
UNIT 16 TECHNIQUES OF CONTROL

Structure

- 16.0 Objectives
- 16.1 Introduction
- 16.2 Traditional Control Techniques
 - 16.2.1 Budgetary Control
 - 16.2.2 Standard Costing
- 16.3 Modern Techniques
 - 16.3.1 Break-Even Analysis
 - 16.3.2 PERT (Programme Evaluation and Review Technique)
 - 16.3.3 CPM (Critical Path Method)
 - 16.3.4 Statistical Quality Control
 - 16.3.5 Management Audit
- 16.4 Let Us Sum Up
- 16.5 Key Words
- 16.6 Answers To Check Your Progress
- 16.7 Terminal Questions

16.0 OBJECTIVES

After studying this unit, you should be able to:

- explain the characteristics, elements, advantages and limitations of budgetary control
- describe the advantages and limitations of standard costing
- explain the concept and limitations of break-even analysis
- describe the meaning, advantages and limitations of PERT (Programme Evaluation and Review Technique)
- explain the meaning, advantages and limitations of CPM (Critical Path Method)
- describe the meaning and nature of statistical quality control, and
- explain the meaning, advantages and limitations of management audit.

16.1 INTRODUCTION

We have discussed in the previous unit the nature and purpose of the control function, its **importance** and stages. A variety of techniques or methods have been used over the years to help management in this task. Some of these techniques are regarded as traditional techniques in the sense that they have long been used by managers. Some newer modern techniques have also come to be widely used in recent years. However, even with the application of newer techniques, the traditional ones continue to be used by management for control purposes. In this unit we shall discuss in detail the traditional and modern techniques of control.

16.2 TRADITIONAL CONTROL TECHNIQUES

The control function of management is a systematic effort to set performance standards with planned objectives, to compare actual **performance** with the predetermined standards, to determine whether there are any deviations and to adopt suitable measures to ensure that performance is in conformity with the plans..

A variety of tools and techniques have **been** developed and used over the years for purposes of managerial control. Some of these techniques **are** termed as **traditional** and others as

modern. The traditional techniques of control have been found useful for a long period of time in the past and some of these, are still used by organisations. Two such techniques commonly used are: Budgetary Control and Standard Costing. Let us discuss about them in detail.

16.21 Budgetary Control

Simply stated, a **budget** refers to the plan of an enterprise expressed in financial or physical terms. It lays down financial estimates relating to various programmes or activities for a defined period on the basis of given objectives. These estimates are intended to serve as targets or standards for the purpose of controlling actual performance. For a business firm, budgets generally include plans to produce and sell goods at costs and prices which will bring the desired profit. Thus, **budgeting** consists of formulation of plans for future activity. It lays down objectives and programmes of action. It also provides yardsticks by which deviations from planned achievements can be measured.

Budgetary Control, as a technique of managerial control, refers to the principles, procedures and practices of achieving given objectives through budgets. Thus, budgetary control involves preparation of budgets, relating the responsibilities of managers to budgeted activities, and the continuous comparison of actual with budgeted results. It aims at securing the objectives as per the budget and providing a basis for its revision, if necessary.

Usefulness of Budgeting and Budgetary Control

Budgeting serves as a valuable aid to management with respect to planning, coordination and control.

- 1 **Planning:** Budgeting involves drawing up budgets based on well-defined plans of action. The knowledge, skill and experience of all managers are combined in the budgeting process. Hence, problems, if any, can be anticipated in advance and their solutions found after due consideration of various aspects. Past performance, policies and procedures are also evaluated during budget formulation. As a result, proper steps can be taken if there are deficiencies and weaknesses in the organisation.
- 2 **Coordination:** Budgeting serves another useful purpose, that of coordinating plans and activities of various departments and sections. It involves flow of information and communication between various units of activity through which the plans and operations can be properly coordinated. Managers who have to bear the responsibility of executing the plans participate in the formulation of plans. Differences of opinion and conflict of interests can be resolved more easily while budgets are drawn.
- 3 **Control:** Budgetary control which follows budget preparation serves the purposes of controlling income, expenses, costs and profits. It is also a device whereby cash and liquidity as well as the amount of capital provided by owners and leaders can be regulated by management. Of particular significance is the budgetary control of costs and expenses. When budgets are drawn, managers concerned are required to justify their requirements. The budget provision of expenses become standards which set the limits of expenditure. The actual expenses and performance are compared with the budget standards at specified intervals. Differences, if any, have to be explained by the managers responsible for the same.

Characteristics of Budgetary Control

Certain characteristics of 'Budgetary Control' which are evident from its nature and purpose may be stated as follows:

- i) A budget generally relates to a given 'future period' known as the budget period, usually it is one year.
- ii) It differs from objectives or policies because it is set down in specific numerical terms. It is based on realistic expectations supported by factual data rather than abstract thinking or an ideal formulation.
- iii) A good budget has 'flexibility'; it can be adapted to changing circumstances of the future. As budgeting is correlated with planning, a budget should be such as can be revised when the plan is modified.

- iv) It is important to secure the maximum 'participation' of the entire organisation in both preparation of a budget and following it through.
- v) As budgeting is fundamental to the organisation, it generally receives the attention and support of the top management.

