CH0401 Process Engineering Economics

Lecture 5c

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Process Engineering Economics

1. Economic Analysis of a complete process
2. Operating Plants and Proposed Plants

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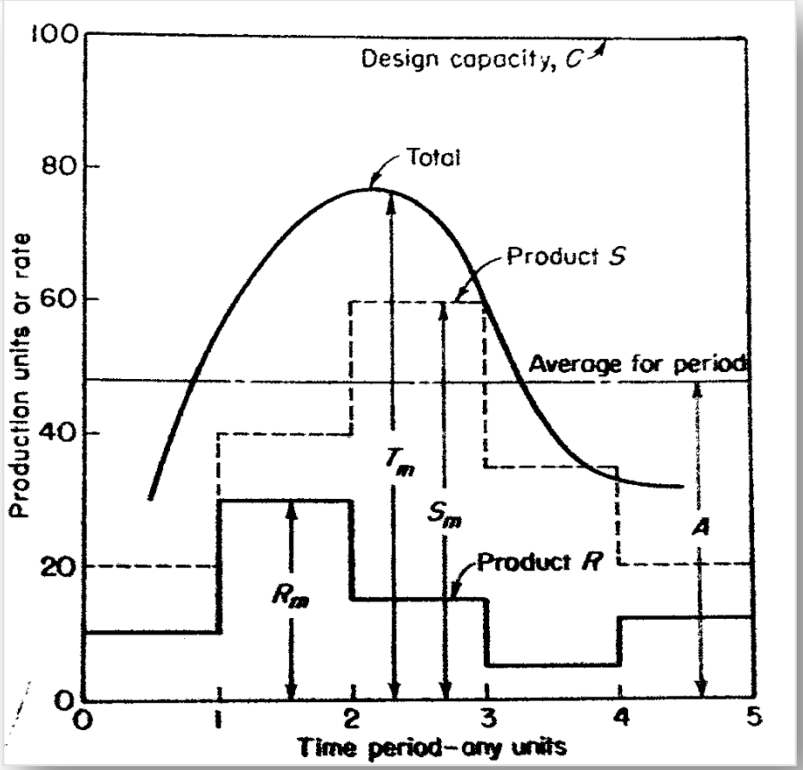
Process Engineering Economics - *Capacity Factors*

Factors that govern the economic production of a process plant operating at full capacity

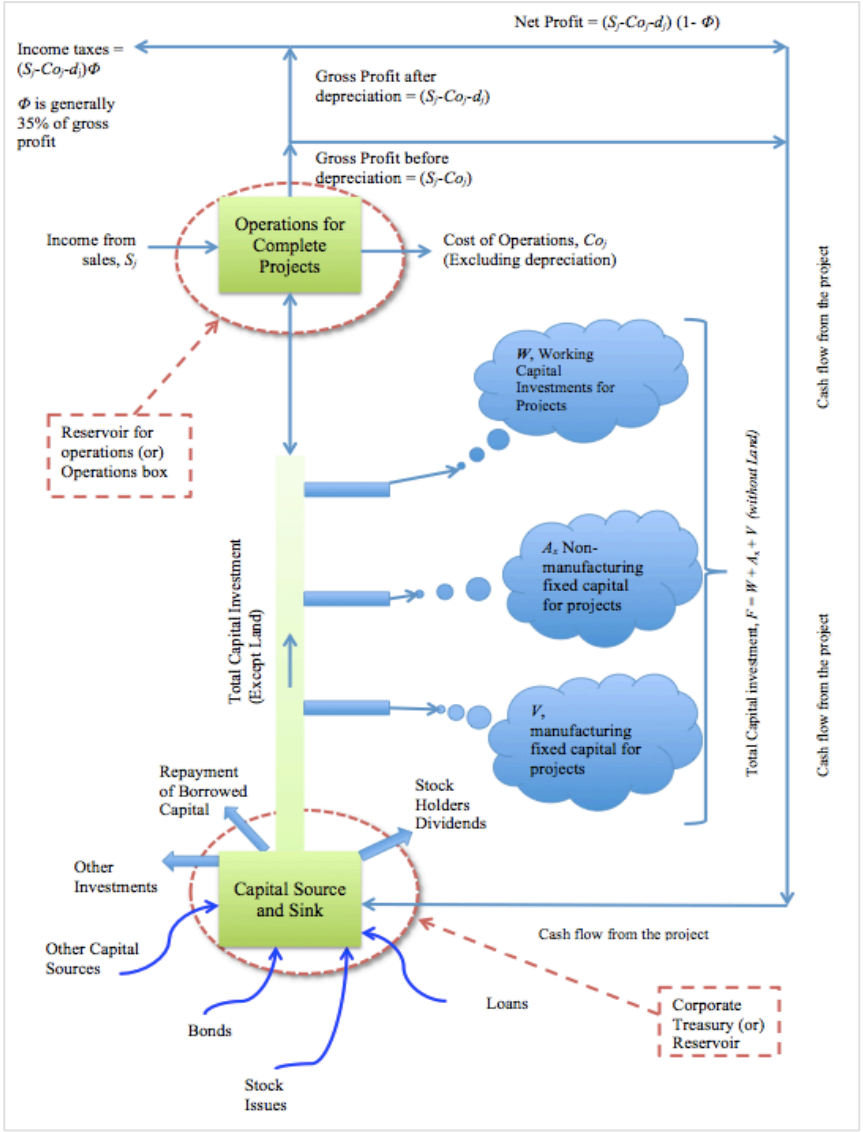
1. Demand Factor
2. Capacity factor
3. Load Factor
4. Diversity factor



