for the internet/internet and supporting complete commercial transactions.
3. Applications with an object-oriented structure by transition from a highly integrated structure to modules with a higher complementarity and "*plug and play*" facilities.