The Budgeting Process or Elements of Budgetary Control

The following four steps are generally required to be taken in a system of budgetary control:

- 1 **Budget policy guidelines:** While estimating the desired performance over a budget period, the line managers base their expectations on several assumptions. These assumptions relate to many spheres, like the state of the economy, political trends, Government Policies, competitors' actions, strengths of the organisation, basic managerial policies to be followed and so on.
- 2 **Preparation of budgets:** Budgets denote statements of desired performance to which managers commit themselves. To secure commitment from managers, it is advisable to involve the managers in preparing their budgets based on the activities of their own budget centres. But while doing so the following points need to be kept in view viz:
 - i) The budget of every department must be in complete harmony with those of other departments. The marketing department cannot budget for hectic sales, if the factory manager wants to close down the plant for a major overhaul.
 - ii) The departmental budgets must also be in line with the targets set by the top management for the entire company.
- 3 **Reporting of variances:** At specified intervals, the managers of the budget centres must know their performance and how they stand vis-a-vis their budgets.
- 4 **Review and follow-up:** For any control system, the review and follow-up are as important as the planning process; the system of budgetary control cannot be effective to any degree, if one neglects this last step.

In short, we may summarise the steps in budgetary control process as under:

- 1 Statement of plans for a future period, expressed in numerical terms,
- 2 Consolidation of estimates into a well-balanced programme,
- 3 Comparison of actual result with the budget, and
- 4 Follow-up action including adjustment of plans where necessary.

Types of Budgets

Budgets are future plans and because an enterprise has more than one plan, there are many types of budgets which are generally used in an organisation. Outlined below are the more commonly used budgets:

- i) **Expense budget:** It lays down the estimates of the standard or norm of operating expenses of an enterprise for a given period.
- ii) **Revenue budget:** It indicates the income or revenue expected to be earned from sale of goods produced or purchased for sale.
- iii) **Cash budget:** It is a statement of the anticipated receipts and payments for a given period along with the resulting surplus or deficit.
- iv) **Capital budget:** This type of budget outlines the anticipated expenditure on plant, machinery, equipment and other items of a capital nature.
- v) **Sales budget:** It represents the plan of sales for a given period.
- vi) **Production budget:** It shows the volume of production to be undertaken for a given period, together with the material, labour and machinery requirements. Sometimes production budgets also show the anticipated cost of production.
- vii) **Purchase budget:** It represents the quantities of raw materials and other consumable items to be purchased by a manufacturing company.

- viii) **Labour budget:** It indicates the types of skills of labourers and the numbers in each category estimated to be required in a given period along with the standard wages payable.
- ix) **Master budget:** This is prepared for the whole enterprise by compiling the different sectional budgets which is finally adopted and worked upon.

Advantages

- i) It provides the management with a means of control over planned programmes.
- ii) Wastage is minimised and hence maximum efficiency is achieved.
- iii) Expenditure beyond what is provided in budgets is not incurred without prior sanction, hence scrutiny is possible before actual expenditure.
- iv) Management by exception is possible, because comparison of actual and budgeted **performance** reveals where management attention is needed the most.
- v) It is not merely an instrument of planning but also of **coordination**.
- vi) It provides an effective means by which top management can delegate authority and responsibility without sacrificing overall control.

Limitations

While the advantages of budgetary control are recognised, certain limitations which may restrict its usefulness should also be guarded against:

- i) Budgets are drawn on the basis of estimates and forecast which are subject to future uncertainties. The usefulness of budgetary control depends on the reliability of forecasts and accuracy of data used for budgeting purposes.
- ii) A **serious** limitation of budgeting is that it tends to bring about rigidity in control. Deviations may be caused by factors beyond the control of managers. As a result, to avoid responsibility, there is a tendency on the part of the managers to play safe while taking decisions. On the other hand, if the budget standards are leniently enforced and deviations are too often excused, the purpose of control is lost.
- iii) Rivalry between departments with regard to budgetary allocation of expenditure may create problems for top management which cannot be easily resolved.
- iv) The cost of employing additional staff for budgeting is often quite high and beyond the means of small enterprises.

16.2.2 Standard Costing

Standard costing as a technique of control may be defined as a system which involves the use of predetermined 'standard costs' relating to each item of cost and for each line of product, manufactured or service rendered.

Standard cost refers to a predetermined estimate of cost which can be used as a standard or yardstick. It suggests what the cost should be under given conditions. Standard costs form the basis of control under standard costing. Actual costs are compared with the standards, variations, if any, are analysed, and **suitable** action is taken to correct adverse tendencies. Thus, standard costing may be **regarded essentially** as a tool of cost control.

Standard costing is an essential part of budgeting and budgetary control. It may be noted that budgetary control is a broader function. It consists of setting objectives and planning business activities for all departments; it lays down standards of cost and expenses as well as targets of sales income. Standard costing provides the **basis** of framing the expense budgets particularly in respect of direct material and labour costs.

Advantages

The advantages of standard costing as a technique of control may be outlined as follows:

- i) **Serves as a yardstick:** Standard costs serve as yardstick to measure the efficiency of operation. Deviations of actual costs **from standards** are regularly analysed and causes are examined. There is a continuous **check on** the costs incurred. Hence, adverse tendencies can be promptly located, and corrective measures may be adopted.

- ii) **Opportunity to review the costs:** Cost control is more effective under standard costing as the standards of cost are reviewed at intervals for improvement. This results in cost reduction and improves the efficiency of operation.
- iii) **Opportunity for the improvement in the method of operation:** A detailed study of all operations is undertaken while setting the standard costs. This involves defining the authority of managers and assigning responsibilities to employees. Causes of inefficiency are often corrected in that process. It may also lead to improvement in the methods of operation and reduction in costs.
- iv) **Serves as a valuable aid to management:** In preparing production plans and pricing of goods, standard costing serves as a valuable aid to management. It does not leave any scope for high prices being fixed due to inefficiency of operation. Thus, standard costing helps competitive pricing of products.

