UNIT 6 CAPACITY PLANNING

Objectives

After going through this unit, you should:

- understand the concept of capacity and how it is measured
- be aware of the unique problems of capacity planning; for services
- know the steps involved in capacity planning
- be familiar with the various methods available ea e predicting icing term capacity requirements
- appreciate the special difficulties encountered in predicting the demand for new and other outputs having a highly uncertain growth rate
- recognise the factors involved in generating alternate capacity plans
- have a feel for economic analysis of different capacity pleas
- identify the issues involved in analysing the strategic effects of alternate capacity plans.

Structure

6.1 Introduction
6.2 What is Capacity?
6.3 Process for Capacity Planning
6.4 Predicting Future Capacity Requirements
6.5 Generation of Capacity Plans
6.6 Evaluation of Alternate Capacity Plans
6.7 Summary
6.8 Key Words
6.9 Self-assessment Exercises
6.10 Further Readings

6.1 INTRODUCTION

The operations strategy of an organisation is revealed to a large extent by its investments made in creation of capacity. Creation of capacity almost always requires investments. In manufacturing organisations this is easy to see as the investments required are large. However, even in service organisations, capacity creation requires more space furniture and other accessories including equipment.

Capacity Planning involves giving shape to all the strategic questions, that we have raised earlier in the previous units and also our response to these. What are our expectations regarding the growth of the industry and our market share? How accurately can we predict market trends, both in terms of product attributes as well as growth in specific segments-geographical and otherwise? What is our basic stand towards risks? Should our planning he based on an optimistic growth scenario or a pessimistic one? As a strategy, should we create capacity in a few large locations, each with a large capacity or should we operate from many locations each with a small capacity? These are some of the questions that have to be answered while preparing a capacity plan.

There are some other related questions which also affect our capacity plans. What is our policy regarding making up of some temporary short-falls in capacity e.g. by use of overtime additional shifts or holiday work? How much of our requirement can be met by resorting to sub-contracting? What is our policy regarding meeting the market demand? Should we, as a matter of policy try to meet it fully or can we plan for some lost sales at least for some periods of time?

All these strategic issues need to be resolved as a part of capacity planning. It is relatively simple to do an economic analysis of the revenues, costs and investments. However, the other strategic effects of capacity decisions-e.g. the consequences of' not having the capacity when it is required or addition of large capacity when the market growth cannot be predicted with much confidence, are more difficult to analyse. We will discuss these issues in this unit.

6.2 WHAT IS CAPACITY?

Capacity is quite an illusive concept and in many cases has to be qualified further. Thus, we find that words like designed capacity, installed capacity, rated capacity and so on are often used. These concepts are based on how we define the capacity of a facility.

Definition of Capacity

Capacity is the limiting capability of a productive unit to produce within a stated time period, normally expressed in terms of output in units per unit of time. However, the limiting capability also depends on the intensiveness of use of the productive unit. By increasing the intensiveness of use, the capacity of a productive unit can be increased without really building new capacity. For example, by working for seven days a week instead of six, or resorting to overtime work, or working two shifts a day in place of one, the capacity of a productive unit can be increased. These alternatives generally come in handy for- managers to meet temporary shortfalls in capacity.

When the transformation process in turn consists of many sub-process, the capacity of the productive unit is governed by the capacity of the weakest link viz. the capacity of the sub-process having the minimum capacity. By strengthening the. weakest link, the capacity of the entire productive unit can be enhanced. This can be done by investing in `balancing equipment' to create a better balance between various sub-processes. The same can also be achieved by subcontracting when it is feasible. One can subcontract the complete production as well as subcontract only those jobs for which enough in-house capacity does not exist.

In some situations, especially processing industries, the capacity is further qualified by mentioning how it was established. Thus there can be a licensed capacity of the plant denoting the capacity that has been licensed by the concerned governmental authorities. There can, similarly, be an installed capacity denoting the capacity that has been provided for while the plant was installed. Finally, the rated capacity may be quite different from the other capacities and based on the highest production rate established by actual trials.

