

Time Value of Money (Interest Rate) & Cash Flow

*Engineering Economic Analysis Section
Perancangan Pabrik Kimia 2*

Schedule

- **Time Value of Money (Interest Rate) & Cash Flow**
- Depreciation & Salvage Value
- Profitability Analysis
- Selection of Alternatif Investment of Chemical Plant Equipment
- Sensitivity/Break Even Analysis
- Tax Principals (Dasar-Dasar Perpajakan)
- Selection of Plant Location
- Ujian Modul

Back View

- You have studied about Fixed Capital, Manufacturing Cost, Working Capital, etc.
- **Economic evaluation** can be carried out to determine:
 - The process generates money
 - The process is attractive compared with other process
- **Money ?????**
 - Consume money as received
 - Retain money for future consumption
 - Simple saving
 - Investments

Interest Rate (“Bunga”)

- Interest rate is the ratio of the interest charged at the end of a period (usually 1 year) to the amount of money owed at the beginning of the period ==> percentage
- Interest may be compounded on basis other than annual ==> may be monthly basis
- Other similar terms but not the same as: DCFROR, ROI

Simple Interest

- The interest is charged on the original loan and not on the unpaid balance
- $F = P + Pin = P(1 + in)$
- F: Future value of money; P: present value of money; i : interest rate; n : number of interest period
- Example: If \$1000 has been borrowed at 10% simple interest for 4 years, how much money will be owed for 5 years?
 - End of year 1: $1000 + (1000 \cdot 0.1 \cdot 1) = 1100$
 - End of year 2: $1000 + (1000 \cdot 0.1 \cdot 2) = 1200$
 - and so on....

Compound Interest (“Bunga Majemuk”)

- Interest ==> has a time value
- $F = P (1 + i)^n$
- Year 1: $F_1 = P + Pi = P (1+i)$
- Year 2: $F_2 = P + P(1+i)i = P(1+i)^2$
- Year n: $F_n = P(1+i)^n$
- Nominal interest: an interest rate is quoted on an annual basis
- However, interest may be payable on a semiannual, quaterly, monthly, or daily basis
- ==>

Nominal Interest

- Formula:

$$F = P \left[1 + \left(\frac{i}{m} \right) \right]^{(m)(n)}$$

- where: m : the number of interest periods per year; n: the number of years; i : the nominal interest

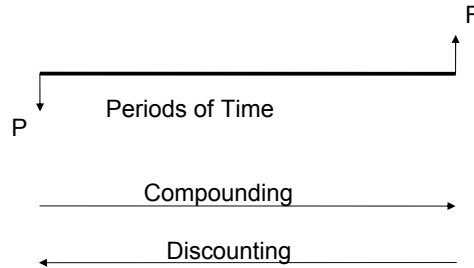
Example:

- If we have \$2500 were invested for 5 years at 10% nominal interest compounded quarterly, what would be the future amount?

$$F = P \left[1 + \left(\frac{i}{m} \right) \right]^{(m)(n)}$$

- $F = (\$2500) \left[(1 + (0.1/4))^{(5)(4)} \right] = (\$2500)(1.025)^{20} = \$4096.54$
- If the interest were compounded monthly, the future amount would be:
 - $F = (\$2500) \left[(1 + (0.1/12))^{(12)(5)} \right] = \4113.19
- If the interest had been compounded on a daily basis, then:
 - $F = (\$2500) \left[(1 + (0.1/365))^{(365)(5)} \right] = \4121.73

Compound Interest Factors



- Compounding: the process of moving money forward in time
- Discounting: The process of moving money backward in time
- The periods are in years, and the interest is normally on an annual basis.

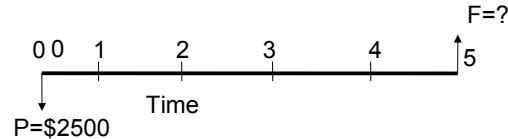
Discount Factor Table

Conversion	Symbol	Common Name	Formula
P to F	$(F/P, i, n)$	Single Payment Compound Amount Factor	$(1+i)^n$
F to P	$(P/F, i, n)$	Single Payment Present Worth Factor	$1 / (1+i)^n$
A to F	$(F/A, i, n)$	Uniform Series Compound Amount Factor, Future Worth of Annuity	$\frac{(1+i)^n - 1}{i}$
F to A	$(A/F, i, n)$	Sinking Fund Factor	$\frac{i}{(1+i)^n - 1}$
P to A	$(A/P, i, n)$	Capital Recovery Factor	$\frac{i(1+i)^n}{(1+i)^n - 1}$
A to P	$(P/A, i, n)$	Uniform Series Present Worth Factor, Present Worth of Annuity	$\frac{(1+i)^n - 1}{i(1+i)^n}$

Examples of Discount Factors

- If \$2500 were invested at 5% interest compounded annually, what would be the balance in the account after 5 years?

