UNIT 3

INTRODUCTION TO COST ESTIMATION

Content 1: 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.

Content 2: 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.

Content 3: Elements of cost estimation:

For the purpose of calculations, the total cost of the product isdivided into the following:

(A) Material cost, (B) Labour cost, (C) Other expenses.

(A) Material Cost

Material cost consists of the cost of materials which are used in the manufacture of product. It is divided into the following

(a) Direct material cost: It is the cost of those materials which are directly used for the manufacture of the product and become a part of the finished product. This expenditure can be directly allocated and charged to the manufacture of a specific product or job and includes the scrap and waste that has been cut away from original bar or casting.

The procedure for calculating the direct material cost is as follows:

(*i*) From the product drawing, make a list of all the components required to make the final product.

(ii) Calculate the volume of each component from the drawing dimensions after adding machining allowances, wherever necessary.

(iii) The volume of component multiplied by the density of material used gives the weight of the material per component.

(iv)Add process rejection and other allowances like cutting allowance to get the gross weight per component.

(v) Multiply the gross weight by the cost of material per unit weight to get the cost of raw material per component.

(*vi*) The cost of raw material for all the components is, similarly, calculated and added up which gives the cost of direct material for the product.

(b) Indirect material cost: In addition to direct materials a number of other materials are necessary to help in the conversion of direct materials into final shape. Though these materials are consumed in the production, they don‘t become a part of the finished product and their cost cannot be directly booked to the manufacture of a specific product. Such materials are called indirect materials. The indirect materials include oils, general tools, grease, sand papers, coolants, cotton waste etc. The cost associated with indirect materials is called indirect material cost.

In some cases certain direct materials like nails, screws, glue, putty etc., are used in such small quantity that it is not considered worthwhile to identify and charge them as direct materials. In such cases these materials are also charged as indirect materials.

Depending upon the product manufactured, the same may be direct materials for one concern and indirect materials for others.

(B) Labour Cost

It is the expenditure made on the salaries, wages, overtime, bonuses, etc. of the employees of the enterprise. It can be classified as:

(a) Direct labour cost: Direct labours are the one who actually works and processes the materials to convert it into the final shape. The cost associated with direct labour is called direct labour cost. The direct labour cost can be identified and allocated to the manufacture of a specific product. Examples of the direct labour are the workers operating lathes, milling machines or welders, or assemblers in assembly shop. The direct labour cost may be allocated to a product or job on the basis of time spent by a worker on a job.

(b) Indirect labour cost: Indirect labours are the one who is not directly employed in the manufacturing of the product but his services are used in some indirect manner.

The indirect labour includes supervisors, inspectors, foreman, storekeeper, gatekeeper, maintenance staff, crane driver etc. The cost associated with indirect labour is called indirect labour cost. The indirect labour costs cannot be identified with a particular job or product but are charged on the total number of products made during a particular period in a plant.

To make the concept of direct and indirect labour cost clear, consider an operator working on a drilling machine. The operator in this case is direct labour whereas the man supervising the job, inspector and store man supplying the material are indirect labour.

(c) Other Expenses

In addition to the material cost and labour cost, several other expenses such as rent of building, depreciation of plant and machinery, cost of packing materials, transport and distribution expenses, wages and salaries of administrative staff and executives are also incurred by the manufacturer. All this expenditure including the indirect material cost and indirect labour cost is called other expenses.

We can say that except direct material and direct labour costs all other expenditure incurred by the manufacturer is known as –Other Expenses‖.

Expenses are further classified as :

(a) Direct expenses: Direct expenses include all that expenditure which can be directly allocated and charged to a particular job. The direct expenses include cost of special jigs or fixtures, patterns, tooling‘s made for job, or cost of research and development work done for that specific job.

(b) Indirect expenses: Except direct expenses, all other indirect expenditure incurred by the manufacturer is called indirect expenses. The indirect expenses are also called overhead expenses or on-cost.

The indirect expenses are further classified as:

(i) Factory expenses.

