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Project Management for Managers

Lec – 01

Introduction of Project Management

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Project Management Fundamentals

Project evaluation methods

Project Integration and scope Management

Project Planning and Scheduling

Project networking

PERT/CPM techniques

Project scheduling with resources

Project risk management

Project contract and materials management

Cost management and Cost estimation

Quality Assurance and Quality Control

Computer Based Project Management



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Project Management Course Objectives:

- To understand the importance of project management in today's world.
- To establish the importance of projects in implementing organization strategy
 - To understand the rules for creating a Work Breakdown Structure for a project
 - To demonstrate the importance of WBS to the management of projects and how it serves as a database for planning and control
 - To develop a network diagram for a project



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- To understand why estimating project times and costs are the foundation for project planning and control
- To understand the intricacies of project earned value analysis
- To illustrate approaches for risk identification, analysis, and assessment
- To understand the procurement process and the risks involved in different contracts
- To identify key characteristics of a high-performance project team
- To understand the critical success factors in project management
- To understand project closure process



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- 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.



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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 pooled together to in a **temporary organization** to serve **specific purpose**.



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What is project success??

A project is “a temporary endeavor undertaken to create a unique product, service, or result.”

Operations is work done to sustain the business.

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.



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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 *heterogeneous*
 - ◊ *Non-repetitive*
 - ◊ Requires *multiple resources* from a finite resource pool



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- Fixed set of objectives
- Team work
- Life cycle
- Made to order
- Multi skilled staff required
- Subcontracting
- Risk and uncertainty



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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.



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SMART project

- Specific: project should be targeting specific aim or goal.
- Measurable: It should be **quantifiable**.
- Attainable: It should be attainable with resources available.
- Realistic: It should be realistic in nature, dreaming is fine, but we certainly can not manage the dreams. We need some real things to be managed.
- Time-limited: As mentioned earlier there is fixed time limit for any project.



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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



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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**



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Process & Project Management

Process

1. Repeat process or product
2. Several objectives
3. On-going
4. People are homogeneous
5. Systems in place
6. Performance, cost, & time known
7. Part of the line organization
8. Bastions of established practice
9. Supports status quo

Project

1. New process or product
2. One objective
3. One shot – limited life
4. More heterogeneous
5. Systems must be created
6. Performance, cost & time less certain
7. Outside of line organization
8. Violates established practice
9. Upsets status quo



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	Project Management	Operations Management
Repetition	Non repetitive	Repetitive
Work force required	Multi-skilled or very highly specialized for short durations	Limited skills, a huge learning effect
Revenues	No revenues	Revenues and profit/losses
Objective	Scope, performance, time, cost	Profits generated, cost reduced, quality of products or services
Equipments needed	Special purpose equipments for a short durations	Same equipments are continuously used
Subcontracting	Essential, involves many subcontracting agencies	Generally avoid use of subcontracting agencies
Risk	Very high risk as generally no chance of recursion	Risk is less as chances of improvement always there



	Project Management	Operations Management
Duration	Fixed, ceases with attainment of objective	Continuous in nature, ceases in special situations like divestment.
Improvement	Radical improvement to face the existing competitor	Incremental improvement to reduce cost or add to value
Major impact	future	present
goal	Creation of new thing	Maintenance of existing thing



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What is project management??

Project management is “the application of knowledge, skills, tools, and techniques (KSTT) to project activities to meet project requirements.”*



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Project Management

- Project Management are the management activities of **planning, directing, and controlling resources** (???????) to meet the technical, cost, and time **constraints** of a project.



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Importance of PM?????



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Importance of PM??????

Fast technological changes: Electronic goods

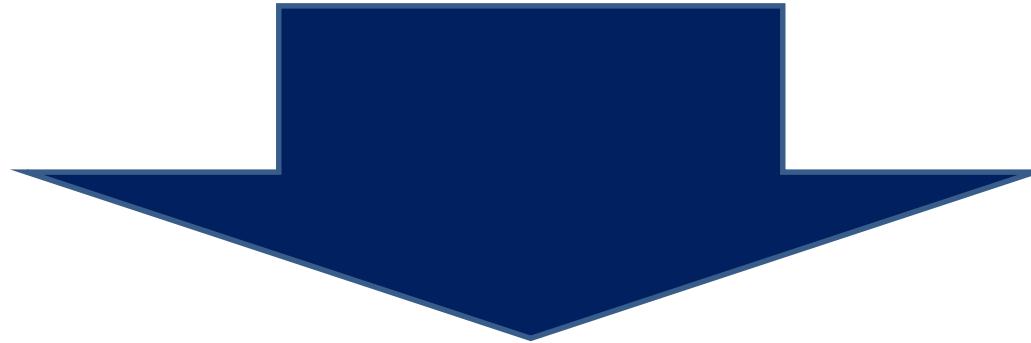
Narrow product launch windows:

High entropy of system: Expansion

Short life cycle of products: s/w,mobile.

Globalization impact: BRICS

Large organizations:



Customer focus



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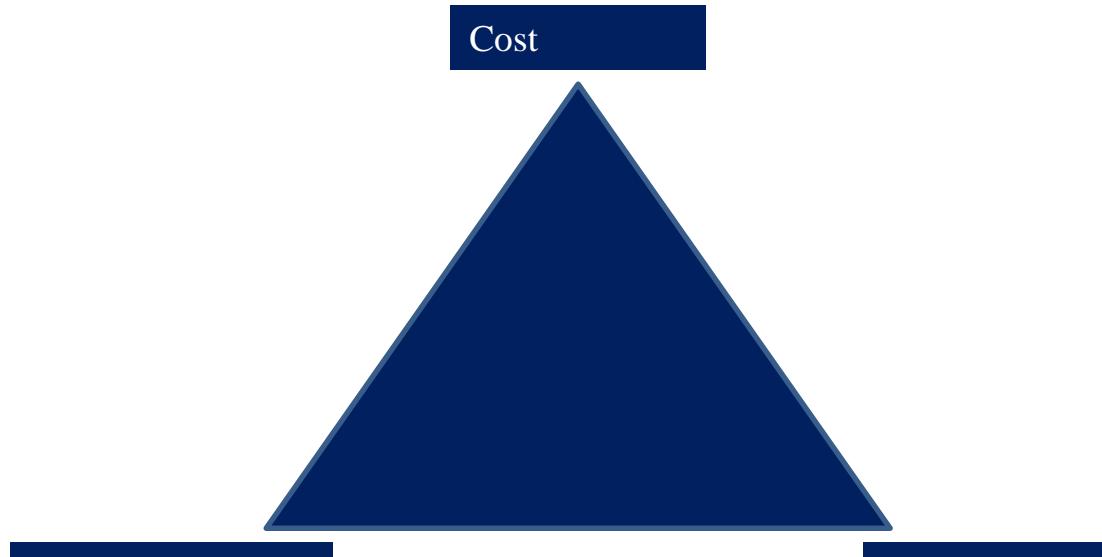
Project Success

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Determinants of project success?????



Iron triangle

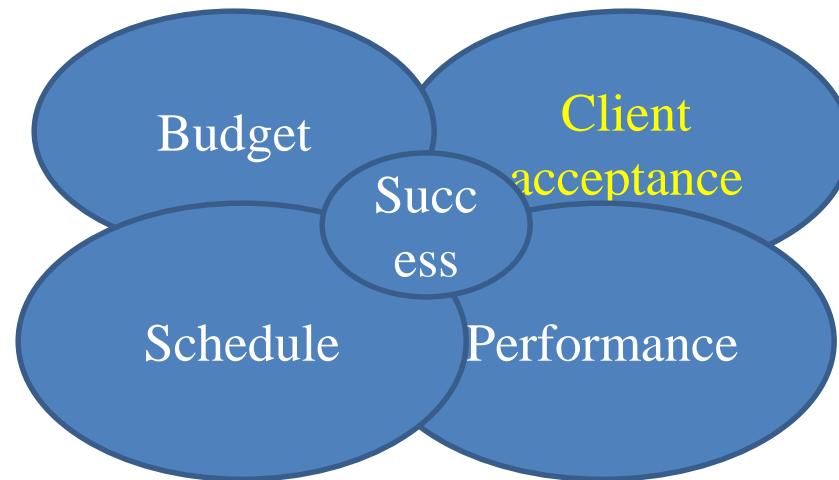


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The new quadruple approach



Objectives of PM/ Determinants of project success

1. **Scope**-cricket, badminton, tennis players have boundaries. People live in slums (No of family, no of family members, their income, etc) .
2. **Performance (technical)**- Water treatment plant- to clean 10000 lts/day.
3. **Time**- a project has fixed time, completion should be in time.
4. **Cost/ Budget**- $f(P,T,S)$
5. **Client acceptance**



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Key indicators of IT project success ???????

- 1. System quality-** easy to use, and they supply quality information.
- 2. Information quality-** the information generated by the implemented IT project must be the info required by users and be of significant quality **that it is ‘actionable’**.
- 3. Use-** IT system must be, problem solving, decision aiding, and networking mechanism.
- 4. User satisfaction-** team must determine user satisfaction.
- 5. Individual impact-** is decision making faster and more accurate. Is info. more retrievable and more affordable, and assimilated.
- 6. Organisational impact-** positive impact on entire organization.

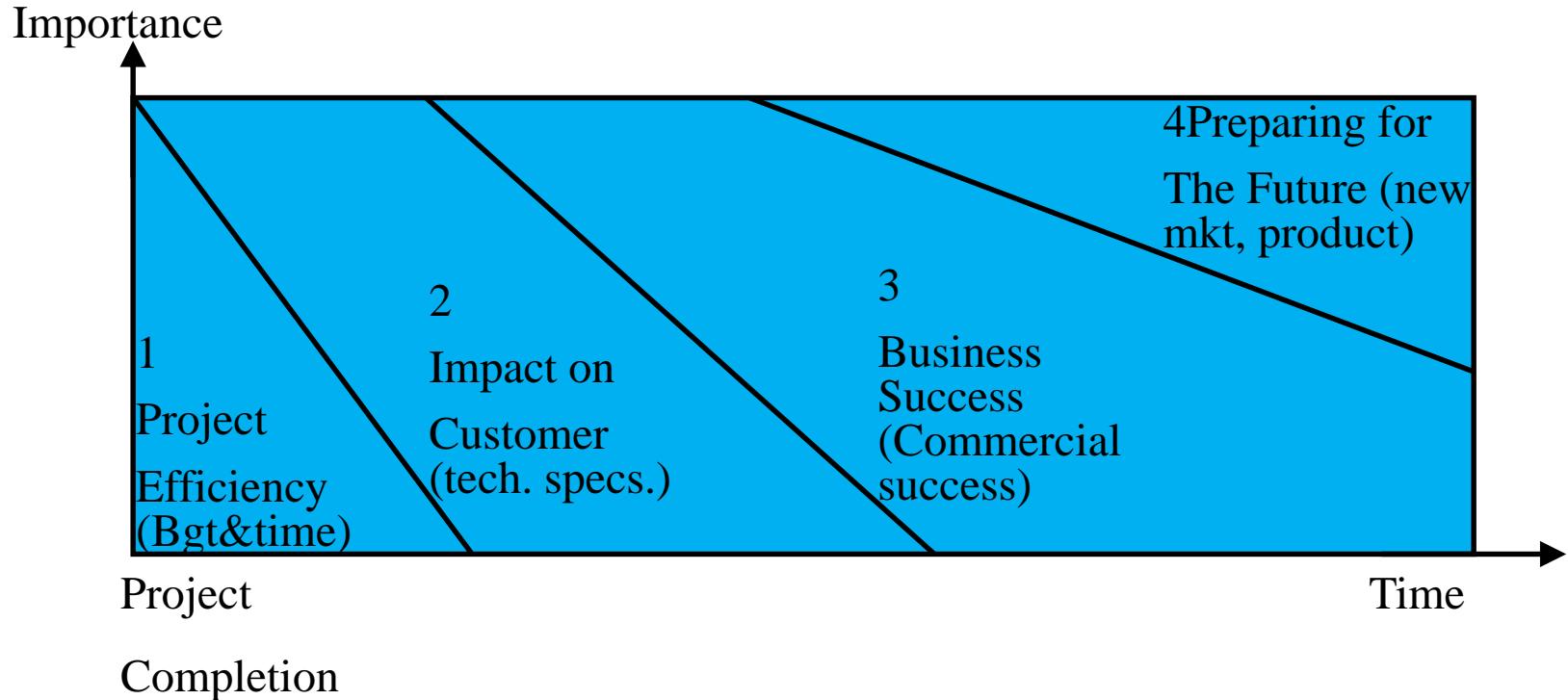


Information Technology Project “Success”

