# Engineering Decision Making for Current Costs
## Making Economic Decisions

### Engineering Decision Making for Current Costs

Some of the easiest forms of engineering decision making deal with problems related to alternative designs, methods, or materials. If results of the decision occur in a very short period of time, one can quickly add up the costs and benefits for each alternative. Then, using suitable economic criterion, the best alternative can be identified. (Note that this course is mostly concerned with matters that deal with the effect of time on money. This approach ignores the time value of money.)

Example 1-2 in the textbook shows one way this can be done.

## Making Economic Decisions

### Engineering Decision Making for Current Costs

Question 1.

Farmer Jones must decide what combination of seed, water, fertilizer, and pest control will be most profitable for the coming year. The local agricultural college did a study of this farmer's situation and prepared the table below.

| Plan | Income/Acre | Cost/Acre |
|---|---|---|
| A | $ 800 | $ 600 |
| B | 2600 | 2300 |
| C | 2250 | 1800 |
| D | 750 | 650 |

Help Farmer Jones make his decision; figure out which plan he should follow.

1. What criterion should you use?

Answer

1.A Minimize Income/Acre.

1.B Maximize Income/Acre.

1.C Maximize profit.

1.D Minimize Cost/Acre.

**1.C**

2. Now figure out which plan to use.

| Answer | Plan | Income/Acre | Cost/Acre |
|---|---|---|---|
| 2.A | A | $ 800 | $ 600 |
| 2.B | B | 2600 | 2300 |
| 2.C | C | 2250 | 1800 |
| 2.D | D | 750 | 650 |

Your response is correct.

This answer maximizes the profit/acre as you can see from the right-hand column.

| Plan | Income/Acre | Cost/Acre | Profit/Acre |
|---|---|---|---|
| 2.A | $ 800 | $ 600 | $ 200 |
| 2.B | 2600 | 2300 | 300 |
| 2.C | 2250 | 1800 | 450 |
| 2.D | 750 | 650 | 100 |

# Engineering Costs

## Engineering Costs and Cost Estimating

### Engineering Costs

An engineering economic analysis may involve many types of costs. Here is a list of cost types, including definitions and examples.

A **fixed cost** is constant, independent of the output or activity level. The annual cost of property taxes for a production facility is a fixed cost, independent of the production level and number of employees.

A **variable cost** does depend on the output or activity level. The raw material cost for a production facility is a variable cost because it varies directly with the level of production.

The **total cost** to provide a product or service over some period of time or production volume is the total fixed cost plus the total variable cost, where:

Total variable cost = (Variable cost per unit) (Total number of units)

A **marginal cost** is the variable cost associated with one additional unit of output or activity. A direct labor marginal cost of $2.50 to produce one additional production unit is an example marginal cost.

The **average cost** is the total cost of an output or activity divided by the total output or activity in units. If the total direct cost of producing 400,000 is $3.2 million, then the average total direct cost per unit is $8.00.

The **breakeven point** is the output level at which total revenue is equal to total cost. It can be calculated as follows:

BEP = FC/(SP - VC)

where
BEP = breakeven point
FC = fixed costs
SP = selling price per unit
VC = variable cost per unit

A **sunk cost** is a past cost that cannot be changed and is therefore irrelevant in engineering economic analysis. One exception is that the cost basis of an asset installed in the past will likely affect the depreciation schedule that is part of an after-tax economic analysis. Although depreciation is not a cash flow, it does affect income tax cash flow. Three years ago, an engineering student purchased a notebook PC for $2,800. The student now wishes to sell the computer. The $2,800 initial cost is an irrelevant, sunk cost that should play no part in how the student establishes the minimum selling price for the PC.

An **opportunity cost** is the cost associated with an opportunity that is declined. It represents the benefit that would have been received if the opportunity were accepted. Suppose a product distributor decides to construct a new distribution center instead of leasing a building. Leasing a building immediately would have resulted in a $12,000 product distribution cost savings during the next 6 months while the new warehouse is being constructed. By forgoing the warehouse leasing alternative, the distributor experiences an opportunity cost of $12,000.

A **recurring cost** is one that occurs at regular intervals and is anticipated. The cost to provide electricity to a production facility is a recurring cost.

