CHAPTER 2

OVERVIEW OF ENTERPRISE RESOURCE PLANNING (ERP) SYSTEM

2.1 Introduction
This chapter gives overview of Enterprise Resource Planning (ERP) system. Section 2.2 explains the need for ERP system by organizations, in present era, traces its evolution and gives an overview of ERP systems. Section 2.3 is designed to explain the various phases of ERP system. Section 2.4 discusses the concept of ERP system performance evaluation and based on this a general model for evaluation of ERP system is presented.

2.2 Enterprise Resource Planning (ERP) system
2.2.1 Need for Enterprise Resource Planning
Organizations today face twin challenges of globalization and shortened product life cycle. Globalization has led to unprecedented levels of competition. To face such competitions, successful corporations should follow the best business practices in the industry. Shortened life cycles call for continuous design improvements, manufacturing flexibility, super-efficient logistics control and better management of the entire supply chain. All these need faster access to accurate information, both inside the organization and the entire supply chain outside. The organizational units such as finance, marketing, production, human resource development etc. need to operate with a very high level of integration without losing flexibility. ERP system with an organization-wide view of business processes, business need of information and flexibility meet these demands admirably. One of the developments in computing and communication channels is providing tighter integration among them. The server technology today permits very high reliability and access to large data securely at reasonable cost. The open system philosophy, client-server architectures, high performance operating systems, relational database management system (RDBMS) and Rapid Application Development tools that
permit such enterprise-wide systems to be deployed are available today. These explain the motivating factors behind contemporary ERP systems\(^1\).

2.2.2 Evolution of Enterprise Resource Planning

2.2.2.1 Pre Material Requirement Planning (MRP) stage

Enterprise resource planning (ERP) has evolved as a strategic tool, an outcome of over four decades. This is because of continuous improvements done to the then available techniques to manage business more efficiently and also with developments and inventions in information technology field.

Prior to 1960s businesses generally relied on traditional ways of managing inventories to ensure smooth functioning of the organizations. These theories are popularly known as ‘Classical Inventory Management or Scientific Inventory Control Methods’. Most popularly used among them were Economic Order Quantity (EOQ); Bill of Material (BOM) etc. However these systems had very limited scope.

ERP system has evolved from the Material Planning System of 1980’s. There are various phases through which this evolution process has gone through. The various phases of development of resource planning system in relation to time and evolution of concept of ERP as shown in figure 2.1
2.2.2.2 Material Requirement Planning (MRP)

MRP was the fundamental concept of production management and control in the mid-1970s and considered as the first stage in evolution of ERP. Assembly operations involving thousands of parts such as automobile manufacture led to large inventories. The need to bring down the large inventory levels associated with these industries led to the early MRP systems that planned the order releases. Such planned order releases ensured proper time phrasing and accurate planning of the sub-assembly items, taking into account complex sub-assembly to assembly relationships characterized by the Bill of Materials. A typical example is a bicycle manufacture. To manufacture 100 units of bicycles, one needs 200 wheels, 100 foot-pedals, and several thousands of spokes. On a given day, a plant may have 40 units of complete bicycles in stock, 57 units of wheels, 43 units of foot-pedals and 879 units of spokes. If the plant is to assemble 20 units of bicycles for the next 4 days of production, wheels and spokes is a non trivial problem. If the independent demand of the spare parts is also to be taken into account, one can
visualize the complexity of it. A typical automobile plant with hundreds, if not thousands of parts, has to face problems that are in order of magnitude even more difficult. MRP systems address this need. Using the processing power of computers, databases to store lead-times and order quantities and algorithms to implement Bill-of-Material (BOM) explosion, MRP systems brought considerable order into the chaotic process of material planning in a discrete manufacturing operation. Essentially MRP addresses a single task in manufacturing alone\(^2\). Material requirement planning (MRP) system was adopted by firms for creation and maintenance of master data and bill of material across all products and part within an organization. MRP on the other hand was an outgrowth of bill of material (BOM) processing, which is purchase order management that utilizes parts list management and parts development.

