

Enterprise Resource Planning

Course No: MCA 608-EA

UNIT 1

1 Introduction

ERP is an acronym that stands for Enterprise Resource Planning. ERP software saw phenomenal interest from the corporate sector during the period 1995-2000. Substantial investments (often running into millions of dollars) were made in hardware, software, consulting and training to support ERP implementations. The ERP market is estimated to be in excess of USD 80 Billion in the year 2000 [1]. Significant benefits are associated with successful implementation of ERP in the Fortune 500 companies - in the form of faster inventory turnover, higher capacity utilization, faster time to market and overall profitability. Many analysts feel that today's global business environment - products and services customized to suit the individual needs of millions of customers, delivered over multiple timelines in a 24X7 basis - would have been impossible without such enterprise software. Undoubtedly ERP represents one of the most complex and demanding application software in the corporate environment.

2 What is ERP?

ERP is a package software solution that addresses the enterprise needs of an organization by tightly integrating the various functions of an organization using a process view of the organization.

- A. ERP software is ready-made generic software; it is not custom-made for a specific firm. ERP software understands the needs of any organization within a specific industry segment. Many of the processes implemented in an ERP software are core processes such as order processing, order fulfillment, shipping, invoicing, production planning, BOM (Bill of Material), purchase order, general ledger, etc., that are common to all industry segments. That is the reason why the package software solution works so well. The firm-specific needs are met through a process of customization.
- B. ERP does not merely address the needs of a single function such as finance, marketing, production or HR; rather it addresses the entire needs of an enterprise that cuts across these functions to meaningfully execute any of the core processes.
- C. ERP integrates the functional modules tightly. It is not merely the import and export of data across the functional modules. The integration ensures that the logic of a process that cuts across the function is captured genuinely. This in turn implies that data once entered in any of the functional modules (whichever of the module owns the data) is made available to every other module that needs this data. This leads to significant improvements by way of improved consistency and integrity of data.
- D. ERP uses the process view of the organization in the place of function view, which dominated the enterprise software before the advent of ERP. The process view provides a much better

insight into the organizational systems and procedures and also breaks the "kingdoms" that work at cross-purposes in many organizations.

- E. To implement such a demanding software one needs high performance computing, high availability systems, large, high-speed, high-availability on-line storage and high-speed, high-reliable networks, all at affordable cost.

3 **Why ERP?**

In spite of heavy investments involved in ERP implementation, many organizations around the world have gone in for ERP solutions. A properly implemented ERP solution would pay for the heavy investments handsomely and often reasonably fast. Since ERP solutions address the entire organizational needs, and not selected islands of the organization, ERP introduction brings a new culture, cohesion and vigor to the organization. After ERP introduction the line managers would no longer have to chase information, check compliance to rules or conformance to budget. What is striking is that a well-implemented ERP can guarantee these benefits even if the organization is a multi-plant, multi- location global operation spanning the continents. In a sense ERP systems can be compared to the "fly-by-wire" operation of an aircraft. ERP systems similarly would relieve operating managers of routine decisions and leave them with lots of time to think, plan and execute vital long-term decisions of an organization. Just as "fly-by-wire" operation brings in amazing fuel efficiency to the aircraft operation by continuous monitoring of the airplane operation, ERP systems lead to significant cost savings by continuously monitoring the organizational health. The seemingly high initial investments become insignificant in the face of hefty long-term returns

At another level, organizations today face the twin challenges of globalization and shortened product life cycle. Globalization has led to unprecedented levels of competition. To face such a competition successful corporations should follow the best business practices in the industry. Shortened life cycles call for continuous design improvement, manufacturing flexibility and super-efficient logistics control; in short a better management of the entire supply chain. This in turn presupposes faster access to accurate information both inside the organization and from the entire supply chain outside. The organizational units such as Finance, Marketing, Production and HRD need to operate with a very high level of integration without losing flexibility. ERP systems with an organizational wide view of business processes, business needs of information and flexibility meet these demands admirably.

Thanks to developments in computing and communication technology, it is possible to network organizational units through reliable communication channels, providing tighter integration among them. The server technology today permits very high reliability and access to large data securely at reasonable cost. The open systems philosophy, client server architecture, high performance operating systems, RDBMS and Rapid Application Development tools are available today that permit such enterprise wide systems to be deployed.

These explain the motivating factors behind contemporary ERP systems.

4 ERP – A Historical Perspective

ERP systems evolved from the Materials Requirements Planning (MRP) systems of the seventies and the Manufacturing Resources Planning (MRP II) systems of the eighties. Essentially MRP addressed a single task of materials planning within manufacturing function while the Manufacturing Planning Systems (MRP II) addressed the entire manufacturing function.

Industries such as automobile manufacture had large inventories of assemblies and sub-assemblies; often there were complex sub-assembly to assembly relationships characterized by Bill of Materials (BOM) involving thousands of parts. The need to drive down the large inventory levels led to the early MRP systems that planned the “order releases”. Such planned order releases ensured the time phasing and accurate planning of the sub-assembly items.

A typical example from bicycle manufacture can illustrate the point - to manufacture 1000 units of bicycles, one needs 2000 wheels, 2000 foot-pedals and several thousands of spokes. On a given day, a plant may have 400 units of complete bicycles in stock, 6300 units of wheels, 370 units of foot-pedals and 87,900 units of spokes. If the plant is to assemble 800 units of bicycles for the next 4 days of production, determining the precise numbers of each of the items – foot-pedals, wheels and spokes – is a non-trivial problem. If the independent demand for spare parts is also to be taken into account, one can visualize the complexity. A typical automobile plant with hundreds, if not thousands of parts, has to face problems that are orders of magnitude more difficult. MRP systems address this need.

Using the processing power of computers, databases to store lead-times & order quantities and algorithms to implement Bill-of-materials (BOM) explosion, MRP systems brought considerable order into the chaotic process of material planning in a discrete manufacturing operation.

MRP II went beyond computation of the materials requirement to include loading and scheduling. MRP II systems could determine whether a given schedule of production is feasible, not merely from material availability but also from other production resource point of view. The increased functionality enabled MRP II systems provided a way to run the MRP II systems in a loop;

- First: 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 schedule;
- Third to plan the materials using the traditional MRP.

The nineties saw an unprecedented global competition, customer focus and shortened product life cycles. To respond to these demands corporations had to move towards agile manufacturing of products, continuous improvements of processes and business process reengineering. This called for integration of manufacturing with other functional area including accounting, marketing, finance and human resource development. For example,

- Activity based costing would not be possible without the integration of manufacturing and accounting.
- Mass customization of manufacturing needs integration of marketing and manufacturing.
- Flexible manufacturing with people empowerment necessitates integration of manufacturing with HRD function.

In a sense the business needs in nineties called for integration of all the functions of management. ERP systems are such integrated information systems.

