
UNIT 11 AGGREGATE PRODUCTION PLANNING

Objectives

Upon reading this unit you will get to know:

- Necessity of aggregate planning
- Linkage between different levels of production planning
- Steps in aggregate planning
- Sources of medium range production capacity
- Managerial importance of aggregate planning.

Structure

- 11.1 Introduction
- 11.2 Linkage between Long Term and Short Term Planning
- 11.3 The Purpose of Aggregate Planning
- 11.4 Steps in Aggregate Planning
- 11.5 Dimension of Production Capacity
- 11.6 Managerial Importance of Aggregate Planning
- 11.7 Summary
- 11.8 Self-Assessment Exercises
- 11.9 Further Readings

11.1 INTRODUCTION

If the demand for a company products was absolutely stable, there would be no need for aggregate planning. The company can develop a production process and a workforce level that would produce exactly the amount demanded every month in a repeating cycle while maintaining practically no inventory. However this is seldom found to be true and the demand mix among the products do fluctuate over time.

The problem facing the company is to create production, inventory and the workforce plans far enough in advance to satisfy the anticipated demand at minimum total cost without harming the company's long terms strategy and viability. The output of the planning process should be a period by period plan of how much of each product type to produce, how much to add or remove from the inventory, how much the workforce to be increased or decreased, how much over time work should be planned and, if applicable, how much production should be subcontracted.

As the aggregate plan is based on satisfying expected intermediate term demands, it is necessary that accurate forecasts of these demands be made. Due importance must be given to seasonal factor while arriving at forecasts. In addition, intermediate range wage rates, material prices and holding costs also affect optimal plans. All these parameters must be properly considered.

Aggregate Planning is necessary in Production and Operations Management (POM) because it provides for,

Fully loaded facilities and minimizes overloading and underloading, thus reducing costs.

Adequate production capacity to meet expected aggregate demand.

Getting the most output for the amount of resources available, which is important in times of scarce production resources.

Aggregate planning is the key to managing change in POM because the changing patterns of customer demand and the plans for providing production resources that adapt to those changes are fundamental to aggregate planning.



11.2 LINKING LONG TERM AND SHORT TERM PLANNING

Decisions involving design and mix of products, the location and capacity of facilities and design of production process are long term decision and they decide the environment within which the production system must operate.

On the other hand Aggregate planning is the process of determining the company's production, inventory and personnel levels etc. for three to twelve month ahead.

Aggregate plans act as interface (Fig-11.1) between strategic decision, which fix the operating environment, and short term scheduling and control decisions, which guide the company's day-to-day operations.

Aggregate planning typically focuses on manufacturing several aspects of operations-aggregate production, inventory, and personnel levels-to minimize costs over some planning horizon while satisfying demand and policy requirements.

Intermediate term planning is normally performed in terms of aggregate production units and resources (hence the term aggregate planning) rather than for individual products. Although in the intermediate term major facility and process changes usually be expanded by using overtime - work, subcontracting production, hiring addition workers, or even adding entire work shifts. This approach takes the demand pattern as forecasted and focuses on minimizing the costs.

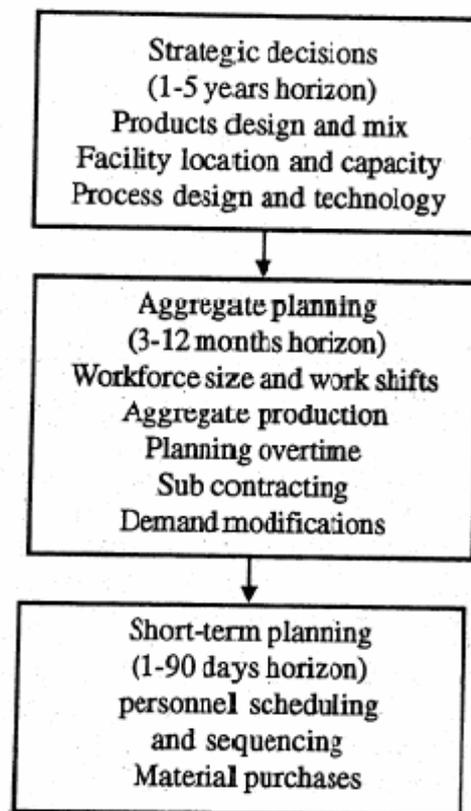


Fig. 11.1

11.3 THE PURPOSE. OF AGGREGATE PLANS

In this section we explain why companies need aggregate plans and how they use them to take a macro view of their business. We also discuss how the aggregate plan relates to a company's long-term and short-term plans. Only qualitative aspect of the aggregate planning in discussed. Quantitative explanation of aggregate planning is given in block -4 of MS-5.