- Software & hardware projects **fail at a 65% rate**
- Over **half of** all IT projects become **runaways**
- Up to **75%** of all software projects are **cancelled**
- Average **cost overrun is 45%**; schedule overrun **is 63%**; with only 67% of originally contracted features
- **47%** of IT projects delivered but not used, **29% paid for but not delivered**; **19% abandoned**



Four Dimensions of Project Success



Benefits (organization)

Improved efficiency

Improved effectiveness

Increased profit

Strategic goals

Organization learning

Reduced waste



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Benefits (stakeholders)

Satisfied users

Social and environmental impact

Personal development

Professional learning

Capital supplier

Project team

Impact on surrounding community



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Understanding success criteria

Iron triangle	Information system	Benefits (organization)	Benefits (stakeholders)
Cost	Maintainability	Improved efficiency	Satisfied users
Quality	Reliability	Improved effectiveness	Social and environmental impact
Time	Validity	Increased profit	Personal development
	Information Quality	Strategic goals	Professional learning
	Use	Organization learning	Capital supplier
		Reduced waste	Project team
			Impact on surrounding community



Project Management Maturity Model (PMMM):

PMMM allow an organization to benchmark the best practices of successful PM firms.



Developing Project Management Maturity

Project management maturity models: 4 models

- SEI's (Software Engineering Institute –Carnegie Mellon University) capability maturity model integration
- Center for business practices
- Kerzner's project management maturity model
- ESI (Education Service Institute) International's project framework



Development of PM maturity

PMMM allow an organization **to benchmark the best practices of successful PM firms**

Level of sophistication is different - practices (Boeing, L&T)

Purpose of Benchmark- process improvements of project delivery

New organizations – where to start?

MM – provide necessary frame work to first, **analysis and evaluate** current practices, and second **compare them** with chief competitor ?

Industry standards, and third, define a **systematic route** for improving these practices



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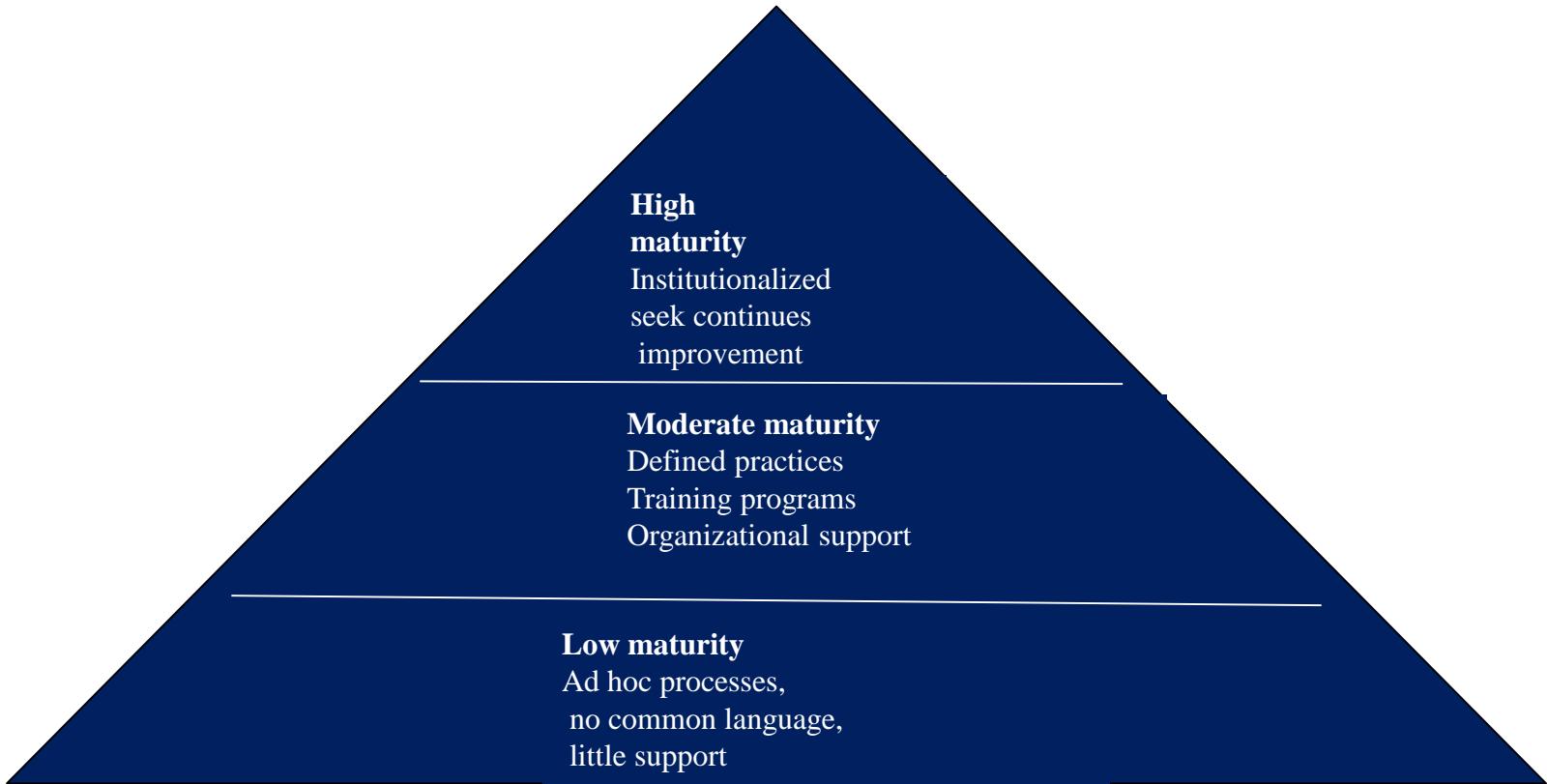


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MM- continuous improvement in practices, MM offer the **template** for defining and then achieving such a **progressive improvement**.

MM charts both – set of **standards** currently accepted and as well as **process** for achieving significant movement towards these benchmarks.





Success is contextual: Depends on

- (1) Strategy
- (2) Structure
- (3) Organizations' culture

What is strategy: ??????????????



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Project and organizational strategy: (strategic mgt) SM is the science of:

**Formulating,
Implementing and,
Evaluating cross functional decisions** that enable them to achieve its **Objectives.**



SM consists of

Developing vision statement and mission statement: where you want to be.

Formulating, implementing, and evaluating: based on SWOT, and resources.

Making cross functional decisions: All the departments.

Achieving objectives: market leadership through cost, innovative product, superior quality, other means.



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Projects Reflect Strategy

Projects are *stepping stones* of corporate strategy

The firm's strategic development is a *driving force* behind project development

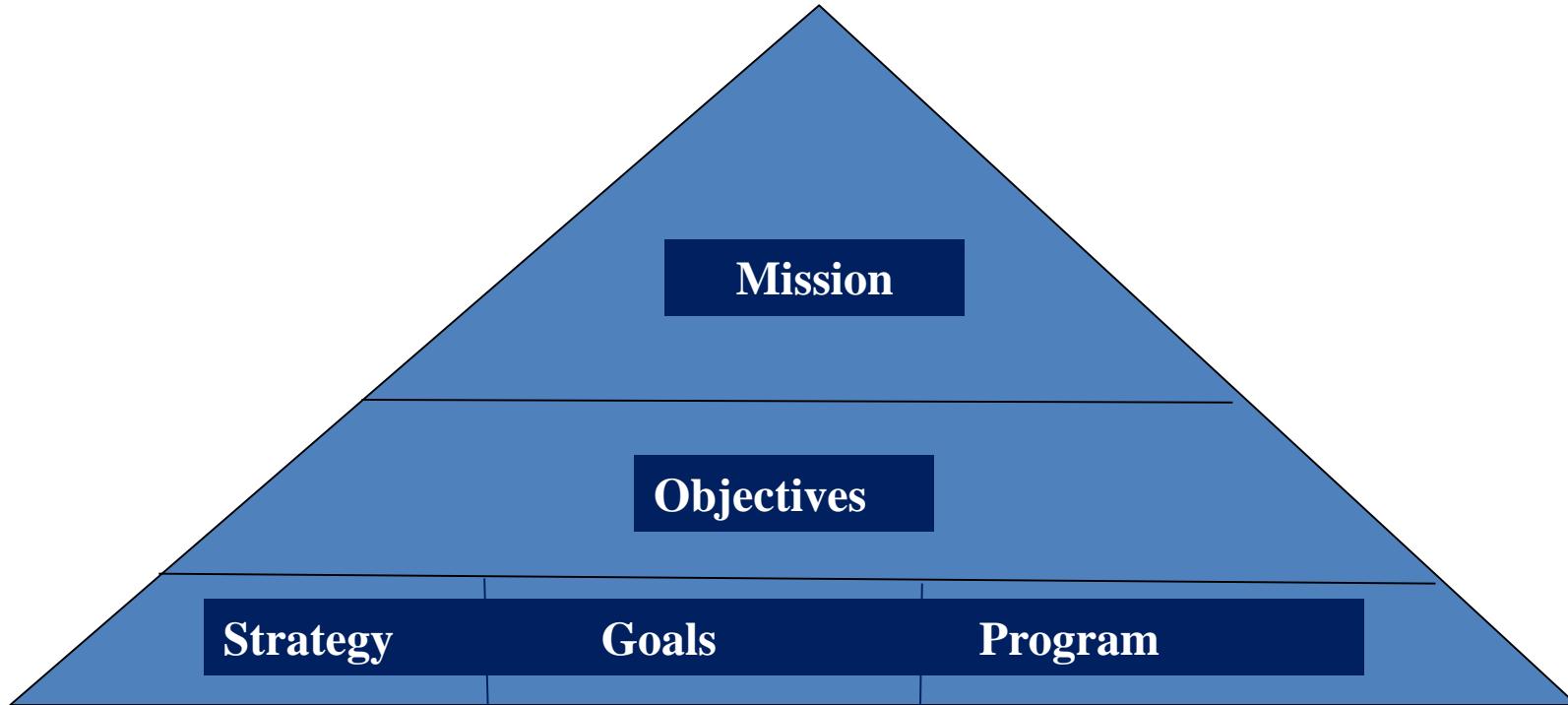
Some examples include:

A firm wishing to...	...may have a project
redevelop products or processes	to reengineer products or processes.
changes strategic direction or product portfolio configuration	to create new product lines.
improve cross-organizational communication & efficiency	to install an enterprise IT system.