5 ERP – An IS Perspective

ERP systems can be viewed as a logical extension of the evolution of Electronic Data Processing (EDP), Management Information Systems (MIS), Decision Support Systems (DSS) and Knowledge Based Systems (KBS) systems over the past four decades [2]. The EDP systems concentrated on the efficiency aspect to get mundane things like payroll calculation, inventory reports or census reports generated faster and accurately. The MIS systems addressed the operational information needs through effectiveness measures like exception reporting, insights into processes etc. The DSS used extensive modeling tools such as optimization, simulation and statistical analysis to reveal patterns in the information generated by MIS systems to genuinely support tactical and even strategic decisions. The KBS systems went beyond data, information and models to capture knowledge of the decision-maker and to use the captured knowledge to propose far superior innovative solutions.

Another categorization of applications view business systems as Office Automation Systems (OA), Online Transaction Processing (OLTP) and Decision Support Systems (DSS). OA included tasks like word processing, spreadsheets, presentation, e-mail & other communication tools that are generally used for personal productivity. OLTP systems use large databases, networks and mission-critical applications to improve the organizational productivity. DS systems address the needs of top management through Natural Language Processing, Expert Systems and other sophisticated tools [2].

Unfortunately both the approaches missed out the key issue of integration. The EDP, MIS, DSS and KBS based classification assumes a compartmentalization across the layers of management. The OA, OLTP, DS classification assumes that the tasks are independent. Both assumptions are invalid in the real world scenario. The ERP systems remove the deficiencies by taking holistic view of information across the organization. ERP systems capture the essence of the business processes. It is driven by the business needs and not the IT needs. An IT driven solution often attempts to formulate a way of using a technique to solve a known business problem. The emphasis is on the usage of a technique or a technology. ERP systems take a business driven view. They solve the business problem using a combination of the tools and implement the best practices using contemporary technology. This explains the phenomenal success of ERP compared to many other systems.

6 Components of ERP

Typically any ERP software consists of the following key features

Finance Module_with the following key topics

GL Management accounting

Balance Sheet and Profit & Loss statement

Closing Procedures

AR Customer management

- Invoice & Credit / Debit memo

- Dunning (reconciliation)

AP Invoice receipt

- Payments

- Credit

- Invoice posting

With the following key function

Consolidation

- Capital

- Debt

- Fiscal year choice

- Internal & external company reporting

Financial Control

- Cash Management

- Electronic Banking

- Account clearance

- Cash management

- Foreign Exchange

Asset Management

- Loans

- Stocks

- Currency Exchange

- Depreciation, Valuation, Plant Maintenance

Funds Flow

Budgeting

Expense accounts

Funds availability control

As can be readily seen the features are very rich, comprehensive and in turn complex; this explains the widespread interest as well as the confusion that surrounds typical ERP software.

Most ERP software provide extensive facilities for data protection, security, access control, automatic logging of key transactions, business model editors, data migration tools, reporting tools, MIS tools, data archiving tools, data warehousing and data mining capability either as part of the core product or through strategic partnership with Report writing software vendors, DBMS vendors, data storage vendors etc..

7 ERP Life Cycle

Typically ERP introduction in an organization goes through the following stages

- a) Concept selling – In this stage ERP consultants take the top management through the ways in which ERP will help the organization in achieving the business goals. Generally this process takes several weeks. The CEO, CFO, CTO and the CIO must be actively involved in this process.
- b) ERP Feasibility Study – Once the top management is convinced of the role of ERP, consultants do a feasibility study that broadly quantifies the benefits, costs and the readiness of the organization for ERP implementation.
- c) ERP Readiness – Once the feasibility is achieved the organization is readied for ERP by way of getting the IT and information infrastructure good enough for ERP implementation. This may involve hardware addition / upgradation, network upgradation and standardizing key business elements (account codes, material codes, cost centers etc.,) and key business processes (order entry, procurement, production, logistics, invoicing etc.,). Often this process leads to significant Business Process Reengineering (BPR). Depending on the context BPR could be a full blown exercise or integrated with ERP implementation. It is pragmatic to view the “best business processes” built into the ERP software as desirable for the organization and modify the existing processes to adapt to the ERP software.
- d) ERP Software Selection – At this stage a detailed evaluation of the existing leading edge ERP software available and support in the local market is done (based on distributor availability, knowledgeable user / consultant support and training support). Some puritans postpone software selection to a later stage.

- e) Mapping “as is” processes and “to be” processes (through pragmatic reengineering) – At this stage, the existing organizational processes are modelled and using the combined expertise of the entire organization, the processes are improved to take advantage of the ERP. This process is often called the “reengineering process”. Special tools to map processes, document processes and improve processes are available either as part of the ERP software or as independent software pieces under the name “process modelling software” such as ARIS Toolset or Visio Enterprise Edition.
- f) ERP Implementation Plan – After the process mapping, the entire process of implementation is identified that includes the nature of implementation, extent of implementation, time schedule, cost schedule, training requirements, identifying key users, transition planning, data migration etc., A key issue is the nature of implementation – some users prefer “big bang” that implies all modules implemented across all departments of the enterprise in one go. Many others prefer module based implementation, say finance first, followed by sales... Yet others implement all modules in one location and roll out the modules in other location (in multi-location organizations). There is no universal “best” option; the user & consultant should jointly decide the choice. Generally an ERP Steering Committee with the blessings and representation of the top management is constituted to supervise the implementation.
- g) Actual Implementation – This stage involves the training of the users in the detailed modules, customizing the software to meet the specific needs of the enterprise, configuring the software to understand industry and firm specific practices (accounting, material, bill of material structures, scheduling practices, depreciation options, valuation of inventory / storage, stocking policies...)
- h) Preparing to “go live” – At this stage the decision of project going live is decided. This may coincide with natural “roll over” dates such as beginning of the fiscal year, planning period etc., To keep the enthusiasm level of the people, a “kick off” function is organized to formally mark the “go live” phase of ERP. All account related start-up figures are fed into the ERP software.
- i) “Go live” - when the organization starts using the ERP software
- j) Post implementation – In this phase the ERP software performance is fine tuned to meet the user’s needs. Often more reports as demanded by the user community is identified and designed.

8 The benefits of ERP

Data discipline, build-up of solid information infrastructure, integration across firm-level functions (finance, production, marketing and HR), process orientation at the level of internal processes, significant usable transactional data generation are some of the real benefits of ERP. Data discipline provides an ability to try out new business models that are necessary in the connected world; a solid information infrastructure provides robustness and control in the “mergers and acquisition” dominated volatile business world. Firm-level integration provides foundation for

integration across suppliers and customers. Process orientation within an enterprise, that is characteristic of ERP, is another key benefit.

