UNIT 9 INTELLIGENCE INFORMATION SYSTEM

Objectives

The objectives of this unit are to enable you:

- to learn about the recent developments in the information system, particularly in the supply chain context;
- to learn about Materials Requirement Planning (MRP), Enterprise Resource Planning (ERP), and Distribution Resource Planning (DRP/DRP-II); and
- to compare the ERP and Supply Chain Planning (SCP).

Structure

9.1 INTRODUCTION

Decision-making is a key activity for management. Unfortunately, the early information systems developed during the 1960s and 1970s often had few implications for decision-making. Today, firms routinely monitor a variety of activities, for examples, sales and production. A company is very likely to store information on its competitors' sales as well. Given the wealth of information kept in corporate databases, there are many opportunities today to use intelligence information system to aid decision-making.

Information is tangible and intangible entity that reduces uncertainty about some state or event. As an example, consider a weather forecast predicting clear and sunny skies tomorrow. This information reduces our uncertainty about whether an event such as a cricket match will be held. Information that a bank has just approved a loan to our firm reduces our uncertainty about whether we shall be in a state of solvency or bankruptcy next month. Information derived from processing transactions reduces uncertainty about a firm's order backlog or financial position. Information used primarily for control in the organization reduces uncertainty about whether the firm is performing according to plan and budget.

In this unit, the paradigm shifts in manufacturing, the materials requirement planning, the enterprise resource planning, the distribution requirement planning and the supply chain planning are presented. All these planning capsules focus and make use of the intelligence information system for an effective and efficient business. Through these the organizations achieve the competitive advantage for global competitiveness.

9.2 CHANGING PARADIGM OF MANUFACTURING

Since, 1950, global trade is growing at a faster pace than the overall growth Gross Domestic Product (GDP) of the world. Indian Government, with its new open policies towards foreign investments; overhauling of customs and duties; fewer stringent rules toward repatriation of profits; and open market policies through privatization are positioning it to harness the benefits in the new surge in globalization of economics.

Increased global competition, informed customers, technology adaptation, and global trade will put pressure on Indian companies to become more efficient. This means, the Indian companies have to strive for manufacturing excellence by improving product quality, making their price competitive, promoting product delivery and enhancing flexibility to absorb markets varied needs.

The manufacturing function is undergoing through a period of extra-ordinary revitalization. This requires attention on customer oriented products, excellent processes, the best tools and equipment, efficient production goods flow, clear and transparent controls, carefully engineered job, renewed emphasis on productivity, vastly upgraded quality standards empowered with total quality programs and innovation experiments in the management of people in the organization. This revitalization is also seen new manufacturing technologies. These technologies are being accompanied by innovation in management of manufacturing systems. These innovations place greater emphasis on manufacturing excellence – an important consequence of global competition in the global economy. These innovations are in effect answers to the challenges placed on the prominent manufacturing capability, by manufacturing enterprises who were caught up between high technology spurred by heavy investment, intelligent customers, new political and economic environments, demanding workforce and increasing competition. Every segment of manufacturing enterprise has gone through close scrutiny and as a result excellent and efficient new technologies emerged and earned their due place in the organization.

Table 9.1: Changing Paradigm of Manufacturing

Old Rules of Manufacturing	New Rules of Manufacturing
Produced to forecast	Produced to order
Uniform/standardized	Highly variable/customized
Low on information content	High information content
Characterized by a specific market niche.	Characterized by multiple market niche
Expected to have a larger market life.	Expected to have a shorter market life
Self-contained	Open ended platform for upgrades/information/services
Line personnel shouldn't challenge current practices.	The person closet to the problem is the world's best expert
Layout the factory by function	Cellular layout
Always keep people busy and equipment humming.	Make only as such as you need only when you need
Inventory is an asset.	Inventory is liability
Traditional performance measures such as labor and machine efficiencies, purchase price variance and overhead absorption rates.	Measurements focus on improvement rates in cost, quality, flexibility and value-added activities and customers satisfaction.
Quality is inspected at the end of line.	Building quality in throughout entire process.
Large lot sizes are better because we amortize setup and change – over times over more units.	Constantly try to economically reduce lot size and setup times.

The new rules of manufacturing that cause the changing paradigm of manufacturing are compared against the old rules of manufacturing – shown in Table 9.1. The intelligence information systems consisting of MRP. ERP, DRP and SCP are a few solutions that gained significance to meet the current business challenges.

9.3 MATERIALS REQUIREMENT PLANNING (MRP)

The materials requirement planning system is a major element in a manufacturing company and is also the heart of MRPII (Manufacturing Resource Planning). MRP is a computer-based information system designed to order and schedule 'dependent' demand inventories (raw materials, component parts, and subassemblies) in a coordinated manner. MRP is as much a philosophy as it is a technique, and as much as an approach to scheduling as it is an approach to inventory control. It views inventory from the vantage point of the stock-room, trying to insure that there will always be "just enough" on hand to meet projected demand.

Until the 1970s, the materials planning process in manufacturing environment suffered from two problems. The first was the enormous task of setting up schedules, keeping track of large numbers of parts and components, and coping with schedule and order changes. The second was the perception that a company had to choose between investing in high quantities of inventory or having excessive stock-outs. Practitioners used inventory-planning techniques that were designed for independent demand items, resulting in high inventories and frequent stock outs. Starting in the late 1960s and early 1970s, manufacturers recognized that planning dependent items differently from independent items (using MRP) could produce lower inventories and lower stock-out rates. Additionally, they enlisted the power of the computer to handle much of the burden of keeping records and determining material requirements.

The main purposes of an MRP system are to control inventory levels and assign operating priorities for ordered items. These may be briefly expanded as follows:

1) Inventory
   - Order the right part
   - Order in the right quantity
   - Order at the right time (start data)
2) Priorities
   - Order with the right due date
   - Keep the due date valid

The motto of MRP is getting the right materials to the right place at the right time. The operating philosophy of MRP is that materials should be expedited when their unavailability would delay the overall production schedule, and de-expedited when a schedule change postpones their need. To this end, MRP logic will always plan inventory to the lowest possible amount, unless instructed otherwise by order modifiers. Order modifiers, including safety stock and lot sizes are discussed later in this unit.