Measurement of Capacity

When the productive system produces a single output or when the different outputs are relatively homogeneous, capacity can be measured in number of units of output per unit of time. The capacity of a thermal power plant is expressed in megawatts of power, that of a television unit in thousands of television sets per month and that of a steel mill in million tons of steel in a year.

However, when a production unit produces multiple outputs, with some outputs sharing common facilities and some other outputs using special facilities, measurement of capacity becomes really difficult..An extreme example is a job shop which produces products as per customers' specifications. In such a case the capacity cannot be measured in terms of the number of output units per unit of time. For such organisations, capacity is usually expressed in terms of available units of the limiting resources. For example, the capacity of a job shop can be measured ,in units of labour hours available per month. The capacity of a hospital can be similarly measured in bed days per month and that of a consultancy organisation in consultation days per year.

Service Capacity

For those organisations whose output is a service of some kind, the capacity can be measured using the concepts outline above. If the service produced is homogeneous, the capacity can be measured in number of services per unit of time-e.g. number of units of power produced per unit of time for a thermal power plant or number of insurance policies serviced per year for an insurance company. Similarly, when the service produced is heterogeneous, it can be expressed by the availability of the limiting resource-e.g. man hours per week for a bank branch, tonne kilometers for a trucking company and so on.

However, service organisations typically face a problem in capacity planning because of the fact that their output cannot be stored. The demand for services is also quite variable and often fluctuates during the course of the day. Service organisations should therefore provide for enough capacity to take care of the peak demand. This can be seen in the demand for electricity or that for banking services or even for public transportation. As the average demand is much less than the peak demand, this means that the organisation produces its output, on an average, at a rate less than its capacity. This amounts to lower capacity utilisation on one side and can give rise to productivity problems on the other.

Activity A

How is capacity defined in your organisation? Can it be defined in any other ways? What are the different ways in which the capacity of your organisation can be extended?

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6.3 PROCESS FOR CAPACITY PLANNING

In brief, the process for capacity planning involves the following eight steps:

1. Assess company situation and environment to predict future demands, including the possible impact of technology, competition and other events
2. Determine the available capacity
3. Translate predictions into physical capacity requirements
4. Develop alternate capacity plans for matching required and available capacity
5. Analyse the economic effects of alternate capacity plans
6. Analyse the risks and other strategic consequences of alternate plans
7. Recommend a course of action
8. Implement the course of action.

We will discuss these steps in the following sections. However, it may be pertinent to point out that a quantitative analysis of the alternate capacity plans is not enough because, for one, the capacity requirements that are used for this analysis are only estimates and in many cases may not be very reliable and secondly, the strategic effects are not easy to quantify in most cases. The steps listed above highlight the importance of both quantitative (step 5) and qualitative (step 6) analysis.

6.4 PREDICTING FUTURE CAPACITY REQUIREMENTS

Any capacity plan that we prepare is heavily dependent on our assessment of the likely demand of our outputs. However, preparing long-range forecasts of demand is quite difficult. Apart from the general growth in demand of the product due to the trend and cyclical effects, there can be contingencies which affect' the demand significantly but are quite difficult to predict. Such contingencies can range from failure of monsoon to wars, oil embargoes or major technological breakthroughs. In general though, mature products are likely to have more stable and predictable growth as compared to products in the introduction or growth phases of their respective product life-cycles.

Multiple Outputs

If a productive unit is producing many outputs, then for predicting future capacity requirements, the demand for each of these outputs has to be forecast. These outputs could be in different phases of their product life cycles. In general, the outputs will have different growth rates and it is possible that some of the outputs are actually in the decline phase of their life cycles.

In general, the total demand for a number of outputs will show much less fluctuation than the fluctuations in the demand for any one of them. This is because the rate of growth of demand for each output is different and it is possible that as the demand for one output accelerates in its high growth phase, that of another output decelerates as it reaches its maturity phase. We might as well note, in passing, that if different outputs have unequal growth rates, the output mix of the organisation will also change with time.

