

CHAPTER -7

COST ESTIMATION AND ECONOMICS(Ref:8)

Cost of 2-Ethyl hexanol of capacity 50,000 tons
per annum in May 1975 is DM 55 Million $= 55 \times 10^6$ DM (Ref:9)

Assume : 1 DM = Rs. 20.85/- (exchange rate is constant throughout this 27 years)

\therefore Cost of 2- Ethyl Hexanol plant of 50,000 tons $= 55 \times 10^6 \times 20.85$
per annum is 1975 $= \text{Rs. } 1.147 \times 10^9$

Chemical Engineering Plant Cost Index:

Year	Cost Index
1975	182.0
2002	401.8 \approx 402

\therefore Present cost = $\frac{(\text{Original cost})}{\text{Index value at the time when original cost was obtained}} \times \text{Index value at present year}$

i.e. Fixed Capital Investment (FCI) $= \frac{(1.147 \times 10^9)}{182} \times 402$
 $= \text{Rs. } 2.533 \times 10^9$

Estimation of Total Investment Cost:

I. Direct Costs:

A. 1. Purchased equipment cost (PEC):

(15-40% of Fixed-Capital Investment (FCI))

Consider Purchased Equipment cost = 25% of Fixed-capital
Investment

$$\begin{aligned} \text{i.e., Purchased Equipment Cost (PEC)} &= 0.25 \times 2.533 \times 10^9 \text{ /-} \\ &= \text{Rs. } \underline{0.6333 \times 10^9} \end{aligned}$$

2. Installation Cost:

(25-55% of Purchased Equipment Cost.)

Consider the Installation cost = 30% of Purchased equipment cost

$$\begin{aligned} \therefore \text{Installation cost} &= \text{Rs. } 0.3 \times 0.6333 \times 10^9 \\ &= 0.19 \times 10^9 \text{ /-} \end{aligned}$$

3. Instrumentation and control cost:

(6-30% of PEC)

Consider the installation cost = 20% of Purchased equipment cost

$$\begin{aligned} \therefore \text{Instrumentation cost} &= 0.20 \times 0.6333 \times 10^9 \\ &= \text{Rs. } \underline{0.1267 \times 10^9} \end{aligned}$$

4. Piping installed consider:

(10-80% of Purchased equipment cost)

Consider the piping cost = 40% Purchased equipment cost

$$\begin{aligned} \therefore \text{Piping cost} &= 0.40 \times 0.6333 \times 10^9 \\ &= \text{Rs. } \underline{0.2533 \times 10^9} \end{aligned}$$

5. Electrical, installed:

(10-40% of Purchased equipment cost)

Consider Electrical cost = 25% of Purchased equipment cost

$$\begin{aligned} \therefore \text{Electrical Cost} &= 0.25 \times 0.6333 \times 10^9 \\ &= \text{Rs. } \underline{0.1583 \times 10^9} \end{aligned}$$

B. Buildings, process and Auxiliary:

(10-70% of Purchased equipment cost)

Consider Buildings, process and auxiliary cost = 40% of PEC

$$\begin{aligned}\therefore \text{Cost of Building} &= 0.40 \times 0.6333 \times 10^9 \\ &= \text{Rs. } \underline{0.2533 \times 10^9}\end{aligned}$$

C. Service facilities and yard improvements:

(40-100% of Purchased equipment cost)

Consider the cost of service facilities and

Yard improvement = 70% of PEC

$$\begin{aligned}\text{Service facilities \& yard improvement} &= 0.70 \times 0.6333 \times 10^9 \\ &= \text{Rs. } \underline{0.4433 \times 10^9}\end{aligned}$$

D. Land:

(1-2% of fixed capital investment or 4-8% of PEC)

Consider the cost of land = 6% PEC

$$\begin{aligned}\text{Land} &= 0.06 \times 0.6333 \times 10^9 \\ &= \text{Rs. } \underline{0.038 \times 10^9}\end{aligned}$$

Thus, Direct cost = Rs. 2.0962 × 10⁹

(II) Indirect costs:

Expenses, which are not directly involved with material and labour of actual installation of, complete facility (15-30% of Fixed-capital investment)

A. Engineering and Supervision:

(5-30% of direct costs)

Consider the cost of engineering and supervision = 10% of Direct costs

$$\begin{aligned}\text{i.e., cost of engineering and supervision} &= 0.10 \times 2.0962 \times 10^9 \\ &= \text{Rs. } \underline{0.20962 \times 10^9}\end{aligned}$$

B. Construction Expenses and Contractor's fee:

(6-30% of direct costs)

Consider the construction expense and

$$\begin{aligned}\text{Contractor's fee} &= 10\% \text{ of Direct costs} \\ \text{i.e., construction expenses and contractor's fee} &= 0.10 \times 2.0962 \times 10^9 \\ &= \text{Rs. } \underline{0.20962 \times 10^9}\end{aligned}$$

C. Contingency:

(5-15% of Fixed-capital investment)