Limitations

Even though standard costing may be applied in any industrial organisation, in practice it is found to be most suitable in industries where the product and its components are standardised. In other cases, it is more difficult and expensive to apply. Secondly, the success of standard costing depends on the reliability and accuracy of standards. Employees often resent standards which are too ambitious and are difficult to attain. Moreover, standards may mean different things to different persons unless they are clearly defined and well understood by the employees concerned.

Check Your Progress A

1 What is 'budgeting' ?

.....

2 Define budgetary control.

.....

3 Why is standard costing regarded as an essential part of budgetary control ?

.....

4 Which of the following statements are True and which are False.

- i) The difference between actual and budgeted expenses must be explained by the managers concerned.
- ii) Budgetary control is a traditional technique of control which is not used in modern times.
- iii) Departmental budgets must be in harmony with each other.
- iv) Budgetary control serves only as an instrument of planning.
- v) Standard costs generally indicate what costs should be under ideal conditions.
- vi) Standard costing cannot be easily applied except in the case of standardised products.

16.3 MODERN TECHNIQUES

Besides the traditional techniques of budgetary control and standard costing, there are several other techniques of control which have been developed in modern times. These techniques may also be called non-budgetary techniques. One or more of these techniques may be adopted along with budgetary control and standard costing. Let us discuss the more important techniques in detail.

16.3.1 Break-Even Analysis

Break-even analysis as a technique of control consists of the analysis of costs in relation to changes in the volume of sales and its impact on profit. It is basically concerned with determining the relationship between cost, volume of sales and profit. One of the major concerns of the management of an enterprise relates to the impact of changes in the volume of sales on profits. It is of interest to them to know the volume of sales at which costs will be fully covered and beyond which profits will be earned. For this purpose, two types of costs are distinguished. Variable costs (like direct materials cost, direct wages, etc.) and Fixed costs (like factory and office rent, managers' salary, etc.). If production and sales increase, variable cost per unit remains constant but fixed cost per unit declines. Suppose, the direct materials cost of a product is Rs. 10 per unit and direct wages per unit comes to be Rs. 5, whereas fixed cost upto the total production capacity is Rs. 400. Then, for 100 units produced and sold, the variable cost will amount to Rs. $(10 + 5) \times 100$ i.e., Rs. 1500. For 200 units, the variable cost will be double the amount i.e., Rs. 3000. Fixed cost remains the same. Total cost for 100 units will thus be Rs. 1900, and for 200 units it would be Rs. 3400, not Rs. 3800. Hence, the total cost is found to rise less than proportionately to the increase in sales revenue. If the volume of production and sales decrease, there is a reverse effect. Thus, for 50 units the total cost will be Rs. $(15 \times 50) + 400$ i.e. Rs. 1150. It will not be half of Rs. 1900 (total cost of 100 units). In other words, the total cost decreases less than proportionately to the decrease in sales revenue.

Further, suppose the selling price of the product per unit is fixed at Rs. 17. In that case, for each unit sold there will be a margin of Rs. 2 after meeting the variable cost of Rs. 15. To recover the fixed cost of Rs. 400, the firm must sell at least 200 units. The total sale price $(200 \times \text{Rs. } 17)$ will then be equal to the total cost i.e. Rs. 3400.

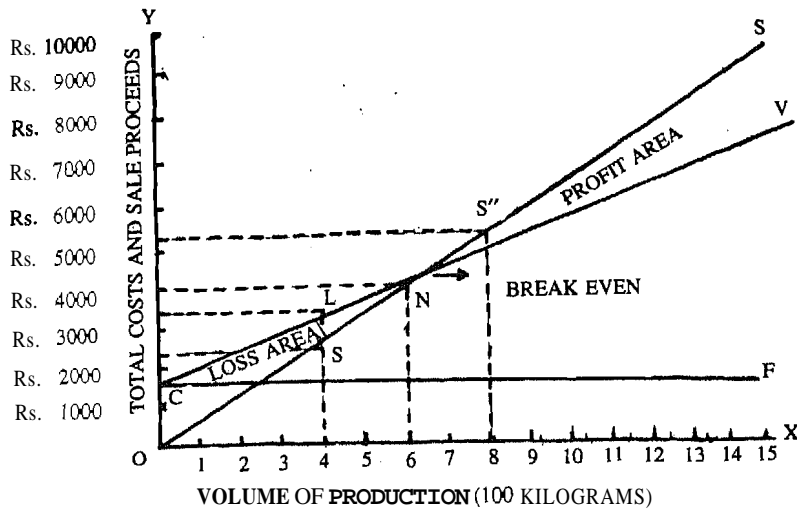
Thus, sale of 200 units (or Rs. 3400 sales revenue) may be regarded as the volume at which there is neither any profit nor any loss. This is known as the break-even volume. It indicates the number of units that must be sold if the business is to be run without loss. Each unit of product sold above the break-even volume is expected to yield profit. If 250 units are sold, the profit earned will be Rs. 100 $(50 \times \text{Rs. } 2)$. This is because, the variable cost will increase by Rs. 15 per unit while sales revenue will rise by Rs. 17 per unit and there being no increase in fixed costs, there will be a margin of Rs. 2 per unit on 50 units as the profit.

