Renewal/replacement & Obsolescence of Capital assets in manufacturing systems

Inadequacy, aging, obsolescence

In regard to the renewal/replacement of plants (& machines), it is useful to consider three elements that characterize plants (& machines) along their lifecycle:

- **inadequacy**: the plant is inadequate if, after a constant variation of the demand, it becomes definitely over- or under-sized. The plant has achieved the end of its possible/potential life.
- **aging**: the plant is aged when it is not possible anymore to intervene in effective and convenient way through maintenance. The plant has achieved the end of its **physical life.**
- **obsolescence**: the plant is obsolete when its replacement is induced by the technological development that offers, on the market, more competitive plants. The plant has achieved the end of its **useful life.**

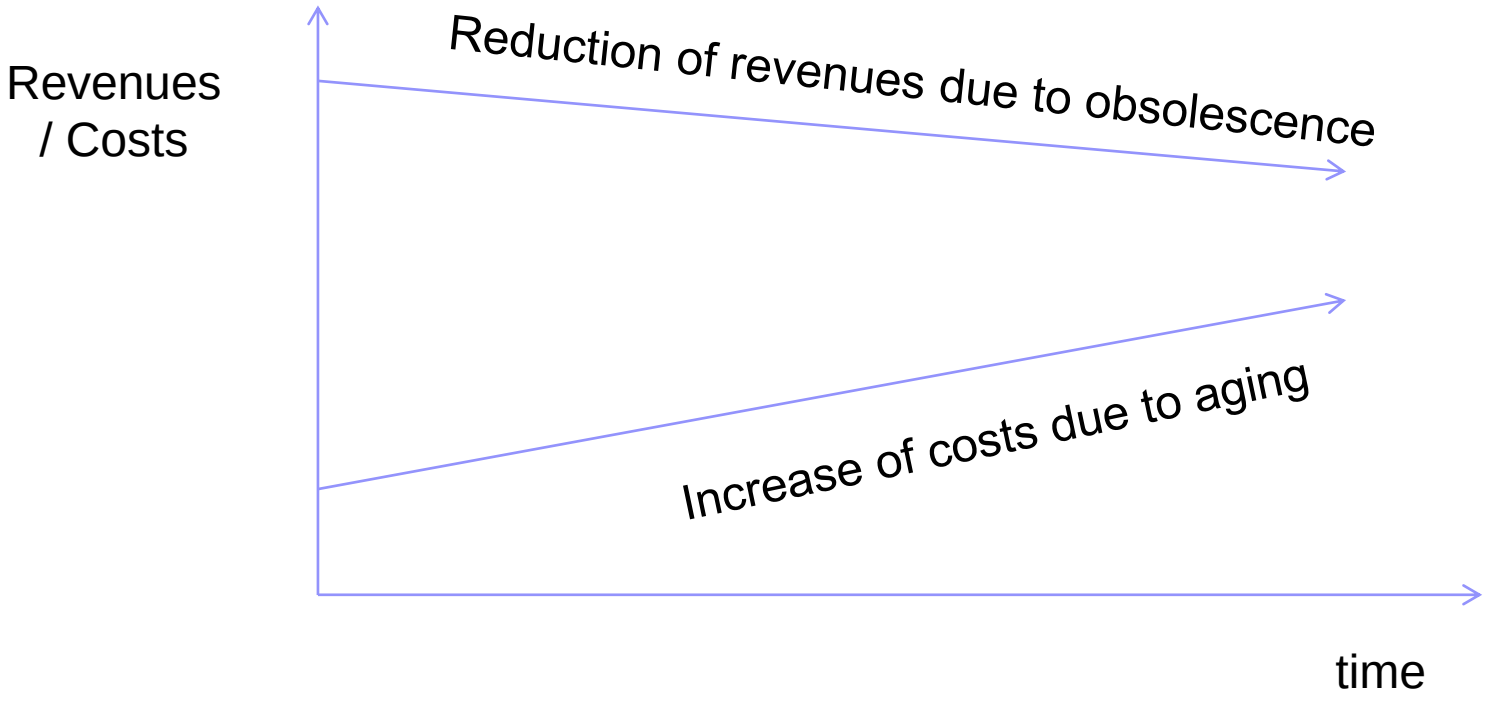
Inadequacy, aging, obsolescence

- When the plant is inadequate, economic factors arise from the market (i.e. changed demand for goods and services) determining obsolescence; therefore, decisions should be made in relationship to the market trends.

- If aging is considered, the maintenance costs – required to keep the capital assets (that is: plants & machines) in effective working conditions – are growing along time.

- Obsolescence induces, in pratice, a reduction of revenue because competitors can produce at lower costs.

Inadequacy, aging, obsolescence



Trends of costs & revenues due to aging and obsolescence

Renewal of plants & machines

- To evaluate the opportunity to transfer the ownership or to replace the plant / machine, a comparison of the existent plant / machine with an alternative plant / machine usable for the same production, is recommended.

