

# PROJECT MANAGEMENT





## PROJECT MANAGEMENT

What is a Project?

A project is accomplished by performing a set of interrelated activities over a fixed period of time within a certain cost and specifications.

Definition of Project by Harrison -

A Project can be classified as a non routine, non repetitive work with discrete time having financial and technical performance goals.

e.g;

- Construction of a building, setting up a power plant, developing a software.

Texonomy / Classification of Projects →

I. Classification on the basis of project completion time

- 1) long duration project (completion time  $> 5$  years)
- 2) Medium duration project (3 to 5 years)
- 3) Short duration project (1 to 3 years)
- 4) Special short duration project ( $< 1$  year)

II Classification on the basis of project value →

- 1) Mega value project ( $> 1000$  Crores)
- 2) Large value project (100 - 1000 crores)
- 3) Medium value project (1 - 100 - crores)
- 4) Small value project ( $< 1$  crore)

### 3) On the basis of Ownership -

- 1) Government sector projects (PSU or PSE)
- 2) Private sector projects
- 3) Public private partnership / Viability gap funding  
(joint sector projects)

### 4) On the basis of Type of Work

- 1) Industrial projects (to set up an industry for the purposes of production, manufacturing or converting into any other form)
- 2) Non industrial projects (Telecom, healthcare etc)  
education, irrigation, ...

### 5) On the basis of Duration / Time

- 1) Normal type
- 2) Fasttrack project

Normal Project → Project takes estimated time to complete.

Fasttrack Project → Project to be completed before normal estimated time.

### What is Management

It is an art of getting people together available resources to accomplish a work or goal effectively and efficiently.

In management following resources are considered -

- a) Human Resource
- b) Time Resource
- c) Financial Resource
- d) Mechanical / Machinery Resource
- e) Technology Resource
- f) Natural Resource

# What is Project Management →  
It is an application of knowledge, skills, tools  
technologies (KSTT) to meet the project requirement

The objective is to use the optimum resources so as to complete the task either in minimum cost or in minimum time.

# Process / Phases of Project Management →

- Project Initiation or Project Formulation
- Project Appraisal
- Project Planning
- Project Scheduling
- Project Implementation
- Project Controlling or Monitoring
- Project Completion
- Project Evaluation

# Qualities of a Good Project Manager → (Attributes)

An effective project manager should have the following -

- 1) Planning and organizational skill
- 2) Communication and leadership skill
- 3) Decision making skill
- 4) Knowledge of project management tools.
- 5) Resource allocation skills.
- 6) Negotiation skills.
- 7) Time management skills.

## # What is Project life Cycle (PLC) →

Every project has certain phases of development. The understanding of phases helps in monitoring and control.

--- All the phases from start to end are known as life cycle phases.

The number of phases may differ from project to project.

The four important phases of PLC are as follows —

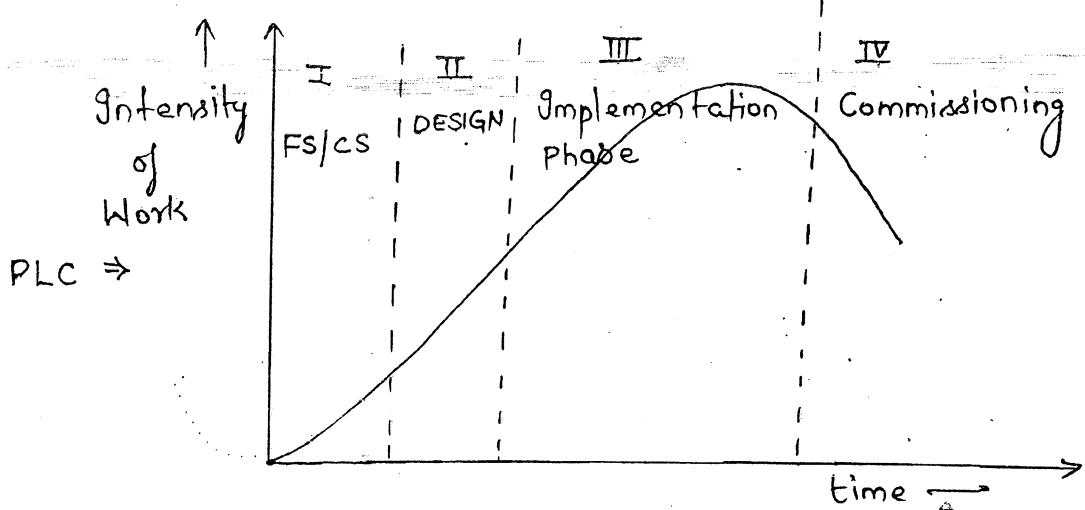
Phase 1) → Feasibility phase / conception phase / appraised phase.

In the stage the project is identified and the ideas are concived after making feasibility study and identifying the objective financial and commerical analysis are made.

The important features of this phase are —

- 1) Identifying the objective.
- 2) Making feasibility studies for alternative approaches.
- 3) Making analysis of alternative methods.
- 4) Making proper decisions in terms of technology, economy, legality, operations and schedules decisions.
- 5) Taking proper decisions in terms of technology, economy, legality, operations and schedules decisions.
- 6) Setting up the boundaries or outline of the project.

This phase / stage is also known as initiation stage. The intensity of activity increases from the second phase.



Phase-2 : Design phase (planning and scheduling phase)  
Once the investment decision has been taken the design phase starts.

In this phase the original ideas of first phase are amplified to prepare blueprint for next phase i.e; technical parameters and basic design standards are decided. Cost and time are estimated in detail.

The scheduling follows by planning however sometime may be parallel. The resources are identified which are needed for execution and the detailed report of design is prepared which is called as detailed project report. (DPR)

DPR is further examined by concerned organization.  
From I phase to II phase of PLC, intensity of activities continuously increases.

Phase-3 : Implementation Phase (Execution and production phase)

- The 3<sup>rd</sup> phase starts where physical shape is given to ideas conceived in earlier phase. In this phase

procurement of resources is done and there is great need of continuous monitoring and control of all the activities in this phase.

In this phase the project manager will experience the peak demand.

The intensity of activities initially increases which reaches to its peak and then decreases.

Phase-4 Commissioning Phase (Completion & turning phone) It is the last phase of a project cycle during which activities are completed and tested one by one to remove final teething problem. A trial is done during the commissioning. If trial is successful then commissioning is complete.

After commissioning the project is handed over. This stage might include training for operations and maintenance.

In this phase intensity of activities continuously decreases and reaches to minimal at the end.

+ Elements of PLC (Parameters which effect project completion time)

1. Operations and Activities (maintenance)  
Every kind of activity should be performed in a particular sequence and that sequence should be maintained.

## 2. Resources

The availability of human resource, material resource, machinery resource whenever required.

### 3. External Conditions (Constraints)

It includes natural factors like flood, earthquake and artificial factors like power supply breakdown, health hazards, policy changes etc.

#### Halo Effect →

It is an assumption that because the person is good at technology and technical skills he will be a good project manager.

