

Module – 5

Materials Requirement Planning And Enterprise Resource Planning

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**(As per Syllabus of MBA (SCM), MBA(HRM)
Semester – II)**

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Part – I of II

Material Requirements Planning (MRP) - Introduction

Materials requirements planning (MRP) system is a software-based solution that works backwards from customer orders to determine when materials will be needed for production and then initiates their purchase to have delivery coincide with upcoming manufacturing runs and scheduled product delivery dates. It plans production, schedules raw material purchase and delivery, and manages completed inventory levels.

Since customers want and expect products to be delivered in a timely manner, manufacturers work to ensure they have enough inventory on hand to meet that demand, without going overboard.

MRP System - Basics

An MRP system is designed to do three main things:

1. Make sure raw materials and component parts are always on-hand for production, to keep the production schedule running smoothly
2. Support just-in-time (JIT) production by enabling the lowest levels of materials and inventory to be available and still keep production on track
3. Plan production schedules to meet customer demand for products in a timely manner.

Controlling Costs

By managing materials and inventory levels, MRP systems help prevent revenue loss, which can happen when:

- Insufficient raw materials on-hand prevents scheduled production and customer delivery deadlines to be missed, causing contracts to be cancelled
- Overbuying raw materials causes cash to be tied up and unavailable for use in other areas of the company, such as hiring, marketing, or shipping
- Excess inventory risks product obsolescence and ties up cash that could be used elsewhere in the business

By connecting raw material delivery to production schedules and customer purchases, MRP systems keep production running smoothly.

History of MRP

The MRP concept was developed by Joseph Orlicky, PhD, while at J.I. Case to compete with Toyota's new lean production system. Early in its development, MRP was a basic production control system that required arithmetic, not computing power. Once converted to computer, it became faster and more accurate. Black & Decker was the first company to test the technology, back in 1964.

The next generation of MRP, referred to as MRP II, incorporates data from outside manufacturing, including human resources, finance, accounting, and marketing, to create a more holistic system.

Material Requirement Planning – Concept and Definition

Material requirement planning is a system based approach, which organizes all necessary production material. Material Requirements Planning, abbreviated as MRP is a straightforward system to calculate arithmetically the requirements of the input materials at different points of time based on actual production plan. Theorists described MRP as a planning and scheduling system to meet time-phased materials requirements for production operations. It is a set of techniques that calculate the requirement of all items structured in bill of material. The calculated requirements are based on the quantity and timing requirement of end items listed in master production schedule. The item calculation requirement is based on the master production schedule, the bill of material

file and the item master file (Toomey, 1996). The main intent of is to meet the delivery schedule of finished products as specified in the master production schedule. MRP is a material planning method that developed in the decade of 1970 that utilized computer technology.

Material requirement planning is an information system for production planning based on inventory management. It is stated in management studies that Information Technology has major role in designing and implementing Material Requirements Planning systems and processes as it provides information about manufacturing needs 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. The main traits of MRP are the creation of material requirements via exploding the bills of material, and time-phasing of requirements using posted average lead times. MRP II was developed as the second generation of MRP and it features the closed loop system: production planning drives the master schedule which drives the material plan which is the input to the capacity plan. Feedback loops provide input to the upper levels as a reiterative process.

The *Vital Components of Material Planning* include the following:

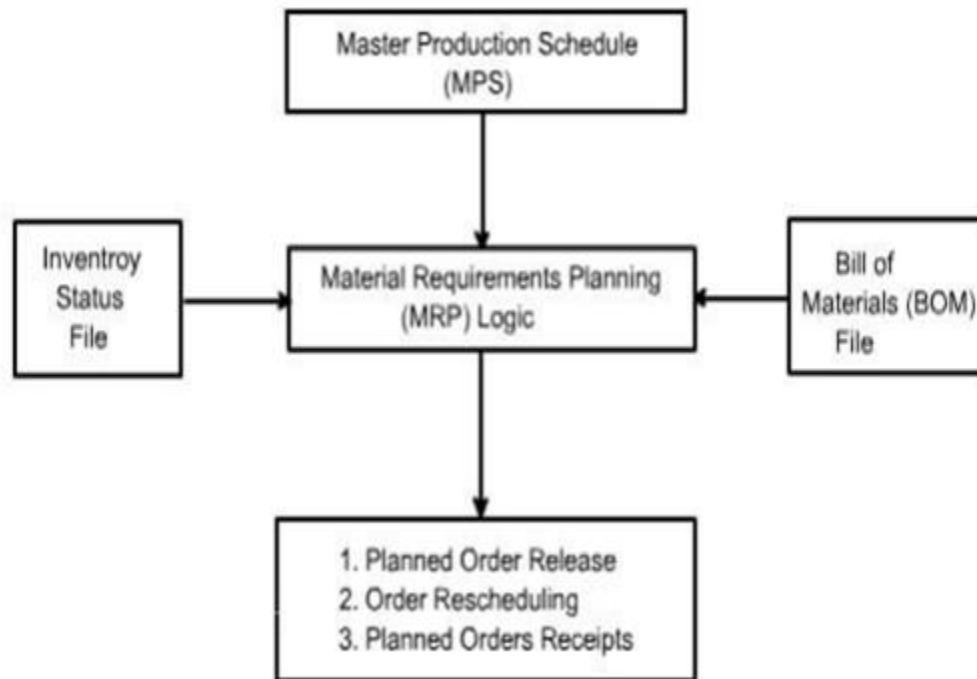
1. Material planning provides information that all the required raw material and products are available for production.
2. Material planning guarantees that inventory level is maintained at its minimum levels. But also ensures that material and product are available whenever production is scheduled, therefore, helping in matching demand and supply.
3. Material planning provides information of production planning and scheduling but also provides information around dispatch and stocking.

Objectives / Goal of MRP

The goal of the Material Requirements Planning document is to supply information that will facilitate the company to have enough inventory on hand to fulfil demand, available only when needed at a quality level that meets specification, (and at the lowest price. A good Material Requirements Planning program can offer the fundamental needs of keeping inventory levels low and fulfilling customer expectations for on time delivery. Major objectives are as under:

1. *Reduction in Inventory Cost:* MRP offers accurate quantity of material at right time to meet master production schedule to avoid the cost of excessive inventory.
2. *Meeting Delivery Schedule:* By minimizing the delays in materials procurement, production decision making, MRP assists evade delays in production thereby meeting delivery schedules more consistently.
3. *Improved Performance:* By stream lining the production operations and minimizing the unplanned interruptions, MRP focuses on having all components available at right place in right quantity at right time.

Material Requirements Planning System Architecture - Basics



Master Production Schedule: MPS is designed to fulfil the market demand that include company orders and forecasted demand in future in the taken planning horizon. MPS mainly represents the complete delivery schedule of the end products. However, orders for replacement components can also be included in it to make it more comprehensive.

Bill of Materials File: This symbolizes the product structure. It includes information about all sub components needed, their quantity, and their sequence of develop in the end product. Information about the work-centres performing build-up operations is also included in it (Toomey, 1996).

Inventory Status File: Inventory status file maintains recent record of each item in the inventory. Information such as, item identification number, quantity on hand, safety stock level, quantity already allocated and the procurement lead time of each item is recorded in this file.

After getting input from these sources, MRP logic processes the available information and gives information about the following:

Planned Orders Receipts: This is the order quantity of an item that is planned to be ordered so that it is received at the beginning of the period under consideration to meet the net requirements of that period. This order has not yet been placed and will be placed in future.

