
UNIT – 7 AGGREGATE PLANNING

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7.1 INTRODUCTION

In the previous unit, we have discussed about the strategic decisions which refer to the long range planning decisions with a special focus on the material requirements (MRP). In this unit the study is extended to medium range and short range decisions and its premises are widened to capacity requirement and human resources as well. Thus, all these clubbed together become a part of Manufacturing Resource Planning (MRP-II). In this unit we shall discuss about these aspects under the head Aggregate Planning (AP).

Objective

After studying this unit you should be able to

- Understand the importance of sourcing and resourcing the manufacturing process through aggregate planning
- Understand aggregate planning decisions
- Understand and assist in decision making process in respect of human resources, capacity resources and material resources.
- Describe the functions of aggregate planning

7.2 DEFINITIONS OF AGGREGATE PLANNING

Aggregate planning refers to the process of developing, maintaining, and analyzing the approximate scope of the operations of a company. It usually

contains targeted sales forecasts, inventory levels, and production levels. It is defined with various perspectives of which most popular are given below:

Aggregate planning is a planning method in the production process using Material Requirement Planning (MRP), Capacity Requirement Planning (CRP), and Human Resource Planning (HRP) techniques to determine resource requirements to meet expected demand.

Aggregate Planning is critical to an organization which wants to optimize its operational activity because it helps in balancing short term production plans and long term strategic plans.

7.3 HORIZON AND PREMISES OF AGGREGATE PLANNING

An organization can finalize its business plans on the recommendation of demand forecast. Once business plans are ready, an organization can do backward work from the final sales unit to raw materials required. Thus, annual and quarterly plans are broken down into labour, raw material, working capital, etc. requirements over a medium-range period (6 months to 18 months). This process of working out production requirements for a medium range is called aggregate planning. Like capacity planning, aggregate planning considers the resources needed for production such as equipment, production space, time and labour.

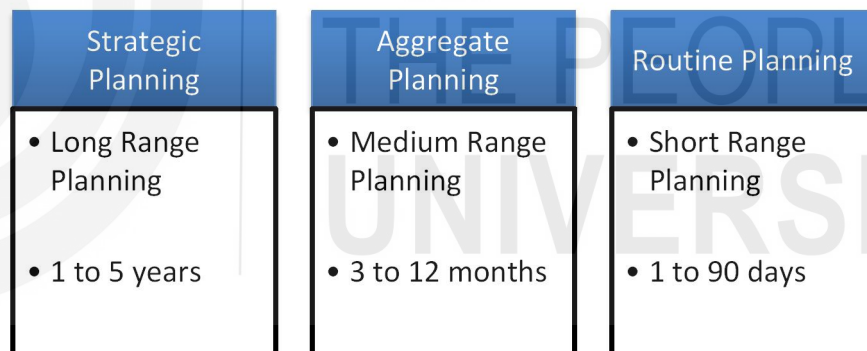


Figure 7.1: Horizon of Aggregate Planning (AP)

The aggregate planning concentrates on scheduling production, personnel and inventory levels during intermediate term planning horizon such as 3-12 months. Aggregate plans act as an interface between strategic decision (which fixes the operating environment) and short-term scheduling and control decision which guides firm's day-to-day operations. Aggregate planning typically focuses on manipulating several aspects of operations-aggregate production, inventory and personnel levels to minimize costs over some planning horizon while satisfying demand and policy requirements. In brief the objectives of AP are to develop plans that are feasible and optimal.

Thus, in simple but comprehensive words, the aggregate planning is done in advance of 6 – 18 months and includes a combination of sub-contracting,

sourcing, outsourcing, employment, labour overtime, amount of inventory and planned output to match demand and supply cost-effectively.

The objective of aggregate planning is usually to meet forecast demand while minimizing cost over the planning period usually referred to as horizon.