2.2.2.3 Manufacturing Resources Planning II (MRP- II)
A natural evolution from the first generation MRP systems was the manufacturing planning systems MRP II that addressed the entire manufacturing function and not just a single task within the manufacturing function. MRP II went beyond computations of the materials requirement to include loading and scheduling. MRP II systems could determine whether a given schedule of production was feasible, not merely from material availability but also from other resource point of view. Typically, the resources considered from MRP II systems would include production facilities, machine capacities and precedence sequences. The increased functionality enabled MRP II systems provided a way to run the system in a loop. First it was used to check the feasibility of a production schedule taking into account the constraints; second to adjust the loading of the resources, if possible, to meet the production schedules; third to plan the materials using the traditional MRP II systems. Both MRP system and MRP II systems were fairly successful in industry. Due to the power of information systems-databases, algorithms and their integration, organizations did find real support for efficiently managing the manufacturing function in the eighties\(^3\).
2.2.2.4 Enterprise Resource Planning (ERP)

The nineties saw unprecedented global competition, customer focus and shortened product life cycles. To respond to these demands corporations had to move towards agile (quick moving) manufacturing of products, continuous improvements of process and business process reengineering. This called for integration of manufacturing with other functional areas including accounting, marketing, finance and human resource development. Activity-based costing would not be possible without the integration of manufacturing and accounting. Mass customization of manufacturing needed integration of marketing and manufacturing. Flexible manufacturing with people empowerment necessitated integration of manufacturing with the HRD function. In a sense the 1990s truly called integration of all the functions of management. ERP systems are such integrated information systems build to meet the information and decision needs of an enterprise spanning all the functions of management\textsuperscript{4}.

2.2.2.5 Extended ERP (E-ERP)

Further developments in the enterprise resource planning system concept have led to evolution of extended ERP (E- ERP) or web - enabled ERP. With globalization on one hand and massive development in the internet technology on the other, need for web based IT solution was felt. Thus E- ERP is development in the field of ERP which involves the technology of Internet and World Wide Web (WWW) to facilitate the functions of an organization around the web.

2.2.2.6 Enterprise Resource Planning II (ERP- II)

ERP II is the advanced step of E-ERP. It is the software package which has strengthened the original ERP package by included capabilities like customer relationship management, knowledge management, workflow management and human resource management. It is a web friendly application and thus addresses the issue of multiple office locations. It is capable of delivering information in an instant to people who need it, no matter wherever they are.
2.2.2.7 ERP – A Manufacturing Perspective

ERP systems evolved out of MRP and MRP II systems. MRP systems addressed the single task of materials requirements planning. MRP II extended the scope to the entire manufacturing function. The manufacturing industry traditionally had a better climate to use computers. First of all the manufacturing community being dominated by engineers had no computer phobia. Second the extensive use of Computer Aided Drafting (CAD), Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) had prepared the manufacturing function to use computers well, in fact exceptionally well. In fact manufacturing engineers contributed significantly to the theoretical computer science by way of contributions in the areas of graphics, computational geometry, significant visualization, feature recognition etc. Large corporations like General Motors (GM), Ford, Hewlett Packard (HP), and Digital primarily viewed themselves as manufacturing companies until the 1980s. Naturally complex MRP systems were considered the ultimate in enterprise information systems. The investments in hardware and software to manage such complex manufacturing solutions gave these systems a visibility unparalleled in the industry. Compared to these systems accounting systems, financial systems or personnel information systems were relatively inconsequential to the organization.

With the globalization of operations and the proliferation of computer networks, it was important that the manufacturing organizations extend their information system across the supply chain. The supplier’s information system spread across continents with complex combinations of hardware and software need to be integrated. Similarly the dealer-distributor network had to be integrated with the manufacturing information systems. The reduction in product life cycle necessitated a quick response manufacturing system that had its ears tuned to the market. This forced manufacturing information systems to have a tighter integration with marketing information systems. The manufacturing flexibility had translated into mass customization calling for further integration of information systems. The opening up of several world economies including that of the Asian giants like China and India, the emergence of trade blocks and consolidated markets such as European Union paved the need for accounting and finance
functions to be tightly integrated with manufacturing functions. It was not sufficient anymore just to manufacture and sell but organizations had to arrange for finance, comply with complex trade restrictions, barriers, and quotas. The balance sheets needed to account for multiple currencies, multiple export import rules and regulations, multiple accounting codes, practices, accounting periods. This necessitated further integration of accounting and financial information systems with manufacturing systems. In fact with large capacities built around the world particularly in Asian countries, outsourcing and contract manufacturing became viable alternative even in the high-tech industries like semiconductor manufacturing. Suddenly the need was for an Enterprise Information System that looks beyond the manufacturing function to address inbound logistics, outbound logistics, manufacturing, materials managements, project management, quality management, accounting, finance, sales and personnel management. It was nearly impossible to integrate individual modules of information systems. What was necessary was a system that addressed the enterprise needs from the design stage. ERP systems were the natural choice in this changed scenario.