Multiple outputs also provide some kind of a hedge against changes in environmental conditions-especially if the demand for these outputs are independent. As compared to a plant making only one brand of soap, another plant producing more brands and catering to different market segments will have much more stability in its total capacity requirements. In fact, this analysis leads us to the conclusion that better predictions of future demands could be made for those operations which are flexible as compared to the ones which have been designed for specific outputs using continuous flow processing or process industries.

Mature Outputs with Stable Demand Growth

Outputs which are in the maturity phase of their product life cycles exhibit less volatility in their demands. If the life cycle is very long, then the demand growth is steady and the demand can be predicted with great confidence. One can easily give examples of such outputs-steel, fertiliser, sugar, cement, textiles, electricity, hospital services and so on.

Long term forecasts of the demand of an output are made by using causal forecasting methods like regression analysis and econometric models or by using predictive methods like Delphi, market Surveys, Historical analogy and life cycle analysis or else by using non-formal methods like executive opinions and extrapolation.

Regression analysis tries to develop a forecasting function, called a regression equation, wherein the demand for the output is expressed in terms of other variables which perhaps cause or control the demand. For example, the demand for furniture may be expressed as a function of a number of variables such as, new construction activity index for the previous year, new marriages performed during the year, disposable personal income during the year and a trend effect. Although good computer programmes are easily available to carry out the computations involved in regressiqn analysis, it requires considerable time and cost as various hypotheses regarding the effect of variables may have to be tested to develop the regression equation. When used for long term forecasting, the causal variables needs to be forecast in future before a forecast for demand is made available by the regression equation.

Econometric forecasting method are really an extensive of regression analysis and include a system of simultaneous regression equations. For example, the demand of an output could be expressed as a function of GNP, price and advertising. The price in turn, is a function of its cost, selling expenses and profit; the cost could be a function of the production and the inventory levels and finally, the selling costs. Instead of one relationship we now have to estimate four and estimate them simultaneously. These methods require high am punts of time and cost.

All predictive methods, including Delphi technique, are qualitative methods which can be used even when historical data regarding past sales etc. are not available. They have a special role in long term forecasting since quantitative methods have strong limitations in predicting contingencies. The Delphi method draws upon a panel of experts in a structured manner to eliminate the possible dominance of the more vocal, more prestigious and the better salespersons in the group. Each expert in the group makes independent predictions in the form of brief statements. The coordinator edits and clarifies these statements and then provides a series of written questions to the experts along with the feedback by the other experts. This process is continued for several rounds. However, a reasonable amount of convergence is achieved in a small number, usually three to four, rounds.

Market surveys and other studies on consumer behaviour provide us-with a lot of primary data which can provide insights on factors like what makes a customer buy the product, what features have a high priority in the customers' preference structure, what are the perceptions of the competing products, the likely impact of price changes and so on. Such insights can prove to be extremely useful while the long term demand of the product is being predicted.

Historical analogy and life cycle analysis try to predict the growth of demand of an output by analysing its progress so far along its product life-cycle and also by comparing it with the life-cycle of another similar output. For example, the growth of demand of colour TV sets can be compared with the life-cycle of black and white TV sets and long term predictions of clour TV sets can be made based on such comparisons.

In case of multiple outputs, a similar exercise is to be carried out for each of the outputs and when added, they provide the capacity required throughout the planning horizon. If the outputs are not homogeneous, this might mean different capacity requirements for each sub-process.

Table 1

Projected Capacity Gap or Slack for a Multiple Output Organisation

	Capacity, units per year					
	Current 1987	1989	1991	1993	1995	1997
Predicted Capacity Requirements						
Output 1	10000	12000	14500	17500	21000	25000
Output 2	5000	6500	8500	11000	14500	18500
Machine Shop Capacity (Output 1 Equivalent)						
Requirement	20000	25000	31500	39500	50000	62000
Current	25000	—	—	—	—	—
(Gap) or Slack	5000	—	(6500)	(14500)	(25000)	37000)
Assembly Shop Capacity (output 1 Equivalent)						
Requirement	15000	18500	23000	28500	35500	43500
Current	15000	—	—	—	—	—
(Gap) or Slack	—	(3500)	(8000)	(13500)	(20500)	(28500)

