

Alternative Investments

Book : *Plant Design and Economics for Chemical Engineers*, M.S. Peters and K. D. Timmerhaus
Chapter 10 (4th Edition)

- In industrial operations, it is often possible to produce equivalent products in different ways
- Though the physical results may be approximately the same, the capital required and the expenses involved can vary considerably depending on the method chosen
- Thus, it often becomes necessary to choose one option from the several available
- The option that is chosen as the best alternative investment is one that provides an adequate rate of return for every extra rupee invested

The minimum investment which will give the necessary functional results and the required rate of return should always be accepted unless there is a specific reason for accepting an alternative investment requiring more initial capital.

- The above is a general rule for making comparisons of alternative investments.
- When alternatives are available for comparison, the option with the minimum acceptable investment is chosen as the base plan. The alternatives should be compared with the base plan, and additional capital would not be invested unless an acceptable incremental return or some other distinct advantage could be shown over the base plan.

- When investment comparisons are made, alternatives requiring more initial capital are compared only with lower investments which have been found to be acceptable
 - For eg., comparing three investment options of Rs. 60,000, Rs. 50,000 and Rs. 70,000, the base option is the Rs. 50,000 investment.
 - This is compared with the Rs. 60,000 investment, and if the Rs. 60,000 investment is found unacceptable then Rs. 50,000 investment is compared with the Rs. 70,000 investment. The one which is found acceptable is the final option.
- The alternate investments are compared in pairs on a mutually exclusive basis

An existing plant has been operating in such a way that a large amount of heat is being lost in the waste gases. It has been proposed to save money by recovering the heat that is now being lost. Four different heat exchangers have been designed to recover the heat, and all prices, costs, and savings have been calculated for each of the designs. The results of these calculations are presented in the following:

Design	No. 1	No. 2	No. 3	No. 4
Total initial installed cost, \$	10,000	16,000	20,000	26,000
Operating costs, \$/yr	100	100	100	100
Fixed charges, % of initial cost/yr	20	20	20	20
Value of heat saved, \$/yr	4,100	6,000	6,900	8,850

The company in charge of the plant demands at least a 10 percent annual return based on the initial investment for any unnecessary investment. Only one of the four designs can be accepted. Neglecting effects due to income taxes and the time value of money, which (if any) of the four designs should be recommended?

The first step is to calculate the amount of money saved per year for each design
 The net annual savings = value of heat saved – (sum of operating cost and fixed charges)
 This is used to calculate annual percent return on the initial investment for each case

For design No. 1,

$$\text{Annual savings} = 4100 - (0.2)(10,000) - 100 = \$2000$$

$$\text{Annual percent return} = \frac{2000}{10,000}(100) = 20\%$$

For design No. 3,

$$\text{Annual savings} = 6900 - (0.2)(20,000) - 100 = \$2800$$

$$\text{Annual percent return} = \frac{2800}{20,000}(100) = 14\%$$

For design No. 2,

$$\text{Annual savings} = 6000 - (0.2)(16,000) - 100 = \$2700$$

$$\text{Annual percent return} = \frac{2700}{16,000}(100) = 16.9\%$$

For design No. 4,

$$\text{Annual savings} = 8850 - (0.2)(26,000) - 100 = \$3550$$

$$\text{Annual percent return} = \frac{3550}{26,000}(100) = 13.6\%$$

All four investments show annual rate of return > 10%, so all are possible alternatives

Now the designs are compared with each other. The incremental (extra) savings along with incremental (extra) investment of a pair of options are compared and the better one determined.

Design 1 (least initial investment) is taken as the base option

Comparing Design 1 and Design 2, shows savings of \$ 700 (\$2700 - \$2000) for \$6000 (\$16,000 - \$10,000) extra investment.

Annual percent (%) return = $(700/6000) \times 100 = 11.67\%$ [**Design 2 is acceptable and preferred over Design 1**]

Comparing Design 2 and Design 3, shows savings of \$ 100 for \$4000 extra investment.

Annual percent (%) return = $(100/4000) \times 100 = 2.5\%$ (unacceptable) [**Design 2 is acceptable and preferred over Design 3**]

Comparing Design 2 and Design 4, shows savings of \$ 850 for \$10,000 extra investment.