Consider the contingency cost = 10% of Fixed-capital investment

$$\begin{aligned}\text{i.e., Contingency cost} &= 0.10 \times 2.533 \times 10^9 \\ &= \text{Rs. } \underline{0.2533 \times 10^9}\end{aligned}$$

$$\begin{aligned}\text{Thus, Indirect Costs} &= (0.20962 + 0.20962 + 0.2533) \times 10^9 \\ &= \underline{0.67254 \times 10^9}\end{aligned}$$

(III) Fixed Capital Investment:

Fixed capital investment = Direct costs + Indirect costs

$$= (2.0962 + 0.67254) \times 10^9$$

i.e., Fixed capital investment = Rs. 2.7687 x 10⁹

(IV) Working Capital:

(10-20% of Fixed-capital investment)

Consider the Working Capital = 15% of Fixed-capital investment

$$\begin{aligned}\text{i.e., Working capital} &= 0.15 \times 2.7687 \times 10^9 \\ &= \text{Rs. } \underline{0.4153 \times 10^9}\end{aligned}$$

(V) Total Capital Investment (TCI):

Total capital investment = Fixed capital investment + Working capital

$$= (2.7687 + 0.4153) \times 10^9$$

i.e., Total capital investment = Rs. 3.184 x 10⁹

Estimation of Total Product cost:

$$(I) \quad \underline{\text{Manufacturing Cost}} = \text{Direct production cost} + \text{Fixed charges} \\ + \text{Plant overhead cost.}$$

A. Fixed Charges:

(10-20% total product cost)

(i) Depreciation:

(Depends on life period, salvage value and method of calculation- about 10% of FCI for machinery and equipment and 2-3% for Building Value for Buildings)

Consider depreciation = 10% of FCI for machinery and equipment and 3% for Building Value for Buildings)

$$\text{i.e., Depreciation} = (0.1 \times 2.7687 + 0.03 \times 2.7687) \times 10^9 \\ = \text{Rs. } \underline{0.3599 \times 10^9} \text{/-}$$

(ii) Local Taxes:

(1-4% of fixed capital investment)

Consider the local taxes = 3% of fixed capital investment

$$\text{i.e. Local Taxes} = 0.03 \times 2.7687 \times 10^9 \\ = \text{Rs. } \underline{0.0831 \times 10^9}$$

(iii) Insurances:

(0.4-1% of fixed capital investment)

Consider the Insurance = 0.75% of fixed capital investment

$$\text{i.e. Insurance} = 0.0075 \times 2.7687 \times 10^9 \\ = \text{Rs. } \underline{0.0208 \times 10^9} \text{/-}$$

(iv) Rent:

(8-12% of value of rented land and buildings)

Consider rent = 10% of value of rented land and buildings

$$= 0.10 (0.2533+0.038) \times 10^9$$

$$\text{Rent} = \text{Rs. } \underline{0.0291 \times 10^9}$$

$$\text{Thus, Fixed Charges} = [0.3599+0.0831+0.0208+0.0291] \times 10^9$$

$$= \text{Rs. } 0.4929 \times 10^9$$

B. Direct Production Cost:

(about 60% of total product cost)

Now we have Fixed charges = 10-20% of total product charges – (given)

Consider the Fixed charges = 15% of total product cost

$$\text{Total product charge (TPC)} = \frac{\text{fixed charges}}{0.15} = \frac{0.4929 \times 10^9}{0.15}$$

$$\text{Total product charge(TPC)} = \text{Rs. } \underline{3.286 \times 10^9}$$

(i) Raw Materials:

(10-50% of total product cost)

Consider the cost of raw materials = 25% of total product cost

$$\text{Raw material cost} = 0.25 \times 3.286 \times 10^9$$

$$\text{Raw material cost} = \text{Rs. } \underline{0.8215 \times 10^9}$$

(ii) Operating Labour (OL):

(10-20% of total product cost)

Consider the cost of operating labour = 12% of total product cost

$$\text{Operating labour cost} = 0.12 \times 3.286 \times 10^9$$

$$\text{Operating labour cost} = \text{Rs. } \underline{0.3943 \times 10^9}$$

(iii) Direct Supervisory and Clerical Labour (DS & CL):

(10-25% of OL)

Consider the cost for Direct supervisory and

clerical labour = 12% of OL

Direct supervisory and clerical labour cost = $0.12 \times 0.3943 \times 10^9$

Direct supervisory and clerical labour cost = Rs. 0.0473×10^9

(iv) Utilities:

(10-20% of total product cost)

Consider the cost of Utilities = 12% of total product cost

Utilities cost = $0.12 \times 3.286 \times 10^9$

Utilities cost = Rs. 0.3943×10^9

(v) Maintenance and repairs (M & R):

(2-10% of fixed capital investment)

Consider the maintenance and

repair cost = 6% of fixed capital investment

i.e. Maintenance and repair cost = $0.06 \times 2.7687 \times 10^9$

= Rs. 0.1661×10^9

(vi) Operating Supplies:

(10-20% of M & R or 0.5-1% of FCI)