In Table I we show how capacity gap or slack is calculated for each sub-process in case of a multiple output organisation. Both outputs 1 and 2 require some machine shop operations and then some assembly operations. However, each unit of output 2 requires twice as much machining as a unit of output 1. On the other hand, both the outputs require the same amount of assembly shop time for each unit. In Table

the capacities of both the machine shop and the assembly shop have been expressed in terms of units of output 1 using the above mentioned ratios. For example, in 1989, predicted capacity requirements are of 12,000 units of output 1 and 6,500 units of output 2. However, as each unit of output 2 requires twice as much machining time as one unit of output 1, the total capacity requirement of machine shop in 1989 would be equivalent to (12,000+2x6,500) i.e. 25,000 units of output 1.

In Table 1, we have predicted the expected capacity requirement for outputs 1 and 2 and used these to find the capacity (gap) or slack. One can also prepare the optimistic and pessimistic predictions.

New Outputs and Prediction of Demand

It is exceedingly difficult to prepare reliable long term demand forecasts for new outputs in their introduction or even rapid growth phases. This may also be the case for some mature products where the capacity planning is dependent on availability of supplies and this could be risky-for instance for petroleum.

As the uncertainty involved in such cases is higher, it is better to try to understand the probability distribution of the demand. One of the simplest ways for this is to estimate an optimistic prediction of demand for the output as well as a pessimistic prediction of demand for the same, over and above the expected predicted demand.

Let us consider a new product which is still in the rapid growth phase of its product life cycle. The growth in sales have been of the order of 80% this year and it is expected to continue to have a high growth rate. Table 2 gives the expected as well as the optimistic and the pessimistic capacity requirements. The optimistic assessment assumes that our market share will increase and when the market itself is growing, the demand for our product, could really grow very fast. However, with time there will be a slowdown in the growth rate. On the other hand, the pessimistic predictions assume that due to increased competition our market share will fall even though the predicted demand increases because of the expanding market. It can also be seen that uncertainty, in terms of the difference between the optimistic and the pessimistic predictions, increases as we look further into the future.

Table 2
Projected Capacity Requirements on Expected, Optimistic and Pessimistic Bases

	Capacity, units per year					
	Current .1987	1989	1991	1993	1995	1997
Expected Capacity Requirement	10000	16000	25000	38000	58000	83000
Optimistic Capacity Requirement	10000	20000	35000	60000	96000	145000
Pessimistic Capacity Requirement	I0000	14000	19000	24500	32000	42500

Using the capacity predictions of Table 2, we can easily work out the capacity gaps or slacks in different sub-processes. This has been done in Table .3 and 4 for the optimistic and the pessimistic predictions. A quick comparison reveals that if the optimistic predictions come true, then large capacity additions have to be built and the process has to start immediately as there would be a shortfall of 7,000 units per year by 1989 in machine shop capacity. On the other hand, the capacity additions need to be much smaller and slower if the pessimistic estimates were to come true.

Table 3
Projected Capacity Gaps or Slacks for the Optimistic Prediction

	Capacity, units per year					
	Current 1987	1989	1991	1993	1995	1997
Predicted Optimistic Capacity Requirements	10000	20000	35000	60000	96000	145000
Machine Shop Capacity	13000	-	-		-	
Machine Shop Capacity (Gap) or Slack	3000	(7000)	(22000)	(47000)	(83000)	(132000)
Assembly Shop Capacity	10000		-	--	-	-
Assembly Shop Capacity (Gap) or Slack		(10000)	(25000)	(50000)	(86000)	(135000)

Table 4
'Projected. Capacity Gaps or Slacks for the Pessimistic Prediction

	Capacity, units per year					
	Current 1987	1989	1991	1993	1995	1997
Predicted Pessimistic Capacity Requirements	10000	14000	19000	24500	32000	42500
Machine Shop Capacity	13000		-			
Machine Shop Capacity (Gap) or Slack	3000	(1000)	(6000)	(11500)	(19000)	(29500)
Assembly Shop Capacity (Gap) or Slack		(4000)	(9000)	(14500)	(22000)	(32500)

Activity B

Prepare a capacity forecast for your organisation. Which activities or, processes, or sub-organisation will pose slack (or gap) situations?