9 ERP as Information Infrastructure for an enterprise

The key benefit of ERP implementation is that ERP provides a solid information infrastructure for an enterprise. As an infrastructure, ERP data is shared by all departments across the organization and owned by all users. ERP is NOT one more project initiative from EDP/ MIS/ IT departments. ERP also ensures ready data availability. A well-implemented ERP would pave the way for organizational level data discipline. With “Information available on tap”, it is important that the users start planning for innovative use of this information for planning & analysis. Finally infrastructure should not be viewed from a narrow “cost benefit” and ROI perspective. The true benefits of ERP are not necessarily apparent on day one. Accordingly benefit cost ratio might unduly overemphasize costs that are apparent and underemphasize benefits that may not be apparent. Like every other infrastructure - roads, seaports, airports, telecom and railways – information infrastructure in the form of ERP needs a different mindset too. It must be noted that investments in infrastructure pays by the innovative ways in which the infrastructure is put to use – investments in roads pays off through returns from trucking industry, business generated through phone calls pays for investments in telecom network – similarly innovative use of data generated through ERP would pay for ERP investments. The improved organizational agility provided by ERP must be put to good use.

10 ERP and Supply Chain Management (SCM)

With every enterprise setting up web-based storefront with fancy shopping carts, order processing has become relatively simple for the end users. It is particularly true of B2C (Business to Consumer) scenario. As the Christmas 1999 season proved, it is NOT sufficient to build easy-to-use electronic storefronts. There must be a rugged ERP-class backend system to support thousands of customers and variety of products that can be sold on 24X7 basis throughout the year. More important is the ability to manage the logistics of supply of raw materials that are needed for the production of items to meet the orders taken over the electronic storefront. One must also manage multiple levels of supply and in-house store – finished goods, work-in-process, raw materials and even consumables across the entire supply chain. Ultimately the delivery of the items to the end customer at the right time at right cost must be guaranteed too. All this calls for advanced planning and optimization of goods and services across multiple echelons. This exercise calls for sophisticated multi-stage optimization systems with superior performance to handle millions of customers, thousands of orders and hundreds of products – the core of Supply_Chain Management software. Once again SCM software has changed too – it is not limited to manufacturing execution and sophisticated planning. SCM is merging into e-business scenario, permits web-based usage, works across corporate intranets and extranets and triggers production planning systems from supply planning through sophisticated middleware – powerful application integration indeed.

11 ERP and Customer Relationship Management (CRM)

Corporate applications of the nineties concentrated on internal efficiencies. With functional integration, process orientation and “best of breed” practices embedded in the software, internal users did get significant benefits. Corporations gained through better cost control, inventory reduction, reduced cycle times, improved resource utilization etc., With the arrival of the WWW and the surge in interest in e-commerce, the interest shifted from back office to front office. Once the front office is the focus area, customer moved to the center stage. The super efficient ERP systems had also built solid information base about past customers – their buying pattern, their

product preferences, payment preferences, shipping preferences, location preferences, brand preferences and even time preferences, thanks to solid transaction handling capability of ERP systems. Thanks to the technology of data warehousing and data mining, the customer information and transaction information that has been “logged” religiously by ERP systems and faithfully “backed up” could turn into “goldmines” of information. The retail industry could launch “market basket analysis”, the telecom industry could perform “churn analysis”, the financial industry (particularly credit card firms) could predict spending pattern that can be used to target focused advertisements. It is important to realize that many of these data mining could not have been attempted before the ERP systems were running for several years. It is interesting though that in some industries like telecom and banking, the benefits of using customer information through Customer Relations Management (CRM) far outweigh the benefits of ERP, proving that the customer is still the king, even in Internet age! In addition, e-CRM addresses not only CRM in the Internet age but also CRM in the specific context of web-based business processing; and even processing associated with Dot.Com companies. For example pure Dot.Com companies like Yahoo and AltaVista and Web-hosting companies like Exodus need guaranteed web-serving performance at customer end. To manage “page to page” refresh time across millions of customers under varying load is a very demanding customer service. Issues like personalization, studying customer navigation in user sites and “delivering” information “most relevant” to the individual customer preferences are challenging.

12 ERP and Y2K

In the late nineties many organizations implemented ERP because of their need to get Y2K-compliant software, though implementing ERP just for Y2K readiness may be an overkill. The past few months also were post Y2K months; users and CIO’s no longer look at Enterprise Systems, particularly ERP systems, to get over Y2K problem; they look for business benefits. The feverish growth of ERP in the late nineties was fuelled by the CIO’s wanting to put in place some systems that guarantee Y2K compliance. The integration benefits offered by ERP systems were overshadowed by their guaranteed Y2K compliance. Also some of the dominant ERP vendors such as SAP had by their stature, a hidden stamp of approval for the Y2K compliance; CIO’s discovered that certification from less-known software houses was not that easy to “sell” to their CEO’s. All these factors compounded stalled the growth of ERP in the past two years. Yet ERP is not “finished” by any standards – McKinsey Quarterly estimates almost \$ 82 Billion for the year 2000!

The last six months of 1999 were tense moments for most CIO’s. The supposedly imminent Y2K doom was writ large on their faces. Thanks to the fear of Y2K, the management attention it got and the media hype, Y2K came and practically went away without much noise. Call it better preparation to face the disaster or over-estimation of the possible impact of the Y2K disaster, Y2K was handled exceptionally well by MIS managers. Thanks to Y2K again, IT spending was very much controlled in the last six months of 1999. The worst to suffer was Enterprise Systems – ERP, SCM and the like. Most CIO’s postponed their decision till the new millennium was born.

13 ERP and E Commerce

It is true that during 1996-98 ERP was the “talk of the town”. Starting 1999, thanks to Dot.Com phenomenon the “flavor of the year” was clearly E Commerce. Companies were busy setting up store-fronts on the cyberspace, putting catalogues online, setting up websites with “bells and whistles”, signing up web-hosting contracts, putting in place a Net strategy, hiring consultants to get a Net marketing in place to attract and retain “eyeballs”, understanding payment systems, ensuring interactivity on their sites through mail, chat, discussion groups, opinion polls etc. But

the December 1999 Christmas fiasco in USA clearly proved that without an Enterprise System (call it ERP or whatever) in place, one would not be able to manage all - customers, orders, inventories, suppliers and logistics - particularly in “physical” goods industries. The Dot.Com burst in the later half of the year 2000 brought some sanity to the enterprise growth.

ERP is inward focused– it looks at the enterprise. E-Commerce is outward focused – it looks at the customers. To deliver value and succeed in business, you need both ERP & E-Commerce. Dell Computers had initially put a stop to SAP because Dell found ERP was too rigid; today Dell E-Commerce solution works with ALL ERP software! Since Dell sells to UniLever, GM and Boeing, Dell’s E-Commerce solution should co-work with all the ERP systems of Dell’s customers. Dell primarily assembles PC’s and Servers; naturally their processes are far simpler. But for companies like Boeing and GM with complex operations, ERP is far more important. But everyone needs both E-Commerce and ERP. Their relative importance will vary with the nature of a specific company’s operations. While E-Commerce may be more important for a company like Dell that sells computers directly to millions of end customers globally, ERP may be more important for a company like Boeing that sells far complex equipment to just dozens of Airlines.