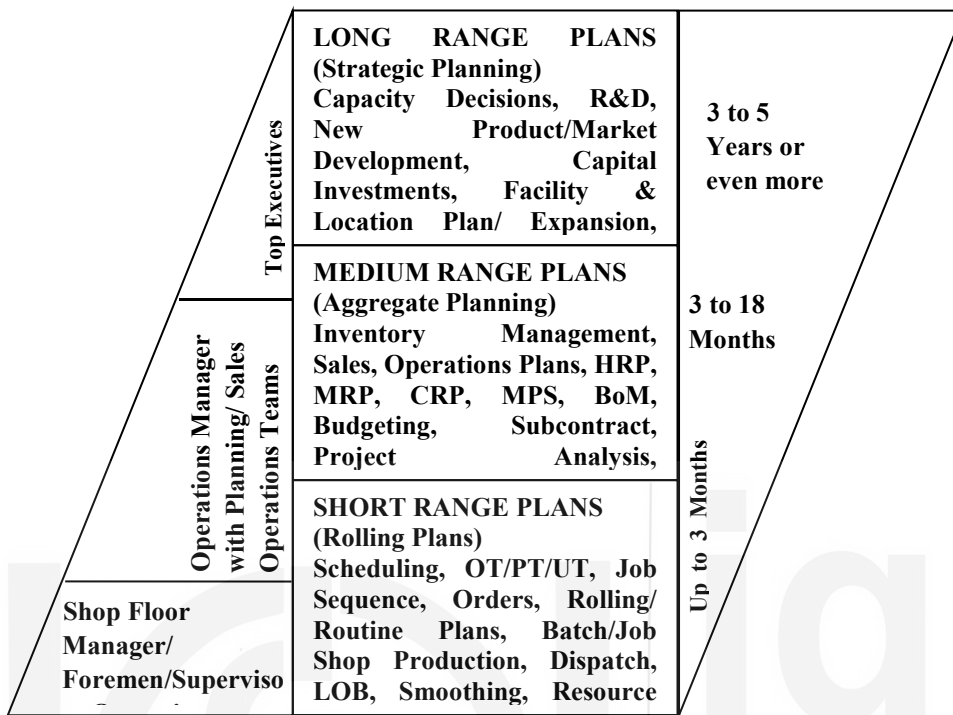


Fig. 7.2: Premises & Horizon of Aggregate Planning (AP)

7.3.1 Significance of Aggregate Planning

Aggregate planning is a proven technique that brings an element of foresight and stability into manufacturing. It helps the management to achieve the long-term objectives of a company. The importance of aggregate planning can be witnessed in

- Minimizing costs associated with inventory stocking
- Reducing investments related to various inventories
- Matching demand with supply and minimizing the waiting time for the customers to maximize customer service
- Offers better customer value
- Removing variable cost and improves the bottom line of the financial statement for achieving the business goals of an organization
- Proper utilization of production facilities
- Creating a satisfied and happy workforce
- Reducing changes in the levels of the workforce
- Determining resources for the short-term
- Maximizing utilization of space
- Meeting the overall goals and objectives of a company

- Adjusting capacity to meet demand
- Maximizing usage of various types of equipment
- Reducing the changes in production rates

7.3.2 Aggregate Planning as an Operational Tool

Aggregate planning helps achieve balance between operation goal, financial goal and overall strategic objective of the organization. It serves as a platform to manage capacity and demand planning.

In a scenario where demand is not matching the capacity, an organization can try to balance both by pricing, promotion, order management and new demand creation.

In scenario where capacity is not matching demand, an organization can try to balance the both by various alternatives such as.

- Laying off/hiring excess/inadequate excess/ inadequate excess /inadequate workforce until demand decrease/increase.
- Including overtime as part of scheduling there by creating additional capacity.
- Hiring a temporary workforce for a fix period or outsourcing activity to a sub-contractor.

SAQ – 7.1

- Define aggregate planning. What is its significance?
- Explain why Aggregate Planning follows strategic planning.
- What is the Significance of Aggregate Planning? How is important in materials perspective?
- Compare strategic planning, aggregate planning and routine planning.
- Explain horizon and premises of aggregate planning.

