

## **A method of production cost estimation for business sustainability**

Dr Abdul Md Mazid, School of Engineering and Technology, Central Queensland University, Melbourne Campus

E-mail: [a.mazid@cqu.edu.au](mailto:a.mazid@cqu.edu.au)

### **Introduction:**

Accurate production cost calculation, optimisation of production processes, uses of suitable process machines, appropriate utilisation of equipment and manpower, required quality and accuracy of products are the main roots of being long-term sustainable in business. This article highlights on an innovative production cost estimation only.

In general, the cost of a product is defined as the expenses charged to an account for items purchased, for the cost of distribution of items, sold, or for the distribution or production services.

Costs involved of engineering products can broadly be grouped as:

- a) Direct cost, and
- b) Indirect cost or overhead cost.

**Direct cost:** Direct cost is the cost of those factors which can be directly attributed to the manufacture of a specific product. Direct cost is subdivided into:

- a) Material cost
- b) Labour cost

Material cost is the cost of that material which goes into the finished product and includes all wastages which has been cut away from the original bar, casting, workpiece, etc.

Labour cost is the 'product' of the number of pieces produced and the piece work rate (in the case of a simple incentive scheme). Or the 'product' of the time spent in manufacturing the product by the direct shop floor workers and the wage rate (in the case of standard time system).

**Indirect or overhead costs:** Indirect or overhead costs are those factors which can only be indirectly attributed to the manufacturing of a specific product.

These indirect or overhead costs are subdivided, for convenience, as follows:

- i) Works overheads
- ii) Office overheads
- iii) Sales overheads

Works overheads – these consists of the cost of the wages of works superintendents, foremen, inspectors, storekeepers, labourers, etc. in the cases of metal cutting shops it includes cost of cutting lubricant, depreciation of machine tools, heating, lighting, rents, rates, etc.

Office overheads – these consists of the costs of the wages of all office staff, postage, legal expenses, depreciation of office equipment, etc.

Sales overheads – these consist of the costs of the wages of all sales staff, advertising, sales commissions, etc.

These basic unit costs may be precisely depicted in the following Figure 1 to make it more comprehensible and visual friendly:

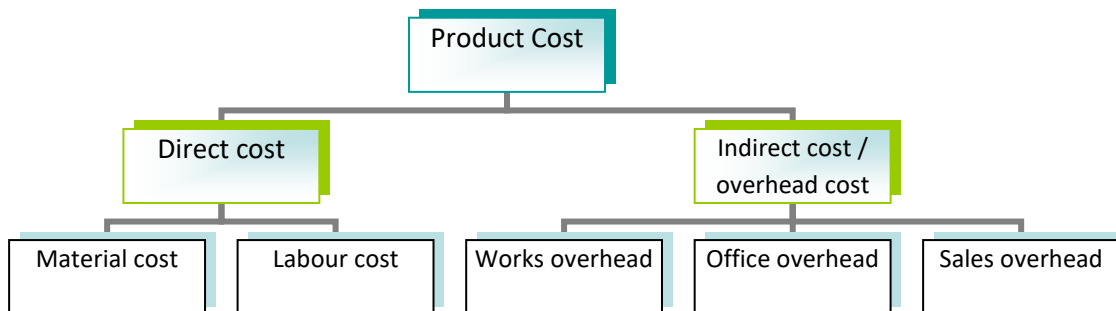


Figure 1. Elements of product cost

Again, these basic unit costs may be broken down into various cost stages involved in manufacturing practices and the descriptions of what may be out of the scope of a newsletter article.

**Basic techniques/methods for cost calculation:**

There are two major methods for calculating production cost used in manufacturing sectors, these are:

- 1) Actual cost method, and
- 2) Standard cost method

Actual cost method includes such items as the cost of materials, direct labour and an equitable distribution of the other manufacturing expenses incurred in support of the enterprise.

The standard cost method is one based upon standards and tries to determine the cost of a product before it is put into production. This method is based on the following factors:

- a) Determination of the quantities of materials used and their cost based on standard pricing.
- b) A determination of the standard labour cost from standard wage rates.
- c) Standard overhead cost.

#### **Standard cost method:**

Usually in a production system the production cost is calculated considering all of the elements and their breakdown (Fig. 1) for better economic sustainability. In the industrial enterprises, to avoid the clumsiness and the lengthiness of calculation processes the various smaller cost elements are grouped and for these groups some factory standard price/cost rates are accepted and advantageously used these pre-calculated data. Considering these given data the production calculation method may be described as follows:

Firstly, the elements of cost (Figure 1) are calculated individually and then their summation gives the total product cost.

#### **Direct cost = direct material cost + direct labour cost**

Direct material cost is consisted of costs of local and imported raw materials, cost of local and imported standard components used. Direct labour cost is the product of total direct man-hour required and the rate of direct man-hour cost. This can be expressed as follows:

Direct cost,

$$T_d = M_r + M_{st} + (H_m * R_m) \quad (1)$$

Where,

$M_r$  = composite cost of local and imported raw materials required including tooling.

$M_{st}$  = composite cost of local and imported standard components.

$H_m$  = direct finishing man-hours required including design development personnel, packaging, etc.

$R_m$  = factory rate of direct man-hour.