The message is loud and clear – it is NOT ERP or E-Commerce; it will always be ERP and E Commerce – both today and tomorrow.

14 Future of ERP

ERP software sales did slow down in 1999 and the trend continues in 2000. In fact, what was considered a great advantage became a disadvantage. ERP was replacing legacy systems but with the businesses moving towards e-business, the rigid ERP systems were getting to be viewed as stumbling blocks that were holding the companies from embracing the Internet! There was some reasonable bad Press coverage that magnified the woes of ERP. The failing fortunes of an unusually successful ERP software vendor BaaN Company (that was finally acquired by InvenSys) kept the rumor milling machine fairly busy for the first six months of the year 2000! But such undue criticism of ERP was quite unfounded. The unrealistic faith in the Dot.Com companies was partly responsible for this negative view of ERP. Thanks to Dot.Com “burst”, users are now realizing the folly of writing premature obituaries for ERP.

The Christmas shopping season of 1999 also taught everyone some true lessons. There were millions of people ordering things – in fact all kinds of things – over the Net. The e-commerce pundits thought it was a paradigm shift – new economy eclipsing the old economy. Yet, reality dawned on the people a couple of weeks later. The “clicks” could “take the order”; but the “bricks” were not there – ready to supply the order! There were millions of disgruntled customers – those whose orders were considerably delayed, those whose orders got mixed up and messed up and finally those whose orders vanished into cyberspace. In turn many of the users promising NEVER to order over the Net. The pendulum swung to the other extreme.

What went wrong? Web-enabling applications just meant web page enabling to many CIO’s – quickly paint a HTML screen, put some graphics and an animated shopping cart. To put spice on the user interface, add a Java applet that would move around a shopping cart over the user screen –the cart that gets filled when items are ordered and gets emptied when orders are cancelled – with a nice visual appeal. It was cool; it was fun. But it was useless too. What led to the disaster of New Year 2000 shopping was that the backend was not ready to cope with such huge demand. Accepting millions of orders over the Net needs solid backend application – typical ERP class

mission critical application, which is robust and scaleable. Such enterprise applications form the bedrock of e-commerce. Not having such an infrastructure was the rub; e-commerce slowed down.

ERP fever as it existed until 1999 may never come back, but ERP software is slowly and steadily transforming itself to what some people call XRP (eXtended Resource Planning); XRP though not widely accepted does bring out the enlarged scope of corporate application systems.

With the explosive growth of the Internet and businesses continuing to find new ways of doing business, there was a sudden move to embrace e-business approach to everything – procurement to e-procurement, logistics to e-logistics, market to e-market, billing to e-billing – not mere commerce to e-commerce. This had a tremendous impact on corporate applications. ERP systems had excellent order processing systems but could not readily extend to the Web. Users got used to the “slick” shopping carts on the screen and expected the “easy” interface from ERP software too. For simple B2C buying, typical of Amazon Bookstore, such “slick” interfaces were fine; the solid enterprise systems were built for complex products and were naturally complex. But once the users get used to simple and universal interfaces, they demanded the same from every corporate applications. By now, most ERP vendors offer such interfaces; but it did take time

Client server computing to componentization

Corporate applications in general and ERP systems in particular were well-integrated and offered reliable solid code that appealed to CIO's; prior to ERP they had the “headache” of integration problems associated with many disjoint systems. One key success factor for the wide acceptance of ERP systems was the client-server architecture. This architecture allowed corporations of varying size with multiple product lines and many locations to distribute database servers, application servers and clients across diverse platforms – IBM mainframes / high-end servers for database servers, medium end servers / PC-based servers for application servers and PC / Mac / Terminals for clients. This partitioning allowed CIO's to choose servers best suited for a specific function from a cross section of vendors, shift hardware as per application need without users even knowing the changes; and guaranteed performance over the natural growth of application complexity and the extent of implementation. Of course there was a price to pay – the ERP code was a solid monolithic code! With e-enabling of corporations and individual functions like HR, procurement, logistics, manufacturing getting a Web-interface, there was a felt need to move towards “nimble” software that was less complex, needs less training and runs on limited hardware resources (server and network). Also, there was a need for “mix and match” across the functions. For example, users wanted an option of using PeopleSoft for HR, BaaN for Manufacturing and Oracle for Financials. The ERP vendors also realized the potential of the emerging object-based framework (that goes beyond object-oriented programming) using technologies such as COM/DCOM from Microsoft, CORBA from OMG, EJB from Sun Microsystems that promised better, reusable and far more reliable code to replace the solid but monolithic code.

In the connected world, alliance is the key

In the early days of enterprise applications, the watchword was “tight integration”. Companies like SAP offered a level of integration among all its modules that was unparalleled in corporate applications earlier. With the extension of enterprise to suppliers through SCM and customers through CRM, new players like i2 have emerged as market leaders. Though ERP vendors were quick to re-position themselves as “full service” providers (ERP, SCM and CRM) it was clear that ERP vendors would not be able to match the functionality of vendors like i2 (for SCM) and Siebel (for CRM) in their niche areas. Thanks to the Net, portals, vortals (vertical portals) and exchanges

quickly emerged in the year 2000 that offered a new business model of offering enterprise products as service. Companies like CommerceOne, Ariba and IBM got their act together with their service offerings through their partnerships with ERP, SCM and CRM vendors. More interestingly IBM, CommerceOne and Ariba announced in October 2000 a strategic alliance that appears more promising than any other alliances announced earlier. It will be an interesting development to watch in the year 2001. Similar announcements have been announced by SAP also.

Cross-discipline integration to integration across enterprises

The key to the success of Enterprise Systems was their process orientation and application integration across the enterprise – financials, accounting, order processing, human resources, procurement, production, logistics, sales, support, invoicing and billing. In the pre-Internet era such integration was sufficient. As the new Millennium dawned and the Net economy boomed, organizations could not afford to be content with the success of the firm within their walls. Applications had to necessarily extend to their business partners – suppliers, resellers and key customers (if not all customers). This in turn necessitated the move to look beyond enterprise – to an extended enterprise.

Web changes everything

The arrival of the Internet had a profound impact on corporate applications. Almost every business is becoming e-business. There is no industry unaffected by the impact of WWW – core industries like Coal, Steel, Power, Utilities, Manufacturing, Auto industry, Oil & Gas etc., - all these industries could all benefit from the power of the Net. This in turn led to the demand for Web-enabling all corporate applications. Most HR systems had to shift to self-service operation over the corporate Intranet; Manufacturing had to embrace e-engineering, e-procurement over public Internet or Virtual Private Net between its suppliers. Marketing had to adapt to electronic storefront, e-services and e-support. Accounting and Financials had to adapt to e-commerce. In a sense every function of the enterprise had to be e-enabled calling for design changes in ERP systems. The transformation of SAP to mySAP and Oracle to e-applications represents this fundamental shift in corporate applications.