ACTIVITY 7.1

In an organization with which you are familiar, collect the information about their decisions made with reference to materials management during the last two years and classify them into Long Range (Strategic), Medium Range (Aggregate) and short Range (Routine) decision (At least five decisions in each category).

a) Strategic Plans

b) Aggregate Plans

c) Routine Plans

7.4 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;

- 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, labour, inventory planning, etc.
- Organization policy around labour management, quality management, etc.

7.4.1 Input Requirements for Aggregate Planning

- 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.

7.5 ADVANTAGES OF AGGREGATE PLANNING

The advantages associated with aggregate planning include the following:

- It helps the organization in dealing with production facilities in a lean manner. If a manufacturing facility has an excess of finished products, then it is not suitable for it. The chance of product damage before reaching the end target is higher and this means loss. Moreover, excess

inventory costs mean additional expense for the company. The only way to minimize these costs is by implementing a proper aggregate planning process.

- The process helps to develop effective strategic plan as well as relationships with distributors and suppliers. It also assists in making developing accurate market research
- The planning helps in the optimization of inventory. Carrying excessive inventory will mean additional expenses for a manufacturing company. It also results in more storage space to keep it properly because the chances of damage increase if the storage space is not proper. The organization will also have to invest in more resources, labor and equipment to manage the inventory and for its movement. The process makes an adequate estimation for the anticipated inventory that will be sufficiently able to meet projected demands.
- An essential advantage is that it serves as a useful tool for making viable forecasts about product demand. A business entity is now able to make predictions about staff requirements, for instance, the number of additional workers it will need temporarily or the number of employees it will need to lay-off. Proper forecasting helps the company to fill the positions with temporary staff from agencies. The need for additional hires is easily met without other expenses that are part of the full-time workforce. The aggregate planning method helps the organization to make considerable savings in terms of both money and time that would have to be spent on the hiring and training process.
- It helps to adjust capacity so that it can meet demands
- The aggregate planning process helps to calculate capacity, for instance, how many units can be produced daily or in a week or a month.
- Production orders cannot be constant throughout the year. It will vary and this makes it difficult for the business entities to keep up with a similar production plan for all times. The aggregate planning process takes this thought into consideration and allows for contingency measures. These are put in place so that the manufacturing facilities can accommodate the changes that occur in production as well as orders from the customers. The organization keeps shifting between the level strategy, chase strategy and hybrid strategy to keep up with the changes.
- It helps the organization to identify the best options so that it can meet the demands easily.
- It assists in knowing about the inefficiencies that exist within the organization
- It helps to determine resources for instance amount of raw materials on hand, availability of total machine hours and the total number of

workers along with products in progress, packaging materials, and tools required for manufacturing finished goods

- An advantage of the planning process is that it helps to project demand and figure out the units in need for the short-term by factoring in advertising campaigns, special pricing, and promotions.
- It encourages the optimized utilization of space. The facilities that are used by organizations for manufacturing purposes are too costly and it is not feasible to own or rent it at all times. Besides paying for space, an organization also has to pay for maintenance and utilities. The planning helps the company to avoid any scenario where the space is unused for an extended period and it has to bear unnecessary expenses
- It helps to offer optimized value to both the direct buyers from which it is getting raw materials etc. and end customers to which it will sell the products. The process reduces the production costs and this helps them to pass on savings. Ultimately the end consumer gets the best quality products at the minimum price levels

SAQ – 7.2

1. What is meant by aggregation of units? Discuss
2. Why Aggregate Planning is used? What does it do?
3. Brief out the factors affecting aggregate planning.
4. What are the input requirements for Aggregate Planning?
5. List out the advantages of aggregate planning

ACTIVITY 7.2

In the organization where you are working or with which you are familiar, collect the information on the aggregate planning decisions that have been taken during the last 2 to 5 years. What are causes and effects of such decisions? Show them as an Ishikawa (Fishbone) diagram.