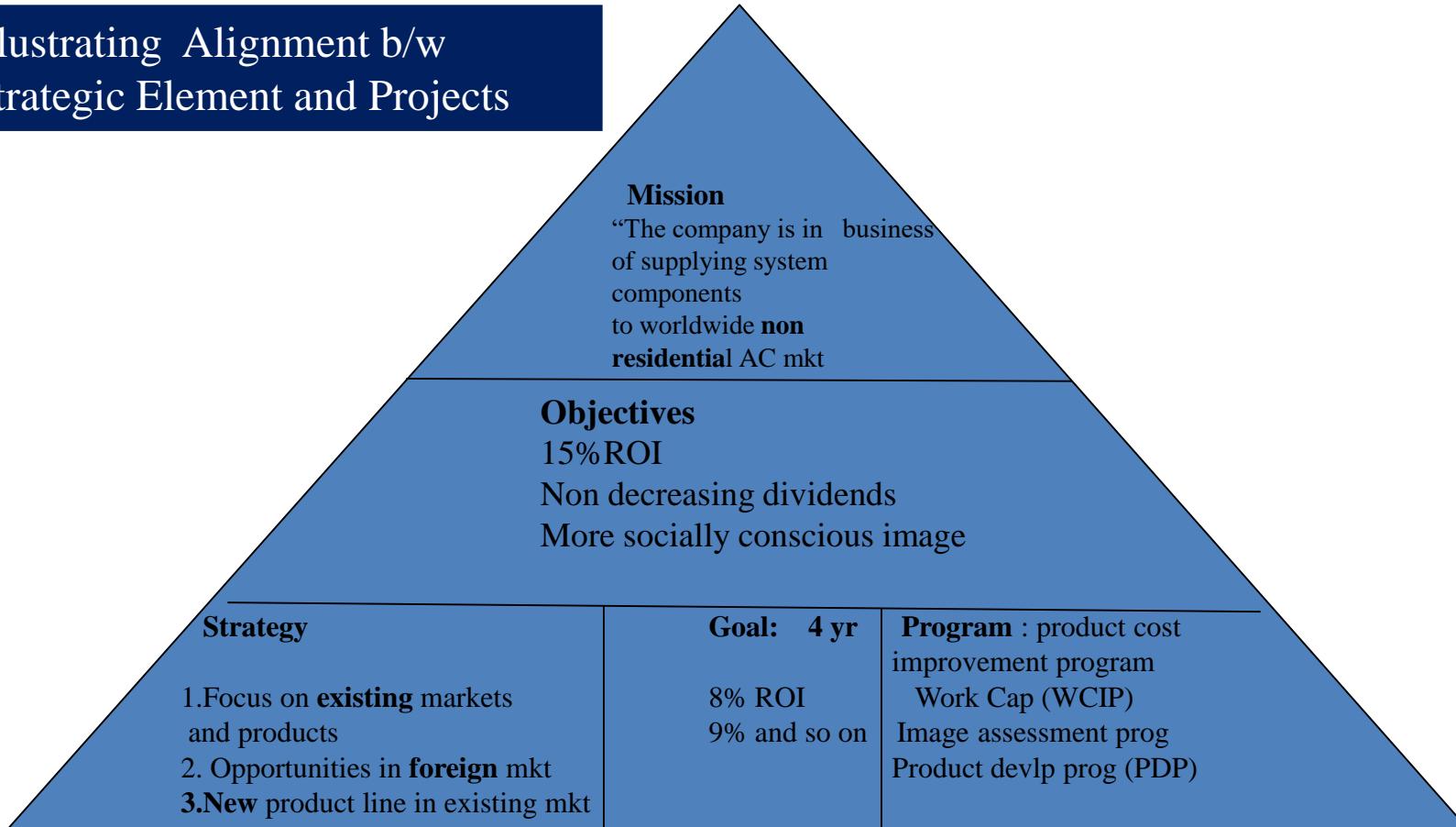


Strategy	Project
Redevelopment of products for greater mkt. share	R E P
New business processes for greater streamlining	REP
Creation of new strategic alliances	SCM
Improving cross org. communication	???
New distribution strategy	???





Illustrating Alignment b/w Strategic Element and Projects





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Types of Structure Organizations

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Work Breakdown Structure

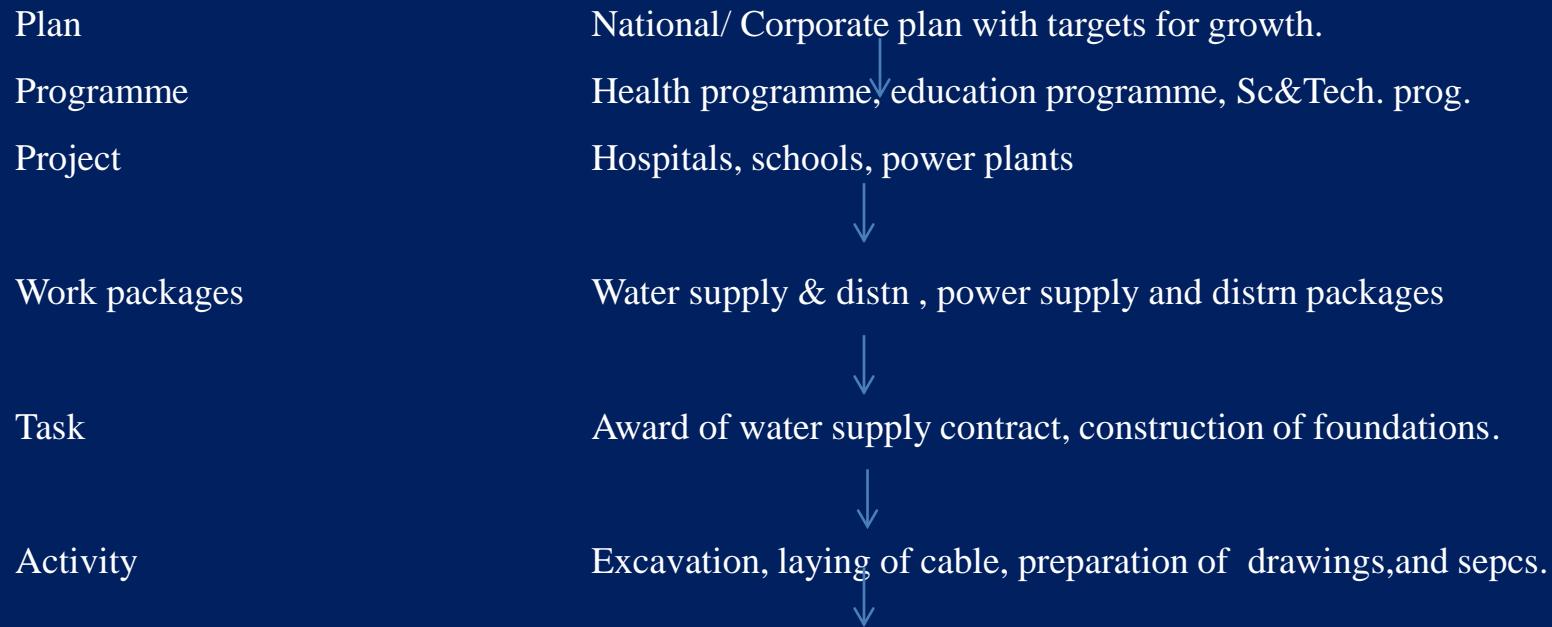
- ✓ Hierarchical organization of work to be done on a project
- ✓ Project broken down into modules
- ✓ Modules subdivided into subcomponents, activities, and tasks
- ✓ Identifies individual tasks, workloads, and resource requirements