In parallel of direct cost there are indirect cost generally called as overhead cost which is a larger portion of production cost.

**Indirect/overhead cost = works overhead cost + office overhead cost + sales overhead cost**

Works overhead cost includes in it its wages of works superintendents/supervisors, foremen, quality control inspectors, cost of cutting fluids, maintenance lubricants and personnel, depreciation of machines, heating, lighting, power, rents, etc.

Works overhead cost,

$$T_{w.oh} = (H_{m.ind} * R_{m.ind}) + (H_{m/c} * R_{m/c.dep}) + (H_{m/c} * R_{p.ind}) \quad (2)$$

Where,

$H_{m.ind}$  = total man-hour of indirectly involved personnel such as production superintendents, supervisors, foremen, quality control inspectors and personnel, storekeepers, maintenance personnel, etc.

$R_{m.ind}$  = average factory rate of wages of the above-mentioned personnel.

$H_{m/c}$  = total machine hours required.

$R_{m/c.dep}$  = factory depreciation rate of machines directly involved in production.

$R_{p.ind}$  = factory cost rate (per machine hour) of heating, lighting, power, rents, cutting oil, maintenance lubricant, etc.

Office overhead cost comprises of cost of wages of all other office staff, postages, legal expenses, taxes, insurances, interest of borrowed capital, workers' welfare facilities, superannuation, pensions, etc.

Office overhead cost,

$$T_{of.oh} = (H_{m.staff} * R_{m.staff}) + (H_{m/c} * R_{leg.exp}) \quad (3)$$

Where,

$H_{m.staff}$  = total man-hour of auxiliary office staff.

$R_{m.staff}$  = factory rate of man-hour of auxiliary office staff.

$R_{leg.exp}$  = factory rate of legal expenses which considers postages, taxes, insurances, interest of borrowed capital, workers welfare facilities, superannuation, etc.

Sales overhead cost is consisted of the wages of all sales staff, advertising, sales commissions, goods transit, additional packaging for fragile items, special materials handling facilities, etc.

Sales overhead cost,

$$T_{s.oh} = (H_{m.s} * R_{m.s}) + (H_{m/c} * R_{s.prom}) \quad (4)$$

Where,

$H_{m.s}$  = total man-hour involved in sales and sales promotion.

$R_{m.s}$  = factory rate of wages of sales and sales promotion personnel.

$R_{s.prom}$  = factory rate of expenditure in sales promotion and it considers cost of advertisement, sales commissions, additional packaging and transit, special materials handling facilities, etc.

### Total production cost (T):

Considering the above described understanding we may formulate the following:

Total Production Cost,

$$T = T_d + T_{oh} \quad (5)$$

Since  $T_{oh} = T_{w.oh} + T_{of.oh} + T_{s.oh}$

We can derive the following:

$$T = T_d + T_{w.oh} + T_{of.oh} + T_{s.oh} \quad (6)$$

Hence, considering the equations (1, 2, 3, and 4), equation (6) may be rewritten as follows:

$$T = \{M_r + M_{st} + (H_m * R_m)\} + \{(H_{m.ind} * R_{m.ind}) + (H_{m/c} * R_{m/c.dep}) + (H_{m/c} * R_{p.ind})\} + \{(H_{m.staff} * R_{m.staff}) + (H_{m/c} * R_{leg.exp})\} + \{(H_{m.s} + R_{m.s}) + (H_{m/c} * R_{s.prom})\} \quad (7)$$

This is a complicated but detailed equation, and this yield an innovative and accurate ever method for production cost calculation enhancing the knowledge on production costs analysis. For simplicity, for a particular factory/industry in cases of mass and lot production systems, it is accepted that an average rate of man-hour wage for all types of manpower of the factory and is called factory manpower overhead cost ( $R_{m.oh}$ ). In this case theoretically,

$$R_{m.oh} = \frac{(R_m + R_{m.ind} + R_{m.staff} + R_{m.s})}{4} \quad (8)$$

In the similar way, an average rate (value) for machine hours used, and can be calculated in the following way:

Factory machine overhead,

$$R_{m/c.oh} = \frac{R_{m/c.dep} + R_{p.ind} + R_{leg.exp} + R_{s.prom}}{4} \quad (9)$$

Then equation (7) becomes to be as simpler and as follows:

$$T = M_r + M_{st} + \Sigma(H_m * R_{m.oh}) + \Sigma(H_{m/c} * R_{m/c.oh}) \quad (10)$$

Replacing  $(M_r + M_{st})$  by total material cost (M), equation (10) may be rewritten as follows:

$$T = M + (\Sigma H_m * R_{m.oh}) + (\Sigma H_{m/c} * R_{m/c.oh}) \quad (11)$$

This equation has taken easier form and has become user friendly for production cost calculation in manufacturing enterprises, as well as, this gives more, if not the most, unbeatable accurate production cost.

As the derivation of this manufacturing processes-based cost calculation method depends upon how the processes were designed and what process parameters were used to design manufacturing processes, it is crucial to do research on processes optimisation. This may dramatically reduce the operation/cycle times taken for various fractions of processes.

#### Reference:

1. A. M. Mazid, PRODUCT COST ANALYSIS, ACQUIRE submission at CQUniversity Library as working paper. (10 pages). 2009.