7.6 AGGREGATE PLANNING STRATEGIES

There are three aggregate planning strategies available for organization to choose from. They are

1. Leveling strategy
2. Chasing strategy
3. Hybrid strategy

7.6.1 Level Strategy

As the name suggests, level strategy looks to maintain a steady production rate and workforce level. In this strategy, organization requires a robust forecast demand as to increase or decrease production in anticipation of lower or higher customer demand. Advantage of level strategy is steady workforce. Disadvantage of level strategy is high inventory and increase back logs.

This type of aggregate planning deals with producing goods of similar quantities over equal duration. This is done to handle a peak in market demand by filling out back orders or by sending the extra products to inventory. The level strategy is considered a traditional aggregate planning method that maintains a steady production rate as well as the level of the workforce by continuing consistent human resources and production in the organization.

It is best suited where the inventory carrying costs are not high and are adopted by mainly manufacturing companies. The advantages of using level strategy are well-trained workforce as their changes are not so frequent, experienced workers and a low rate of absenteeism and employee turnover. An essential disadvantage of level strategy is building up inventory costs during the lean period when the demand is low.

7.6.2 Chase Strategy

As the name suggests, chase strategy looks to dynamically match demand with production. Advantage of chase strategy is lower inventory levels and back logs. Disadvantage is lower productivity, quality and depressed work force.

The chase strategy of aggregate planning puts its onus on reducing inventory. It keeps pace with demand fluctuations by varying either actual level of output or the workforce number. It is considered not as rigid as a level strategy as it allows room for some deviation from the conventional approach. This methodology helps to minimize waste by receiving goods when needed. It often leads to stressed employees.

This strategy is popular in several industries like hospitals, hospitality business and educational centers like schools. The advantage of chase strategy is high flexibility to meet the fluctuations in demand and the disadvantages related to the strategy include high costs associated with hiring as well as training the workforce.

7.6.3 Hybrid Strategy

As the name suggests, hybrid strategy looks to balance between level strategy and chase strategy

As the name indicates, the Hybrid strategy is an integration of both level and chase strategies to get a better result. It maintains a sufficient balance between stock level, recruiting, termination and production rate. In the hybrid strategy of aggregate planning, the organizations build up inventory before rising demands. It uses backorders to level with high peak periods.

It can easily cover short-term peaks by hiring workers temporarily or by subcontracting production. Hiring, lay-off and reassigning workers is a normal part of the hybrid strategy.

Types of Application of Strategies

1. Pure strategy

Pure strategy means, if the demand and supply is regulated by any one of the following strategy, i.e.

- (a) Utilizing inventory through constant work force.
- (b) Varying the size of workforce.
- (c) Subcontracting.
- (d) Making changes in demand pattern.

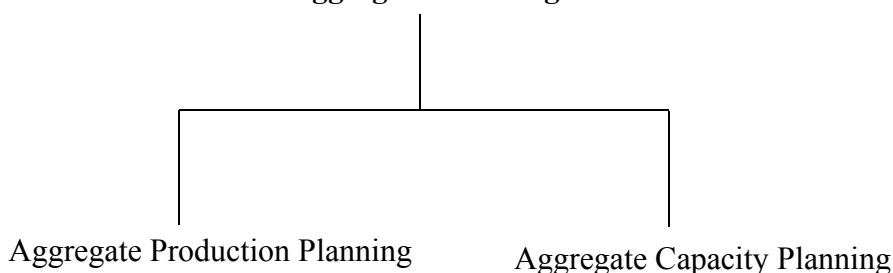
2. Mixed strategy

If the demand and supply is regulated by mixture of the strategies as mentioned, it is called mixed strategy.

