

## **Session 3-4**

# **Project/Portfolio Management – Evaluation and Selection**

**CP Garg, PhD**

- Cement Project, Power project, Refinery project, Fertilizer project, etc.
- Term project is common - plants are not. In each case the project is for the plant but as soon as the plant is operational, the project is deemed to be completed.
- Project for method improvement.
- The explicit use of the term “project” is not always necessary - elections, admission process, road-dam-building construction.
- A project, therefore, is not a **physical object, nor it is the end result** – it has something to do with **the going - on in between**, which must be the same, whether we build a high technology process plant or merely hold an election, to deserve a common name and to be termed as a project.

A project is, thus, initiated to achieve the mission-whatever the mission may be. A project is completed as soon as the mission is fulfilled.

A combination of **human and non human recourses** polled together to in a **temporary organization** to serve **specific purpose**.

# What Is a Project?

- A project is “a temporary endeavor undertaken to create a unique product, service, or result.”\*
- Operations is work done to sustain the business/Service.
- A project ends when its objectives have been reached, or the project has been terminated.
- Projects can be large or small and take a short or long time to complete.

# What is a project?

- A group of tasks (activities) performed within a definable time period (schedule) in order to meet a specific set of goals/objectives (performance) within a budget (cost plan)
- A project generally exhibits most of the following conditions:
  - ⚙ It is *unique*
  - ⚙ A project is *finite*
  - ⚙ Usually *complex*
  - ⚙ A project is *homogeneous/heterogeneous*
  - ⚙ *Repetitive/Non-repetitive*
  - ⚙ Requires *multiple resources* from a finite resource pool
  - ⚙ It has some *novelty* in some sense

It is a one shot, time limited, **goal directed**, major undertaking, requiring the commitment of **varied skills and resources**.

A project is defined to be a **task** which has a definite **beginning-definite end time** and which consists of several activities or jobs.

Examples of projects include, but are not limited to:

- Developing a **new product** or service
- Effecting a change in **structure**, staffing, or style of an **organization**
- Designing a new **transportation** vehicle
- Developing or acquiring a new or modified **information system**
- Constructing a **building** or facility
- Building a **water system** for a community
- Running a **campaign** for political office
- **Implementing** a new business procedure or process

# Various elements of project:

Based on set of definitions

Projects are complex , one time processes

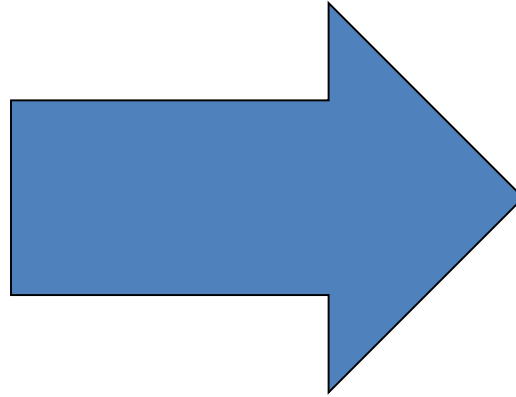
Projects are **limited by budget ,schedule, and resources**

Projects are developed to resolve a clear goal or set of goals

Projects are **customer focused**

# Importance of PM

- Fast technological changes
- High uncertainty
- Short life cycle of products
- Globalization impact
- Large organizations



Customer focus

## Portfolios and Portfolio Management

A portfolio is a **collection of projects** that are grouped together to facilitate effective management of that work to meet strategic business objectives.

The projects in the portfolio may not necessarily be **interdependent or directly** related.

Funding and support can be assigned on the basis of **risk/reward** categories, specific lines of business, or general types of projects, such as infrastructure and internal process improvement.

## Subprojects

Projects are frequently divided into **more manageable components** or **subprojects**.

Subprojects are often contracted to an external enterprise or to another functional unit in the performing organization.

Examples include:

- Subprojects based on the project process, such as a single phase in the project life cycle
- Subprojects according to human resource skill requirements, such as **plumbers or electricians** needed on a construction project
- Subprojects involving **specialized technology**, such as the automated testing of computer programs on a software development project ( WLL, VLSI, etc..)

On very large projects, the subprojects can consist of a series of even smaller subprojects (GATI- SHAKTI Project, Ganga project-SAGARMALA, BHARATMALA, UDAN)

.

**Project Management Office:** A project management office (PMO) is an organizational unit to **centralize and coordinate** the management of projects.

Other names are also prevalent in business

“program management office,”

“project office,” or

“program office

- Oversees the management of **projects, programs, or both**.
- Coordinated **planning, prioritization and execution** of projects and subprojects
  
- **Resource leveling and variance** reporting.
- **Central repository** of lesson learned.
- **New PM improvements** are first identified, tested refined and passed.
- **Training**, software, **standardized policies**, and procedures.

- **Shared and coordinated** resources across all projects administered by the PMO
- Identification and development of project management **methodology, best practices, and standards**
- **Clearinghouse** and management for project **policies, procedures, templates,** and other shared documentation
- Centralized repository and management for both **shared and unique risks for all projects**
- Central office for operation and **management of project tools,** such as enterprise-wide project management software

- Central coordination of **communication management across projects**
- A **mentoring** platform for project **managers**
- Central monitoring of all PMO project **timelines and budgets**, usually at the enterprise level
- Coordination of **overall project quality** standards between the project manager and any internal or external quality personnel or standards organization.

Differences between project managers and a PMO may include the following:

- Project managers and PMOs pursue **different objectives**
- A project manager is responsible for delivering **specific project objectives** (within constraints) , while a PMO is an organizational structure with specific mandates that can include an **enterprise-wide perspective**.
- The project manager focuses on the specified project objectives, while the PMO manages major program scope changes and can view them as potential opportunities to better achieve **business objectives**.
- The project manager controls the assigned **project resources** to best meet project objectives, while the PMO optimizes the use of **shared** organizational resources across all projects.
- The project manager manages **the scope, schedule, cost, and quality** of the products of the work packages, while the PMO manages **overall risk, overall opportunity, and the interdependencies among projects**.
- The project manager **reports** on project progress and other project specific information, while the PMO provides **consolidated reporting** and an enterprise view of projects under its purview.

**Weather station:**

(tracking and monitoring status)

-milestones achieved

-diff b/w plan and actual progress

-budget warning signal

-money paid

- status of major project risks

-update contingency plan

**-Report to top mgt.**

**Control tower:** (development of PM skills, find and resolve shortcomings, directly support to manager and team)

-establish **standards** for managing projects (uniform methodology-budget-risk mgt, etc)

-**consult** how to follow standards

-**Enforces** the standards-awards-refusal.

-**Improve** standards

**Resource pool:**

-to maintain and provide a cadre of trained and skilled professionals

## Critics of PMO:

- all egg in one basket- one location of professionals.
- another layer of oversight and bureaucracy in organization

**Organizational culture** is the **collective behavior** of **humans** that are part of an organization.

It is also the pattern of such collective behaviors and assumptions that are **taught to new organizational members** as a way of perceiving, and even thinking and feeling.

Organizational culture affects the **way people and groups interact** with each other, with clients, and with stakeholders.

## How do cultures form?

- Technology : high –low
- Environment: global-regional
- Geographical location: ???
- Reward systems:
- Rules and procedures:
- Key organizational members:
- Organization values, Visions, Working language, Systems, and symbols, It includes beliefs and habits.<sup>1</sup>

## **Types of projects**

1. Personal : exam, vacation, writing book, getting dressed, wedding, etc.
2. Local: school function, cleanliness drives
3. Organizational : NPD, new highway, dam, etc.
4. National: Poverty, satellite, annual budget, census.etc.
5. Global: SURN experiment, environmental (UN).
6. High and low tech
7. Industrial and non industrial
8. Type of partnership

## **Types of projects**

**a)Based on duration:** Long term 10 +, medium 5-10, short less than 5

**b)Based on investment:** High 20 crore, medium 5-20, low less than 5, cottage 50 lac

**c)Based on ownership:** Govt, public sector, corporate , cooperative, proprietorship, partnership.

**d)Based on risk:**

1.Greenfield project/grass root project- new venture by fresh entrepreneur/  
promoter

2.Brown field projects- existing promoter company or existing projects goes  
for **addition of product/capacity**

Brown field projects

Expansion projects- add capacity through mkt intensification or mkt development

Vertical integration projects-degree to which a firm owns its **upstream suppliers** and **down stream customers** is called vertical integration .

Vertical integration

Forward integration :?????

Backward integration: ?????

## Vertical integration

**Forward** integration : **downward** expansion is called forward integration, ex- steel industry moves for manufacturing of steel pipes

**Backward** integration: **upstream** expansion is called backward integration, pipe manufacturer makes its own steel

**Diversification Project:** Financial synergy may obtained by combining two firms – lower tech and high financial.

Concentric diversification project: firm adds related products: cars – scooter and bikes

Conglomerate diversification project: Unrelated areas

## The Project Life Cycle

Project managers or the organization **can divide projects into phases** to provide **better management control** with appropriate links to the ongoing operations of the performing organization.

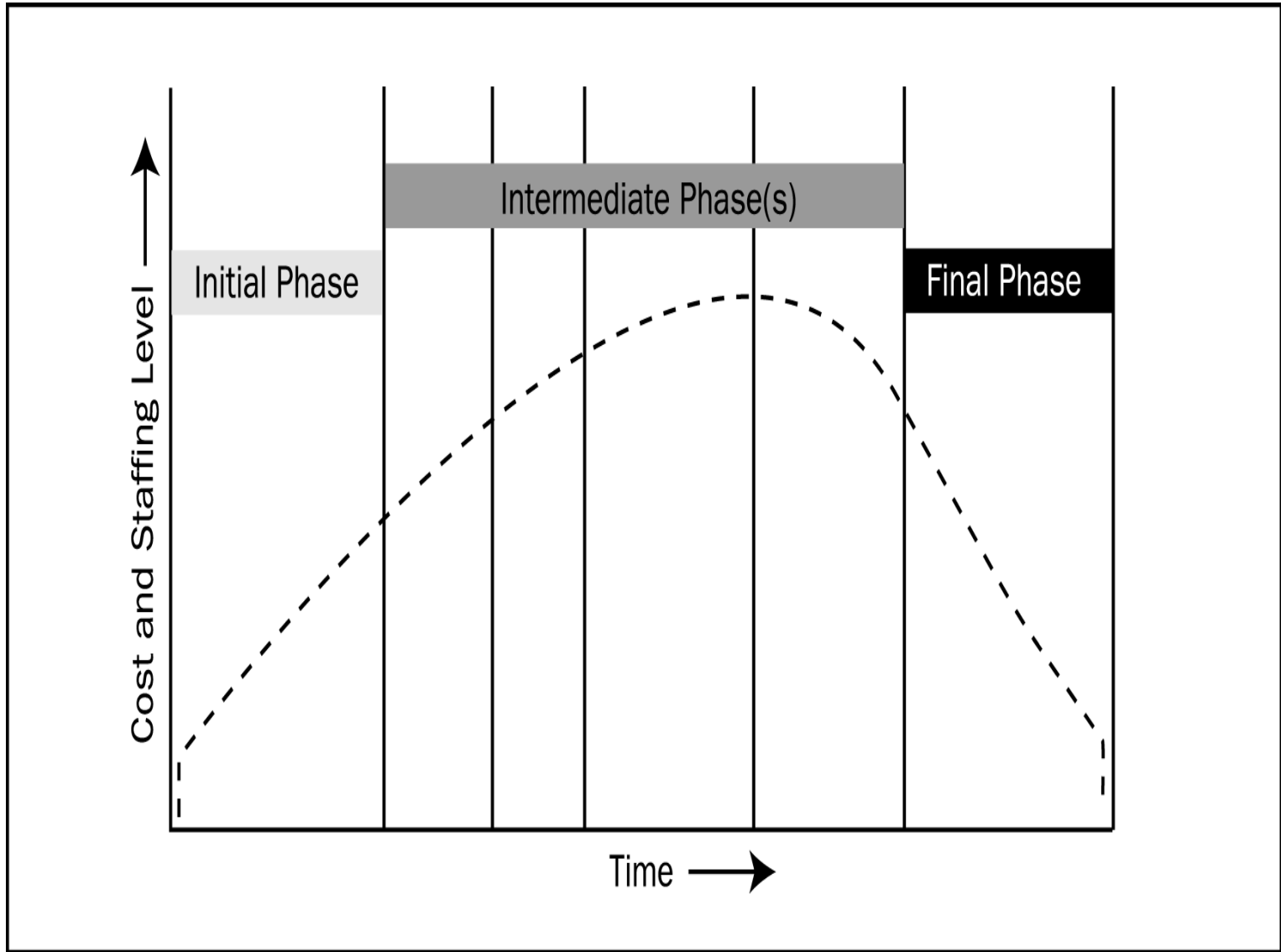
Collectively, **these phases are known as the project life cycle**. Many organizations identify a specific set of life cycles for use on all of their projects.