- $F=?$; $P=\$2500$; $i=5\% = 0.05$; $n=5$;



- $F = P(F/P, i, n) = P(1+i)^n = (2500)(1+0.05)^5 = \3190.70

Examples...

- A person desires to borrow \$18500 now to be paid back in 10 years at 8.5% compounded annually. How much is this person required to pay annually?

- $P=\$18500$; $i=0.085$; $n=10$ years; $A = ?$

- $A=P(A/P, i, n) = P \left[\frac{i(1+i)^n}{(1+i)^n - 1} \right]$

- $A = (\$18500) \left[\frac{0.085(1+0.085)^{10}}{(1+0.085)^{10} - 1} \right]$

- $A = \$2819.50$

Effective Interest Rates

- Nominal interest rates as noted previously are on an annual basis, but effective interest rates may be for any period
- Effective interest rate:

$$i_{eff} = \left[1 + \frac{i}{m} \right]^m - 1$$

- Example: 8.33% interest rate compounded monthly. What is the effective interest rate?
 - $i_{eff} = (1 + (0.083/12))(12)(1) - 1 = 0.0865$ atau 8.65%

Capitalized Cost

- The capitalized cost method is a present analysis in which the economic life of an asset or venture is considered indefinitely long
- Perpetuity: an annuity in which the periodic payments continue indefinitely
- Capitalized Cost is defined as the original cost of the equipment plus the present value of the renewable perpetuity:

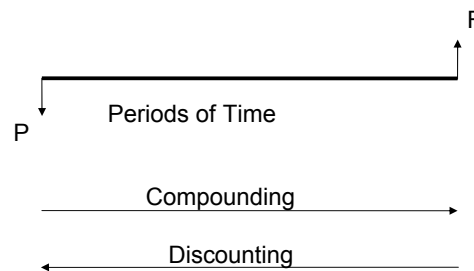
$$K = C_V + \frac{C_R}{(1+i)^n - 1}$$

- K : capitalized cost; C_V : the original cost; C_R : the replacement cost, and i: interest rate, and n: interest period
- $C_R = C_V - SV$ (where SV: Salvage Value)

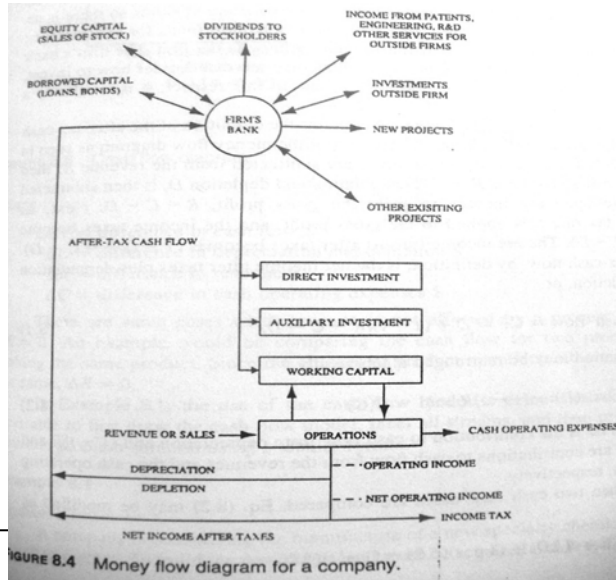
Example: Capitalized Cost

- A new piece of completely installed equipment costs \$12,000 and will have a scrap value of \$2000 at the end of its useful life. If the useful-life period is 10 years and the interest is compounded at 6 percent per year, what is the capitalized cost of the equipment?
 - The cost for replacement of the equipment at the end of its useful life = $\$12000 - \$2000 = \$10000 \implies C_R$
 - Capitalized cost (K) = $C_V + C_R / ((1+i)^n - 1)$
 - $C_V = \$12000$; $i = 0.06$; $n = 10$
 - $K = (\$12000) + (\$10000 / ((1+0.06)^{10} - 1)) = \24650