The difference between the selling price and variable cost per unit is known as the contribution margin. The amount of this difference contributes towards the recovery of fixed costs. Hence, the break-even volume of sales in units can be calculated by dividing the total fixed cost by the contribution margin. In the above example, the contribution margin is Rs. 2 $(\text{Rs. } 17 - \text{Rs. } 15)$, and the fixed costs are Rs. 400. So, the break-even volume is $\text{Rs. } 400 \div 2$ i.e. 200 units. On this basis, the break-even volume can be determined by the formula:

$$\text{Break-Even Volume} = \frac{\text{Total Fixed Cost}}{\text{Contribution Margin per unit}}$$

The break-even analysis is often carried out with the help of a chart. It is called break-even chart. This is a graphical representation of variable and fixed costs in relation to the volume of operation. The chart is described as break-even chart because there is a particular point in it, which breaks even the volume or shows the particular volume at which there is neither profit nor loss but equality between total costs and total revenues from the operation.

The figure below is a hypothetical break-even chart; the X-axis represents the volume of production in 100 kilograms unit; Y-axis, the total cost, as also the total sale proceeds; the line FC shows the (total) fixed cost; VC, variable cost; OS, the sale proceeds; and N the break-even point.



When the volume of production is 600 kgs., the total cost of production = total fixed cost + total variable cost = Rs.1500 + Rs. 2500 (as read from lines FC and VC respectively) =Rs.4,000; total sale proceeds also = Rs. 4,000 (as indicated by the line OS). Thus, N is a point where total costs just equal sale proceeds. But when production is less, say 400 kgs., total cost corresponding to point L on VC is about Rs. 3,300 while total sale proceeds at point S' are about Rs. 2,600. This means a loss of about Rs. 700. On the other hand, when production is 800 kgs., total cost is about Rs. 5,000 and total sale proceeds at point S'' on OS equal about Rs. 5,300. This means a profit of Rs. 300. Similarly, it may be shown that all production which is more than 600 kgs, yields profits and all production which is less, leads to loss.

Advantages

The break-even analysis renders many benefits for managerial guidance and action:

- 1 **Tool for profit planning and controlling:** Cost, volume, price and product-mix being the four variables affecting profit, planning and controlling of profit are better effected by the break-even analysis which shows the interplay and mutual relationship of these variables.
- 2 **Basis for budgeting:** As budgeting calls for marshalling anticipated costs and budgeted revenues for realising optimum profits, break-even analysis show the most profitable path for projecting budgets.
- 3 **Objectivity in cost controlling:** The break-even analysis introduces objectivity in cost control by indicating the way of controlling cost. Although changes in fixed costs affect the break-even point, it is not susceptible to control by managerial actions in the short run.
- 4 **Indication of safety margin:** Break-even analysis not only points out the level of sales at which the company breaks even on expenses but it also indicates the extent of nearness of sales to the break-even point before they occur. By providing this information about the safety margin, management is warned for taking remedial actions.

Limitations

The break-even analysis tends to be rigid due to certain limiting assumptions involved therein. Assumptions which underline the break-even analysis include the following:

- 1 Either one product is **manufactured** or a group of products having the same volume and contribution margin are dealt in by the company.
- 2 Selling prices are not affected by the volume of operations and the general price level of the industry does not change.
- 3 Variable costs vary directly with the volume of output and sales and fixed costs remain **constant**. Actually, variable costs may change more or less proportionately due to

technical factors, and fixed costs may rise or fall in the long run. There is no time lag between production and sales and the entire production is sold out.

16.3.2 PERT (Programme Evaluation and Review Technique)

The key to success of most organisations is to clearly examine the projects or activities for the achievement of an objective within stipulated time and cost. Management is then required to determine detailed activities and their interrelationships, to estimate resources required and the time needed to complete these activities as per schedule, and to monitor and control the time and cost of the project.

Network analysis is a technique which is concerned with minimising the total completion time of the project, as well as minimising the over-all project costs. The network analysis is eminently suitable to projects which are not routine or repetitive and which may be conducted only once or a few times, such as construction of buildings, dams, research and development, marketing of new products, building a ship, construction of factories, missile production, etc. PERT and CPM are the two very popular types of network analysis used in modern management.

PERT is basically a technique of project which is useful in the following managerial functions.

- 1 **Planning:** The planning of any project involves the listing of various jobs that have to be performed to complete the venture. Requirements of men, material and equipment are drawn up alongwith the estimates of costs and durations for the various Jobs, in the process of planning.
- 2 **Scheduling:** Scheduling is the arrangement of the actual jobs of the project according to sequence of the time in which they have to be performed. Calculations of manpower and materials required at each stage of production are made alongwith the expected completion time of each job.
- 3 **Control:** The process of control commences with comparison of the difference between schedules and actual performance, once the project has begun. The analysis of the difference and the remedial action taken is the essence of control.

The first and most important condition for using PERT is the breaking up of the project into jobs or activities and determining the order of precedence for these jobs, that is, deciding which jobs are to be completed before an other can be started.