## Project life cycles generally define:

- **What technical work** to do in each phase (for example, in which phase should the architect's work be performed?)
- **When** the **deliverables** are to be generated in each phase and how each deliverable is reviewed, verified, and validated
- **Who is** involved in each phase (for example, concurrent engineering requires that the implementers be involved with requirements and design)
- How to **control and approve** each phase.

Most project life cycles **share a number of common** characteristics:

- Phases are generally **sequential** and are usually defined by some form of technical information transfer or technical component handoff.
  
- **Cost and staffing levels are low at the start, peak during the intermediate phases, and drop rapidly as the project draws to a conclusion.**



**Typical Project Cost and Staffing Level Across the Project Life Cycle**

## Project life cycle phases

**1a. Conception phase**

**1b. Definition phase**

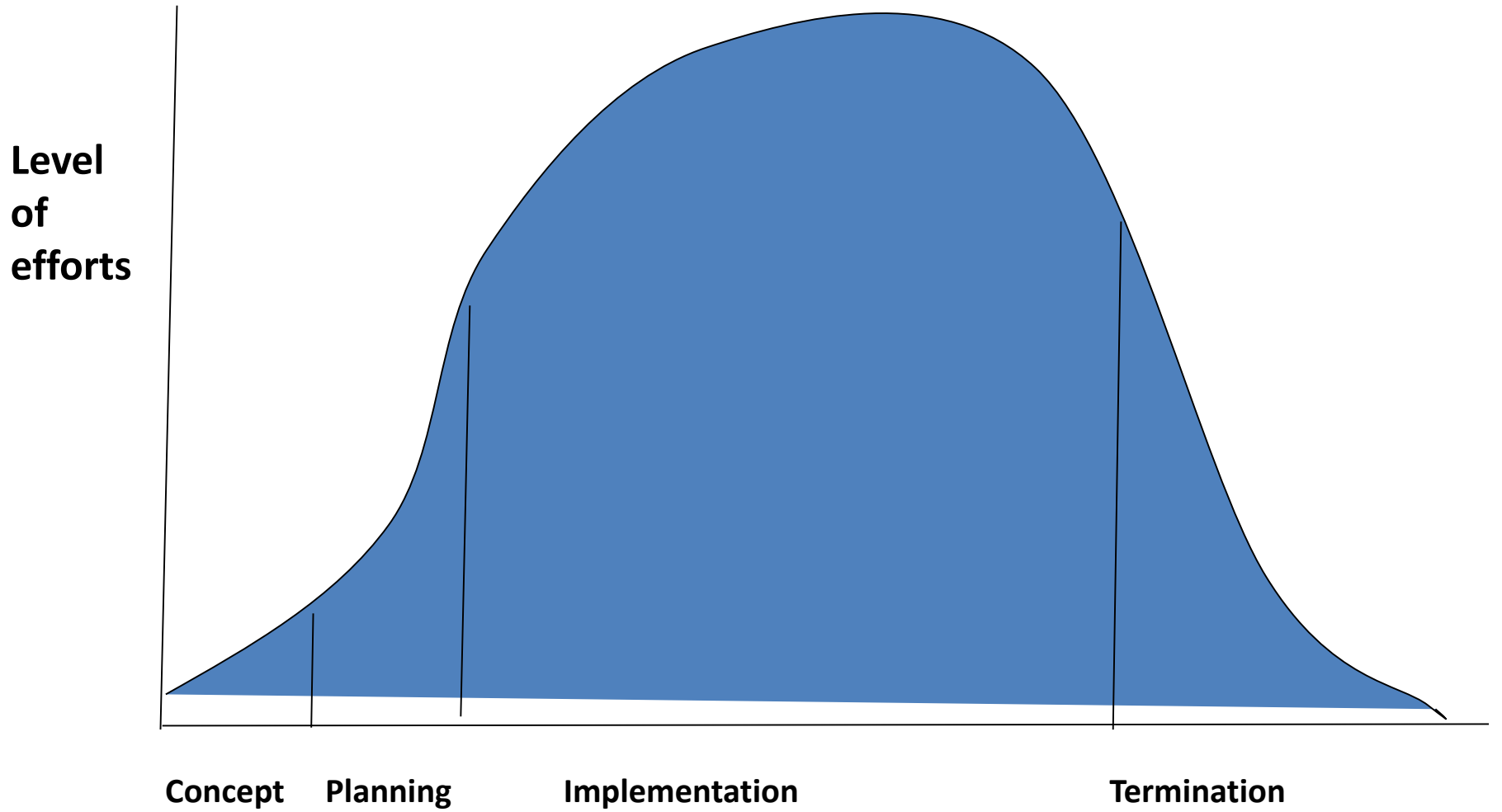
**2. Planning and organizing**

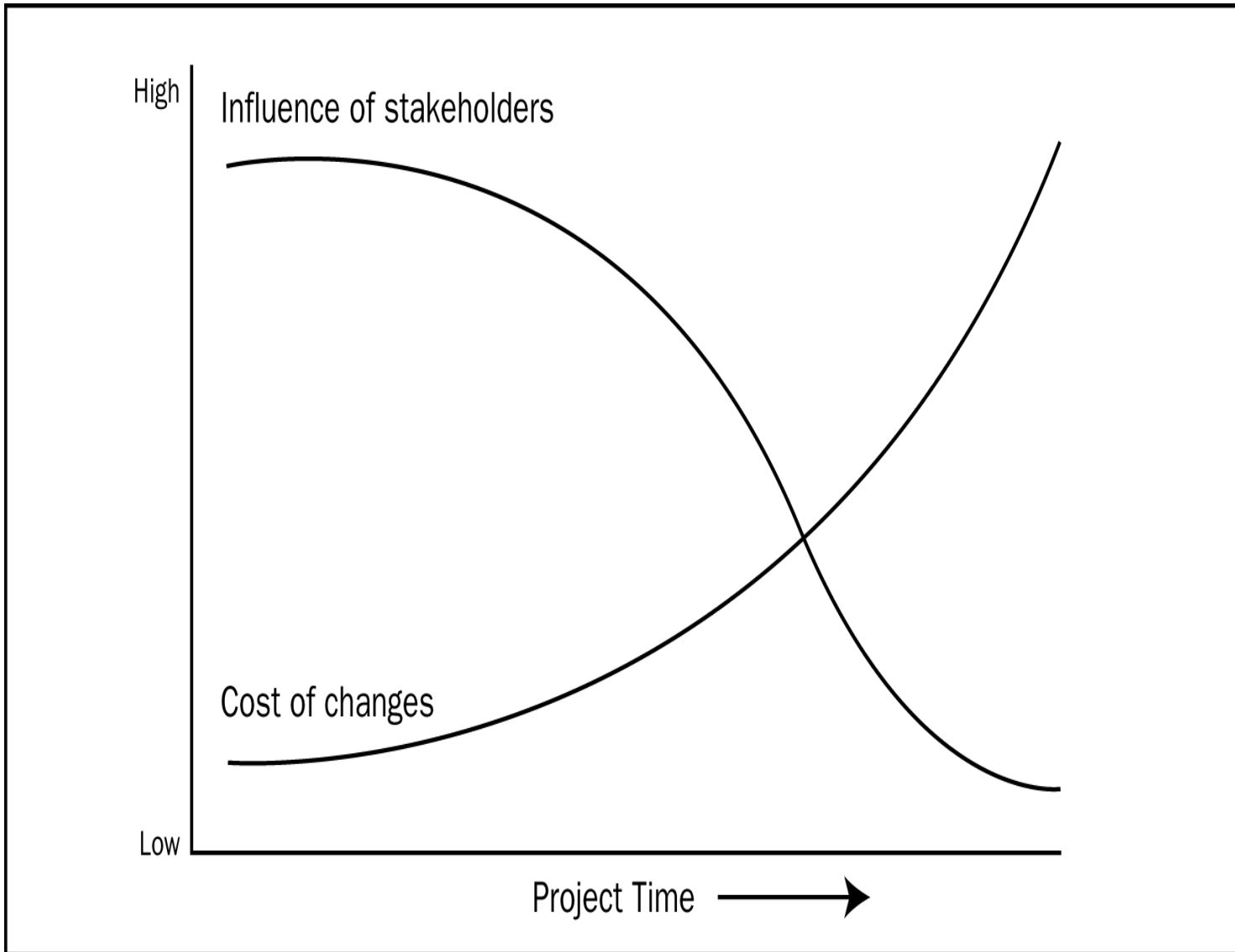
**3. Implementation**

**4. Project clean-up phase**



Initiation phase or Selection of a project





**Stakeholders' Influence Over Time**

1. **Project selection** : Major decision of top mgt. (**How to select a project ??????**). Project selection can be divided into three major activities:

**Project identification**

**Project appraisal**

**Project selection**

**Project identification:** Brainstorming (structured – sequential, 20-30 ideas,) and unstructured.

# Ways to create new product development through brainstorming

- **Run pizza:** Kodak- informal sessions- engineer and designer with customers -problems - need.
- **Allow time off:** scouting time- for technical people to putter in their own, pet projects
- **Survey your customers**
- **Use iterative models:** customers group discussing problems- technical people in another room listening and solving
- **Set up an idea vault**
- **Interaction** b/w technical people and supplier - through visits

## **Forces fighting new ideas**

I have got great idea

## **Forces fighting new ideas**

It wont work here

## **Forces fighting new ideas**

We have tried it before

## **Forces fighting new ideas**

This is not the right time

## **Forces fighting new ideas**

It can't be done

## **Forces fighting new ideas**

It's not the way we do things

## **Forces fighting new ideas**

We have done all right without it

## **Forces fighting new ideas**

It will cost too much

## **Forces fighting new ideas**

Let us discuss in our next meeting

# During brainstorming activity: management has to be

-Receptive

-Vision for future growth

-Keep long term objectives in mind

-SWOT

-Perform preliminary project analysis to assess whether a project proposal is worthwhile or not.