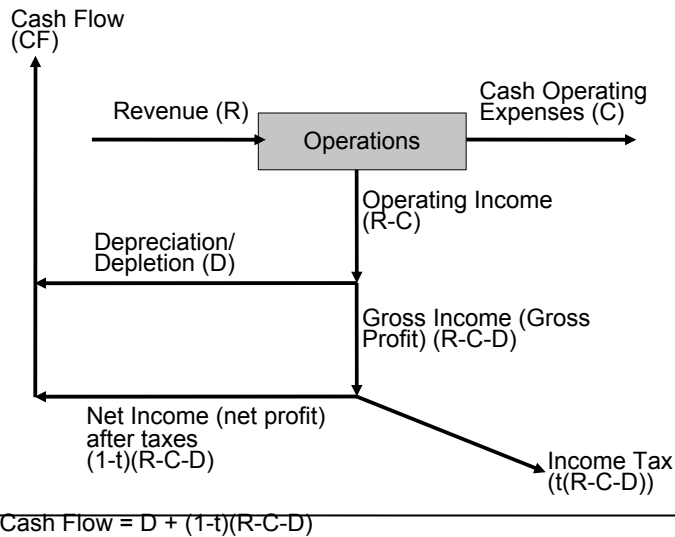
CASH FLOW CONCEPT



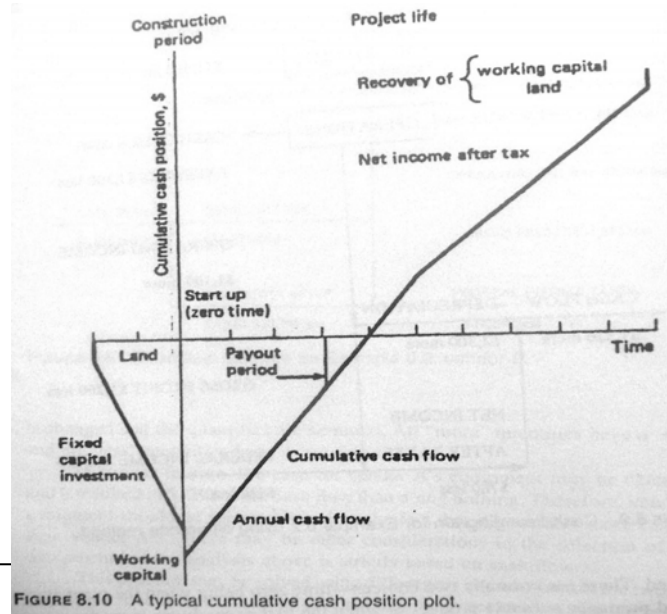
Money Flow of a Company



Concept of Cash Flow



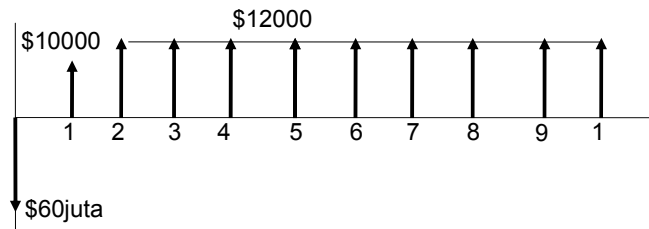
Cummulative Cash Flow



Example:

- Sebuah perusahaan berkeinginan menginvestasikan sejumlah uang untuk sebuah proyek pabrik kimia. Besarnya aliran kas (cash flow) setelah pajak adalah:
 - investasi awal = \$60juta
 - cash flow after tax pada tahun ke-1 = \$10juta
 - cash flow after tax pada tahun ke-2 hingga ke-10 = \$12
 - Jika internal discounted rate of return adalah 10%, maka:
 - Gambarkan cash flow diagram
 - Hitunglah Net Present Value (NPV)
 - Hitunglah Future Worth

■ Cash flow Diagram:



- $NPV = [-\$60 + \$10(P/F, 0.1, 1) + \$12(P/A, 0.1, 9) (P/F, 0.1, 1)] \times 1 \text{ juta}$
- $NPV = [-\$60 + (\$10)(1/(0.1+1)) + [(\$12)((0.1+1)^9 - 1)/(0.1(0.1+1)^9)]] [1/(0.1+1)^9]$
- $NPV = \$11.9 \text{ juta}$
- Hitunglah untuk Net Future Worth