2.2.3 ERP System Overview

2.2.3.1 Meaning of ERP

Enterprise resource planning is an integrated information system which is considered a vital backbone information system of the enterprise. A cross functional enterprise system integrated and automates all the internal cross functional business processes such as production, order processing, logistics, sales, distribution, accounting, finance and human resource. It helps the enterprise to achieve efficiency, agility and responsiveness. The meaning of ERP system is very well explained in figure 2.2
2.2.3.2 Definition of ERP
Researchers and practitioners have defined ERP in many different ways. Minahan\(^6\) (1998) defines ERP as a complex software system that ties together and automates the basic processes of a business. ERP has been defined by various authors but with few differences.

Kumar et al.\(^7\) (2000) define enterprise resource planning (ERP) systems as “configurable information systems packages that integrate information and information-based processes within and across functional areas in an organization”

Al-Mashari and Zairi\(^8\) (2000) states that ERP represent an optimal enterprise-wide technology infrastructure. The basic architecture of an ERP system builds on one database, one application, and a unified interface across the entire enterprise.

Nah et al.\(^9\) (2001) defines ERP as “An enterprise resource planning (ERP) system is typically defined as a packaged business software system that facilitates a corporation to manage the efficient and effective use of resources (materials, human resources, finance,
etc.) by providing a total integrated solution for the organization’s information-processing requests, through a process-oriented view consistent across the company.”

Wallace and Kremzar\textsuperscript{10} (2001) describes ERP as an enterprise-wide set of management tool that balances demand and supply, containing the ability to connect customers and suppliers into a complete supply chain, employing proven business processes for decision making and providing high degree of cross functional integrations among sales, marketing, manufacturing, operations, logistics, purchasing, finance and new product development and human resources, thereby enabling people to run their business with high level of customer service and productivity and simultaneously lower cost and inventories; and providing the foundation for effective e-commerce.

It is seen that with passage of time the definition of ERP has undergone changes as these systems were further extended to include inter-firms activities through integration of front-office and back-office business applications such as supply chain management and customer relation management.

\textbf{2.2.3.3 Outline of ERP system}

Enterprise resource planning (ERP) is a planning philosophy which is enabled with software technology that successfully attempts to integrate all the business process to different department and functions across a company onto a single computer system. Before ERP implementation each department within the organization had its own computer system optimized for the requirements of that department’s needs alone. As shown in figure 2.3 each department will maintain separate database and design application as per their functionalities. This may result in good performance of the departments individually but it may not maximize the overall performance of all the departments together or the company as a whole.
ERP system program combines all the business requirements of the company together into a single integrated software program that runs on a single database so that various departments can easily share information and communicate with each other. Figure 2.4 shows that ERP conceptually replaces the old stand-alone computer system with a single software program that facilitates various functional modules. Thus, everybody from different departments will get their own advantages of software along with the added features of availability of information across other departments to improve decision quality and overall performance of the organization.
2.2.3.4 Characteristics of ERP system

Study of various definitions of ERP put forth by various researches suggests that ERP system is an integrated system that operates in real time. ERP system creates common database which support all applications facilitating the organizational functions, activities and services. ERP system also facilitates analytical planning and has the capability to bridge the information gap across the organization.

According to O’Leary\textsuperscript{11} (2000), ERP systems have the characteristics like: ERP systems are packaged software designed for a client server environment, whether traditional or web-based; ERP systems integrate the majority of a business’s process; ERP systems process a large majority of an organization’s transactions; Use an enterprise-wide database that typically stores each piece of data once; It allow access to the data in real time.
Thus the features of ERP system can be listed as follows:\textsuperscript{12}:

(a) Flexibility: An ERP system should be flexible to respond to the changing needs of an enterprise. The client server technology enables ERP to run across various data base back ends through Open Data Base Connectivity.

(b) Modular and open: ERP system has to have open system architecture. This means that any module can be interfaced or detached whenever required without affecting the other modules. It should support multiple hardware platforms for the companies having heterogeneous collection of systems. It must support some third-party add-ones also.

(c) Comprehensive: It should be able to support variety of organizational functions and must be suitable for a wide range of business organizations.

(d) Beyond boundaries: It should not be confined to the organizational boundaries, rather support the on-line connectivity to the other business entities of the organization.

(e) Best business practices: It must have a collection of the best business processes applicable world-wide.

