POST GRADUATE DIPLOMA IN MANAGEMENT

MP-09

Logistics & Supply Chain Management

Block

3

AGGREGATE PLANNING

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Aggregate Planning

Unit-2

MRP 1 & MRP 2

Unit-3

ERP in Supply Chain Management

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Unit- 1

Aggregate Planning

Learning Objectives

After completion of the unit, you should be able to:

- Know what is Aggregate Planning
- Understand factors and techniques for Aggregate Planning
- Understand mathematical approach to Aggregate Planning
- Understand it's difference in manufacturing and services
- Understand the advantages of Aggregate Planning

Structure

1.1 Introduction

1.2 The Aggregate Planning Strategies

1.3 Factors for Aggregate Planning

1.4 Factors affecting Aggregate Planning

1.5 Techniques for Aggregate Planning

1.6 Mathematical Approaches to Aggregate Planning

1.7 Difference between Aggregate Planning in Manufacturing & Aggregate Planning in Services

1.8 The Advantages of Aggregate Planning

1.9 Let's sum-up

1.10 Key Terms

1.11 Self-assessment Questions

1.12 Further Readings

1.13 Model Questions

1.1 INTRODUCTION

An organization can finalize its business plans on the recommendation of demand forecast. Once business plans are ready, an organization can do backward working from the final sales unit to raw materials required. Thus annual and quarterly plans are broken down into labor, raw material, working capital, etc. requirements over a medium-range period (3 months to 18 months). This process of working out production requirements for a medium range is called aggregate planning.

An aggregate plan also consists of the targeted sales forecasts, production levels, inventory levels, customer backlogs etc. In this type of planning, the word ‘aggregate’ is used because the planning at this level includes all the resources in the aggregate. The schedule used in the aggregate planning plays a very critical and an essential role in providing the satisfaction to the demand forecast at a minimum cost.

Aggregate planning serves as the basic structure for the future short – range type planning and this type of planning can be categorized as follows:

1. Production plan –

• Also called as the manufacturing aggregate plan.

• Is a managerial statement of the period – by – period production rates, work – force levels etc.

2. Staffing plan –

• Also called as the service aggregate plan.

• Is a managerial statement of the period – by – period staff sizes and the labor – related capacities, given customer requirements and the capacity limitations.

1.2 The Aggregate Planning Strategies

There are two pure planning strategies available to the aggregate planner: a level strategy and a chase strategy. Firms may choose to utilize one of the pure strategies in isolation, or they may opt for a strategy that combines the two.

LEVEL STRATEGY

A level strategy seeks to produce an aggregate plan that maintains a steady production rate and/or a steady employment level. In order to satisfy changes in customer demand, the firm must raise or lower inventory levels in anticipation of increased or decreased levels of forecast demand. The firm maintains a level workforce and a steady rate of output when demand is somewhat low. This allows the firm to establish higher inventory levels than are currently needed. As demand increases, the firm is able to continue a steady production rate/steady employment level, while allowing the inventory surplus to absorb the increased demand.

A second alternative would be to use a backlog or backorder. A backorder is simply a promise to deliver the product at a later date when it is more readily available, usually when capacity begins to catch up with diminishing demand. In essence, the backorder is a device for moving demand from one period to another, preferably one in which demand is lower, thereby smoothing demand requirements over time.

A level strategy allows a firm to maintain a constant level of output and still meet demand. This is desirable from an employee relations standpoint. Negative results of the level strategy would include the cost of excess inventory, subcontracting or overtime costs, and backorder costs, which typically are the

cost of expediting orders and the loss of customer goodwill. The salient points are:

- Use a constant workforce & produce similar quantities each time period
- Use inventories and back-orders to absorb demand peaks & valleys
- Use inventories in better way to absorb the peak of demand and valleys

CHASE STRATEGY

A chase strategy implies matching demand and capacity period by period. This could result in a considerable amount of hiring, firing or laying off of employees; insecure and unhappy employees; increased inventory carrying costs; problems with labor unions; and erratic utilization of plant and equipment. It also implies a great deal of flexibility on the firm's part. The major advantage of a chase strategy is that it allows inventory to be held to the lowest level possible, and for some firms this is a considerable savings. Most firms embracing the just-in-time production concept utilize a chase strategy approach to aggregate planning.

Options which can be used to increase or decrease capacity to match current demand include:

1. **Hire/lay off.** By hiring additional workers as needed or by laying off workers not currently required to meet demand, firms can maintain a balance between capacity and demand.
2. **Overtime.** By asking or requiring workers to work extra hours a day or an extra day per week, firms can create a temporary increase in capacity without the added expense of hiring additional workers.
3. **Part-time or casual labor.** By utilizing temporary workers or casual labor (workers who are considered permanent but only work when needed, on an on-call basis, and typically without the benefits given to full-time workers).

4. **Inventory.** Finished-goods inventory can be built up in periods of slack demand and then used to fill demand during periods of high demand. In this way no new workers have to be hired, no temporary or casual labor is needed, and no overtime is incurred.
5. **Subcontracting.** Frequently firms choose to allow another manufacturer or service provider to provide the product or service to the subcontracting firm's customers. By subcontracting work to an alternative source, additional capacity is temporarily obtained.
6. **Cross-training.** Cross-trained employees may be able to perform tasks in several operations, creating some flexibility when scheduling capacity.
7. **Other methods.** While varying workforce size and utilization, inventory buildup/backlogging, and subcontracting are well-known alternatives, there are other, more novel ways that find use in industry. Among these options are sharing employees with counter-cyclical companies and attempting to find interesting and meaningful projects for employees to do during slack times.

HYBRID STRATEGY

Most firms find it advantageous to utilize a combination of the level and chase strategy. A combination strategy (sometimes called a hybrid or mixed strategy) can be found to better meet organizational goals and policies and achieve lower costs than either of the pure strategies used independently. A strategy between Level and Chase follows an intermediate path and the salient points are:

- Build-up inventory ahead of rising demand and use back-orders to level extreme peaks. Minimize finished goods inventories by trying to keep pace with demand fluctuations.
- Matched demand varying either work force level or output rate.
- Layoff or furlough workers during lulls
- Subcontract production or hire temporary workers to cover short-term peaks

- Reassign workers to preventive maintenance during lulls

1.3 Factors for Aggregate Planning

Aggregate planning is considered to be intermediate-term (as opposed to long- or short-term) in nature. Hence, most aggregate plans cover a period of three to 18 months. Aggregate plans serve as a foundation for future short-range type planning, such as production scheduling, sequencing, and loading. The master production schedule (MPS) used in material requirements planning (MRP) has been described as the aggregate plan "disaggregated."

Steps taken to produce an aggregate plan begin with the determination of demand and the determination of current capacity. Capacity is expressed as total number of units per time period that can be produced (this requires that an average number of units be computed since the total may include a product mix utilizing distinctly different production times). Demand is expressed as total number of units needed. If the two are not in balance (equal), the firm must decide whether to increase or decrease capacity to meet demand or increase or decrease demand to meet capacity. In order to accomplish this, a number of options are available.

Options for situations in which demand needs to be increased in order to match capacity include:

1. **Pricing.** Varying pricing to increase demand in periods when demand is less than peak. For example, matinee prices for movie theaters, off-season rates for hotels, weekend rates for telephone service, and pricing for items that experience seasonal demand.
2. **Promotion.** Advertising, direct marketing, and other forms of promotion are used to shift demand.
3. **Back ordering.** By postponing delivery on current orders demand is shifted to period when capacity is not fully utilized. This is really just a form of smoothing demand. Service industries are able to smooth demand by taking reservations or

by making appointments in an attempt to avoid walk-in customers. Some refer to this as "partitioning" demand.

4. **New demand creation.** A new, but complementary demand is created for a product or service. When restaurant customers have to wait, they are frequently diverted into a complementary (but not complimentary) service, the bar. Other examples include the addition of video arcades within movie theaters, and the expansion of services at convenience stores.

Options which can be used to increase or decrease capacity to match current demand include:

8. **Hire/lay off.** By hiring additional workers as needed or by laying off workers not currently required to meet demand, firms can maintain a balance between capacity and demand.
9. **Overtime.** By asking or requiring workers to work extra hours a day or an extra day per week, firms can create a temporary increase in capacity without the added expense of hiring additional workers.
10. **Part-time or casual labor.** By utilizing temporary workers or casual labor (workers who are considered permanent but only work when needed, on an on-call basis, and typically without the benefits given to full-time workers).
11. **Inventory.** Finished-goods inventory can be built up in periods of slack demand and then used to fill demand during periods of high demand. In this way no new workers have to be hired, no temporary or casual labor is needed, and no overtime is incurred.
12. **Subcontracting.** Frequently firms choose to allow another manufacturer or service provider to provide the product or service to the subcontracting firm's customers. By subcontracting work to an alternative source, additional capacity is temporarily obtained.
13. **Cross-training.** Cross-trained employees may be able to perform tasks in several operations, creating some flexibility when scheduling capacity.
14. **Other methods.** While varying workforce size and utilization, inventory buildup/backlogging, and subcontracting are well-known alternatives, there are

other, more novel ways that find use in industry. Among these options are sharing employees with counter-cyclical companies and attempting to find interesting and meaningful projects for employees to do during slack times.

1.4 Factors Affecting Aggregate Planning

Aggregate planning is an operational activity critical to the organization as it looks to balance long-term strategic planning with short term production success. Following factors are critical before an aggregate planning process can actually start;

- A complete information is required about available production facility and raw materials.
- A solid demand forecast covering the medium-range period.
- Financial planning surrounding the production cost which includes raw material, labor, inventory planning, etc.
- Organization policy around labor management, quality management, etc.

For aggregate planning to be a success, following inputs are required;

- An aggregate demand forecast for the relevant period.
- Evaluation of all the available means to manage capacity planning like sub-contracting, outsourcing, etc.
- Existing operational status of workforce (number, skill set, etc.), inventory level and production efficiency.