Material Requirements Planning Inputs

Figure 9.1 illustrates the five major sources of information required for MRP to operate:

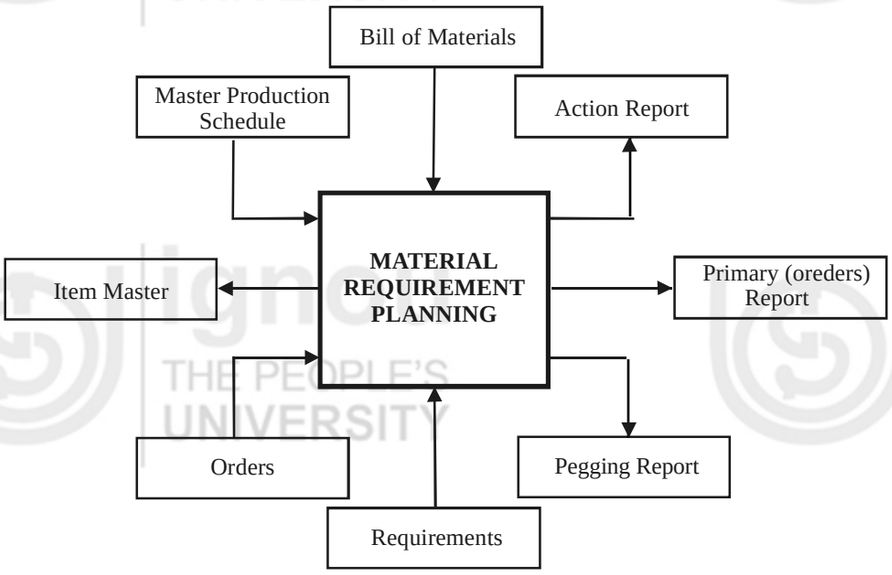

Figure 9.1: MRP Inputs and Outputs

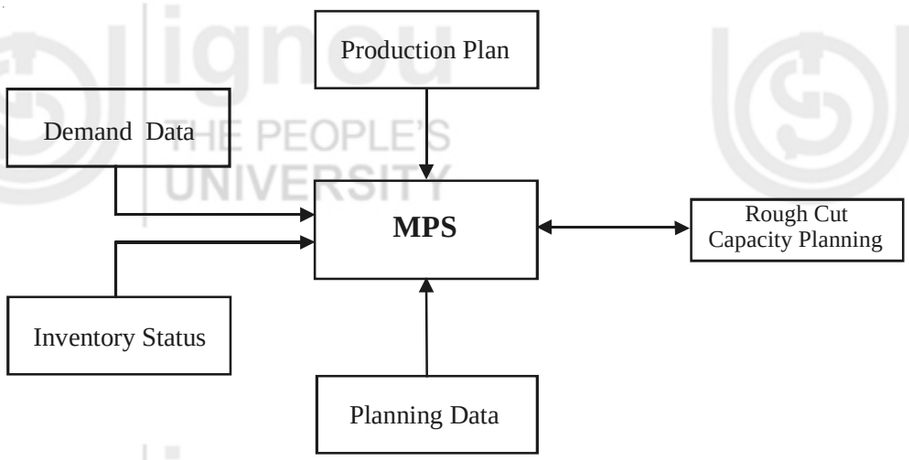

Figure 9.2: Inputs to Master Production Schedule

Master Production schedule states which end items (items that are sold to customers) are needed, in what quantities, on which specific dates, and when these items will be produced. The MPS has five major inputs, as shown in Figure 9.2.

The production plan provides a set of constraints on the MPS. The MPS must take into account all types of demand data for the items being scheduled including: sales forecasts, customer orders, distribution warehouse requirements, interplant requirements, service demand forecasts, and safety stocks. The MPS must know how much is available to accurately determine how much to orders. This requires the inventory status information on hand inventory, allocated stock, released production and purchase orders, and firm planned orders. The item master file provides planning data on each item to guide the MPS planning process, such as: lot-sizing rule to be used, shrinkage factor, safety stock, and lead-time. Rough cut capacity planning determines the capacity requirements to implement the Master Production Schedule, verifying the schedule's feasibility or causing the master schedules to revise the schedule.

1) The Bill of Materials (BoM), also called a product structure or parts list, is a list of all the materials, and the quantity of each, required to produce one unit

of a manufactured product, or parent. MRP uses the bill of materials, as the basis for calculating the amount of each raw material required for each time period. The engineering Bill of materials (often called the parts list) for a simple product (ball-point pen) is as shown in Table 9.2.

Table 9.2: Engineering Bill of Materials (Parts List) for ball-point pen

Item No.	Description	Quantity	Make or Buy	Drawing File No.
1	Barrel	1	Make	26079
2	Tip	1	Buy	26080
3	Spring	1	Buy	20091
4	Refill	1	Buy	20026
5	Cap	1	Make	26048
6	Plunger	1	Buy	26032
7	Clip	1	Buy	26054

In an MRP system, a Bill of Materials (BOMs) file is an up-to-date computerized file that contains a single record for each individual parent-component relationship. The BOMs represent the actual sequence of fabrication and assembly.

2) Item Master in an MRP system is a computerized file with a complete record for each item, or part. Because MRP systems are part-oriented, the Item Master File is the heart of the system. Each item, no matter at how many levels it is used in a product, or in how many products, and no matter whether it is currently stock-on-hand or not, has one and only one record. The item master record for a part contains many types of information, including: static data, such as part description, unit of measure, and MRP planning factors (lot sizes, lead times, safety stock, and scrap rates); plus dynamic data, such as various costs, current quantities on hand and on order.

3) Requirement is a computerized record of a future stockroom issue that will diminish stock-on-hand. There are two types of requirements: Internal (which will be used within the plant to make other products), and External (which will be sent outside the plant, such as customer orders and service parts.

   A typical requirements record contains the item number of the part required, the quantity required, the date on which it is needed, and the quantity already issued from the stock room. Customer orders also contain such additional information as the customer name and ship to address, the date on which the customer wants delivery, and the date we promised to ship.

4) Orders are computerized record of a future stockroom issue receipt that will increase stock-on-hand. Just as there are two types of requirements, there are two types of orders:

   a) Shop orders (or work orders or manufacturing orders), which will be manufactured within our own plant. These are similar to our internal requirements, because they will be procured internally.

   b) Purchase orders, which will be procured from outside our plant. These are similar to our external requirements, because they will come into our plant from external sources.

   We can also categorize the incoming orders (both shop orders and purchase orders) in a different manner, which tells whether the order has been released, or whether it is still planned. The categories are:

a) Scheduled receipts (or open order, or released order), which is an order that has been officially released, either in the shop or to a supplier. A scheduled receipt commits our company to take action and spend money.

b) Planned order, which exists only in the computer, and perhaps some printouts at this point. Our company has not yet been authorized to spend money; no supplier or shop has been authorized to start work on this order.

Planned order can become scheduled receipts only when a human expressly takes action, this is one of the primary responsibilities of a materials planner. An MRP order record contains considerable data, including item number being ordered, order quantity, original due date, actual received quantity, revised due date, quantities in MRB (Material Review Board) and scrap, supplier (if purchase order), and other information.

Activity 1

Identify and discuss the different Bill of Material Database in an organization. Does the Bill of Material Database vary from department to department? Why? Draw a Bill of Material "tree" for one of a typical product that you know.

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Material Requirement Planning Logic and Mechanics

The logic underlying MRP is to use the product structure (BOM) and lead time information to determine when purchase and production orders should be released so that materials are obtained just when they are needed.

1) ***Exploding the Product***

The first step is to use the BOM to 'explode' the product into a production (or assembly) time chart. Figure 9.3 is a production time chart for the spider climber (It is the playing implement that kid uses in the children's park).

