UNIT 3

INTRODUCTION TO COST ESTIMATION

IMPORTANCE OF COSTING AND ESTIMATION

Estimating, in general, implies indication of a carefully considered computation of some quantity, the exact magnitude of which cannot be determined at that stage.

COST ESTIMATING

Cost estimating is the estimation of the expected cost of producing a job or executing a manufacturing order before the actual production is taken up or predicting what new products will cost, before they are made. The expected expenditure on all the items used to make a product is added to give the estimated cost of final product.

An ideal estimate will give lowest cost of production in actual practice but an estimate will never guarantee that the actual cost of production will be equal to the estimated cost. The accuracy of cost estimate depends on the order of details of estimate, basis of calculation and the reliability of the data used. In general, the accuracy of an estimate increases, i.e., the estimated cost approximates more closely to the actual production cost, as more and more detailed calculations are made in estimating.

COST ACCOUNTING

Costing or cost accounting means classifying, recording and allocating the appropriate expenditure for determining the cost of production and achieved by keeping a continuous record of all the costs involved in manufacturing.

DIFFERENCE BETWEEN COSTING OR COST ACCOUNTING AND COST ESTIMATION

Costing or cost accounting gives the actual expenditure incurred on the production of the component based on the records of expenditure on various activities involved, when the product has already been manufactured whereas estimating is a type of forecasting and gives the expected expenditure to be incurred on the manufacture of the product before the actual manufacturing is taken up. Also, cost estimating is done by qualified engineers, whereas costing is done by accountants or cost accountants.

OBJECTIVES OF COST ESTIMATION

The objectives of cost estimation are given below:
(i) It gives an indication to the manufacturer whether the project to be undertaken will be economical or not.
(ii) It enables the manufacturer to choose from various methods of production the one which is likely to be most economical, as all possible methods of production forparticular product are analyzed and evaluated.
(iii) It enables the manufacturer to fix the selling price (sales price) of the product inadvance of actual production. This is required to ensure that the product will be competitive and also to provide a reasonable profit on the investment of thecompany.
(iv) it helps in taking decisions to make or to buy.
(v) Cost estimation gives detailed information of all the operations and their costs,thus setting a standard to be achieved in actual practice.
(vi) It gives an estimate of the total expenditure expected to be made on a projectenabling the management to arrange the necessary finance or capital.
(vii) It helps a contractor to submit accurate tenders for entering into contract tomanufacture certain products.
(viii) Cost estimation enables the management to plan for procurement of rawmaterials/tools etc., as it gives detailed requirements.

The value of an estimate lies in its accuracy, which depends on the care with which it is prepared. Carelessly prepared estimates may prove to be harmful to the organization or may even result in the closure of the firm.

If a job is overestimated, *i.e.,* the estimated cost is much above the actual cost of the product, the shop or firm will not be able to compete with its competitors whohave estimated the price correctly and loses the order to its competitors. On the otherhand, to underestimate *i.e.,* estimated cost is below the actual cost of product, meansa financial loss to the firm and too many losses mean failure or closure of the shop.(But when the cost estimate is to be used as a goal, *i.e.*, target cost to be achieved inproduction, it should be set on lower side than the actual estimated cost. The factoryis more likely to try to meet a low cost target than to try to get costs down very far below an overestimated target cost).

ALLOWANCES IN ESTIMATION

Normal Time = Observed time × Rating factor

Observed time and rating factor are obtained during the time study of an operation or a job.

Various allowances are considered in estimating the standard time for a job. These allowances are always expressed as % of Normal Time and are added to Normal Time to compute the Standard Time.

Standard Time = Normal Time + Allowances

Standard Time is time required to complete one cycle of operation (usually expressed in minutes).

Standard Time for a job is the basis for determining the standard output of the operator in one day or shift.

Need for Allowances

Any operator will not be able to carry out his work throughout the day withoutany interruptions.

The operator requires some time for his personal needs and rest, and hence such time should be included in standard time. There are different types of allowances, and they can be classified as follows:

1. Relaxation Allowance: This is also known as **Rest Allowance**. This allowance isgiven to enable the operator to recover from the physiological and psychological effects (Fatigue) of carrying out the specified work and to attend to personal needs.

Relaxation allowance consists of:

(i) Fatigue allowance, and

(ii) Personal needs allowance.

(i) Fatigue allowance is intended to cater for the physiological and psychological effects of carrying out the work.

This time allowance is provided to enable to operator to overcome the effectof fatigue which occurs due to continuous doing of the work (monotony etc.).

Relaxation allowance (Fatigue allowance and Personal needs allowance puttogether) is commonly 5% to 10% (of normal time).

(ii) Personal needs allowance: This allowance is provided to enable theoperator to attend to his personal needs (e.g. going to toilet, rest room, etc.).