-Documents like: **project / product documents** (characteristics of project), **feasibility document** (constraints), **project concept** document (what, how, why – is to be done), **project charter** ( it formally communicates the initiation of the project, scope, authority, KSF)

Ex : Reduce vehicular pollution in Rohtak

- 1.
  - 2.
  - 3.
  - .
  - .
  - .
- N

### **Criteria for screening ideas**

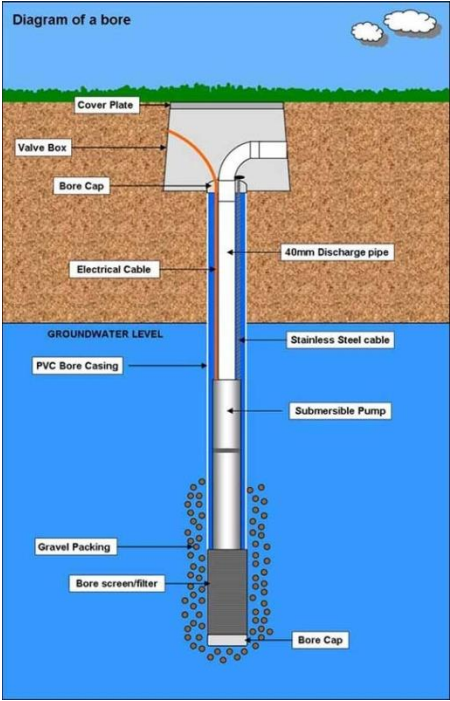
Effectiveness to achieve objectives  
Cost of the proposal  
Ease of implementation  
Time needed

# Project appraisal

**Market appraisal:** customer ( who- needs) , mkt share, current and future competitors- their mkt share , aggregate demand , possible pricing options.

# Project appraisal

**Technical** : engineering aspects, location , size, process, etc. (bore well)



**Financial factor**?????

## **Project appraisal**

**-Financial appraisal:** cost of project and means of sources, impact on financial position of the firm, working capital, cash flows over time, profitability, BEP, net present worth, IRR, PBP, Risk.

## Project appraisal

-**Economic:** Impacts of project on society. Benefits and costs (in shadow price), distribution of income in society, level of saving and investments, employment, etc.

-**Ecological:** Environmental damage (air, water, noise) restoration measures

-**Economic???????**

## **Project appraisal**

Production factors: Time to complete project, availability of resources, flexibility of operations, connection with existing production line, energy requirements and its sources. Expected quality of product.

Personal factors:??????

Legal factors??????

## 2. Planning and organizing

### 3. Project implementation :?????????????

### **3.Project implementation :**

- Organization of project team and allocation of work
- Monitoring – cost, value and time**
- Effective control action to minimize time and cost overruns
- Updation of project schedules ( time and cost)
- Provisioning of financial and other resources needed in the project
- Coordination
- Awarding of contracts-vendors, sub contactor
- Procure and erecting of equipment and services

## 4. Project completion and Review?????

## **4. Project completion and Review**

-Disbanding project team

-Handing over

-Accounting and report writing

-Learning from experience

-What else ????????

**Model for project selection:** Methods for selection run on continuum, from highly qualitative or judgmental to quantitative. The screening models should have:

**Model for project selection:** Methods for selection run on continuum, from highly qualitative or judgmental to quantitative. The screening models should have:

1. **Realism:** organization's objectives, constraints on money and resources.
2. **Capability:** flexible enough to respond to changes in conditions under which projects are carried out. Comparison of projects should be there (time, technology, commercial aspects).
3. **Flexibility:** model should allow tax rate and tax laws, building codes.
4. **Ease of project:** simple enough, help people involved in project roles and functional roles
5. **Cost:** model should be cost effective
6. **Comparability:** broad enough (????) to be applied to multiple projects

## Methods of project selection/evaluation

**Boston Consulting Group (BCG) Matrix:** is a four celled matrix (a 2 \* 2 matrix) developed by BCG, USA. It is the most renowned corporate **portfolio analysis tool**. It provides a graphic representation for an organization to **examine different businesses in it's portfolio** on the basis of their **related market share and industry growth rates**.

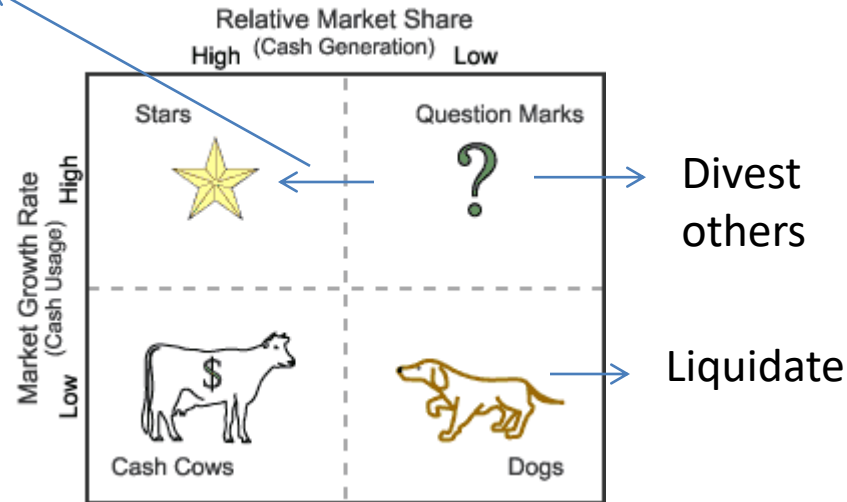
It is a two dimensional analysis on management of SBU's (Strategic Business Units). In other words, it is a comparative analysis of **business potential and the evaluation of environment**.

According to this matrix, business could be **classified as high or low** according to their industry growth rate and relative market share.

**Relative Market Share** = SBU Sales this year leading competitors sales this year.

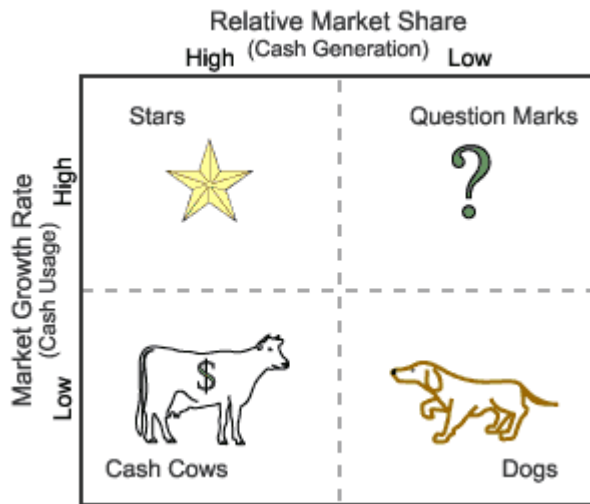
**Market Growth Rate** = Industry sales this year - Industry Sales last year.

Select few



**Stars-** Stars represent business units having **large market share** in a **fast growing** industry. They may generate cash but because of fast growing market, stars require huge investments to maintain their lead. Net cash flow is usually modest.

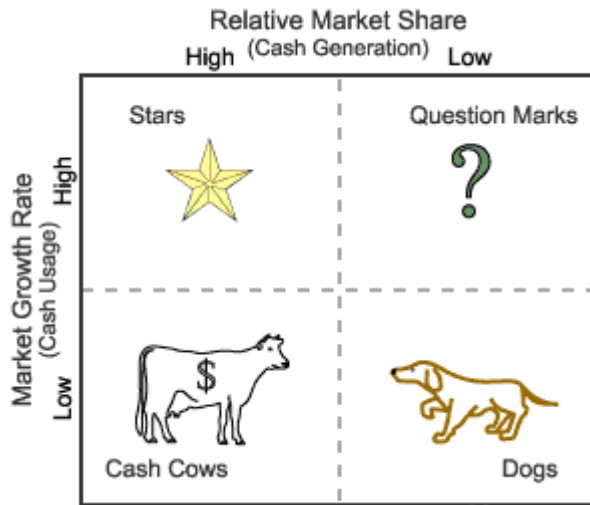
SBU's located in this cell are attractive as they are located in a robust industry and these business units are highly competitive in the industry. **If successful, a star will become a cash cow when the industry matures**



**Cash Cows-** Cash Cows represents business units having a **large market share in a mature, slow growing industry.**

Cash cows require little investment and generate cash that can be utilized for **investment in other business units.** These SBU's/products are the corporation's key source of cash, and are specifically the core business.

They are the base of an organization. **These businesses usually follow stability strategies.** When cash cows lose their appeal and move towards deterioration, then a retrenchment policy may be pursued.

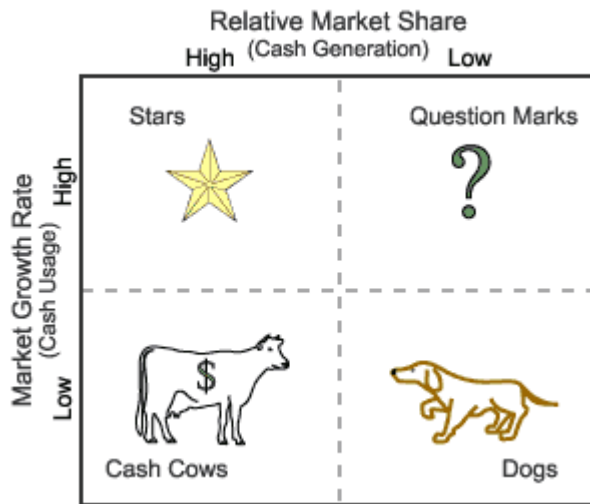


**Question Marks-** They require **huge amount of cash** to maintain or gain market share. They require attention to determine if the venture can be viable.

If the firm thinks it has **dominant market share**, then it can adopt **expansion** strategy, else **retrenchment** strategy can be adopted.

Most businesses start as question marks as the company tries to enter a high growth market in which there is already a market-share.

**If ignored, then question marks may become dogs, while if huge investment is made, then they have potential of becoming stars.**

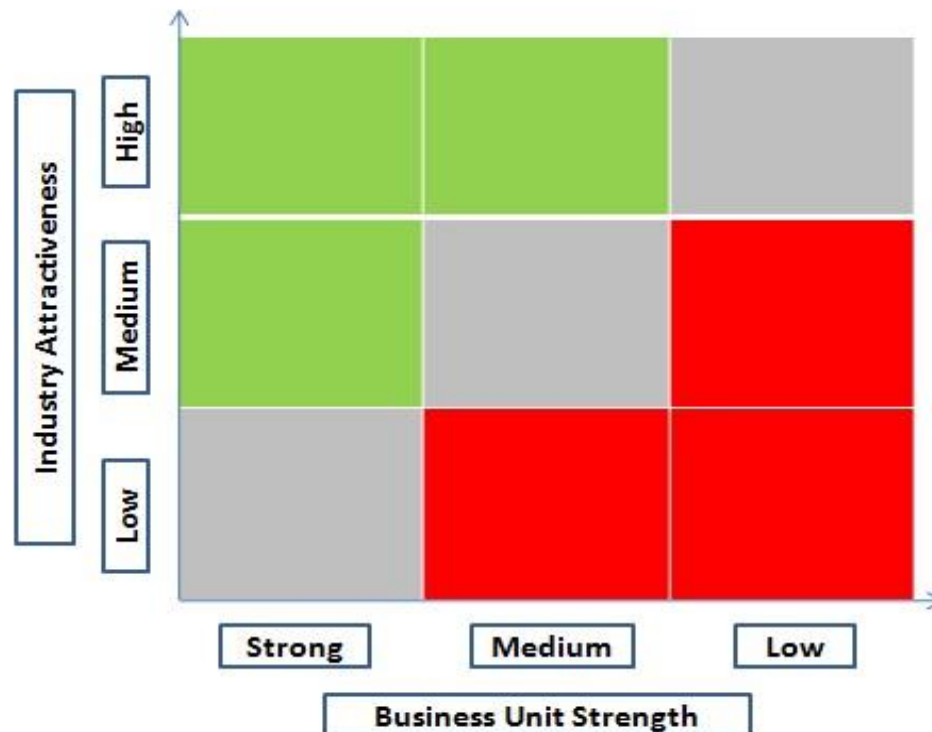


**Dogs-** Dogs represent businesses having weak market shares in low-growth markets. **They neither generate cash nor require huge amount of cash.** Due to low market share, these business units face **cost disadvantages**. Generally **retrenchment strategies are adopted** because these firms can gain market share only at the expense of competitor's/rival firms.