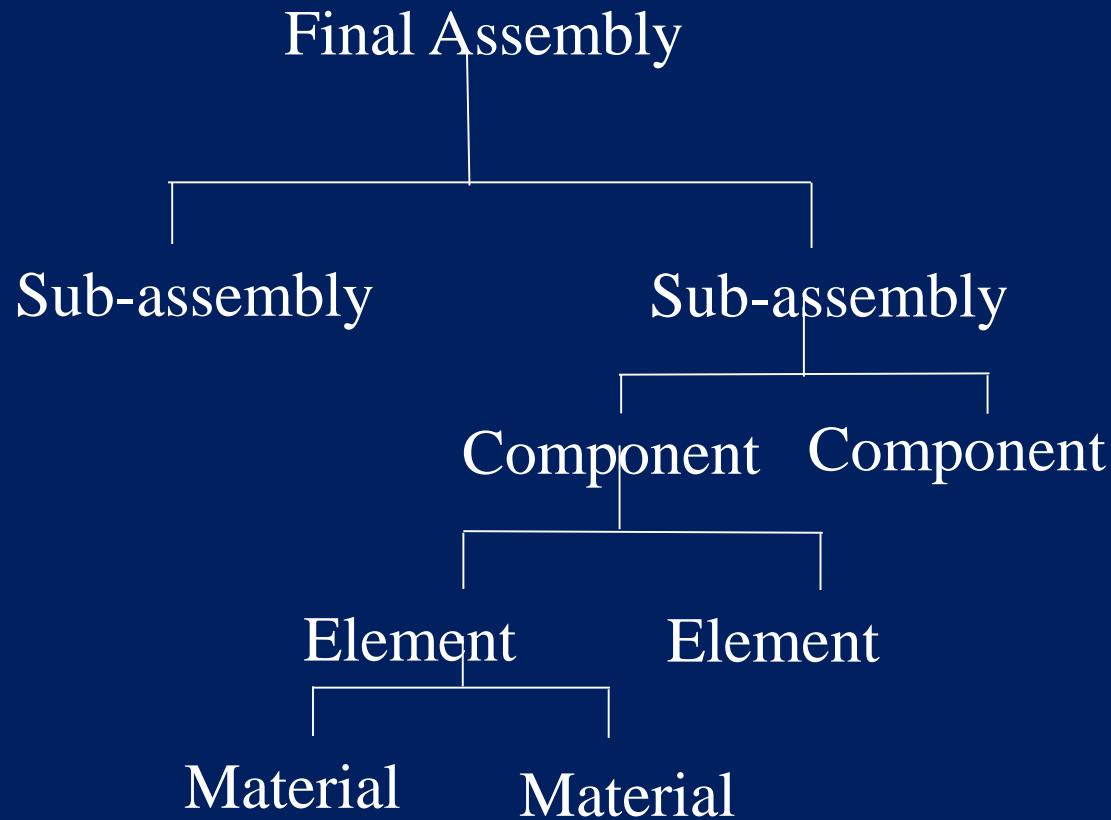
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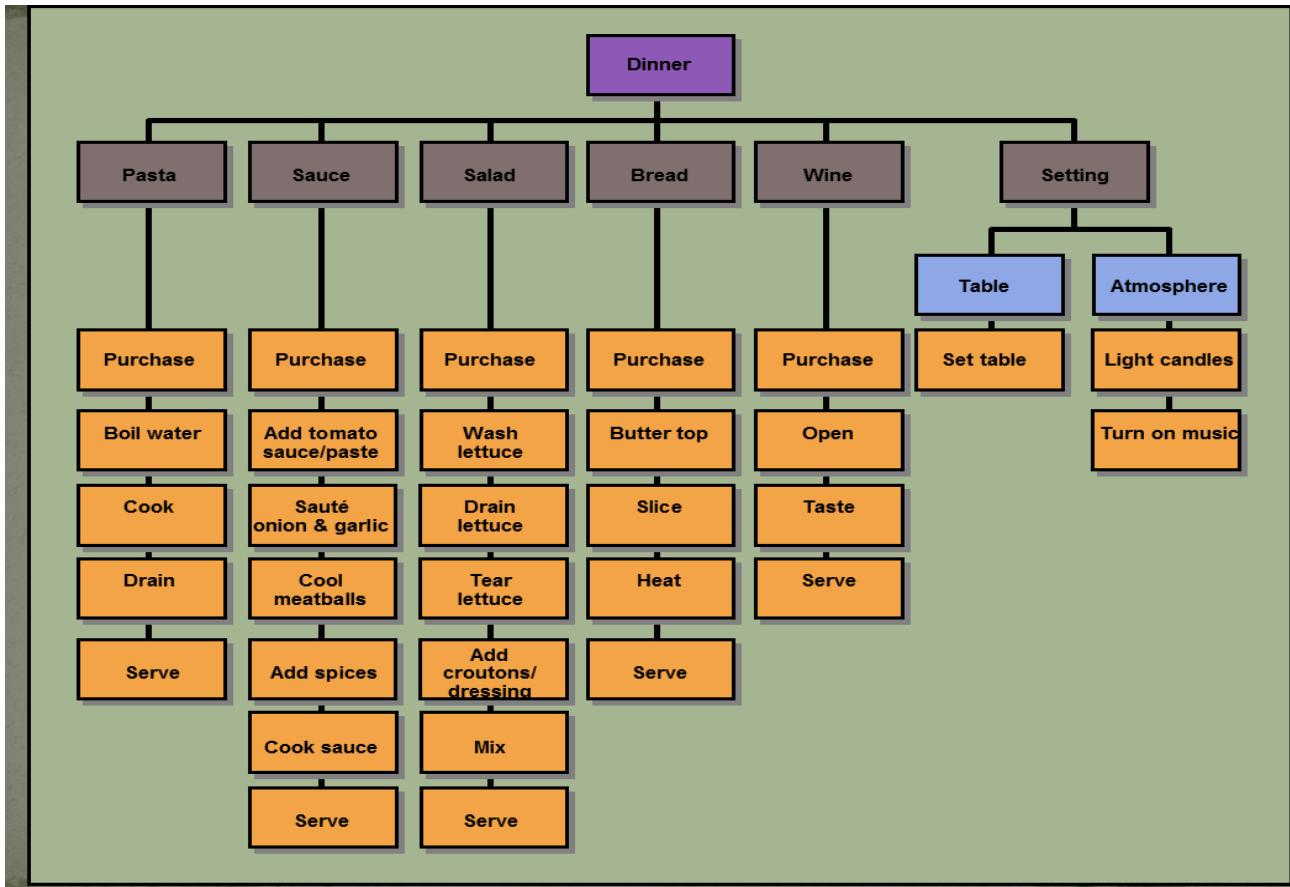


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Project Family Tree





Organization structure consists of three key elements

- 1. Organizational structure (OS) designates formal reporting relationship, including no of levels, span of control of managers and supervisors.**
- 2. OS identifies the grouping together of individuals into departments and departments into total origination.**
- 3. OS includes the design of systems to ensure effective communication, coordination, and integration of efforts across departments.**



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Forms of organizational structure

Internal and external organization environment?

Functional organization: grouping people performing similar activities into departments

Project organization: grouping people into project teams on temporary assignments

Matrix organization: companies are structured by creating a dual hierarchy in which functions and project have equal prominence.