Mobility is the watchword

With its inherent globalization, Internet is permitting many users to be mobile. With its ability to send and receive information during movement, mobile computing is introducing a “paradigm shift” in corporate applications whose real impact will be felt in the next two years. Mobile computing and mobile Internet access have suddenly started to influence corporate applications. Thanks to explosive growth of NTT DoCoMo mobile Internet service (with 1.4 million customers in 18 months), applications have to address ways of delivering information over mobile devices. The added complication is the multiplicity of promising technologies; with no clear indication of any one of them dominating. For example, in the access area: analog mobile phones dominate the US market; GSM dominates Europe and much of Asia; a range of technologies (UMTS, GRMT) are under deployment in Japan and Europe; there is a promise of 3-G (third generation mobile) that is likely to be around by the year 2003 throughout the globe. Then there are intermediate technologies like WAP (Wireless Application Protocol). On the devices front, there are competing technologies –

Low-end handheld devices from 3Com and SONY (powered by Palm OS)

High-end handheld devices from Compaq and HP (powered by Pocket PC and Windows CE from Microsoft)

Technologies like Blue Tooth that promise extremely low-cost (less than \$ 10) that permit wireless access within short distances (within 100 feet) across a variety of devices (computers, phones, fax machines and even refrigerators) offer further avenues to exploit information delivery.

There are significant strengths and weaknesses of these products that address different user needs (such as salespersons, managers, senior executives). Being nascent the devices are all evolving with continuous improvement in terms of battery life, display quality, display size and colour capability. The challenge for corporate applications is to constantly watch and continuously improve the information delivery mechanisms to address this fundamental change in user behavior.

With enough data to warehouse and cheap processing power OLAP is a reality

Thanks to ERP deployment over several years in the corporations, enough corporate data has been archived that is structured, machine readable, accurate and authentic. Enterprise systems being transaction oriented, the data captured has sufficient “metadata” information (organizational units, time stamp, account codes, customer profile, batch size etc..) that is “hidden” but recoverable through sophisticated “data cleansing” and “transformations” that modern data warehouse engines can perform. With the sophistication of OLAP tools, visualization tools and data mining tools and the increased processing power of the corporate desktop, online analytical processing is a reality today. Managers with sufficient analytical ability can routinely perform sophisticated analysis right from their desktop computers without needing an analyst to assist them. The “what-if analysis” need not be a mere “simulation” or “scenario planning” but use “live” and “real” data captured for years through OLTP systems (that are part of enterprise systems). This offers an unprecedented ability to the end managers to go past “information” to “insight” into corporate performance.

ERP Verticals

In the recent years ERP software vendors have partially addressed this problem by the introduction of "ERP verticals". Typical such solutions are specific to vertical market segments - Oil, Automotive manufacturing, Banking, Telecom, Food & Beverage, Media, Government etc. These are re-packaged solutions based on extensive experience gained by a specific software vendor through dozens of implementations in many firms that are key players in a chosen industry. Some ERP software vendors are more successful in specific industry segments - for example SAP in oil industry, BaaN in discrete manufacturing and Oracle in Telecom, for example - this is a natural evolution. Such re-packaged solution leads to significant gains in implementation time and quality. However, they continue to maintain the "plain vanilla" nature of the ERP software by way of addressing mainly the "common business processes".

ERP Products

BaaN ERP

The ERP software from BaaN Company (acquired by InvenSys in June 2000) grew out of a product with unique strengths to address manufacturing industry, particularly those with complex process oriented production. Over the years the product has evolved to address all aspects of an enterprise across a range of industry segments. The strength of BaaN ERP has been its component-based architecture, modeling based implementation and tight integration across all sub-systems of manufacturing – production, materials, procurement, shipping and logistics.

The component-based architecture gives the unique advantage of reduced code size (in millions of lines) with every new release of the product. Much of BaaN's component technology is built around COM / DCOM / COM+ architecture of Microsoft. BaaN's Business Object Interfaces is a set of API's that offer component-based approach to ERP. Such an approach permits easy mix and match approach to deploy the "best of breed" modules among different ERP products.

BaaN ERP products also exploit fully the back-office and front-office features of Microsoft Office products so that MS Word can be used for documentation, MS Excel can be used for analysis and decision support and MS Exchange / MS Mail / MS Outlook can be used for communication seamlessly with BaaN ERP product suite.

BaaN has a unique Dynamic Enterprise Modeling (DEM), which introduced a model-based approach to implementation of ERP product. During the configuration phase of any ERP implementation, designers use a less structured approach to correctly capture the requirements of an individual organization. Thanks to DEM from BaaN this process could take a more structured approach that leads to consistent, reliable and documented way of configuring the software without extensive programming. Most other ERP vendors have model-based configuration today; but BaaN is the early pioneer and continues to offer superior capabilities in this area.

BaaN ERP is strong in supply chain integration, once again thanks to its strong base among manufacturing and distribution firms. Today every ERP vendor also offers SCM capability. BaaN today has extensive support to both EDI and XML standards for integration across multiple suppliers and business partners. BaaN ERP has unusual support to handheld devices like PDA including wireless devices support so that field staff can get the full benefit of enterprise software.

Like every other ERP vendor BaaN ERP today is no longer sold as a stand-alone ERP but as a series of e-business modules.

The financial troubles of BaaN Company throughout the past one-year and the ultimate acquisition by InvenSys in June 2000 did create problems for BaaN; the company continues to lead through its technological innovation and appears to have come out of the financial troubles.

Oracle ERP

Oracle ERP traditionally has been sold as Oracle Applications. Originally sold as Oracle Financials and Oracle Manufacturing where the product had unique strengths, Oracle ERP has matured into a full-service ERP provider addressing all needs of an enterprise – order processing, financials, manufacturing, financials and human resources.

For many years Oracle Applications suffered from a lack of tight integration across modules and a two-tier architecture. In the past couple of years Oracle has integrated the products well and started to fully support the n-tier architecture; in fact, Oracle's support to thin clients and web-based applications permit MIS managers to upgrade new versions of the software with practically no installation at client end.

Self-service across all modules (HR, financials, supply chain) is a unique strength of Oracle Applications. This reflects the broad philosophy that drives the company and its products – using Internet at the core of all its products and technologies.

Today Oracle Applications is tightly integrated with its Supply Chain and CRM modules.

Reflecting the broad technology directions, Oracle Applications supports middleware, CORBA-based components and an excellent support to EJB (and several Java-based technologies).

Oracle's strengths in database technology and the related areas of data warehousing and data mining gives Oracle Applications significant advantages to address enterprise-wide OLAP applications and Business Intelligence.