7.7 AGGREGATE PLANNING DECISIONS

Aggregate Production Planning indicates the levels of input, in process and output. The decisions on these situations will have a greater impact on the performance of the entire system. However, these aggregate planning decisions may be classified into two major categories as aggregate production planning and aggregate capacity planning. Aggregate production planning involves in the decision of on materials, manpower and other allied resources, while the capacity planning is associated with the volume of the factory, machinery, equipment, capital financial decisions and resource adjustment and their management. Aggregate Capacity Planning focuses more on capacity utilization at desired level and test the feasibility of planned output

Aggregate Planning



Decision focuses basically on two directions:

- 1. Demand Centric Decisions i.e. Modification of demand for a product.
- 2. Supply Centric Decisions i.e. Modification of supply of a product.

7.7.1 Demand Centric Decision Options

Demand can be modified in several ways as shown below:

(a) **Differential Pricing**

It is often used to reduce the peak demand or to increase the off-period demand. Some examples are: reducing off season fan/woolen item rate, reducing the hotel rate in off season.

(b) **Advertising and Promotion**

These methods are used to stimulate/smooth out demand. Advertising is generally so timed as to increase demand during off period and to shift demand from peak period to the off period.

(c) **Backlogs**

Through the creation of backlogs, the manufacturers ask customers to wait for the delivery of products, thereby shifting the demand from peak period to off period.

(d) **Development of Complementary Products**

Producer, who produces products, which are highly seasonal in nature, applies this technique, e.g. Refrigerator company produce room heater, TV Company produces DVD, etc.

Demand Centric Decision Options	Supply Centric Decision Options
<ul style="list-style-type: none">• Differential Pricing	<ul style="list-style-type: none">• Hiring / Firing
<ul style="list-style-type: none">• Advertising / Promotion	<ul style="list-style-type: none">• Part time / Temporary Labour
<ul style="list-style-type: none">• Backlogs	<ul style="list-style-type: none">• Overtime / Under time
<ul style="list-style-type: none">• Complementary to C	<ul style="list-style-type: none">• Subcontracting
	<ul style="list-style-type: none">• Carrying Inventory

Fig. 7.3: Aggregate Planning Decisions based on Demand/Supply

7.7.2 Supply Centric Decision Options

There are various methods of modification of supply.

(a) **Hiring/Firing and lay off employees**

The policy varies from company to company. The man power/work force varies from peak period to slack/off period. Accordingly, firing/lay off employee is followed without affecting employee morale.

(b) Overtime and Under-time

Overtime and under-time are common options used in cases of temporary change of demand.

(c) Part Time or Temporary Labour

This method is attractive as the payment of part time/temporary labor is less.

(d) Subcontracting

The subcontractor may supply the entire product/some of the components needed for the product.

(e) Carrying Inventories

It is used by manufacturers who produces items in a particular season and sell them throughout the year.

Table 7.1 Comparison among the Aggregate Planning Options

Option	Merits	Demerits	Application
Changing inventory levels	Changes in human resources are gradual or none; no abrupt production changes.	Inventory holding cost may increase. Shortages may result in lost sales.	Applies mainly to production, not for service, operations.
Varying size of workforce by hiring or layoffs	Avoids the costs of other alternatives.	Hiring, layoff, and training costs may be significant	Used where size of labour pool is large.
Varying rate of production through overtime/ idle time	Matches seasonal fluctuations without hiring/ training costs.	Overtime premiums; tired workers; may not meet demand.	Allows flexibility within the aggregate plan.
Subcontracting	Permits flexibility and smoothing of the firm's output.	Loss of quality control; reduced profits; loss of future business.	Applies mainly in production settings.
Using part time workers	less costly and more flexible than full-time workers.	High turnover/ training costs; quality suffers; scheduling difficult.	Good for unskilled jobs in areas with large temporary labor pools.
Influencing demand	Tries to use excess capacity. Discounts draw new customers	Uncertainty in demand. Hard to match demand to supply exactly.	Creates marketing ideas. Overbooking

Back ordering during high demand periods	May avoid overtime. Keeps capacity constant.	Customer must be willing to wait, but goodwill is lost.	Many companies back order.
Counter seasonal product and service mixing	Fully utilizes resources; allows stable workforce.	May require skills or equipment outside the firm's areas of expertise.	Risky finding products or services with opposite demand patterns.