Aggregate planning will ensure that organization can plan for workforce level, inventory level and production rate in line with its strategic goal and objective.

1.5 Techniques for Aggregate Planning

Techniques for aggregate planning range from informal trial-and-error approaches, which usually utilize simple tables or graphs, to more formalized and advanced mathematical techniques. William Stevenson's textbook *Production/Operations Management* contains an informal but useful trial-and-error process for aggregate planning presented in outline form. This general procedure consists of the following steps:

1. Determine demand for each period.
2. Determine capacity for each period. This capacity should match demand, which means it may require the inclusion of overtime or subcontracting.
3. Identify company, departmental, or union policies that are pertinent. For example, maintaining a certain safety stock level, maintaining a reasonably stable workforce, backorder policies, overtime policies, inventory level policies, and other less explicit rules such as the nature of employment with the individual industry, the possibility of a bad image, and the loss of goodwill.
4. Determine unit costs for units produced. These costs typically include the basic production costs (fixed and variable costs as well as direct and indirect labor costs). Also included are the costs associated with making changes in capacity. Inventory holding costs must also be considered, as should storage, insurance, taxes, spoilage, and obsolescence costs. Finally, backorder costs must be computed. While difficult to measure, this generally includes expediting costs, loss of customer goodwill, and revenue loss from cancelled orders.
5. Develop alternative plans and compute the cost for each.
6. If satisfactory plans emerge, select the one that best satisfies objectives. Frequently, this is the plan with the least cost. Otherwise, return to step 5.

An example of a completed informal aggregate plan can be seen in Figure 1. This plan is an example of a plan determined utilizing a level strategy. Notice that employment levels and output levels remain constant while inventory is allowed to build up in earlier periods only to be drawn back down in later periods as demand increases. Also, note that backorders are utilized in order to avoid

overtime or subcontracting. The computed costs for the individual variables of the plan are as follows:

Output costs:

Regular time = `250 per unit

Overtime = `400 per unit

Subcontracted = `600 per unit

Other costs:

Inventory carrying cost = `150 per unit per period applied to average inventory

Backorders = `500 per unit per period

Cost of aggregate plan utilizing a level strategy:

Output costs:

Regular time = `250× 1,500 = `375,000

Overtime = `400 × 0 = 0

Subcontracted = `600 × 0 = 0

Other costs:

Inventory carrying cost = `150 × 800 = `120,000

Backorders = `500 × 100 = `50,000

Total cost (Cost of aggregate plan utilizing a level strategy) = `545,000

Period		1	2	3	4	5	6
Forecast		100	150	300	300	500	150
Output							
	Regular	250	250	250	250	250	250
	Overtime						
	Sub-contract						

Output forecast		150	100	-50	-50	-250	100
Inventory							
	Beginning	0	150	250	200	150	0
	Ending	150	250	200	150	0	100
	Average	75	200	225	175	75	50
Backlog	0	0	0	0	0	100	0

1.6 Mathematical Approaches to Aggregate Planning

The following are some of the better known mathematical techniques that can be used in more complex aggregate planning applications.

LINEAR PROGRAMMING

Linear programming is an optimization technique that allows the user to find a maximum profit or revenue or a minimum cost based on the availability of limited resources and certain limitations known as constraints. A special type of linear programming known as the Transportation Model can be used to obtain aggregate plans that would allow balanced capacity and demand and the minimization of costs. However, few real-world aggregate planning decisions are compatible with the linear assumptions of linear programming. *Supply Chain Management: Strategy, Planning and Operation,* by Sunil Chopra and Peter Meindl, provides an excellent example of the use of linear programming in aggregate planning.

MIXED-INTEGER PROGRAMMING

For aggregate plans that are prepared on a product family basis, where the plan is essentially the summation of the plans for individual product lines, mixed-integer programming may prove to be useful. Mixed-integer programming can

provide a method for determining the number of units to be produced in each product family.

LINEAR DECISION RULE

Linear decision rule is another optimizing technique. It seeks to minimize total production costs (labor, overtime, hiring/lay off, inventory carrying cost) using a set of cost-approximating functions (three of which are quadratic) to obtain a single quadratic equation. Then, by using calculus, two linear equations can be derived from the quadratic equation, one to be used to plan the output for each period and the other for planning the workforce for each period.

MANAGEMENT COEFFICIENTS MODEL

The management coefficients model, formulated by E.H. Bowman, is based on the suggestion that the production rate for any period would be set by this general decisionrule:

$P_t = aW_{t-1} - bI_{t-1} + cF_{t+1} + K$, where

P_t = the production rate set for period t

W_{t-1} = the workforce in the previous period

I_{t-1} = the ending inventory for the previous period

F_{t+1} = the forecast of demand for the next period

a, b, c, and K are constants

It then uses regression analysis to estimate the values of *a, b, c,* and *K.* The end result is a decision rule based on past managerial behavior without any explicit cost functions, the assumption being that managers know what is important, even if they cannot readily state explicit costs. Essentially, this method supplements the application of experienced judgment.

SEARCH DECISION RULE

The search decision rule methodology overcomes some of the limitations of the linear cost assumptions of linear programming. The search decision rule allows

the user to state cost data inputs in very general terms. It requires that a computer program be constructed that will unambiguously evaluate any production plan's cost. It then searches among alternative plans for the one with the minimum cost. However, unlike linear programming, there is no assurance of optimality.

SIMULATION

A number of simulation models can be used for aggregate planning. By developing an aggregate plan within the environment of a simulation model, it can be tested under a variety of conditions to find acceptable plans for consideration. These models can also be incorporated into a decision support system, which can aid in planning and evaluating alternative control policies. These models can integrate the multiple conflicting objectives inherent in manufacturing strategy by using different quantitative measures of productivity, customer service, and flexibility.

FUNCTIONAL OBJECTIVE SEARCH APPROACH

The functional objective search (FOS) system is a computerized aggregate planning system that incorporates a broad range of actual planning conditions. It is capable of realistic, low-cost operating schedules that provide options for attaining different planning goals. The system works by comparing the planning load with available capacity. After management has chosen its desired actions and associated planning objectives for specific load conditions, the system weights each planning goal to reflect the functional emphasis behind its achievement at a certain load condition. The computer then uses a computer search to output a plan that minimizes costs and meets delivery deadlines.

1.7 Difference between Aggregate Planning in Manufacturing & Aggregate Planning in Services

Aggregate planning involves developing, analyzing and maintaining the operational schedule of an organization. It organizes areas of business that include targeted sales forecasts, production levels, inventory levels and customer backlogs. When aggregate planning is carried out effectively, the effects of short-sighted, daily scheduling are minimized. Capacity and demand are balanced in a way that minimizes costs where aggregate resources may include the total number of workers, hours of equipment and machine time, or tons of raw materials.

Techniques

The techniques for aggregate planning include informal trial-and-error that utilize simply graphs or tables as well as advanced mathematical techniques. Aggregate planning requires the demand for each period to be determined, followed by determining the capacity for each period, which should match demand. Company, departmental or union policies that are pertinent are then identified. Unit costs for the total number of units produced and the costs associated with making changes in capacity are also taken into account. Alternative plans and computational costs for each are developed as a result. The plan that best satisfies the business objectives is chose. This is normally the plan with the lowest cost.

Manufacturing

Aggregate planning in manufacturing involves allocating the correct amount of resources for every manufacturing process so that the time and costs are minimized during idle mode. Manufacturing businesses use either the Chase Strategy or the Level Strategy. The Chase Strategy involves matching demand and capacity period by period. This strategy could trigger a considerable amount of hiring or firing workers, increased inventory carrying costs, labor union problems and utilization of plant and equipment. The advantage of the Chase strategy is that inventory is held at the lowest level possible, meaning large savings for the company. With a Level Strategy, a steady production rate and a

steady employment rate is maintained. The business can then raise or lower inventory levels in anticipation of forecasted demand levels.

Services

Since services do not involve stockpiles or inventory, service-focused businesses do not have the luxury of building up their inventories during periods of low demand. In aggregate planning, services are considered “perishable,” where any capacity that is unused is considered to be wasted. For example, an empty hotel room or an empty flight seat cannot be held and sold at a later time. Services have variable processing requirements that make it hard to establish a good measure of capacity.

Differentiation

Aggregate planning in manufacturing works well because of the ability to produce, hold and sell inventory at any given time. Alternatively, aggregate planning in services differs substantially because services cannot be inventoried. The demand for services is much more difficult to predict and capacity is also difficult to measure. Service capacity must be provided at the right place and the right time, while labor is generally the most constraining service resource.

1.8 The Advantages of Aggregate Planning

Aggregate planning is a forecasting technique that businesses use in an attempt to predict the supply and demand of their products and services. Mainly, this is done in an effort to save money, streamline operations and increase productivity. To accomplish this, businesses use an aggregate planning model to develop a game plan that will assist them with determining their staffing requirements, materials needed, estimated timelines and budget costs so they can better plan ahead.

Minimize Staffing Fluctuations

By using aggregate planning to forecast production demand, businesses are better able to predict their staffing requirements. Businesses that need additional employees on a temporary basis tend to fill these positions with workers from temporary employment agencies. Through proper forecasting, a business will be able to reduce or eliminate the need to hire these extra workers. This will save the business both time and money as it won't need to pay the additional fees to the staffing agency and it won't have to pay its own workers to train the new additions.

Reduce Overhead

Excess inventory costs businesses a lot of money. Additional materials will need to be stored, and having finished products laying around increases the likelihood of damage to the products before they reach the customer. Adhering to an aggregate planning model can help businesses operate in a leaner manner. Managers will be able to better anticipate how much product they will need and when they will need it so they won't have to stockpile it in advance due to a fear that they'll run out before they can get more.