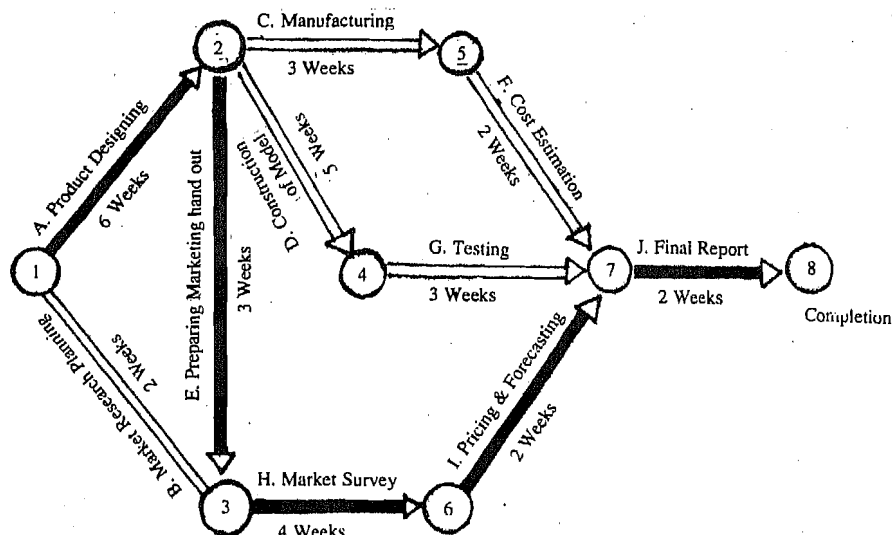
The next step is to draw a picture or graph which illustrates the jobs outlining the predecessor and successor relations among them. A thorough understanding of the steps associated with the construction of the graph is essential for the grasp of PERT and CPM.

The concept may be explained through an illustration. Let us suppose a company is developing a new product. The major activities (tasks) in this job are listed below in their sequence.

Activity	Description	Immediately preceding activities	Expected time of completion in weeks
A	Designing the product		6
B	Market Research		
C	Manufacturing	A	3
D	Prepare the model of product	A	5
E	Prepare marketing handout	A	3
F	Estimate cost	C	2
G	Test the acceptability of the product	D	3
H	Market Survey	B,E	4
I	Pricing and Forecasting of sale	H	2
J	Final report	F,G,I	2
		Total	<u>32</u>

From the list of activities, it may be seen that estimation of cost (task F) cannot begin until task C, manufacturing, has begun. Similarly, pricing and forecasting of sale (task I) cannot be started till market survey (task H) is completed. The list of activities also shows the expected time of completing each task. The network of activities can now be constructed as shown in the figure below:

Figure 16.2: Pictorial representation of PERT and CPM



The network chart above shows which tasks can be performed simultaneously and which must wait for the preceding tasks to be completed. For example, once the product has been designed, preparing a model, testing the acceptability of the product, manufacturing and cost estimation can be undertaken at the same. Buhmarket survey cannot begin until the market research plan and the marketing handout have been prepared. The jobs are shown as arrows leading from one circle in the graph to another. The circles are described as 'nodes' and denote the events or completion of particular jobs. The 'node' from which the arrow starts is known as the 'initial node' and the node at which the arrow ends is the 'terminal node'. Thus, the 'node' where the arrow depicting a job ends will be the starting point for the arrow depicting the next job or the succeeding job.

Picturisation of a project is nothing but division of the project into activities and arrangement of activities in the order in which they are to be performed, first, second and so on. The activities are then named and portrayed in the project graph or arrow diagram.

Advantages

PERT is useful and convenient tool in the hands of management, particularly for the top level manager who has the overall managerial responsibility of a project. Moreover, it is helpful in solving problems of scheduling the activities of one-time projects, that is, the projects which are not taken on routine basis. As a tool of planning and control, its specific contribution is as under:

- 1 **Advance planning is possible:** It compels managers to make advance planning for fitting the relevant parts into an integrated whole. Actually speaking, it is impossible to make a time-event analysis without planning and seeing how the pieces fit together. It also forces planning at lower levels because each manager has to plan the activities for which he is responsible.
- 2 **Systematic planning:** Because it includes a number of events and activities at different levels of the organisation, it calls for systematic planning all down the line.
- 3 **Attention on critical events:** It is instrumental for concentrating attention on critical or strategic elements that may need correction or modification, because a delay in their performance will delay the whole project unless managers are able to make up the time by shortening some future activities.
- 4 **Possibility of forward-looking control:** It requires a system of forward-looking control with a view to completing sequential events and activities in proper time, i.e. it presses for right action, at right point and at right time in the organisation.

- 5 All-round coordination: It rosters all-round coordination by way of looking into the time, quantity and direction dimensions of coordination.

Limitations

It has got certain limitations also such as:

- 1 Time estimate: The main difficulty comes in the way of time estimates for the completion of activities because activities are of non-repetitive nature. Actually speaking, the expected time for each activity of any programme cannot be determined with certainty.
- 2 Not worthwhile for routine planning: PERT has special application in creating planning and it is not advisable for adoption in routine planning for recurring events as in the case of mass production.
- 3 No emphasis on costs: PERT gives emphasis on time only and ignores costs. As a result, it is suitable for programmes where time is of essential consideration or where time and costs have a close relationship. In other cases, it has limited application.

16.3.3 CPM (Critical Path Method)

CPM was developed by the engineers of the Du Pont Company in the 1950s for its application in all scheduling work, construction projects, research and development programmes and in many other situations that require estimates of time and performance. It calls for dividing a programme or project into its elementary parts in their chronological order of sequence. By breaking a project into interconnecting parts, the CPM technique is helpful in finding out the more strategic elements of a plan for the purpose of better designing, planning, coordinating and controlling the entire project.

Let us examine the concept of critical path to appreciate the significance of the critical path method as a technique of control.

In a network of activities one can enumerate a number of sequences of operations (paths) from starting event to end event of the project. Each sequence contains different combinations of activities with different durations. The study of the duration of various paths in a project can tell us the minimum time in which a particular project can be completed. The sequence of activities (path) for which the duration is the maximum indicates the minimum duration for the completion of the project.