Planned Order Release: This is the order quantity of an item that is planned to be ordered in the planned time period for this order that will ensure that the item is received when needed. Planned order release is determined by offsetting the planned order receipt by procurement lead time of that item.

Order Rescheduling: This emphasizes the need of any expediting, de-expediting, and cancellation of open orders etc. in case of unexpected situations.

Basic Steps in Material Requirement Planning are as follows:

1. Identifying requirement.
2. Running MRP- creating the suggestion.
3. Firming the suggestion.

Material Requirements Planning solution consist of modules for inventory management, product definition and costing, master scheduling and materials requirement planning, capacity planning, work order management, purchase order management, sales order management, shipping and receiving, and sales analysis. Material requirements planning software can also include a full accounting package, if desired.

Advantages of MRP

Material requirement planning is framework to give valuable information for decision makers. Main benefits from any MRP system are the capability of the inventory planner to use the information well. The particular benefits of MRP include the following:

1. Increased customer service and satisfaction
2. Improved utilization of facilities and personnel
3. Better inventory planning and scheduling
4. Faster response to market changes and shifts
5. Reduced inventory levels without reduced customer service

Major issues of using procedure of Material requirements planning are that they are not fully perfect. If there is some error in the system, then it is going to throw off all the other numbers thus making the outputted data inaccurate. The issue with MRP systems is the integrity of the data. If there are any errors in the inventory data, the bill of materials, that are called 'BOM data, or the master production schedule, then the outputted data will also be incorrect. Data integrity is impacted by imprecise cycle count adjustments, mistakes in receiving input and shipping output, scrap not reported, waste, damage, box count errors, supplier container count errors, production reporting errors, and system issues. Many of these types of errors can be minimized by implementing pull systems and using bar code scanning. Most sellers of this type of system recommend at least 99% data integrity for the system to give valuable results. Another problem is that Material requirements planning systems do not necessarily factor in other warehouses in other cities or states. Therefore, the system will explain that company do not need to order anymore parts when in fact those parts are in other factories. Other major factor is that the MRP system can not consider manpower.

To summarize, material requirements planning is a computer-based inventory management system designed to help production managers in scheduling and placing orders for items of dependent demand. Material Requirements Planning is software based production planning, which utilizes an inventory system to systematize various manufacturing processes. Principally when a company is going to produce products to sell, this software organizes all inventories, while making sure that all the products and materials are in place in order for this to be possible.

MRP Structure – Concept and Explanation

Material Requirement Planning (MRP) happens to be the best model of dependent demand pattern of Inventory. Under it, the requirement of an item is predetermined as it depends upon the actual need of it, triggered by certain production schedule. Obviously, MRP has two main characteristics, the known requirement and the known period of requirement (time).

Materials Requirements Planning (MRP) also known as MRP-I, little MRP, MRP, or the original MRP is a set of techniques that takes the Master Production Schedule and other information from inventory records and product structure records as inputs to determine the requirements and schedule of timing for each item.

Based on a Master Production Schedule (MPS), a Material Requirements Planning system:

- Creates schedules identifying the specific parts and materials required to produce end items
- Determines exact numbers needed
- Determines the dates when orders for those materials should be released, based on lead times

MRP, by its nature, does not need carrying of any inventory ahead of requirement. It starts with the finalization of the production plan in a firm.

The production plan then is used by the Materials management professionals to explode the “Bill of Material” which is a complete detailing of the materials needed including their various components. It is exploded for the number of units to be produced, to obtain that product's exact requirement.

Since a given common part is used in many items, sub-assemblies etc, total requirement of that part is summed up to draw a consolidated requirement. Since this exercise is done for a great number of materials computers become very useful for the purpose. After the Bill of Material is finalized it's taken over by the Materials professionals of the firm who check the availability of any item. A detailed action plan indicating the materials, quantity to be procured and most importantly the time these are required at is prepared. Accordingly, the orders are placed and the suppliers are asked to match the given delivery period.

In practice, under this system, the production material requirement are calculated on weekly basis. It then generates requisitions for each material to be delivered in the required quantity a given number of days prior to the start of manufacturing operation. Obviously, it puts more pressure on purchasing and production planning rather than on maintenance of inventory.

In MRP system master production schedule which is updated periodically is the force that directly initiates and drives subsequent activities of the purchasing and manufacturing functions.

Applicability of MRP System

It is best suited where production is not done on a continuous basis. It is ideally suited for the job shop operations environment. Where the demand is directly dependent on the production of other specific inventory items or finished products. It is used where the demand of the individual components are dependent on the requirement of the main product. It can be used where the flexibility is possible in placement of orders or delivery releases is to be done on short term basis.

Inputs for MRP

MRP process is triggered by the Master Production Schedule (MPS) which indicates the production volume of finished products on weekly basis. MPS is the primary input. Therefore, for a successful run of the MRP, MSP must have a time schedule that is greater than the total lead time of the finished product.

Bill of Materials (BoM) which is a detailed item wise requirement document is the second input for MPR. It may contain multistage type of products that may require several stages of a number of components to be fitted or converted into leading to the making of the final or finished product. Inventory Record File (IRF) is the third input for MRP. It contains the status of an inventory item. It indicates the current stock position, the past timing and sizes of all orders, including the open orders for the item, the lead time for each item. IRF basically happens to be the past experience and serves as a good reference point for planning for the future MRP.

Working of MRP

The MRP process involves the following steps:

- Determine the gross requirements for a particular item;
- Determine the net requirements and when orders will be released for fabrication or subassembly;

$$\text{Net Requirements} = \text{Total Requirements} - \text{Available Inventory}$$

$$\text{Net Requirements} = (\text{Gross Requirements} + \text{Allocations}) - (\text{On Hand}) + \text{Scheduled Receipts}$$

- Develop a master production schedule for the end item (this is the output of the aggregate / production planning). The MPS is adjusted accordingly, as follows:
 - Create schedules identifying the specific parts and materials required to produce the end items. The bill of materials will be useful here
 - Determines the exact numbers needed
 - Determines the dates when orders for those materials should be released, based on lead times

Outputs of MRP

The basic outputs of the MRP system are the planned orders from the planned order release row of the MRP matrix which details the timing and the quantity of subassemblies, parts and raw materials used to plan purchasing and manufacturing actions. Specifically, these outputs include:

- Purchase orders - sent to outside suppliers
- Work orders - to be released to the shop floor for in-house production
- Action notices or rescheduling notices - issued for items that are no longer needed as soon as planned or for quantities that may have changed

Benefits of MRP

The MRP is a framework for providing useful information for decision makers. The key to realizing the benefits from any MRP system is the ability of the inventory planner to use the information well. The specific benefits of MRP include the following:

- Increased customer service and satisfaction
- Improved utilization of facilities and personnel
- Better inventory planning and scheduling
- Faster response to market changes and shifts
- Reduced inventory levels without reduced customer service

The MRP is also a very powerful tool since it takes into consideration changes in certain assumptions especially under uncertain conditions, especially when the inputs to the MRP system change because of the following realities in the production area:

- Delays in scheduled receipts
- Changes in planned order sizes because of capacity constraints
- Changes in gross requirements which dictate changes in lot sizes at sub-component levels
- Unavailability of raw materials for one sub-component which negates the need for a fellow subcomponent as both must be ready for the parent production
- Utilization of same parts at different levels indicating the need to restructure the bill of materials and
- Presence of price discounts or some other features which makes it advisable to purchase more than the anticipated need

Thus MRP can be summarize as being a system which is solely dependent upon three concepts:

- Dependent demand;
- Inventory / Open order netting; and
- Time phasing on the basis of requirement period and the Lead time for each item

MRP system, thus, generates a complete set of planned orders for all manufactured parts and purchased materials based on information inputs. Accurate forecast and a timely lead time happen to be the main determinant of its success in a run.