(ii) Administrative expenses.

(iii) Selling and distribution expenses.

(i) Factory expenses: Factory expenses comprise of the indirect expenses incurred from the receipt of the order to the completion of production. In addition to indirect material and indirect labour cost it includes rent of factory building, license fee, electricity and telephone bills of factory, insurance charges etc.

Factory expenses are also called ―Works expenses‖, or ―Factory or Works overhead.

(ii) Administrative expenses: Administrative expenses or office expenses include the expenditure incurred on control and administration of the factory. It includes the salaries of office and administrative staff, rent of office building, postage and telephone charges, water and electricity charges for office, Director‘s fee, legal and audit charges etc. Administrative expenses are also known as Administrative overheads ‘.

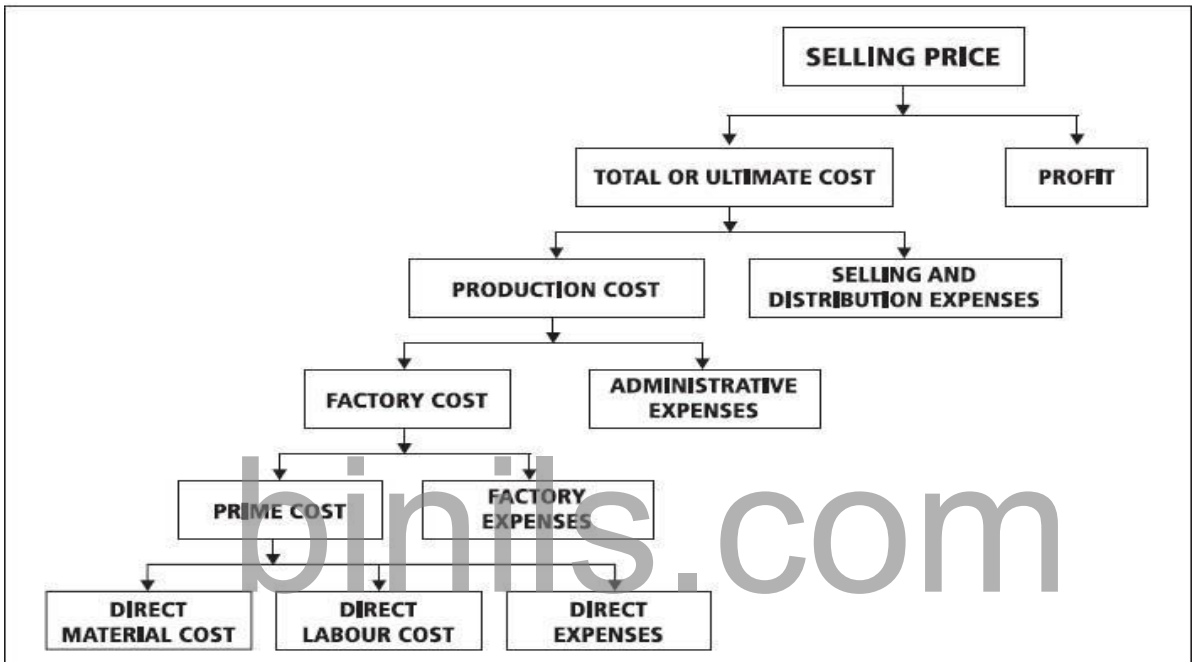
(c) Selling and distribution expenses: This is the expenditure incurred on Sales Department for selling the product, *i.e.*, wages, salaries, commission and travelling allowances of salesmen and officers in Sales Department, cost of advertisement, packing, delivery and distribution expenses, rent of warehouses etc.