This path is known as the 'Critical Path' being the path of maximum duration and reflects the minimum time necessary for the completion of the project. The critical path is so called because any delay in the completion of the activities lying on this path would cause a delay in the whole project. To finish the project in time, the activities lying on the critical path should be given top priority.

In the PERT network graph shown earlier, the critical path is marked by thick arrows. For example, once the path reaches node 2, there are three possible routes to node 8. The longest route is 2,3,6,7 which indicates the critical path since the path will take 9 weeks, the longest period. Other possible routes are 2,5,7, and 2,4,7 which would take 5 weeks and 8 weeks respectively. Paths other than the critical path are called sub-critical paths. The total time for their completion is less than that of the critical path. Hence, these are also known as 'slack' activities.

Main Features

The main features of the critical path method may be stated as follows:

- i) A network of events and activities is presented pictorially in CPM with the help of several circles and arrows.
- ii) Each circle represents an event and each arrow represents an activity.
- iii) An event signifies the beginning of one activity and the end of another activity.
- iv) Events are assigned serial numbers for expressing their sequence and their separate identification.

- v) An activity, on the other hand, implies time-consuming efforts or action required for achieving an event.
- vi) The flow of sequential activities is indicated by the arrowhead, and such flow calls for estimating the time in number of days or weeks in respect of each activity between any two events.

After a network of events and activities has been presented and times for all the activities have been shown, the critical path is identified by reference to those strategic events and activities which take the longest time to complete the whole project and which thereby leave the least slack time. (Slack time is the difference between the target time and project-completion time.) In other words, the critical path shows the minimum expected time in which the project as a whole can be completed. Although attention is focused on one critical path in network system, there may exist several paths in order of importance.

Objectives of CPM Analysis

The following are the main objectives of critical path analysis in a network:

- i) To determine a route or path between two or more operations which optimises some measure of performance.
- ii) To locate the points of likely obstacles and difficulties in the execution of any project.
- iii) To determine starting and finishing times for each operation/ activity in a network/ project.
- iv) To determine the slack associated with each non-critical activity.

Advantages

The network analysis through CPM leads to a number of benefits:

- 1 It focuses attention on the timely completion of the whole project.
- 2 It results in the optimum utilisation of resources and facilities.
- 3 It enables managers to:
 - i) make advance planning for all activities;
 - ii) identify strategic events;
 - iii) direct potential bottlenecks to the flow of work; and
 - iv) avoid an unnecessary pressure on other paths.
- 4 It improves the quality of planning and controlling in a number of ways, because of concentrated thinking and attention on each activity of the project, rather than on the whole of it.

Hence, it provides a systematic procedure to determine the minimum duration in which project can be completed.

Limitations

The CPM analysis is subject to two major limitations:

- 1 It has limited use and application in repetitive or routine operations and for recurring projects.
- 2 Time allowed for different activities may prove to be unrealistic, because the same estimate for each activity is based on a single time without any consideration of future contingencies and impending difficulties.

PERT and CPM Compared

PERT and CPM as techniques of planning and control have certain similarities as well as differences.

The two techniques are similar in the following respects :

- 1 Both CPM and PERT use the project network as their basis.
- 2 The concepts of critical paths and activity slack are common to both.
- 3 Both the techniques are basically time-oriented. They are now used for cost control as well.

The differences between the two techniques are the following:

- 1 PERT is used for new industries with rapidly changing technology having more uncertainties, while CPM is used for construction projects where uncertainties are limited.
- 2 CPM is activity-oriented while PERT is event-oriented.
- 3 CPM lays stress on the element of costs whereas PERT is concerned essentially with the time factor.

Usefulness of PERT, and CBM

The applicability and usefulness of PERT and CPM techniques depend largely on the validity of the following assumptions:

- 1 A project can be broken up into a set of independent and predictable activities.
- 2 The predecessor-successor relationships of the activities can be effectively represented by non-cyclical network graph in which each activity can be connected directly to its immediate successor. In many cases, it is not possible to clearly lay down the procedure relationship between the activities.
- 3 All the activities can be estimated in respect of the duration. Here again it is a difficult proposition in respect of many activities.
- 4 The CPM technique assumes that the duration of an activity is inversely related to the cost of resources allotted to the activity. Here again it is quite often that estimation is difficult.

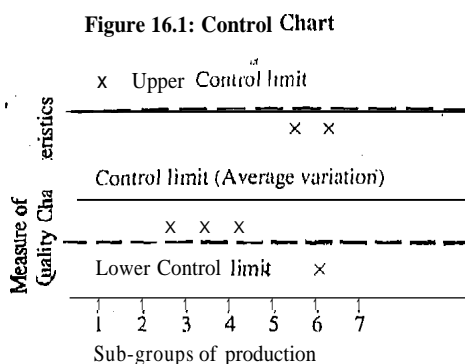
16.3.4 Statistical Quality Control

The purpose of quality control is to ascertain whether the quality of a product or service is being maintained or if there is any variation in size, weight, finish etc. In every production process there are always some standard specifications laid down either by the producer or the consumer. A good quality item is one which conforms to these specifications. However, variation in the quality of a product is inherent in every production process due to a number of factors. So, it is necessary to ascertain the variation which may be quantitative and qualitative. Quantitative characteristics are those which can be directly measured, e.g. weight, height, diameter etc, and such variations can be noted with the help of specific instruments. On the other hand in qualitative characteristics, direct quantitative measurement is not possible, e.g. cracks, breakage, colour etc. These can be determined by inspection only or by distinguishing between defective and non-defective items. But variation in the quality of products being an inherent characteristic of manufacturing process, irrespective of all possible precautions and measures there are possibilities of random disturbances responsible for deviations in the quality of the product from the set standards. The sources of these disturbances are known as chance causes, e.g. changes in machine speed due to sudden changes in temperature or voltage of power supply etc. The presence of these causes in the system is due to multitude of reasons which are difficult to identify and uneconomic to eliminate. There may be other sources of variations which further cause the product to deviate from set standards. These causes are individual and can be identified and eliminated economically. The magnitude of variability due to these causes varies with the conditions of the production process, nature of raw material, behaviour of operation etc. These causes are known as assignable causes.