This effect describes an error in thinking in which one makes an inference about a person.

Q.1. Who is ultimately responsible for quality ?  
a) Team members    b) Project manager    c) Quality manager

Quality Engineer.

~~Q.2.~~ Ideally a project manager should be selected and assigned the task at which stage of PLC

a) Design stage

Inception stage

c) Execution stage

d) Completion of design stage

Q.3. In which phase of PLC the intensity of activity is maximum ?

a) FS

b) design

Implementation

d) Commissioning

- Q. Arrange the following elements of project cycle  
in correct order—
- a) Project appraisal
  - b) Feasibility analysis
  - c) Project selection
  - d) Project execution

Sol<sup>n</sup>. (b) (a) (c) (d)

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## PROJECT FORMULATION & APPRAISAL

### I Project Formulation →

- # It is the process by which one obtains a complete picture about a project being undertaken.
- # The information collected through this process can be used for preliminary screening of projects. The formulation structure may vary from project to project. Following aspects are considered in project formulation -

- 1) Conceptualization of Project idea
- 2) Conceptual validity of project idea → It means the conceived project idea is examined for its validation. It may happen that with the current level of technology it is not feasible to complete the project idea.
- 3). Making assessment of pre-investment study  
DPR should be only undertaken when there is sufficient evidence of positive indicators.
- 4) Project demand analysis
- 5) Technical assessment  
Technology has to be evaluated from the point of view of available resources and material.
- 6) financial appraisal  
It means cost benefit analysis, with respect to the finances to be incurred for the future project.
- 7) Economic Analysis  
The project is accessed from wider angle of society and countries economy.

8) Social feasibility  
Will the society accept the project. Is the project benefiting the society.

9) Environmental impact analysis (EIA)

Will this project benefit the environment / not pollute the environment. Its impact has to be judged.

Note → If on rough estimates all the above criteria are accessed +ve then further detailed studies are carried out for project development. But if initial rough study gives -ve report the project idea is suspended.

III Project Development → A Typical project process may have following 3 phases -

1) Pre Investment Phase → It is related to authorization of investment decision for a particular project idea. It involves 4 stages -

- a) Identification of relevant project idea.
- b) Preliminary filtration of project idea through feasibility study.
- c) Detailed feasibility study.
- d) Final evaluation and decision.

2) Investment Phase →

It involves detailed design and actual implementation. This phase involves following 4 stages -

- a) Negotiating and contracting.
- b) Project design and engineering.
- c) execution and control.
- d) Commissioning and optimization.

### 3) Post investment Phase →

It is post commissioning phase when project is running for outputs or benefits.

### 4) Pre Investment Phase →

# Identification of Relevant project idea / Conceptualization of idea -

A company / investor / organization would like to explore profitable opportunities either by expanding the existing market or by creating a new market. Such studies may be carried out considering the following three parameters.

- 1) A given geographical area.
- 2) Study of economy of various segments
- 3) use of renewable and non renewable sources

Identification of a new project is a complex situation.

It involves careful study of the following -

- i) Performance of existing industry
- ii) Availability of raw material.
- iii) Export import scenario
- iv) Price trends.
- v) Research results.
- vi) Government policies.

- vii) Data available from various sources.
- viii) Study of social and economic trends.
- ix) Study of sick units.

### # Pre feasibility Stage →

After the identification stage the project ideas are filtered through pre feasibility study. In this stage more elaborated study is required than the previous stage. It is an intermediate stage b/w conceptualization and feasibility studies.

This phase I stage is recommended when techno economic feasibility study is time consuming and costly. For a project this stage should not take more than 3 months. After this stage one should be able to decide whether the project is accepted or rejected.

- Whether the project requires more detailed feasibility study.
- Some aspects of the projects need special investigation.

### II Feasibility Study (Detailed techno economic study) →

If previous stage of pre feasibility study is unable to conclude about project decision - then detailed feasibility study is required. Feasibility study is an analysis of technical feasibility, financial feasibility, economic feasibility, social feasibility, environmental impact analysis and market demand.

In this stage there is more rigorous and detailed understanding of the project.

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Note → Usually after feasibility study final decision about the project is conceived. It is to be noted even if feasibility has covered all aspects then also it may result in a wrong or incorrect decision. If -

▷ Project analysis is based on inadequate data.

ii) Data is unrealistic.

iii) Report has been deliberately failed acceptance criteria.

iv) Unknown or unpredictable factor occurred.

#### # Technical Feasibility Studies (Technical analysis)

Technology aspect is different from commercial, financial and managerial aspects.

In this case the technology selected is e.g; power base project, fuel engine based projects which may become constraint for a location. The technology selection is influenced by specification of work, life and tenure of work, adaptability and simplicity, cost involved, safety consideration, operation and maintenance, availability of spare parts, availability of gas and fuel supply.

Technology selection is influenced by location and sight. For location decision location cost index is used.

$$L.C.I. \text{ of } A = \frac{\text{Cost of Project A at location}}{\text{Cost of Project at location B}} \times 100$$

- The location preferred is that which has  $L.C.I. < 100$

## # Market and demand Analysis →

It is required to meet planning and decision making. There are 3 possibilities for analysing the demand for market -

a) For short term planning (less than 1 year)-Data required is for specific items and their demands only.

b) For medium term planning (1 to 3 or 1 to 4 years)-  
The data required is aggregate demand of technology and site selection.

c) For long term planning (4 years or more) - Broader amount of data is analyzed and seen how much broad is the market.

## # Forecasting

Forecasting is the ability to use any previous data or records to estimate happenings of the future.

## # Criteria for good Forecasting →

- It should have accuracy
- Plausibility (it should be consistent)
- It should be economical.
- Time saving.
- It should be flexible.
- Durable
- User friendly.

## Steps used in Demand Forecast

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- i) Determine the use of forecast.
- ii) Select the item to be forecasted.
- iii) Determine the time period / cost / revenue of forecast
- iv) Select forecasting model or method.
- v) Collect the relevant data.
- vi) Make forecast from the same data.
- vii) To implement proper results.

## # Methods of demand Forecasting

### i) Qualitative method

a) Collective opinion survey method or sales force composite method →

It is based on market survey i.e; opinion of people involved in marketing and sales.

This method forms the basis of market analysis and demand forecasting. Although it is simple, direct and most acceptable but it suffers from the following weaknesses.

- a) It is difficult to conduct at national level.
- b) There may be error or lack of accuracy
- c) There may be lack of experience in sales person.
- d) The estimates are based on personal judgement hence they may be biased.

Note → This method may be used for long term forecast for new projects and in some cases existing

projects also.

2) Consumer survey method / customer intention method →  
 It is based on what consumer intend to buy. It can be done by personal contact or printed questionnaire or e-mail. This method is preferred when bulk mass is from institutions and industry.

In this case few people may be contacted from that institution because demand of all people from that institution will be reflected through small group of people.