Increase Production Rates

A significant advantage to using aggregate planning is that it maximizes the utilization of production equipment. Since production equipment is being used at its full capacity, production rates significantly increase. This creates a much more streamlined process where businesses can accurately determine the time it will take to fulfill orders and can then plan their production operations accordingly. The idea is to create a good balance so orders are fulfilled before the deadlines, but they're not completed so far in advance that they are placed in storage for long periods before delivery.

Accommodate Changes

Since production orders often vary, most businesses cannot stick to one plan at all times. Aggregate planning allows for contingency measures to be put in place

so businesses can better accommodate significant changes in customer orders and production. At different times, businesses can rotate between active, passive and mixed strategies. They can also fluctuate between using the chase strategy where production levels equal forecast demands, and the level production strategy where stable output rates remain constant.

1.9 Let's sum-up

Aggregate planning involves planning the best quantity to produce during time periods in the intermediate-range horizon (often 3 months to 18 months) and planning the lowest cost method of providing the adjustable capacity to accommodate the production requirements. For manufacturing operations, aggregate planning involves planning workforce size, production rate (work hours per week) and inventory levels.

The objectives of Aggregate Planning is

A· to develop plans that are:

1. Feasible: The plans should provide for the portion of demand that the firm intends to meet and should be within the financial and physical capacity of the firm.

2. Optimal: The firm should aim for plans which will ensure that resources are used as wisely as possible and costs kept as low as possible.

B· to increase the range of alternatives of capacity use, that can be considered by the management of the firm.

Operations Planning and Scheduling Systems

Operations planning and scheduling systems are concerned with the volume and timing of outputs, the utilization of operations capacity and balancing outputs with capacity at the desired levels of competitive effectiveness.

In doing the Aggregate Capacity Planning, we should take the following steps:

1. Prepare the sales forecast for each product that indicates the quantities to be sold in each time period (usually weeks, months or quarters) over the planning horizon (3 to18 months).
2. Sum up the individual product or service forecast into one aggregate demand for the factory.
3. Transform the aggregate demand for each time period into labor, materials, machines and other elements of production capacity required to satisfy aggregate demand.
4. Develop alternative resource schemes for supplying the necessary production capacity to support the cumulative aggregate demand.
5. Select the capacity plan from among the alternative considered that satisfy aggregate demand and best meets the objectives of the organizations.

1.10 Key Terms

Supply Chain Model: Supply chain model is strategic and systematic coordination model for supplying products to the end user or customer. In other words, SCM is a model that provides oversight of materials, finances, and information as they move from the supplier to the final user. It involves coordinating and integrating the aforementioned flows within and among companies. Generally, the ultimate goal of an effective supply chain model is to reduce inventory in our business (with the assumption that our products are available to our potential customers when needed).

Supply chain model is not only used to ensure business success or customer satisfaction, but can also be applied in other industries or societal settings, including

disaster relief operations, medical missions, cultural evolutions, and to improve quality of life among other applications.

Sales Forecast: Projection of achievable sales revenue, based on historical sales data, analysis of market surveys and trends, and salesperson's estimates. Also called sales budget, it forms the basis of a business plan because of the level of sales revenue affects practically every aspect of a business.

Customer backlog: Customer *Backlog stands for the amount of sales orders that a company has received but has not completed yet, also referred to as order backlog or BL.* The perception of the impact backlog orders have on a company varies. Majority of companies measure their backlog rations in sales values. If the backlog sales value is high, this is considered very positive on the business, as it shows a high level of customer demand as well as future financial stability.

Make to order: Make to order, also referred to as build to order (BTO) or made to order (MTO), is a manufacturing process in which the production of an item begins only after a confirmed customer order is received. MTO (Make to Order) is a manufacturing process in which manufacturing starts only after a customer's order is received. Forms of MTO vary, for example, an assembly process starts when demand actually occurs or manufacturing starts with development planning.

Make to Stock: MTS (Make to Stock) literally means to manufacture products for stock based on demand forecasts, which can be regarded as push-type production. MTS has been required to prevent opportunity loss due to stockouts and minimize excess inventory using accurate forecasts. In the industrialized society of mass production and mass marketing, this forecast mass production urged standardization and efficient business management such as cost reduction.

Pull Push Manufacturing: "Push type" means Make to Stock in which the production is not based on actual demand. "Pull type" means Make to Order in which the production is based on actual demand. In supply chain management, it is important to carry out processes halfway between push type and pull type or by a combination of push type and pull type.

Theory of Constraints: The "TOC (Theory of Constraints)" developed by Eliyahu Goldratt is a method of increasing throughput by managing "constraints" (bottlenecks). It is a concept that serves as the theoretical base of supply chain management and a model that explains the relationship of variables in business as to how cash flow-based profitability is affected by decision-making in the supply chain concerning business processes in terms of time.

1.11 Self-assessment Questions

1. Planning tasks associated with job scheduling, machine loading, and dispatching typically falls under

a. Long-range plans

b. intermediate-range plans

c. Short-range plans

d. Mission-related planning

e. Strategic planning

2. Dependence on an external source of supply is found in which of the following aggregate planning strategies?

a. varying production rates through overtime or idle time

b. using part-time workers

c. back ordering during high demand periods

d. subcontracting

e. hiring and laying off

3. Which of the following aggregate planning strategies might direct your client to a competitor?

a. using part-time workers

b. subcontracting

c. changing inventory level

d. varying production rates through overtime or idle time

e. varying workforce size by hiring or layoffs

4. Which of the following statements about aggregate planning is true?

a. Advertising/promotion is a way of manipulating product or service supply.

b. Work station loading and job assignments are examples of aggregate production planning.

c. Overtime/idle time is a way of manipulating product or service demand.

d. Aggregate planning uses the adjustable part of capacity to meet production requirements.

e. All of the above are true.

5. Which of the following statements about aggregate planning is true?

a. In aggregate planning, backorders are a means of manipulating demand while part-time workers are a way of manipulating product or service supply.

b. A pure chase strategy allows lower inventories when compared to pure level and hybrid strategies.

c. In spite of the research into mathematical models, aggregate production planners continue to use trial and error methods when developing their plans.

d. All of the above are true.

e. None of the above are true.

6. In level scheduling, what is kept uniform from month to month?

a. product mix

b. inventory levels

c. demand levels

d. production/workforce levels

e. sub-contracting levels

7. Which of the following is consistent with a pure chase strategy?

a. vary production levels to meet demand requirements

b. vary work force to meet demand requirements

c. vary production levels and work force to meet demand requirements

d. little or no use of inventory to meet demand requirements

e. all of the above.

1.12 Further Readings

Chopra, Sunil and Peter Meindl. *Supply Chain Management: Strategy, Planning, and Operation.* Upper Saddle River, NJ: Pearson Prentice Hall, 2004.

Iyer, Ananth V., Vinayak Deshpande, and Zhengping Wu. "A Postponement Model for Demand Management." *Management Science* 49, no. 8, (2003): 983–1002.

Stevenson, William J. *Production Operations Management.* Boston: McGraw-Hill Irwin, 2004.

1.13 Model Questions

1. What are the factors of Aggregate Planning? Discuss.

2. Elaborate Chase Strategy with example.

3. Justify adoption of level strategy with an example for a Bakery industry.

Unit- 2

MRP 1 & MRP 2

Learning Objectives

After completion of the unit, you should be able to:

- Know what is MRP 1 & MRP 2
- Understand the scope of MRP in manufacturing
- Weigh the advantages of MRP for SCM department
- Understand the disadvantages of MRP
- Understand the pros and cons of MRP II

Structure

2.1 Introduction

2.2 What is Material Requirement Planning (MRP)?

2.3 The Scope of MRP in Manufacturing

2.4 Advantages of MRP for SCM Department

2.5 Disadvantages of MRP

2.6 MRP vs. MRP II

2.7 Manufacturing Resource Planning (MRP II)

2.8 Pros and Cons of MRP II system

2.9 Let's sum-up

2.10 Key Terms

2.11 Self-assessment Questions

2.12 Further Readings

2.13 Model Questions

2.1 INTRODUCTION

Material Requirements Planning is a time phased priority-planning technique that calculates material requirements and schedules supply to meet demand across all products and parts in one or more plants.

Information Technology plays a major role in designing and implementing Material

Requirements Planning systems and processes as it provides information about manufacturing needs (linked with customer demand) as well as information about inventory levels. MRP techniques focus on optimizing inventory. MRP techniques

are used to explode bills of material, to calculate net material requirements and plan future production.

MRPII stands for Manufacturing Resource Planning and represents an extension of MRP.

MRPII points to computer based planning and scheduling designed to improve management's control of manufacturing and its support functions. MRPII maps an extension of MRP to capture all manufacturing requirements including materials, human resources, scheduling, etc.

An MRP system is intended to simultaneously meet three objectives:

- Ensure materials and products are available for production and delivery to customers.
- Maintain the lowest possible level of inventory.
- Plan manufacturing activities, delivery schedules and purchasing activities

2.2 What is Material Requirements Planning (MRP)?

The globalization of the economy and the liberalization of the trade markets have formulated new conditions in the market place which are characterized by instability and intensive competition in the business environment. Competition is continuously increasing with respect to price, quality and selection, service and promptness of delivery. Removal of barriers, international cooperation, technological innovations cause competition to intensify. In terms of manufacturing emphasis is placed on reducing cost while improving quality. In addition, other factors such as timely delivery of the product become critical (this is captured by emphasis in Just in Time or JIT in short) techniques.

A key question to a MRP process is the number of times a company replenishes (or turns around) inventory within a year. There are accounts of inventory annual turnover ratios of greater than 100, mainly reported by Japanese companies. One can readily realize that a high inventory ratio is likely to be conducive to lowering production cost since less capital is tied up to unused inventory.