(f) Simulation of reality: ERP system must stimulate the reality of business processes on the computer system. In no way it should have the control beyond the business processes and it must be able to assign accountabilities to the users controlling the system.

2.2.3.5 Modules of ERP System

Early implementers deployed ERP system modules that addressed key intra-firm activities pertaining to the finance, logistics, and human resources functions. Typically firms deployed modules such as financial accounting, controlling, personnel administration, personnel development, general logistics, materials management, procurement, inventory control production planning, and sales and distribution. Each of these modules in turn comprised of numerous sub-modules that accessed a common database\textsuperscript{13}. 
Modules and sub-modules can be deployed by firms either individually addressing the specific business activity as per the need. Another way of deployment is they deployed one or more modules and/or sub-modules as a partially integrated solution that addressed a group of business activities. Firms can also choose to leverage the full integration potential of the ERP system by implementing all the modules and sub-modules to form a complete ERP system. As firms stabilized their intra-firm deployments, they then extended their implementations with the addition of modules that addressed inter-firm activities across the supply chain. ERP modules that commonly found implemented are: Finance module (FI), Human Resource Module (HR), Materials Management Module (MM), Production planning module (PP), Quality management module (QM), Sales and distribution module (SD), Controlling (CO), Supply Chain Management (SCM), General logistics (LO), Project system (PS), Plant maintenance (PM), Customer Relation Management (CRM), E-commerce (E-COM), Advance Planner Optimizer/ Advance Planner Scheduler (APO/APS). Each of these modules in turn comprises of numerous sub-modules that accessed the firm’s common database. These modules are discussed in detail in chapter 3, section 3.4.1

**Figure 2.5**

Common Modules of ERP System
2.2.3.6 Advantages of ERP

ERP system selection and implementation is a major capital intensive strategic decision for any organization. The business drivers impacting ERP strategies are cost reduction, customer service and growth. Organizations go in for this decision to standardize their business process, as well as to integrate and co-ordinate the people, processes and technology that can have a significant impact on the benefits achieved by the organizations.

Vendors of EPP packages mention and promise potential benefits of improved process flow, better data analysis, higher quality data for decision making, reduced inventories, improved coordination throughout the supply chain, and better customer service etc. Studies that surveyed the impact of ERP systems in the performance of organizations indicated that company size and industry segment do not affect the results. Benefits have been indicated for large and small firms, whether they make standard or custom products or are in the service sector. These benefits can be broadly classified into direct benefits and quantifiable benefits. These benefits are discussed in detail later in this chapter.

In other words, ERP has to provide timely and accurate productions- oriented information for long-range planning and day-to-day operational planning and control. It has to improve productivity and enhance the competitive edge by optimizing the use of resources, i.e. Men, Material, Machines and Money. It is a tool in the hands of management to balance the demand and supply and to stay competitive.

In context of profitability, the interdependencies of various functions in an enterprise which are required in order to improve profits and stay competitive are presented in the Profit Structure Design as shown in figure 2.6. A production engineer’s perennial problem is shortage of parts, materials and sub-assemblies to make products on time. At the same time, there is problem of high inventories and accumulated parts in the stores due to various reasons like safety stock, product modifications and defectives storage methods. Load balancing between various manufacturing and assembly shops as well as
quality and customer-service problems need not be over-stressed. If we add cash flow and human resources problem to the above, the production manager’s cup of woes is full.\footnote{15}

\textbf{Figure 2.6}

![Profit Structure Diagram (PSD)](image)


\textbf{Benefits of ERP:}

(a) \textbf{Business integration:} The first and the most important advantage lie in the promotion of integration. The reason ERP packages are called integrated is the automatic data upgradation between related business components, since conventional company information systems were aimed at the optimization of independent business functions in business units, almost all were weak in terms of the communication and integration of information that transcended the different business functions in the case of large companies in particular, the timing of system structure and directives differs from each product and department / functions and sometimes they are disconnected. For this reason, it has become an obstacle in the
shift to new product and business classification. In the case of ERP packages the data of related business functions is also automatically updated at the time a transaction occurs. For this reason, one is able to grasp business details in real time, and carry out various types of management decisions in a timely manner based on that information.

(b) **Flexibility**: The second advantage of ERP packages is their flexibility. Diverse multi-functional environments such as language, currency, accounting standards and so on are covered in one system and functions that comprehensively managed multiple locations that span a company are packaged and can be implemented automatically. To cope with company globalization and system unification, this flexibility is essential, and one could say that it has major advantages, not simply for development and maintenance, but also in terms of management.