3) DELPHI Technique →

It is a group process which is based on panel of experts. The panel may includes ordinary employees or industry experts. In this method consensus among all members is aimed. This is based on-

- i) Analyzing economic conditions
- ii) Conducting sample surveys.
- iii) Conducting opinion polls.

Based on the above criteria demand forecast is done on the basis of following steps -

- i) Coordinator sends out a set of questionnaire in writing to all the experts in the panel. who are requested to reply their brief prediction.
- ii) The written predictions of experts are collected, edited and summarized by the coordinator.

iii) Based on summary coordinator designs a new set of questions and given again to the experts who answer back again.

iv) Coordinator repeats the process of collecting, editing and summarising.

v) Step III and IV are repeated until consensus is released.

vi) Jury of Execution method → (Nominal group technique)

# It is improvement over delphi method.

# A panel of 7-10 experts is formed to interact and discuss all the suggestions in descending order as per following procedures:-

i) Experts sit around a table and are allowed to interact with each other.

ii) Facilitator hands over copies of questionnaire needed to forecast and each expert is expected to write ideas about questionnaire.

iii) After every one has given their ideas facilitator permits to share their ideas on a flip board or display board which everyone can see.

iv) Experts give ideas in rotation until all of the experts have given their ideas. Till this phase no discussion has taken place. Usually 15 to 25 ideas has emerged.

v) In this step experts discuss their ideas and facilitator

tries to combine similar ideas. Thus no. of ideas are reduced.

ii) After completing group discussions experts are asked to give ranking to the group ideas with priority

### # Quantitative tools →

These tool analyse the exact demand of the market in terms of quantity. There are two models in quantitative forecasting-

#### i) Time Series Model →

Under this model the demand is evenly spaced in terms of numerical data approach. This is obtained by observing response at regular intervals. The past collected data are used for future forecast.

#### ii) Causal model →

It is a mathematical technique i.e; regression analysis. It is used to relate demand and price through linear equations.

### Methods under Quantitative Approach →

#### i) Simple Average method →

This is also known as "nive" approach.

It is based on past data of atleast 12 months. Simple average is sum of demand of all periods in past divided by total no. of periods.

$$\text{Simple av. method} = \frac{\text{Sum of demand of all periods in past}}{\text{Total no. of periods}}$$

3) Moving average method →

It is better than simple average because the old and obsolete data is discarded, and the trend of most recent data is used.

$$\text{Moving average} = \frac{\text{sum of demand of chosen period (which is recent)}}{\text{No. of chosen periods}}$$

3) Weighted average method →

It is further improved over moving av. method in which weightage is given for important and valuable data.

$$W_A = W_1 D_1 + W_2 D_2 + W_3 D_3 + \dots + W_n D_n$$

$$\text{Weights} = W_1, W_2, \dots, W_n$$

$$\text{Demands} = D_1, D_2, \dots, D_n$$

This method has the advantage that it allows to compensate for non-trends or seasonality by using appropriate coefficient.

4) Exponential smoothing method →

This method has become popular due to software intervention. It is different from ~~weighted~~ av. method by the way of assigned weightage to each past period.

Note → All the above methods are called as statistical methods. Other than above there are other methods known as subsidiary methods.

- 1) Double exponential smoothing method.
- 2) Economic model
- 3) End-used methods

- 4) leading integrator method.
- 5) chain ratio method.
- 6) Regression analysis (It is used to relate dependent variable with independent variable)

### + Errors in Demand forecasting →

Forecasting error may be defined as the numeric difference b/w forecasted demand and actual demand. The error will impact on the economic appraisal of the project.

There can be 3 types of errors in demand forecast -

1) Measurement and data error → Errors which take place due to numeric values only by miscalculation.

2) Model specification error → Error on the basis of a proper model v/s its actual implementation.

3) External Error → Errors due to external factors which are beyond our control is known as external error.

Following aspects are important in the measuring the effectiveness of any method of forecasting -

1) Mean absolute deviation → It is measure of the forecast error. without considering dir. of the error.

(i.e; +ve or -ve sign) MAD is given as

$$\text{MAD} = \frac{\text{Sum of absolute values of forecast of all periods}}{\text{Total no. of periods}}$$

There is a relation b/w MAD and standard deviation where standard deviation =  $1.25 \times$  smooth mean absolute deviation.

If forecast is reasonably accurate than MAD and standard deviation will approach to zero.

## ii) Bias

It is less commonly used for error forecast. It takes into account the dir<sup>n</sup> of account. Hence some of the errors is algebraic as follows -

$$\text{Bias} = \frac{\text{Algebraic sum of forecast error of all periods.}}{\text{Total no. of periods.}}$$

If forecasted value is greater than the actual (over estimated), then error will be +ve. and vice-a-versa.

If errors are repeatedly +ve then bias will be +ve.

If errors are repeatedly -ve then bias will be continuously have a -ve value.

\* Bias can also be zero.

Note → For a very accurate forecast, MAD and bias both should be zero. It will be desirable to choose the method of forecasting, in which MAD can be controlled and brought nearer. If MAD is lower then bias will be automatically reduced.

## Cost of Forecast Error →

Important decisions whether short term or long term are based on forecasts. Large errors in forecast will lead to a costly affair. The error is in the dir<sup>n</sup> and magnitude.

Either error can be critical in some cases whereas in other cases errors in magnitude may be more critical.

## I# Financial Feasibility →

There are 3 major aspects of financial appraisal related to a project -

- 1) Estimation of project cost (total cost of project has to be correctly estimated)
  - 2) Estimation of project operation cost (cost related to managing day to day operation.)
  - 3) Estimation of project funding →
- The cost of project is made through following two means -
- a) Equity (capital of investor)
  - b) Debt (loan from financial institutions)

The proper equity and debt combination is essential which depends upon revenue earning capacity of the project. The equity does not attract any interest and is not needed to be paid back. \*\* The debt component is required to be paid with interest. Hence the revenue earning capacity with debt of the project should be sufficient enough to meet repayment of debt with interest. In addition to that project should also earn revenue to meet cost of equity capital.

## # Methods of Financial Appraisal / Criteria used for selection of investment opportunities →

- 1) Average Rate of Return on Investment or Accounting rate of investment → (ARR or ROI) → This is an

accounting method and their are several definition and formulae to compute ARR.

But most commonly used is

$$ARR = \frac{\text{Av. annual profit after taxes (Net profit)}}{\text{Av. investment over the project life}}$$

$$\text{Av. investment over the project life} = \frac{1}{2} [I.C. - S.V.] + S.V. + W.C.R$$

I.C. → Initial cost

W.C.R → Working capital requirements

S.V. → Salvage value

Where Salvage value means book value of the project after useful life.

Working capital represents operating liquidity available for the project and is given by

$$W.C.R = C.A - C.L$$

C.A → current assets.