The explosion begins with the time the end product is needed and then works backward through each production or purchasing activity that must be done to make each succeeding item. For example, consolidating and packing a spider climber requires one day of lead time, so if a supply of climbers is required at time T, shells, leg supports, ladders, and bolts and nuts must be available one day earlier, at time T-1. Welding and coating a shell requires three days of lead-time, so an order to begin welding shell quads must be released three days earlier, or at time T-4. Casting and demolding shell quads also has a three-day lead-time, so an order to cast shell quads must be issued and aluminum ingots must be available at time T-7. Figure 9.3 shows that the cumulative lead time for producing a spider climber is eight days, so the company would have to initiate production or purchase activities at least eight days before climbers are required.

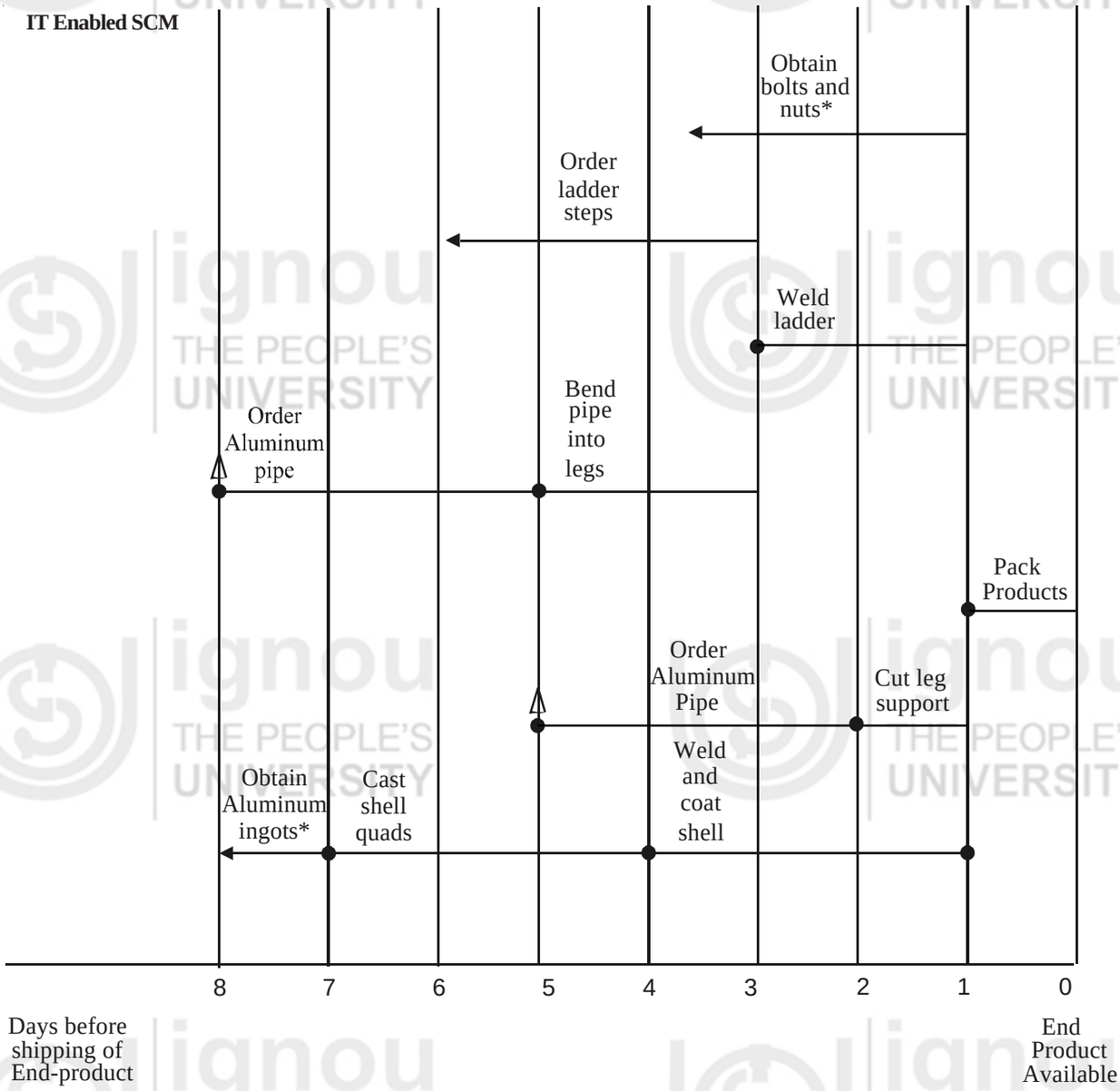

Figure 9.3: Production Time Chart for the Spider Climber.

2) ***Developing the Material Requirements Plan***

The next step is to construct a material requirements plan for each item in the BOM, as illustrated in Figure 9.4.

Master Production Schedule

Day	1	2	3	4	5	6	7	8	9	10	11
Quantity	0	0	0	0	0	0	0	0	20	0	30

Spider Climber

Gross requirements										20		30
Projected on hand										0		0
Scheduled receipts										0		0
Net requirements										20		30
Planned order release									20		30	

Shells

Gross requirements									20		30
Projected on hand									0		0
Scheduled receipts									0		0
Net requirements									20		30
Planned order release						20		30			

Shells Quads (× 4)

Gross requirements						80		120			
Projected on hand						0		0			
Scheduled receipts						0		0			
Net requirements						80		120			
Planned order release			80		120						

Leg supports (× 4)

Gross requirements									80		120
Projected on hand									0		0
Scheduled receipts									0		0
Net requirements									80		120
Planned order release								80		120	

Pipe (× ¼)

Gross requirements								20		30	
Projected on hand								0		0	
Scheduled receipts								0		0	
Net requirements								20		30	
Planned order release					20		30				

Ladders (× 4)

Gross requirements									80		120
Projected on hand									0		0
Scheduled receipts									0		0
Net requirements									80		120
Planned order release							80		120		

Ladder Legs (× 2)

Gross requirements							160		240		
Projected on hand							0		0		
Scheduled receipts							0		0		
Net requirements							160		240		
Planned order release					160		240				

Figure 9.4: (Contd..)

Pipe (× 4)

Gross requirements					160		240				
Projected on hand					0		0				
Scheduled receipts					0		0				
Net requirements					160		240				
Planned order release	160		240								

Ladder Steps (× 7)

Gross requirements							560		840		
Projected on hand							0		0		
Scheduled receipts							0		0		
Net requirements							560		840		
Planned order release			560			840					

Figure 9.4: Material Requirements Plans for Spider Climber

A material requirements plan is a production or purchase schedule for an item that makes up the end product. The procedure begins by converting the gross product requirements in the MPS into net product requirements. The gross requirements are the number of units actually required (desired) at the beginning of each time period. The requirements are the gross requirements less any available inventories and any scheduled receipts, where the available inventories are total inventories for the item at the beginning of the period less any desired safety stock (in the MRP, available inventories are normally labeled as projected on hand). The scheduled receipts are replenishment orders that have already been placed, either in our plant (shop orders) or at a supplier (purchase orders). These will increase the inventory on hand. Hence,

$$(\text{net requirements})_t = (\text{gross requirements})_t - (\text{projected on hand} + \text{scheduled receipts})_t$$

$$(\text{projected on hand})_t = (\text{total expected inventory})_t - (\text{safety stock})_t$$

Gross product requirements are transferred from the MPS to the material requirements plan for the end product, and the net requirements are computed, as shown in figure 9.4. The next line in the material requirements plan is the amount of product or material planned to be received through production or from a vendor at the beginning of the time period. Under lot-for-lot ordering (production) we order or produce exactly what is needed in a time period so that the planned order receipts will equal the net requirements. (It may be noticed that in Figure 9.4, the planned order receipts is combined with the net requirements).

