# Chapter 2

# Engineering Costs and Cost Estimating

**2-1**
A small community outside of Calgary, Alberta, is planning to construct a new fire station. As currently planned it will have 7,000 square-feet under roof. The area cost factor is 86% of the 144-city average. The estimated cost per square foot for a typical 3,500 square facility is $98. Based on economies of scale a size adjustment factor of 95% can be used. Estimate the cost of the construction. Assume a cost growth factor of 1.364.

**2-2**
In 2000 a new 21-kW power substation was built in Saskatoon, Saskatchewan, for 1.4 million dollars. The neighbouring Weakley County is planning on building a similar, though smaller, 18-kW substation in 2003. The inflation rate between 2001 and 2003 has averaged 1.5% per year. If the power sizing exponent is .85 for this type of facility what is the estimated cost of construction?

**2-3**
The time required to produce the first gizmo is 1500 blips. Determine the time required to produce the 450th gizmo if the learning-curve coefficient is .85.

**2-4**
Four operations are required to produce a certain product produced by ABC Manufacturing. Using information presented in the table below, determine the labour cost of producing the 1000 piece.

| | Time required for 1st piece | Learning curve coefficient | Labour cost per hour |
|---|---|---|---|
| Operation 1 | 1 hour 15 minutes | .90 | $ 8.50 |
| Operation 2 | 2 hours | .82 | 12.00 |
| Operation 3 | 2 hours 45 minutes | .98 | 7.75 |
| Operation 4 | 4 hours 10 minutes | .74 | 10.50 |

**2-5**
Canadian Petroleum (CP) recently completed construction on a large refinery in Alberta. The final construction cost was $17,500,000. The refinery covers a total of 340 acres. The Expansion and Acquisition Department at CP is currently working on plans for a new refinery in northern Manitoba. The anticipated size is approximately 260 acres. If the power sizing exponent is 0.67 for this type of facility what is the estimated cost of construction?

**2-6**

A new training program at Arid Industries is intended to lower the learning curve coefficient of a certain moulding operation that currently costs $95.50/hour. The current coefficient is 0.87 and the program hopes to lower the coefficient by 10%. Assuming the time to mould the first product is 8 hours. What cost savings can be realized when the 2,000$^{th}$ piece is produced if the program is successful?

**2-7**

The following data is has been provided by XYZ Manufacturing concerning one of their most popular products. Estimate the selling price per unit.

| | |
|---|---|
| Labour | = 12.8 hours at $18.75/hour |
| Factory overhead | = 92% of labour |
| Material costs | = $65.10 |
| Packing cost | = 10% of materials |
| Sales commission | = 10% of selling price |
| Profit | = 22% of selling price |

### *2-1 Solution*

Estimated cost = 98(7,000) (0.95) (0.86)(1.364)
= $764,470

### *2-2 Solution*

Cost of the 21-kW substation in 2003 dollars = $1{,}400{,}000(1.015)^3 = \$1{,}463{,}950$

$C_x = C_k(S_x/S_k)^n$

$C_{21} = C_{18}(18/21)^{.85} = 1{,}463{,}950\ (0.8772)$
$= \$1{,}284{,}177$

### *2-3 Solution*

$T_i = T_1\Theta^{(ln\ i/ln\ 2)}$

$T_{450} = 1500\ (0.85)^{(\ln 450/\ln 2)} = 358.1$ blips

### *2-4 Solution*

$T_i = T_1\Theta^{(ln\ i/ln\ 2)}$

Operation 1

$T_{1000} = 75\ (0.90)^{(\ln 1000/\ln 2)} = 26.25$ minutes
Cost = 26.25/60 x 8.50 = $3.72

Operation 2

$T_{1000} = 120\ (0.82)^{(\ln 1000/\ln 2)} = 16.61$ minutes
Cost = 16.61/60 x 12.00 = $3.32

Operation 3

$T_{1000} = 165\ (0.98)^{(\ln 1000/\ln 2)} = 134.91$ minutes
Cost = 134.91/60 x 7.75 = $17.43

Operation 4

$T_{1000} = 250\ (0.74)^{(\ln 1000/\ln 2)} = 12.44$ minutes
Cost = 12.44/60 x 10.50 = $2.18

Total cost = 3.72 + 3.32 + 17.43 + 2.18 = $26.65

### *2-5 Solution*

$$C_x = C_k(S_x/S_k)^n$$

$$C_{260} = C_{340}(260/340)^{.67} = 17{,}500{,}00\ (0.83549)$$
$$= \$14{,}621{,}075$$

### *2-6 Solution*

$$T_i = T_1\Theta^{(\ln i/\ln 2)}$$

Without the training program:

$$T_{2000} = 8\ (0.87)^{(\ln 2000/\ln 2)} = 1.74 \text{ hours}$$

With the training program:

$$T_{2000} = 8\ (0.783)^{(\ln 2000/\ln 2)} = .547 \text{ hours}$$

Cost savings = (1.74 - .547)(95.50) = $113.93

### *2-7 Solution*

| | | | |
|---|---|---|---|
| Labour Cost | = | 12.8 x 18.75 | = $240.00 |
| Factory overhead | = | 92% of labour | = 220.80 |
| Material cost | = | | = 65.10 |
| Packing Cost | = | 10% of material costs | = 6.51 |
| | | | $532.41 |

Let X be the selling price

$$0.10X + 0.22X + 532.41 = X$$
$$0.68X = 532.41$$
$$X = 532.41/0.68 = \$782.96$$