A **nonrecurring cost** is one that occurs at irregular intervals and is not generally anticipated. The cost to replace a company vehicle damaged beyond repair in an accident is a nonrecurring cost.

An **incremental cost** represents the difference between some type of cost for two alternatives. Suppose that A and B are mutually exclusive investment alternatives. If A has an initial cost of $10,000 while B has an initial cost of $12,000, the incremental initial cost of (B - A) is $2,000. In engineering economic analysis we focus on the differences among alternatives, thus incremental costs play a significant role in such analyses.

A **cash cost** is a cash transaction, or cash flow. If a company purchases an asset, it realizes a cash cost.

A **book cost** is not a cash flow, but it is an accounting entry that represents some change in value. When a company records a depreciation charge of $4 million in a tax year, no money changes hands. However, the company is saying in effect that the market value of its physical, depreciable assets has decreased by $4 million during the year.

**Life-cycle costs** refer to costs that occur over the various phases of a product or service life cycle, from needs assessment through design, production, and operation to decline and retirement.

## Engineering Costs and Cost Estimating

### Engineering Costs

Question 1.

A company produces a single, high-volume product. One year its production volume was 780,000 units, its fixed costs were $3.2 million and its variable costs were $16 per unit. What was the company's total cost for the year?

Choose an answer by clicking on one of the letters below, or click on "Review topic" if needed.

A $3,200,000

B $3,200,016

C $12,480,000

D $15,680,000

# D

Your response is correct.

You correctly included the fixed costs and the total variable costs.

Question 2.

A company produces a single, high-volume product. One year its production volume was 780,000 units, its fixed costs were $3.2 million and its variable costs were $16 per unit. What was the company's average cost per unit produced?

Choose an answer by clicking on one of the letters below, or click on "Review topic" if needed.

A $20.10

B $4.10

C $16.00

D $36.10

# A

Your response is correct.

You calculated the total cost as in the first question and divided by the total number of units (volume) manufactured.

Question 3.

A manufacturer purchased and installed a shrink-wrap machine 4 years ago at a cost of $4,000. A new machine is now needed, and one is available for $7,000 less a $1,000 trade-in allowance for the old machine. The market value of the old machine without trade-in on a new model is $500.

Which of the four dollar values above is a sunk cost that is irrelevant in a pre-tax engineering economic analysis?

Choose an answer by clicking on one of the letters below, or click on "Review topic" if needed.

A $500

B $1,000

C $4,000

D $7,000

## C

Your response is correct.

The $4,000 was spent 4 years ago and nothing done in the future will change that.

Question 4.

A manufacturer purchased and installed a production machine 6 years ago at a cost of $40,000. Since then the machine has been depreciated for tax purposes to a value of $7,000 and it now requires replacement. A new machine will be purchased for $60,000 and the old machine sold to a used equipment dealer for $10,000.

Which of the four dollar values above is a book cost, not an actual cash transaction?

Choose an answer by clicking on one of the letters below, or click on "Review topic" if needed.

A $7,000

B $10,000

C $40,000

D $60,000

## A

Your response is correct.

The machine is valued in the company’s financial records at $7000; that is, this is the “book” value. The book referred to here is the financial book (or books) of the compa

Question 5.

A manufacturer produces and sells exactly 600,000 units of a single product annually. The fixed cost of the company is $3.6 million per year, and the variable cost is $47 per unit. In the coming year, the company is selling its product at a price of $56 per unit. Calculate the breakeven point (BEP) in units for the coming year.

Choose an answer by clicking on one of the letters below, or click on "Review topic" if needed.

A BEP is about 77,000 units

B BEP is about 64,000 units

C BEP is 400,000 units

D BEP is 600,000 units

# C

Your response is correct.