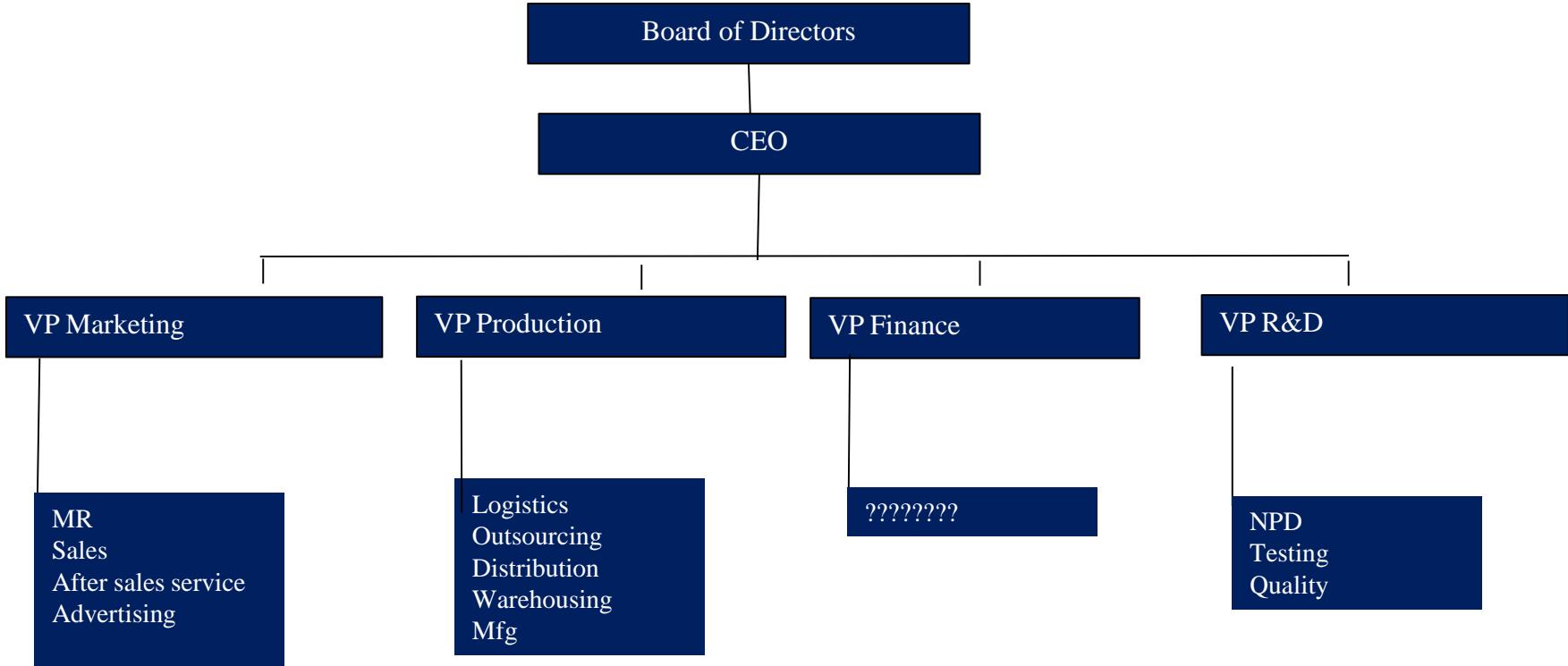


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Functional organization

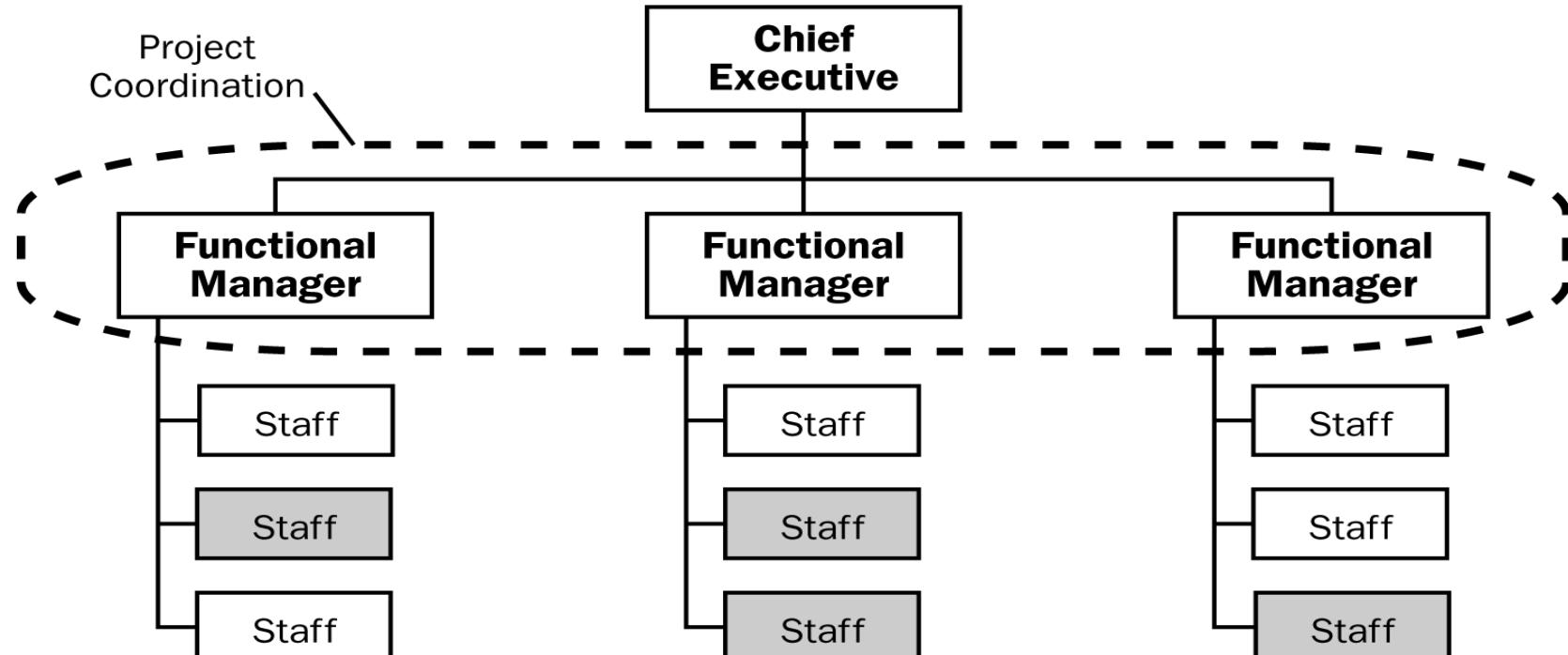


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Functional Organization



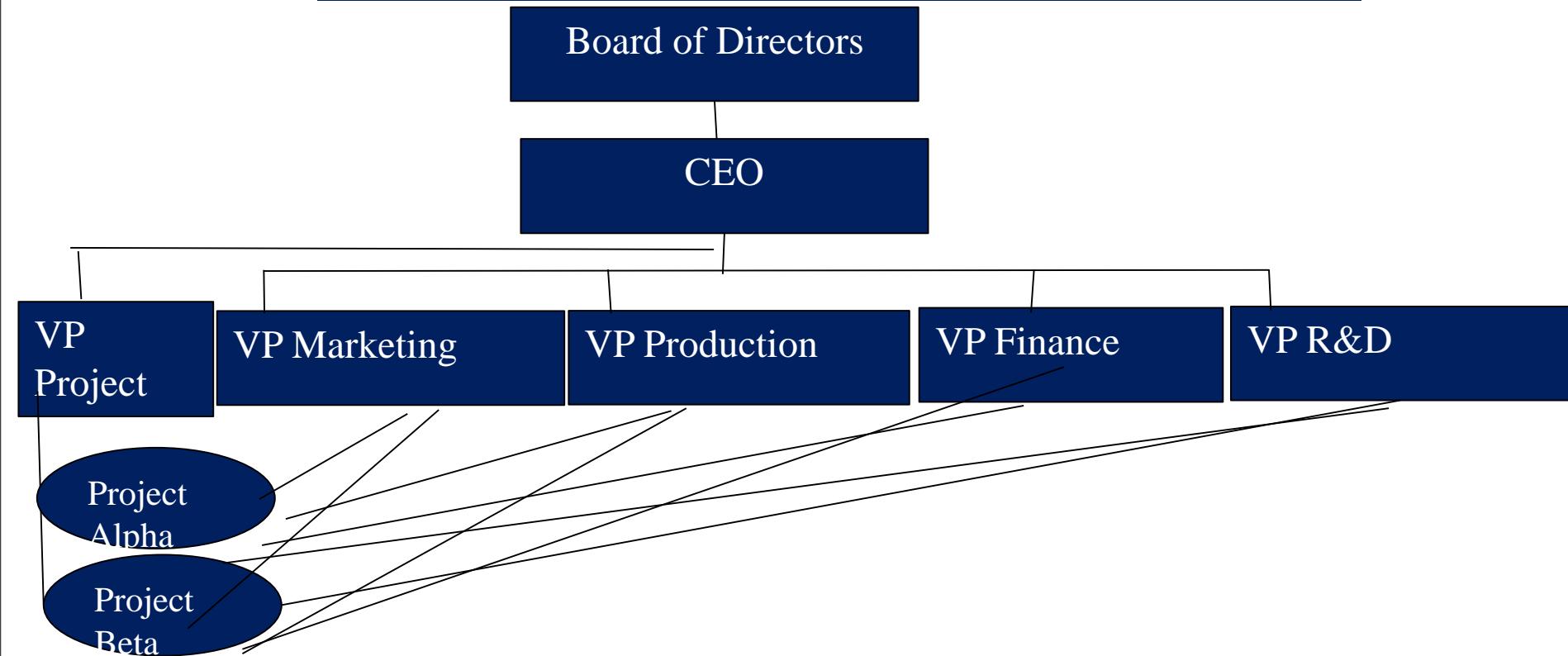
(Gray boxes represent staff engaged in project activities.)

Functional organization

Strengths	Weaknesses
No change is required in firm's design	Siloing – difficult to achieve cross functional cooperation
Enables the development of in-depth knowledge	Lack of customer focus
Allows for standard career paths	Long time – due to structure problems, lack of ownership , slower communication
	Project may be sub optimize due to varying interest or commitment



Project organization

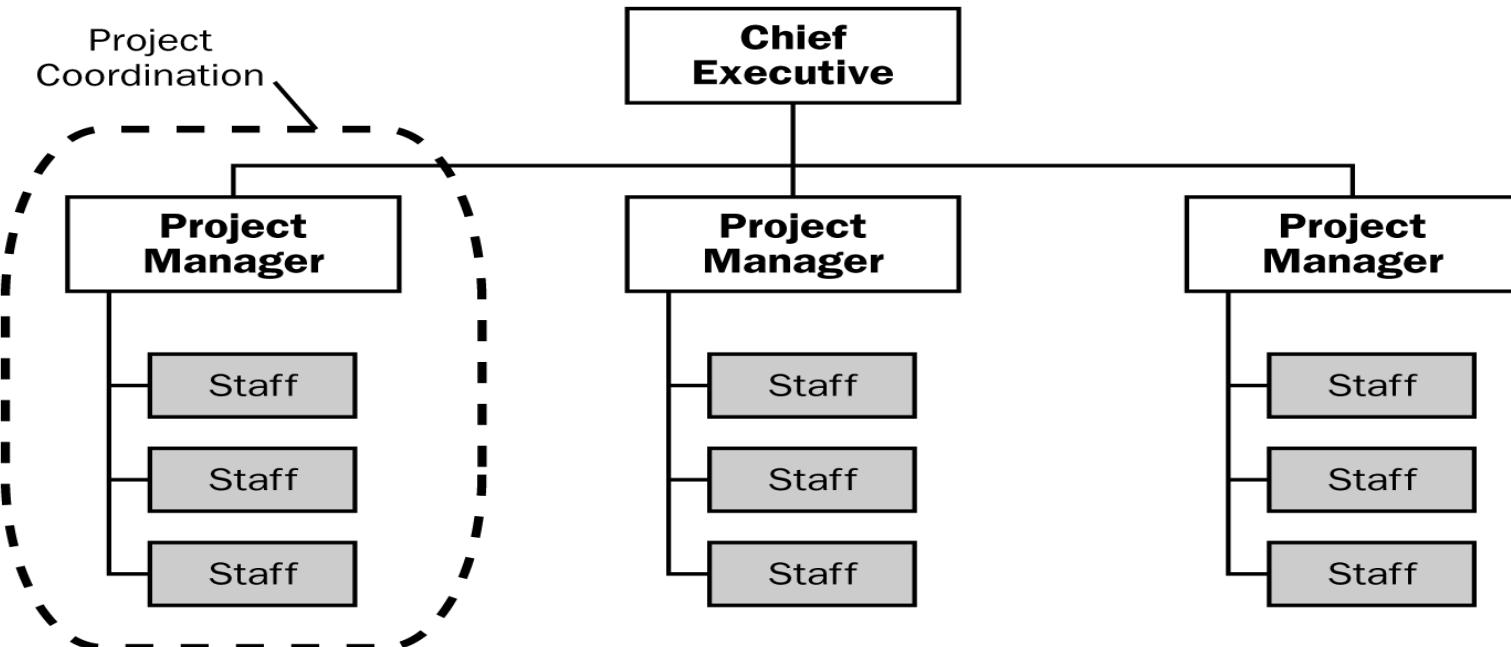


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Project Organization



(Gray boxes represent staff engaged in project activities.)



Project organization

Strengths?????

Weaknesses????



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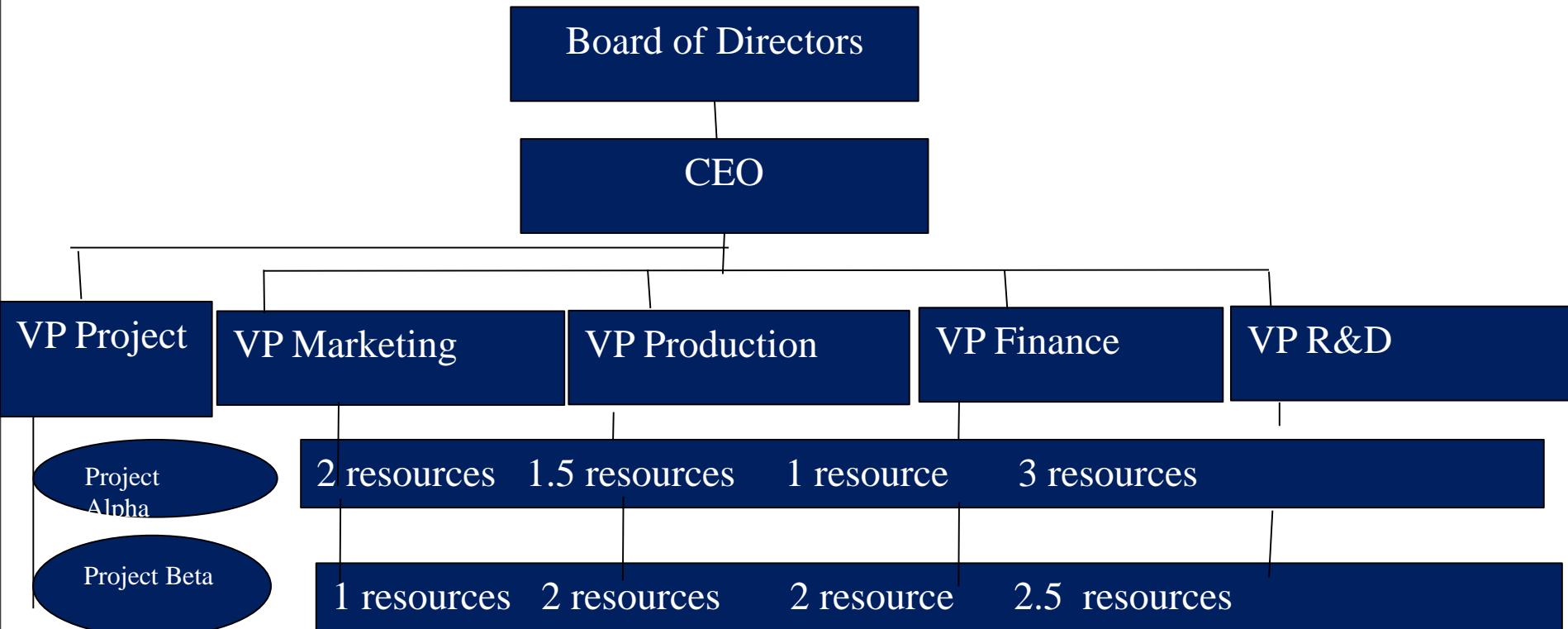
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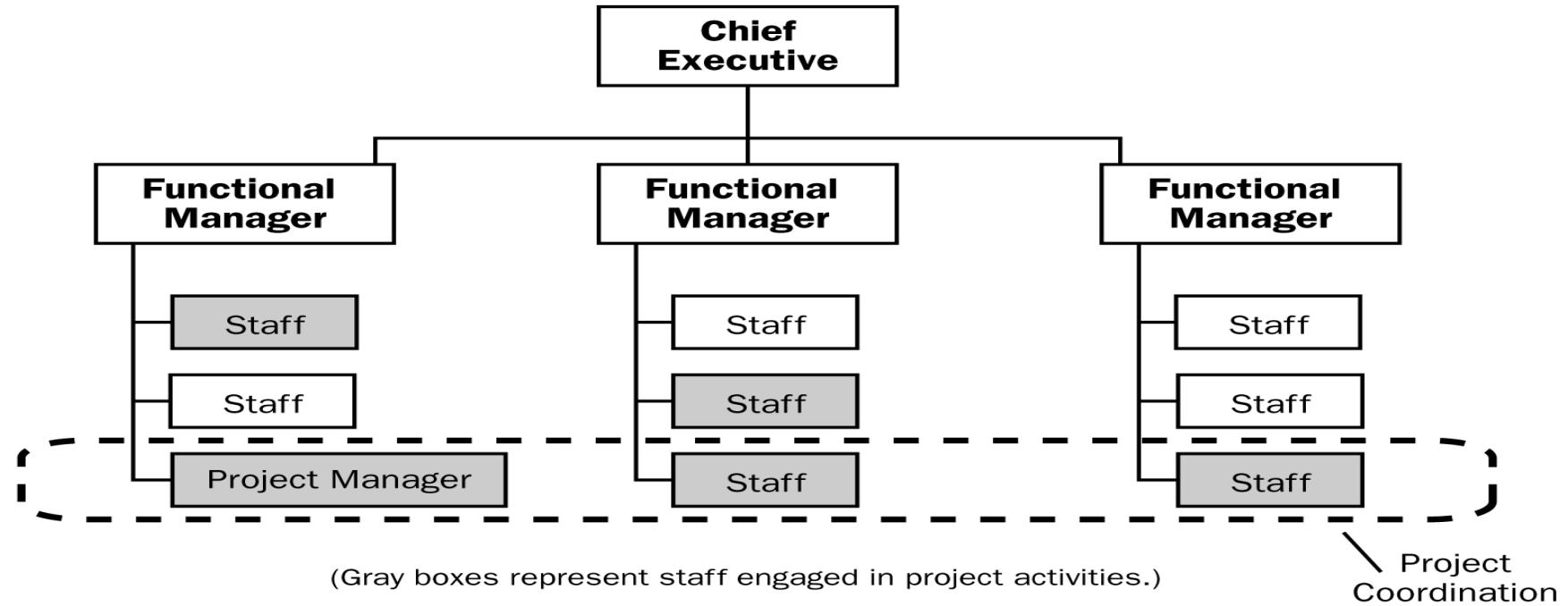
Project organization

