

## **6. FINANCIAL**

Topics:

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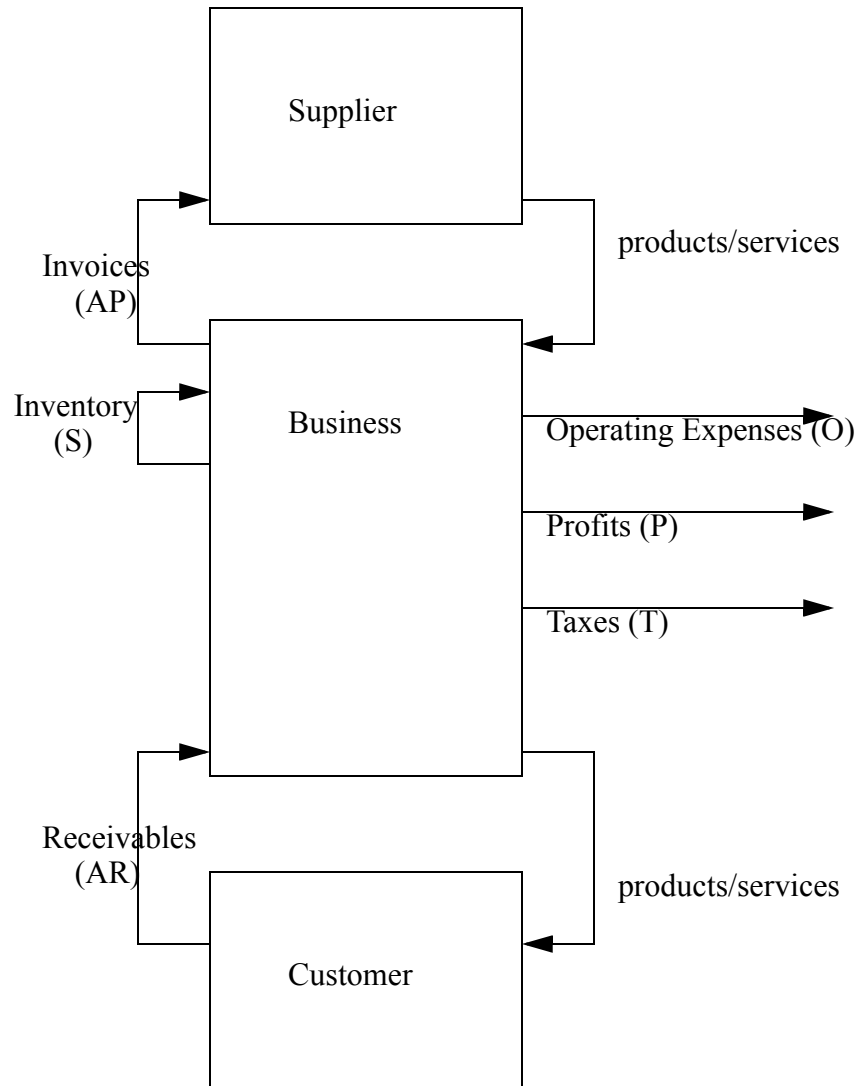
Objectives:

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### **6.1 Introduction**

- The primary object of a public corporation is to generate the maximum amount of profit possi-

ble. A simple model is shown below.



$$T = 0.5P \quad (\text{assumes 50\% tax on profit})$$

$$\sum = AR - AP - O - P - T = 0$$

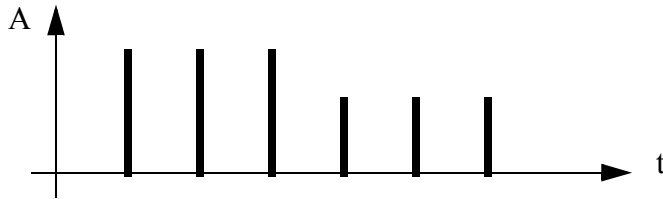
$$\therefore AR - AP - O - P - 0.5P = 0$$

$$\therefore P = \frac{AR - AP - O}{1.5}$$

- Operating expenses include a number of factors such as,
  - Depreciation on capital equipment

## - Wages/salaries

- When cash flow occurs over a number of years it is often shown with cash flow diagrams.