(c) **Better analysis and planning capabilities**: Yet another advantage is the boosting of planning type functions. By enabling the comprehensive and unified management of related business and its data, it becomes possible to fully utilize many types of decision support systems and stimulation systems. Furthermore, since it becomes possible to carry out flexibility and in real time the feeling and analysis of data from a variety of dimensions, one is able to give decision makers the information they want, thus enabling them to make better and informed decisions.

(d) **Use of latest technology**: The fourth advantage is the utilization of latest developments in information technology (IT). The ERP vendors were very quick to realize that in order to grow and to sustain that growth: they have to embrace the latest developments in the field of information technology. So they quickly adopted their systems to take advantages of the latest technologies like open systems, client server technology, internet/ intranet, computer aided acquisition and logistics support, electronic commerce etc. It is this quick adaptation to the latest changes in information technology that makes the flexible adaptation to changes to future business environments possible. It is this flexibility that makes the incorporation of the latest technology possible during the system customization, maintenance and expansion phases.
(e) **Reduced inventory and inventory carrying cost:** The manufacturing nature of many ERP users makes the issue of process and material costs savings paramount. The main factor behind these savings is that implementation of the ERP system allows customers to obtain information on cost, revenues and margins, which allow it to better, manage its overall material cost structure. This ability to manage costs is best seen in savings that organizations can obtain in their inventory systems. Customers can perform a more complete inventory planning and status checking with the ERP system. These checks and plans reveal existing surpluses or shortages in supplies. Improved planning and scheduling practices typically lead to inventory reductions to the order of 20 per cent or better. This provides not only a one time reduction in assets (cost of the material stocked), but also provides ongoing savings of the inventory carrying costs. The cost of carrying inventory includes not only interest but also the costs of warehousing, handling, obsolescence, insurance, taxes, damage and shrinkage.\(^{20}\)

(f) **Reduced manpower cost:** Improved manufacturing practices lead to fewer shortages and interruptions and to less rework and overtime. Typical labor savings from a successful ERP system are a 10 per cent reduction in direct and indirect labor costs. By minimizing rush jobs and parts shortages, less time is needed for expediting, material handling, extra setups, disruptions and tracking splits lots odd jobs that have been set aside. Production supervisors have better visibility of required work and can adjust capacity or loads to meet schedules. Supervisors have more time for managing, directing and training people. Production personnel have more time to develop better methods and improve quality.\(^{21}\)

(g) **Reduced material costs:** Improves procurement practices lead to better vendor negotiations for prices, typically resulting in cost reductions of 5 per cent or better. Valid schedules permit purchasing people to focus on vendor negotiations and quality improvements rather than spending their time on shortages and getting material at premium prices. ERP systems provide negotiation information, such as projected material requirements by commodity group and vendor performance statistics. Giving suppliers better visibility of future requirements help them achieve efficiencies that can be passed on as lower material costs.\(^{22}\)
(h) **Improves sales and customer service:** Improved coordination of sales and production leads to better customer service and increased sales. Improvements in managing customer contacts, making and meeting delivery promises, and shorter order to ship lead times, lead to higher customer satisfaction, goodwill and repeat orders. Sales people can focus on selling instead of verifying or apologizing for late deliveries. In custom product environment, configurations can be quickly identified and prices, often by sales personnel or even the customer rather than the technical staff. Taken together, these improvements in customer service can lead to fewer lost sales and actual increase in sales, typically 10 per cent or more. ERP systems also provide the ability to react to changes in demand and to diagnose delivery problems. Corrective actions can be taken early such as determining shipment priorities, notifying customers of changes to promise delivery dates, or altering production schedules to satisfy demand.

(i) **Efficient financial management:** Improves collection procedures can reduce the number of days of outstanding receivables, thereby providing additional available cash. Underlying these improvements is fast, accurate invoice creation directly from shipment transactions, timely customer statements and follows through on delinquent accounts. Credit checking during order entry and improved handling of customer inquires further reduces the number of problem accounts. Improved credit management and receivable practices typically reduce the days of outstanding receivables by 18 per cent or better. Trade credit can also be maximized by taking advantage by supplier discounts and cash planning, and paying only those invoices with matching recipients. This can lead to lower requirements for cash-on-hand.