These business firms have **weak market share because of high costs, poor quality, ineffective marketing, etc.** Unless a dog has some other strategic aim, it should be liquidated if there is fewer prospects for it to gain market share. **Number of dogs should be avoided and minimized in an organization.**

**McKINSEY/GE Matrix:** It is similar to the BCG Matrix and actually the GE / McKinsey Matrix is an extension of the BCG Matrix. This tool compares different businesses on "**Business Strength**" and "**Industry/ Market Attractiveness**".

The GE / McKinsey Matrix is divided **into nine cells** - nine alternatives for positioning of any SBU or product offering. **Based on the strength of the business and its market attractiveness each SBU will have a different position in the matrix.**

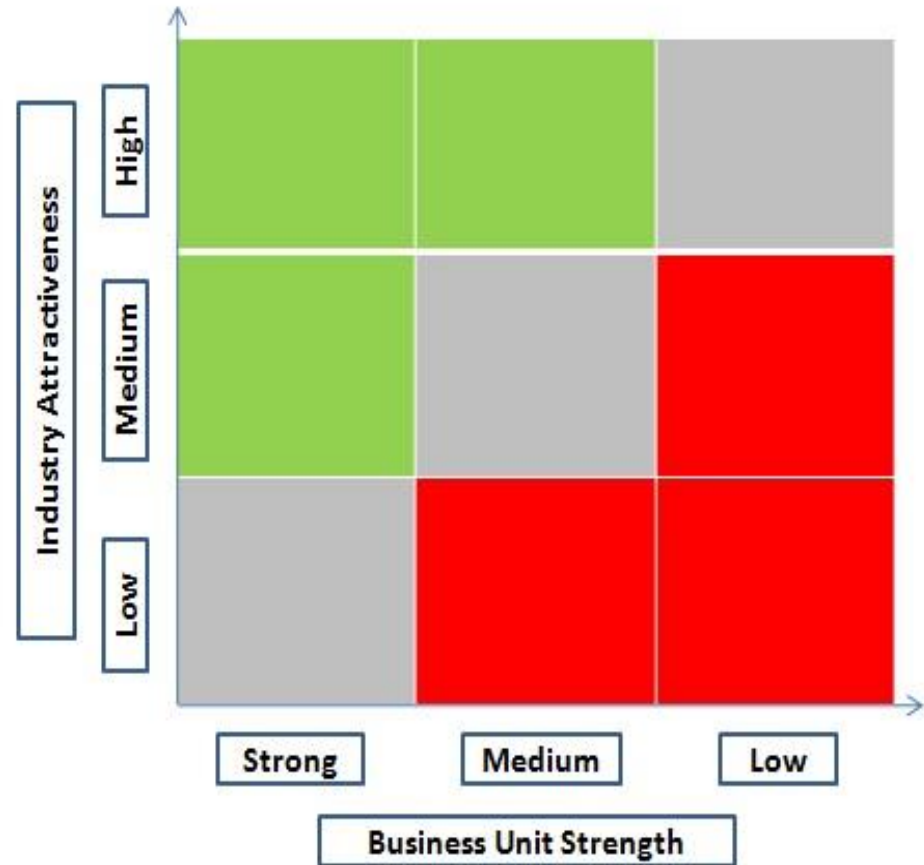


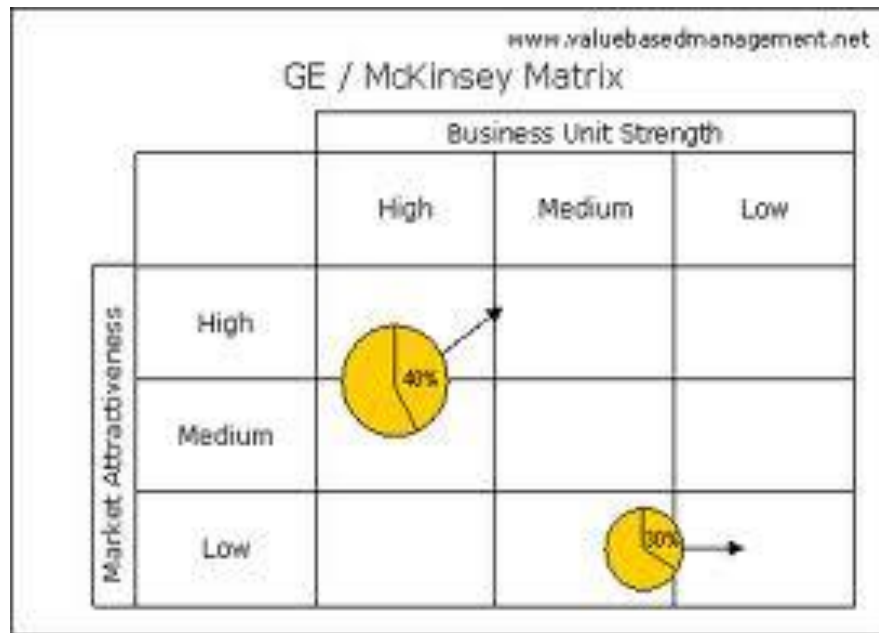
## Industry Attractiveness

- Market growth rate
- Govt support**
- Market size
- Demand variability
- Industry profitability
- Industry rivalry
- Global opportunities
- Macroenvironmental factors

## Business Unit Strength

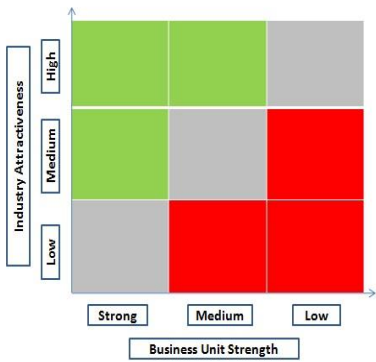
- Market share
- Growth in market share
- Customer loyalty
- Brand equity
- Distribution channel access
- Production capacity
- Profit/cost margins relative to competitors
- Financial and **channels'** strength



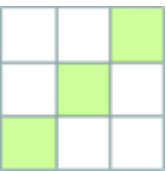


**Plotting the Information:** Each **business unit can be portrayed as a circle** plotted on the matrix, with the information conveyed as follows:

- Market size is represented by the size of the circle.
- Market share is shown by using the circle as a pie chart.
- The expected future position of the circle is portrayed by means of an arrow.



Segment I: This is the best segment. The business is strong and the market is attractive. The company should **allocate resources in this business and focus on growing the business and increase market share.**



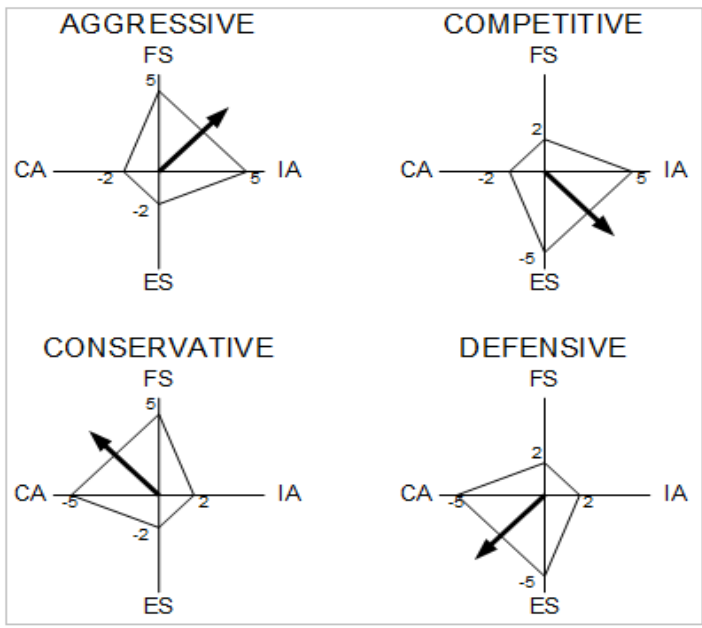
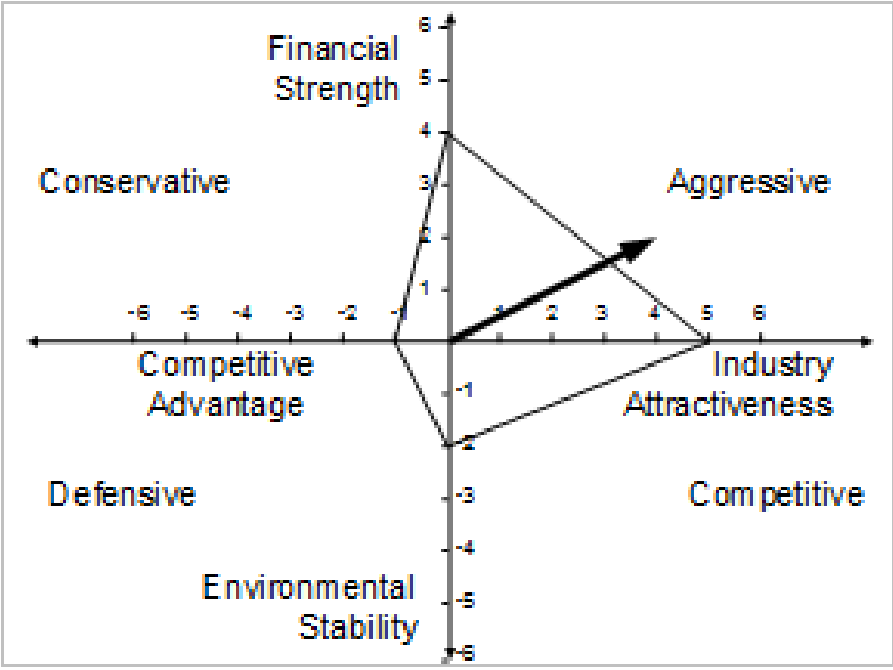
Segment II: The business is either strong but the market is not attractive or the market is strong and the business is not strong enough to pursue potential opportunities. **Decision makers should make judgment on how to further deal with these SBUs.** Some of them may consume too much resources and are not promising while others may need additional resources and better strategy for growth.



Segment III: This is the worst segment. Businesses in this segment are **weak and their market is not attractive.** Decision makers should consider either **repositioning these SBUs** into a different market segment, develop **better cost-effective offerings**, or **get rid of these SBUs** and invest the resources into more promising and attractive SBUs.

**SPACE : (strategic position and action elevation) diagram:** A management tool to analyse a company and decide its future strategy.

