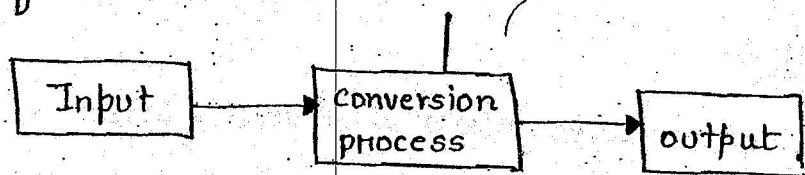
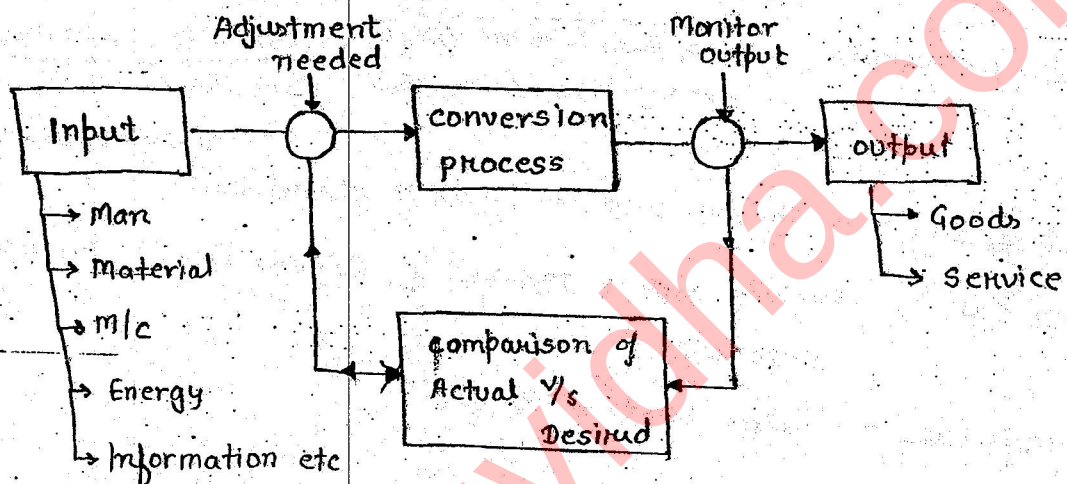


Production :- It is a step by step value addition process of converting one form of material into another form to increase the utility of the product for the user.



Production System :- It is an organised process of converting raw material into final product with a feed back loop.



Productivity :-

$$\text{productivity} = \frac{\text{Output}}{\text{Input}}$$

It is a quantitative ratio b/w what we produce and what we use as resources to produce them. Every organisation always want to increase productivity by applying new technique and method.

Industrial Engineer :- Industrial engg. is concerned with design, installation, an improvement of production system. His objective is to eliminate unproductive operation in order to increase productivity.

Production Manager :- Prod. manager is concerned with planning, controlling and directing day to day working of prod. system.

His objective is to produce goods and service of right quality and quantity and predetermined time and cost.

Cost in production :-

1) Prime or Direct cost = Direct Material + Direct labour + Direct Expenses.

2) Factory overhead or Factory expenses = Indirect material + Indirect labour + Indirect Expenses.
 watchman, Supervisor, Higher officer
 cutting fluid, lubricant, Grease, stationery item, cotton, Jute, Rent, Land, Telephone bills, facility development, Electric.

3) Factory cost = Prime cost + Factory overhead.

4) Total Cost = Factory cost + marketing, Advertising, Transportation cost etc.