Consider cost of Operating supplies = 15% of Maintenance & Repairs

Operating supplies cost = $0.15 \times 0.1661 \times 10^9$

Operating supplies cost = Rs. 0.0249×10^9

(vii) Laboratory Charges:

(10-20% of OL)

Consider the Laboratory charges = 15% of OL

Laboratory charges = $0.15 \times 0.3943 \times 10^9$

Laboratory charges = Rs. 0.0591×10^9

(viii) Patent and Royalties:

(0-6% of total product cost)

Consider the cost of Patent

and royalties = 3% of total product cost

Patent and Royalties = $0.03 \times 3.286 \times 10^9$

Patent and Royalties cost = Rs. 0.0986×10^9

Thus, Direct Production Cost = Rs. 2.0061×10^9

C. Plant overhead Costs:

(50-70% of Operating labour, supervision, and maintenance or 5-15% of total product cost); includes for the following: general plant upkeep and overhead, payroll overhead, packaging, medical services, safety and protection, restaurants, recreation, salvage, laboratories, and storage facilities.

Consider the plant overhead cost = 60% of OL, DS & CL, and M & R

Plant overhead cost = $0.60 \times \{0.3943 + 0.0473 + 0.1661\} \times 10^9$

Plant overhead cost = Rs. 0.3646×10^9

Thus,

Manufacture cost = Direct production cost + Fixed charges

+ Plant overhead costs.

Manufacture cost = $(2.0061 + 0.4929 + 0.3646) \times 10^9$

Manufacture cost = Rs. 2.8636×10^9

(II) General Expenses = Administrative costs + distribution and selling costs
+ research and development costs

A. Administrative costs:

(about 15% of costs for operating labour, supervision, and maintenance or 2-6% of total product cost); includes costs for executive salaries, clerical wages, legal fees, office supplies, and communications.

Consider the Administrative costs = 15% of OL, DS & CL, and M & R

$$\text{Administrative costs} = 0.15\{0.3943 + 0.0473 + 0.1661\} \times 10^9$$

$$\text{Administrative costs} = \text{Rs. } \underline{0.0912 \times 10^9}$$

B. Distribution and Selling costs:

(2-20% of total product cost); includes costs for sales offices, salesmen, shipping, and advertising.

Consider the Distribution and selling costs = 11% of total product cost

$$\text{Distribution and selling costs} = 0.11 \times 3.286 \times 10^9$$

$$\text{Distribution and Selling costs} = \text{Rs. } \underline{0.3615 \times 10^9}$$

C. Research and Development costs:

(about 5% of total product cost)

Consider the Research and development costs = 5% of total product cost

$$\text{Research and development costs} = 0.05 \times 3.286 \times 10^9$$

$$\text{Research and Development costs} = \text{Rs. } \underline{0.1643 \times 10^9}$$

D. Financing (interest):

(0-10% of total capital investment)

Consider interest = 5% of total capital investment

$$\text{i.e. interest} = 0.05 \times 3.184 \times 10^9$$

$$= \text{Rs. } \underline{0.1592 \times 10^9}$$

$$\text{General Expenses} = (0.0912 + 0.3615 + 0.1643 + 0.1592) \times 10^9$$

$$= \text{Rs. } \underline{0.7762 \times 10^9}$$

$$\begin{aligned}
 \text{(III) Total Product Cost} &= \text{Manufacturing cost} + \text{General Expenses} \\
 &= (2.8636 + 0.7762) \times 10^9 \\
 &= \text{Rs. } \underline{3.6398 \times 10^9}
 \end{aligned}$$

$$\begin{aligned}
 \text{Selling Price (Per Kg)} &= 7\text{DM} = 7 \times 20.85 = \text{Rs. } \underline{145.95} \\
 &\text{(Ref : 9)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Total Income} &= (50,000 \times 1000) \times 145.95 \\
 &= \text{Rs. } \underline{7.298 \times 10^9}
 \end{aligned}$$

$$\begin{aligned}
 \text{Gross Income} &= \text{Total Income} - \text{Total Product cost.} \\
 &= (7.298 - 3.6398) \times 10^9 \\
 &= \underline{\text{Rs. } 3.6582 \times 10^9}
 \end{aligned}$$

$$\begin{aligned}
 \text{Tax} &= 45\% \text{ of Gross Income} \\
 &= 0.45 \times 3.6582 \times 10^9 \\
 &= \underline{\text{Rs. } 1.6462 \times 10^9}
 \end{aligned}$$

$$\begin{aligned}
 \text{Net Profit} &= (3.6582 - 1.6462) \times 10^9 \\
 &= \underline{\text{Rs. } 2.012 \times 10^9}
 \end{aligned}$$

$$\begin{aligned}
 \text{Rate of return} &= \frac{\text{Net Profit}}{\text{Total Capital Investment}} \times 100
 \end{aligned}$$

$$= \frac{2.012 \times 10^9}{3.184 \times 10^9} \times 100$$

$$= \underline{63.19\%}$$