The final lines in the material requirements plan for an item is the planned order releases. This is the amount that must be ordered (internally through production or externally from a vendor) at the beginning of a time period so that the planned order receipts occur when needed. Therefore, the planned order releases equal the net requirement (or planned order receipts), except that they are offset by the lead-time. For example, in figure 9.4 the net requirements for the spider climber are 20 units on day 9 and 30 units on day 11. The lead-time for final consolidation and packing is one day, so the planned order releases for the climber must be 20 on day 8 and 30 on day 10.

9.4 MANUFACTURING RESOURCE PLANNING (MRP-II)

As we have noted, MRP is a production planning system that converts an MPS into planned order releases. Manufacturing resource planning (MRP-II) is a philosophy that attempts to incorporate the other relevant activities of the firm into the production planning process. In particular, the financial, accounting, and marketing functions of the firm are tied to the operations function. As an example of the difference between the perspectives offered by MRP and MRP II, consider the role of the master production schedule. In MRP, the MPS is treated as input information. In MRP II, the MPS would be considered a part of the system and, as such, would be considered a decision variable as well. Hence, the production control manager would work with the marketing manager to determine when the production schedule should be altered to incorporate revisions in the forecast and new order commitments. Ultimately, all divisions of the company would work together to find a production schedule consistent with the overall business plan and long-term financial strategy of the firm.

Another important aspect of MRP II is the incorporation of CRP (capacity resource planning). Capacity considerations are not explicitly accounted for in MRP. MRP-II is a closed-loop cycle in which lot sizing and the associated shop floor schedules are compared to capacities and recalculated to meet capacity restrictions. An MRP-II system may convert information from the material requirements plans into specific work schedules for departments and machines, evaluate department workloads and capacity conditions, generate shipping documents and customer invoices, and produce management reports on production and financial performance. Typically, these systems have feedback mechanism (and therefore called closed-loop MRP systems) so that if department, machine, or personnel capacity limits are exceeded, the material requirements plans and corresponding production schedules are revised to stay within capacity limits.

9.5 ENTERPRISE RESOURCE PLANNING (ERP)

In the past, most of the planning covered only limited routine operational requirements, with focus on historical record keeping and accounting. The business functions in the enterprise were using information technology to automate the departmental activities, to fulfill only individual and departmental needs and objectives, not realizing the effect on other functions.

However, the enterprise is the group of people with a common goal, which has certain resources at its disposal to achieve this. The group has some key functions to perform inline with the goals. Resources are anything, which cost money. Resources include raw materials, purchased parts, and produced parts, personnel, processing machine capacity, material handling capacity, tools, fixtures, NC programs and such others as needed to produce the end items. Planning is to ensure that nothing goes wrong and also putting necessary functions in place. ERP is the method of effective planning of all resources in an organization.

Every organization committed to making and selling goods and services has three major objectives:

- To provide maximum customer service
- To minimize inventory carrying cost
- To optimize plant operation

Unfortunately, these objectives are basically conflicting in nature and represent certain trade-offs. Sales department requires all the inventory necessary to service their customers and at the same time production flexibility to meet changing demands. Factory desires a constant production schedule with long runs and less overtime. Finance insists on keeping the capital investments to a minimum. More often they end up with the managers nightmare:

- More was bought than required
- More was used than essential
- More was produced than sold

ERP is an attempt to bridge the gap. It is defined to be a company wide planning system which works around core activities of business and has all logical interfaces to achieve seamless flow of information within the supply chain and value stream. Such systems can optimally plan and manage all the resources of enterprise to run the business with high level of customer service at lower cost and improved productivity.

The evolution of ERP took over three decades, during which the continuous improvement for integration and planning with creative thinking by innovators developed this comprehensive planning and control framework. Three ancestors of ERP serve as milestones:

- 1960's Material Requirement Planning (MRP)
- 1970's Closed Loop MRP
- 1980's Manufacturing Resource Planning.

During this it also absorbed the new techniques proven to produce business benefits from Just-in-Time (JIT) and Business Process Reengineering (BPR).

In 1960's the computerized production and inventory control systems began to provide better methods of ordering materials and control inventory. It uses master production schedules (What are we going to make?), bills of material (What does it take to make it?), and inventory records (What do we have?) to determine future requirements (What do we have to get?), which is called as Material Requirement Planning (MRP). In the changing conditions of manufacturing environment, the priority planning and capacity planning were tied in with MRP to accommodate the variations in demand and supply using feedback from tactical plans and execution levels. This closed structure is called as closed loop MRP. The next generation, Manufacturing Resource Planning (MRP-II), plans to forecast sales, to set production rates and resources levels integrated with investments decisions before translating the business plans to Master Production Plans (MPS).

In the new generation ERP, the whole supply chain management concept is incorporated extending the planning concept to trading partners where the complete visibility throughout the enterprise is possible and the concept of virtual enterprise is supported using electronic commerce.

This incorporates the techniques, Just-in-Time (JIT) and Business Process Reengineering (BPR), particularly in the areas of work empowerment, human engineering and waste reduction. The benefits of JIT are never fully realized unless it is being applied within the rational framework without which one could easily make wrong part at wrong time with utmost efficiency. The drawback of MRP II was the planning based on lead times, which never asked for improvement and taken as it is. The BPR is becoming an essential tool before and while ERP implementation concentrating on reduction in non value adding activities and work simplification causing reduction in cycle time.

ERP consists of different modules integrated into one system. The modules are:

1) Distribution and transportation which serves day-to-day logistics using forecasting tools, extensive planning, comprehensive sales, purchasing, warehousing, packaging, inventory management and electronic commerce.
2) Order management integrates customer order processing into master production schedule, supports multiple sites and currencies, electronic commerce for real time information.
3) Manufacturing module supports master production schedule, material requirement planning, capacity planning, supplier scheduling and shop floor control.
4) Finance module delivers high level of visibility of financial transactions, supports accounts payable, accounts receivable, different costing methodologies, general ledger and electronic commerce.
5) Human resource module integrated with pay-roll track skills, capabilities, experience and training needs of an organization, prepares and maintains organization structure.
6) Quality management lets user tap collect, distribute and analyze critical quality information and uses powerful statistical tools to monitor and control products and processes.
7) Maintenance management calls for optimal schedules for personnel, availability of spares, and effective maintenance tasks. It handles all types of maintenance, keeps details of equipments, generates spare parts and maintenance requirements automatically.
8) Project module supports cost management of projects includes estimates, bids, scheduling, planning, budgeting, purchasing, tracking, billing, and integration with finance, manufacturing and distribution operations.