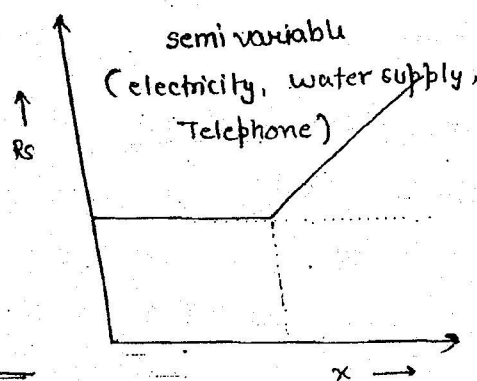
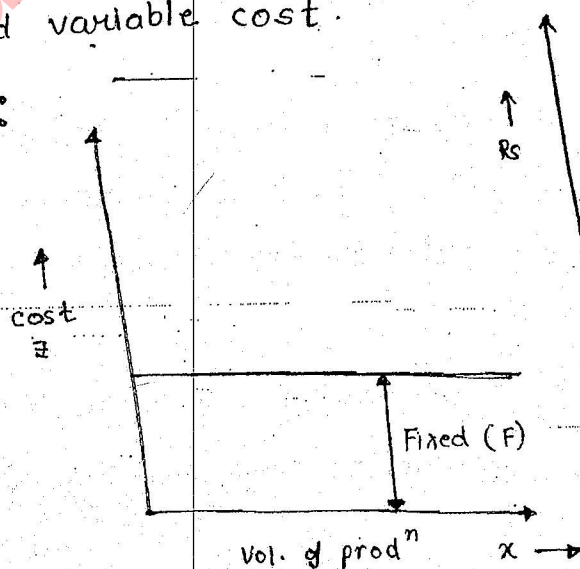
5) Selling cost = Total cost + Profit

Break Even Analysis

It is an important tool used by the production manager to analyse the potential profit or loss possible in future.

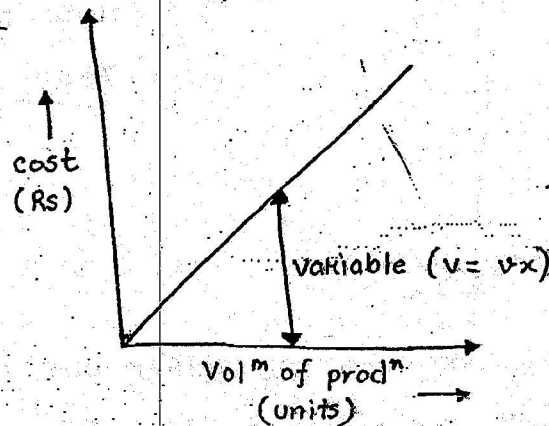
1) Total Cost : It indicates the expenditure required in order to produce certain no. of units and it is the sum of fixed and variable cost.

Fixed cost :



Fixed cost remain fixed or const irrespective of volume of production. It include cost of m/c, salary of watchman, higher officers, rent of building, land cost, set up cost, advertisement cost, insurance cost, interest etc.

Variable Cost :-



This cost increases directly and proportionally with the volume of production. It include direct material, direct labour and running cost.

Notations -

F = Fixed cost in Rs

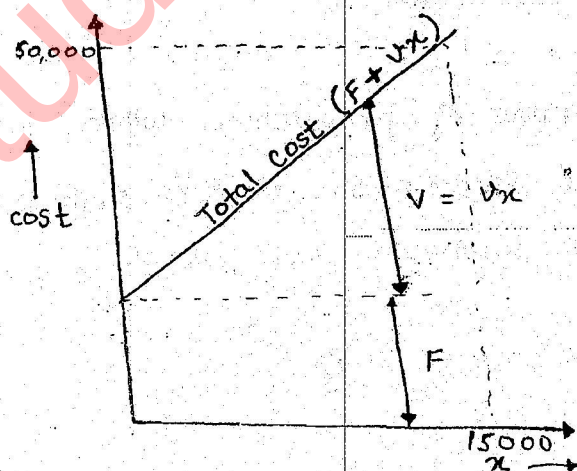
x = No. of units produced or volume of production

v = variable cost per unit (₹/unit)

V = Total variable cost in ₹ = vx

s = selling cost per unit (₹/unit)