MRP systems use four pieces of information to determine what material should be ordered and when:

- the master production schedule, which describes when each product is scheduled to be manufactured;
- bill of materials, which lists exactly the parts or materials required to make each product;
- production cycle times and material needs at each stage of the production cycle time; and,
- Supplier lead times.

The master schedule and bill of materials indicate what materials should be ordered; the master schedule, production cycle times and supplier lead times then jointly determine whenorders should be placed.

The Master Production Schedule includes quantities of products to be produced at a given time period. Quantities are included both at aggregate and detailed levels. Aggregate may refer to monthly production and detailed may refer to weekly or daily production. The master production schedule takes the form of a table in which rows represent products and columns represent time components. Entries of the table map to units of each product to be produced at a given time period.

Bill of Materials gives information about the product structure, i.e., parts and raw material units necessary to manufacture one unit of the product of interest.

MRP was pioneered in the 1970's with the work of Orlicky. Later evolved or became part of integrated to Manufacturing Resource Planning systems (or MRPII). MRPII is a computer based planning and scheduling system designed to improve management's control of manufacturing and its support functions.

In today's corporate environment MRPII is often termed as ERP (or Enterprise Resource Planning).
MRPII represents a group of software programs designed to tie together disparate company functions to create more efficient operations in areas such as assembly or delivery of products or services.

Thus MRP has evolved to become a component of a MRPII system. Technically, MRPII extends MRP and links it with the company's information resources such as human resource information system, financial management, accounting, sales, etc.

Such extension is typical according to modern trends in business management and modeling and made possible by advances in information technology. On the other hand, the need to integrate is well established in management thinking and practice. Since the pioneering work of Anthony during the sixties, management decision-making processes are viewed from extending from strategic planning, to management control and to operational control. MRP systems lay in-between management control and operational control processes. However, as detailed production data are linked with overall organizational information resources it becomes clear that MRP and MRPII system implementations play a significant role in company's corporate advantage.

2.3 The scope of MRP in manufacturing:

Manufacturing organizations, whatever their products, face the same daily practicalproblem - that customers want products to be available in a shorter time than it takesto make them. This means that some level of planning is required.
Companies need to control the types and quantities of materials they purchase, planwhich products are to be produced and in what quantities and ensure that they are ableto meet current and future customer demand, all at the lowest

possible cost. Making abad decision in any of these areas will make the company lose money. A few examples are given below:

- If a company purchases insufficient quantities of an item used inmanufacturing, or the wrong item, they may be unable to meet contracts tosupply products by the agreed date.
- If a company purchases excessive quantities of an item, money is beingwasted - the excess quantity ties up cash while it remains as stock and maynever even be used at all. This is a particularly severe problem for foodmanufacturers and companies with very short product life cycles. However,some purchased items will have a minimum quantity that must be met,therefore, purchasing excess is necessary.
- Beginning production of an order at the wrong time can cause customerdeadlines to be missed.

MRP is a tool to deal with these problems. It provides answers for several questions:

- ***What* items are required?**
- ***How many* are required?**
- ***When* are they required?**

MRP can be applied both to items that are purchased from outside suppliers and tosub-assemblies, produced internally, that are components of more complex items.

The data that must be considered include:

The *end item* (or items) being created. This is sometimes called Independent Demand, or Level "0" on BOM (Bill of materials).
How much is required at a time.

When the quantities are required to meet demand.

Shelf life of stored materials.

Inventory status records. Records of *net* materials *available* for use already instock (on hand) and materials on order from suppliers.

Bills of materials. Details of the materials, components and subassembliesrequired to make each product.

Planning Data. This includes all the restraints and directions to produce theend items. This includes such items as: Routings, Labor and MachineStandards, Quality and Testing Standards, Pull/Work Cell and Pushcommands, Lot sizing techniques (i.e. ***Fixed Lot Size***, ***Lot-For-Lot***, ***and EconomicOrder Quantity***), Scrap Percentages, and other inputs.

Outputs:

There are two outputs and a variety of messages/reports:

- Output 1 is the "Recommended Production Schedule" which lays out adetailed schedule of the required minimum start and completion dates, withquantities, for each step of the Routing and Bill of Material required to satisfythe demand from the MPS.
- Output 2 is the "Recommended Purchasing Schedule". This lays out both thedates that the purchased items should be received into the facility AND thedates that thePurchase orders, or Blanket Order Release should occur tomatch the production schedules.

Messages and Reports:

- Purchase orders. An order to a supplier to provide materials.
- Reschedule notices. These *recommend* cancelling, increasing, delaying orspeeding up existing orders.

Note that the *outputs* are *recommended*. Due to a variety of changing conditions incompanies, since the last MRP / ERP system Re-Generation, the recommendedoutputs need to be reviewed by *trained* people to group orders for

benefits in set-up orfreight savings. These actions are beyond the linear calculations of the MRP computersoftware.

Problems with MRP systems:

The major problem with MRP systems is the integrity of the data. If there are anyerrors in the inventory data, the bill of materials (commonly referred to as 'BOM')data, or the master production schedule, then the output data will also be incorrect.

Most vendors of this type of system recommend at least 99% data integrity for thesystem to give useful results.

Another major problem with MRP systems is the requirement that the user specifyhow long it will take a factory to make a product from its component parts (assumingthey are all available). Additionally, the system design also assumes that this "leadtime" in manufacturing will be the same each time the item is made, without regard toquantity being made, or other items being made simultaneously in the factory.

A manufacturer may have factories in different cities or even countries. It is no goodfor an MRP system to say that we do not need to order some material because wehave plenty thousands of miles away. The overallERP system needs to be able toorganize inventory and needs by individual factory, and intercommunicate needs inorder to enable each factory to redistribute components in order to serve the overallenterprise.

This means that other systems in the enterprise need to work properly both beforeimplementing an MRP system, and into the future. For example systems like varietyreduction and engineering which makes sure that product comes out right first time(without defects) must be in place.

Production may be in progress for some part, whose design gets changed, withcustomer orders in the system for both the old design, and the new one, concurrently.

The overallERP system needs to have a system of coding parts such that the MRPwill correctly calculate needs and tracking for both versions. Parts must be

bookedinto and out of stores more regularly than the MRP calculations take place. Note,these other systems can well be manual systems, but must interface to the MRP. Forexample, a 'walk around' stock-take done just prior to the MRP calculations can be apractical solution for a small inventory (especially if it is an "open store").

The other major drawback of MRP is that takes no account of capacity in its calculations. This means it will give results that are impossible to implement due tomanpower or machine or suppler capacity constraints which is taken care by MRP II.

2.4 Advantages of MRP for Supply Chain Management Department:

- Helps to minimize inventory levels
- Increases inventory turn
- Tracks material requirements
- Identifies shortages in inventory items
- Helps to track raw material, WIP, finished goods and partner inventories
- Helps plan the procurement schedule
- Determine the most economical lot sizes for orders
- Computes quantities needed as safety stock
- Calculates BOM and subassemblies required
- Helps plan for future facilities expansions
- On time delivery
- Customer service and responsiveness
- Minimizes inventory purchase, ordering, carrying & stock-out costs
- Reduces the amount of funds tied up in over-stock situation such as capital investment, interest, warehousing cost, insurance, taxes, risk cost, opportunity cost, labor cost etc.
- Improves cash conversion cycle
- Improves operating efficiency
- Improves profitability

- Increases the operating capital
- AR is more liquid than inventory itself
- Reduces employee theft

2.5 Disadvantages of MRP:

MRP relies upon accurate input information i.e. if a business has not maintained good inventory records with all relevant changes; it may encounter serious problems with the outputs of its MRP system. The problems could range from:

- Missing parts
- Excessive order quantities
- Schedule delays
- Missed delivery dates
- Time consuming inventory counts
- Resistance from employees as it is more disciplined approach

At a minimum, an MRP system must have standardized inventory practice across the organization, good estimates of lead-time, safety stock, and other current inventory records in order to function effectively and produce useful information.

2.6MRP Vs. MRPII

MRP stands for material requirements planning and deals with bringing in the right amount of raw material at the right time to support production. MRPII stands for manufacturing resource planning and builds on MRP by adding shop floor production planning and tracking tools. A third-generation system available at time of

publication is called ERP, or enterprise resource planning, which integrates all departments of the business, not just manufacturing and purchasing.

MRP

Material Requirements Planning, or MRP, was developed in the 1970s to help manufacturing companies better manage their procurement of material to support manufacturing operations. MRP systems translate the master production schedule into component- and raw material-level demand by splitting the top level assembly into the individual parts and quantities called for on the bill of materials, which reports to that assembly, and directs the purchasing group when to buy them based on the component lead time which is loaded in the MRP system.

MRPII

Manufacturing Resource Planning, or MRPII, goes several steps beyond MRP. While MRP stopped at the receiving dock, MRPII incorporates the value stream all the way through the manufacturing facility to the shipping dock where the product is packaged and sent to the end customer. That value stream includes production planning, machine capacity scheduling, demand forecasting and analysis modules, and quality tracking tools. MRPII also has tools for tracking employee attendance, labor contribution and productivity.

ERP

A discussion of MRP and MRPII would be incomplete without mentioning Enterprise Resource Planning. ERP is the next evolution of the MRP system. While MRP helped companies plan material purchases, and MRPII added in-plant scheduling and production controls, ERP attempts to integrate the information flow from all departments within a company: finance, marketing, production, shipping, even human resources. While some argue that ERP does not deliver on its promise, according to an article on CIO.com, a properly set up ERP system allows better communication and monitoring than ever before, giving all departments access to the exact status of a customer order at any point in time.