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6.5 GENERATION OF CAPACITY PLANS

Once the capacity requirements have been worked out, alternate capacity plans, listing the size and timing of capacity additions, can be generated. If the capacity available does not match the capacity required in any year, the capacity plan also mentions whether alternate sources of capacity will be used or whether the plan is prepared with the possibility of lost sales.

Size of Capacity Increments

When there is a growth in predicted demand of a product, the important question is how much of capacity has to be added and when, rather than whether capacity has to be added. Two strategies for capacity addition could be easily formulated: (i) add capacity in small increments but more often, and (ii) add large capacity increments but less often.

Two other related options are: (i) add capacity before the requirement exceeds the capacity available, and (ii) add capacity after the requirement has overtaken the available capacity. Of course, one can have mixed options such as adding a large capacity increment so that the available capacity is much in excess of the likely demand. However, as the demand is continuously growing, it will soon overtake the available capacity and then add another large increment of capacity.

Alternate Sources of Capacity

We have seen above the capacity of any facility also depends on the intensiveness of use. Therefore, a manager has access to a higher capacity without really building additional capacity by increasing the intensiveness of use. This includes alternatives like overtime, holiday work, additional shift working, etc. There is a further possibility of subcontracting a part or all of the transformation processing to outsiders and have access to their capacities as well. However, for specialised and sophisticated processing, subcontracting may not be feasible and similarly, for process industries working round the clock, it may not be possible to increase the intensiveness of use.

By making use of these alternate sources of capacity, one can reduce the cost of carrying a high capacity along with reducing the risk of not using the capacity built. Alternate capacity plans may have capacity gaps which would be met from these alternate sources of capacity.

Cost-Volume Relationships

For a given capacity, unit cost of production decreases with higher volume as the fixed cost gets spread over a larger volume. However, near the capacity limit and marginally above the normal capacity, the unit cost increases as the variable cost per unit starts increasing due to higher costs involving overtime, holiday work, subcontracting, etc. as well as the effect of general congestion at work places and of equipment. In effect, therefore, the unit cost of production will have the shape of a 'U' with the minimum being somewhere near the normal capacity established.

Economies of Scale

A higher capacity plant offers some economies of scale. It is. worthwhile going in for greater automation only in a high capacity plant. This, coupled with more sophisticated technology enables. a larger capacity plant to produce at a lower variable cost per unit although the fixed cost of production is much higher. The combined effect of these is that a lower unit cost can be achieved in a larger capacity plant.

There are other economies of scale as well. With increase in capacity, the increase in investment in inventories is less than proportional e.g. a 10007o increase. in capacity would require an increase of about 40%--50% in investment in inventories giving rise to an economy of scale. Similarly, in many process industries, the capacity increases as per the volume of pressure vessels, pipes, tanks, etc.where as construction costs vary as per the surface area of the same giving rise to an economy of scale in construction costs.

Lost Sales

An alternative to meeting the capacity requirement through additional capacity or alternate sources is to absorb some lost sales. However, lost sales always amount to losing some market share. This is a very risky. alternative, especially in the face of competition, while generating capacity plans because market share losses could be permanent.

Although lost sales are not found in capacity plans of commercial organisations, capacity could be perenially found to be below the requirement in case of many infrastructural facilities. This could be seen in power, public transportation, telephones, water supply and other. facilities. Even for commercial organisations, when there are sudden spurts in demand growth, there may be no alternative to meeting the demand through lost sales which amounts to absorbing a loss in. possible contribution.