Aggregation

The aggregate plan is useful because it focuses on a general course of action, consistent with the company's strategic goals and objectives, without getting bogged down in detail's, for example, it allows managers to determine whether they can satisfy budgetary goals without having to schedule each of the company's thousands of products and



employees. Even if a planner could prepare such a detailed plan, the time and effort required to update it would make it uneconomical. For this reason, production and staffing plans are prepared by grouping together, or aggregating, similar products, services, units of labour, or units of time. For instance, a manufacturer of bicycles that produces 12 different models of bikes might divide them into two groups, mountain bikes and road bikes, for the purpose of preparing the aggregate plan, it might also consider its work-force needs in the terms of unit of labour needed per month. In general, companies aggregate products or services, labour, and time.

Following Definitions may be used for Aggregating Products:

- Items are the end products sold to customers.
- Families are groups of items that are processed on the same equipment and share the same general machine setup.
- Product types are groups of product families that have similar cost structures, holding costs per unit, productivities, and seasonal demand patterns.

Aggregate planning is normally done at the product type level of aggregation and at the facility level, rather than at the corporate level.

Assigning items to families and product types is easier than it may at first appear. One of the tricks to making this assignment is somewhat counter intuitive. Product types, families, and item from a hierarchy, with product types being the highest level of the three.

Selecting the aggregate measures of production and inventory is normally straight forward because items within the same product type should be very similar physically for example, the units may be expressed in terms of the number of appliances, number of refrigerators, thousand of TV, or tones of steel produced and stored. Production resources and capacity should be expressed in aggregate form as well. For example, one of the variables to be determined by the plan is the amount of direct labour (workforce level) needed, including the amount of overtime labour to use in each time period. The measure of workforce or overtime would be expressed in labour-hours or resources consumed in production, such as gallons of paint or hours of machine time should be expressed in terms of the aggregate amount of each resource consumed to produce one unit of the aggregate product.

Product Families: Sometimes, products families relate to market grouping or in the case of production plans, to specific manufacturing processes. A firm can aggregate its products or services into a set of relatively broad families, avoiding too much detail at this stage of the planning process. Common and relevant measurements, such as units, rupees, standard hour or litre, should be used. For example, consider the bicycle manufacturer that has aggregated all products into two families: mountain bikes and road bikes, this facilitates production planning for the assembly lines in the plant. A firm that specializes in quick oil changes might aggregate the services it offers into two categories: the basic service and special services.

Labour: A company can aggregate labour in various ways, depending on workforce flexibility. For example, if workers at the bicycle manufacturer are trained to work on either mountain bikes or road bikes, for planning purposes management can consider its work force to be a single aggregate group, even though the skills of individual workers may differ.

Alternatively, management can aggregate labour along product family lines by splitting the work force into subgroups and assigning a different group to the production of each product family devoting production lines and even entire plants to separate product families. In service operations, such as a city government, workers are aggregated by the type of service they provide: fire fighters, police officers, Sanitation workers, and administrators.

Companies that aggregate labour along product lines must plan for change in economic conditions and consumer demand that may cause cutbacks in production of some product families and increases in production of others when such shifts occur, labour may not be interchangeable. For example, in automobile assembly, production of different product families takes place in scattered locations. In such cases, planning for changes in work-force levels and the use of overtime by aggregating labour around product families is the most practical approach.



Time: A planning horizon is the length of time covered by an aggregate plan. Typically, the planning horizon is one year, although it can differ in various situations to avoid the expense and disruptive effect of frequent changes in output rates and the work force adjustment usually are made monthly or quarterly. In other words, the company rather than days or hours. Some companies use monthly planning periods for the near portion of the planning horizon and quarterly periods for the later portion. In practice, planning periods reflect a balance between the needs for (i) a limited number of decision points to reduce planning complexity and (ii) flexibility to adjust output rates and work-force levels when demand forecasts exhibit seasonal variations. The bicycle manufacturer for example may choose monthly planning periods so that timely adjustments to inventory levels can be made without excessively disruptive changes to the work force.