The benefits from ERP come in three different forms i.e. in the short-term, medium-term and long-term. When initially implemented, in a year of the organization going live with ERP, it helps in streamlining the operational areas such as purchase, production, inventory control, finance and accounts, maintenance, quality control, sales and distribution, etc. This benefit is in form of ‘automating’ the transactions which promises accuracy, reliability, availability and consistency of data.
The next level of benefits accrues in the medium-term after the data in the above area is in place. At this stage the organization not only gets data but can use it in meaningful analysis and plan the major resources (material, machine capacity, manpower and money). At this stage organization realizes benefits in terms of reduced working capital (inventory and receivables) better financial forecasts, reduces cycle-time for order fulfillment, improved coordination between various related processes in the organization, etc.

The real benefits of the ERP comes in the long-term when the organization is in the position to apply the experience of the best business processes evolved over years of implementing the ERP for other organizations. At this stage the organization adopts the ‘Best Business Processes’ such as Total Quality Management (TQM), Just-in-Time (JIT), and Computer Integrated Manufacturing (CIM). In the long-term ERP also enhances the organizations competitive edge by providing it the ability to change easily. An ERP package provides various ways of performing a business activity, and an organization can adopt a different way of performing the same activity by reconfiguring the ERP and testing the changes²⁵.

Al-Mashari et al.⁶ (2003) classifies changes in performance measures due to ERP system implementations into five categories. The operational category concerns improvements in functional areas leading to cost reductions, cycle time reductions, and productivity improvements. Benefits such as better resource management, improved decision-making, planning, and performance improvements fall into the managerial grouping. Strategic benefits help firms to innovate, build cost leadership, generate product differentiation, and build external links in the supply chain. The firm’s IT infrastructure benefits through IT cost reductions and increased IT capacity. Organizational benefits such as business learning and successful organizational changes also accrue to firms²⁷.

ERP investment is the single biggest information technology investment an organization makes, the implementation cost running in millions of dollar for any medium size or large size organizations. Despite of many benefits promised by the vendors, the adoption
of ERP system generally is found to result into time and cost overrun. Also studies reveal that all the implementation do not deliver all the promised benefits. Due to this high expenses and low success rate, role of critical success factors (CSFs) need to be understood.

2.2.3.7 Critical Success Factors (CSFs)

A well-designed and implemented ERP system should help reduce the production manager’s problems. However not at all ERP implementations succeed fully. It seems to be generally conceded that failure of an MRP/ERP installation can be traced to problems such as:

- Lack of top management’s commitment to the project
- Lack of training for those who will eventually have to use the system
- Unrealistic master production schedules and
- Inaccurate data

To achieve good results from an ERP system, top management has to review the ERP implementation, support the efforts of key through the ERP implementation and take proactive action to enhance the utility of ERP.  

Along with effective implementation of ERP modules and sub-modules, studies have recognized various critical success factors (CSFs) that are associated with effective implementation of the ERP system. CSF affects various phases of ERP system implementation. Each one of the different CSF has a different degree of importance in different stage of ERP implementation and ERP life cycle. Though, firms generally reported success in their ERP system deployments, there are many failures or near failures in implementing these systems. Therefore appropriate resources should be allocated to each of these factors to reduce the chances of ERP failure.

Firms faced difficulties in completing their implementations and achieving effective integration due to numerous technical, managerial, and organizational challenges. Most firms adopted a CSF-based implementation approach to overcome these difficulties.
Early CSF research identified individual CSFs and indicated that firms which focus on these factors will achieve implementation success. Researchers later realized that these CSF are interdependent and hence later CSF research focused on developing CSF frameworks to aid the ERP system implementation process. Realizing that different CSFs are important in different phases of the ERP project, recent literature prioritized and classified CSFs, according to the ERP life cycle implementation process"}
may seem very linear and distinct from each other, but in real, throughout the actual implementation, the phases are in fact quite fluid. In many cases companies go through many implementations – in different business units, different modules, or manufacturing locations, so at any given time, more than one of the phases may be operational. Some companies opt for one and only one ‘Big Bang’, while other companies favor sequential roll out, the life cycle phases are the same.

(a) **Pre-evaluation screening**

Once the company decides to go for ERP system the search for the perfect package starts. But there are hundreds of ERP vendors - of all shapes and sizes- all claiming to have the solution that is ideal for a company. Analyzing all packages before reaching to a decision is not possible. It is also very time consuming process. So it is better to limit the number of packages that were evaluated to less than 5. It is always better to do a thorough evaluation of small number of packages, rather than doing a superficial analysis of dozen of packages. So the company should do a pre-evaluation screening to limit the number of packages that are to be evaluated by the committee.