Multiple and Anticyclic Outputs

As mentioned in 8.4 above, multiple outputs increase the stability of demand growth. Each output being in a different phase of its respective product life cycle, the demand for some outputs shows decline that of others could be in their growth phases. Consequently, the overall capacity requirement will have much less fluctuation than that for any one output.

A similar concept is useful even when the demand for an output is highly seasonal and varies widely during the course of a year. If possible, the addition of an anticyclic output can help in stabilising the capacity requirement throughout the year. The demand for electric fans is highly seasonal with the peak occurring in summer and the sales in winter coming close to nil. If heat convectors, which require similar production process, are added to the product range, the capacity requirement throughout the year will be more stable as the demand for heat convectors peak in winter. Electric fans and heat convectors are therefore anticyclic and the addition of anticyclic outputs makes it possible to have better capacity plans.

Activity C

In your organisation, how much alternative capacity resources. are there? Can certain work be subcontracted?

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6.6 EVALUATION OF ALTERNATE CAPACITY PLANS

The alternate capacity plans developed will have to be analysed to find the one which is most desirable for our purpose. This involves a quantitative 'analysis to find the economic consequences of different capacity plans based on the assumptions made regarding what is going to happen in future. However, there are uncertainties regarding future as well as many strategic effects flowing from capacity plans all of which cannot be quantified precisely. That is why there is a need for quantitative assessment of the risks and other. strategic consequences.

Economic Analysis for Mature Outputs with Stable Demand Growth

Establishment of capacity is always an ivestment and the returns from it accrue over a period 'of time. That is why some kind of discounted cash flow analysis has to be used so that alternate capacity plans can be compared.

For each alternate capacity plan, the general procedure requires that all the cash flows occurring in different years up to the planning. horizon have to be listed. All the costs incurred are cash outflows and the revenues earned are cash inflows. When all these cash flows are discounted at the cost of capital for the enterprise, we get the Net Present Value (NPV) for each capacity plan. The capacity plan having the highest NPV will be the most attractive from an economic perspective.

This basic methodology can be expanded by adding to the list of alternative capacity plans to take care of different locations e.g. when considering capacity expansions and even plans to have vertical integration-both backward (to produce what we are buying from our suppliers) and forward (to use in further processing and assembly what is currently our finished product).

Economic Analysis for Outputs with Highly Uncertain Demand Growth

When the demand growth is highly uncertain, the consequent cash inflows from any capacity plan are not reliable enough to make any conclusions. In such a case, knowledge of the probability distribution of demand is quite useful and in the absence of the detailed distribution, one needs to know the optimistic, expected and pessimistic predictions of demand. For each of these scenarios, the NPV for each alternate capacity plan can be computed. Different and appropriate capacity plans can turn out to be the most economic under each of these scenarios.

A more formal approach for such a situation involves using a decision tree to analyse the various alternate plans. Both the alternatives and the uncertain outcomes are shown on the decision tree. Probabilities are assigned to each of the uncertain outcomes and finally, the tree is folded back to find the best capacity strategy which results in the highest value of some criterion like the expected NPV. When the demand growth is highly uncertain, the choice of a capacity plan is highly dependent on the strategic effects of having. an over or an under-capacity.

Risk Analysis of Alternate Capacity Plans

All capacity plans are based on prediction of probable demand and the future

can never be predicted exactly. Thus, there is always some element of risk present in any planning process. What we have said above is that the risks are higher in the case' of new outputs than in the case of mature outputs with stable demand.

If demand cannot' be predicted exactly, the actual demand will either be low or higher than the predicted demand. In the first case, we are likely to be burdened with over capacity and in the second event we are likely to suffer from an under capacity. We should analyse the likely consequences of both overcapacity and undercapacity.

In each of the following situations the organisation may plan for having an overcapacity rather than an undercapacity if: (a) there are some minimum economic capacity sizes, below which the process becomes uneconomic, (b) the cost involved in establishing capacity is relatively low, (c) subcontracting is very difficult or impossible, (d) the lead time required to establish new capacity is very long, (e) the demand growth is more likely to be nearer the optimistic prediction than the pessimistic one, (f) cost sales are perceived by the trade very negatively and may amount to a more than proportionate drop in market share.