11.4 STEPS IN AGGREGATE PLANNING

- 1) Begin with a 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 (usually 3 months to 12 months).
- 2) Total all the individual product or service forecasts into one aggregate demand. If the products are not additive because of heterogeneous units, a homogeneous unit of measure must be selected that both allows the forecasts to be added and links aggregate outputs to production capacity.
- 3) Transform the aggregate demand for each time period into workers, 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 alternatives considered that statistics aggregate demand and best meets the objective of the organisation.

Activity A

Visit to some manufacturing company in your neighborhood. Study their forecast for next year for different products. Suggest a suitable aggregate plan based on it.

.....

11.5 DIMENSIONS OF PRODUCTION CAPACITY

An essential part of aggregate planning is a comprehensive understanding of each production system's capacities. If particular importance are the answers to the following questions:

- 1) How much of each. production resources is available ? Production capacity in each time period maybe constrained of machines.
- 2) How much capacity is provided by each type of resource? The amount of resources required to produce a single products allows the translation of demand into production capacity needs. Labour standards (labour-hours per product) and machine standards (machine hours per product) are commonly used to translate demand into the number of workers and machines needed:
- 3) At what step in production do we determine capacity? In product-focused production, capacity may be determined by a bottleneck operation, or an operation with the least capacity for a product. In other types of production, capacity may be determined by the number of labour hours or machine-hours in a particular production department or an entire factory.
- 4) How much does it cost to scale capacities up to down? The cost of hiring laying in and recalling employees, for example, can affect plans for providing production capacity.



Such intricacies of production capacity have led production systems to identify several practical sources of providing medium-range production capacity.

Sources of medium-Range production capacity

Because aggregate planning spans periods from only 3 to 12 months, not enough time is available to increase capacity by adding building, machines, and other capital goods. This shifts the focus to other sources of production capacity as plan are developed for supplying customer demand. Several variables can be altered to change production capacity from month to month. Among these variables are:

- 1) **Straight-time labour** - Production by workers paid straight-time; labour rates, which usually means for 40 hours or less per week. The sources of labour are full-time and part time present employees, new hires, and workers who have been laid off and can be recalled. The local labour market could be a limiting factor, and union contracts can limit management's flexibility in hiring new employees and laying off experienced workers.
- 2) **Overtime labour** - Production by workers paid overtime labour rates, which usually means for more than 40 hours per week, overtime can be limited by union or company policies.
- 3) **Inventory** - Production in previous time periods that is held for shipment in later time periods.
- 4) **Subcontracting** - Production of products or services by suppliers.

Straight-Time labour is the preferred source of production capacity and is used to provide abase production capacity when demand exceeds the capacity of the existing work force, new hires overtime inventory and subcontracting can be used. But new hires, overtime, inventory, and subcontracting can cost more an cause other difficulties. Companies approach with caution the decision of how to best production capacity for the peaks of demand.

Activity B

Study the policy followed by the company to meet the fluctuating demands. Suggest a better alternative.

.....

11.6 MANAGERIAL IMPORTANCE OF AGGREGATE PLANS

In this let us concentrate on the managerial inputs, objectives, alternatives and strategies associated with aggregate plans.

Managerial Inputs

Figure 11.2 shows the type of information that managers from various functional areas supply to aggregate plans. One way of ensuring the necessary cross-functional coordination and supply of information is to create a committee of functional -area representatives, chaired by a general manager, the committee has the overall responsibility to make sure that company policies are followed, conflicts are resolved amanda final plan is approved.

Typical Objectives

The many functional areas in an organisation that give input to the aggregate plan typically have conflicting objectives for the use of the organisation's resources. Six objectives usually are considered during development of a production or a staffing plan:

- 1) Minimize costs maximize profits. If customer demand isn't affected by the plan minimizing costs will also maximize profits.
- 2) Maximize customer service. Improving delivery time and on-time delivery may require additional work-force, machine capacity, or inventory resources.