C.L → current liability

Note → The above formula is most widely used but other formulas are also in practice.

$$ARR = \frac{\text{Av. annual profit after taxes}}{\text{Av. book value of investment}} \times 100$$

Where av. book value = initial cost - depreciation  
(and this formula has to be applied year after year) and then av. is calculated.)

$$IRR = \frac{U}{Total initial investment cost} \times 100$$

Q. There are 2 machines A and B both have initial purchase price of 60,000 rupees. Calculate ARR if yearly profit after depreciation and taxes is given below -

Profit After Taxes ₹

Year	Machine A	Machine B
1	4000	12000
2	5000	9000
3	7000	7000
4	9000	5000
5	12000	4000
S.V.	3000	1000

Working capital for both machines = 0, useful life = 5 years for both.

Soln Av. annual profit of A = 7400

Av. annual profit for B = 7400

Av. investment over life of project

$$A = \frac{1}{2} [ I.C - S.V ] + S.V + WCR$$

$$= \frac{1}{2} [ 60000 - 3000 ] + 3000 + 0$$

$$= 30,500$$

$$ARR_{for A} = 23.49\%$$

$$ARR_{for B} = 24.20\% \quad \therefore \text{We should purchase m/c B.}$$

## 2) Payback Period Method → (PB)

- # It is a traditional method widely used for project evaluation.
- # It is a measure in terms of which will take to recover the cost of investment, in terms of time.
- # If cash inflow after tax (CFAT) per annum is uniform (equal in all periods) then following formula will be used.

$$PB = \frac{\text{Initial Investment}}{\text{Constant annual Cash Inflow}}$$

- # It is important for every investor know how and when he will be getting his investment back.
- # If cash inflow after tax is non-uniform or non-even per annum then payback period is computed by the following formula

$$PB = A + \frac{B}{C}$$

Where  
 $A$  = last period with -ve cumulative cash outflow  
 (Net invested cash flow) in years

$B$  = absolute value of cumulative cash outflow  
 (Net invested cash flow) at the end of period A

$C$  = Cash inflow during the period after period A

Note → ① Except the project if its payback period is less than the targeted payback period.

② If there are 2 projects then choose that one which has least payback period.

Q. Imagine company is planning to undertake a project requiring investment of ₹ 105 Cr. The project is expected to generate a constant cash inflow after tax of ₹ 25 Cr per annum. for the next 7 years. Calculate the payback period.

$$\text{Soln} \quad PB = \frac{105}{25} = 4.2 \text{ years.}$$

2. A company is planning to take a project that requires initial invest of ₹ 50 cr. and is expected to generate cash inflow after tax per annum as follows -

Year	CFAT (Rs Cr)
1	10
2	13
3	16
4	19
5	22

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$$\text{Soln} \quad A = 3 \text{ years}$$

$$B = .11 \text{ Cr}$$

$$C = 19 \text{ crore}$$

$$\therefore PB = A + \frac{B}{C}$$

$$= 3 + \frac{11}{19}$$

$$= 3.57 \text{ years.}$$

## # Advantages of payback period method →

- ① Calculations of the method are easy and simple.
- ② It can be used to measure risk in a project.
- ③ For companies facing liquidity problem this method provides ranking of projects which would return money early.

## # Disadvantages →

- ① It does not take into account the time value of money. To remove this drawback discounted cashflow techniques can be used.
- ② It does not take into account the cash flow that occurs after payback period.

## 3] Discounted Cashflow technique → (DCF)

# Traditional methods of project evaluation do not take into account the total benefits from the entire life of the project and they do not consider the time value of money.

# In techniques discussed below, a discounting factor is used to account for time value of money. This analysis uses the future free cash flow projections and discounts them to convert in the present value estimates.

$$DCF = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \dots + \frac{CF_n}{(1+r)^n}$$

Where CF = Future cash flow (after tax)

r = discounted rate

n = no. of periods of life.

~ If discounted cash flow  $>$  NPV Then project<sup>28</sup>  
should be preferred.

### # Net Present Value (NPV) $\rightarrow$

A) The money received today is worth more than the sum received in future because it has time value. It is due to the following reasons -

1) Interest or cost of finance

2) Impact of inflation.

3) External factors which have an effect on risk

NPV computes the present value of the cash inflow after tax in each of the future financial years by discounting them suitably and then subtracting the cash outflow in that period.

Net present value = Present value of cash inflow after tax  
PV of cash outflow (entire investment cost)

### # Interpretation of results $\rightarrow$

If  $NPV > 0$  Then project is financially viable.

~~Prakash Book Depot~~  $NPV < 0$  Then project is financially unviable.

$NPV = 0$  Then project is meeting break even point  
(no profit, no loss situation)

Note  $\rightarrow$  Project with greater NPV / +ve NPV is preferred.

Sometimes benefit cost Ratio is used to evaluate financial viability of the project.

Benefit cost ratio is defined as

$$BCR = \frac{\text{Total Present value of benefits (cash inflows)}}{\text{Total present value of investment}}$$

Interpretation of results →

If  $BCR > 1$  then project is financially viable.

$BCR = 1$  It meets breakeven point

$BCR < 1$  then project is nonviable

NBCR (Net benefit cost ratio)

$$NBCR = BCR - 1$$

Interpretation of results

If  $NBCR > 0$  Viable

$NBCR = 0$  Indifferent situation

$NBCR < 0$  Non viable situation.

# The future sum of cash inflow after tax can be converted into present value using following formula.

$$F = \frac{P}{(1+r)^n}$$

$$P = CF (1+r)^n$$

$$= CFXDF$$

$$DF = \frac{1}{(1+r)^n} = (1+r)^{-n}$$

PV → Present value

DF → Discounting factor

Q. Initial investment (cash outflow) by a company is ₹ 2,50,000 in a project and cash inflow after tax, is

Year	Amount
1	80,000
2	1,20,000
3	70,000
4	40,000
5	20,000

If the cost on capital (interest rate) is 9%. Then calculate the NPV of the project.

$$\text{Soln} \quad DCF = \frac{1}{(1+r)^n}$$

for 1st year

$$DCF_1 = \frac{1}{(1+0.09)}$$

$$PV_1 = DCF_1 \times 80,000$$

$$= \frac{1}{1.09} \times 80,000 = ₹ 73,394.5$$

$$DCF_2 = \frac{1}{(1+0.09)^2}$$

$$PV_2 = \frac{1}{(1.09)^2} \times 1,20,000 = ₹ 101,001.6$$

$$DCF_3 = \frac{1}{(1+0.09)^3}$$

$$PV_3 = \frac{1}{(1.09)^3} \times 70,000 = ₹ 54,052.8$$

$$DCF_4 = \frac{1}{(1+0.09)^4}$$

$$PV_4 = \frac{1}{(1.09)^4} \times 40,000 = 28337.0$$

$$DCF_S = \frac{1}{(1+0.09)^5}$$

$$PV_5 = \frac{1}{(1.09)^5} \times 20,000 = 12998.6$$

Year	Cash inflow	DF	PV
1	80,000	0.7339	73394
2	1,20,000	0.841	1,01001
3	70,000	0.772	54,052
4	40,000	0.7084	28337
5	20,000	0.649	12998

2,69,784

- 2,50,000

NPV = 19,784

NPV > 0  $\Rightarrow$  financially viable.