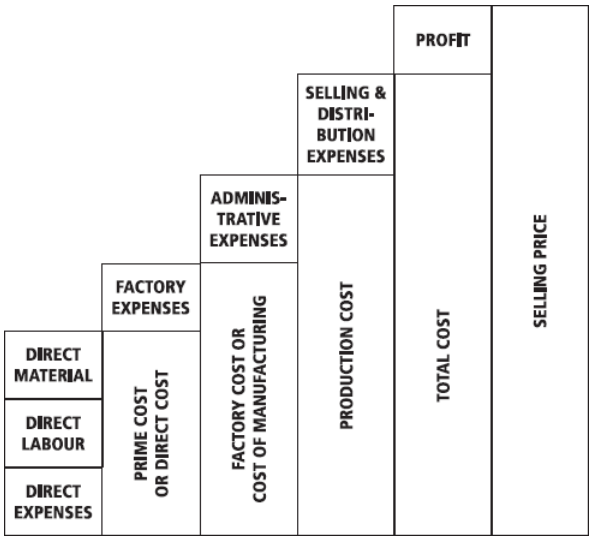
COST OF PRODUCT (LADDER OF COSTS)

The components of cost discussed above can be grouped as follows :

1. Prime cost = Direct material cost + Direct labour cost + Direct expenses
2. Factory cost = Prime cost + Factory expenses
3. Production cost = Factory cost + Administrative expenses
4. Total or Ultimate cost = Production cost + Selling and distribution expenses.
5. Selling price = Ultimate cost + Profit

The above relations can be illustrated on a chart (Ladder of costs) Fig. 3.2





Example 1: Calculate prime cost, factory cost, production cost, total cost and selling price per item from the data given below for the year 2003-04.

	Rs.
Cost of raw material in stock as on 1-04-2003	25,000
Raw material purchased	40,000
Direct labour cost	14,000
Direct expenses	1,000
Factory/Works overhead	9,750
Administrative expenditure	6,500
Selling and distribution expenses	3,250
No. of items produced	650
Cost of raw material in stock as on 31-03-2004	15,000

Net profit/item is 10 percent of total cost of the product.

Solution: For 650 units produced during 2003-04

(i) Direct material used= Stock of raw material on 1-04-2003 + raw material purchased

– Stock of raw material on 31-03-2004

= 25,000 + 40,000 – 15,000

= Rs. 50,000

(ii) Direct labour = Rs. 14,000

(iii) Direct expenses = Rs. 1,000

Prime cost = 50,000 + 14,000 + 1,000

= Rs. 65,000

Factory cost = Prime cost + Factory expenses

= 65,000 + 9,750

= Rs. 74,750

Production cost = Factory cost + Administrative expenses

= 74,750 + 6,500

= Rs. 81,250

Total cost = Production cost + Selling expenses

= 81,250 + 3,250

= Rs. 84,500

Selling price = 84,500 + 10 percent of 84,500

= 84,500 × 1.10 = Rs. 92,950

Selling price = 84,500 + 10 percent of 84,500
= 84,500 × 1.10 = Rs. 92,950

Prime cost/item = 65, 000 / 650 = Rs. 100

Factory cost/item = 74, 750 / 650 = Rs. 115

Production cost/item = 81, 250 / 650 = Rs. 125

Total cost/item = 84, 500 / 650 = Rs. 130

Selling price/item = 92, 950 / 650 = Rs. 143

Example 2: From the following data for a sewing machine manufacturer, prepare a statement showing prime cost, Works/factory cost, production cost, total cost and profit.

	Rs.
Value of stock of material as on 1-04-2003	26,000
Material purchased	2, 74,000
Wages to labour	1, 20,000
Depreciation of plant and machinery	8,000
Depreciation of office equipment	2,000
Rent, taxes and insurance of factory	16,000
General administrative expenses	3,400
Water, power and telephone bills of factory	9,600
Water, lighting and telephone bills of office	2,500
Material transportation in factory	2,000
Insurance and rent of office building	2,000
Direct expenses	5,000
Commission and pay of salesman	10,500
Repair and maintenance of plant	1,000

Salary of office staff	60,000
Value of stock of material as on 31-03-2004	36,000
Sale of products	6,36,000

Solution:

(i) Material cost = Opening stock value + Material purchases – Closing balance

= 26,000 + 2, 74,000 – 36,000

= Rs. 2, 64,000

Prime cost = Direct material cost + Direct labour cost + Direct expenses

= 2, 64,000 + 1, 20,000 + 5,000

= Rs. 3, 89,000

(ii) Factory overheads are:

	Rs.
Rent, taxes and insurance of factory	16,000

Depreciation of plant and machinery	8,000
Water, power and telephone bill of factory	9,600
Material transportation in factory	2,000
Repair and maintenance of plant	1,000
Work Manager Salary	30,000
Factory overheads or Factory cost	66,600

Factory cost = Prime cost + Factory expenses
= 3, 89,000 + 66,600
= Rs. 4, 55,600

(*iii*) Administrative/office expenses are:

	Rs.
Depreciation of office equipment	2,000
General administrative expenses	3,400
Water, lighting and telephone bills of office	2,500
Rent, insurance and taxes on office building	2,000
Salary of office staff	60,000
Total	**69,900**

Production cost = Factory cost + Office expenses
= Rs. 4, 55,600 + Rs. 69,900
= Rs. 5, 25,500

(iv) Selling overheads are:
Commission and pay to salesmen = Rs. 10,500
Total cost = Production cost + Selling expenses
= 5, 25,500 + 10,500
= Rs. 5, 36,000

(v) Profit = Sales – Total cost = 6, 36,000 – 5, 36,000
= Rs. 1, 00,000

Example 4: A factory is producing 1000 high tensile fasteners per hour on a machine. The material cost is Rs. 375, labour cost is Rs. 245 and direct expense is Rs. 80. The factory on cost is 150 Percent of the total labour cost and office on cost is 30 percent of the factory cost. If the selling price of each fastener is Rs. 1.30, calculate whether there is loss or gain and by what amount?

Solution : For 1000 fasteners

Material cost = Rs. 375.00
Labour cost = Rs. 245.00
Direct expenses = Rs. 80.00
Factory on cost = 150 percent of labour cost
= 245 × 1.5
= Rs. 367.50
Factory cost = 375 + 245 + 80 + 367.50
= Rs. 1,067.50

Office on cost = 30 percent of factory cost
$= \frac{30}{100} \times (1,067.50)$
= Rs. 320.25

Total cost for 1000 fasteners = 1,067.50 + 320.25
= Rs. 1387.75

Cost per fastener $= \frac{1\,387.75}{1000}$
= Rs. 1.387 = Rs. 1.39
Selling price = Rs. 1.30

As selling price is lower than total cost per fastener, the management will suffer a loss.

Loss per fastener = (1.39 – 1.30) = Rs. 0.09
Loss per 1000 fastener = 0.09 × 1000 = Rs. 90

Example 7 : The catalogue price of a certain gadget is Rs. 1,050, the discount allowed to distributors being 20 percent. Data collected for a certain period shows that the selling price and factory cost are equal. The relation between material cost, labour cost and factory on cost (overhead expenses) are in the ratio 1 : 2 : 3. If the labour cost is Rs. 200, what profit is being made on the gadget?

Solution:

Catalogue Price = Rs. 1,050

Distributors discount = 20% = $\frac{20}{100} \times (1{,}050)$

= Rs. 210

Selling price = 1,050 – 210

= Rs. 840

Labour cost = Rs. 200

Material cost = $\times \frac{1}{2} \times (200)$

= Rs. 100

Factory on cost = $\frac{3}{2} \times (200)$

= Rs. 300

Factory cost = 200 + 100 + 300 = Rs. 600

It is given that selling price = Factory cost

= Rs. 600

Selling price = Total cost + Profit

840 = 600 + Profit

Profit = 840 – 600

= Rs. 240

Profit = Rs. 240 per gadget.

Content 4: Types of estimates – Estimating procedure

TYPES OF COST ESTIMATES

One classification system for cost estimates is based on design level when theproduct is designed. The three levels of design considered are :

(i) Conceptual design,
(ii) Preliminary design, and
(iii) Detailed design.