Annual percent (%) return = $(850/10,000) \times 100 = 8.5\%$ (unacceptable) [**Design 2 is acceptable and preferred over Design 4**]

DESIGN 2 IS THE FINAL CHOICE

Advantage and disadvantage of various profitability measures for comparing alternatives

- Among the different methods for profitability evaluation and economic comparison of alternatives, **(1) *net present worth*** and **(2) *discounted cash flow*** are the most recommended methods
- *Capitalized costs* are useful and appropriate for certain specific situations
- *Payout period* does not consider the working capital and is useful for a rough, preliminary analysis
- *Rate of return on investment* does not consider the time value of money and considers only approximate average incomes
- If comparison of a series of alternative investments using different methods, results in different recommendations, then the option provided by *net present worth* should be used as the final choice, as it considers time value of money and hence provides a more realistic answer
- Investment costs due to land can be accounted for in all methods except *payout period*
- Costs incurred during construction period prior to start-up can be considered for *net present worth* and *discounted cash flow methods* while they are not considered in either *return on investment* or *payback period method*
- Income tax effects can be included in all evaluation methods. Income tax affects the net profit and cash flow into the corporate treasury but not capital investment

Comparison of alternative investments by different profitability methods

A company has to choose one of the three alternative investments available for its consideration. Risk factors are the same in all three options. Company policy dictates that a minimum annual return on the original investment of 15% after taxes must be predicted. Company policy also dictates that straight line depreciation is to be used wherever necessary and for time value of money calculations, end of the year cost and profit analysis is used. Land value and pre-startup costs can be ignored.

Given the following data, determine which investment, if any should be made using the mentioned profitability investment method

- | | |
|---|-----------------------|
| (a) Rate of return on investment | (d) Net present worth |
| (b) Minimum payout period with no interest charge | (e) Capitalized cost |
| (c) Discounted cash flow method | |

Investment No	Total initial FCI, \$	Working capital investment, \$	Salvage value, \$	Service life, n, years	Annual flow to project after taxes, \$	Annual cash expenses* (annual income – annual cash flow), \$
1	100,000	10,000	10,000	5	30,000	44,000
					31,000	
					36,000	
					40,000	
					43,000	
2	170,000	10,000	15,000	7	52,000 (constant)	28,000
3	210,000	15,000	20,000	8	59,000 (constant)	21,000

(a) Rate of return on investment

Investment 1

Average annual profit = Annual cash flow – Depreciation

Depreciation = $(100,000 - 10,000)/5 = 18,000$

Year	Average annual profit	Arithmetic average of profit
1	$30,000 - 18,000 = 12,000$	$= 90,000/5 = 18,000$
2	13,000	
3	18,000	
4	22,000	
5	<u>25,000</u>	
	<u>90,000</u>	

$$ROI = \frac{18,000}{100,000} \times 100 = 16.4\%$$

Investment 2

Depreciation = $(170,000 - 15,000)/7 = 22,100$

Average annual profit = $52,000 - 22,100 = 29,900$

$$ROI = \frac{29,900}{170,000} \times 100 = 16.6\%$$

All three options have ROI > 15%, hence acceptable

Comparing Investment 2 with Investment 1

$$ROI = \frac{29,900 - 18,000}{180,000 - 110,000} \times 100 = 17\%$$

Comparing Investment 3 with Investment 2

$$ROI = \frac{35,250 - 29,900}{225,000 - 180,000} \times 100 = 11.88\%$$

Therefore, Investment 2 is recommended

Investment 3

Depreciation = $(210,000 - 20,000)/8 = 23,750$

Average annual profit = $59,000 - 23,750 = 35,250$

$$ROI = \frac{35,250}{210,000} \times 100 = 15.67\%$$

Investment 2 is preferred over Investment 1

This return is not acceptable

(b) Payout period (Payback period)

Investment 1

$$PBP = \frac{\text{depreciable FCI}}{\text{avg. profit per year} + \text{avg. depreciation per year}} = \frac{(100,000 - 10,000)}{18,000 + 18,000} = 2.5 \text{ years}$$

Investment 2

$$PBP = \frac{\text{depreciable FCI}}{\text{avg. profit per year} + \text{avg. depreciation per year}} = \frac{(170,000 - 15,000)}{29,900 + 22,100} = 2.98 \text{ years}$$

Investment 3

$$PBP = \frac{\text{depreciable FCI}}{\text{avg. profit per year} + \text{avg. depreciation per year}} = \frac{(210,000 - 20,000)}{35,250 + 23,750} = 3.22 \text{ years}$$

Based on PBP, Investment 1 should be recommended as it has the shortest payback period