(b) **Package evaluation**

The evaluation/ selection process is one of the important phases of the ERP system implementation because the package that a company selects will decide the success or failure of the project. Since ERP systems involve huge investments, once a package is purchased, it is not an easy task to switch to another one. So it is ‘do it right the first time’ proposition and there is no room for error. The most important factor to be kept in mind while evaluating the package is that none of them are perfect. The idea that there is no perfect package needs to be understood by everyone in the decision making team. The objective of the selection process is not to identify a package that covers each and every requirement. It is to find a package that is flexible enough to meet the company’s needs, or in other words, software that could be customized to obtain a ‘good fit’.
Some important points to be kept in mind while evaluating ERP software includes:

- Functional fit with the company’s business process
- Degree of integration between various components of the ERP system
- Flexibility and scalability
- Complexity
- User friendliness
- Quick implementation
- Ability to support multi-site planning and control
- Technology- client/ server capabilities, database independence, security
- Availability of regular upgrades
- Amount of customization required
- Local support infrastructure
- Availability of reference sites
- Total cost including cost of license, training, implementation, maintenance, customization and hardware requirements.

(c) **Project planning phase**

This is the phase that designs the implementation process. It is in this phase that the details of how to go about the implementation are decided. Time schedules, deadlines, etc. of the project are arrived at. The project plan is developed. Roles are identified and responsibilities assigned. The organizational resources that will be used for the implementation efforts are decided and the task allocation is done. This phase will decide when to begin the project, how to do it and when the project is to be completed. This is the phase which will plan what to do in case of contingencies; how to monitor the progress of implementation, what control measures should be installed and what corrective actions should be taken when things get out of control. Usually a committee constituted by the team leader of each implementation group, do the project planning. It will be headed by the ERP in-charge and will meet periodically to review the progress and chart the future course of action.
(d) **Gap analysis**

This is arguably the most crucial phase in the success of the ERP implementation. This is the process through which the company creates a complete model of where they are now and where they want to be headed. The trick is to design a model which both anticipates and covers any functional gaps. It has been estimated that even the best ERP package, custom tailored to the company’s need meet only 80 per cent to the company’s functional requirement.

The remaining of the requirement present a problematic issue for the company’s business process reengineering one of the company’s most affordable solutions entails altering the business to fit the ERP package. Other solutions include:

- Pinning hopes on an upgrade
- Identifying a third party product that might fill the gap
- Designing a custom program
- Altering the ERP source code

(e) **Reengineering**

It is the phase that the human factors are taken into account. In ERP implementation settings, reengineering has two different connotations. The word reengineering in the ERP field refers to an ERP implementation model initially designed and used with much success by the major ERP consulting firms. The BPR approach to an ERP implementation implies that there are really two separate but closely linked implementations involved in an ERP site: a technical implementation and business process implementation. The BPR approach emphasizes the human element of necessary change in an organization, this approach is generally more time consuming and has received its share of criticism for creating bloated and extended projects. But adherences of the BPR approach to ERP would argue that there is no way that you can ignore the human element to an implementation that involves significant changes in responsibilities. As the ERP market shift to the mid-market focus and as all implementations are becoming more cost-sensitive the BPR approach has come under some real scrutiny.
(f) **Customization**
This is main functional area of ERP implementation. It is a bit of mystique around the customization process and for good reason. In order to do so, business processes have to be understood and mapped in such a way that they arrived at solutions match up with the overall goals of the company. But, companies cannot just shut down their operations while the mapping processes take place. Hence, the prototype a simulation of the actual business processes the company will be used. The prototype allows for thorough testing of the ‘to-be’ model in a controlled environment. As the ERP consultants configure and test the prototype, they attempt to solve any logistical problem inherent in the BPR before the actual go-live implementation.

(g) **Implementation team training**
Around the same time the these customization is taking place, the implementation team is being trained, not so much on how to use the system, but on how to implement it. This is the phase where the company trains its employees to implement and later run the system. The ERP vendors and the hired consultants will leave after the implementation is over, but for a company to be self sufficient in running the ERP systems; it should have a good in house team that can handle the various situations. So it is very vital that the company recognizes the importance of this phase and selects employees with the right attitude people who are willing to change, learn new things and are not afraid of technology and good functional knowledge.