Material Planning - Concept

In any integrated Materials Management environment, planning for getting the materials is the starting point for the whole MM function. Materials planning sets the procurement function and the subsequent material functions rolling.

Material planning is a scientific way of determining the requirements starting with raw materials, consumables, spare parts and all other materials that are required to meet the given production plan for a certain period.

Material planning is derived from the overall organizational planning and hence it is always a sub-plan of the broad organizational plan. What it does is forecasting and initiating for procurement of materials.

Factors affecting Material Planning

1. **Macro factors:** Global factors such as price trends, business cycles, government's import and export policies etc. are called the Macro factors. Credit policy of the government is a critical factor as banks follow these guidelines only while extending financial support to a business entity.
2. **Micro factors:** These are essentially the factors existing within the organization such as corporate policy on Inventory holding, production plan, investments etc. For any organization, factors such as Lead-time of procurement, acceptable inventory levels, working capital, seasonality, delegation of power are micro factors.

Techniques of Planning Materials

There are a few techniques used for planning material for the given period. The following two are, however, commonly used:

1) Materials Requirement Planning (MRP)

2) Requirement based on past consumption

MRP has, as its starting point, the annual production plan of the manufacturing concern. Once a firm determines its annual production plan, the over all material requirement, to meet the given production plan, is worked out. It is a detailed analysis encompassing the materials and quantities available for use, materials with quantities not available and hence needing procurement, the actual lead time of procurement etc..

Since, it is always possible to have a situation where some parts of an assembly are available and some others not available, Bill of Materials is exploded. It is quantifying all the materials (components) needed for various assemblies, all needed as per the production plan. BOM is thus a list displaying the code, nomenclature of an item, its unit and quantity, location of use and also the estimated price of each component. An explosion chart is a series of bills of materials grouped together in a matrix form so that combining the requirements for different components can be made.

Once the BOM is ready, the same is handed over to the Purchasing wing which initiates the purchasing activities. MRP thus keeps in view the Lead time also. Using computers, preparation of BOM through explosion of lists is quite easy and smooth.

MRP – II – Basics & Definition

Manufacturing Resource Planning (MRP-II) is an integrated method of operational and financial planning for manufacturing companies. MRP-II serves as an extension of MRP (closed loop Manufacturing Resource Planning, also abbreviated as CLMRP).

The typical MRP-II system employs a modular organizational structure. Modules keep track of, and regulate, specific characteristics and functions of the entire organization.

Examples include, but are not limited to, the following: Product Design; Product Specifications; QC (Quality Control); QA (Quality Assurance); Shop Floor Control; Order Management; Purchasing; Inventory; Cost Calculation; Cost Reporting; General Accounting; Cash Flow; Tax Calculation; Tax Payments, and so on.

The MRP-II process is carried out by a synergistic combination of computer and human resources. The MRP-II differs fundamentally from point contact planning, in which individual characteristics and functions have their own dedicated systems.

MRP – II – Concept

The initial versions of MRP in the early 1970s were limited to the planning of purchase orders and factory work orders and did not take into account such issues as capacity planning or feedback data from the factory for shop floor control. MRP was strictly a materials and parts planning tool whose calculations were based on the MPS. It became evident that MRP should be tied to other software packages to create a more integrated PPC system. The PPC software packages that evolved from MRP became known as manufacturing resource planning, or MRP II, to distinguish it from the original abbreviation and perhaps to suggest that it was second generation; that is, more than "just" MRP.

Manufacturing Resource Planning can be defined as a computer based system for planning, scheduling, and controlling the materials, resources, and supporting activities needed to meet the MP& MRP-II is a closed loop system that integrates and coordinates all of the major functions of the business to produce the right products at the right times, The term "closed loop system" means that MRP-II incorporates feedback of data on various aspects of operating performance so that corrective action can be taken in a timely manner; that is, MRP II includes a shop floor control system.

Application modules typically provided in a high end MRP II system include the following:

Management Planning: Functions included in this module are business strategy, aggregate production planning, master production scheduling, rough cut capacity planning and budget planning.

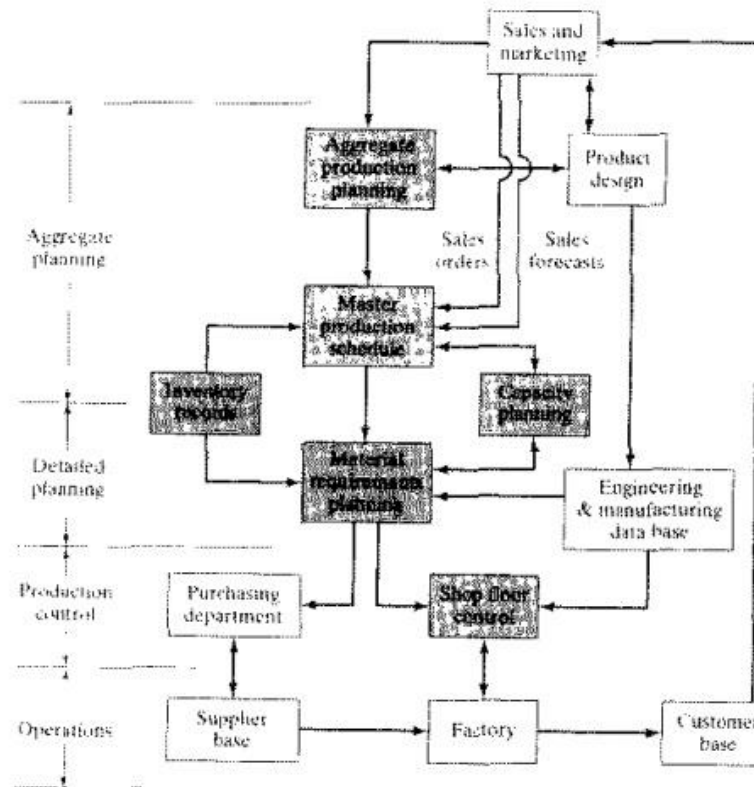
Customer Service: Typical components in this module are sales forecasting, order entry, sales analysis, and finished goods inventory.

Operations Planning: This is the MRP module, enhanced with capacity requirements planning. The output consists of purchase order and work order releases.

Operations Execution: This includes purchasing, production scheduling and control, inventory control, shop floor control and labor hour tracking.

Financial Functions: These include cost accounting, accounts receivable, account, payable, general ledger and payroll.

In effect MRP-II consists of virtually all of the functions in the PPC system diagramed in Figure below plus additional business functions that are related to production. Software vendors continue to add new features to their MRP-II packages to gain competitive advantages in the market.



Some of the applications that have been added to recent generations of MRP-II are in the following areas: quality control, maintenance management, customer field service, warranty tracking, marketing support, supply chain management, distribution management, and product data management.

Product data management (PDM) is closely related to CAD/CAM and includes product data filing and retrieval, engineering change control, engineering data capture, and other features related to product design. In fact, the POM area has emerged as a separate software market, although available commercial packages are designed to integrate with MRP-II.