A set of variables should be selected to define **financial strength, competitive advantage, environmental stability, and industry strengths**. The set of variables could be as follows:



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## Internal Dimensions

### **Financial Strength**

- Return of investment
- Ability to raise funds
- Liquidity
- **Working capital**
- Cash flows

### **Competitive Advantage**

- Market share
- Capacity utilization
- **Location advantage**
- Brand image
- Product Quality
- Product life cycle
- Customer preference
- Technological innovation
- Sound supply chain

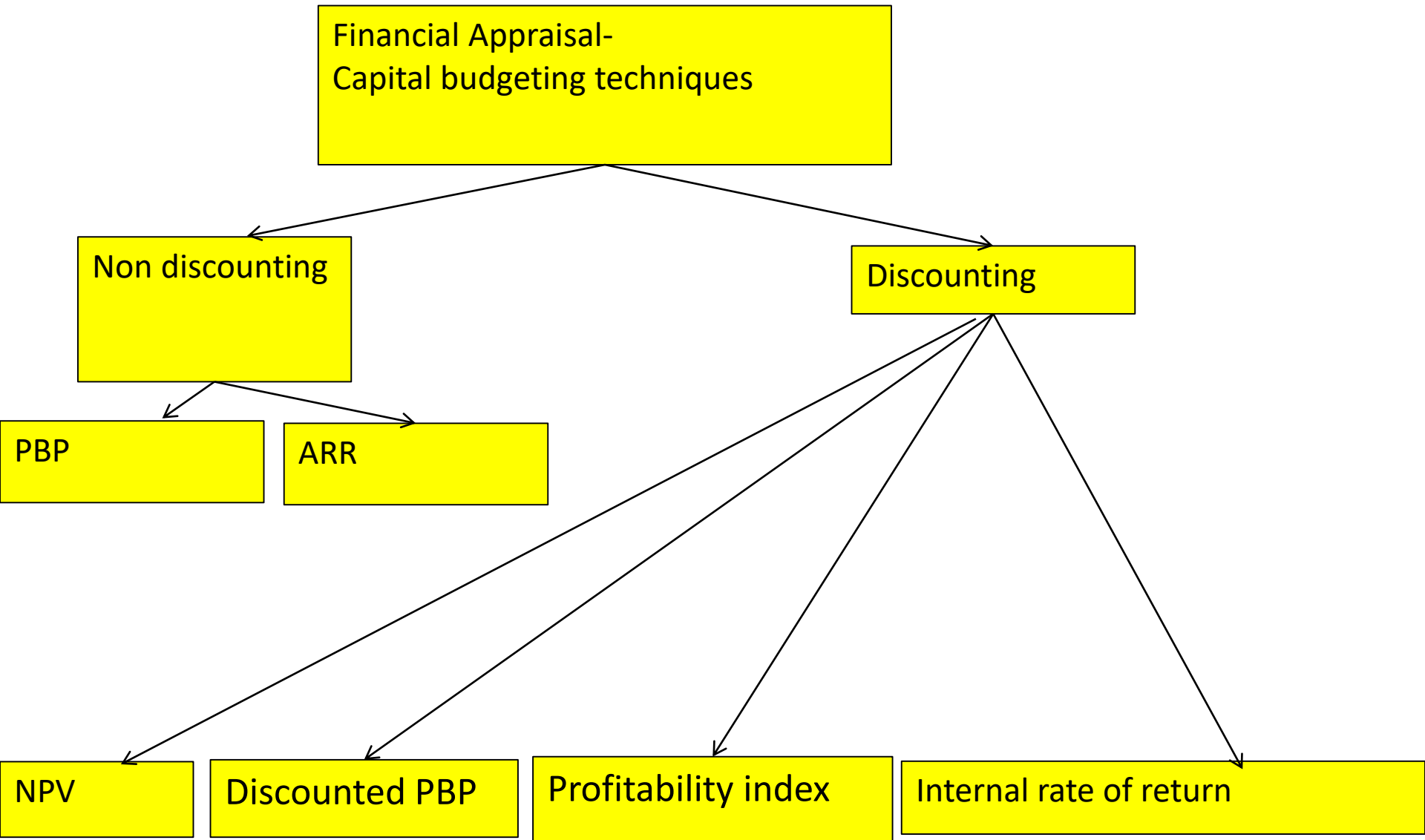
## External Dimensions

### **Environmental Stability**

- Technological changes
- Inflation
- **Demand elasticity**
- Competitor's price ranges
- Barriers to entry
- Competitive pressure
- **Ease of exit**
- Price elasticity of demand
- Risk exposure

### **Industry Strength**

- Growth potential
- Profit potential
- Financial stability
- Resource availability
- **Ease of entry**
- Capacity utilization



**PBP = time period in which investor gets back his invested money in fixed assets from the project**

Initial investment	300000
Annual cost of operation	20000
Expected annaul revenues	
first two years	100000
next three years	200000
Planning horizone	5 yrs

**Find : PBP ??**

**What are the drawbacks of PBP ?**

**PBP = time period in which investor gets back his invested money in fixed assets from the project**

$$\text{PBP} = Y_0 - (\text{CuCF}_0) / (\text{CF}_1)$$

$Y_0$  = is the year just before the pay back period is attained

$\text{CuCF}_0$  = cumulative cash flow of  $Y_0$

$\text{CF}_1$  = cash flow of pay back year

1. does not consider WC and Salvage value
2. does not considerter cash flows after the PBP
3. does not consider time value of money
4. no consideration for risk
5. ignores cost of capital

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investment, yearley cost and revenues gross cash flows undiscounted CFBT

Year	Cash flow	Cum CF
0	-300	-300
1	80	-220
2	80	-140
3	180	40
4	180	220
5	180	400

PBP= (interpolated as the year when CCF becomes zero)  
= 2- (-140/180)=2.78 yrs

**Example:** Projected cash flow 30 lac in first year, CF is going to increase by 10 lac for next 3 years, and then decreases by 15 lac and closes in 5 year. Initial investment 140 lac, working capital requirement is 20 lac. The company foresees to fetch a net salvage value of 35 lac after 5 years. **Find PBP??**

**Example:** Projected cash flow 30 lac in first year, CF going to increase by 10 lac for next 3 years, and then decreases by 15 lac and closes in 5 year. Initial investment 140 lac, working capital requirement is 20 lac. The company foresees to fetch a net salvage value of 35 lac after 5 years. **Find PBP??**

Year	Cash flow	Cum CF
0	-140	-140
1	30	-110
2	40	-70
3	50	-20
4	60	40
5	45	

$$\text{PBP} = Y_0 - \frac{\text{CuCF}_0}{\text{CF}_1}$$
$$= 3 - \frac{20}{60} = 3.33$$

<b>Year</b>	<b>Project A</b>	<b>Project B</b>	<b>Project C</b>
<b>0</b>	<b>-110</b>	<b>-110</b>	<b>-110</b>
<b>1</b>	<b>20</b>	<b>20</b>	<b>0</b>
<b>2</b>	<b>30</b>	<b>30</b>	<b>0</b>
<b>3</b>	<b>40</b>	<b>40</b>	<b>90</b>
<b>4</b>	<b>30</b>	<b>30</b>	<b>30</b>
<b>5</b>	<b>20</b>	<b>20</b>	<b>20</b>
<b>6</b>	<b>20</b>	<b>10</b>	<b>20</b>

**Which is the best project and why???**

**Project A**

Year	Cash flow	Cum CF
0	-110	-110
1	20	-90
2	30	-60
3	40	-20
4	30	10
5	20	30
6	20	50

**Project B**

Year	Cash flow	Cum CF
0	-110	-110
1	20	-90
2	30	-60
3	40	-20
4	30	10
5	20	30
6	10	40

**Project C**

Year	Cash flow	Cum CF
0	-110	-110
1	0	-110
2	0	-110
3	90	-20
4	30	10
5	20	30
6	20	50

A better than B, additional 10 lac,

A better than C, early recovery

**Average rate of return (ARR) : Considers cash flows after PBP , working capital and salvage value**

ARR = average return/ average investment

Average return= Sum of all CFs/n,

Average investment=  $1/2$  (initial investment+ terminal cash flow)  
=  $1/2$ ((fixed investment +WC) +(WC+SV))

FI= fixed invest., WC =working capital, SV =salvage value

**Ex.** Projected cash flow 30 lac in first year, CF is going to increase by 10 lac for next 3 years, and then decreases by 15 lac and closes in 5 year. Initial investment 140 lac, working capital requirement is 20 lac. The company foresees to fetch a net salvage value of 35 lac after 5 years

**Find :ARR**

**Ex.** Projected cash flow 30 lac in first year, CF is going to increase by 10 lac for 4 years, and then decreases by 15 lac and closes in 5 year. Initial investment 140 lac, working capital requirement is 20 lac. The company foresees to fetch a net salvage value of 35 lac after 5 years

**Find :ARR**

**Sol.**

Year	Cash flow	Cum CF
0	-140	-140
1	30	-110
2	40	-70
3	50	-20
4	60	40
5	45	

$$\text{PBP} = 3 - (-20/60) = 3.33 \text{ n yrs}$$

Average return = Sum of all CFs/n, =  $225/5 = 45$

Average investment =  $1/2 [(140+20)+(20+35)] = 107.5 \text{ lac}$

ARR =  $45/107.5 = .418$

**Example:-** Let us determine the ARR for the following 2 alternative investments:

	Machine A:	Machine B:
Cost	56,125	58,125
Annual estimated income after depreciation & tax		
Year 1	3,375	11,375
Year 2	5,375	9,375
Year 3	7,375	7,375
Year 4	9,375	5,375
Year 5	11,375	3,375
<b>Total earnings</b>	<b>36,875</b>	<b>36,875</b>
Estimated life	5 years	5 years
Estimated salvage value	3,000	3,000

**Which investment is better????**

	Machine A:	Machine B:
Cost	56,125	58,125
Annual estimated income after depreciation & tax		
	Year 1	11,375
	Year 2	9,375
	Year 3	7,375
	Year 4	5,375
	Year 5	3,375
<b>Total earnings</b>	36,875	36,875
Estimated life	5 years	5 years
Estimated salvage value	3,000	3,000

ARR =  $\frac{\text{Annual average net earnings after taxes} \times 100}{\text{Average investment over the life of the project}}$

Average earnings = Total earnings / Estimated life in years

For machines A:-  $36,875 / 5 = 7,375$

For machines B:-  $36,875 / 5 = 7,375$

Average investment =  $(\text{Initial investment} - \text{Salvage Value}) / 2 + \text{Working capital} + \text{Salvage value}$ .

For Machine A:  $(56,125 - 3000) / 2 + 0 + 3000 = 29,562.50$

For Machine B:  $(58,125 - 3000) / 2 + 0 + 3000 = 30,562.50$

ARR for Machine A :  $7375/29562.50 * 100 = 24.95\%$  or 25%

ARR for Machine B :  $7375/30,562.50 * 100 = 24.13\%$  or 24%.

Machine A would be preferred as ARR is higher.

## De-merits of ARR method:

Like the pay-back period method, this method ignores the **time value of money**.

This method takes into account the accounting profits rather than the cash inflows and hence **ignores the fact that the actual cash flows can be re-invested**.

It is the discretion of the management to choose the **arbitrary cut-off rate of return** in choosing the projects. This may not always ensure the right selection.

The concept of average investment and average earnings **differ widely** and hence may produce different results

Capital budgeting techniques

Discounting

NPV

Discounted PBP

Profitability index

**Time value of money:** Money available today is more than tomorrow.

Compound amount = Principal  $(1+r)^n$

or, principal = Compound amount /  $(1+r)^n$

**or, present value of money = future value \* present value factor**

where PVF =  $1/(1+r)^n$

R = discount factor,

N = No of periods

**Present value:** Any value that occurs at the beginning of the problem is a present value. As zero is good baseline, **all cash flows are converted into their present value for analysis.** PVF is the ratio of PV and future value and is available in the form of table.