PeopleSoft

Originally started as human resource applications software, PeopleSoft has evolved over the years to address all functions of an enterprise and managed to win clients in financial and other applications as well. Ease of use continues to be the key strength of PeopleSoft.

With its acquisition of CRM software company Vantive, PeopleSoft became a pioneer in visualizing the strength of ERP and CRM products to address corporate applications. This strategy also gives the added advantage of tighter integration across ERP and CRM segments of PeopleSoft enterprise software, currently marketed as e7.5 – Integrated e-Business Backbone.

A unique aspect of PeopleSoft ERP is its ability to address enterprise performance management through the evolving concept of “balanced scorecard” methodology – a radically new approach to measuring performance using KPI (Key Performance Indicators). Through its web-enabled interface to enterprise performance appraisal, PeopleSoft attempts to provide insight into organizational performance that can be used by senior executives from anywhere.

PeopleSoft industry solution templates is a unique way to address vertical industry segments (like Insurance) that are also “ready to run” – significantly reducing the time and effort to implement PeopleSoft ERP in customer premise.

SAP

SAP is the market leader in ERP segment for many years with its SAP R/2 product for the mainframes and R/3 for the client-server environment. SAP ERP has the highest level of tight integration of functional modules. This feature was the strength of SAP ERP particularly for Fortune 500 companies. The Internet era, e-business scenario and the turbulence in the global marketplace, the strength of a monolithic product like SAP R/3 became a liability. Thanks to its quick re-design and re-positioning of its products, SAP continues to drive the enterprise segment.

SAP Business Framework addresses the need for architecture and framework based application development. Business Framework is an evolution from SAP Business Engineer, which is more of a toolset.

SAP Business API (BAPI) is a powerful way through which SAP could embrace component-based approach to ERP implementation. BAPI provides application integration across multiple vendor products without complex programming. In a sense the core product feature could be extended without extensive development efforts. Through an innovative object repository (a collection of BAPI's), business objects could be built out of BAPI.

Addressing the needs of extended enterprises in the form of SCM and CRM, SAP built Advanced Planner and Optimizer (APO) and Sales Force Automation (SFA) and CRM functionality. Through strategic partnerships with SCM vendor Manugistics and CRM vendor Siebel, SAP also offers multi-vendor solutions to address the complex demands of extended enterprises.

Recognizing the e-Business challenge, SAP introduced mySAP – a combination of personal portal, e-marketplace and an ASP (Application Service Provider) offering – all three rolled into one. mySAP has evolved quickly over the past one year – started as a fancy interface with “bells and whistles” personalization into a Business-to-Business portal. With added functionality that cuts across personal productivity, personal workplace, personal desktop, mySAP evolved into e-marketplace that goes beyond B2B portal. Through strategic relationship with key industry leaders in MRO segment, chemical and pharmaceutical industry, SAP could use its established presence in Fortune 500 companies with a formidably stable ERP product, SCM, CRM and SFA offerings to offer a powerful e-marketplace. Again through its relationship with telecom giants like Deutsche Telecom and British Telecom, SAP could position mySAP as a flexible ASP that can offer a test drive, solution builder, solution implementer, solution provider or a solution builder–cum–provider.

ERP Trends

One major trend that continues from the past couple of years is the Web-enabling of the ERP software. Market pressures force every ERP vendor to embrace the Web. Not all architectures permit easy web enabling. To stay with the competition every vendor announced web enablement in 1999; it stayed as web page enablement in many cases. By 2000 most ERP vendors have rewritten their software for genuine web enabling. Today’s ERP software permits access to the ERP software from any Internet connected client that runs a browser. Some of the ERP software vendors like Oracle have standardized their product interface to a web interface. This trend will continue through 2001.

To cope with continuous change to the very core of product functionality and to co-work with other products, most ERP vendors have started the process of componentization. Both Microsoft COM+ architecture and OMG CORBA architectures continue to be supported. This process is far from complete and will continue till 2002. The emerging Enterprise Java Beans (EJB) would be a major candidate for the component exercise in the year 2001. This architecture combines the component advantage with cross-platform deployment advantage and drive the rewrite of ERP software over the years till 2003.

Multi-client support beyond PC, Mac and Linux to support handheld computers, PDA’s, Palm computers and mobile phones (WAP, 3G technology support) is another area where ERP software will see some major developments. As the technology evolves, avenues open up for creative applications, particularly for field office staff. As ERP moves beyond the boundaries of an enterprise and office and factory workers become mobile, ERP extensions for multiple clients would be an interesting area to watch through 2001 – 2003.

E-ERP

Like every other software product, ERP software is transforming itself to address the needs of the e-Business environment. This includes

- Interface improvements like web-enabling
- Extension to other parts of extended enterprise such as suppliers and customers
- Provision for online payments
- Providing online sales and service support
- Making many services on self-service mode

- Personalizing the software to suit individual user needs
- Support for mobile works through multiple technologies and multiple devices, and
- Net-based software licensing in the form of Application Service Provider (ASP)

18 Conclusions:

Corporate applications are undergoing a metamorphosis. First, Enterprise Resource Planning (ERP), Supply Chain Planning (SCM) and Customer Relationship Management (CRM) are seamlessly coalescing into one another; with practically all enterprise software vendors offering these features as part of their broader e-business suite. This in turn has led to several mergers and acquisitions (BaaN and Invensys, PeopleSoft and Vantive, Nortel and Clarify) indicating a shift from growth phase to consolidation phase. Second, all the product suites are fully web-enabled that the Internet Browser has become the de facto user interface for all corporate applications. Third, as we enter the post “PC centric” computing model, access and delivery of the enterprise software through portable and mobile devices are getting the maximum attention. Fourth, as we go past the “Dot.Com burst”, robust e-commerce through business exchanges would be the order of the day. Several companies will move to e-markets; IT services will get outsourced; Application Service Providers (ASP) will host applications; many of the enterprise software products will be offered as services; and the companies that help corporations to leverage e-business – companies who provide global e-commerce solutions and professional services - will be the most influential ones.

6 Common Challenges in ERP Implementation

Enterprise resource planning (ERP) systems are one of the most popular business management systems, providing benefits of real-time capabilities and seamless communication for many organizations. However, since ERP implementation affects entire organizations such as process, people, and culture, there are a number of challenges that enterprises may stumble upon in executing ERP systems.

Choosing an adequate ERP system

The first and foremost challenge organizations face, is determining what sort of an ERP system they should implement. Managers must decide on the size, type and scope of the ERP system they need and how to select the best solution amongst the existing multitude of systems in the market. This selection dilemma arises for all businesses (without exception) and is of critical importance as an ERP system choice defines an enterprise’s strategy for at least the following 5 to 10 years (or longer) and, has a considerable impact on the future success of the entire business.