New names have been coined in the attempt to differentiate the latest generation of MRP-II software from its predecessors. Some of the newer terms include:

- *Enterprise Resource Planning (ERP)*: Software packages described by the term ERP have the traditional MRP If modules. Use of the word “enterprise” in the title denotes that these packages extend beyond manufacturing to include applications such as maintenance management, quality control and marketing support.
- *Customer Oriented Manufacturing Management Systems (COMMS)*: This term competes with ERP but the definition is similar. COMMS software packages are organized into three major phases: (1) Planning, (2) Execution, and (3) Control. Modules in the execution phase are known as manufacturing execution systems, which have become recognized on their own.
- *Manufacturing Execution Systems (MES)*: As mentioned above, this name refers to the execution phase of COMMS. MES typically includes production scheduling, quality control, and material handling modules.
- *Customer Oriented Management Systems (COMS)*: This term was coined by one of the originators of COMMS who started up his own commercial venture to market software and services for a more general clientele than only manufacturing. Hence, the word

"manufacturing" was dropped from the title. What remained was *customer oriented management systems*. Application modules in COMS are again similar to those in ERP and COMMS.

Commercially available MRP-II packages number in the hundreds and range in price from several hundred dollars to several hundred thousand dollars. Depending on features and support delivered by the software vendor. The cost of the software itself is only a portion of the total cost that may ultimately be paid by the user company. Other costs include: (1) training of user company personnel in the operation of the specific MRP-II package, (2) interfacing the MRP-II package with other software and data bases in the user company, and (3) reprogramming the MRP-II package to customize it to other user company's systems

Part – II of II

Enterprise Resource Planning (ERP) - Introduction

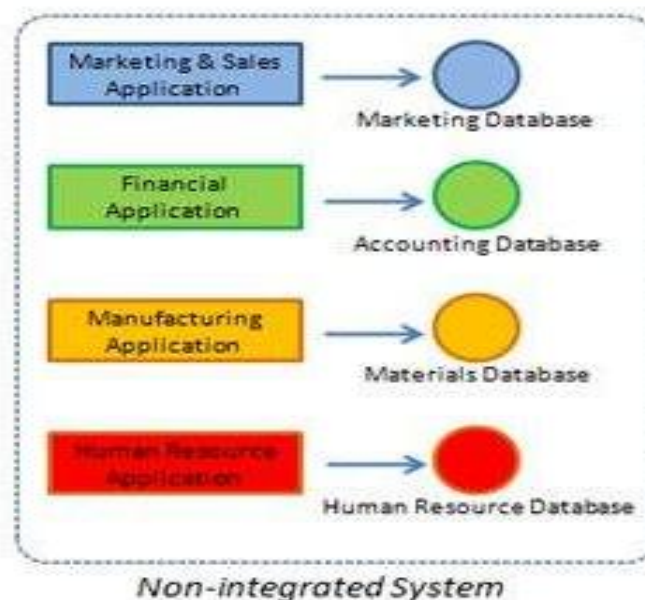
In any industry, some of the demands managers face is to be cost effective. In addition to that, they are also faced with challenges such as to analyze costs and profits on a product or consumer basis, to be flexible to face ever altering business requirements, and to be informed of management decision making processes and changes in ways of doing business. However, some of the challenges holding managers back include the difficulty in attaining accurate information, lack of applications that mimic existing business practices and bad interfaces. When some challengers are holding a manager back, that is where Enterprise Resource Planning (ERP) comes into play.

Over the years business applications have evolved from Management Information Systems with no decision support to Corporate Information Systems, which offer some decision support to Enterprise Resource Planning. Enterprise Resource Planning is a software solution that tackles the needs of an organization, taking into account the process view to meet an organization's goals while incorporating all the functions of an organization. Its purpose is to make easy the information flow between all business functions within the boundaries of the organization and manage the organization's connections with its outside stakeholders.

In a nutshell, the Enterprise Resource Planning software tries to integrate all the different departments and functions of an organization into a single computer system to serve the various needs of these departments. The task at hand, of implementing one software program that looks after the needs of the Finance Department together with the needs of the Human Resource Department and the Warehouse, seems impossible. These different departments usually have an individual software program that is optimized in the way each department works. However, if installed correctly this integrated approach can be very cost effective for an organization. With an integrated solution, different departments can easily share information and communicate with one another.

Difference Between Non-Integrated and Integrated ERP Systems

The following diagram illustrates the differences between non-integrated systems versus an integrated system for enterprise resource planning.





ERP – Concept and Definition

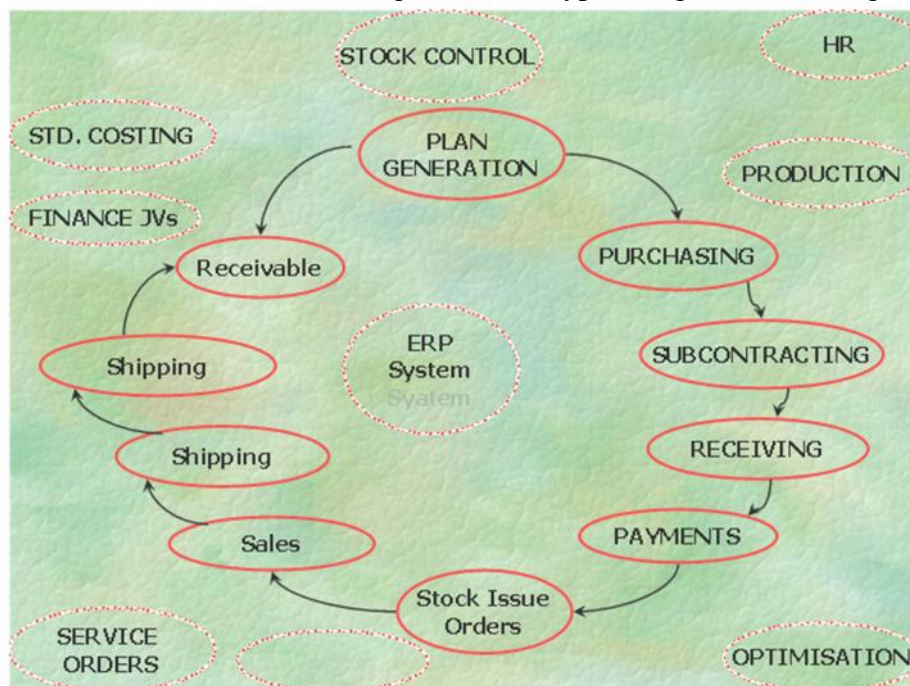
There are various ways in defining an Enterprise Resource Planning System. This is how it has been defined by American Inventory and Production Control System (APICS) dictionary:

“Enterprise Resource Planning: **An accounting oriented information system for identifying and planning the enterprise-wide resources to make, ship and account for customer orders.**”

Again in Internet encyclopedia, it has defined as “An enterprise planning system is an integrated computer-based application used to manage internal and external resources, including tangible assets, financial resources, material and human resources”.

Basically, an ERP combines several traditional management functions into a logically integrated system and facilitate the flow of information across these functions. It is designed to model and automate basic processes across the organization over a centralized database and eliminates the need of disparate systems maintained by various units of the organization.

Figure below shows how information is integrated into a typical organization using an ERP system.



Need for ERP

Separate systems were being maintained during 1960/70 for traditional business functions like Sales & Marketing, Finance, Human Resources, Manufacturing, and Supply Chain Management. These systems were often incongruent, hosted in different databases and required batch updates. It was difficult to manage business processes across business functions e.g. procurement to pay and sales to cash functions. ERP system grew to replace the islands of information by integrating these traditional business functions.