S = Total Sales or Revenue in ₹ = sx



$$F = 20,000$$

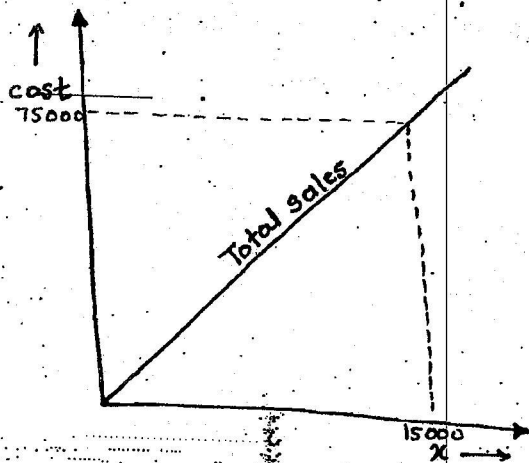
$$v = \text{Rs } 2/\text{unit}$$

$$T.C = F + vx$$

$$= 20000 + 2 \times 15000$$

$$= 50,000$$

2) Total Sales or Revenue ($S = \text{\pounds}x$)

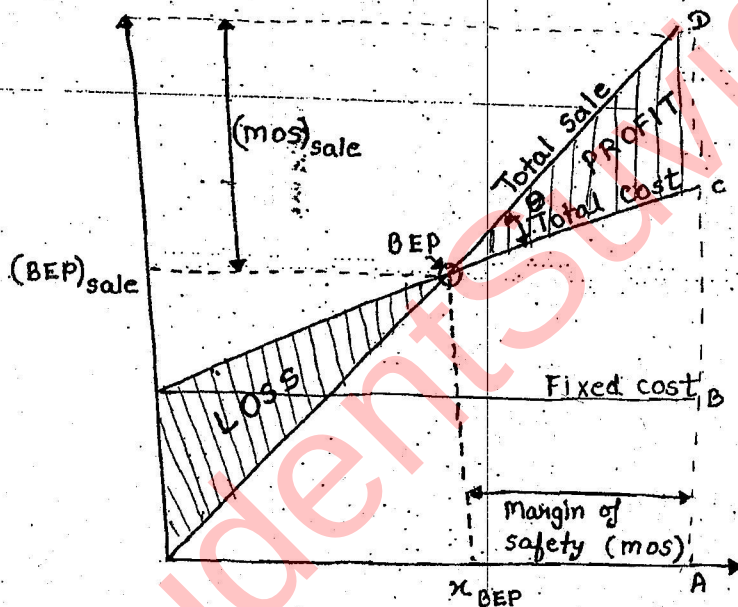


$$\text{\pounds} = \text{Rs } 5/\text{unit}$$

$$S = 15000 \times \text{\pounds} \\ = 75000$$

It indicates the return obtained by selling out the quantity produced and is directly proportional to volume of production.

3) Break Even Chart



Break even point is the volume of production where total cost is equal to total sales and organisation neither earns profit nor suffers from loss. It is also known as no profit no loss point.

$$\text{Total Sales} = \text{Total cost} + \text{Profit}$$

$$\text{Total Sales} = S = \text{\pounds} \cdot x$$

$$\text{Total cost} = F + V = F + Vx$$

$$\text{Profit} = P$$

$$S = F + V + P$$

or

$$\$x = F + vx + P$$

$$(\$ - v)x = P + F$$

$$x = \frac{P + F}{(\$ - v)} \rightarrow \begin{matrix} \text{Rs} \\ \text{Rs/unit} \end{matrix}$$

At BEP -

$$P = 0$$

$$x_{\text{BEP}} = \frac{F}{(\$ - v)} \text{ units}$$

$$(\text{BEP})_{\text{sale}} = x_{\text{BEP}} \$ = \frac{F}{(\$ - v)} \$ \text{ Rs}$$

Angle of Incidence (θ) :- It is the angle at which total sales line cut the total cost line, larger this angle better the working conditions will be.