The conceptual design stage is that stage at which only the functional requirements are considered by the designer using techniques such as feature-based design and/or solid modelling and a rough magnitude of estimate can be obtained. Geometry of parts and materials are not known at this stage.

The accuracy of conceptual cost estimates are approximately – 30% to + 50%. The cost estimation methods used at this level are

(a) Factor method,
(b) Material cost method, and
(c) Function method.

(a) Factor Method of Cost Estimation

According to this method:

Estimated cost of an item = Factor for total cost estimate × Amount of majorcost item some examples of factor are:

(i) Cost of construction per km of highway.
(ii) Cost of fabricated component per kg of casting.
(iii) Cost of house construction per SQ.M. of livable space.

(b) Material Cost Method of Estimation

Material cost method predicts the total cost of the product based on the ratio ofthe material cost of the product to the material cost share of the total cost.

According to this method:

$$\text{Estimated cost of an item} = \frac{\text{Material cost of the item being estimated}}{\text{Material cost share of item being estimated (in \%)}}$$

(c) Function Method of Cost Estimation

This method is also referred to as **Parametric cost estimating.**

This method is similar to the factor method, but more variables are used. Function method uses a mathematical expression with constants and parameters derived for specific process, such as casting or machining or for specific classes of parts based on material, size, weight or other cost parameters.

According to this method:
Estimated cost of an item = G × (a + *b*) + (R × *c*) + (N × *d*) whereG = Weight of the item, kg

a = Material cost per kg
b = Tolerance cost per, kg
R = Weight of material Removed, kg
c = Cost per kg of material removed
N = No. of dimensions of a product surface
d = Cost per dimension
(The above is an example of function method for a machined component).Other types of cost estimates are based on the following:

(i) Product comparison: The new product is compared with existing products (ofsimilar function, design etc.) and adjustments/modifications are made for the differences.

(ii) Data base calculations: The product cost estimate is determined from cost data bases which a company is expected to maintain over a period of time (Historical Cost Data Base).

(iii) Detailed cost functions and/or parametric cost estimation: The product cost estimate is determined using parametric cost estimation technique. All variables or parameters of process, part features and other cost parameters are considered in cost estimation.

METHODS OF COST ESTIMATES

There are different methods of estimates of cost. These are in addition to conventional method of estimating of cost such as calculating material cost, labour cost, factory expenses and overhead expenses and adding all these cost elements.

The methods of estimates are:

1. Conceptual Cost Estimating

It is estimating during the conceptual design stage. In the conceptual design stage, the geometry of parts and materials have not been specified, unless they dictate essential product functions. In the conceptual design stage, the costs associated with a change in the design are low. In the conceptual design stage, the incurred costs are only 5 to 7% of the total cost whereas the committed costs are 75 to 85% of the total cost.

The accuracy of the conceptual cost estimate depends on the accuracy of the data base. The accuracy of conceptual cost estimating is approximately – 30% to + 50%. Accuracy in conceptual cost estimating is important since at the conceptual design stage only significant cost savings can occur.

Conceptual cost estimating methods include:

(a) Expert opinion,

(b) Analogy methods, and Formula based methods.

(a) Conceptual Method Based on Expert Opinion

If back-up and/or historical cost data are not available, getting expert opinion is the only way for estimating cost.

The disadvantages of this method are

(i) The estimate is subjected to bias.

(ii) The estimate can‘t be quantified accurately.

(iii) The estimate may not reflect the complexity of the product or project.

(*iv*)Reliable data base for future estimates are not possible.

In spite of these disadvantages, the expert opinion is useful when historical data base is not available. It is also useful to verify cost estimate arrived at using other methods of conceptual estimating (like analogy methods and formula based methods).

(b) Conceptual Method Based on Analogy

Analogy estimating derives the cost of a new product based on past cost data of similar products.

Cost adjustments are made depending on the differences between the new and previous product/system. Analogy estimating requires that the products be analogous or similar and products manufactured using similar facilities or technology. If the technology changes, the analogy estimating relationship has to changed to reflect the changes in technology. Another limitation of this method is that analogy estimates often omit an important detail that makes cost considerably higher than the original cost estimates.