The successful implementation of an ERP system will have many advantages, as indicated below:

- **Business Integration and Improved Data Accuracy:** ERP system is composed of various modules / sub-modules where a module represents a particular business component. If data is entered in one module such as receiving, it automatically updates other related modules such as accounts payable and inventory. This updating occurs at real time i.e. at the time a transaction occurs. Since, data needs to be entered only once at the origin of the transaction, the need for multiple entries of the same data is eliminated. Likelihood of duplicate/erroneous data is, therefore, minimized. The centralized structure of the database also enables better administration and security provisions, which minimizes loss of sensitive data.
- **Planning and MIS:** The various decision support tools like planning engines and simulations functions, form an integral part of an ERP system that helps in proper utilization of resources like materials, human resources, and tools. Constrained based planning help in drawing appropriate production schedules, thereby improving the operation of plant and equipment. As a part of MIS, an ERP system, contains many inbuilt standard reports and also a report writer that produce ad hoc reports, as and when needed.
- **Improved Efficiency and Productivity:** In addition to provision of improved planning, ERP system provides a tremendous boost to the efficiency of day to day and routine transactions such as order fulfillment, on time shipment, vendor performance, quality management, invoice reconciliation, sales realization, and cash management. Cycle time is reduced for sales to cash and procurement to pay sequences.
- **Establishment of Standardized Procedures:** ERP system is based on processes of international best practices, which are adopted by the organizations during implementation. Department silos are purged, and maverick practices are done away with. Because of top-down view available to management, chances of theft, fraud and obsolescence are minimized.
- **Flexibility and technology:** Due to the globalized environment, where production units, distribution centers, and corporate offices reside in different countries, organizations need multi-currency, multi-language and multi-accounting modes, in an integrated manner. These provisions are available in most of the ERP systems, particularly in products offered by tier 1 and tier 2 vendors. ERP vendors are also quick to adopt latest technologies, from mainframe to client server to the internet. Unlike a bespoke system, Upgrading to latest technology for a running ERP system is uncomplicated, involving mostly adoption of service packs and patches.

History of ERP

Use of computer systems is a post second world war phenomenon. The first working computer was developed by two scientists at the University of Manchester, UK. However, commercial applications of computer commenced during the 1960s.

Pre ERP systems

In the sixties, computers were bulky, noisy and without the facility of standard operating systems. The organizations used to develop computerized systems that were stand alone; tailor made and without an integrated approach. The software development, in a sense, was a re-inventing wheel, as the basic business process is similar for all organization in the same business sector. Due to this restrictive environment, Development, maintenance, and modification cost became prohibitive. Developer ended up developing isolated and piecemeal systems, even within an organization. Thus, a payroll system, accounting system, and inventory system were developed in isolation as per specific need of business units and were incompatible with each other.

MRP-Advent of ERP

Stand alone systems, in vogue during the sixties, were incapable of processing planning requirement of an enterprise encompassing production planning, procurement, and inventory, which became an impediment to adopting Materials Requirement Planning (MRP). MRP was first adopted by IBM and J I Case (a tractor maker from the USA) during the late seventies, when integrated systems started taking shape. The basic idea of MRP was to assimilate planning and scheduling elements to the manufacturing process. The process of MRP was to plan and procure purchase requirements based on finished products, inventory on hand, allocated inventory and expected arrivals. Subsequently, it was supplemented by Capacity Requirement Planning (CRP) to create capacity plans of shop floors and sub=contractors.

There was continued development of MRP system during the 1980s. The need moves beyond shop floor, and MRP II was introduced incorporating planning element of distribution as well as forecasting requirement.

ERP Evolution

ERP was introduced in late 1980 to integrate other business functionalities not covered by MRP or MRP II. It is not confined to manufacturing only but covers all facets of organization such as:

- Finance
- Human Resources
- Supply Chain
- warehouse management, and
- Project Management

ERP development from software solution provider mainly emerged as a sequel of their MRP products. Some of the early solution providers are

- SAP from Germany
- BaaN from Netherland
- JD Edwards from USA, and
- Lawson from USA

Few vendors did not follow this course. Starting point of Oracle ERP was their accounting package whereas People-soft ERP evolved from their HR suite.

During the 1990s, ERP products continued to evolve. Vendors added new functionalities, incorporated Graphic User / Internet browser interface and brought out new versions of their products. Some solutions were found to be more suitable for a particular vertical such as discrete manufacturing, utility, process industries, public sector and retail. Several vendors brought out reference models of their product, meaning that through pre-configuring basic and common data, a particular flavor of their product will be more compatible with the business need of a particular sector / sub-sector.

Traditionally, the biggest purchaser of an ERP solution is fortune 500 companies. But, this market has since been saturated. Vendors are now looking to increase their presence in small and medium business sector. Due to fierce competition and financial crisis, there are also some takeover and mergers across ERP solution providers during early 2000 such as Oracle taking over People Soft, Infor taking over BaaN and Microsoft taking over Axapta.

Current Trend

ERP solutions, which were mostly, operating as a back-end system, is now broadening its horizon. ERP vendors are extending their products to become Internet-enabled. ERP extension products (mostly as an add-on to their existing products) now provide solutions for Advanced Planning and Scheduling, Manufacturing Execution System, Advanced Business Intelligence and Dashboards, Salesforce Automation, Product Lifecycle Management and Warehouse Management. Business to Businesses and Business to Commerce functionalities, as add-on solution, is now getting seamlessly integrated with Back-end, thus making it possible to bring e-commerce under the gambit of ERP.

Advantages of ERP System

- With Enterprise Resource Planning (ERP) software, accurate forecasting can be done. When accurate forecasting inventory levels are kept at maximum efficiency, this allows for the organization to be profitable.
- Integration of the various departments ensures communication, productivity and efficiency.
- Adopting ERP software eradicates the problem of coordinating changes between many systems.
- ERP software provides a top-down view of an organization, so information is available to make decisions at anytime, anywhere.

Disadvantages of ERP System

- Adopting ERP systems can be expensive.
- The lack of boundaries created by ERP software in a company can cause problems of who takes the blame, lines of responsibility and employee morale.

Characteristics of ERP

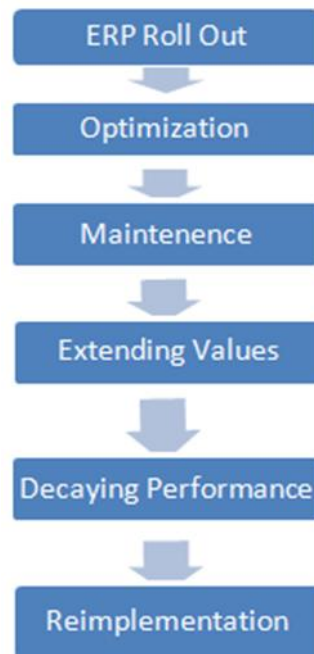
Following are the characteristics of a good ERP:

- *Flexible:* These days, way of doing business is changing fast due to changing in law and amendments in the standards. So, management of business process which is done through ERP should be flexible. If ERP system will be flexible, we can change processing system as per our requirement.
- *Modular and Open:* One of the great characteristics of any good ERP system that it has open module architecture. It means, if there is error in any module, we can correct it by opening it instead affecting all other modules. For example, OpenERP has following module which can be open separately.
 - ✓ Sales Management
 - ✓ Purchase Management
 - ✓ Customer Relationship Management
 - ✓ Project Management
 - ✓ Warehouse Management
 - ✓ Manufacturing
 - ✓ Accounting & Finance