Contribution Margin (cm) :-

$$\text{CM} = \text{Total sales} - \text{Total variable cost}$$

$$\text{CM} = S - V = (\$ - v)x$$

$$\text{contribution} = (\$ - v) \rightarrow \text{indicates profit/unit}$$

if $F = \text{Rs } 25000, \quad v = \text{Rs } 6/\text{unit}$

$$\$ = \text{Rs } 10/\text{unit}$$

$$(\$ - v) = \text{Rs } 4/\text{unit}$$

$$S = F + V + P$$

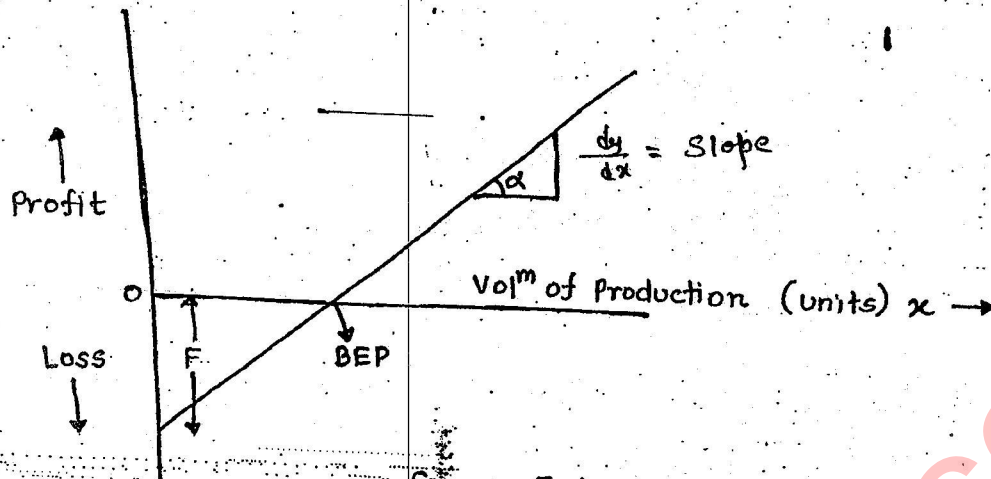
$$\text{CM} = S - V = F + P$$

$$\text{CM} = \frac{F}{c} + \overset{\uparrow}{P} = \frac{(\$ - v)}{c} \overset{\uparrow}{x}$$

$$P = \text{CM} - F$$

Marginal Profit or
Gross Margin

Profit Volume Graph :



$$S_x = F + vx + P$$

$$P = (S - v)x - F$$

$$y = mx + c$$

At $x = 0$

$$P = -F \quad (\text{loss}) \rightarrow F.C$$

At $x_{BEP} = \frac{F}{(S - v)}$

$$P = 0$$

Profit Volume Ratio :-

It is the term used to represent profitability related to sales and it is the ratio of contribution margin to the volume of sales. This ratio always remains constant for a particular product and it is normally used in an organisation when it deals with multiproduct.

$$\left(\frac{P}{V}\right)_{\text{ratio}} = \frac{CM}{S} = \frac{S - V}{S} = \frac{S - v}{S}$$

$$\left(\frac{P}{V}\right)_{\text{ratio}} = \frac{F + P}{S} = \frac{S - v}{S} \rightarrow \text{const}$$

$$\frac{F + P_1}{S_1} = \frac{F + P_2}{S_2}$$

at BEP -

$$\frac{F}{S_{BEP}} = \frac{S - v}{S}$$

Note :- If there is option of increasing the sale highest P/v ratio product should be preferred and if there is a option of decreasing the sale lowest P/v ratio product should be preferred.

$$\left(\frac{P}{V}\right)_{\text{ratio}} = \frac{\Delta P}{\Delta S}$$

$$0.33 \uparrow$$

$$\downarrow 0.16 \times$$

Margin of Safety :- (mos)

It is the diff. of output at full capacity compared to output at BEP

$$(mos)_{\text{sale}} = (Sale)_x - (Sale)_{BEP}$$

$$(mos)_{\text{sale}} = S_x - S_{BEP}$$

$$= Q \cdot x - Q \cdot x_{BEP}$$

$$= Q \left[x - \frac{F}{(S - V)} \right]$$

$$= Q \left[\frac{(S - V)x - F}{(S - V)} \right]$$

$$= \frac{P}{\left(\frac{S - V}{Q}\right)}$$

$$(mos)_{\text{sale}} = \frac{P}{\left(\frac{P}{V}\right)_{\text{ratio}}}$$

$$mos \% = \left(\frac{S_x - S_{BEP}}{S_x} \right) \times 100$$

changes in BEP when -

$$x_{BEP} = \frac{F}{S - v}$$

a) F.C increases —

x_{BEP} increases

b) v increase — x_{BEP} increases.

c) S increase — x_{BEP} decrease.