2. Process Allowance: It is an allowance to compensate for enforced idleness of the worker.

During the process, it may be likely that the operator is forced to be idle due tocertain reasons, such as:

(i) When the process is carried out on automatic machines, (the operator is idle after loading the job on the machine).

(ii) When the operator is running more than one machine (as in the case of cellular manufacturing).

Process allowance varies from one manufacturing situation to another depending on factors such as hazardous working conditions, handling of heavy loads, strain involved, mental alertness required etc. Generally 5% of the normal time is provided towards process allowance.

3. **Interference Allowance:** This allowance is provided where in a cycle of operation, there are certain elements which are machine controlled. The operator cannot speed up those elemental operations.

This allowance is also provided when one worker is working on several machines.

4. **Contingency Allowance:** This is a small allowance of time which may be included in the standard time to meet unforeseen items of work, or delays (e.g. waiting for raw materials, tools). Contingency allowance is 5% (maximum) or Normal Time.

5. **Special Allowances:** These allowances are a policy matter of the management,

e.g. when the job is newly introduced or when a new machine or new method is introduced, because worker takes some time to learn the new method or job; Specialallowance is also provided depending on the working conditions such as noise, dust,etc.

Once the normal time is obtained, the standard time can be estimated or obtained by adding all the allowances to normal time.

Standard time = Normal time + Allowances

Example 1 : In a manual operation, observed time for a cycle of operation is 0.5 minute and the rating factor as observed by the time study engineer is 125%. All allowances put together is 15% of N.T. (Normal Time). Estimate the Standard Time.

Solution:

Observed time for a cycle = 0.5 min.

Rating factor = 125%

Normal time = Observed time × Rating factor

= 0.5 × 1.25

= 0.625 min.

Allowances = 15% of Normal Time

Standard Time = Normal Time + Allowances

= 0.625 min. + (0.15 × 0.625) min.

= 0.625 min. + 0.094 min.

= 0.719 min.

= 0.72 min.

Example 2: In a manufacturing process, the observed time for 1 cycle of operation is 0.75 min.

The rating factor is 110%. The following are the various allowances as % of normal time: Personal allowance = 3%
Relaxation allowance = 10%
Delay allowance = 2%

Estimate the standard time.

Solution:

Basic time or normal time = Observed time × Rating factor
= 0.75 min × 110%
= 0.75 × 1.1
= 0.825 min.

Standard time = Normal time + All allowances
= Normal time + [3% + 10% + 2%] of normal time
= 0.825 min. + (0.15 × 0.825) min.
= 0.825 min. + 0.124 min.
= 0.949 min. (0.95 min).

Standard time is the basis for calculation of standard output (i.e., no. of components produced) in 1 day or in 1 shift (of 8 hours). Incentive schemes are based on the standard output.

METHODS OF COSTING:

Methods of costing can be classified as follows:

1. Job Costing

It is essentially a method of costing applicable to industrial manufacture in which the cost figures are determined for each job or a batch of jobs. This method proves valuable in jobbing work (job shop production *i.e.,* or production of low quantities, often one of a kind of specialized products) or batch production.

2. Output Costing

In many cases cost figures for a job or a batch may not be easy to isolate (e.g.In the case of foundry operations, chemical plants, collieries, etc.) and in such casesthe cost figures are usually expressed in terms of overall output, viz. Rs. per ton, orRs. per kg, or Rs. per litre etc.

3. Operating Cost

This method usually applies to utilities or service undertakings viz. transport,gas, electricity etc. and is same as servicing cost (Rs. per km, Rs. per kWHr/unit).

4. Process Costing

Process costing refers to accumulation of cost by process (Dept./section) rather than by jobs. Cost of a process such as filtering or of a Dept. is distributed tounits of products processed through by simple division of total cost by number of units or products processed.

ALLOCATION OF OVERHEAD EXPENSES OR DISTRIBUTION OF OVERHEAD COSTS

As we know the overhead charges or on-costs cannot be directly charged to a specific job or item produced in the factory. In industries producing single product the total overhead costs may be simply divided by the number of items produced. However, in the industries where two or more items are produced, the distribution ofoverheads *i.e.*, determination of overhead charge per unit is a complicated task. There are several methods used for allocation of overheads to different jobs and thechoice of method depends on the type of organization. Following are some important methods of allocation of overhead costs:

1. Allocation by cost proportion.
2. Allocation by hourly rate.
3. Allocation by unit rate.

1. Allocation by Cost Proportion

This method is sub-divided into three categories:

(a) Proportional to prime cost: In this method the total overhead costs of the industry are expressed as a fraction or percentage of the prime cost. This percentage multiplied by the prime cost of individual item gives the part of total overheads to be allocated to that item of manufacture. The formula for calculating the percentage of overheads is : Total overhead cost

$$\text{Percentage of overheads} = \frac{\text{Total overhead cost}}{\text{Total prime cost}} \times 100$$

This method of distribution of overhead costs ignores the difference in labour ratesand material and machines employed for the manufacture of different items.