Learn more about ERP Implementation

To decide on the implementation of a successful ERP program, managers should possess an extensive understanding of the organization’s current business processes, organizational structure, culture, work environment and financial and economic strength. They should also consider the strategic implications of implementing an ERP solution keeping in mind the size of the organization and the modules required. Management should review the following questions:

- **Does the ERP system strengthen the organization’s competitive position?**

- **How does ERP affect the organizational structure and the culture? What is the scope of the ERP implementation — only a few functional units or the entire organization?**
- **Are there any alternatives that meet the company's needs better than an ERP system?**
- **If it is a multinational corporation, should management be concerned about whether it would be better to roll the system out globally or limit it to certain regional units?**

Organizational Changes

ERP implementation produces significant changes in an organization's conventional business model and its day-to-day practices. It requires organizations to reengineer their key business processes in fundamental ways, overhauling old methods of conducting business, redefining position responsibilities, and restructuring the organization. For major multinational corporations, the ERP systems must be customized to tackle global issues where different countries have diverse ways of doing business, and to incorporate country-specific business practices relating to accounting, tax requirements, environmental regulations, human resources, manufacturing, and currency conversion into the integrated systems.

ERP Implementation Goals

One of the principal issues with ERP implementations derives from not having well-defined measurable goals and objectives at the outset of the project as well as a process in place for adding to or changing these goals. Many projects, not just an ERP implementation, have failed because of this. One of the most often misinterpreted issues with most ERP systems is that they normally need extensive customization. Often what an organization is buying is not a packaged solution, but a framework with which to build a solution. When decision makers do not ask the right questions and are not able to appreciate these two factors, projects are delayed and thus experience cost overruns.

Flexibility of ERP Software/System

An ERP system that is not flexible may force an adopter to change their business processes to fit the ERP system model. This requires a re-engineering of steps needed to complete business tasks and a retraining of employees and business partners; and sometimes even customers or clients. As people do not inherently like change, this will create resistance and delays for any organization (at least in the short term).

Time consuming & costly to Implement

Plenty of time and effort needs to be invested into ERP implementation before it actually starts yielding results. ERP cost structure categories include:

- **Analysis;**
- **System designing and customization;**
- **Implementation;**
- **Training cost;**

- **Maintenance; and**
- **Support cost**

Usually, the implementation and support costs are not planned properly and as a result, organizations are obliged to cut back on ERP maintenance services and support.

Resistance to Change

Another ERP implementation challenge is organizational cultural resistance. It can often be difficult to convince business units of an organization to switch from already running business processes to a new ERP system. Usually in these circumstances, the two main threats are replacing known processes with an unknown, and taking away decision-making authority for the routine business activities. If the advantages of ERP systems are not explained well, the employees can even resist and slowdown the development and adaptation process of the ERP system.

Despite these challenges, ERP is a resource that can significantly improve an organization's workflows, business, and decision making. Preparing early and being proactive and aware of the various challenges that come with the implementation of an ERP system is definitely worth the effort

Figure I. ERP systems concept

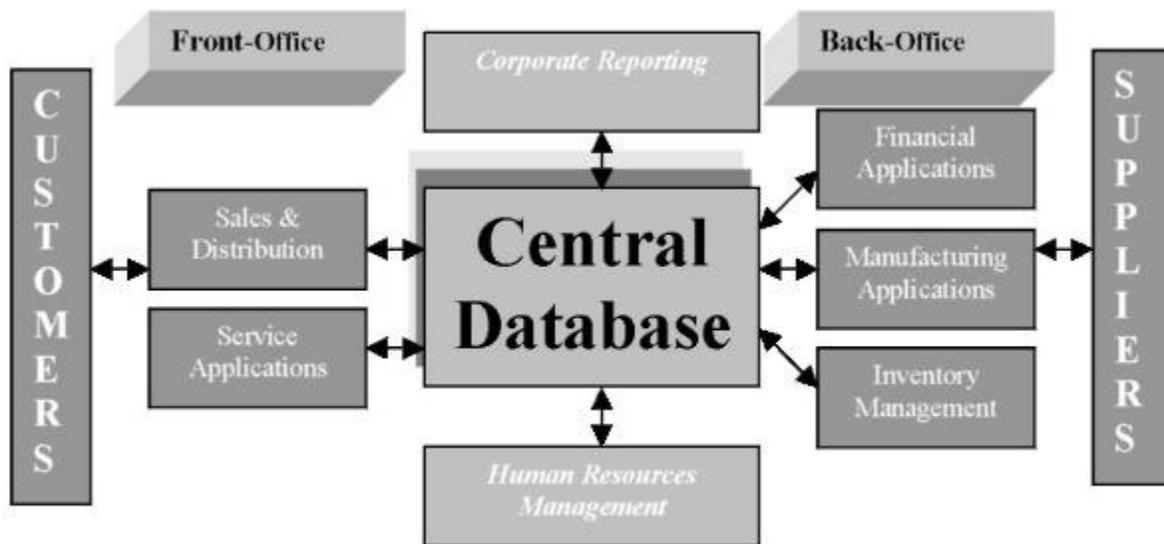


Figure 2. ERP evolution



During the 1990s, ERP vendors added more modules and functions as “add-ons” to the core modules, giving birth to the “extended ERPs.” These ERP extensions include advanced planning and scheduling (APS), ebusiness solutions such as customer relationship management (CRM), and supply chain management (SCM). Figure 2 summarises the historical events related with ERP. **Organisations choose and deploy ERP systems for many tangible and intangible benefits and strategic reasons.** In many cases, the calculation of return on investment (ROI) is weighted against the many intangible and strategic benefits. The benefits that an ERP system may bring to organizations are shown in Table 1 while Table 2 shows the problems and disadvantages organisations need to overcome to reap the benefits.

Table 1. Advantages of ERP systems

What Benefit	How
Reliable information access	Common DBMS (database management system), consistent and accurate data, improved reports
Avoid data and operations redundancy	Modules access same data from the central database, avoid multiple data input, and update operations
Delivery- and cycle-time reduction	Minimizes retrieving and reporting delays
Cost reduction	Time savings, improved control by enterprise-wide analysis of organisational decisions
Easy adaptability	Changes in business processes, easy to adapt and restructure
Improved scalability	Structured and modular design with add-ons
Improved maintenance	Vendor-supported, long-term contract as part of the system procurement
Global outreach	Extended modules such as CRM and SCM
E-commerce, e-business	Internet commerce, collaborative culture

Table 2. Disadvantages of ERP systems

Disadvantage	How to Overcome
Time consuming	Minimize sensitive issues, internal politics, and raise general consensus
Expensive	Cost may vary from thousands of dollars to millions, business process reengineering cost may be extremely high
Conformity of the modules	The architecture and components of the selected system should conform to the business processes, culture, and strategic goals of the organisation
Vendor dependence	Single vendor versus multivendor consideration, options for “best of breeds,” long-term committed support
Feature and complexity	ERP system may have too many features and modules that the user needs to consider carefully and implement the needful only
Scalability and global outreach	Look for vendor investment in R&D, long-term commitment to product and services, consider Internet-enabled systems
Extended ERP capability	Consider middleware add-on facilities and extended modules such as CRM and SCM