Warnings

MRP, MRPII, and ERP are iterations of the same type of system: A software program that aims to help businesses better manage their costs, control inventory, meet customer delivery expectations, and track and improve their internal processes. However, according to an article by the Business Performance Improvement Consultancy, most implementations of any of the three systems fail to achieve the desired results. This is based primarily on a lack of proper training and understanding on the part of the business managers and the IT managers. A business manager with insufficient IT understanding may set the system up incorrectly, while an IT manager who does not understand the business needs may simply automate the current process flow without improving it. If you are contemplating implementing any of these systems, it is critical to make sure that business management and IT management are on the same page and that proper training has been invested in.

2.7 Manufacturing Resource Planning (MRP II)

Manufacturing Resource Planning (**MRP II**) is defined by APICS (American Production and Inventory Control Society, Estd. 1957) as a method for the effective planning of all resources of a manufacturing company. Ideally, it addresses operational planning in units, financial planning in dollars, and has a simulation capability to answer "what-if" questions and extension of closed-loop MRP.
This is not exclusively a software function, but a marriage of people skills, dedication to data base accuracy, and computer resources. It is a total company management concept for using human resources more productively.

MRP II is not

Many items on this list can be part of an MRP II, but are not solely what it is.

- A computer system
- Manufacturing control system
- Inventory reduction plan

- Sales & Purchase System
- Material Management

Purpose

MRP II integrates many areas of the manufacturing enterprise into a single entity forplanning and control purposes, from board level to operative and from five-year planto individual shop-floor operation. It builds on closed-loop Material RequirementsPlanning (MRP) by adopting the feedback principle but extending it to additionalareas of the enterprise, primarily manufacturing-related.

Key functions and Features

MRP II is not a proprietary software system and can thus take many forms. It isalmost impossible to visualize an MRP II system that does not use a computer, but anMRP II system can be based on either purchased / licensed or in-house software.

Almost every MRP II system is modular in construction. Characteristic basic modulesin an MRP II system are:

- Master Production Scheduling (MPS)
- Item Master Data (Technical Data)
- Bill of Materials (BOM) (Technical Data)
- Production Resources Data (Manufacturing Technical Data)
- Inventories & Orders (Inventory Control)
- Purchasing Management
- Material Requirements Planning (MRP)
- Shop Floor Control (SFC)
- Capacity planning or Capacity Requirements Planning (CRP)
- Standard Costing (Cost Control)
- Cost Reporting / Management (Cost Control)
- Distribution Resource Planning (DRP)

The MRP II system integrates these modules together so that they use common dataand freely exchange information, in a model of how a manufacturing enterpriseshould and can operate. The MRP II approach is therefore very different from the“point solution” approach, where individual systems are deployed to help a companyplan, control or manage a specific activity. MRP II is by definition fully integrated orat least fully interfaced.
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
- Timely and valid cost and profitability information

Industry Specifics

MRP II systems have been implemented in most manufacturing industries. Some industries need specialized functions e.g. lot traceability in regulated manufacturing such as pharmaceuticals, food, casting units. Other industries can

afford to disregard facilities required by others e.g. the tableware industry has few starting materials

– Mainly clay

– And does not need complex materials planning.

Capacity planning is the key to success in this as in many industries, and it is in those that MRP II is less appropriate.

This is not exclusively a software function, but a marriage of people skills, dedication to data base accuracy, and computer resources. It is a total company management concept for using human resources more productively.

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 runbased on sales forecasts. In order to calculate the raw materials needed to produceproducts and to schedule the purchase of those materials along with the machine andlabor time needed, production managers recognized that they would need to usecomputer and software technology to manage the information. Originally,manufacturing operations built custom software programs that ran on mainframes.

Like today's ERP systems, MRPII was designed to integrate a lot of information byway of a centralized database. However, the hardware, software, and relationaldatabase technology of the 1980s was not advanced enough to provide the speed andcapacity to run these systems in real-time, and the cost of these systems wasprohibitive for most businesses. Nonetheless, the vision had been established, andshifts in the underlying business processes along with rapid advances in technologyled to the more affordable enterprise and application integration systems that bigbusinesses and many medium and smaller businesses use today (Monk and Wagner).

MRPII systems begin with MRP, Material Requirements Planning. MRP allows forthe input of sales forecasts from sales and marketing. These forecasts determine theraw materials demand. MRP and MRPII systems draw on a Master ProductionSchedule, the breakdown of specific plans for each product on a line. While MRPallows for the coordination of raw materials purchasing, MRPII facilitates thedevelopment of a detailed production schedule that accounts for machine and laborcapacity, scheduling the production runs according to the arrival of materials. AnMRPII output is a final labor and machine schedule. Data about the cost ofproduction, including machine time, labor time and materials used, as well as finalproduction numbers, is provided from the MRPII system to accounting and finance(Monk and Wagner).

2.8 Pros and Cons of MRP II Systems

What is standing behind the MRP II systems? The question is about the manufacturing resource planning. The issue comprises special software for various segments of manufacturing companies, including material requirements planning, purchasing, capacity planning, inventory, shop floor scheduling, accounting and customer order entry. The MRP II systems are known to have both – advantages and disadvantages. As for the “pluses”, one may point to the automation and standardization of business processes leading to enhancement in cost control as well as revenue. When the question is about disadvantages, the issues are related to the misunderstanding of the limitations and impact of MRP II Systems.

Advantages

The MRP II is a useful tool, the main function of which is to standardize all the business processes through providing automated methods for various business segments. Standardization leads to the processes that are easily repeated as

well as a platform that gives an opportunity to improve all those processes. The point is that the organization that successfully implements MRP II for the first time faces with a range of troubles regarding controlling the process of controlling the increase in transactions in purchasing, manufacturing and selling associated with growth. Besides, the MRP II systems provide the employees with an opportunity to do more and, as a result, to have a clearer visibility of information for their businesses. All the advancements in the way all the work is performed enable the company to become more competitive.

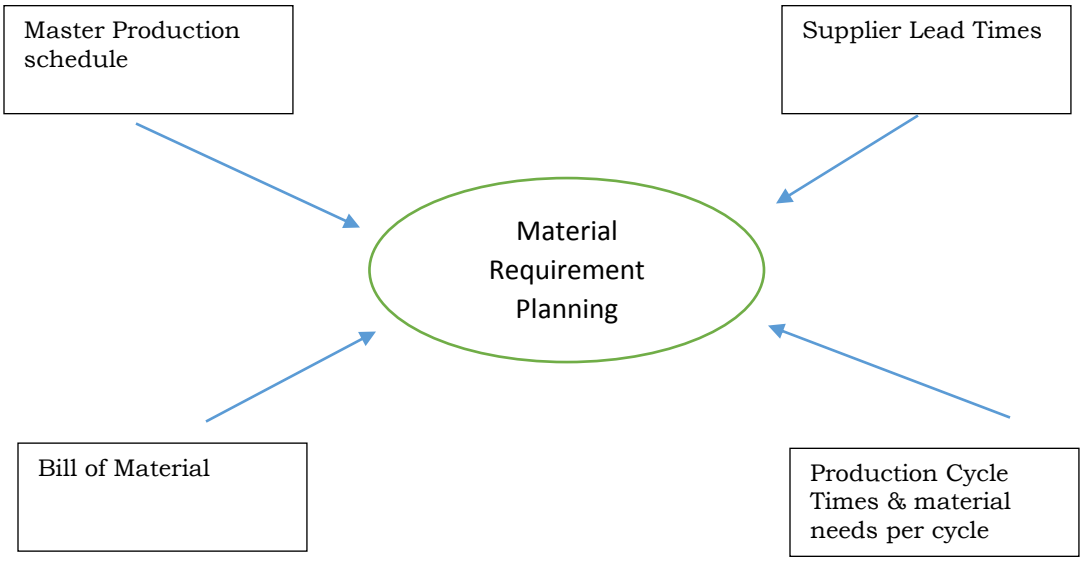
Disadvantages

When it comes to the disadvantages of the MRP II, one should mention the fact that the implementation of the MRP II systems requires information to be accurate. In case poor quantity info is applied either in the bill of material module or the inventory segment, this will result in automated planning processes errors. The planning modules use averages for length of particular time to manufacture (lead times) or purchase and for quantities that are usually purchased regarding the purchase order or manufactured on a work order (usually known as “lot sizes”.) In case there is variability regarding the actual lot sizes produced or bought and the lead times then the planning software won’t generate plans that go with what is actually happening. The whole point is that the lack of understanding and poor information on the lot sizes and lead times average impact can cause costly reimplementation and implementation failure.

When the question is about the implementation of the **MRP II systems**, one should take into consideration the sequence of implementation of the MRP II systems software modules and the organization tolerance for the business processes adopting changes. As a rule, the MRP II systems are implemented in various phases allowing for a period of proving the system will function before proceeding further. The components of the first phase can be the following: purchasing, inventory and accounting. Among the other phases one can mention customer order entry, material requirements planning and shop floor control. One must remember that every module requests information and data that may be

created within the system for the first time, what means it is highly important to take care of in what way information is defined and stored up to date.

Exhibit 1-1. MRP in context with production management processes



2.9 Let's sum-up

Powerful tools for solving wide spectrum of non-clear defined problems are artificial intelligence (AI) technique like fuzzy logic, genetic algorithm, neural networks (a typical computational model used in machine learning), simulatedannealing, tabulation search etc. hence they can be also appliedin the field of production optimization and scheduling.

Artificial Intelligence (AI) is formed from the processes;recognizing information researching the cause-reasonrelationship, recognizing and development of somecomprehension techniques, with a large number of experiments by using computer.

AI uses Computer and Intelligence to help to solution of problems and provides the operations to be moreproductive and work at optimum. AI applications producenew generation and alternative information. The mostcommonly applied AI techniques comprise four parts:Genetic Algorithms, Fuzzy Logic, Neural Network andExpert Systems.

Genetic Algorithm (GA) is used in the problems whosemathematical model cannot be produced and solutionarea is wide. It takes the evaluation process of themetabolisms in the nature. The basic of GA is beingrandomize and producing successful solutions.