### ③ Internal Rate of Return $\rightarrow$ [IRR]

- # It is also known as yield on investment method.
- # Marginal efficiency of capital method
- # Marginal productivity of return method.
- # Rate of return method.
- # Economic rate of return method.
- \* This method takes into account the time value of money by discounting cash inflow and cash outflow. The term internal means that the calculation does not incorporate environmental / external factors such as

interest rate and inflation. Interest rate may<sup>32</sup> be considered as an internal factor also. Due to this feature this method is also known as discounted cashflow rate of return method or effective interest rate method.

### # Definitions of IRR →

1. The IRR of an investment or project is the discounted rate of return that means  $NPV = 0$
2. It is the discounted rate at which the present value of all future cashflows is equal to the initial investment. i.e; the rate at which the investment achieves a break even point.
3. IRR of an investment is the discounted rate at which the NPV of cost (cash outflow - cash inflow) of the investment = Net present value of the benefits.

### # Characteristics of IRR →

- IRR is used for capital budgeting and to compare the profitability of the investment.
- Greater IRR is desirable and project should be undertaken only when  $IRR >$  Rate of return or interest rate.  
(cost. of capital)
- IRR gives rate and it is an indicator of efficiency or yield. of an investment whereas NPV is an indicator of value of magnitude of investment.
- IRR can also be used as an indicator to evaluate whether new project / product is viable or exists.  
..... Existing existing project is viable.

- IRR can also be used to evaluate buy back scheme.
- Some companies get better IRR by buying their own shares and products instead of investing at other place.

$$\text{IRR} = \sum_{n=0}^N \frac{CF_n}{(1+r)^n} = NPV = 0$$

When  $CF_n$  = Cash flow after tax for  $n^{th}$  year

$r$  = IRR

$N$  = total useful life or period

Q. Find IRR for the data shown below

Year	CF
0	-123,400
1	+36,200
2	+54,800
3	+48,100

Soln

$$\frac{36,200}{(1+r)} + \frac{54,800}{(1+r)^2} + \frac{48,100}{(1+r)^3} - 123,400 = 0$$

$$(1+r)^2(36,200) + (1+r)54,800 + 48,100 = 123,400(1+r)^3$$

$$r = 0.0596 = \text{IRR}$$

$$r = 5.96\% = \text{IRR}$$

$$\text{let } 1+r = x$$

$$36,200x^2 + 54,800x + 48,100 = 123,400x^3$$

## # Economic Analysis

Economic analysis is done from the point of view from society or economy as a whole for the country.

The evaluation is done from wider prospective including financial terms and general terms useful for society.

- ‡ Economic analysis of a project should be checked for -
- ↳ It should fit into national priority.
- ↳ It contributes to the development of that sector of the economy.

↳ The benefits from that project justify the consumption of scarce resources of that country.

↳ The project has to be evaluated for the economic viability also.

‡ The focus of economic analysis is to evaluate direct and indirect benefits to the society / nation. Hence it is also known as social and cost benefit analysis.

## # Social and Cost Benefit Analysis (SCBA)

The concept of SCBA evolved since 1844 by Jules Dupet, a french engineer who used SCBA as the indicator for society development.

In SCBA direct and indirect benefits both are accounted. Among the developing countries India is a pioneer and has used it one of the most important indicator is project evaluation especially in public sector projects and government projects.

The main objective of an individual, firm or a company in investing in a new project is to maximize returns and

profits where social benefits are least important.<sup>35</sup>

- The mindset of promoters is commercial profitability whereas in public sector commercial returns may not be favourable but projects are undertaken for social implications (that benefit the society). e.g; public projects such as roads, railways, power projects etc. For such projects social economic analysis is required.

- There may be two types of investment / cost is involved
  - i) Direct cost - cost that directly benefits the society
  - ii) Indirect cost - cost that is not visible but benefits the society anyways.

# The social cost benefit analysis takes into the account the real cost, the direct cost and direct benefits are considered for commercial profitability also. Whereas indirect cost and indirect benefits are for social benefits. It means nation bears indirect cost and people of the nation enjoy indirect benefits.

# Objectives of SCBA →

# Contribution of the project to the economy of the nation (national income/ GDP)

# Contribution of the project to improve the benefits to poor section of society and to reduce regional imbalance in growth and development.

# Justification of use of scarce resources in the project.

# Contribution of the project in protecting or improving the environment.

## # Methods of SCBA →

① UNIDO Method (United nations industrial development organisation)

UNIDO gave this approach in 1960 and its detailed guidelines were issued in 1978. It suggest five stages as follows.

- 1) Calculation of financial stability / profitability of the project measured at market prices.
- 2) Calculation of net benefits of the project in terms of economic prices / shadow prices.

Note → What is shadow prices?

Shadow price is a proxy value of a good or a service which is often defined by the value which has to be spend to pay or buy one good or service. If the price does not reflect the actual value of a good or market value is not fixed. for such good then shadow pricing is used.

3) Adjustment for impact of project on savings and investment.

4) Adjustment for impact of project on income distribution.

5) Adjustment for impact of project on merit and demerit goods for which the social values differs from monetary values.

## 2) Little & Mirrless Method (LM Method)

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This approach measures cost and benefits in terms of international prices also known as border prices. Whereas UNIDO method measures cost and benefits in domestic prices.

The argument in the favour of using international prices is that it takes care of the fluctuations in domestic currency which helps in improving trade efficiency.

LM method has divided the goods into the following paths

i) LM shadow price for traded goods

Goods which can go across boundaries called as traded goods.

# For goods which are exported the shadow price is freight on board basis (FOB) whereas for imported goods shadow price is CIF (cost insurance freight) basis.

# 2) LM shadow price for non tradable goods.

Non tradable goods include land, electricity, building, power supply, natural resources excluding labour.

# Shadow price for non traded goods are in terms of marginal social cost and marginal social benefits which are estimated at border prices. By using border prices for traded and non traded goods both, the conversion rates are frozen (frozen).

In LM approach for labour component standard wage rate is used. It is difficult to quantify hence the following equation is used -

$$\text{SWR for 1950UR} = C' - \frac{1}{S} (C-M)$$

(Standard wage Rate)

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$C'$  → Additional resources devoted to consumption.

$\frac{1}{S}$  → Consumption of wage Social value of unit of consumption

$C$  → consumption of wage earner

$M$  → Marginal productivity of labour. (Whatever additional cost borne on labour is also given effect)

# Similarities b/w Unido & LM Method →

# Calculation of shadow prices (economic prices) for foreign exchange saving at unskilled labour.

# Consideration of equity.

# Use of discounting cash flow approach.

# Differences b/w Unido & LM Method →

# LM Method measures cost and benefit in international prices (border prices) and Unido suggest cost and benefit at domestic prices.

# LM measures cost and benefit in terms of uncommitted social income whereas Unido method measures in terms of consumption.

# Unido suggest stage by stage analysis of efficiency prices, savings and income distribution whereas LM method reviews in together and simultaneously.