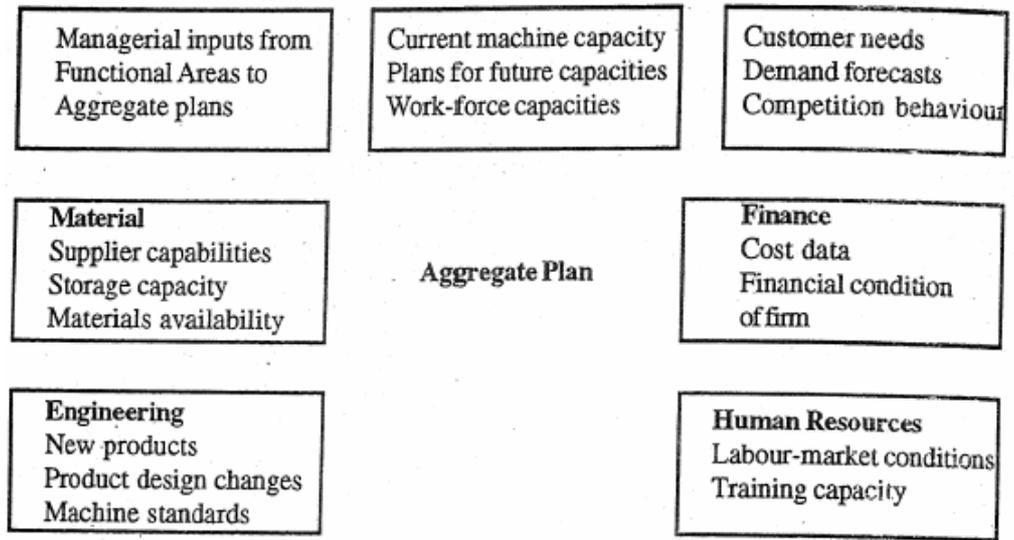


Fig: 11.2

- 3) Minimize inventory investment. Inventory accumulations are expensive because the money could be used more productive investments.
- 4) Minimize changes in production rates. Frequently changes in production rates can cause difficulties in coordination line rebalancing.
- 5) Minimize changes in work-force levels. Fluctuating work-force levels may cause lower productivity because new employees typically need time to become fully productive.
- 6) Maximize utilisation of plant and equipment. Firm with a product focus require uniformly high utilisation of plant and equipment.

The weight given to each one in the plan involves cost trade-offs and consideration of non-quantifiable factors. For example, maximizing customer service with fast, on-time delivery can be improved by increasing -not minimizing-the stock of finished goods in a production plan. Or, for example, a staffing plan that minimizes costs may not minimize changes in work-force levels or maximize customer service.

Balancing these various objectives to arrive at an acceptable aggregate plan involves consideration of various alternatives the two basic types of alternatives are actions that adjust demand pattern, whereas reactive alternatives are actions that respond to given demand patterns.

Reactive Alternatives

Reactive alternatives are actions that can be taken to cope with demand requirements. Typically, an operations manager controls reactive alternatives that is the operations manager accepts forecaster demand as a given and modifies work-force levels overtime, vacation schedules, inventory levels, subcontracting and planned backlogs to meet that demand.

Work force Adjustment. Management can adjust work-force levels by hiring or laying off employees. The use of this alternative can be attractive if the work force is largely unskilled or semiskilled and the labour pool is large. However, for a particular company, the size of the qualified labour pool may limit the number of new employees that can be hire at any one time also new employees must be trained and the capacity of the training facilities themselves might limit the number of new hires at any one time in some industries laying off employees is difficult or unusual for contractual reasons (unions) in other industries such as tourism and agriculture, seasonal lay offs and hiring are norm.

Overtime and undertime an alternative to work -force adjustment is the use of overtime and undertime. Overtime can be used to satisfy output requirements that cannot be completed on regular time. However, overtime is expensive. Moreover, in many cases, workers do not want to work a lot of overtime for extended period of time, and excessive overtime may result in declining quality and productivity. Undertime is used when labour capacity exceeds demand requirements, workers are kept on the payroll rather than being laid off. This option is used by companies that have highly skilled, hard-to-replace employees (particularly firms with a process focus) or that confront contractual obstacles



to laying off workers. In the latter case, undertime can cause inefficiency and higher unit costs.

Vocations Schedules: A firm can shut down during an annual full in sales, leaving a skeleton crew to cover operations and perform maintenance, employees might be required to take all or pan of their allowed vacation time during this period. The companies sometimes use of this alternative during the holiday period, not only to do maintenance work or install equipment, but also to decrease inventory. Use of this alternative depends on whether the employer can mandate the vacation schedules of its employees. In any case, employees may be strongly discouraged from taking vacations during peak periods or encouraged to take vacation during periods when replacement part-time labour is most abundant.

Anticipation Inventory: A plant facing seasonal demand can stock anticipation inventory during light 6unand periods and use it during heavy demand periods although this approach stabilizes output rates and work-force levels, it can be costly because the value of the product is greatest in its finished state, stocking components and sub assemblies that can be assembled quickly when customer orders come in might be preferable to stocking finished goods.