Statistical quality control refers to the technique of ascertaining whether the variation in the quality of the product is due to chance causes or due to assignable causes. If the variation is due to assignable causes it is detected and some corrective action is planned to improve the quality of the product. Statistical quality control is carried out with the help of control charts. To prepare a control chart the whole production line is divided into a number of sub-groups. The basis of selecting these sub-groups is such that variation in the quality of items within each sub-group is attributed due to chance causes, whereas the corresponding variation between various sub-groups can be due to assignable causes. The variation of quality characteristic within and between the sub-groups is analysed by some method to identify whether the process is in control or not.

Briefly speaking, statistical quality control is based on statistical estimation of errors or possible variation from the average (normal) proportion of errors. In its simple operation it involves specifying the quality levels and limits on control, and then plotting the variations

on the control chart. For example if the lower limit of variation (due to assignable causes) is 5%, and the upper limit of variations (due to chance causes) is 10%, the management may allow variations of quality between 5 and 10% as acceptable. However, if the control chart indicates the variations (or errors) above 10%, the quality of work performed is investigated. The fixation of the control limits for a process is based on the assumption that the system is stable and only chance causes are present. In case assignable causes are operative in the system then quality characteristic will fall outside the two control limits. A typical control chart is shown below :



The following interpretations can be made from the Control Chart:

- i) If all the points in the chart lie within **U.C.L.** and **L.C.L.** then the process is said to be in control indicating presence of chance causes only.
- ii) If points lie predominantly on one side of the central line then it is not safe to derive any conclusion about the process control.

16.3.5 Management Audit

Management audit is a systematic and impartial examination, **analysis** and appraisal of management's overall performance. It is basically a procedure of appraisal of management's total performance by means of an objective, and comprehensive **examination** of the organisation structure, its objectives, plans and policies, its operation and its use of physical and human resources, and methods of operation. Thus 'management audit' signifies a critical assessment of management of the enterprise from the broadest point of view. It may be undertaken by the management itself or it may be carried on with the help of management consultants.

One very important feature of management audit is that instead of comprehensive audit, company may even apply it to a specific section of the organisation. As regards its scope, 'production efficiency' or 'investment appraisal' may be the subject matter of 'management audit'. It may even be used to provide guidance on critical assessment of capital budgeting or profit performance.

Advantages

Management audit serves to make overall managerial functions more effective. Its advantages may be outlined as follows:

- 1 It is an insurance against self-complacency and illusions of good management on the part of managerial personnel.
- 2 It supplies management with **useful information** on a continuous basis which measures efficiency and shows deviations from plans, policies and procedures.
- 3 It has also a preventive effect on deviations and mistakes because the **audit** keeps executives on the track and make them careful: It acts as a sort of safety valve, watchman and conscience keeper of the organisation.
- 4 It can appraise all aspects of the organisation and lead not only to sound performance, but also to peak performance.
- 5 It enables management to see things in proper perspective and in the light of future developments.
- 6 Since **plans, policies and operations** are subjected to critical study under **management**

audit, their **appropriateness** and effectiveness in the organisation are also revealed in the process.

Limitations

The major limitation of management audit is that it may discourage management from taking initiative and bringing about changes in policy and procedures in view of risks involved. In other words, management audit may induce executives to play safe where critical decisions are required to be taken. Executives are also likely to be demoralised if their performance is critically reviewed and responsibility cast on them for deficiencies caused by factors beyond their control

Check Your Progress B

1 What is meant by Break-even analysis?

.....
.....
.....
.....
.....

2 Define Statistical Quality Control.

.....
.....
.....
.....
.....

3 Spell out the following abbreviations:

PERT:

CPM:

4 Which of the following statements are True and which are False.

- i) Management audit is nothing but appraisal of the financial performance of the organisation.
- ii) PERT and CPM are two aspects of network analysis.
- iii) PERT is only helpful in controlling the execution of time bound projects which may be undertaken occasionally.
- iv) Control Charts are not essential for statistical quality control.
- v) Break-even analysis is possible without the use of a break-even chart.

16.4 LET US SUM UP

A variety of tools and techniques of control have been developed and used for purposes of managerial control. The traditional techniques of control have been found useful for a long period of time and some of these are still used by organisations. Two of these techniques are: Budgetary control and Standard costing.

Budgetary control refers to the principles, procedures and practices of achieving given objectives through budgets. It involves preparations of budgets, relating the responsibilities of managers to budgeted activities, and the continuous comparison of actual with budgeted results. Budgeting and budgetary control serve as valuable aids to management with respect to **planning**, coordination and control.