- ✓ Content Management
 - ✓ E-commerce
 - ✓ Asset Management
 - ✓ Human Resource Management
 - ✓ Fleet Management
 - ✓ Event Management
 - ✓ Social Network
 - ✓ Point of Sale
 - ✓ Knowledge and Document Management
 - ✓ Calendar
 - ✓ Expense Management
 - ✓ Time Tracking
 - ✓ Employee Appraisals
 - ✓ Manufacturing Resource Planning
 - ✓ Portal
 - ✓ Employee Directory
 - ✓ Address Book
 - ✓ Recruitment Process
- *Comprehensive:* ERP system should be advance and it should use comprehensive way. It means, all most all the functions of business should be done through ERP System. If we will get only small number of activities through ERP and other will be done through manual, then, this ERP system is not ok. Its capacity should be to cover all the functions of business.
 - *Online-Connection with Other ERP System:* Today, in the market, there are lots of ERP solution but which is the best, it will tell its features. It is important to check whether it has capacity to connect other ERP system online or not. Because, today business has started to interact with millions of other business. So, it is necessary to connect them online through our ERP.
 - *Best Business Practices:* Each business activities have lots of standards. For example, accounting follows IFRS, quality management follows ISO 9000 and marketing follows the standard of MASB. So, your ERP system will updated regarding all standards.
 - *Multi-Facilities:* A good ERP System should have multi-facilities. It means, it can work in multi-currencies, multi-mode manufacturing and multi-platform.
 - *Strategic Planning:* Strategic Planning is the main and top function of business. It should be done through ERP. ERP should integrate all its sub-part systems for making better strategic planning.
 - *Optimize the data:* A good ERP system optimizes the data for effective utilization of limited business resources. It also optimizes the data for reducing cost and risk.
 - *Project Management:* A good ERP System collaborate the team in real time for working together on a project. Everything about the project process can be tracked through this.
 - *Automatic Functions:* We can measure the quality of ERP from its advance automatic functions. With these automatic functions, organization saves his lots of time. This automatic function may be in electronic fund transfer, electronic data interchange and e-Commerce.

ERP Life Cycle

ERP life cycles, which encompass entire 10 to 20 years of effective operating life, are often confused with ERP Implementation Life Cycle. Some of the *Phases of ERP Life Cycle* is shown in following diagram.



1. **ERP Roll out:** The initial roll out of an ERP system itself consists of various phases commencing with Request for Proposal (RFP) and vendor selection and ending with go live and hand holding phase. Some important matter concerning this phase, as given below, will have direct bearing on subsequent phases of ERP lifecycle:
 - Degree of matching of vanilla ERP product to current business need and extent of customization done, particularly source code customization.
 - Commitment of the vendor for future development and their financial health
 - Support issues including License fees and escalation thereof.
2. **Optimization:** After the system is live and rolled out, there will be a period of turmoil. Due to lack of understanding, a lot of confusion will prevail amongst users. There will be teething problems and some software bugs will invariably appear. With retraining, some tweaking of the system and assistance from a responsive help desk, this phase should be over within six months to one year and the system should start stabilizing.
3. **Maintenance:** This is the longest period of life cycle, when the organization start realizing value of their investment. Users will get familiar and start owning the system. Some changes will be continuing such as new reports, different workflows, some localization on taxes etc. Maintenance will be covered by service level agreement, entailing payment of license fee to the vendor. For a complicated system, there may be a third party vendor, helping maintenance at site. The license fee, due to provision of escalation, gets escalated at regular intervals and after some years, adversely effects Total Cost of Ownership (TCO).
4. **Extending Values:** This phase overlap with the phase of maintenance. New or changed business processes necessitate minor or moderate changes in the system. There may be extensive changes under scenario such as (i) implementing a new accounting system e.g. International Finance Reporting standard (IFRS) (ii) A new regulatory requirement like Sarbanes-Oxley (iii) Mergers and acquisitions / restructuring. (iv) Extending the system with add on products such as Customer Relationship Management and Business

Intelligence (BI). Sometime the cost changes may be prohibitive, particularly for systems where a lot of customization has been done during implementation phase.

Parallel to business changes, technological changes also occur. New release and versions appear for underlying technological platforms like Operating System and Data Base. ERP vendors release patches and versions of their products at regular intervals which needed to be incorporated in the existing system. This usually involves minor or moderate efforts. But, problem arises where many software objects were customized during implementation. Retrofitting these objects for making them compatible with later versions, may turn out to be a major migration exercise involving exorbitant cost and effort.

5. **Decaying Performance:** For an enterprise, business need and technological requirement, continue to evolve. Cost, Complexity and difficulty to modify and update the existing system mount. Fixing existing system is no more viable and provides diminishing return. Alternatives are investigated and decision of reimplementation is taken.
6. **Reimplementation:** Similar to Roll Out phase as mentioned above. However, the organizations are better organized now. Initial process will be carried out more professionally. It is likely that they will adopt more of a vanilla version with minimum need of customization, so that the next cycle gives a better Return on Investment (ROI).

Implementation of ERP

Implementation of ERP System, is a complex exercise, involving many process alterations and several legacy issues. Organizations needs an implementation strategy encompassing both pre implementation and implementation stages. The fallout of a poor strategy is unpreparedness of employees, implementation not in conformity with wider business strategy, poor business process redesign and time and cost overrun.

Following issues must be carefully thought out and formulated, as a part of implementation strategy, before embarking on actual implementation:

Business Process: Hypothetically, company insiders should know best about the processes of their organization. But employees often constrained to work in departmental silos and overlook wood for the tree. Under most circumstances, prevailing business practices are not properly defined and no “AS-IS” flow charts, documenting existing processes, are available.

An ERP implementation could be a great occasion to assess and optimize existing business processes, control points, breaking points between departments, and interfaces with trading partners. But, often, due to resistance to changes and departmental clouds, ERP implementation is comprehended as an exercise to automate legacy processes. This may lead to little improvement in underlying business processes, resulting no appreciable return on investment.

Automating existing manual processes peculiar to a company necessitates, significant source code customization, as even a best fit ERP product match to a maximum of 85% to 90% of legacy processes. Source code customization will not only require changing of software objects but also need changing data models. The efforts needed to make such changes are significant in terms of development, testing and documentation. The future cost of maintenance and upgrades will be substantial, affecting entire life cycle of the system.

Unless a considered view favoring process changes is taken as a part of implementation strategy, pressure will mount subsequently for more and more customization, when the exercise of Business Process Mapping and Gap Analysis is taken up during implementation.