Why a Company Pursues a New ERP Solution

a) The company wants to achieve performance improvements, such as reducing operational costs, gaining competitive advantage, improving customer service, and improving or reengineering business processes.
b) The existing system in the company is not able to support its needs and requires significant information system resources for maintenance and support.
c) The system uses multiple points of input, often with duplication of effort.
d) Staff members are unable to answer questions easily or respond to information requests by key customers or suppliers.
e) The enterprise has grown through mergers and acquisitions and contains a variety of incompatible systems
f) Key information is updated on a batch basis instead of in real time.

A few ERP software modules and their features are presented in Unit 10.

9.6 DISTRIBUTION REQUIREMENT PLANNING (DRP)

Distribution Requirement Planning (DRP) is a management process that determines the need of inventory stocking locations (store, distribution center, regional distribution center, central DC, manufacturing DC, or warehouse that carries product for sale) and ensures that supply sources (third party supplier, a regional distribution point, or a factory) will be able to meet the demand. This is accomplished in three distinct phases.

First, DRP receives input from the following:

a) Sales forecasts by stock keeping unit by stocking location.

b) Customer orders for current and future delivery.

c) Available inventory for sale by stock keeping unit (SKU) by stocking locations.

d) Outstanding purchase orders and/or manufacturing orders by product purchased and/or manufactured.

e) Logistics, manufacturing, and purchasing lead times.

f) Modes of transport used as well as deployment frequencies.

g) Safety stock policies by SKU by stocking locations.

h) Normal minimum quantity of product to be purchased, manufactured, and distributed.

Second, once all inputs are received, DRP generates a time-phased model of resource requirements to support the logistics strategy. These include:

a) Which product is needed, how much, and where and when it is needed.

b) Transportation capacity needed by mode of transport by stocking locations.

c) Needed space, manpower, and equipment capacity by stocking locations.

d) Required inventory investment by stocking locations and in total.

e) Required level of production and/or purchases by product and by supply source.

Third, DRP compares the required resources to what is currently available at supply sources, and what will be available in the future. It then recommends what actions must be taken to expedite or delay purchases and/or production, thereby synchronizing supply and demand. This third phase forces integration and feedback into the system, thus closing the loop among manufacturing, purchasing, logistics, and the customers.

DRP Logic

Consider a company manufactures distributes and sells pharmaceuticals and supports a network of six retail stores. Specifically, we will track the planning for vitamin C tablets packaged in bottles of 100. The store at Mumbai has 500 of this product on hand, 200 as a safety stock, and a forecast that varies between 80 and 120 per week (see Figure 9.5).

On-hand Balance : 500
Safety Stock: 200
Lead Time: 2 weeks
Order Quantity: 300

Mumbai Store
Vitamin C Tablet 100/Bottle

	Past	**Week**							
	Due	1	2	3	4	5	6	7	8
Forecast		100	120	90	110	120	100	80	120
In Transit									
Projected on hand	500	400	280	190	80	-40			
Planned Shipments.– Receipt. Date									
Planned Shipments.– Ship Date									

Figure 9.5: DRP Logic for a Mumbai Store

In Figure 9.5, the projected on-hand balance is determined by means of the simple computations. This logic reduces the on-hand balance by the quantities forecast for each week. In the beginning of the first week, for example, 500 are on hand. Forecast sales for the week are 100; they are subtracted from the 500 on hand, leaving a projected balance of 400 at the beginning of the next week. The same mechanism ripples through the schedule. The projected on-hand balance dips below the safety stock of 200 in week 3 (projected on-hand balance of 190), at which point the store will probably run out of stock and go on back order in week 5. In the example in Figure 9.5, no product is in transit. If that were the cases, the product in transit would be added to the projected on-hand balance in the week that it is due to arrive.

The situation shown in Figure 9.5 will occur if nothing is shipped from the supply source. The store manager needs more of the product delivered in week 3 to keep the balance from dropping below safety stock, which means that more product must arrive by week 5 to keep the product from going on back order.

On-hand Balance : 500
Safety Stock: 200
Lead Time: 2 weeks
Order Quantity: 300

Mumbai Store
Vitamin C Tablet 100/Bottle

Past	**Week**							
Due	1	2	3	4	5	6	7	8
Forecast	100	120	90	110	120	100	80	120
In Transit								
Projected on hand 500	400	280	490	380	260	460	380	260
Planned Shipments.– Receipt. Date			300			300		
Planned Shipments.– Ship Date	300			300				

Figure 9.6: DRP Logic for a Mumbai Store with Planned Shipment

The replenishment lead-time for vitamin C at the Mumbai store is two weeks, and normally 300 bottles, or four full cases, are shipped at a time. Therefore, a shipment of 300 units must arrive in week 3 to prevent the inventory from dropping below the desired safety-stock level. Since the replenishment lead-time is two weeks, the shipment should be ordered from the supply source in week 1. Figure 9.6 includes this planned shipment (i.e., future order) from the supply source in the two lines labeled planned shipments. One shows the planned shipments on the date they are due to arrive at the store (planned shipments – receipt date). The other shows the planned shipments on the day they are due to be shipped from the supply source (planned shipment – ship date).

The planned shipments provide enough stock to last until week 8, although the store will drop below safety stock in week 6. Therefore, another order must arrive in week 6. This order should be sent from the supply source in week 4. Figure 9.6 shows the complete picture of the Vitamin C product at the Mumbai store.

Now that we have seen how DRP functions in one store, let's expand it to all the stores for the Vitamin C product. The following examples (Figure 9.7) show DRP displays for the other stores and are similar to the DRP display shown for the Mumbai store.

In the case of the Indore store in Figure 9.7, an order of 150 is in transit. The order was shipped because the lead-time is two weeks; and it is due to arrive in

week 2. The in-transit quantity is added to the projected on-hand balance in the week the order is due to arrive. The store manager can now see what material is in route and when it should be expected.

In the case of Calcutta store (Figure 9.7), a planned order is overdue for shipment. This is the planned shipment for 300, which appears in the past-due time period. There could be several reasons for the past-due order. Perhaps sales were greater than forecasted, so the product was needed in Calcutta earlier than anticipated. Or, the shipment might not have been sent from the supply source on time. In that case, because of the visibility that DRP affords, the manager of the store could determine whether the supply source is shipping on time. Moreover, the manager could determine the problem well before a stock out occurs.

The situations at the New Delhi, Chennai and Bangalore stores, as shown in Figure 9.7, are similar to the Mumbai store. Nothing is in transit, but there are several planned shipment from the supply source to the stores. The Bangalore store is in the same city as the supply source, so its lead-time for product is only one day.

The lead-time (LT), order quantities (OQ), and safety stock (SS) are different for each store, so each store can be scheduled independently if desired. In addition, the lead times, order quantities, and safety stocks can be different for different products at the store. (This is not apparent in the figures 9.6 and 9.7 because only one of many products is shown. Each product at each store, however, is scheduled independently). DRP gives the people operating the system complete flexibility in scheduling any item at any stocking locations.