(b) Proportional to direct labour cost: In this method the percentage of

overhead costs to be allocated is given by

$$\text{Percentage of overheads} = \frac{\text{Total overhead cost}}{\text{Total direct labour cost}} \times 100$$

This percentage of overheads multiplied by the direct labour cost on the manufacture of the item gives the part of total overhead costs allocated to that item.

This method is used where practically all the work is done by hand (manually) and the wages paid to direct labour are quite uniform.

(c) Allocation proportional to direct material cost : According to this method, the percentage of overhead cost equals the total overhead cost of the factoryexpressed as a fraction of the total direct material costs.

$$\text{Percentage of overheads} = \frac{\text{Total overhead cost}}{\text{Total direct material cost}} \times 100$$

The percentage of overhead costs multiplied by the direct material cost of the manufacture of the item gives overhead costs to be allocated to that item. This method does not consider the fact that values of materials used in different items ofmanufacture are different.

2. Allocation by Hourly Rate

This method is again sub-divided into two categories:

(a) By man-hour rate: The rate of overhead is obtained by dividing the total overhead costs by the total production man-hours worked during that period.

Total overhead costs for entire factory

Rate of overhead = Total production man-hours employed

This factor multiplied by production man-hours used in manufacture of the item, gives the overhead costs to be allocated to the item under consideration. This method does not take into consideration use of different types of equipment in manufacture of different products.

(b) By machine hour rate: In this method the overhead costs are allocated onthe basis of fraction of the time used on particular machine in the manufacture of anitem.

$$\text{Rate of overhead} = \frac{\text{Total overhead costs for entire factory}}{\text{Total production man-hours employed}}$$

Rate of overhead multiplied by number of machine-hours used in the manufacture of the item, gives part of total overhead costs to be allocated to that item. This method takes into account variation in type and size of equipment, powerrequired etc., for manufacture of different products.

This method is used where most of the work is done with machines. The on-cost for a machine is calculated by taking into account the depreciation of machine, power consumed by the machine, building expenses on the basis of floor area occupied by the machine and other indirect charges.

3. Allocation by Unit Rate

In this method of allocation of overhead costs, it is assumed that the overhead

$$\text{Rate of overhead per machine-hour} = \frac{\text{Overhead expenses for specific machine}}{\text{Number of machine-hours}}$$

expenses are proportional to the total output.

This method is applied in concerns where one type or similar products are manufactured. This method gives a standard rate of overheads for all the components produced.

TYPES OF OVERHEAD COSTS

Indirect costs are the costs of those factors which can only be indirectly attributed to the manufacture of a specific product. They are sometimes called overheads or oncosts. Overhead charges can be subdivided for convenience under three headings :

1. **Works overheads :** These consist of the cost of the salary of works manager, works superintendents, foreman, inspectors, operators, labourers etc. costof cutting oil, depreciation of machines, lighting, rent of factory buildings, insuranceand electricity bills etc.
2. **Office overheads:** These consist of the salary of office manager, office staff, postage, FAX, telephone, legal expenses, depreciation of office equipment andrent of office building etc.
3. **Sales overheads:** These consist of the cost of salary of all sales staff, advertising, sales commissions etc.

Therefore, it can be seen that indirect costs are the total costs of running the organization less the direct material costs and the direct labour costs. The major difficulty in dealing with indirect costs is to decide accurately how much of the total overheads should be borne by a particular component or batch of components. If thisis not done reasonably accurately then the sales price of the product will be unrealistic, since

Sales price = Direct costs + Overheads + Profit

Overheads are based on past experience and in many engineering works, it isalways expressed as a % of the direct labour cost. Overhead are 300% to 500% of

direct labour costs.

DEPRECIATION

The reduction in the value and efficiency of the plant, equipment or any fixed assetbecause of wear and tear, due to passage of time, use and climatic conditions is known as depreciation.

Depreciation is the process of allocating the acquisition cost of the tangible asset lesssalvage

value, if any, in a systematic and a rational manner over the estimated life

of anasset.