Service providers generally cannot use anticipation inventory because services cannot be stocked, in some instances however, services can performed prior to actual need, for example telephone company workers usually lay cables for service to a new subdivision before housing construction begins, they can do this work during a period when the workload for scheduled services is low.

Subcontractors: Subcontractors can be used to overcome short-term capacity shortages, such as during peaks of the season or business cycle. Subcontractors van supply services, n0he components and subassemblies, or even assemble an entire product. If the subcontractor can supply components or subassemblies of equal or better quality less expensively than the company can produce them itself, these arrangements may become permanent, the major automakers. For example, typically subcontract for underbody frames, steering linkage components, and other item. In the service industry, book publishers are turning increasingly to free-lance artists and copy editors as part of a downsizing trend.

Backlogs, Backorders and Stockouts: Another way **in** which firms with a process focus often cope with a high demand forecast is to plan for order backlogs. A backlog is an accumulation of customer orders that have been promised of delivery at some future date. Ming a stable backlog may be a good strategy, if on time delivery and quality are not sacrificed. Delivery lead times typically increase during seasonal peaks in demand. Finns with a process focus often use this method. The customer places an order for a customized product or service, and the firm promises it for later delivery, job shops, TV repair shops, and automobile repair shops work to varying degrees to backlogs. Examples of backlogs in services are tickets for a concert and appointments to see a dentist.

Backorders and stockouts are used by firms with a product focus. A back order is a customer order that is not ready for the customer when promised or demanded, thereby delaying demand requirements to later periods. A stockout is an inability to satisfy the demand for a stock item when it occurs. In this case, the customer may go to a competitor, resulting in a lost scale. Generally, backorders and stockouts are to be avoided. Planned stockouts may be used, but only when the expected loss in sales and customer goodwill is less than the cost of using other reactive alternatives or aggressive alternatives, or adding the capacity needed to satisfy demand.

In conclusion, decisions about the use of each alternative for each period of the planning horizon specify the output rate for each period. In other words, the output rate is a function of the choices among these alternatives.

Activity C

Analyse some real life cases and find out whether sub-contracting is an effective alternative or not, in Indian Context.

.....



11.7 SUMMARY

It is clear from foregoing discussions that the success of any organisation very much depends on how its long range planning is converted into reality. Aggregate planning plays pivotal role in achieving this goal. Any mistake in medium range planning leads to wastage/improper use of resources, excess/shortage of inventory etc. The success of organisation is directly linked with how efficiently the medium range planning is done. Despite the number of models available and the favourable results in a few cases aggregate planning models have not gained widespread acceptance in industry. A more concerted implementation effort may be needed which includes careful definition of the decision problem in each case, tailor-made models, and demonstration of improved planning results.

11.8 SELF-ASSESSMENT EXERCISES

1. Aggregate planning is sometimes confused with scheduling. What is the difference?
2. The XYZ company manufactures a seasonal product. At the present, they use a level labor force as a matter of company policy. The company is afraid that, if they lay off workers they will not be able to rehire them or to find qualified replacements. Does this company have an aggregate planning problem? Discuss.
3. It has been said that aggregate planning is related to personnel planning, budgeting, and marketing planning. Describe the nature of the relationship between these types of planning.
4. What factors are important in choosing the length of the planning horizon for aggregate strategy?
5. What assumptions are used in deriving the LDR model?
6. What problems are being experienced in using aggregate planning in industry? How can these problems be overcome?
7. How is the choice between a level strategy and a chase strategy influenced by the skill level of the work force and the degree of automation? After all, isn't the choice between these strategies just a matter of the lowest cost?
8. Provide a definition of decision rule always required in an aggregate planning model?
9. A barber shop has been using a level work force of barbers 5 days a week, Tuesday through Saturday. The barbers have considerable idle time on Tuesday through Friday, with certain peak periods during the noon hours and after 4 p.m. each day. On Friday afternoon and all day Saturday, all the barbers are very busy, with customers "waiting a substantial amount of time and some customers being turned away. What options should this barber shop consider for aggregate planning? How would you analyze these options? What data would be collected and how would be collected and how would the options be compared.

11.9 FURTHER READINGS

1. Adam, Jr. E.E and Elbert, R.J., *Production and Operations Management*. Prentice-Hall of India, New Delhi.
2. Schroeder, R.G., *Operation Management*, McGraw-Hill Book Company.
3. Narasimhan, S.L, McLeavey, D.W., and Billington, P.J., *Production Planning and Inventory Control*, Prentice-Hall of India, New Delhi.