SAQ – 7.3

- a) Discuss the importance of forecasting in aggregate planning.
- b) Name the three aggregate planning strategies. Briefly explain them
- c) Compare and contrast leveling strategy, chasing strategy and hybrid strategy.
- d) What is pure strategy and mixed strategy with reference to aggregate planning?
- e) Differentiate between pure and mixed strategies under aggregate planning premises.
- f) Explain Demand Centric and Supply Centric Decision Options.
- g) Compare and contrast with reference to the merits and demerits

ACTIVITY 7.3

In the organization where you are working or with which you are familiar, collect the information on the aggregate planning decisions that have been taken during the last 2 to 5 years. What are problems faced while implementing them? Briefly describe how they were solved.

7.8 AGGREGATE PLANNING METHODS / TECHNIQUES

There are two ways of employing Aggregate Planning techniques viz. graphical methods and analytical methods.

1. Graphical Methods

The graphical methods are

- popular techniques

- trial-and-error approaches do not guarantee an optimal solution
- easy to understand,
- easy to use and
- require only limited computations

2. Analytical Models

Analytical models use mathematical principles and concepts. Some complex situations make use of the advanced mathematics, operations research and optimization techniques including general linear programming, transportation models, sequencing, scheduling techniques, line balancing, assignment model, dynamic programming and simulation and so forth. However, analytical methods are -

- Relatively accurate
- Objectively produce an optimal plan
- Works well for inventories, overtime, subcontracting
- Does not work when nonlinear or negative factors are introduced

[In view the notion that these techniques are studied more relevantly under courses such as Operations Research, Optimizations Techniques and Operations Management, etc. these are left to the readers and advised to go through the courses given under further readings].

However, an illustration is shown here below using graphical method.

7.9 PROCEDURAL STEPS OF GRAPHICAL METHODS

The procedural steps for applying graphical are as follows:

1. Determine the demand for each period
2. Determine the capacity for regular time, overtime, and subcontracting each period
3. Find labor costs, hiring and layoff costs, and inventory holding costs
4. Consider company policy on workers and stock levels
5. Develop alternative plans and examine their total cost

Now let us understand this with illustrations.

Illustration

Solve graphically for the following data in Table-I, by using average monthly forecast demand to level the production.

Table-7.2: Monthly Forecast

Month	Expected Demand	Production Days	Demand Per Day (Computed)
Jan	900	22	41
Feb	700	18	39
Mar	800	21	38
Apr	1200	21	57
May	1500	22	68
Jun	1100	20	55
	6200	124	

Solution:

Average Requirement = Total expected demand/No. of production days = 6200 /124 = **50 units per day**