**Future value: ????????????**

**Future value:** The **last cash flow** is generally called future value, it can be understood the **cash transaction taking place after certain duration of time**. If the **same amount is transacted after a regular interval**, it is termed annuity.

**Annuity payment:** ????????????????????

**Annuity payment:** As per literary meaning, an annuity payment means the **yearly payment that occurs every year for more than one year**. But in financial terms, the duration may not be yearly, it may be less as well, say quarterly, monthly, weekly etc., but the **duration b/w two successive payments remains constant**. Each **payment, if taken alone, is a future value**, but together they make an annuity.

**Discount factor:** DF is the **expected returns per unit of period over the life of the project or investment**. It is necessary to understand that if annuity is for quarterly payment or transactions, the **annual expected return should be reduced to one quarter** for computational purpose, similarly  $1/12$ , if it is monthly.

**Number of periods:** The total no. of periods in any annuity is very important as they **define the value of annuity.**

It should again be noted that **if transactions are done yearly**, it is the no. of years, but in the situation of **quarterly payments**, the no. of periods should be **quadrupled the no. of years.**

Ex: Mr Sharma wishes to invest some money for future need of 5 lac after 5 yrs. @ 9 %, how much money should he deposit in Bank.

If interest is paid semi annually , then how much money should he deposit in Bank.

Ex: Mr Sharma wishes to invest some money for future need of 5 lac after 5 yrs, @ 9 %, how much money should he deposit in Bank

$$\begin{aligned}\text{Present value} &= 500000 / (1 + 0.09)^5 \\ &= 325000\end{aligned}$$

What if interest is paid semi annually?

$$\text{Present value} = 500000 / (1 + 0.045)^{10} = 318712$$

Ex: Mr X wants to receive 120, 000 for next 10 years from now. How much should he deposit now ? If interest rate is 10%.????

Ex: Mr X wants to receive 120, 000 for next 10 years from now. How much should he deposit now ? If interest rate is 10%.

Solutn:  $120000 * 6.1445$  (from table) = 737340.

**Discounted PBP:** while evaluating projects with DPBP method, **present values of cash flow are considered instead of cash flow itself** as in the case of PBP method. DPBP is **length of time required to recover the initial cash outflow** from the discounted future cash flow.

$$DPBP = Y_0 - (Cu.PV_0) / (CF_1),$$

$Y_0$  = is the year just before the pay back period is attained

$CuPV_0$  = cumulative present value of  $Y_0$

$CF_1$  = cash flow of pay back year

Ex: Find DPBP, if discount factor is 10%

Year	Cash flow
0	-140
1	30
2	40
3	50
4	60
5	45

$$DPBP = Y_0 - (Cu.PV_0) / (CF_1),$$

$Y_0$  = is the year just before the pay back period is attained

$CuPV_0$  = cumulative present value of  $Y_0$

$CF_1$  = cash flow of pay back year

Ex: FIND DPBP, if discount factor is 10%

Year	Cash flow	PVF	PV	CuPV
0	-140	1	-140	-140
1	30	$1/1.10=0.9$	27	-113
		$1/(1.10)^2=0.8$		
2	40	26	33.04	-79.96
3	50	0.751	37.55	-42.41
4	60	0.683	40.98	-1.43
5	45	0.621	27.945	26.515

$$\text{DPBP} = 4 + (1.43/27.94) = 4.05 \text{ yrs}$$

1	0.980	0.962	0.943	0.926	0.909	0.893	0.877	0.862	0.847	0.833	0.820	0.806	0.794	0.781	0.769
2	0.961	0.925	0.890	0.857	0.826	0.797	0.769	0.743	0.718	0.694	0.672	0.650	0.630	0.610	0.592
3	0.942	0.889	0.840	0.794	0.751	0.712	0.675	0.641	0.609	0.579	0.551	0.524	0.500	0.477	0.455
4	0.924	0.855	0.792	0.735	0.683	0.636	0.592	0.552	0.516	0.482	0.451	0.423	0.397	0.373	0.350
5	0.906	0.822	0.747	0.681	0.621	0.567	0.519	0.476	0.437	0.402	0.370	0.341	0.315	0.291	0.269
6	0.888	0.790	0.705	0.630	0.564	0.507	0.456	0.410	0.370	0.335	0.303	0.275	0.250	0.227	0.207
7	0.871	0.760	0.665	0.583	0.513	0.452	0.400	0.354	0.314	0.279	0.249	0.222	0.198	0.178	0.159
8	0.853	0.731	0.627	0.540	0.467	0.404	0.351	0.305	0.266	0.233	0.204	0.179	0.157	0.139	0.123
9	0.837	0.703	0.592	0.500	0.424	0.361	0.308	0.263	0.225	0.194	0.167	0.144	0.125	0.108	0.094
10	0.820	0.676	0.558	0.463	0.386	0.322	0.270	0.227	0.191	0.162	0.137	0.116	0.099	0.085	0.073
11	0.804	0.650	0.527	0.429	0.350	0.287	0.237	0.195	0.162	0.135	0.112	0.094	0.079	0.066	0.056
12	0.788	0.625	0.497	0.397	0.319	0.257	0.208	0.168	0.137	0.112	0.092	0.076	0.062	0.052	0.043
13	0.773	0.601	0.469	0.368	0.290	0.229	0.182	0.145	0.116	0.093	0.075	0.061	0.050	0.040	0.033
14	0.758	0.577	0.442	0.340	0.263	0.205	0.160	0.125	0.099	0.078	0.062	0.049	0.039	0.032	0.025
15	0.743	0.555	0.417	0.315	0.239	0.183	0.140	0.108	0.084	0.065	0.051	0.040	0.031	0.025	0.020
16	0.728	0.534	0.394	0.292	0.218	0.163	0.123	0.093	0.071	0.054	0.042	0.032	0.025	0.019	0.015
17	0.714	0.513	0.371	0.270	0.198	0.146	0.108	0.080	0.060	0.045	0.034	0.026	0.020	0.015	0.012
18	0.700	0.494	0.350	0.250	0.180	0.130	0.095	0.069	0.051	0.038	0.028	0.021	0.016	0.012	0.009
19	0.686	0.475	0.331	0.232	0.164	0.116	0.083	0.060	0.043	0.031	0.023	0.017	0.012	0.009	0.007

Ex: Find DPBP, if DF=10%

Year	Cash flow	PVF	PV	CuPV
0	-300	1	-300	-300
1	80	0.909	72.72	-227.28
2	80	0.826	66.08	-161.2
3	180	0.751	135.18	-26.02
4	180	0.683	122.94	96.92
5	180	0.621	111.78	208.7

$$\text{DPBP} = 3 + (26.02/180) = 3.21\text{yrs}$$

# Profitability index and NPV

**Profitability index (PI)** : PI is the **ratio of sum of cash inflows to sum of cash outflow**, a necessary condition for project to be feasible is that the PI should be more than 1.

$$PI = (\text{sum of cash inflows}) / (\text{sum of cash outflow})$$

$$\text{Net profitability index} = PI - 1$$

**NPV**: NPV is the most common approach used in the field of financial investment analysis. It is very simple to use and evaluates on the basis of **wealth maximization objective**. It is defined as the **difference b/w the present value of cash inflows and present value of cash out flows** .

**PI** : is ratio of cash inflows and outflows whereas NPV is the difference b/w them

## Advantages of NPV

1. Considers all cash flows
2. Considers time value of money
3. Computes contribution towards wealth creation
4. Allows expected changes in cost of capital

The limitation of NPV ????- pre determination of DF

**Determine PI and NPV, assuming DF as 10%, should we accept project?????????**

Year	Cash flow
0	-160
1	30
2	40
3	50
4	60
5	100

### Determine PI and NPV, assuming DF as 10%

Year	Cash flow	PVF (10%)	PV
0	-160	1	-160
1	30	0.9091	27.27
2	40	0.826	33.06
3	50	0.751	37.57
4	60	0.683	40.57
5	100	0.621	62.09
		<b>Total</b>	<b>40.97</b>

$$\text{PI} = 200.97/160 = 1.256$$

Should we accept project????

Criteria



Tangible: Rs, %, Rs/year

Intangible: (Not measurable on a well defined scale)

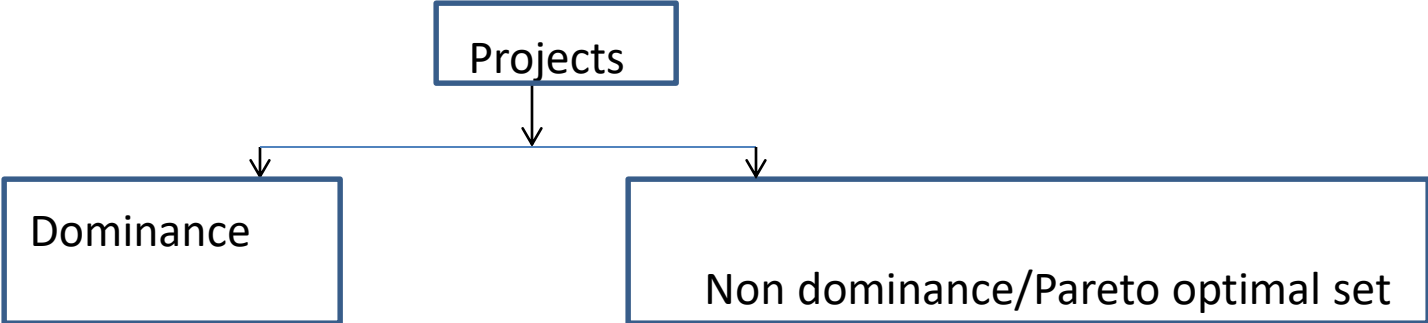


Commensurate

Incommensurate



(Not measurable – Score on a subjective scale ??????)



# Selection method: Check list (un-weighted)/ Dominance

Project	Criteria	Performance on criteria		
		High	Medium	Low
Alpha	Cost	x		
	Profit potential			x
	Time to market		x	
	Development risk			x
Beta	Cost		x	
	Profit potential		x	
	Time to market	x		
	Development risk		x	
Gamma	Cost	x		
	Profit potential	x		
	Time to market		x	
	Development risk	x		
Delta	Cost			x
	Profit potential			x
	Time to market	x		
	Development risk		x	

Maximize : which is the best project based on maximizing all the criteria?