Indore, Calcutta, New Delhi, Chennai & Bangalore Store Vitamin C Tablet 100/Bottle

On-hand Balance : 160
Safety Stock: 75
Lead Time: 2 weeks
Order Quantity: 150

Indore Store

	Past	Week							
	Due	1	2	3	4	5	6	7	8
Forecast		40	50	45	50	40	45	40	50
In Transit			150						
Projected on hand	160	120	220	175	125	85	190	150	100
Planned Shipments. – Receipt. Date							150		
Planned Shipments. – Ship Date					150				

On-hand Balance : 160
Safety Stock: 75
Lead Time: 2 weeks
Order Quantity: 150

Calcutta Store

	Past	Week							
	Due	1	2	3	4	5	6	7	8
Forecast		120	130	115	125	140	110	125	105
In Transit									
Projected on hand	300	180	350	235	110	270	160	335	230
Planned Shipments. – Receipt. Date			300			300		300	
Planned Shipments. – Ship Date	300			300		300			

Figure 9.7: Indore, Calcutta, New Delhi, Chennai & Bangalore Store

On-hand Balance : 140
Safety Stock: 50
Lead Time: 3 weeks
Order Quantity: 150

New Delhi Store

	Past	Week							
	Due	1	2	3	4	5	6	7	8
Forecast		20	25	15	20	30	25	15	30
In Transit									
Projected on hand	140	120	95	80	60	180	155	140	110
Planned Shipments. – Receipt. Date						150			
Planned Shipments. – Ship Date			150						

On-hand Balance : 120
Safety Stock: 50
Lead Time: 1 weeks
Order Quantity: 150

Chennai Store

	Past	Week							
	Due	1	2	3	4	5	6	7	8
Forecast		25	15	20	25	20	20	25	15
In Transit									
Projected on hand	120	95	80	60	185	165	145	120	105
Planned Shipments. – Receipt. Date					150				
Planned Shipments. – Ship Date				150					

On-hand Balance : 400
Safety Stock: 150
Lead Time: 1 day
Order Quantity: 300

Bangalore Store

	Past	Week							
	Due	1	2	3	4	5	6	7	8
Forecast		105	115	95	90	100	110	95	120
In Transit									
Projected on hand	400	295	180	385	295	195	385	290	170
Planned Shipments. – Receipt. Date				300			300		
Planned Shipments. – Ship Date				300			300		

	Past	Week							
	Due	1	2	3	4	5	6	7	8
Mumbai		300			300				
Indore					150				
Calcutta	300			300		300			
New Delhi			150						
Chennai				150					
Bangalore				300		300			
Total	300	300	150	750	450	300	300	0	0

Figure 9.8: Summary of Planned Shipments to the Stores

In figure 9.7, forecasts for New Delhi and Chennai stores are nearly the same from week to week. Based on this, you might expect that the demand on the supply source would be smooth as well, with demand in any one-week nearly the same as demands in other weeks. Yet, the opposite is true. The demand on the supply source is lumpy. Figure 9.8 illustrates this point very well. For example, in week 2 the demand is only 150, but in week 3 it jumps to 750.

Lumpy demand is one of the reasons why it is so important to have visibility in the supply chain system. Because the demand on the supply source can vary so much from one week to another, a planner or buyer needs to be able to see what product is needed and when it must be shipped to meet the needs of the stores in the systems without DRP, buyers must use averages – hence, the inevitability of lumpy demand. With DRP, however, buyers see the true needs of the supply chain system. This gives tremendous visibility into the distribution network, and enables buyers to realistically plan for the needs of the stores. The better buyers see what the stores need in the future, the better they are able to meet those needs and resolve problems before they occur.

9.7 DISTRIBUTION RESOURCE PLANNING (DRP-II)

Distribution Requirements Planning (DRP) has been defined as the application of MRP principles to the distribution environment, integrating the special needs of distribution networks of retailers, etc. It is a dynamic model that looks at a time-phased plan of events that affect inventory.

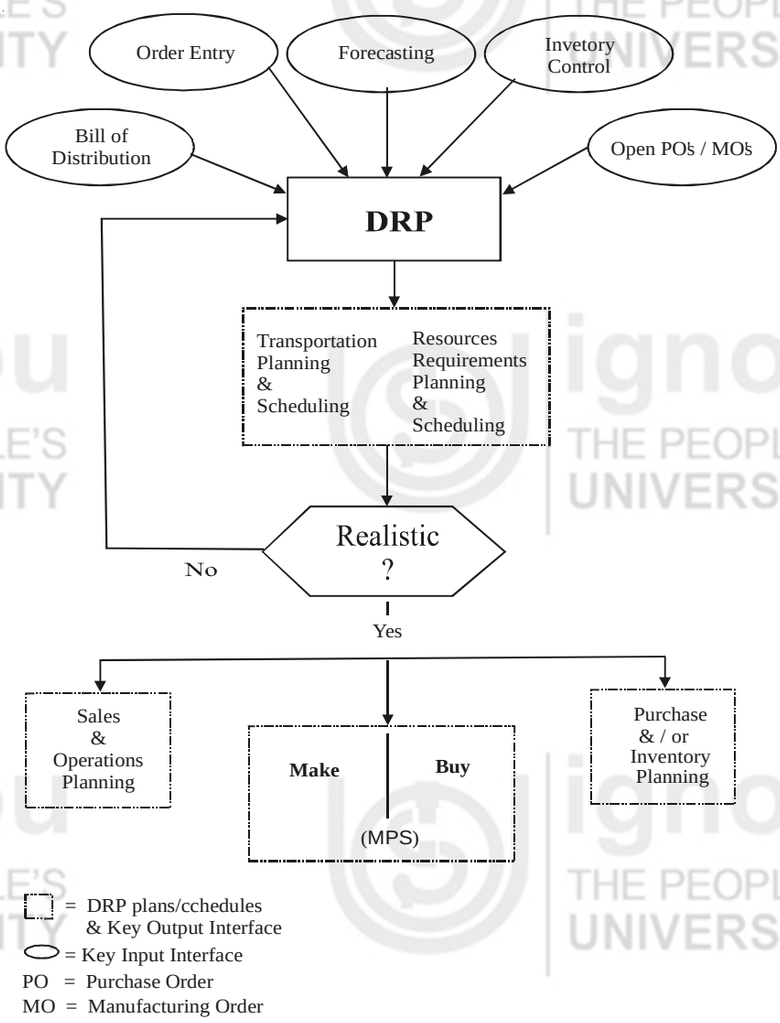

Figure 9.9: Distribution Resource Planning Process

Distribution Resource Planning (DRP-II) is an extension of distribution requirements planning. DRP applies the time-phased logic to replenish inventories in multiechelon warehousing systems. DRP-II extends DRP to include the planning of key resources in a distribution system – warehouse spaces, manpower levels, transport capacity (e.g., trucks, railcars), and financial flows.

Figure 9.9 depicts the DRP-II system schematically. It is to be noticed that the accurate forecasts are essential ingredients for successful DRP-II systems. A DRP-II system translates the forecast of demand for each stock keeping unit (SKU) at each warehouse and distribution center into a time-phased replenishment plan, transportation plan, financial plan and budgeting, predicting warehouse space requirements and predicting labour requirements and equipment needs, and more importantly manufacturing plan such as master production schedule. More details may be found in reference on MRP-II.

Activity 2

Prepare a feasibility report for the recommendation of MRP, MRP-II, DRP, DRP-II, ERP, and SCM that suits your organization or an organization of your choice.