7.6.1 Graphical Method For Engine Supplier Case- Example 1

Engine Supplier Example 1

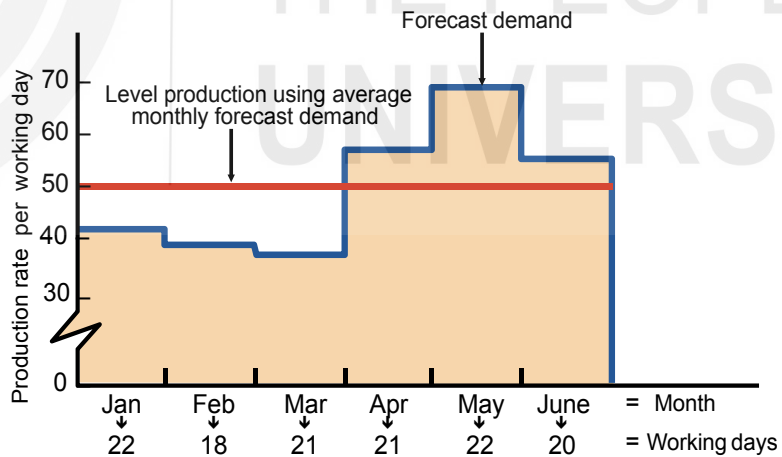


Figure 7.4: Engine Supplier Example 1

7.6.2 Graphical Method For Engine Supplier Case- Example 2

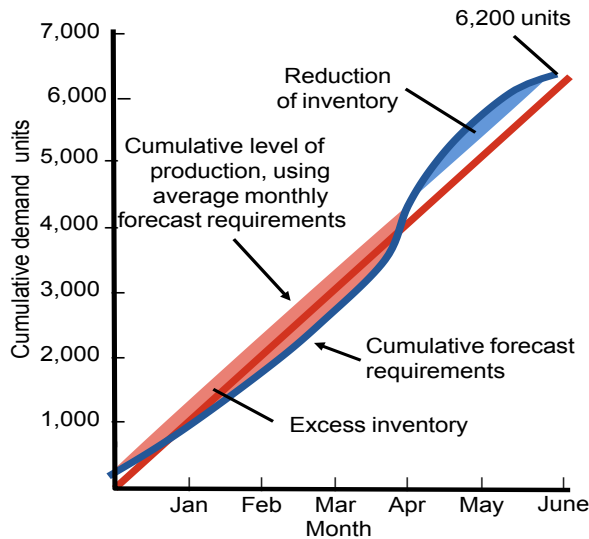


Figure 7.5: Engine Supplier Example 2

SAQ – 7.4

- a) List out various graphical methods and analytical methods of aggregate planning
- b) Write down the steps involved in solving graphical methods of aggregate planning
- c) Compare the merits & demerits of graphical and analytical methods of aggregate planning.

ACTIVITY 7.4

In the organization where you are working or with which you are familiar, collect the information about last one year production or inventory consumption and plot them on graph sheet and level them.

7.7 SUMMARY

Aggregate planning is a proven technique that brings an element of foresight and stability into manufacturing. It refers to the process of developing, maintaining, and analyzing the approximate scope of the operations of a company. It helps in balancing operation goal, financial goal and overall strategic objective of the organization. There are three aggregate planning strategies available for organization namely levelling strategy, chasing strategy and hybrid strategy. Further, strategies can also be categorized as pure strategy and mixed strategy. If the demand and supply is regulated by any one of the strategy, is referred as pure strategy. Whereas, in mixed strategy the demand and supply is regulated by mixture of the strategies. The decisions of aggregate planning will have a greater impact on the performance of the entire system.

These decisions may be classified into two major categories as aggregate production planning and aggregate capacity planning. The initial one involves in the decision of on materials, manpower and other allied resources, while the later on is associated with the volume of the factory, machinery, equipment, capital financial decisions etc. Aggregate planning can be done either using graphical method or using analytical technique.

7.11 KEYWORDS

Aggregate planning: It is the process of developing, maintaining, and analyzing the approximate scope of the operations of a company.

Capacity requirements planning (CRP): it is the process of specifying the level of resources (facilities, equipment and labor force size) that best supports the enterprise's competitive strategy for production.

Human resources: It is the set of people who make up the workforce of an organization, business sector, industry, or economy.

Human Resource Planning (HRP): It is the process of systematically reviewing HR requirements to ensure that the required number of employees with the required skills is available when they are needed.

Aggregate production planning: It is concerned with the determination of production, inventory, and work force levels to meet fluctuating demand requirements over a planning horizon that ranges from six months to one year.

Aggregate capacity planning: It is the process of planning and managing the overall capacity of an organization's resources.

Forecasting: It is the process of making predictions based on past and present data and most commonly by analysis of trends.

Outsourcing: It is the business practice of hiring a party outside a company to perform services and create goods that traditionally were performed in-house by the company's own employees and staff.

7.12 FURTHER READINGS

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