(c) Conceptual Method Based on Formula

There are formula based methods that are primarily used in the conceptual cost estimating. These are:

(i) Factor method,

(ii) Material cost method,

(iii) Function method, and

(iv) Cost-size relationship.

These methods are known as **Global cost estimation methods** and theygenerally use one of the above methods only.

(i) Factor method

This is the simplest method, but it can give reliable estimates if the data are kept up-to-date, taking into consideration factors such as inflation, and environmental issues which tend to increase the cost.

(ii) Material cost method

Material cost method is justified since the material cost is the largest cost item in the prime cost of many manufacturing companies.

According to this method :

$$\text{Estimated cost of an item} = \frac{\textit{Material cost of the item being estimated}}{\textit{Material cost share of item being estimated in \%}}$$

(iii) Function method

In function method more variables are used and the expressions are non-linear. The function is basically a mathematical expression with constants and variables that provides a mathematical function for the cost estimate. One expression is given below : Cost of turbo fan engine development, (in Rs. Lakhs).

(iv) Method based on cost-size relationships

Another approach to the determination of conceptual costing is by considering the cost-size relationships. In this approach, one can compare the cost ofdifferent designs on a relative basis or on an actual cost basis. Expression has been developed from data on investment castings and for machined parts.

The cost-size relationship in respect of investment casting is given below as an example : Relative cost of an investment casting of volume V cm^3 = 5.0 $V^{0.6}$

Where

5.0 represent cost of 1 cm^3 investment casting

V, Volume of investment costing, cm^3

0.6, size cost exponent for investment casting (the relationship is less than linear).

Data requirements and sources of information for cost estimation

1. Man-hour cost (Labour rate) *i.e.*, hourly cost of skilled, semi-skilled and unskilled labours of the company.
2. Machine-hour cost for different types of equipment and machinery available in the company.
3. Material cost in respect of commercially available materials in the market:
   - Cost in Rs. per kg for different categories of materials like ferrous, non-ferrous, special steel etc., for rods of different diameters and for different thicknesses in respect of flats/sheet metals.
4. Scarp rates *i.e.*, scarp values of different materials in Rs. per kg.
5. In respect of welding operations, information such as electrode cost, gas cost, flux cost, power cost, etc.
6. Set-up time for different processes.
7. % allowances to be added for computing standard time, relaxation

allowance, process allowance, special allowance as % of normal time as per the policy of the management.

8. Standard time for different types of jobs, if available.

9. Overhead charges in terms of % direct labour cost or overhead rate in Rs. per hr.

10. Life in years permitted for various types of equipment and machines available in the plant for calculation of depreciation, for cost recovery and for calculation of machine — hour rate.

11. Data base of cost calculations carried out by the company in respect of earlier products or jobs (Historical cost data).

12. Cost data of products available in the market similar to the ones manufactured by the company.

13. Budget estimates prepared by the company for new projects/products.

BASIC STEPS IN COST ESTIMATION

The basic steps in the cost estimation of any product are given below:

1. Make thorough study of cost estimation request to understand it fully.

2. Make an analysis of the product and prepare a bill of materials.

3. Make separate lists of parts to be purchased from the market and parts to be manufactured in plant.

4. Determine the cost of parts to be purchased from outside.

5. Estimate the material cost for the parts/components to be manufactured in plant.

6. Make manufacturing process plan for the parts to be manufactured in plant.

7. Estimate the machining time for each operation listed in the manufacturingprocess plan.

8. Multiply each operation time by the labour wage rate and add them up tofind direct labour cost.

9. Add the estimate of step 4, 5, and 8 to get prime cost of component.

10. Apply overhead costs to get the total cost of the component.

The selling price of the component is estimated by adding profit to the total costobtained instep 10.

UNIT 3

INTRODUCTION TO COST ESTIMATION

Content 6: Calculation of depreciation cost

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 |

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

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