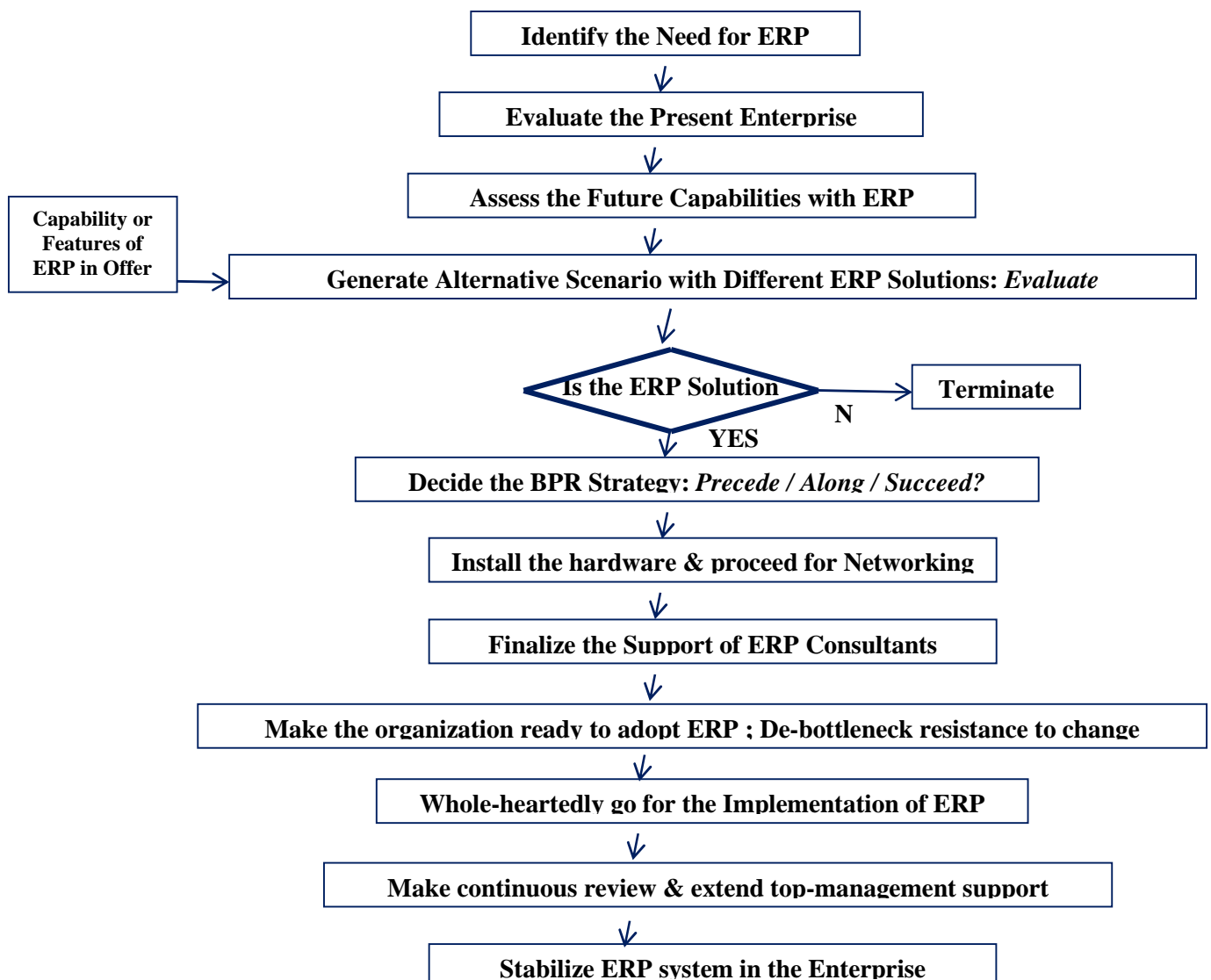
ERP systems are highly configurable and contain series of design trade off to meet various nuances of the same business cycles / processes. This should, normally, be sufficed to cover needed processes, probably with a little bit of swapping whenever needed. At occasions, it may be imperative to change source code to account for some unique core processes of the organizations.

Procedure for authorization of such changes, normally requiring attention from sponsor, should also form part of the strategy document.

Implementation Methodology: Selection of implementation methodology constitutes an important component of implementation strategy. Most popular implementation methodology is “big bang” approach where on a scheduled cut-off date; entire system is installed throughout the organization. All users move to the new system and manual / legacy systems are discontinued. The implementation is swift and price tag is lesser than a phased implementation. On the flip side, risk element is much higher and resources for training, testing and hand holding are needed at a much higher level, albeit for a shorter period of time.

Another major implementation strategy is “Phased Implementation”, where roll out is done over a period. This method is less focused, prolonged and necessitates maintenance of legacy system over a period of time. But, phased implementation is less risky, provides time for user’s acquaintance and fall back scenarios are less complicated. There are various choice of phasing such as i) phased roll out by locations for a multi location company ii) phased roll out by business unit e.g. human resources iii) Phased roll out by module e.g. general ledger.

Methodology of implementation should form an important constituent of implementation strategy, which should be formulated after considering availability of resources, state of preparedness, risk perception, timeframe of implementation and budgetary provisions.



ERP Pre-requisites

Enterprise Modeling is the most important prerequisite before the selection / implementation of and ERP system. It encompasses complete understanding & detailed mapping of the firm's business functions and decision-making process, both independently & interactively.

Enterprise Integration leads to:

- ✓ More agile enterprise;
- ✓ Helps in eliminating redundant or non-value added activities;
- ✓ More efficient system after being enabled by information technology;
- ✓ Streamlines five important flows in an enterprise, viz, Information, Material, Money, Control & Intangibles, such as, customer satisfaction & quality improvement.
- ✓ Empowerment of employees to take action.

Based on Hansen (1991), there are five reasons which help in building the employees motivation due to integration, viz,

- ✓ When people understand the vision or large task of an enterprise and are given the right information, the resources and the responsibility, “they will do the right thing”.
- ✓ Empowered people – and with good leadership, empowered grouse – will have not only the ability but also the desire to participate in the decision process.
- ✓ The existence of a comprehensive & effective communications network must distribute knowledge and information widely, embracing the openness and trust that allows the individual to feel empowered to affect the ‘real’ problems.
- ✓ The democratization & dissemination of information throughout the network in all directions, irrespective of organizational position, ensures that the integrated enterprise is truly integrated.
- ✓ Information freely shared with empowered people who are motivated to make decisions, will naturally distribute the decision-making process throughout the entire organization.

The integration of the enterprise helps in building and efficient & effective information network across the enterprise. Hoffman (1992) indentified the following reasons for integration,

- ✓ Identification of the major functions to be included in a program management organization;
- ✓ Defining the scope and content of the information systems architecture and related metrics as a management guide; and
- ✓ Providing guide and / or roadmap through the process of developing such an organization so as to manage a large-scale integration program.

Selection of ERP

Selection of an appropriate ERP package involves careful evaluation of an existing ERP alternatives and the need / profile of the enterprise.

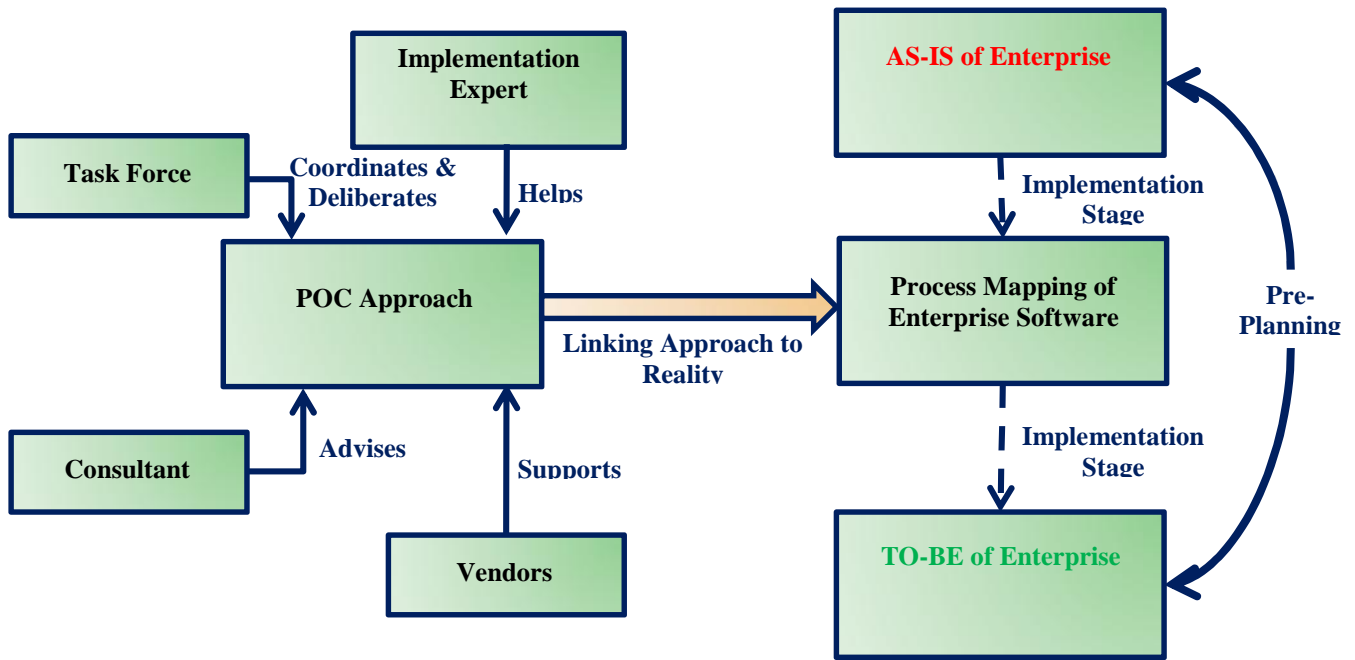
Proof-Of-Contact (POC) Approach is a comprehensive & real-time selection approach for ERP solution.