In practice, resources are finite and if optimum benefits cannot be obtained from the application of traditionalapproaches, no significant enterprise improvement willresult by leaving the significant uncertainty within thesystem. Hence, the role of artificial techniques is crucial formore optimum application MRPII/ERP systems.

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Enterprises must use the MRP to manage the production process more efficient. If they realize theproduction process more efficient and productive with MRPcan decrease the costs. But the existing MRPII/ERP

AI techniques, enterprises can work more efficient,productive and realistic with the existing conditions.

As a conclusion, it is time to abandon MRP fixes and movetoward a new generation of production control methodsthat exploit both the simplicity and robustness of the AIideas and the sophistication and power offered by moderncomputer technology.

2.10 Key Terms

Material Requirements Planning (MRP) is a software based production planning and inventory control system used to manage manufacturing processes. Although it is not common nowadays, it is possible to conduct MRP by hand as well.

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.

Bill of Material (product structure): A bill of materials (BoM) is a list of the parts or components that are required to build a product. At its most complex, a BoM is a multi-level document that provides build data for multiple sub-assemblies, which are essentially products within products.

Standard costing is an accounting technique that some manufacturers use to identify the differences or variances between 1) the actual costs of the goods that were produced, and 2) the costs that should have occurred for those goods. The costs that *should have occurred* for the *actual good output* are known as standard costs.

Forecast/ Demand variations: Forecast variations determine the extent to which the Push system needs to be in place and the fluctuation on daily demand affects the pull system.

Capacity Constraints: The capacity constraints or bottle necks determine the success of pull systems. Generally, pull systems demand for a modular approach. Otherwise the manufacturing lead time will increase.

Shop Floor Control (SFC) is a software system of methods and tools that are used to track, schedule and report on the progress of work in a manufacturing plant. Shop Floor Control systems generally evaluate the portion of an order or operation that has been completed. That percentage of work in process is useful

for resource planning, inventory evaluations [1] and supervisor and operator productivity on a shop floor.

2.11 Self-assessment Questions

1. What is manufacturing resource planning (MRP II)?

2. Identify the differences between manufacturing resource planning (MRP II) and materials requirements planning (MRP).

2.12 Further Readings

1. CIM: Principles of Computer Integrated Manufacturing by Waldner Jean-Baptiste

2. Concepts in Enterprise Resource Planning, 2nd Edition by Monk, E. and Wagner, B.

3. Manufacturing Resource Planning (MRP II) with Introduction to ERP, SCM, and CRM (McGraw-Hill Professional Engineering) by Khalid Sheik

2.13 Model Questions

Q1. What are the main 7 elements of MRP?

Unit- 3

ERP in SUPPLY CHAIN MANAGEMENT

Learning Objectives

After completion of the unit, you should be able to:

- Know what is ERP and what are its components
- Understand the role of ERP in Supply Chain Management
- Understand the ERP system architecture
- Find who are the leading ERP vendors
- Understand the key elements to Supply Chain Management
- Go ahead with ERP implementation step by step
- Understand advantages and disadvantages

Structure

3.1 Introduction

3.2 ERP and Components

3.3 Role of ERP in Supply Chain Management

3.4 ERP systems architecture

3.5 Commercial ERP systems

3.6 Key elements to Supply Chain Management

3.7 Steps of ERP implementation

3.8 Main advantages and disadvantages of ERP system

3.9 Let’s sum-up

3.10 Key Terms

3.11 Self-assessment Questions

3.12 Further Readings

3.13 Model Questions

3.1 INTRODUCTION

Tougher competition in the marketplace is generating the need to better optimize resources, improve profitability and keep customers satisfied. Companies are increasingly implementing Enterprise Resource Planning (ERP) software solutions to improve operations and provide faster customer response.

Choosing an ERP solution that meets our *specific* business requirements will enable us to have a smoother implementation. If the software package is written for our industry, we won't have to custom design a solution. Customized solutions are time consuming to implement and add unnecessary cost. One of the top reasons ERP implementations fail is because the software doesn't meet basic industry specific business requirements. However; purchasing an ERP application is only half the battle. A well designed implementation plan is the key to success.

Enterprise resource planning systems or enterprise systems are software systems for business management, encompassing modules supporting functional areas such as planning, manufacturing, sales, marketing, distribution, accounting, financial, human resource management, project management, inventory management, service and maintenance, transportation and e-business. The architecture of the software facilitates transparent integration ofmodules, providing flow of information between all functions within the enterprisein a consistently visible manner. Corporate computing with ERPs allowscompaniesto implement a single integrated system by replacing or re- engineeringtheirmostly incompatible legacy information systems. American Production andInventoryControl Society (2001) has defined ERP systems as "a method for

theEffectiveplanning and controlling of all the resources needed to take, make, shipand account for customer orders in a manufacturing, distribution or servicecompany."

By another definition:

"ERP (enterprise resource planning systems) comprises ofa commercial software package that promises the seamless integration of all theinformation flowing through the company–financial, accounting, human resources,supply chain and customer information" (Davenport, 1998). "ERPsystemsare configurable information systems packages that integrate informationand information-based processes within and across functional areas in anorganization"(Kumar & Van Hillsgersberg, 2000). "One database, one applicationand a unified interface across the entire enterprise" (Tadjer, 1998). "ERPsystemsare computer-based systems designed to process an organization'sTransactionsand facilitate integrated and real-time planning, production, andcustomer response" (O'Leary, 2001).

3.2 ERP and Components

ERP is the acronym for the term "Enterprise Resource Planning" is one of the most widely implemented business software systems in a wide variety of industries and organizations. ERP is just not only software. ERP definition refers to both; ERP software and business strategies that implement ERP systems.

ERP is the evolution of Manufacturing Requirements Planning (MRP II) in 1980s, which was mainly related to Manufacturing Industry and was designed to control manufacturing process and planning the required production with efficient output. Whereas MRP is the evolution of Inventory Management and Control conceived in 1960s, which was mainly designed for management of Stocks in any particular industry. ERP has expanded from coordination of manufacturing processes to the integration of enterprise-wide backend processes like production planning

and scheduling of delivery. In terms of technology, ERP has evolved from legacy implementation to more flexible tiered client-server architecture.

What is Resource Planning?

Enterprise Resource Planning- refers to a computer application utilized to coordinate and manage every resources, functions and data from shared information stores of a business. The ERP includes hardware and services that could be link over a LAN. The design permits an administrator to reconfigure or add modules to the system while protecting the reliability of the database.

ERP is principally an integration of business management practices and modern technology. Information Technology (IT) integrates with the core business processes of a corporate house to streamline and accomplish specific business objectives.

Key Components

ERP is an amalgamation of the following three most important components:

- Business Management Practices
- Information Technology and
- Specific Business Objectives.

In simpler words, an ERP is a massive software architecture that supports the streaming and distribution of geographically scattered enterprise wide information across all the functional units of a business house. It provides the business management exe3cutives with a comprehensive overview of the complete business execution which in turn influences their decisions in a productive way.

At the core of ERP is a well-managed centralized data repository which acquires information from and supply information into the fragmented applications operating on a universal computing platform.

Information in large business organizations is accumulated on various servers across many functional units and sometimes separated by geographical boundaries. Such information islands can possibly service individual

organizational units but fail to enhance enterprise wide performance, speed and competence.

3.3 Role of ERP in Supply Chain Management

The integration of Supply chain management and ERP allows manufacturing and distribution businesses the ability to gain greater visibility into all operations while increasing speed, efficiency and overall customer satisfaction.

A growing number of businesses recognize the many potential **benefits of Enterprise Resource Planning (ERP)** when it comes to managing business information, integrating various systems and working processes, and ensuring optimal operational efficiency.

When it comes to Supply Chain Management (SCM), businesses need to interact with numerous suppliers and partners in order to obtain the raw materials and resources needed to bring finished goods to market. ERP plays a vital role in combating inefficiency; reducing waste and ensuring that workers are better able direct their efforts. The integration of both systems may pose some unique challenges. It is in the company's best interest to ensure that the Management and the staff fully understand the role of ERP within the SCM process.

The feature-rich working environment of ERP combined with the more streamlined and efficient workflow of an effective SCM can provide a range of important advantages, including:

- Improved efficiency across multiple departments and organizations working within the supply chain.
- Improved customer service for increased customer retention and greater chance of repeat business opportunities.
- Automation of workflow for reduced overhead and operational costs.

- IT issues and problems that are less likely to create bottlenecks to impede efficiency.
- More flexible supply chain solutions that may be readily adapted to meet the needs of changing circumstances or future business growth and expansion.

3.4 ERP SYSTEMS ARCHITECTURE

ERP vendors, mostly experienced from the MRP and financial software services fields, realized the limitations of the old legacy information systems used in large enterprises of the 1970s and 1980s. Some of these old systems were developed in-house while others were developed by different vendors using several different database management systems, languages and packages, creating islands of non-compatible solutions unfit for seamless data flow between them. It was difficult to increase the capacity of such systems or the users were unable to upgrade them with the organization's business changes, strategic goals and new information technologies.

An ERP system is required to have the following characteristics:

- Modular design comprising many distinct business modules such as financial, manufacturing, accounting, distribution, etc.
- Use centralized common database management system (DBMS)
- The modules are integrated and provide seamless data flow among the modules, increasing operational transparency through standard interfaces
- They are generally complex systems involving high cost
- They are flexible and offer best business practices
- They require time-consuming tailoring and configuration setups for integrating with the company's business functions
- The modules work in real time with online and batch processing capabilities

- They are or soon they will be Internet-enabled

Different ERP vendors provide ERP systems with some degree of specialty but the core modules are almost the same for all of them. Some of the core ERP modules found in the successful ERP systems are the following:

- Accounting management
- Financial management
- Manufacturing management
- Production management
- Transportation management
- Sales & distribution management
- Human resources management
- Supply chain management
- Customer relationship management
- E-Business

The modules of an ERP system can either work as stand-alone units orseveral modules can be combined together to form an integrated system. Thesystems are usually designed to operate under several operating platformssuch as UNIX, MS Windows NT, and Windows 2000, IBM AIX, and HP-UXsystems. SAP AG, the largest ERP vendor, provides a number of moduleswith its famous R/3 ERP system, which are shown in Table 3. New modulesare introduced by SAP and other vendors in response to the market andtechnological demand such as the Internet technology.