Table 3. Brief profile of the dominating ERP vendors

<i>Vendor Name</i>	<i>Founding Year</i>	<i>Flagship Product</i>
SAP AG	Germany, 1972	R/3, mySAP.COM
PeopleSoft Inc.	USA, 1987	PeopleSoft8
Oracle Corporation	USA, 1977	<i>Oracle Applications Oracle11i</i>
SSA Global	USA, 1981	<i>SSA Baan ERP</i>
Sage	UK, 1980	Sage Line 500
Microsoft (Microsoft Business Solutions)	USA, 1981	Great Plains, Navision, Axapta, and Solomon

The continued growth of the ERP systems market is attributed to the fact that the vendors are adding applications such as supply chain management, customer relationship management, and the integration of Internet-enabled applications for e-business. ERP vendors are targeting the

untapped SME (small and medium-sized enterprise) market with supposedly scaled-back systems suitable for smaller firms by offering simple, cheaper, and preconfigured, easy-to-install solutions within budget and time constraints. For some vendors, this may lead to offering centrally managed, Internet-enabled, ERP-system-based services for SMEs to access and use anytime from anywhere.

ERP systems are becoming more and more Internet-enabled (Lawton, 2000), extending legacy ERP systems to integrate with newer external business modules such as supply chain management, customer relationship management, sales-force automation (SFA), advanced planning and scheduling, business intelligence (BI), and ebusiness capabilities. In fact, ERP is becoming the ebusiness backbone for organisations doing online business transactions over the Internet. Adoption of e-commerce and e-business solutions, especially business-to-business (B2B) solutions, is seen by many as the wave of current and future extensions of traditional ERP systems of most small, medium, and large vendors. The front-end, Web-based Internet-business applications are integrated with the back-office, ERP-based applications enabling business transactions such as order placement, purchasing, inventory updates, employee benefits, and so forth to take place between the customers, suppliers, and the enterprise based on reliable, relevant data and applications instantly in a borderless domain. Examples of such Internet-enabled, extended ERPs are available from most of the ERP vendors. The concept of the Internet-enabled, extended ERP system is shown in Figure 3.

CONCLUSION

The unprecedented growth of computing power and the proliferation of the Internet brings new challenges to ERP vendors for redesigning their products, breaking the barrier of proprietorship and customisation, and embracing the collaborative business over intranet, extranet, and the Internet in a seamless manner. A sign of acceptance of these challenges is the appearance of new add-on modules that follow open architecture, provide interchangeable modules, and allow easy customisation and user interfacing.

Evolution of MRP

Manufacturing resource planning (MRP II) is defined as a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning, and has a simulation capability to answer "what-if" questions and extension of closed-loop MRP.

This is not exclusively a software function, but the management of people skills, requiring a dedication to database accuracy, and sufficient computer resources. It is a total company **History and evolution**

Material requirements planning (MRP) and manufacturing resource planning (MRPII) are predecessors of enterprise resource planning (ERP), a business information integration system. The development of these manufacturing coordination and integration methods and tools made today's ERP systems possible. Both MRP and MRPII are still widely used, independently and as modules of more comprehensive ERP systems, but the original vision of integrated information

systems as we know them today began with the development of MRP and MRPII in manufacturing.

MRP (and MRPII) evolved from the earliest commercial database management package developed by Gene Thomas at IBM in the 1960s. The original structure was called BOMP (bill-of-materials processor), which evolved in the next generation into a more generalized tool called DBOMP (Database Organization and Maintenance Program). These were run on mainframes, such as IBM/360.

The vision for MRP and MRPII was to centralize and integrate business information in a way that would facilitate decision making for production line managers and increase the efficiency of the production line overall. In the 1980s, manufacturers developed systems for calculating the resource requirements of a production run based on sales forecasts. In order to calculate the raw materials needed to produce products and to schedule the purchase of those materials along with the machine and labor time needed, production managers recognized that they would need to use computer and software technology to manage the information. Originally, manufacturing operations built custom software programs that ran on mainframes.

Material requirements planning (MRP) was an early iteration of the integrated information systems vision. MRP information systems helped managers determine the quantity and timing of raw materials purchases. Information systems that would assist managers with other parts of the manufacturing process, MRPII, followed. While MRP was primarily concerned with materials, MRPII was concerned with the integration of all aspects of the manufacturing process, including materials, finance and human relations.

Like today's ERP systems, MRPII was designed to tell us about a lot of information by way of a centralized database. However, the hardware, software, and relational database technology of the 1980s was not advanced enough to provide the speed and capacity to run these systems in real-time,^[1] and the cost of these systems was prohibitive for most businesses. Nonetheless, the vision had been established, and shifts in the underlying business processes along with rapid advances in technology led to the more affordable enterprise and application integration systems that big businesses and many medium and smaller businesses use today.^[2]

General concepts

Material requirements planning (MRP) and manufacturing resource planning (MRPII) are both incremental information integration business process strategies that are implemented using hardware and modular software applications linked to a central database that stores and delivers business data and information.

MRP is concerned primarily with manufacturing materials while MRPII is concerned with the coordination of the entire manufacturing production, including materials, finance, and human relations. The goal of MRPII is to provide consistent data to all members in the manufacturing process as the product moves through the production line.

Paper-based information systems and non-integrated computer systems that provide paper or disk outputs result in many information errors, including missing data, redundant data, numerical errors that result from being incorrectly keyed into the system, incorrect calculations based on numerical errors, and bad decisions based on incorrect or old data. In addition, some data is unreliable in non-integrated systems because the same data is categorized differently in the individual databases used by different functional areas.

MRPII systems begin with MRP, material requirements planning. MRP allows for the input of sales forecasts from sales and marketing. These forecasts determine the raw materials demand. MRP and MRPII systems draw on a master production schedule, the breakdown of specific plans for each product on a line. While MRP allows for the coordination of raw materials purchasing, MRPII facilitates the development of a detailed production schedule that accounts for machine and labor capacity, scheduling the production runs according to the arrival of materials. An MRPII output is a final labor and machine schedule. Data about the cost of production, including machine time, labor time and materials used, as well as final production numbers, is provided from the MRPII system to accounting and finance.^[2]

For the companies that want to integrate their other departments with their manufacturing management, ERP software are necessary.

Benefits

MRP II systems can provide:

- Better control of inventories
- Improved scheduling
- Productive relationships with suppliers

For design / engineering:

- Improved design control
- Better quality and quality control

For financial and costing:

- Reduced working capital for inventory
- Improved cash flow through quicker deliveries
- Accurate inventory records