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9.8 ERP VS. SCP (SUPPLY CHAIN PLANNING)

ERP: Enterprise Resource Planning is company wide planning systems, which works around core activities of business and has all logical interfaces to achieve seamless flow of information within the supply chain context. Such systems can optimally plan and manage all the resources of enterprise to run the business with high level of customer services at lower costs and improved productivity.

SCM: Supply Chain Management is the logistics of managing the pipe line of goods from contracts with suppliers and receipt of incoming material, control of work-in-process, and finished goods inventories in the plant, to contracting the movement of finished goods through the channels of distribution.

From the above definitions of ERP and SCM one may understand that there is a great deal of commonality. However, the software designers consider the key process shown in Table 9.

Table 9. : Comparison of key processes of ERP & SCM

	ERP Key Processes	SCM Key Processes
1.	Sales and Distribution • Order entry • Delivery scheduling	1. Customer relationship management 2. Customer service management
2.	Business planning • Demand forecasting • Planning of product production & capacity • Detailed routing	3. Demand management 4. Order fulfillment 5. Manufacturing flow management 6. Procurement
3.	Production planning • Master production schedule • Material requirement planning	7. Product development and commercialization 8. Returns channel (reverse logistics)

	ERP Key Processes	SCM Key Processes
4.	Shop Floor Control • Production orders • Scheduling, dispatching & job costing.	
5.	Logistics • Inventory management • Warehouse management • Delivery management • Purchasing management	

Supply Chain Management Pitfalls

Supply chain management faces the following 14 key pitfalls:

1) No supply chain strategy
2) Inadequate definition of customer service
3) Inaccurate delivery status data
4) Inefficient information systems
5) Ignoring the impact of uncertainties
6) Simplistic inventory stocking policies
7) Discrimination against internal customers
8) Poor coordination
9) Incomplete analysis of shipment methods
10) Incorrect assessment of inventory costs
11) Organizational barriers
12) Product-process design without supply chain consideration
13) Separation of supply chain design from operational decisions
14) Incomplete supply chain strategy.

There are however excellent ways to overcome these problems. The suggested approaches deal with design and measurement. First, the design of the product or service should give consideration to the cost and service implications for the existing or proposed supply chain. Second, database should be integrated throughout the supply chain to ensure operational control. Appropriate data include past performance, current inventory levels, positions and schedules, as well as forecast data. This system would support the opportunity for improved supply chain performance: the integration of control and planning support systems. This in turn would reduce independent decision making, which ignores the systems approach. Thus, the fourth point-to expand the view of the supply chain is critical. Supply chain members should embrace the systems approach with the realization that each member's activities have an impact on the others.

The last two issues concern internal and external measurement. The organization must redesign its incentives, so that individuals, divisions, and sites are rewarded for taking a system-wide, supply chain approach. In addition, the organization should institute supply chain performance measurement. For example, inventory measurement should be viewed across the supply chain instead of local assessments.

Supply Chain Planning (SCP)

Managers responsible for supply chain process improvement planning, implementation, and measurement received a much-needed framework to guide their efforts in November 1996 when the 69 members Supply Chain Council introduced its Supply Chain Operations Reference Model (SCOR). The major benefit of SCOR is that it gives inter-organizational supply chain partners a basis for integration by providing them, often for the first time, with something tangible to talk about and work with. It turns out that the various departments are now talking in the same language, which is a notable achievement. The framework helped to break down functional silos and allowed people to look at real issues and practices supply chain management improvements. It gave people the chance to look at the supply chain with company-wide needs in mind.

The development of software applications pertinent to supply chain management is currently a hotbed of activity, promising continued growth into the future. A new software program developed by Ross Systems, Inc. called Supply Chain Planning (SCP) is an integrated suite of constraint-based planning tools that provide demand replenishment, and manufacturing tools for accurate planning and scheduling of various activities. This software provides an end-to-end enterprise-resource planning solution incorporating the most advanced supply chain planning capabilities available. SCP is just an example of hundreds of software titles that address some aspect of supply chain management.

ERP Vs. SCP

A supply chain is a network of facilities and distribution options that performs the function of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these products to the customers. Supply chain exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly form industry to industry.

The most distinguishing characteristic of ERP systems is their comprehensiveness. We take SAP's R/3 package (refer unit 10 for details) and try to differentiate between ERP and SCP by taking this as a model. R/3 broadly covers Sales and Distribution, Business Planning, Production Planning, Shop Floor Control, and Logistics. On the surface, this would seem to cover anything that SCP claims to provide. Therefore, it helps to review the relevant functions of R/3 in detail, to be able to contrast to SCP software. First, Sales and Distribution covers order entry and delivery scheduling. This module also naturally checks on product availability to ensure timely delivery, and checks the customer's credit line. Business Planning consists of demand forecasting, planning of product production and capacity, and the detailed routing information that describes where (in which work cells) and in what sequence the product is actually made.

The capacity and production planning gets very complex, therefore simulation tools are provided as part of R/3 that can help managers to decide how to overcome shortages in materials, labour, or time. Once the Master Production Schedule is complete, that data is fed into the MRP (Materials Requirements Planning) module. The MRP has three principle pieces of output: an exception report, an MRP list, and order proposals. The exception report brings to attention situations that need attention, such as late delivery of materials, and rescheduling proposals. The MRP list shows the details of shipments and receipts for each product and component. Order proposals are used to order materials and issue production orders.

This naturally leads to Shop Floor Control. The planned orders from the MRP are converted to production orders. This leads to production scheduling,

dispatching, and job costing. Finally, the Logistics system takes care of rest, assuring timely delivery to the customer. Logistics in this case consists of inventory and warehouse management, and delivery. The purchasing function is also usually grouped under logistics. The overall process summary looks like: Sales & Forecasting Data, Production & Capacity Planning, Production Execution, and Logistics.

This functionality is representative of all the major ERP vendors, including SAP, Oracle, Baan, and PeopleSoft. However, it also seems to be very close in functionality to SCP products such as those from i2 and Manugistics. So what's the difference?

The Manugistics web site (http://www.manugistics.com) has the following description of supply chain management: "Effective supply chain management enables you to make informed decisions along the entire supply chain, from acquiring raw materials to manufacturing products to distributing finished goods to the consumer."

This sounds a lot like what R/3 does. R/3 has detailed functionality to order needed materials, schedule and track the manufacture of products, and to schedule and track distribution. So really, what's the difference? The description of i2's Rhythm product line (found at http://www.i2.com) is slightly different: "RHYTHM's Supply Chain Planner provides advanced planning capabilities to leading companies in many industries. RHYTHM plans and optimizes the supply chain as a continuous and seamless activity that integrates all planning functions across the supply chain. RHYTHM goes beyond traditional planning solutions like MRP (Manufacturing Resource Planning) and DRP (Distribution Resource Planning) by simultaneously considering demand, capacity and material constraints". This provides a better idea of the chief differences between ERP and SCP systems.