# SCBA in India → (Social and Cost Benefit Analysis)

In India ICICI was probably first financial institution which introduced

later other financial institutions started and adopted LM method. Project Appraisal division (PAD) was part of formal planning Commission which has now been named as NITI ayog. The government of India follows economic analysis and they called it as profitability analysis.

Government also follows modified LM version under which the key element of profitability analysis are as follows -

- 1) All tradable units are valued at international prices.
- 2) Non tradable items like land, building, power are valued at marginal cost.
- 3) Taxes duties fees, cesses are ignored in all cases.
- 4) Foreign exchange for inputs and outputs is valued at specified premium.
- 5) Social wage rate are applied for unskilled labour and semiskilled labour.
- 6) Unit of currency in savings is measured in rupees rather than in any other currency.

# Indian financial institution use the following criteria for cost benefit analysis →

- 1) Economic rate of return (ERR) or internal rate of return (IRR) → explained earlier
- 2) Domestic resource cost / Price (DRP)
- 3) Effective rate of protection (ERP)

## # DRP → (DRC)

# DRC measures the domestic cost of manufacturing a product as against the cost of importing it. DRP attains to measure the cost of import substitution. If production of a product is substituted by import then there will be saving of own resources at the cost of foreign exchange.

F By measuring the DRC of such a project an attempt is made to calculate the amount of domestic resources required for saving foreign exchange. (FOREX)

# The DRC can be calculated as follows-

$$\frac{\text{Value added at domestic prices} \times \text{E.R.}}{\text{Value added at international prices}}$$

# DRC may be taken as a measure of total rupees spent to save one unit of foreign currency. (This definition of DRC is applicable where goods produced are considered over imports.) Similarly DRC may be taken as a measure of total rupees spent to earn one unit of foreign currency.

# DRC acts as an indicator to decide whether manufacturing or production is suitable or not.

# If DRC is less than the exchange rate of a foreign currency then it indicates manufacturing within the country is advisable.

# If DRC is more than exchange rate than the import is financially viable than the indigenous production. However keeping in view the scarcity of forex and socio economic benefit like employment opportunities and use of indigenous resources. The government of country may decide to produce.

and manufacture within the country even though DRC is slightly higher than exchange rate.

e.g; If the value added at domestic price per unit of the proposed product is ₹ 5,000 and value added at international price per unit of the product is ₹ 7,000. (Exchange rate 1 USD = ₹ 68, then -

- a) Indigenous production is financially unviable -.
- b) Domestic production is financially viable.
- c) Indigenous production is socio economically viable.
- d) Indigenous production is non economically viable.
- D a & c are correct
- i) b & c are correct
- ii) a & d are correct
- b & c are correct

$$\text{Soln} \quad \text{DRC} = \frac{5000}{7000} \times 68$$

$$= 48.57 < \text{Exchange Rate}$$

∴ Domestic production is viable.

∴ DRC is less than the forex rate domestic production is financially viable and it is also socio economically viable as it would also benefit the society.

#### # Effective rate of Protection →

It measures the net protection offered to the domestic products. The domestic price of a product is effected by subsidies, taxes, duties, concessions which are governed by the govt. or local agencies. Thus, the cost of inputs which go into production are effected by such controls, concessions and policies. The competitive strength

of the product in the world market is revealed only<sup>42</sup> by prices. after concession and control. In the absence of concessions and control the value added to a product at domestic prices and internal prices will be the same. If there is any difference in value addition at domestic and international prices then it is measured by ERP.

$$ERP = \frac{\text{Value added at Domestic prices} - \text{Value added at world prices}}{\text{Value added at world prices}}$$

### Interpretation of Results

1) If  $ERP = 0$  It means that the project or product does not enjoy any protection from international competition.

2) If  $ERP > 0$  It indicates that the project enjoys protection from international competition. Higher the value of  $ERP$  (+ve  $ERP$ ) it represents greater protection by government.

e.g. find the  $ERP$  for data shown - Cost of input of a project at domestic price is ₹ 550 cr. Whereas its world price 570 crore. The sales realization in domestic price is 620 cr. and its world price is 610 cr.

Soln - Value added at domestic prices =  $620 - 550 = ₹ 70$  cr.  
Value added at International prices =  $610 - 570 = ₹ 40$  cr.

$$ERP = \frac{70 - 40}{40} = .75 > 0$$

Note :- The projects with higher  $ERP$  requires careful analysis as to gather the protection available against international competition is likely to continue. It may be possible that  $ERP$  is higher bcoz there are subsidies and concessions. If in future govt. withdraws subsidies

and concession in input then ERP may come down<sup>43</sup> and project may face international competition.

### # Risk Analysis →

# Risk refers to the variability of the project. The indicators used to measure risk are range, standard deviation, coefficient of variation, variance, semi variance, mean absolute deviation etc.

# In project Appraisal risk analysis plays an important role becoz all the projects are prone to some kind of risk. Though there may be similarity b/w 2 projects but no two projects are ever identical. Hence several elements in a project contain assumed value. The project appraisal for risk is based on -

- Project (periodic) cash inflows
- Periodic cash outflows
- life of machinery (all machines in a project)
- Salvage value of machinery.

Note → Risk is defined as the variability of return on investment based on certain probability of outcome Whereas uncertainty does not involve probable approach.

### # Types of the risk in the project →

- 1] Project completion risk → If project is not completed on time then it will result in time over run and cost overrun.
- 2] Resource risk → Variation in use of resources like raw material, power, fuel shortage, man power also results in a risk.
- 3] Technology risk → It may happen in two forms -
  - a) The technology used is not proven.
  - b) Rapid growth in technology makes older technology

4) Political Risk → changes in govt may results in the types of policies which were implemented by the earlier govt. that is also a risk.

5) Interest rate risk → increase in rate of interest during long projects carries a risk.

6) Exchange rate risk →

7) Price Risk.

#. Techniques of Risk Analysis →

How should we analyze the risk on the basis of certained defined methods?

The following techniques can be applied for risk analysis —

1) Sensitivity Analysis →

This analysis is based on the question "What if" analysis. If sales or investment deviates from its expected value then sensitivity analysis is conducted.

This analysis gives an idea that how the project is vulnerable.

i.e.

Any of the financial indicator like NPV, IRR, ARR of the project are analysed for variability. Due to change in any one variable at a time keeping other factors as constant, difference can be calculated. Due to change in one variable change in NPV or IRR is calculated.

e.g; if the quantity sold of a product decreases by 1% (other variables remain constant) then NPV changes by 6%.

limitations of sensitivity analysis →

It nearly shows change in NPV, IRR or any other indicator due to change in some variables and no further conclusion. In the analysis only one variable at a time is changed whereas others are held constant. In reality several

variables can change.

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# The interpretation of result is very subjective, one decision maker may accept the project whereas others may reject the project.

## 2) Scenario Analysis →

\* In this analysis several variables are varied simultaneously and their effect is observed on financial indicators (NPV, IRR etc.)