Since there is a $9 profit on each unit ($56 - $47), you divided the fixed cost for all units manufactured, $3.6 million, by the unit profit to get 400,000 units

# Cash Flow Diagrams

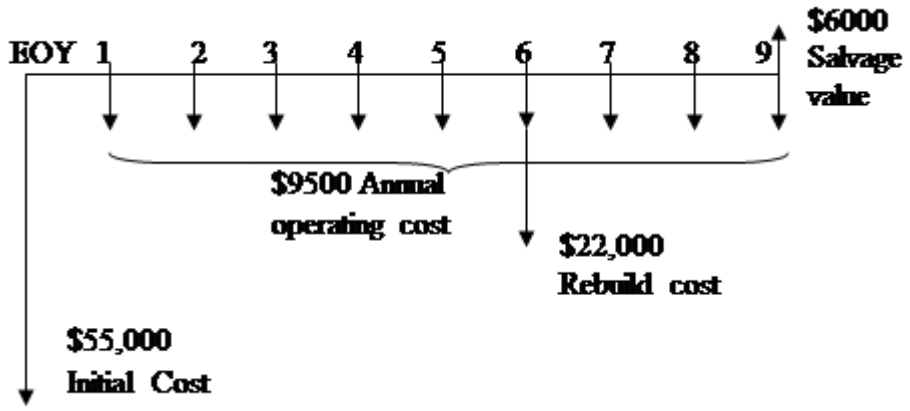
## Engineering Costs and Cost Estimating

### Cash Flow Diagrams

Cash flow diagrams visually represent income and expenses over some time interval. The diagram consists of a horizontal line with markers at a series of time intervals. At appropriate times, expenses and costs are shown.

Note that it is customary to take cash flows during a year at the end of the year, or EOY (end-of-year). There are certain cash flows for which this is not appropriate and must be handled differently. The most common would be rent, which is normally taken at the beginning of a cash period. There are other pre-paid flows which are handled similarly.

For example, consider a truck that is going to be purchased for $55,000. It will cost $9,500 each year to operate including fuel and maintenance. It will need to have its engine rebuilt in 6 years for a cost of $22,000 and it will be sold at year 9 for $6,000. Here is the cash flow diagram:



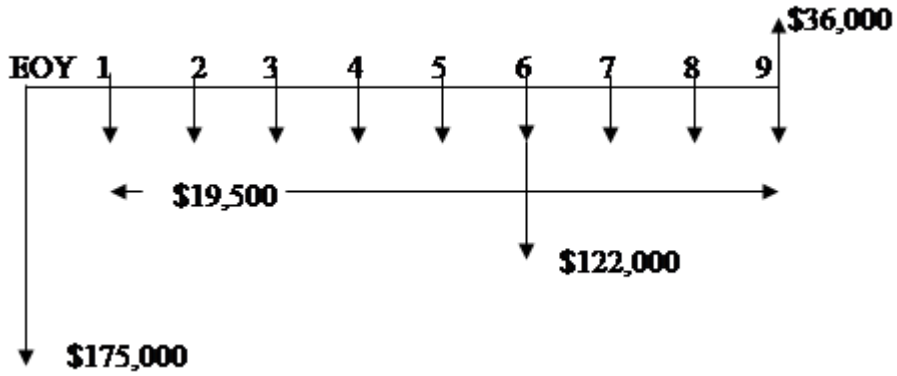

Note that the initial cost, the purchase price, is recorded at the beginning of Year 1, sometimes referred to as end-of-year 0, or EOY 0. Also, operating and maintenance costs actually will occur during a year, but they are recorded at EOY, and so forth.

## Engineering Costs and Cost Estimating

**Cash Flow Diagrams**

Question 1.

Given the cash flow diagram below, answer the questions by clicking on the correct answer. Note that there are several questions; as you correctly answer each, you go to the next question. (Note that these questions will take more time than previous questions did.)




1.What is the initial cost of this new machine?

1.A $122,000

1.B $19,500

1.C $175,000

1.D $36,000

## 1.C

Your response is correct.

It is the cost incurred at the beginning of the first year.

2.What is the rebuild cost of the machine?

2.A $122,000

2.B $19,500

2.C $175,000

2.D $36,000

## 2.A

Your response is correct.

The rebuild cost will be incurred several years into the use of the equipment.

3.What is the salvage value for the machine?

3.A $122,000

3.B $19,500

3.C $175,000

**3.D $36,000**3.D

Your response is correct.

The salvage value is what the equipment brings (the owner receives) when it is sold.

4.In what single year is the total combined value of the machine positive?

4.A 2

4.B 4

4.C 6

# 4.D

Your response is correct.

In year 9, there are two cash flows, the annual cost of $19,500 and the salvage value, which is revenue and is $36,000. The net is $16,500 positive.