Enterprises with multi-echelon distribution networks that have aggregation, dis-aggregation, balancing or echelon-skipping requirements within the distribution network will need to augment their existing ERP applications with advanced SCP functionality or risk incurring distributions costs that are at least 10 percent higher due to expediting, low order fill rates and inventory imbalances. This is caused by the static sourcing tables used in ERP systems. While ERP systems provide a great deal of planning capabilities, the various material, capacity, and demand constraints are all considered separately, in relative isolation of each other. The more leading edge SCP products are able to consider all the relevant constraints simultaneously, and to perform real-time simulations of adjustments in the constraints. ERP systems have a harder time adding this more dynamic functionally because they are chiefly concerned with transaction processing, and also have many more jobs to do than just SCP. Getting answers from an overloaded ERP systems may take hours, whereas getting them from a separate SCP system may take minutes or seconds.

The leading SCP products generally have many other enhancements as compared to the ERP packages. Many employ visible maps of the entire supply chain, showing where problems are. Here is a description of Manugistics latest version: "Navigating your way through mountains of supply chain information is made easier with Supply Chain Navigator's state-of-the-art graphical user interface. This intuitive GUI gives you complete visibility into the inner-workings of the supply chain – through demand, supply, manufacturing scheduling, and transportation – all at your fingertips." Just recently, SAP has added similar functionality. But that functionality is actually a SAP version of the SCP product made by i2, which SAP is selling as a separate module. This is a relatively

simplistic explanation of the key differences between the ERP vendors' SCP modules and the leading SCP only products, but it hits the main points.

Now, since these products have many naturally overlapping features, how is data kept consistent between them? i2 uses SAP's ALE (Application Link Enabling) to exchange data between R/3 and Rhythm (i2's SCP product suite). Oracle and the other ERP vendors also have APIs that i2 and other vendors can use as common denominator middle-ware to interface to. However, this means that each vendor has to change their middle ware interface software quite often, which is often a trial and error process, doesn't usually perform well, and often turns into a nightmare. A newer, and possibly better solution to this problem is SIS (Specialized Integration Software). This software is designed specifically to allow ERP and other systems to share processes and data. This removes the core of developing an interface to every other vendors software. The major company in this area is Cross Worlds Software Inc., although more are appearing. This software, which runs on Windows NT, claims to work by simply pointing and clicking on a sending application (such as SAP) and a receiving application (such as Manugistics) and then selecting the processes to link together. No programming is required.

One other key development that should be noted is the rapid convergence that is happening between ERP and SCP software. The ERP vendors have awaken, and are rushing to add more sophisticated supply chain functionality to their ERP products. And the SCP vendors are also expanding their functionality, further encroaching on the area inhabited by the ERP vendors. Although it seems that all the leading SCP vendors are partnered with the all the leading ERP vendors, this is only a temporary relationship if SAP, Oracle, etc. have their way. Following SAP's example, Oracle has also added a SCP module, and Baan and People Soft both have recently acquired smaller SCP vendors to integrate into future releases of their ERP products. As the ERP vendors move heavily into the mid-size market with their new supply-chain bolstered products, they should push a lot of the smaller SCP and ERP vendors out of business. With the industry shakeout, implementations should become somewhat simpler and thus shorter and less expensive, since there will be less products to integrate, and more experienced implementers in job market.

Activity 3

Select a case study from a National/International Journal, which discusses the selection and implementation of either ERP or SCM. Discuss the suitability of the selected case study in Indian context.

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9.9 SUMMARY

How to best extract value from information technology resources is a major challenge facing both business and IT managers, particularly as they turn their focus on searching for competitive benefits of strategic information systems and striving for benefits beyond process reengineering. This search becomes increasingly complex for those organizations attempting to operate in supply chains with multiple participants.

In this unit, the recent development in the information system, particularly in supply chain context, has been reviewed. The changing paradigm of manufacturing from old rules to new rules of manufacturing required an intelligence information system. The sets that include MRP, ERP and DRP are a few business intelligence that automate the enterprise activities. This application makes use of recent developments in information technology. However, the supply chain planning (SCP) emerged as a new tool for an integrated business. The benefits of this tool includes, reduction of lead-time, inventory cost reduction, reduction in operating costs, cycle time reduction, and improved productivity. A comparison of ERP and SCP reveals that there exists a great deal of similarity between these two approaches. However, the key processes vary and hence the differences are reflected in the software. Additional features are being handled in the SCM. Supplier reliability, supplier lead time, process reliability, change overtime, schedule attainment, perfect order completion, replenishment lead time, delivery days on hand, total supply chain and total cycle time are the key performance indicators that need to be continuously measured and monitored for competitive advantage. SCM software product developers keep these indicators for benchmarking their products.

9.10 SELF-ASSESSMENT QUESTIONS

1) "Making changes in a manufacturing company is probably the hardest thing that civilized man has ever set out to achieve" – give your comment on this statement in context with the organization switching to supply chain management.

2) Distinguish between independent and dependent demand inventory system. Why inventory control system is not practiced for dependent item material planning?

3) Give major inputs of MRP. Identify the sources through which these inputs are obtained. Give your answer for both Make to Stock (Make to Forecast) and Make to Order situations.

4) Prepare a flow chart for Material Requirement Planning logic. Illustrate the basic mechanics of the logic for a simple product like a ballpoint pen. Assume all the necessary data for your selected product.

5) Each year Sputter Sports, Inc., receives orders for footballs from the Paramutuel Foot ball League (PFL). Because of the destructive left foot of Transylvanian superstar Vladimir 'Toze' Kickofski, the PFL orders a single quantity of balls, so Sputter Sports wants to determine when the materials necessary to produce the order should be obtained. Sputter Sports plans to ship 300 footballs in week 8, 200 in week 10, and 200 in week 12. Sputter has no other customer for footballs.

   A football is composed of a leather cover, a rubber bladder, and a string to lace the leather cover after the bladder has been inserted. Sputter purchases bladders already molded with the inflation valve as an integral part of it. The lead-time to obtain bladders is five weeks and they cannot be purchased in orders of less than 250. Sputter purchases pigskin in sheets large enough to make four footballs. Records of past purchases indicate that it takes two weeks from the time of order until the skins are delivered. It takes one week to cut and stitch 100 footballs with the current work force, and Sputter does not plan to enlarge its facilities or work force for this order. One hundred strings for the footballs are cut from on cowhide, which takes only one week to purchase. It takes one week to assemble an order of footballs up to 500 units.

Show (a) the master production schedule, (b) a product structure tree, and (c) plan Sputters' material requirements for this product.

6) What is MRP-II? How is it different from MRP?

7) Define ERP. Give its tangible and intangible benefits.

8) Why a company pursues a new ERP solution?

9) What are the three distinct phases of Distribution Requirement Planning?

10) Explain the DRP logic for a medium size soft-drink manufacturing company. How is the safety stock decided in such distribution system?

11) Compare and contrast DRP and DRP-II.

12) Give the key processes considered in both ERP and SCM. How are these processes different from one another?

13) What are the supply chain management pitfalls? How are these pitfalls being eliminated?

14) Briefly explain the supply chain planning and a few software for SCP.

15) "The leading SCP products generally have many features as compared to ERP software packages" – Give your elaborate remarks on this statement.

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