Causes of Depreciation

1. Depreciation due to physical conditions
    a. Wear and tear
    b. Physical decay
    c. Accident
    d. Poor maintenance and neglect
2. Depreciation due to functional conditions
    a. Inadequacy
    b. Obsolescence

Methods of Depreciation

1. Straight line method
2. Diminishing balance method
3. Sinking fund method
4. Annuity method
5. Sum of years digit‘s method
6. Insurance policy method
7. Machine hour method
8. Production- unit method
9. Revaluation method
10. Retirement method

1. Straight line method

In this method, the amount of depreciation is distributed over the useful life ofthe machine in equal periodic installments.

$$D = \frac{C-S}{n}$$

Where,

C= Initial cost of the machine in Rs. S= Salvage value or scrap value in Rs.
n=Estimated life of the machine in Years
D=Depreciation amount per year

Problem 1: A CNC machine was purchased for Rs.1, 25,000 on 15th June 1995, theerection and installation cost was Rs.10, 000. The CNC machine is to be replaced bya new one on 14th June 2010. If the estimated scrap value is Rs.25, 000, what shouldbe the rate of depreciation and depreciation fund on June 14th 2002?

If after 9 years of running, some machine parts are to be replaced and the estimated replacement cost is Rs.4000, what will be the new rate of depreciation?

Solution:

Given: Machine cost= Rs.1, 25, 000; Erection and Installation cost= Rs.10, 000;

S=Rs.25, 000; n=from (15th June 1995 to 14th June 2010) is 15 Years

Total cost of machine, C =machine cost + Installation cost
=1, 25, 000+10, 000
=Rs.1, 35, 000

(i) Rate of depreciation, $D = \frac{C-S}{n}$

$$= \frac{1,35,000-25,000}{15}$$

=Rs.7, 333.33

(ii) Depreciation fund on 14th June 2002
15th June 1995 to 14th June 2002 = 7 Years

$= 7333.33 \times 7$
$=$ Rs.51, 333.33

(iii) New rate of depreciation after 9 Years (remaining 6 yrs=n)

Replacement cost=Rs.4, 000

After 9th year the book value of the machine
=Initial cost - Depreciation cost for 9 Years
=1, 35,000-(7,333.33 × 9)
=Rs. 69,000.03

New book value, C'= Rs.69, 000.03 + Rs.4000
= Rs. 73, 000.03

The scrap value is Rs.25, 000 is same, and therefore the depreciation rate for the remaining 6 years is given by

$$D' = \frac{C' - S}{n}$$
$$= \frac{73{,}000.03 - 25{,}000}{6}$$
$$= \text{Rs.}8,\ 000$$

2. Diminishing Balance method (% of Book value method)

In this method the equipment depreciates rapidly in the early years and later on slowly (i.e. .depreciation fund is mare during early years). Therefore repairs and renewals are not costly. The book value of machine goes on decreasing, so a certain percentage of current book value is taken as depreciation.

Depreciation factor, $p = 1 - \left(\frac{S}{C}\right)^{\frac{1}{n}}$

Where,
C= Initial cost of the machine in Rs.
S= Salvage value or scrap value in Rs.
n= Estimated life of the machine in Years
P= Fixed percentage for calculating yearly depreciation

If the rate of interest on the yearly sum insured® is given, then the depreciation fund at the end of nth year is given by |

$$\frac{C.p}{(p+r)}\left[(1+r)^n - (1-p)^n\right] = C - S$$

Note: direct formula depreciation fund after nth year $= C \times [1 - (1 - p)^n]$

Problem 2: A certain machine was purchased for Rs.25, 000 and it was presumed it will last for 20 years. It was also considered that by selling the scrap of the machine, the residual value will be Rs. 4,000. If the depreciation is charged by reducing balance method, find out the depreciation amount for the 3rd year.

Also find out the percentage by which value of the machine is reduced every year.

Given:

C= Rs.25, 000; n = 20 years; S = 4, 000

To find:

(i) Percentage by which value of machine is reduced every year (p)

(ii) Depreciation amount for 3rd year

(iii) Depreciation fund after 3rd year

Solution:

(i) Percentage by which value of machine is reduced every year (p)

$$\text{Depreciation factor, } p = 1 - \left(\frac{S}{C}\right)^{\frac{1}{n}}$$

$$= 1 - \left(\frac{4000}{25000}\right)^{\frac{1}{20}}$$

$$p = 0.08755$$

(ii) Depreciation amount for 3rd year

Value of machine after I year = C (1- p)

= 25000(1 – 0.08755)

= Rs. 22811.09

There fore, Depreciation fund for first year = 25000-22811.09

= Rs.2188.91

Similarly,

Value of machine after 2 years = 22811.09(1- 0.08755)

= Rs. 20813.98

Depreciation fund for 2nd year = 22811.09 – 20813.98

= Rs. 1997.11

Value of machine after 3 years = 20813 (1- 0.08755)

=Rs. 18990.82

Depreciation fund for 3rd year = 20813.98 – 18990.82

= Rs.1823.16

(iii) Depreciation fund after 3rd year = Sum of depreciation funds for first 3 years

= 2188.91 + 1997.11 +1823.16

= Rs. 6009.18