# This method is improvement over sensitivity analysis because it is more realistic.

# Most commonly three scenarios are considered because we have multiple variables which are being considered.

- 1) optimistic scenario
- 2) pessimistic scenario
- 3) most likely scenario.

## 3) Simulation Analysis → (Monte Carlo Analysis)

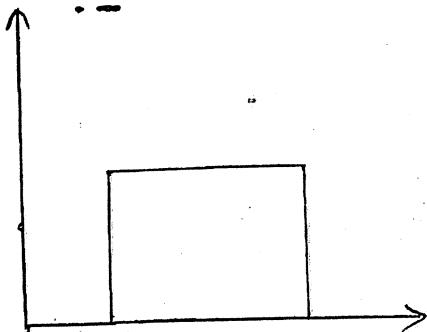
The decision makers would like to know the likelyhood effect of change in variables on actual results. This information can be generated by simulation analysis.

- 1) Modelling the project → The modelling will reveal how NPV is related to other parameters.
- 2) Specified value of parameters and probability distribution of exogenous variable (independent variable)
- 3) Select the value randomly from the probability distribution of each exogenous variable.
- 4) Determine NPV corresponding to randomly selected variable.

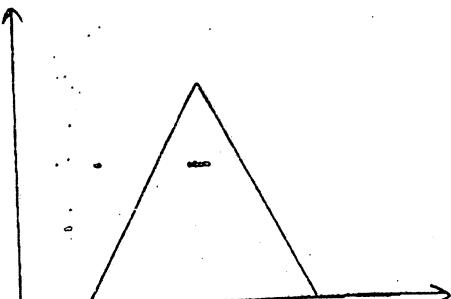
5) repeat step 3 and 4 to obtain large no. of simulated NPV.

6) Plot the frequency distribution of NPV.

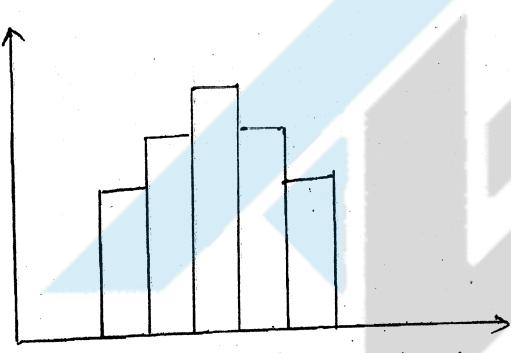
Frequency distribution may be any of the following types.



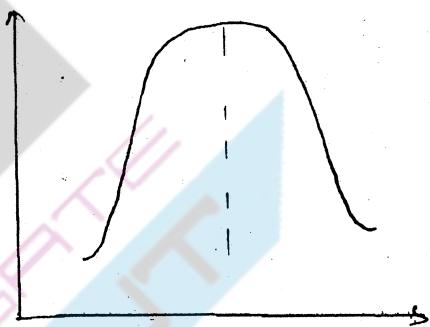
uniform distribution



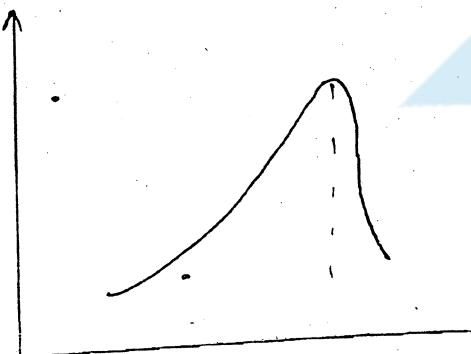
Triangular distribution



Step rectangular method



Symmetrical or Normal



Asymmetrical

4) Break even Analysis →

In this technique the total cost of production is sum of

- i) Fixed cost
- ii) Variable cost

Fixed cost → The cost that remains constant irrespective of volume of production is known as fixed cost.

e.g; rent of factory, land cost, insurance of fixed assets, interest on long term borrowings, administrative expenses, annual maintenance charges, license fees.

Variable cost → This type of cost varies with volume of production. It directly increases with increased in output. e.g; cost of raw material, power supply, fuel consumption, selling expenses, transportation expenses.

$$\text{Total cost} = \text{Fixed cost} + \text{Variable cost}$$

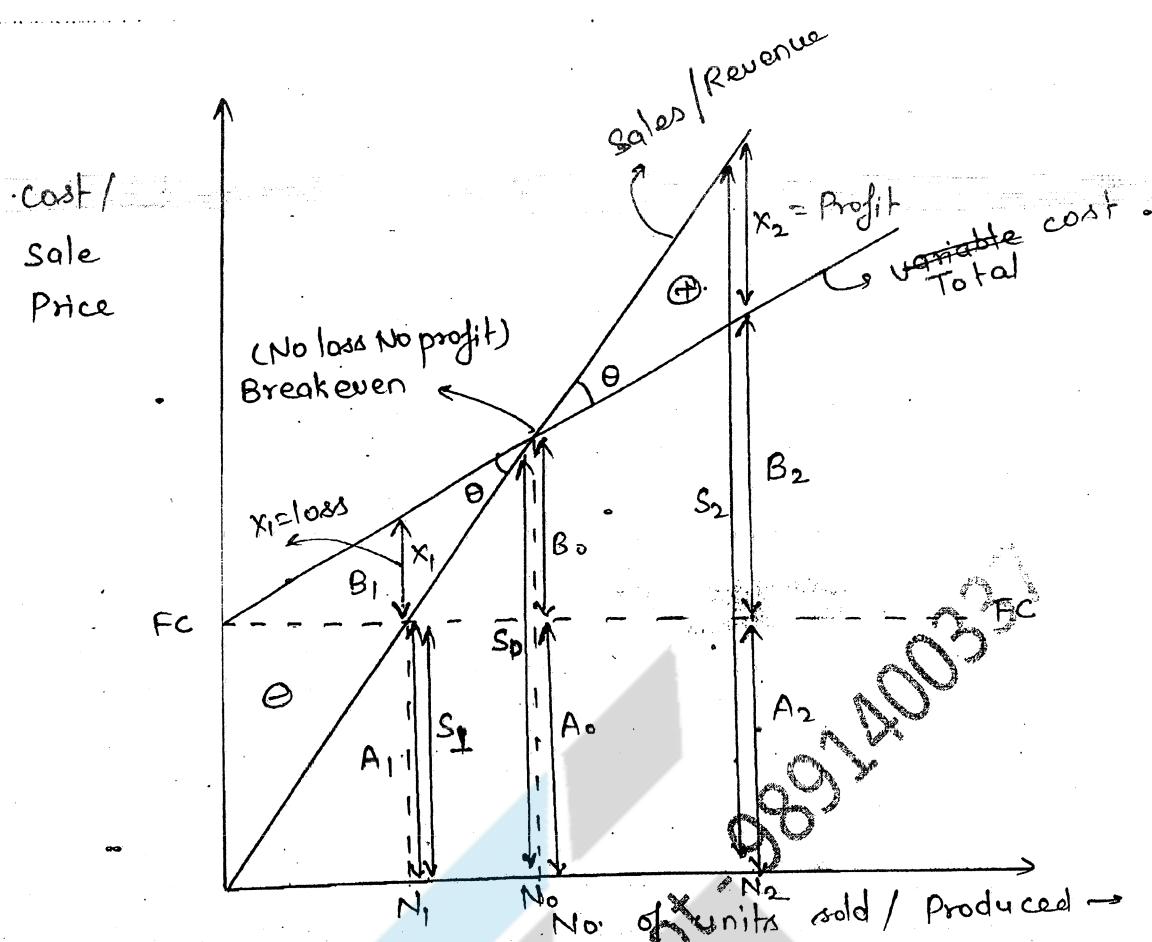
The sales realization is the revenue earned by selling the products which is variable and directly proportional to no. of sold items. At break even point (no profit, no loss situation) sales realization (total revenue) is equal to