(h) **Testing**
This is the phase where the company tries to break its system. It is the phase where the company is testing real case scenario. This system is configured and now you must come up with extreme case scenario- system overloads, multiple users logging on the same time, user entering invalid data, hackers trying to access restricted areas and so on. The test cases may be designed specifically to find the weak links in the system and these bugs should be fixed before going live.
(i) **Going live**

This is the phase where ERP is made available to the entire organization. On the technical side the work is almost complete - data conversion is done and the databases are up and running and on the functional side the prototype is fully configured and tested and ready to go operational. The system is officially proclaimed operational, even though the operational team must have been testing it and running it successfully for some time. But once the system is ‘live’ the old system is removed and the new system is used for doing business.

(j) **End user training**

This is the phase where the actual users of the system will be given training on how to use the system. This phase starts much before the system starts going live. The employees who are going to use the new system are identified. Their current skills are noted and they are divided into groups, based on their current skill levels. Each group is then given training on the new system. This training is very important as the success of the ERP system is in the hands of the end users. Therefore these training sessions should give the participants an overall view of the system and how each person’s action affects the entire system. In addition to these general topics, each employee is trained on the job or the tasks that he or she is supposed to perform once the system goes live. It is human nature to resist change. Also many people are afraid of computers and other new technologies. So there will be resistance to change. Another factor is that not all people will be successful in making the changeover. The company management should address these concerns and should take necessary actions to avoid failures. End-user training is much more important and much more difficult than the implementation team training. Companies are beginning to take this phase seriously as there is now statistical evidence, which shows that the most implementation fail because of lack of end-user failure.

(k) **Post implementation (operations and maintenance)**

One important factor that must be kept in mind is that the post implementation phase is very critical. Once the implementation is over the vendors and the hired consultants will go. To reap the benefits of the ERP system, the system should get enterprise-wide
acceptance. There should be people within the organization who have technical prowess to make necessary enhancements to the system, as and when required. The system must be upgraded as and when new version or new technologies are introduces. Here the organization should think in terms of incremental benefits. Of the new enhancements, there will be a lot of other aspects, like user training, that have to be considered. So instead of going in for upgrade as and when a new version is announces by the vendor, the organization should first analyze the cost and benefits.

The post ERP organizations will need a different set of role and skills than those with less integrated types of systems. At a minimum, everyone who uses the system needs to be trained on how they work, how they relate to the business process and how a transaction ripples through the entire company whenever they press a key. The training will never end; it is an ongoing process; new people will always be coming in and new functionality will always be entering the organization.

2.4 Evaluation of ERP System Performance

2.4.1 Evaluation of ERP system performance

Benefits that are accrued to the firm increase with the implementation of modules and sub-modules. It is seen that the benefits enhances as the modules implemented are effectively integrated within the ERP system. Along with the technical implementation the organizational changes need to be done so as to maximize these benefits. The literature available has been proactive in determining the types of benefits that companies might anticipate from their ERP systems and to what extent organizations had actually attained those benefits on a post-implementation. Companies anticipated realizing both tangible and intangible benefits from the implementation of ERP systems. But to achieve these benefits the role of the CSFs are very crucial. CSFs are found to have different degree of importance at the different stages of ERP implementation. Not only this, CSFs also affect the performance of the ERP system throughout the life cycle of the ERP system. Thus it is the ERP system which affects the change in performance of the firm with the moderating effect of the CSFs at various stages.
2.4.2 General Model for Evaluation of ERP system Performance

Madapusi (2008) in his study found a gap in the present available literature and tried to fulfill this gap by evaluating the change in performance and benefits arising flowing in due to implementation of ERP system and as well as by investigating the impact of various factors that are found critical for the ERP system deployment. The general model of ERP system defining the relation of ERP system implementation status and change in performance with moderating effect of CSFs is given in figure 2.7

**Figure 2.7**

General Model of ERP System Performance

![Diagram of ERP System Model](image)

**Source:** Madapusi (2008); *Post-Implementation Evaluation of Enterprise Resource Planning (ERP) Systems* 2008, Published Doctoral Thesis

The model in the figure 2.7 relates the ERP system implementation status to changes in performance with the moderating effect by CSFs on this relationship. The model is developed by Madapusi (2008) and based on the theoretical underpinnings of the use of Galbraith’s information processing theory (Galbraith, 1977; Galbraith, Lawler III, & Associates, 1993; Mohrman, Galbraith, Lawler III, & Associates, 1998; Galbraith, Downey, & Kates, 2002).

2.5 Chapter Concluding Notes

This chapter gave the overview of ERP system, its advantages and general model to evaluate ERP system performance. Next chapter discusses literature review and theoretical framework of the study.
END NOTES

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