Strengths	Weaknesses
Assign authority to solely project manager	Setting up of maintaining teams can be expensive
Improved communication – across functions	Loyalty to project not to organizations
Effective and speedy DM	Difficult to maintain pool of intellectual capital
Promotes creation of cadres of PM experts	Concern @ future after project gets over
Rapid response to market	



Matrix: We create a dual authority where there is a balance b/w functional and pure project origination, VP projects deals with CEO and other VPs





Balanced Matrix Organization



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Matrix

Strengths???????

Weaknesses?????



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Matrix

Strengths	Weaknesses
Suited to dynamic environment	Two bosses
Emphasizes the dual importance of project management and functional efficiency	Sometime difficult to share resources
Promotes coordination across functions	Frustrating – caught b/w project and functional requirements
Use of scares resources on competing basis	



Project Characteristics	Organization Structure	Functional	Matrix			Projectized
			Weak Matrix	Balanced Matrix	Strong Matrix	
Project Manager's Authority	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total	
Resource Availability	Little or None	Limited	Low to Moderate	Moderate to High	High to Almost Total	
Who controls the project budget	Functional Manager	Functional Manager	Mixed	Project Manager	Project Manager	
Project Manager's Role	Part-time	Part-time	Full-time	Full-time	Full-time	
Project Management Administrative Staff	Part-time	Part-time	Part-time	Full-time	Full-time	

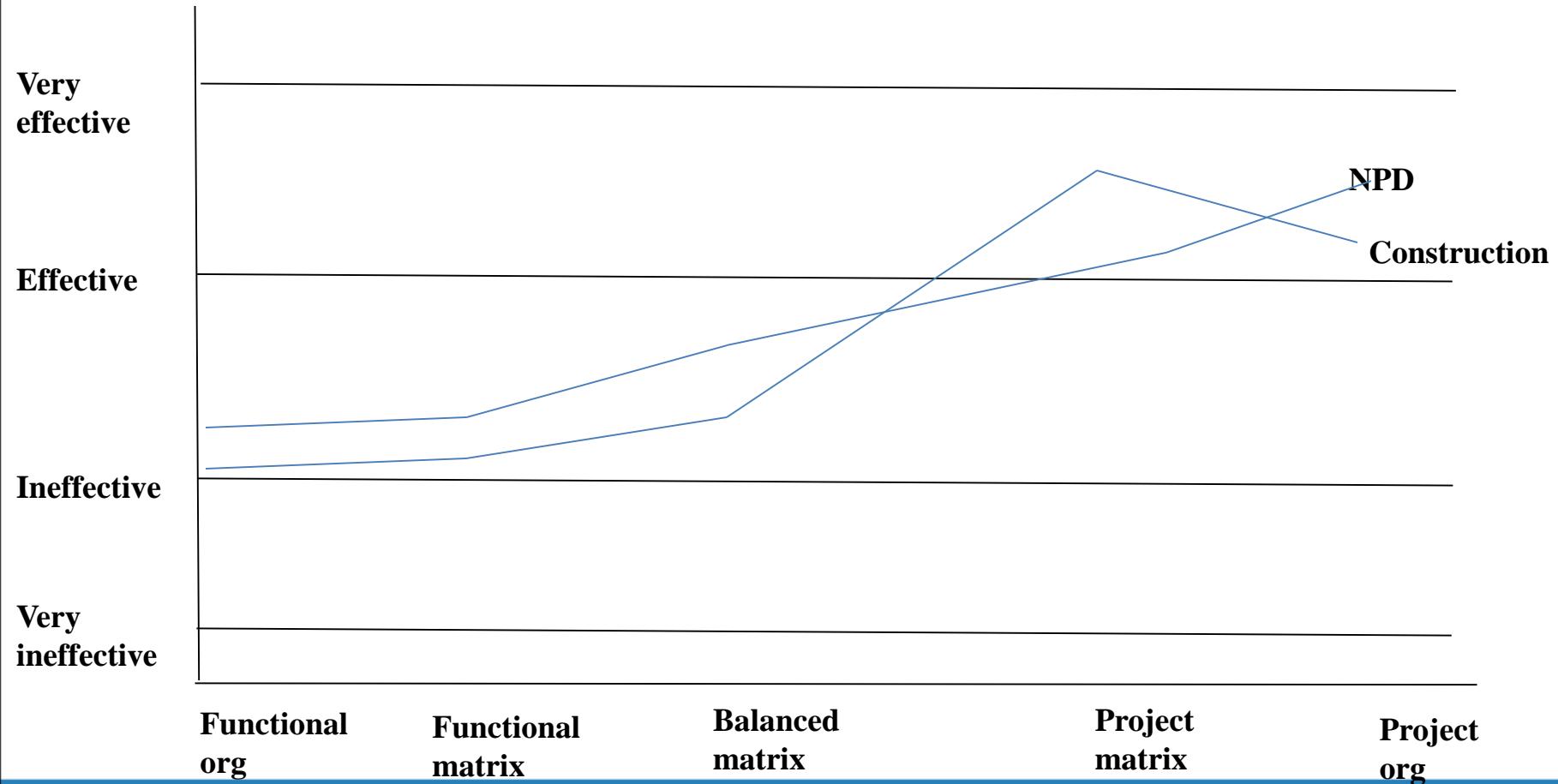
Organizational Structure Influences on Projects



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Project Management for Managers

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Project Management Office

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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.



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Organizational culture?????

How do cultures form?????



A man kills another man and marries woman
Women kills a man and marries other man
Woman marries a man and second man is brother
All live happily together
Men don't talk to each other – not introduced



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The *unwritten rules* of behavior, or norms that are used to *shape and guide behavior* (Speed of work) is shared by *some subset of organization* (Marketing Vs Finacne) members and is *taught to all new members* of the company.



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How do cultures form?

- Technology: high–low
- Environment: global-regional
- Geographical location: ???
- Reward systems:
- Rules and procedures:
- Key organizational members (Govt org. vs CEO of IT firm):
- Organization values, visions, working language, systems, symbols, beliefs, and habits.



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Project and Program Managers- Difference???



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Project and Program Managers

- Project managers work with **project sponsors, project teams, and other people** involved in projects to meet project goals.
- Program: “**A group of related projects** managed in a coordinated way to obtain **benefits and control** not available from managing them individually.”
- Program managers oversee programs and often act as **bosses for project managers**.

Ex. A new car model program (engine, transmission, interior decoration)



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Portfolios and Portfolio Management

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

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



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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 (Ganga project- KM project) .



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Let us talk about PMO ?????



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

“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.



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- **Shared and coordinated** resources across all projects are 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.



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- 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.



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Is PMO required????



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Critics of PMO:

All eggs in one basket - one location of professionals.

Another layer of oversight and bureaucracy in organization



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Differences between project managers and a PMO ??????



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Stakeholders Management

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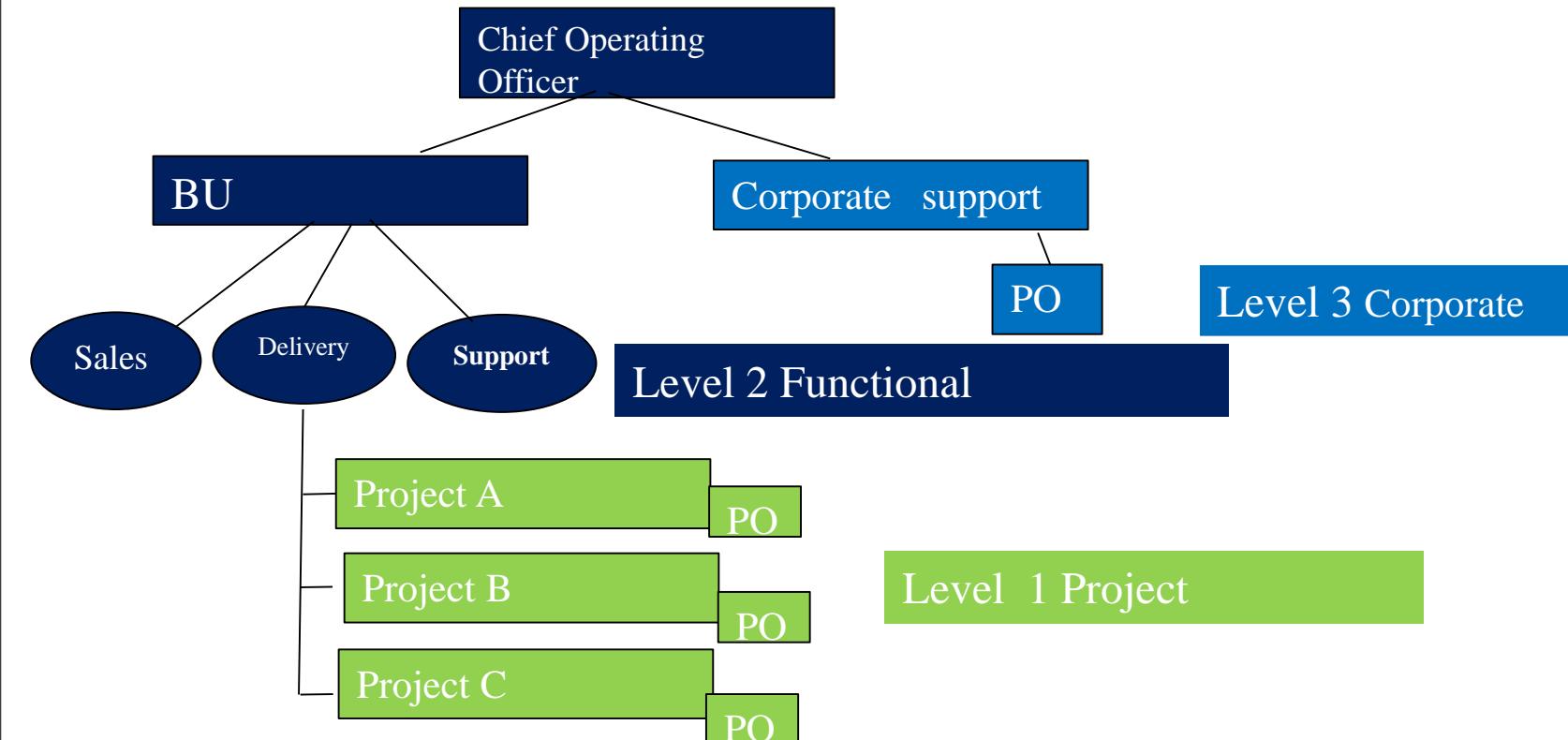