- To set up the comparison two indicators for the plant / machine can be calculated:
  - Total equivalent annual cost (**CTAE**)
  - Technical cost of the delivered service (**CTSR**)

Renewal of plants & machines

Technical cost of the delivered service CTSR

It is the sum of the all costs to operate the plant, inclusive of material costs and maintenance costs. It could be considered an indicator of aging of the plant: it increases with time, even if the plant produces the same level of production volumes.

Renewal of plants & machines

Total equivalent annual cost
CTAE

It is the annual, costant and discounted cost that should be borne during the expected period of usage for the plant.
The components of CTAE are the acquisition cost and all the CTSRs of all the years during the expected period of usage. Eventually, the economic value recovered due to the transfer of ownership (at the end of the expected period of usage), i.e. the salvage value, should be detracted.

Renewal of plants & machines

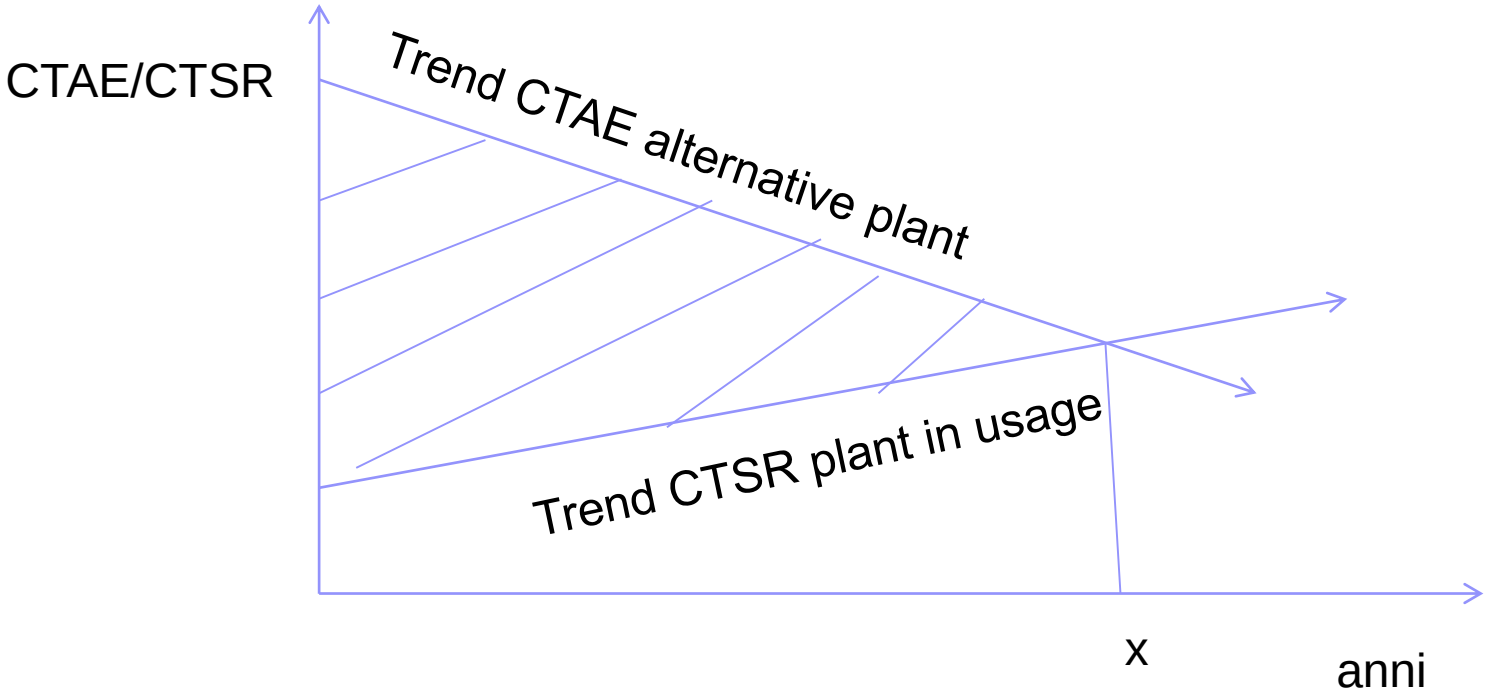
$$CTAE = \frac{C + \sum_{k=1}^{n} CTSR_k \cdot 1/(1+i)^k - Vr \cdot 1/(1+i)^n}{\sum_{k1}^{n} 1/(1+i)^k}$$

C: initial cost of the investment
i: actualization rate (cost of money)
Vr: salvage value
$1/(1 + i)^k$: actualization coefficient
n: number of years of usage for the plant (useful life)

Renewal of plants & machines

Knowing the CTSR of the plant in usage and the CTAE of the alternative plant, we can compare them and, in the hypothesis that, with the years, the first one will increase and the second one will decrease, it is possible to evaluate if and when it will be convenient to replace the plant in usage.

Renewal of plants & machines



Trends due to aging and obsolescence.
At year x the renewal/replacement will be convenient