In this approach, the organization is provided with the ERP software for few months.

The aim is to get confidence on the software before a final selection is made.

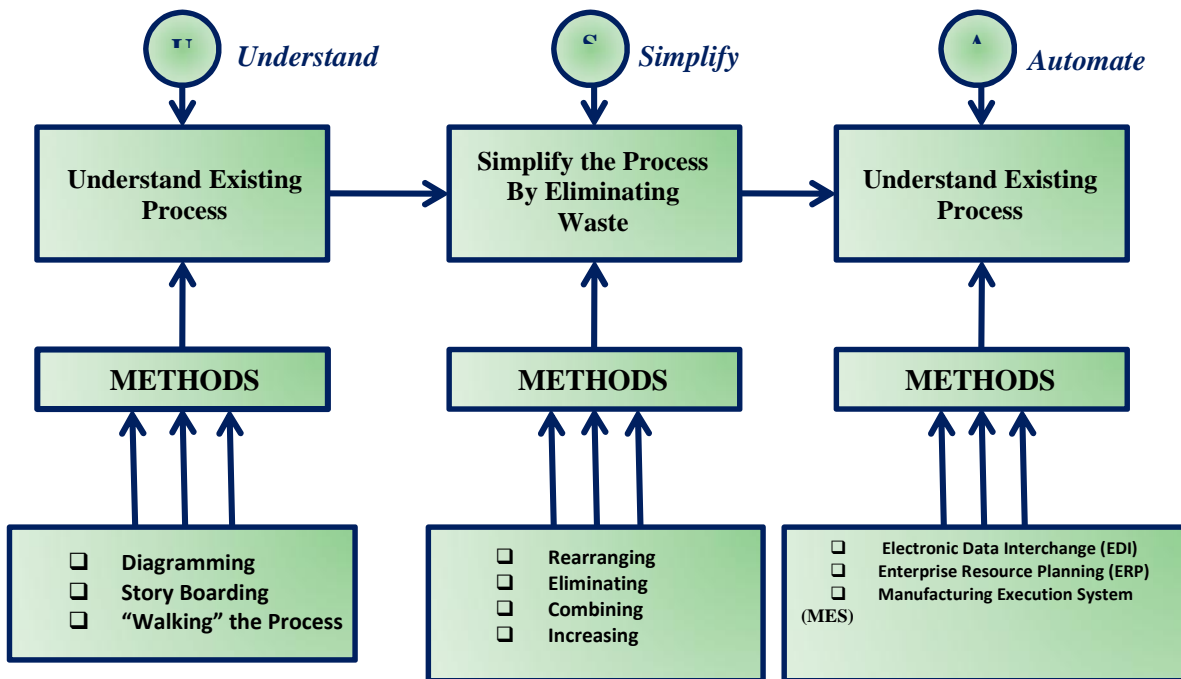
Following stages are incorporated in the POC approach:

- ✓ Preparation of Project & Constitution of an ERP team;
- ✓ Analysis of key business requirements;
- ✓ Selection of the system; and
- ✓ Team agreement on product to prototype.



Use of POC Approach in Transforming Business from AS-IS into TO-BE

Principle of ERP Implementation



The USA Principle: Implementation Flow

Guidelines for ERP Implementation

The following are the main Guidelines that needs to be followed for ERP Implementation:

- ✓ Understand the needs of the enterprise & feeling for corporate culture in the contest of the readiness for change;
- ✓ The message should come from the top regarding adoption of the project;
- ✓ Continuous & frequent communication from top regarding usefulness and mindset for the project;
- ✓ Initiate with a feasibility report;
- ✓ Start with changes in the business processes in the early stage of the project. Make everybody aware of this. Keep them well informed – it reduces the resistance for change;
- ✓ Decide phases of project implementation. Hold consultative meetings and try for consensus;
- ✓ Top executives should play the role of champion and set the project as the ultimate goal in all efforts;
- ✓ Ensure good feedback mechanism to evaluate the results due to implementation;
- ✓ A total dedication & mission is needed at all the stages;
- ✓ Hire experienced consultants;
- ✓ Visit the sites of the vendors and see how the ERP solution is functioning there and extract useful tips from the existing users;
- ✓ Carefully study the documentation of the vendor;
- ✓ Make a balanced implementation team, which should include IT, HRD, works, financial & top executives. Other experienced functional managers should also be included;
- ✓ Hold regular training and appraisal sessions in the organization;
- ✓ Ensure that the problems arising out of changes are handled carefully & sensibly, as such problems are inevitable;
- ✓ Decide whether to go for modular or complete ERP solution;
- ✓ Look into the future capabilities of the enterprise when it is armed with ERP. Take radical decisions for transformation, if need arises.

Causes of Failure in ERP Implementation

The following are the main causes in ERP Implementation:

- ✓ Due to absence of an Executive sponsor.
- ✓ When the project is viewed as an IT effort or as an effort towards automating finance / manufacturing / supply chain / etc..
- ✓ When there is no full-time project manager for ERP implementation;
- ✓ When the IT people start taking decisions in ERP implementation due to dominant role in handling hardware / software / communications / etc.. As a matter of fact they generally lack understanding of the functional requirements of the ERP;
- ✓ Lack of documentation of implementation procedure;
- ✓ Lack of internal communication by top executive regarding project implementation;
- ✓ Lack of vendor support & team work;
- ✓ Lack of re-engineering and insistence on continuation of current practices;
- ✓ Massive change and unmanageable transformation without proper grasping by employees.

Post-Implementation of ERP

To start with, many post-implementation problems can be traced to wrong expectations & fear. Expectations & fear that corporate management have from an ERP are as detailed below,

- ❖ Improvement in process;
- ❖ Enhanced productivity on all fronts;

- ❖ Total automation & disbanding of all manual processes;
- ❖ Improvement of all key performance indicators;
- ❖ Elimination of manual record keeping;
- ❖ Actual information system available to concerned people on requirement basis;
- ❖ Integration of all operations;

A host of fears in respect of ERP implementation are as detailed below,

- ❖ Job redundancy;
- ❖ Loss of importance as information is no longer an individual prerogative;
- ❖ Change in job profile;
- ❖ Loss of proper control & authorization;
- ❖ Increased stress due to greater transparency;
- ❖ Fear of loss of authority by individuals.

Note that, a successful ERP implementation is not the end of the road of decision, rather it is a process that requires continuous improvements so as to derive it's maximum benefits.