# Simplified scoring model (weighted)

Project	Criteria	Performance on criteria		
		High	Medium	Low
Alpha	Cost	x		
	Profit potential			x
	Time to market		x	
	Development risk			x
Beta	Cost		x	
	Profit potential		x	
	Time to market	x		
	Development risk		x	
Gamma	Cost	x		
	Profit potential	x		
	Time to market		x	
	Development risk	x		
Delta	Cost			x
	Profit potential			x
	Time to market	x		
	Development risk		x	

	Weight
Cost	1
Profit potential	2
Time to market	3
Development risk	2

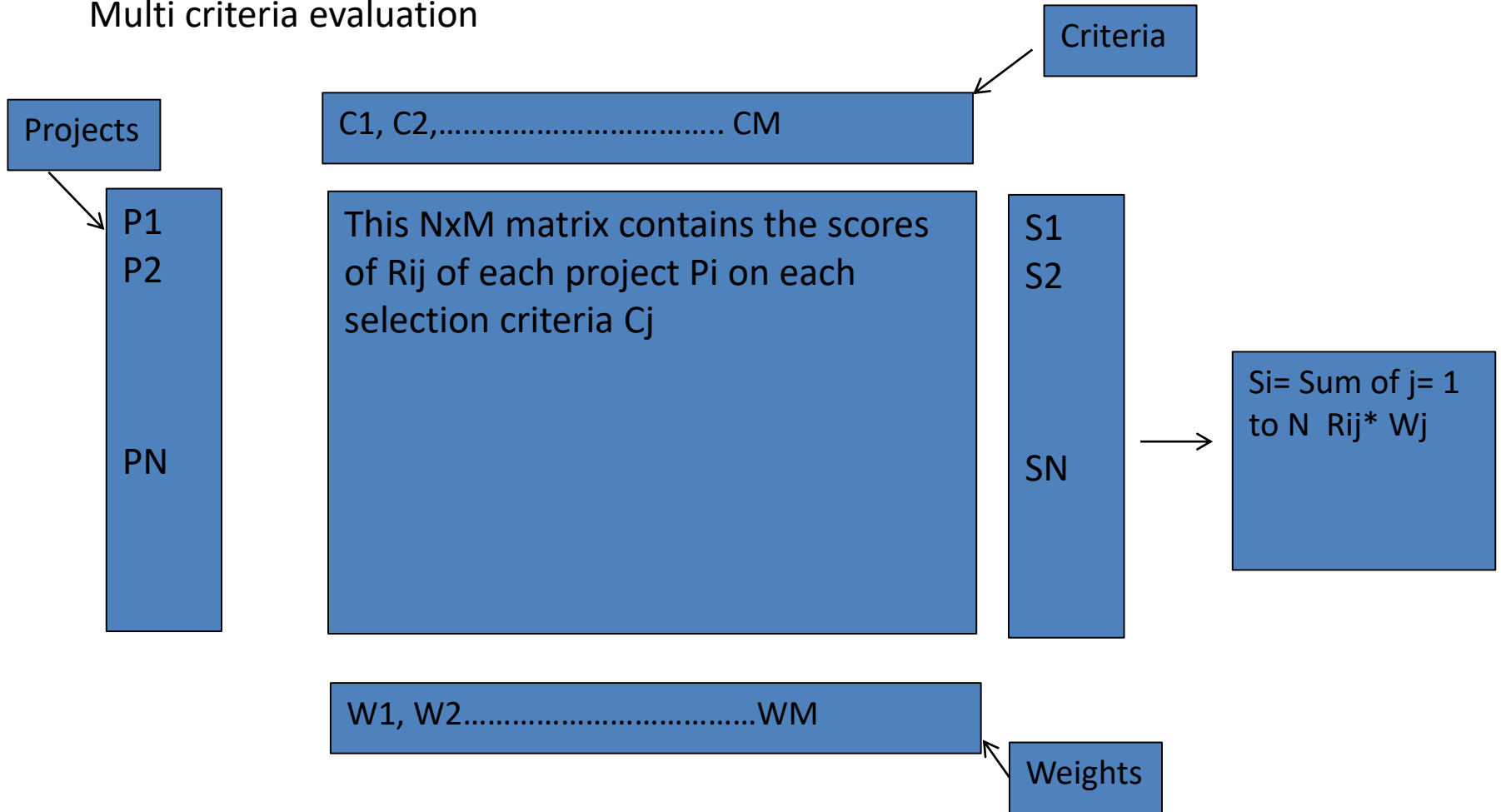
Low-1 Midium-2 High-3

# Limitations

- A scale from 1 to 3 may be intuitively appealing and easy to apply and understand, but it is not very accurate.
- From a managerial perspective, another drawback of scoring models is the fact that they depend on the relevance of the selected criteria and the accuracy of the weight given them. In other words, they do not ensure that there is a reasonable link between the selected and weighted criteria and the business objectives that prompted the project in the first place.

# Project selection: no of criteria????????

Multi criteria evaluation



# Research Methodology

## Analytic Hierarchy Process (AHP)

- Analytic Hierarchy Process is a multi-criteria decision making (MCDM) technique was developed by Saaty in 2000 year.
- The analytic hierarchy process (AHP) is also a structured technique for helping people deal with organizing and analyzing complex decisions.
- AHP is also a measurement theory that priorities the hierarchy and consistency of judgmental data provided by a group of decision makers.
- The AHP provides a comprehensive and rational framework for structuring a problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions

- i. Establish the hierarchy structure
- ii. Various hierarchies' elements weight computation
- ✓ **Establishment of pair-wise comparison matrix**
  - ✓ The relative importance of two elements is rated using a scale with the values 1, 3, 5, 7, and 9.

Equally Preferred	Moderately Preferred	Strongly Preferred	Extremely Preferred	Absolutely Preferred
1	3	5	7	9

- ✓ 2, 4, 6, and 8 indicate intermediate value.

$$A = [a_{ij}] = \begin{matrix} & C_1 & C_2 & \dots & C_n \\ C_1 & \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \end{bmatrix} \\ C_2 & \begin{bmatrix} 1/a_{12} & 1 & \dots & a_{2n} \end{bmatrix} \\ \vdots & \begin{bmatrix} \vdots & \vdots & \dots & \vdots \end{bmatrix} \\ C_n & \begin{bmatrix} 1/a_{1n} & 1/a_{2n} & \dots & 1 \end{bmatrix} \end{matrix}$$

Where  $a_{ij} = 1$  and  $a_{ij} = 1/a_{ji} = 1, 2, \dots, n$ .

$$A = [a_{ij}] = \begin{matrix} & C_1 & C_2 & \dots & C_n \\ C_1 & \begin{bmatrix} w_1/w_1 & w_1/w_2 & \dots & w_1/w_n \end{bmatrix} \\ C_2 & \begin{bmatrix} w_2/w_1 & w_2/w_2 & \dots & w_2/w_n \end{bmatrix} \\ \vdots & \begin{bmatrix} \vdots & \vdots & \dots & \vdots \end{bmatrix} \\ C_n & \begin{bmatrix} w_n/w_1 & w_n/w_2 & \dots & w_n/w_n \end{bmatrix} \end{matrix}$$

Where  $W_i / W_j = a_{ij}$

- Eigen value and eigen vector calculation

$$\lambda_{max} = \sum_{j=1}^n a_{ij} \frac{W_j}{W_i}$$

- Consistency test

$$CI \text{ (Consistency Index)} = \frac{\lambda_{max} - n}{n - 1}$$

$$CR \text{ (Consistency Ratio)} = \frac{CI}{RI}$$

✓ Random index values were already given by Saaty where

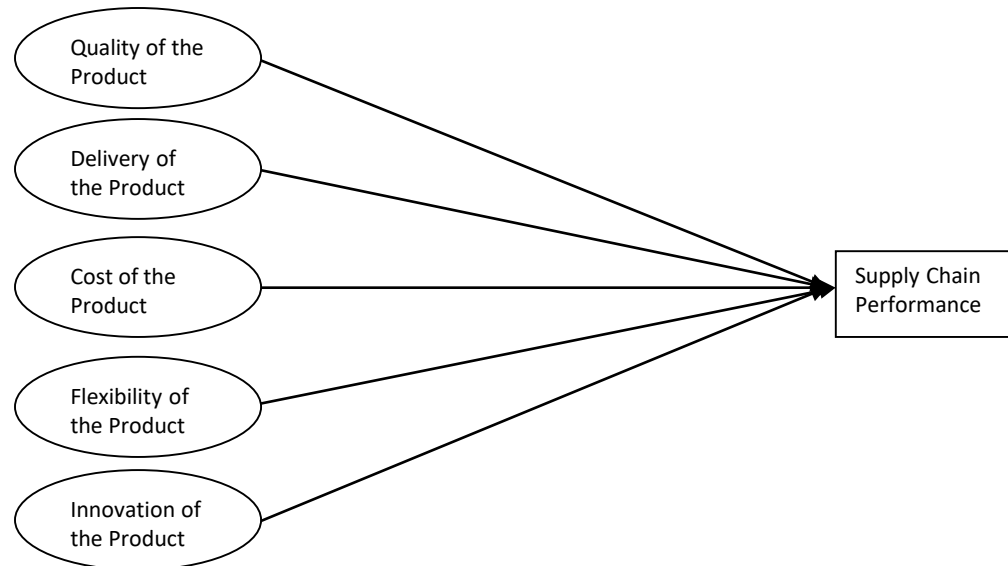
n=1	n=2	n=3	n=4	n=5	n=6	n=7	n=8
RI=0	RI=0	RI=0.52	RI=0.89	RI=1.11	RI=1.25	RI=1.35	RI=1.4

iii. Overall hierarchy weight computation

# Analysis

## Evaluation process using AHP

- Indian industry is facing tough competition both from imports and multinational companies in the domestic markets.
- Thus, the new competition is in terms of reduced cost; improved quality, products with higher performance, a wider range of products and better services, and all delivered simultaneously (Dangayach and Deshmukh, 2001).



Supply chain performance model

- The modified Delphi method has been applied to define evaluation criteria through literature review and then summarized by opinion of experts belonging to automotive industries and academia.
- To summarize these criteria; 16 experts (eight industries and eight academia) were included.

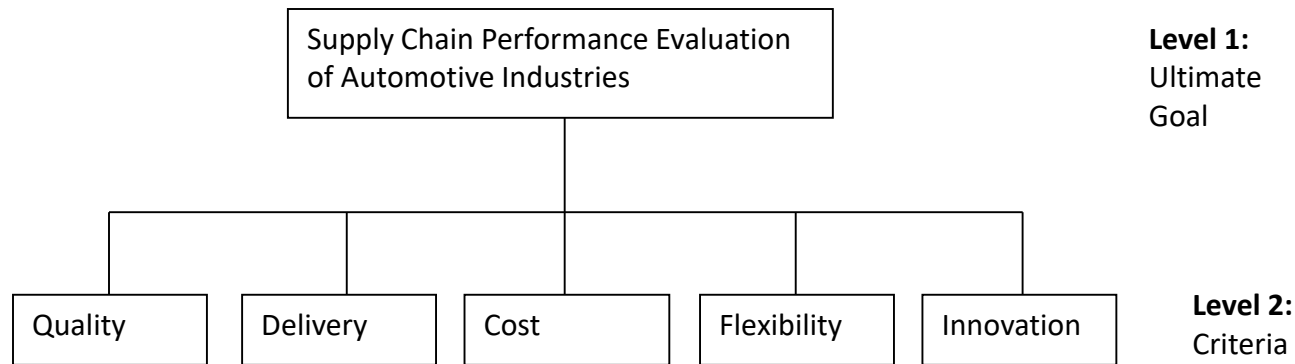


Figure 3: Hierarchical structure to evaluate the supply chain performance evaluation of automotive industries

Gaol	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>
C <sub>1</sub>	1	3	1	1/3	9
C <sub>2</sub>	1/3	1	1/3	1/5	6
C <sub>3</sub>	1	3	1	1/4	7
C <sub>4</sub>	3	5	4	1	8
C <sub>5</sub>	1/9	1/6	1/7	1/8	1