R_m is maximum instantaneous production of product R
S_m is maximum instantaneous production of product S
T_m is maximum instantaneous production of both products

Process Engineering Economics – *Cash flow*

Simplified representation of flow of funds for an over all industrial operations



Process Engineering Economics – *Cash flow*

The figure tells us the capital inputs and output for an industrial operation using a tree growth analogy, depicting as the trunk the total capital investment, excluding land cost in order to initiate the operations.

The total capital investment comprises the fixed capital investment in the plant and equipment, including necessary investments for auxiliaries and non manufacturing facilities, plus the working capital investment.

i.e. Total Capital investment, $F = W + A_x + V$ *(without Land)*

Process Engineering Economics – *Economic Analysis*

Income from sales and cost of operations may occur irregular time basis some times, a reservoir of working capital must be available to meet this requirements. Therefore, the rectangular box at the top of the cash flow diagram represents the operating phase for the complete project with working capital funds maintained at a level of acceptance for an efficient operation.

Cash flows into the operations box as income S_j from sales while annual cost of operation such as raw materials and labor but not including the depreciation are shown as outflow costs Co_j. Where the subscript j indicates the cash flow at j^{th} period (or time period).

Process Engineering Economics – *Economic Analysis*

The difference between the income ad the operating costs ($S_j - Co_j$) is the *gross profit before depreciation charge* and is represented by the vertical line rising out of the operations box.

Depreciation is subtracted as a cost before income tax charges are calculated and paid, and net profits are reported to the stockholders.

Consequently, removal of depreciation as a charge against profits is shown at the top of the cash (or fund) flow diagram.

The depreciation charge d_j is added to the net profit to make up the total cash flow for the return to the capital reservoir.

Process Engineering Economics – *Economic Analysis*

The resulting,

$$\text{gross profit of } (S_j - Co_j - d_j)$$

that accounts for the depreciation charge is taxable.

The income tax charge is shown at the top of the diagram as

$$(S_j - Co_j - d_j)\,\Phi$$

Where Φ is the fixed income tax rate designated as a fraction of annual gross profits.

The remainder after the income taxes paid

$$(S_j - Co_j - d_j)\,(1 - \Phi)$$

is the net profit after taxes that is returned to the capital reservoir.

The depreciation charge d_j is added to the net profit to make up the total cash flow for the return to the capital reservoir.

When the depreciation charge d_j is added to the net profit, total project generated cash flow is returned to the capital reservoir on the annual basis as

$$A_j = (S_j - Co_j)(1-\Phi) + d_j\Phi$$

Where A_j is the cash flow from the project to the capital cash flow from the reservoir

S_j is sales rate in year j ,

d_j is depreciation charge in year j and

Φ is fractional income rate

This cash flow as mentioned above is used for new investments, dividends, and repayments of loans as indicated by the various branches emanating from the capital source

Process Engineering Economics – ***References***

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