$$\text{Sales Realization (SR)} = \text{TC} (\text{FC} + \text{VC})$$

TC = Total cost

FC = Fixed cost

VC = Variable cost



Where  $\theta$  = angle of incidence and it represents rate of profit. ( $\text{increase in } \theta = \text{increase in profit}$ )

$S$  = sales value

$A$  = Fixed cost

$B$  = variable cost

No = Breakeven no. of units

$A + B$  = Total cost

$x_1$  = losses

$x_2$  = Profit

\* Breakeven point is the intersection point of revenue line and total cost curve. At Breakeven no profit no loss situation.

# let  $N_0$  is no. of units produced at B.E.P. if <sup>49</sup> $N_0$  of units produced are less than break even number ( $N_1$ ), then the project will be in losses.

$$N_1 < N_0$$

$$\text{losses} = \text{Total sales} - \text{Total cost}$$

$$x_1 = S_1 - (A_1 + B_1)$$

= -ve

# If total production is greater than break even number ( $N_2$ ), then the project is in profit.

$$N_2 > N_0$$

$$\text{Profit} = \text{Total sales} - \text{Total cost}$$

$$x_2 = S_2 - (A_2 + B_2)$$

= +ve

# The difference b/w actual production and break even production is called profit margin.

$$\text{Profit margin} = N_2 - N_0$$

# Contribution → It is defined as the difference b/w sales realization and variable cost.

$$\text{Contribution} = \text{Sales value} - \text{Variable cost}$$

The excess of selling price over variable cost i.e. contribution contributes towards -

- ① Fixed cost
- ② Profit.

Q. If selling price per unit of a product is ₹ 12.50 and its variable cost is ₹ 7. Then contribution will be ₹ rupees per unit. Lets assume that fixed cost is ₹ 50,000 and breakeven point has been achieved.

Soln  $No = \frac{\text{Fixed cost}}{\text{Contribution}}$

$$= \frac{50,000}{5} = 10,000 \text{ at B.E.P.}$$

$BEP (No) = \frac{\text{Fixed cost}}{(\text{Sales realization} - \text{Variable cost})} \rightarrow$  always on per unit base

$$= \frac{\text{Fixed cost}}{\text{Contribution per unit}}$$

Total sales value at Break even number =  $s_0$

$$s_0 = No \times \text{Selling price per unit}$$

Q. The details of production cost and revenue of a project are as follows -  $T.C = ₹ 65,000$   $FC = ₹ 25,000$

sales cost for 8000 units. ₹ 80,000

i) Find break even no. of units

ii) No. of units to be produced to obtain a profit of ₹ 20,000

$$\underline{\text{Soln}} \quad VC = TC - FC = 65,000 - 25,000 \\ = ₹ 40,000$$

$$\text{Sales realization} = ₹ 80,000$$

$$No = \frac{25,000}{\left( \frac{80000}{8000} \right) - \left( \frac{40000}{8000} \right)} = 5000$$

(11) Sales rate of 1 unit = ₹ 10 at BEP

$$BEP = \frac{\text{Fixed cost}}{\text{Contribution}}$$

$$\text{Contribution} = 20,000 + 25000 = 45,000$$

$$\text{Profit} = \text{Total Revenue} - \text{Total cost}$$

$$20,000 = 10x - (25000 + 5x)$$

$$x = 9000$$

### 5 Decision Tree Analysis →

It is assumed that the project will be completed in accordance with the proposed planning but in reality there is always some flexibility in execution. Hence such flexibility exists in implementation then decision tree analysis is a useful tool in analyzing and evaluating project ~~for~~ flexibility. It introduces risk hence the decision tree analysis can be used for risk analysis.

Steps in decision tree analysis →

- 1) Identify the problem and alternative option.
- 2) Delineate the decision tree → Make the path of decision situation and represent the instruction in diagrammatical form.
- 3) Specify the probability and monetary outcome.
- 4) Evaluate various decision alternative & implement the best decision wherever required.

1) Change Pricing Strategy →

A lower selling price increases the demand however it will ↑ the break even units.

2) Sequential Investment →

Initially start with slow/ small units of production with smaller investment and generally ↑ as demand ↑.

3) Provide Good Insurance Cover →

In implementation of a project there is use of multiple resources hence it is necessary to keep into account insurance for valuable products.

4) Improving Information → (Gather more information about market and technologies and use ~~new~~ and tested method.5) Financial leverage →

Try to reduce dependence on debt and ↑ equity.

6) Risk Reduction strategies →

change proportion of fixed cost and variable cost by procuring some goods from outside.

# Detailed Project Report →

DPR is a detailed and elaborated plan for a project which indicate the overall plan, different roles resources needed for success of the project.

DPR is a final detailed appraisal or a blueprint for the next stage.

## # Elements of DPR →

### ① Market Planning →

It includes demand forecast, comparative description, primary and secondary data source, marketing strategies and product market posture.

### ② Equipment and process technology →

After marketing planning design of facilities is required. In this stage material flow, vendor information, input and output operation and customer operation are mentioned. This phase helps in choice of technology and technology collaboration.

### ③ location of Project →

DPR must consider the location w.r.t. to supply of raw material, power transmission, storage and marketing opportunities.

### ④ layout of the Project →

Layout have implication on profitability and efficiency of project.

### ⑤ Material for the Project →

DPR should provide an estimate of total material required in a project.

### ⑥ Specification of plan and Equipment →

DPR should provide technical specifications for technology and machinery.

### ⑦ EIA (Environmental Impact association) →

DPR should include EIA in order to meet environmental

standards.

⑧ Information of operation →

This should include plant capacity, resource management, vendor management, quality management, operation and maintenance cost, safety concern, management information system.

⑨ Commercial Aspect →

DPR should include contractual relationship likely to occur. It should compute profitability of project.

⑩ Financial Aspect →

DPR should include expected revenue and projected cost, which may occur in project. It may include details about profit and loss statement and projected balance sheet.

⑪ Socio Economic Aspect

It is essential to make an effort at the final stage to provide social benefits. and a sustainable approach. It should include plan for community development, roads, schools, hospital and water-supply planning.