Differences between project managers and a PMO may include the following:

Project Manager	PMO
Responsible for delivering specific project objectives (within constraints),	PMO is an organizational structure with specific mandates that can include an enterprise-wide perspective . PMO manages major program to better achieve business objectives .
Controls the assigned project resources to best meet project objectives.	While the PMO optimizes the use of shared organizational resources across all projects.
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.	PMO provides consolidated reporting and an enterprise view of projects under its purview



Location of PMO





PMO

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 mgmt, 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



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Stakeholders Management



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Who is a stakeholder????



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All individuals or groups who have an active stake in project and can influence either **positively** or **negatively** its development



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Team members must identify them (**How?**). Their **need and expectations**. Manage and influence expectations to complete the project.

- Internal/External



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-Internal

Top mgt

Accountant

Other functional managers

Project team members

-External

Client

Competitors (lessons to be learned, status of project)

Suppliers

Environmental , political, consumer, and other intervener groups (like???)



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- Owners/funders
- Suppliers /contractors
- Team members and their families
- Govt/Media outlets
- Temporary/permanent lobbying organizations
- Society at large



Stakeholders Management

Identify Stakeholders

Plan Stakeholders Management

Manage Stakeholders Engagement

Control Stakeholders Engagement

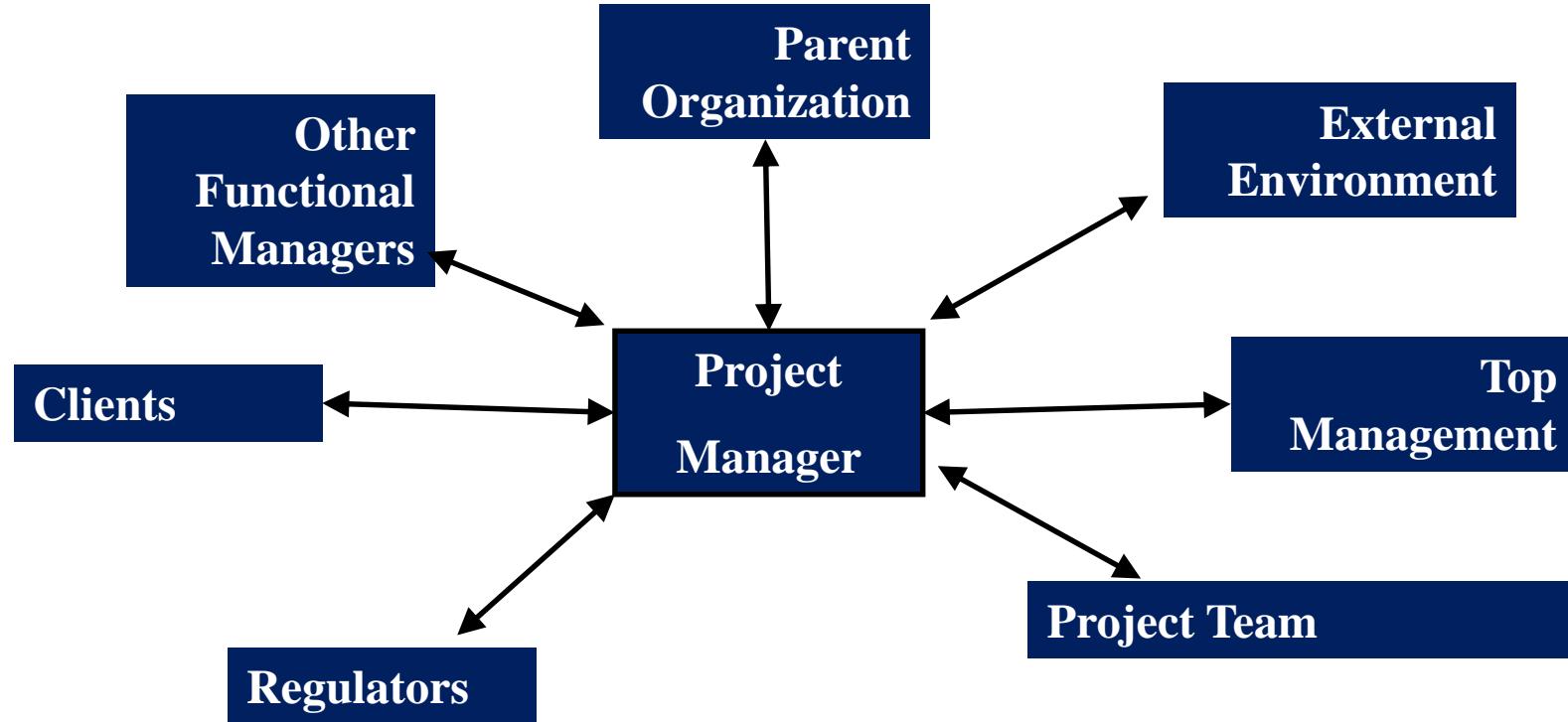


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Project Stakeholder Relationships



Managing stakeholders

Simplified stakeholder management process: planning, organizing, directing, motivating, and controlling the resources necessary to deal with various internal and external groups.



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Managing stakeholders

1. Assess the environment (market research)
2. Identifying the goal of principal actors (low cost software- cost data base, follow up business- mind device, look for hidden agendas)

Manager- low cost MIS

System architect- technical excellence

Programming contractor-Max profit



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New product success at electronics firm

VP (Research)-State- of- the art technology

VP (Mfg.)- World class practices

VP (Mkt)- No. of new feature

Estate development project

Owner- Timely delivery

Local Govt- More taxes

Environmental group-Minimum impact

Nearby residents- Relocation



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Managing stakeholders

3. Assess your own capabilities: tech, political (parties-consultants?), financial, etc.
4. Develop solution: for needs of stakeholders by creating action plans.
5. Test and refine the solution.



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Project Stakeholder Management Cycle



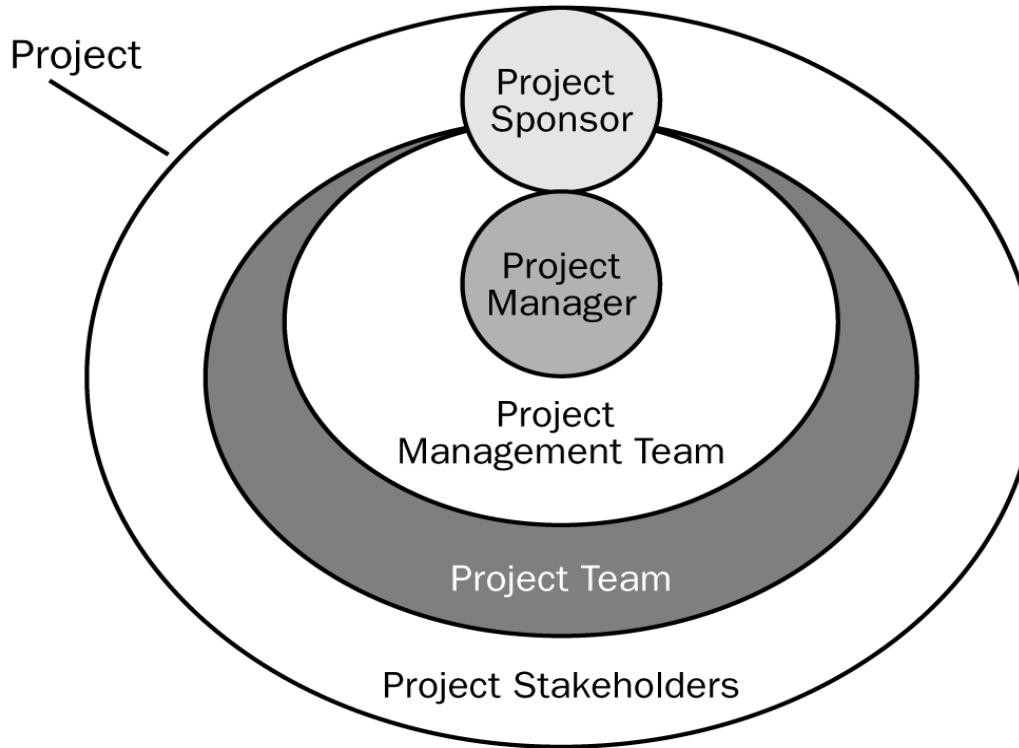
Project Stakeholder Management Cycle (By D.I Cleland)



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Types of projects

1. Personal : exam, vacation, book writing, 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. Industrial and non industrial
6. Type of partnership



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Types of projects

7. European Organization for Nuclear Research ([French](#): Organisation européenne pour la recherche nucléaire), known as CERN .



8. High and low tech



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Types of Projects

- a) **Based on duration:** Long term 10 +, medium ?, short less than ?.
- b) **Based on investment:** High 200m and above, medium 30-200m, low between 5-30m, cottage 5m. (Limits may vary according to States, Departments, Products)

MSMEs in India

Classification	Manufacturing enterprises*	Service enterprises**
Micro	Rs 25 lac	Rs 10 lac
Small	Rs 5 crore	Rs 2 crore
Medium	Rs 10 crore	Rs 5 crore

* Plant and machinery ** Equipment



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Types of Projects

c) Based on ownership: Govt, public sector, corporate, cooperative???, proprietorship, partnership (PPP).