- When considering the economic value of a decision, one method is the payback period.

$$N = \frac{C_I}{S_A}$$

where,

$C_I$  = initial investment (\$)

$S_A$  = savings per year (\$/yr)

$N$  = payback period (years)

- Simple estimates for the initial investment and yearly savings are,

$$C_I = C_E - I_S$$

where,

$C_E$  = cost of new equipment

$I_S$  = revenue from sale of old equipment (salvage)

$$S_A = (L_0 H_0 - L_1 H_1) + (M_0 - M_1)$$

where,

$L_0, L_1$  = labor rate before and after

$H_0, H_1$  = labor hours before and after

$M_0, M_1$  = maintenance costs before and after

- There are clearly more factors than can be considered, including,
  - changes in material use
  - opportunity cost
  - setup times
  - change in inventory size
  - material handling change
- The simple models ignore the conversion between present value and future value. (ie, money now is worth more than the same amount of money later)

$$PW = C_0 + \sum [(R_{A_j} - C_{A_j})(P/F, i, j)]$$

$$(P/F, i, j) = \frac{1}{(1+i)^j} \quad (P/A, i, n) = \sum (P/F, i, j) = \frac{(1+i)^n - 1}{i(1+i)^n}$$

where,

$PW$  = present worth of the money (in today's dollars)

$R_{A_j}$  = Annual revenues (income) for year  $j$

$C_{A_j}$  = Annual costs (expenses) for year  $j$

$j$  =  $j$  years in the future

$i$  = interest rate (fractional)

$n$  = number of years for consideration

- The future value of money can be evaluated using,

$$F = P(F/P, i, n) \quad (F/P, i, n) = (1+i)^n$$

where,

$FW$  = future worth of the money

e.g.,

$$i = 5\% \quad P = 1000 \quad n = 3$$

$$F = P(F/P, i, n) = 1000(F/P, 5\%, 3) = 1000(1 + 0.05)^3 =$$

- Quite often a Rate of Return (ROR) will be specified by management. This is used in place of interest rates, and can include a company's value for the money. This will always be higher

than the typical prime interest rate.

- So far we haven't considered the effects of taxes. Basically corporate taxes are applied to profits. Therefore we attempt to distribute expenses evenly across the life of a project (even though the majority of the money has been spent in the first year). This distribution is known as depreciation.

$$A = B - T = B - (\text{tax}_{rate} C) = B(1 - \text{tax}_{rate}) + D\text{tax}_{rate}$$

where,

$A$  = after tax cash (\$/yr)

$B$  = before tax cash (\$/yr)

$D$  = depreciation of equipment (\$/yr)

$\text{tax}_{rate}$  = the corporate tax rate

- Methods for depreciation are specified in the tax laws. One method is straight line depreciation.

$$D = \frac{C_E - I_S}{n}$$

where,

$D$  = The annual depreciation

- Another methods is the accelerated cost recovery (ACRS) method that is based on US tax law. A similar version is the Modified ACRS (MACRS) system.

$$D_j = C \times f_j$$

where

$D_j$  = The annual depreciation for year j

$f_j$  = the depreciation factor for year j

| year | recovery % for a given depreciation period |       |       |        |
|------|--|-------|-------|--------|
|      | 3 yrs                                      | 5 yrs | 7 yrs | 10 yrs |
| 1    | 33.3                                       | 20.0  | 14.3  | 10.0   |
| 2    | 44.5                                       | 32.0  | 24.5  | 18.0   |
| 3    | 14.8                                       | 19.2  | 17.5  | 14.4   |
| 4    | 7.4  | 11.5  | 12.5  | 11.5   |
| 5    |  | 11.5  | 8.8   | 9.2    |
| 6    |  | 5.8   | 8.9   | 7.4    |
| 7    |  |       | 8.9   | 6.6    |
| 8    |  |       | 4.5   | 6.6    |
| 9    |  |       |       | 6.5    |
| 10   |  |       |       | 6.5    |
| 11   |  |       |       | 3.3    |