Q - A product can be produced by 4 process as given below in order to produce 100 unit, which process should be preferred.

$$x = 100$$

$$F + vx$$

Process	F (Rs)	v (Rs/unit)	T.C
I	20	3	320
II	10	4	410
III	40	1	140 ✓
IV	30	2	230

if $x = 5 \rightarrow$

I = 35

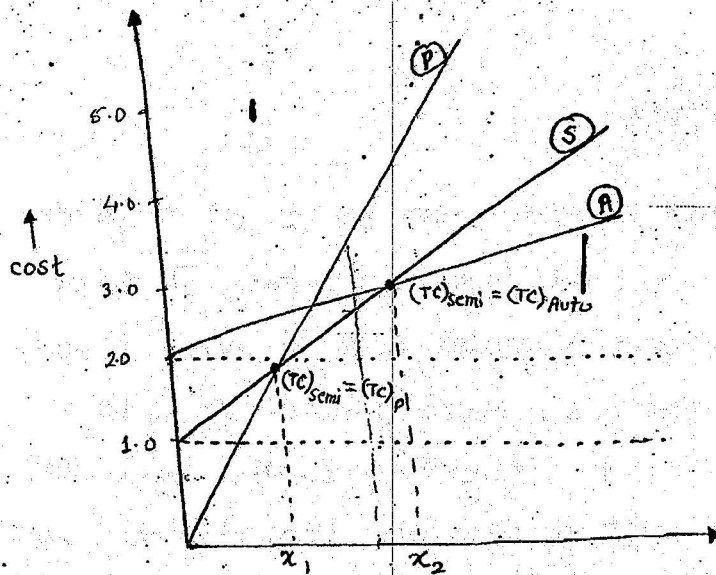
II = 30 ✓

III = 45

IV = 40

Q → A company requires a product for which they have 3 option as given below. Draw the total cost curve for all the three process and find economic feasibility. If 8000 units are to be produced which process should be preferred and corresponding cost.

options	F (Rs)	v (Rs/unit)
Purchase (P)	-	40
Semi-Automate (S)	100000	20
Automatic (A)	200000	10



$$TC_P = 40x$$

$$TC_S = 100000 + 20x$$

$$TC_A = 200000 + 10x$$

$$x_1 = 5000$$

$$x_2 = 10,000$$

$$x = 8000$$

$$TC_P = 3.2 \text{ lakh}$$

$$TC_S = 2.6 \text{ lakh}$$

$$TC_A = 2.8 \text{ lakh}$$

Q- For a production system -

$F = 10 \text{ lakh}$, $v = \text{Rs } 60/\text{unit}$, $s = \text{Rs } 100/\text{unit}$
 due to inflation F.C. increases by 5% and v.c increases by 10%.
 Find the % increase req. in the s.p per unit to keep break even point constant.

$$\rightarrow F = 10 \text{ lakh}$$

$$(BEP)_x = \frac{F}{(s - v)}$$

$$= \frac{10 \text{ lakh}}{40}$$

$$s = 100x$$

$$\rightarrow F = 1.05 \times 10 \text{ lakh}$$

$$s = s'x \quad \frac{Fx}{(s - v)} = \frac{10 \text{ lakh}}{40}$$

$$\frac{10}{40} = \frac{10.5}{s' - 66}$$

$$s' = ₹ 108/\text{unit}$$

$$\frac{s' - s}{s} \times 100 = \underline{\underline{8\% \uparrow}}$$