On the other hand', the organisation may plan to add capacity on a conservative basis in each of the following situations if: (a) alternate sources of capacity are easily available, (b) the cost involved in establishing capacity is relatively low., (c) the lead time required to establish new capacity is relatively short (d) the customers are either expected to wait or the lost sales have no long term consequences if the demand cannot be satisfied.

It is difficult to quantify many of the strategic consequences from having an undercapacity or an overcapacity and what is important is' to assess how these influence the competitive ability of the organisation.

6.7 SUMMARY

We have looked at the process of capacity planning in an organisation in this unit. We defined capacity as the limiting capability of a productive unit to produce. In case of homogeneous. outputs, the capacity can be expressed in units of output per unit of time. However, when the outputs are not homogeneous, the availability of the limiting resource is used to measure capacity.

We have listed an eight step process for capacity planning. One of these relates to the prediction of demand in future. We have discussed some of the methods available for long-term demand prediction which can be used for prediction of demand of mature outputs with stable demand growth. On the other hand, we need to assess the probability distribution of demand in future for new outputs and others where the demand growth is highly uncertain.

While generating alternate. capacity plans, the two primary factors are the size of capacity additions and the timing of such additions. It is necessary to know the alternate sources of capacity, cost-volume relations, economies of scale and the effect of lost sales while generating capacity plans.

Both quantitative and qualitative analyses have their role while analysing the alternate capacity plans recommended for implementation. While quantitative analysis looks at the direct economic consequences emanating from a capacity plan, qualitative analysis evaluates the strategic consequences of ending up with over and undercapacity.

6.8 KEY WORDS

Alternate Capacity Sources: Sources which increase the normal established capacity of any productive unit by increasing the intensiveness of its use e.g. by using overtime, holiday work, additional shift, etc. or by subcontracting the whole or a part of the processing.

Capacity: The limiting capability of a productive unit to produce.

Capacity Gap: The shortfall in capacity available to meet the capacity requirement.

Delphi Technique: A formal, structured method to lead a panel of experts to a consensus rather than a compromise by providing feedback in written form and by eliminating the possible dominance of vocal, prestigious members..

Econometric Forecasting Methods: An extension of regression analysis to include the estimation of a system of simultaneous equations.

Economies of Scale: The reduction in unit cost achieved by employing a higher capacity plant due to lower variable cost per unit from more sophisticated technology, lower capital costs per unit of capacity, lower investment, in inventories per unit of capacity etc.

Life Cycle Analysis: Predicting the demand growth of an output by comparing its growth with the product life-cycle of a similar output.

Lost Sales: The excess of demand over the capacity available, which amounts to a loss in contribution and might lead to a permanent fall in market share.

Market Surveys: Surveys of different elements of the market, e.g. customers, dealers, traders etc. to find facts and attitudes towards an output or any of its characteristics.

Mature Output: An output in the maturity phase of its product life cycle'.

Regression Analysis: A statistical method used in forecasting with the help of a regression equation which expresses the demand in terms of other variables which presumably control or cause the sales to increase or decrease.

Strategic Effects: Long-term effects of any decision which can influence the ability of the organisation to exist or to grow.

6.9 SELF-ASSESSMENT EXERCISES

1 What is meant by intensiveness of use of a productive unit and how is It relevant while establishing its capacity?

2 Service Organisations usually have to be provided with a higher capacity than the annual or monthly requirement. Why?

3 What do you think are the appropriate methods for predicting future requirements for:

i) Cement

ii) Colour television sets

iii) Pre-cooked noodles

iv) Petroleum

4 Establishing a minimum capacity and managing with alternate sources like overtime, additional shifts, and subcontracting is always a low-risk strategy. Comment.

5 Electronic toys are slowly becoming popular in the Indian market. The manufacturing process is relatively simple and primarily involves the assembly of many bought-out components. Assembly capacity can be added in relatively small units and is not very expensive as the assembly operations are highly labour

6.10 FURTHER READINGS

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