(copied from Lindberg FE Review Manual)

- The 'book value' for an item is calculated as,

$$BV = C - \sum D_j$$

- Rate of Return (ROR) Analysis -

- Present worth analysis shifts all of the future costs and incomes into a present day sum.
- Benefit Cost Analysis for choosing between alternatives, All costs must be converted to the present values.

$$\frac{B_2 - B_1}{C_2 - C_1} > 1 \quad \text{Choice 2 is better than 1}$$

- Break Even Analysis

$$C - PBP \times NAP$$

where,

$PBP$  = Payback period

$NAP$  = Net annual profit

- Return On Investment,

$$ROI = \frac{B - C}{C} 100\%$$

- Consider an assembly line that is currently in use, and the system proposed to replace it. The product line is expected to last 5 years, and then be sold off. The corporate tax rate is 50% and the company policy is to require a 17% rate of return. Should we keep the old line, or install the new one?

Current Manual Line:

- used 2000 hrs/yr with 10 workers at \$20/hr each
- maintenance is \$20,000/yr
- the current equipment is worth \$20,000 used

Proposed Line:

- the equipment will cost \$100,000 and the expected salvage value at the end of the project is \$10,000
- 2 workers are required for 1000 hours year at \$40/hr each
- yearly maintenance will be \$40,000

## 6.2 Problems

1. If \$100,000 were borrowed for 3 years at a %10 interest rate, how much would be due at the end of the loan. (ans. \$133,100)

2. If \$100,000 were borrowed for 3 years at a %10 interest rate, how much would be due at the end of the loan if \$20,000 were repaid each year. (ans. \$66,900)

3. A machine was purchased for \$100,000 and generates \$20,000 per year income. How many years would be required to break even if the company charged a 10% internal interest rate. (ans. 7.27 yrs)

4. If a machine is purchased for \$100,000 and the company charges %10 for the use of money, what annual return is required for the machine to break even in 3 years. (ans. \$40,211.49)

5. A machine costs \$100,000 and will be sold for salvage value in 3 years for \$30,000. What is the Equivalent Uniform Annual Cost for the machine assuming the company uses an interest rate of 10%? (ans. \$31,148.69)

6. A machine costs \$100,000 and will be sold for salvage value in 3 years for \$30,000. The alternative is to lease a machine for \$40,000 per year. If the company uses an interest rate of 10% which option should be chosen? (ans. purchasing is a better option)

7. An existing manual production line costs \$100,000 to operate per year. A new piece of automated equipment is being considered to replace the manual production line. The new equipment costs \$150,000 and requires \$30,000 per year to operate. The decision to purchase the new machine will be based upon a 3 year period with a 25% interest rate. Compare the present value of the two options. (ans.  $PV_{\text{manual}} \$195,200$ ,  $PV_{\text{new}} \$208,560$ )

8. Write a general computer program to solve the following project costing problem. Test the program using the numbers provided. The program should accept the initial cost of equipment (C), an annual maintenance cost (M), an annual income (R), a salvage value (S), and an interest rate (I). The program should then calculate a present worth and the ROI.

Test values:

$$C = 100,000$$

$$M = 20,000$$

$$R = 150,000$$

$$S = 10,000$$

$$I = 10\%$$

$$L = 3\text{yrs}$$

9. Write a program that determines the ROI for a project given the project length, initial cost, salvage value, and projected income. To test the program assume that the project lasts for 36 months. The company standard interest rate is 18%. The equipment will cost \$100,000 new and have a salvage value of \$10,000. The annual income will be \$50,000.

### 6.3 Challenge Problems

1. Consider Moore's law that predicts that every 18 months the basic speed and capacity of semi-conductors will double. We have a customer that wants.....