Table 3: Some of the modules of SAP's R/3

Function	Code	Function	Code
Financial Accounting	FI	Controlling	CO
Asset Management	AM	Project System	PS
Workflow	WF	Industry Solutions	IS

Human Resources	HR	Plant Maintenance	PM
Quality Management	QM	Production Planning	PP
Materials Management	MM	Sales & Distribution	SD
Investment Management	IM	Enterprise Controlling	EC
Treasury	TR		

Enterprise systems employ thin client/server (C/S) technology or client/fat server (C/FS) architecture, creating a decentralized computing environment.In a C/S system a number of client devices operated by end users suchasdesktop PCs request services from application servers, which in turn get therequestedservice-related information from the database servers. The requestsmaybe simple data files, data values, communication services, transactionprocessingor master file updates. The general practice is to have three-tierarchitecturesuch as in Figure 3. In this three-tier system the user interface runsonthe client. To run ERP systems relatively powerful PCs (clients) andpowerfulservers are required where most of the hundreds of thousands ofoperationsare performed. The client/server system functions are performedfollowingthree layers of logic:

- **Presentation Layer:** Graphical user interface (GUI) or browser for dataentry or accessing system functions
- **Application Layer:** Business rules, functions, logic, and programsacting on data received/transferred from/to the database servers
- **Database Layer:** Management of the organization's operational ortransactional data including metadata; mostly employs industry standardRDBMS with structured query language (SQL) provisions.

This logical arrangement helps the ERP user interface to run on theclients, the processing modules to run on the middle-tier application servers,and the database system to run on the database servers.

3.5 COMMERCIAL ERP SYSTEMS

The five dominating ERP software suppliers are:

- SAP,
- Oracle,
- PeopleSoft,
- Baan and
- J.D. Edwards.

Together they control more than 60% of the multibillion dollar global market.
Each vendor, due to historic reasons, has a specialty in one particular module area such as Baan in manufacturing, PeopleSoft in human resources management, SAP in logistics and Oracle in financials. There are also about 50 established and a few more newly emerging smaller and midsize ERP vendors including third-party developers competing for the ERP market. The result is stiff competition and feature-overlapping products difficult to differentiate. Due to keen competition for control of the lucrative ERP market share, the vendors are continuously updating their products and adding new technology-based features. Long-term vision, commitment to service and support, module features, specialty, experience and financial strength for R&D are considered the major vendor qualities for product selection and turnkey implementation. In the following sections we provide brief profiles of these five ERP giants.

3.6 Key Elements to Supply Chain Management

Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) have been gaining popularity within organizations over the last few years, across a number of vertical industries.

An ERP system focuses on the management of business information, offering a macro view into a company by integrating disparate systems across functional groups such as procurement, finance, distribution, and inventory control. A Supply Chain Management system ties in supply chain partners who help a company find the raw materials it needs to deliver products and services to its customers. The integration of both systems usually poses some challenge to CIOs, as there is no set formula as to which system should be implemented first.

In cases where the company has already deployed an ERP system to collect information across the board, the supply chain system that follows pulls data from ERP systems; thus making the deployment process easier. In other cases, multiple offices may have stand-alone SCM systems in place that are then integrated into ERP system. With this type of implementation, there may be the need to add in other dashboard components such as; inventory checks, financials and manufacturing.

Supply Chain Management involves the design, planning, execution, control and monitoring of supply activities with the objective of creating net value to build a competitive infrastructure that leverages worldwide logistics, while synchronizing supply with demand, and measuring performance globally. A Supply Chain Management system provides real-time visibility into operations, and integrates activities through improved supply chain relationships, to achieve a sustainable competitive advantage. Below are the four key elements to Supply Chain Management.

- **Supply Chain Planning:** The determination of a set of policies and procedures that govern the operation of supply chain. Planning includes the determination of marketing channels, promotions, respective quantities and timing, stock and replenishment policies and production policies. Planning establishes the parameters within which the supply chain will operate.
- **Chain Execution:** Execution-oriented software applications for effective procurement and supply of goods and services across a supply chain. It includes

manufacturing warehouse and transportation execution systems, and systems providing visibility across the supply chain.

- **Supply Chain Monitoring:** The ability to review supply chain activities in real-time, whether to identify the current status of individual activities or review overall performance.
- **Supply Chain Measurement:** Measurement is comparison of the actual activity against targets. This is often used with scorecards of benchmarks so that unusual or undesirable variances can be identified and investigated.

3.7 Steps of ERP Implementation

Tougher competition in the marketplace is generating the need to better optimize resources, improve profitability and keep customers satisfied. Companies are increasingly implementing Enterprise Resource Planning (ERP) software solutions to improve operations and provide faster customer response.

Choosing an ERP solution that meets your *specific* business requirements will enable you to have a smoother implementation. If the software package is written for your industry, you won't have to custom design a solution. Customized solutions are time consuming to implement and add unnecessary cost. One of the top reasons ERP implementations fail is because the software doesn't meet basic industry specific business requirements. However; purchasing an ERP application is only half the battle. A well designed implementation plan is the key to success.

1. **STRATEGIC PLANNING**

- Assign a project team.
- Examine current business processes and information flow.
- Set objectives.

- Develop a project plan.

Project team: Assign a project team with employees from sales, customer service,accounting, purchasing, operations and senior management. Each team member should becommitted to the success of the project and accountable for specific tasks, i.e. developing atimeline, finalizing objectives, formulating a training plan. Make sure you include first lineworkers as well as management on your team. Base the selection on the knowledge of theteam not status of the employee.

Examine current business processes: Have the team perform an analysis on which businessprocesses should be improved. Gather copies of key documents such as invoices, batchtickets and bill of lading for the analysis. To start the team discussion, consider questionssuch as: Are your procedures up to date? Are there processes that could be automated? Arepersonnel spending overtime processing orders? Does your sales force and customer servicepersonnel have real-time access to customer information? The team members should also conduct interviews with key personnel to uncover additional areas of improvement needed.

Set objectives: The objectives should be clearly defined prior to implementing the ERPsolution. ERP systems are massive and you won't be able to implement every function. Youneed to define the scope of implementation. Ideally, the scope should be all inclusive. Butpractically, it is very difficult to implement. Examples of objectives would include: Does thesolution reduce backlogs? Can the solution improve on-time deliveries? Will you be able toincrease production yields?

Develop a project plan:The team should develop a project plan which includes previously defined goals and objectives, timelines, training procedures, as well as individual teamresponsibilities. The end result of the project plan should be a "to do" list for each projectteam member.

2. PROCEDURE REVIEW

- Review software capabilities.
- Identify manual processes.
- Develop standard operating procedures.

Review software capabilities: Dedicate 3-5 days of intensive review of the softwarecapabilities for the project team. Train on every aspect of the ERP software to fully educatethe team on capabilities and identify gaps. Determine whether modifications are needed priorto employee training.

Identify manual processes: Evaluate which processes that are manual and should beautomated with the ERP system.

Develop standard operating procedures (SOPs):for every aspect of your business. Theseprocedures should be documented. Make sure that you modify the document as your SOPschange. This is a huge task, but it is critical to the success of your implementation.

Examples of SOPs:

- How do you handle global price changes?
- What are the processes for inputting new customer records?
- How do you currently handle the paperwork on drop shipments?
- How do we add a new product or formula?

3. DATA COLLECTION & CLEAN-UP

- Convert data.

- Collect new data.
- Review all data input.
- Clean-up data.

Convert data:You can't assume 100% of the data can be converted as there may be outdatedinformation in the system. Determine which information should be converted through ananalysis of current data.

Collect new data:Define the new data that needs to be collected. Identify the sourcedocuments of the data. Create spreadsheets to collect and segment the data into logical tables(Most ERP systems will have a utility to upload data from a spreadsheet to their database).

Review all data input:After the converted and manually collected data is entered into theERP database, then it must be reviewed for accuracy and completeness. Data drives thebusiness, so it is very important that the data is accurate.

Data clean-up:Review and weed out unneeded information such as customers who haven'tpurchased in a while or are no longer in business. Now is the time for improving dataaccuracy and re-establishing contact with inactive customers.

4. TRAINING AND TESTING

- Pre-test the database.
- Verify testing.
- Train the Trainer.
- Perform final testing.

Pre-test the database:The project team should practice in the test database to confirm that allinformation is accurate and working correctly. Use a full week of

real transaction data topush through the system to validate output. Run real life scenarios to test for data accuracy. Occurring simultaneously with testing, make sure all necessary interfaces are designed andintegration issues are resolved to ensure the software works in concert with other systems.

Verify testing;Make sure the actual test mirrors the Standard Operating Procedures outlinedin step 2, and determine whether modifications need to make.

Train the Trainer: It is less costly and very effective if you train the trainer. Assign projectteam members to run the in-house training. Set up user workstations for at least 2 days oftraining by functional area. Provide additional tools, such as cheat sheets and trainingdocumentation. Refresher training should also be provided as needed on an ongoing basis.

Final Testing: The project team needs to perform a final test on the data and processes oncetraining is complete and make any needed adjustments. You won't need to run parallelsystems, if you have completed a thorough testing.

5. GO LIVE AND EVALUATION

- Develop a final Go-Live Checklist.
- Evaluate the solution.