There are several types of budgets, of which the more commonly used are: expense budget, revenue budget, cash budget, capital budget, sales budget, purchase budget, labour budget,

and master budget. Standard costing as a technique of control consists of the use of predetermined standard costs relating to each item of cost and for each line of product manufactured or service rendered. Standard costing is an essential part of budgeting and budgetary control.

Besides budgetary control and standard costing, several other techniques of control have been developed in modern time, such as, Break-even analysis, PERT, CPM, statistical quality control and management audit. One or more of these techniques are often used along with budgetary control and standard costing.

Break-even analysis is a technique of control which consists of the analysis of costs in relation to changes in the volume of sales and its impact on profit. It determines the volume of sales at which costs will be fully covered and beyond which profits will be earned. The analysis is often carried out with the help of a chart known as break-even chart. This is a graphical representation of variable and fixed costs in relation to the volume of production and sales. At the break-even point on the chart, there is neither profit nor loss and there is equality of total costs and total revenues.

PERT (Programme Evaluation and Review Techniques) is basically a technique of project management. It involves the use of the basic network technique and requires the following steps: (1) breaking up the project into jobs and activities, (2) deciding which jobs are to be completed before another can be started, (3) preparing a graphical flow chart indicating the predecessor and successor relations among the jobs, and (4) specifying time and cost estimates for completion of each job.

Thus, PERT lays down the schedule of job performance according to sequence of time for performance. The process of control commences once execution of the project starts. The difference between schedules and actual performance are analysed and remedial action is taken.

The critical path method calls for dividing a programme or project into its elementary parts in their chronological order of sequence along with the duration of various paths (sequence of operation) from starting event to end event of the project. This reveals the minimum time in which a particular project can be completed. The sequence of activities for which the duration is the maximum indicates the minimum duration for completion of the project and its path is known as the critical path. To finish the project in time, activities lying on the critical path is required to be given top priority.

Statistical quality control is concerned with ascertaining whether the quality of a product or service is being maintained or if there is any variation in the specified size, weight, finish, etc. The main objective of this technique of quality control is to keep the variation in quality due to chance causes within the control limit. Control is effected with the help of control charts. In its simple operation, statistical quality control involves specifying the norm of quality level and limits on control, and then plotting the variation on the control chart. If all the points in the chart lie within the upper control limit and the lower control limit, then the process is said to be in control indicating the presence of chance causes only. If points are outside the control limits, the matter is investigated for assignable causes.

Management **audit** refers to the systematic and impartial examination, analysis and appraisal of the overall performance of management. It consists of a critical assessment of the management of an enterprise through a comprehensive examination of the organisation structure, its objectives, plans and policies, methods of operation and control, and the use of physical and human resources. It may be undertaken by management as self-audit, or may be carried out with the help of management consultants.

16.5 KEY WORDS

Break-Even Analysis: Analysis of costs in relation to volume and impact of the same on profits.

Break-Even Chart: A graphical representation of break-even analysis.

Budget: Plan of an enterprise for a specified period expressed in financial or physical terms,

Budgeting: Formulation of budget.

Budgetary Control: Principles, practices and procedures of achieving given objectives , through budgets.

Control Chart: A chart indicating the variations of quality of products around the control limit.

CPM (Critical Path Method): Technique of determining the minimum duration of completing a project on the basis of the critical path.

Critical Path: Path of activities with maximum duration.

Fixed Cost: Cost which has to be incurred irrespective of the volume of production and sale.

Management Audit: Comprehensive appraisal of management performance with respect to various aspects of organisational plans, policies and decisions.

PERT (Programme Evaluation and Review Technique): Technique based on network analysis which uses estimates of time required to complete tasks for scheduling and controlling execution of projects.

Statistical Quality Control: Technique of controlling product quality through the establishment of control limits.

Variable Cost: Cost which varies in direct proportion to the volume of production and sales.

16.6 ANSWERS TO CHECK YOUR PROGRESS

A 4 i) True, ii) False, iii) True, iv) False, v) False, vi) True

B 4 i) False, ii) True, iii) True, iv) False, v) True.

16.7 TERMINAL QUESTIONS

- 1 What is budgetary control? What are its advantages and limitations?
- 2 Define Standard Costing? How does it help in keeping the costs within control.
- 3 What is meant by Break-even analysis? Explain its uses in decision-making.
- 4 Draw a Break-even chart analysing Break-even point taking imaginary data.
- 5 Discuss the nature, benefits and limitations of Break-even analysis as a control tool.
- 6 Explain the concept and importance of PERT and CPM as tools for control.
- 7 What is network analysis? Evaluate PERT/CPM as planning or control technique in project formulation, implementation and evaluation.
- 8 Explain the importance of statistical quality control. Describe how a control chart is constructed and interpreted.
- 9 Explain the concept of management audit.

Note: These questions will help you to understand the unit better. Try to write answers for them. But do not send your answers to the university. These are for your practice only.

SOME USEFUL BOOKS

Gupta C.B. 1989. *Business Organisation and Management*, Sultan Chand and Sons: New Delhi. (Section vi, Chapters 3, 15 and 16)

Koontz Harold and Cyrill O'Donnell. 1987. *Management*, McGraw-Hill Book Company: New Delhi. (Part 6, Chapters 25, 26 and 29)

Rao VSP and PS Narayana. 1987. *Principles and Practice of Management*, Konark Publishers Pvt. Ltd: Delhi. (Chapters 6, 30 and 31)

Singh B.P. and T.N. Chhabra. 1988. *Business Organisation and Management*, Kitab Mahal : Allahabad. (Section One, Chapter 3, Section Five, Chapters 14 and 15)