UNIT 3

INTRODUCTION TO COST ESTIMATION

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 :

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

(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 of different 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.