Sample **FinalGo Live** Countdown Checklist Sample

- Physical inventory process is complete.
- Beginning balance entry procedures are developed for all modules.
- Any transition issues are addressed.
- Documents & modifications are tested thoroughly.
- Executives and departments heads are fully trained.
- Vendor is available for go-live day.
- Users will have assistance during their first live transactions.

Evaluation:Develop a structured evaluation plan which ties back to the goals and objectivesthat were set in the planning stage. In addition, a post-implementation audit should beperformed after the system has been up and running for the first week for reconciliation purposes and three to six months following to test whether or not the anticipated ROI andbusiness benefits are being realized. Comparing actual numbers with previously establishedbenchmarks will reveal if the software tool does what it is intended to do - add value to thebusiness. It is important to periodically review the system's performance to maximize ROI.

In Summary

- Set reasonable goals and objectives.
- Make project team members accountable for implementation.
- Test software across departments.
- Constantly evaluate to maximize the return on your investment.

You will hit bumps in the road and you need to be patient. Upper management and project team members should be committed for the company to realize the benefits of successful ERP.

3.8 Main Advantages and Disadvantages of ERP System

The advantages presented by the ERP are:

- Optimization of business processes.
- Accurate and timely access to reliable information.
- The ability to share information between all components of the organization.
- Elimination of unnecessary operations and data.
- Reduction of time and costs of litigation

- Then, as each module of the ERP system enters the same real-time database, another advantage is that no duplicate records or playback operations, i.e., redundancy is avoided.
- The performance of all work units that make up their business because better use time is increased. If you previously had to make reports and take them from one place to another, now the time is spent on other activities.
- To improve performance and save time, optimize the control and analysis of management decisions there in the long term, reduced costs for the company.
- Another obvious advantage is in terms of customer service, because the response time is reduced attention to them.
- When a company has an ERP system is more competitive in the environment in which it operates.

Disadvantages of ERP are:

- The installation of the ERP system is costly. ERP consultants are very expensive take approximately 60% of the budget.
- The success depends on the skills and experience of the workforce, including education and how to make the system work properly.
- Resistance in sharing internal information between departments can reduce the efficiency of the software.
- The systems can be difficult to use.
- Change of staff, companies can employ administrators who are not trained to manage the ERP system of the employing company, proposing changes in business practices that are not synchronized with the system.
- Having an ERP system has many advantages, but does not guarantee the total success of the company. Organizational culture, know how to involve staff and anticipate changes that will suffer the organization using this system of administration, are important elements for the completion of the implementation.

- The effectiveness of the ERP system may decrease if there is resistance to share information between business units or departments. Due to strong changes that implementation of the ERP system brings in the culture of work, there may be poorly trained or disinterested in making use of the same staff.
- The benefits of having an ERP system are not presented immediately with the implementation of the software, they will be evident long after the system is running.
- The culmination of the implementation depends on the ability and skill of the workforce, also involves education and training, to make the system is correctly applied.

In conclusion, it is essential to analyze whether the ERP system will be implemented in your company is right for your needs and that does not violate the interests of their organization.

Also it is to be kept in mind that a bad strategy implementation can lead to failure of the same.

3.9 Let's sum-up

The major industrial information systems manufacturers that emerged from the 1980s and early 1990s defined the history of the development of ERP systems. Hence the major providers are representatives of certain industries as much as competitors in a common marketplace. To this extent there are still opportunities for new ERP vendors to emerge from industries that so far have not contributed to the ERP phenomenon. Some obvious examples are the aerospace industry, the finance industry and the logistics industry. Analysis of the market penetration of ERP systems shows clearly that the current players have to downsize their products and offerings to be attractive to SMEs. There appears to be no public discussion as to how this will be achieved and whether it requires a significant

change in software architecture. This situation again is an opportunity for smaller players to seize the day and offer smaller systems running on smaller hardware platforms more efficiently. These innovators will ultimately take the lead in the ERP software market as large systems will not produce the continual income stream that small, robust, easy-to-use systems can achieve. Importantly, these attributes contribute to a system becoming ubiquitous in the same way that Microsoft has achieved ubiquity for its operating system. Future successful vendors will capture large markets of smaller businesses, who will provide a more consistent and enduring income stream.

3.10 Key Terms

3rd Party Application – Software that has been developed by an outside company and is sold through a vendor.

Cloud Computing – A process whereby users are connected to their ERP software via the internet rather than to computer equipment at their location thus eliminating the cost and need to have the hardware infrastructure located and maintained at their site.

E-Commerce – the process by which goods and services are bought and sold via the internet utilizing web sites that are virtual stores. Examples include businesses from banking to baked goods and everything on between.

Electronic Data Interchange (EDI) – EDI replaces paper mail, fax and email by electronically exchanging order and fulfillment/billing information in a standard format between trading partners.

Forecasting – a process that uses historical data to predict future outcomes.

Implementation – the process of installing and configuring ERP software. This process involves installing, configuring, testing, training and preparing an organization for the change.

Key Performance Indicator (KPI) – an approach to helping a business achieve its goals through the development of agreed upon critical performance targets and the measurement of progress towards those targets. It can be, and often is, applied at every level of the business.

Network Administrator– the person who is responsible for managing the computer network of a business, including its security and performance.

User Interface (UI) – the way in which a software user is able to interact with a computer system.

Business Intelligence (BI)- This is the latest buzz word! BI refers to the set of tools that facilitate the senior management to make better decisions by providing a wide range of data and information. The information is provided in graphical or tabular formats. Typically, BI acts like a decision support system.

3.11 Self-assessment Questions

Q1. A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers.

a. True
b. False

Q2. Which of these is NOT a flow that moves up and down the supply chain?

a. Physical
b. Information
c. Monetary
d. Procedural

Q3. Which of the following is not a typical supply chain member?

a. customer

b. retailer's creditor

c. producer

d. reseller

Q4. Stores organization may be defined as a systematic coordination and combination of efforts in manner, which would result in optimum efficiency with a minimum of expenditure.

a. True

b. False

Q5. Which of the following would not generally be a motive for a firm to holdinventories?

a. to decouple or separate parts of the production process

b. to provide a stock of goods that will provide a selection for customers

c. to take advantage of quantity discounts

d. to minimize holding costs

3.12 Further Readings

SAP Implementation at Geneva Chemical by A. Bhattacherjee, (1999).

American Production and Inventory Control Society (APICS) by APICS (2001).

Critical issues affecting anERP implementation. Information Systems Management,By P. Bingi, M.K. Sharma, and J. K. Godla, (1999).

ERP experiences and evolution- Communications of the ACM, by K. Kumar, K. and Van Hillsgersberg, J. (2000).

3.13 Model Questions

1. What are the benefits of ERP?
2. Write about the related technologies of ERP?
3. How do conventional application packages and ERP packages differ?
4. What are the factors that are critical for the success of the ERP implementation?

Answers to Self-assessment questions.

Unit-1.11

1. C
2. D
3. B
4. D
5. D
6. D
7. E

UNIT-2.11

2.11 Self-assessment Questions

1. What is manufacturing resource planning (MRP II)?

Ans:

- Is an integrated method of operational and financial planning for manufacturing companies.
- MRP II serves as an extension of MPR (closed loop manufacturing resource planning, also abbreviated as CLMRP).
- The MRP II process is carried out by a synergistic combination of computer and human resources.
- It addresses operational planning in units, financial planning, and has a simulation capability to answer “what if " questions and extension of closed loop MRP.

2. Identify the differences between manufacturing resource planning (MRP II) and materials requirements planning (MRP).

Ans:

a. State the differences between MRPII and MRP. These differences must be clear

- MRP stands for Material Requirement Planning while MRP II stands for Manufacturing
- Resource Planning.
- MRP schedules production and control flow of inventory to match customer's quantity orders and delivery target.
- MRP II is an upgrade of MRP that comes with advanced functionalities for optimizing production resources and it provides better control of inventory, offer improved scheduling and makes a good relationship with suppliers.

Unit-3.11

1. A
2. D
3. C
4. A
5. D

Answers to Model Questions

2.13 Model Questions

Q1. What are the main 7 elements of MRP?

Ans: 1. Master Production Schedule (MPS) - This enumerates what is the production to be done and schedule.

2. Bill of Materials (BOM) - The complete list of materials/items required for production.

3. Inventory Records - Include stock in hand & safety stock

4. Lead Time. - Time to deliver order

5. Capacity Planning -Ascertain the adequate capacity

6. Purchasing/Procurement - Materials due from Suppliers

7. Shop Floor Control - Orders produced must be on time

3.13 Model Questions

1. What are the benefits of ERP?

Ans:

- Reduction of lead time

- On-time shipment
- Reduction in cycle time
- Better customer satisfaction
- Improved supplier performance
- Increased flexibility
- Reduction in quality costs
- Improved resource utility
- Improved information accuracy and decision making capability

2. Write about the related technologies of ERP?

Ans:

- Business process Reengineering (BPR)
- Management Information system (MIS)
- Decision Support system (DSS)
- Executives Information system
- Data Warehousing
- Data mining
- On-Line Analytical processing (OLAP)
- Supply chain Management (SCM)
- Customer Relationship Management (CRM)
- Business Intelligence (BI)

3. How do conventional application packages and ERP packages differ?

Ans:

- First, ERP packages cannot have only individual business functions such as accounts and inventory, but also the entire range of main business functions necessary for the company's operations

- Second, ERP packages are targeted at everything from small businesses to the largest organizations, and that they can be composed of a highly flexible decentralized database and an information system cluster linked by a network
- Third, is global adaptation, represented by ERP packages' multilingual and multi-currency capacity.

4. What are the factors that are critical for the success of the ERP implementation?

Ans:

- Selection of the right package
- Commitment of top management
- Participation and dedication of the system's future users
- Backing, support and cooperation of the IS/IT personnel
- Development of interfaces with current operational systems and with those under development
- Effort of consultants, who have respect for the company's know-how and work culture
- Spirit and collaboration on the part of all