Table 1: Pair-wise comparison matrix of respondent 1 for all criteria

Respondents (R)	Eigen Value	Weights (Eigen Vector)				
		C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>	C <sub>5</sub>
R <sub>1</sub>	5.3010	0.2070	0.0936	0.1885	0.4817	0.0292
R <sub>2</sub>	5.3194	0.2674	0.0952	0.1987	0.4098	0.0290
R <sub>3</sub>	5.2745	0.2228	0.1187	0.1390	0.4867	0.0328
R <sub>4</sub>	5.3686	0.2065	0.1448	0.1248	0.4879	0.0361
R <sub>5</sub>	5.3554	0.2624	0.1297	0.0823	0.4898	0.0358
R <sub>6</sub>	5.3638	0.2960	0.1788	0.0660	0.4230	0.0362
R <sub>7</sub>	5.4447	0.2255	0.0726	0.4614	0.0490	0.1915
R <sub>8</sub>	5.4146	0.3889	0.1141	0.3887	0.0329	0.0753
R <sub>9</sub>	5.3345	0.1559	0.3374	0.2329	0.2053	0.0686
R <sub>10</sub>	5.2741	0.3079	0.1627	0.0777	0.4142	0.0376
R <sub>11</sub>	5.1311	0.3292	0.2067	0.0817	0.3436	0.0389
R <sub>12</sub>	5.3221	0.4146	0.1957	0.0770	0.2742	0.0386
R <sub>13</sub>	5.4010	0.4060	0.2080	0.0660	0.2796	0.0404
R <sub>14</sub>	5.3423	0.3784	0.3113	0.0639	0.2117	0.0347
R <sub>15</sub>	5.1955	0.2982	0.4136	0.0810	0.1696	0.0375
R <sub>16</sub>	5.3877	0.3327	0.4090	0.1225	0.0993	0.0365

Table : Eigen values and weights (eigen vectors) for criteria of all respondents

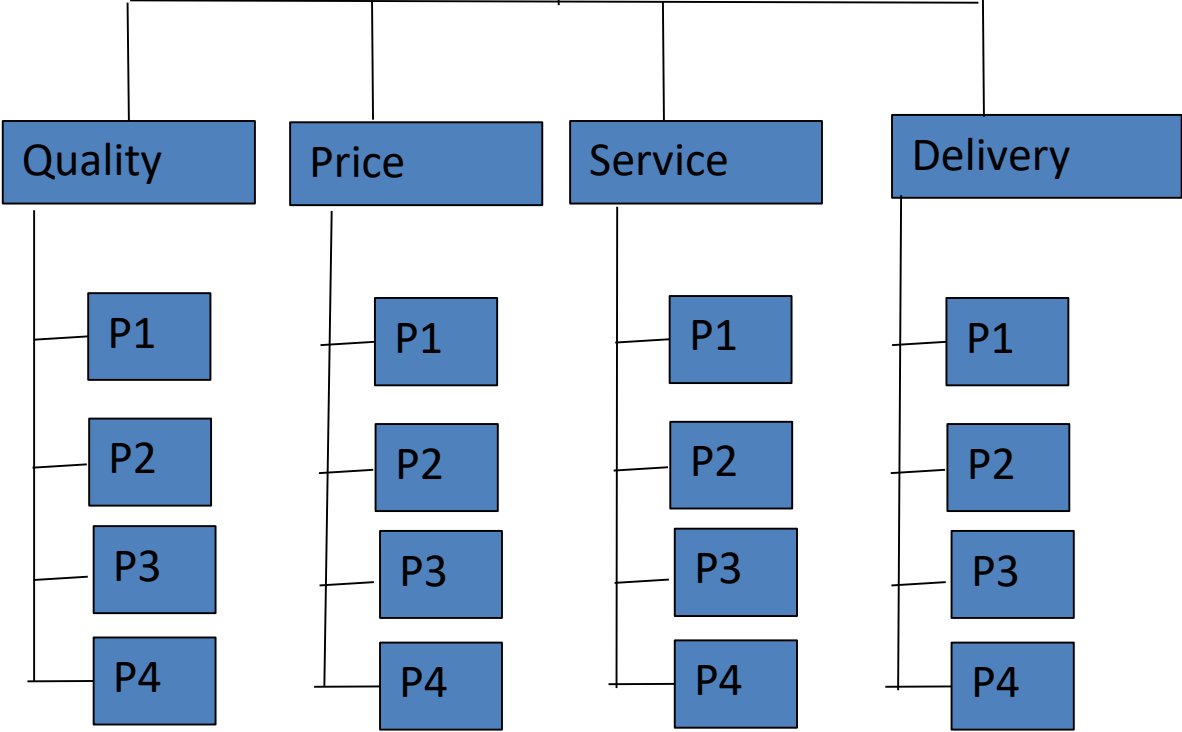
<b>Respondents</b>	<b>CI</b>	<b>CR</b>	<b>Respondents</b>	<b>CI</b>	<b>CR</b>
R <sub>1</sub>	0.07749	0.06918	R <sub>9</sub>	0.08364	0.07467
R <sub>2</sub>	0.07986	0.07131	R <sub>10</sub>	0.06853	0.06119
R <sub>3</sub>	0.06862	0.06127	R <sub>11</sub>	0.03277	0.02926
R <sub>4</sub>	0.09214	0.08227	R <sub>12</sub>	0.08052	0.07189
R <sub>5</sub>	0.08884	0.07933	R <sub>13</sub>	0.10024	0.08950
R <sub>6</sub>	0.09095	0.08120	R <sub>14</sub>	0.08556	0.07640
R <sub>7</sub>	0.11118	0.09927	R <sub>15</sub>	0.04887	0.04363
R <sub>8</sub>	0.10366	0.09255	R <sub>16</sub>	0.09692	0.08653

Table : Consistency index (CI) and consistency ratio (CR) of all respondents

<i>Criteria</i>	<i>Weights of Criteria</i>	<i>Rank</i>
Quality = C <sub>1</sub>	0.2937	2
Delivery = C <sub>2</sub>	0.1995	3
Cost = C <sub>3</sub>	0.1533	4
Flexibility = C <sub>4</sub>	0.3036	1
Innovation = C <sub>5</sub>	0.0499	5

Table : Relative weights of the criteria and global priority

Select the best project



## Pairwise comparison matrix and computations: evaluation criteria

Original matrix	Q	P	S	D
Q	1	2	4	3
P	$\frac{1}{2}$	1	3	3
S	$\frac{1}{4}$	$\frac{1}{3}$	1	2
D	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{2}$	1
Column total	$\frac{25}{12}$	$\frac{11}{3}$	$\frac{17}{2}$	9

Adjusted matrix	Q	P	S	D	Row Total	Weights (row avg.)
Q	$\frac{12}{25}$	$\frac{6}{11}$	$\frac{8}{17}$	$\frac{3}{9}$	1.829376	.457
P	$\frac{6}{25}$	$\frac{3}{11}$	$\frac{6}{17}$	$\frac{3}{9}$	1.199002	.300
S	$\frac{3}{25}$	$\frac{1}{11}$	$\frac{2}{17}$	$\frac{2}{9}$	0.550778	.138
D	$\frac{4}{25}$	$\frac{1}{11}$	$\frac{1}{17}$	$\frac{1}{9}$	0.420844	.105
				Total	4.0	1.0

# Supplier pairwise comparison matrices and priorities

## A: wrt quality

	P1	P2	P3	P4
P1	1	5	6	1/3
P2		1	2	1/6
P3			1	1/8
P4				1
Wts	.297	.08	.053	.563

## A: wrt price

	P1	P2	P3	P4
P1	1	1/3	5	8
P2		1	7	9
P3			1	2
P4				1
Wts	.303	.573	.078	.046

## A: wrt service

	P1	P2	P3	P4
P1	1	5	4	8
P2		1	1/2	4
P3			1	5
P4				1
Wts	.597	.140	.214	.050

## A: wrt delivery

	P1	P2	P3	P4
P1	1	3	1/5	1
P2		1	1/8	1/3
P3			1	5
P4				1
Wts	.151	.060	.638	.151

## Computation of weights: supplier alternatives

Adjusted matrix	Weights (row avg.)
Quality	.457
Price	.300
Service	.138
Delivery	.105

	Quality	Price	service	Delivery	wts
P1	$.457 \times .297$	$.300 \times .303$	$.138 \times .597$	$.105 \times .151$	<b>.325</b>
P2	$.457 \times .087$	$.300 \times .573$	$.138 \times .140$	$.105 \times .060$	.237
P3	$.457 \times .053$	$.300 \times .078$	$.138 \times .214$	$.105 \times .638$	.144
P4	$.457 \times .563$	$.300 \times .046$	$.138 \times .050$	$.105 \times .151$	.294

# Case Study

## Project Selection at Nova Western, Inc.

## Project Selection at Nova Western, Inc.

Phyllis Henry, vice president of new product development, sat at her desk, trying to make sense of the latest new project proposals she had just received from her staff. Nova Western, Inc., a large developer of business software and application programs, had been experiencing a downturn in operating revenues over the past three quarters. The senior management team was feeling pressure from the board of directors to take steps to correct this downward drift in revenues and profitability. Their consensus opinion was that Nova Western needed some new product ideas, and fast.

The report Phyllis was reading contained the results of a project screening conducted by two independent groups within the new product development department. After several weeks of analysis, it appeared that two top contenders had emerged as the optimal new project opportunities. One project, code-named Janus, was championed by the head of software development. The other project idea, Gemini, had the support of the business applications organization. Phyllis's original charge to her staff was to prepare an evaluation of both projects in order to decide which one Nova Western should support. Because of budget restrictions, there was no way that both projects could be funded.

The first evaluation team used a scoring model, based on the key strategic categories at Nova Western, to evaluate the two projects. The categories they employed were: (1) strategic fit, (2) probability of technical success, (3) financial risk, (4) potential profit, and (5) strategic leverage (ability of the project to employ and enhance company resources and technical capabilities). Using these categories, the team evaluated the two projects as shown here. Scores were based on: 1 = low, 2 = medium, and 3 = high.

### Project Janus

Category	Importance	Score	Weighted Score
1. Strategic Fit	3	2	6
2. Probability of technical success	2	2	4
3. Financial risk	2	1	2
4. Potential profit	3	3	9
5. Strategic leverage	1	1	1
			Score = 22

### Project Gemini

Category	Importance	Score	Weighted Score
1. Strategic Fit	3	3	9
2. Probability of technical success	2	2	4
3. Financial risk	2	2	4
4. Potential profit	3	3	9
5. Strategic leverage	1	2	2
			Score = 28

The above results seem to suggest that Project Gemini is the choice for the next new project. However, Phyllis was also presented with an NPV analysis of the two projects by her second team of evaluators. Assuming a required rate of return of 15% and anticipated inflation

*(continued)*

rate of 3% over the lives of the two projects, their findings are shown as follows:

### Project Janus

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Initial investment = \$250,000

Life of the project = 5 years

Anticipated stream of future cash flows:

Year 1 = \$50,000

Year 2 = 100,000

Year 3 = 100,000

Year 4 = 200,000

Year 5 = 75,000

Calculated NPV = \$60,995

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### Project Gemini

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Initial investment = \$400,000

Life of the project = 3 years

Anticipated stream of future cash flows:

Year 1 = 75,000

Year 2 = 250,000

Year 3 = 300,000

Calculated NPV = \$25,695

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The analyses of the two projects by different means had yielded different findings. The scoring model indicated that Project Gemini was the best alternative, and the financial screening favored the higher project NPV of Project Janus. Phyllis was due to present her recommendations to the full top management team this afternoon, seemingly armed with more questions than answers.

### Questions for Discussion

1. Phyllis has called you into her office to help her make sense of the contradictions in project evaluation. How would you explain the reasons for this divergence of opinion from one technique to the next? What are the strengths and weaknesses of each screening method?
2. Choose the project that you feel, based on the above analysis, Nova Western should select. Defend your choice.
3. What does the above case suggest to you about the use of project selection methods in organizations? How would you resolve the contradictions found in this example?