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Project Management for Managers

Lec – 06

Types of Projects and Project Life Cycle

Dr. M.K. Barua

Department of Management
Indian Institute of Technology Roorkee



Types of Projects

- a) **Based on duration:** Long term 10 +, medium ?, short less than ?.
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Types of Projects

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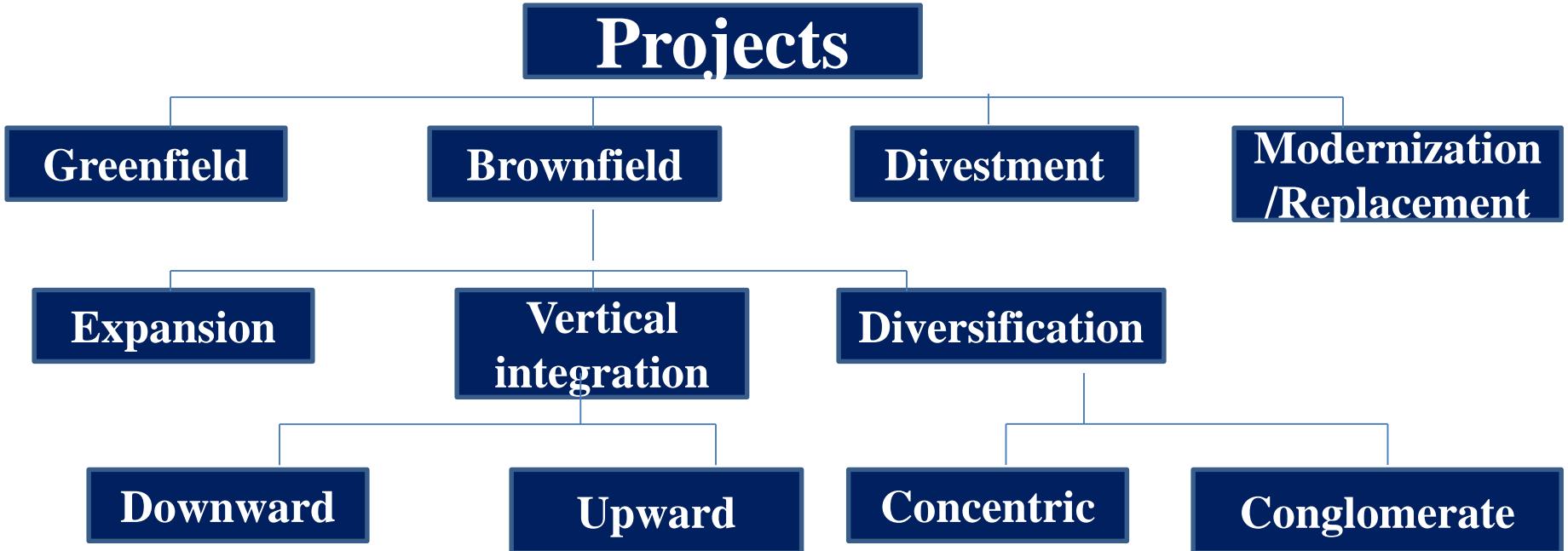


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d) Based on risk:



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 .



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Vertical integration

Forward integration: ??????

Backward integration: ??????



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Vertical integration

Forward integration: **downward** expansion is called forward integration, ex.- steel industry moves for manufacturing of steel pipes (ONGC?).

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



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

Concentric diversification project: firm adds related products: cars??

Conglomerate diversification project: Unrelated areas (TATA, Birla, Ambani, Adaani, etc, IFFCO-TOKIO)



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3. Divestment: Retrenchment of some or all of the activities in a given business of the firm or sell out some of the businesses as such.

Obsolescence-Mobiles

Competition

Failure

Concentration on new product

Better opportunity of investment.

4. Modernization/Replacement: New technology, etc.



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Project Life Cycle (PLC)



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The Project Life Cycle (PLC)

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.



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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 (D for D)).
- How to **control and approve** each phase.



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

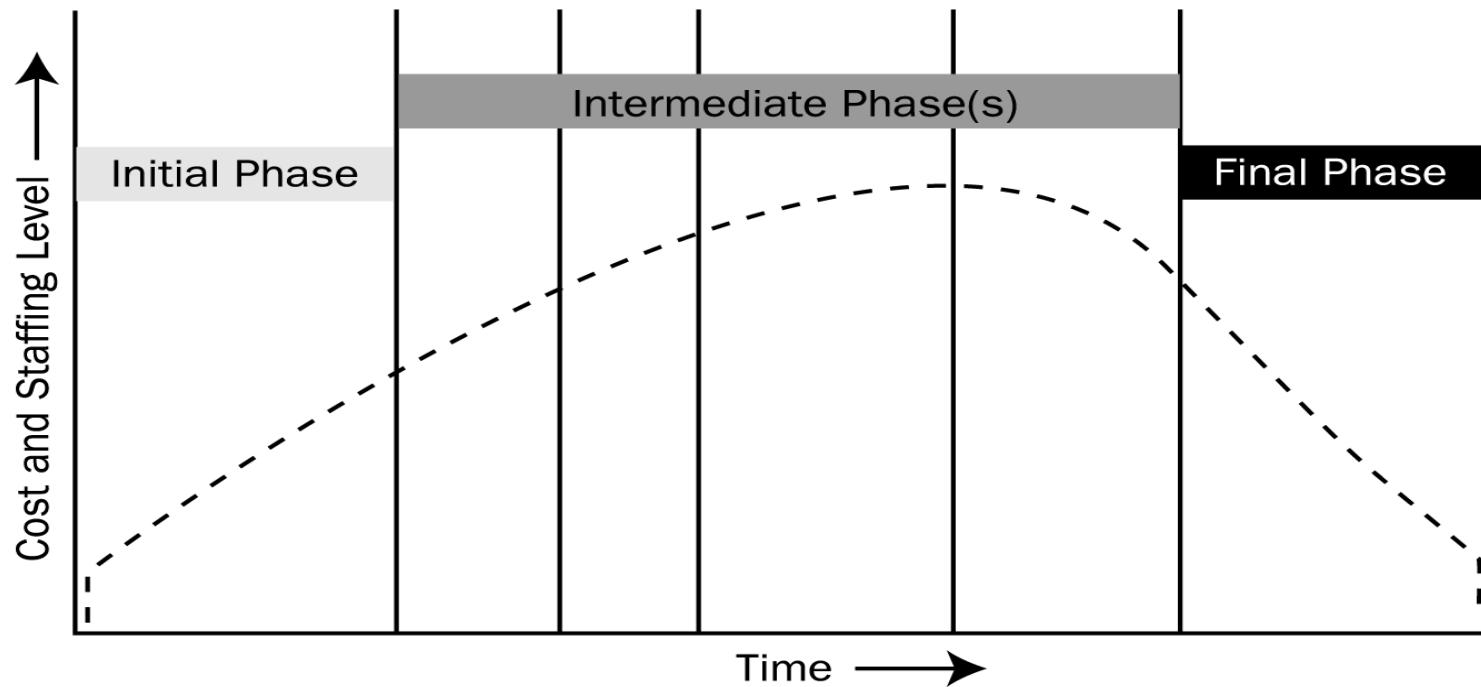
- Phases are generally **sequential** (????) and are usually defined by some form of technical information transfer or technical component handoff.
- Cost and staffing levels are low at the start, peak during the intermediate phases, and drop rapidly as the project draws to a conclusion (**Depends on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



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Typical Project Cost and Staffing Level Across the Project Life Cycle

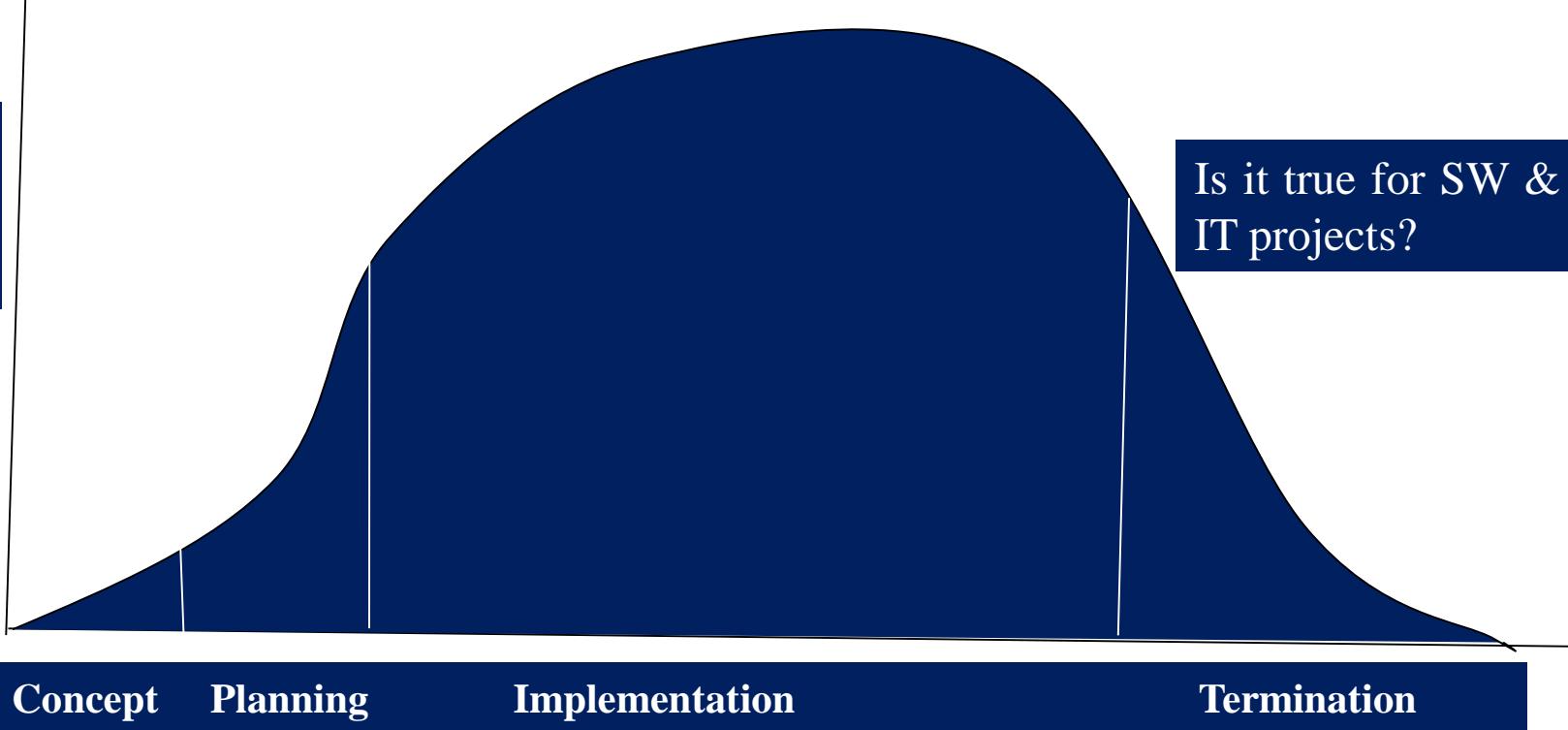


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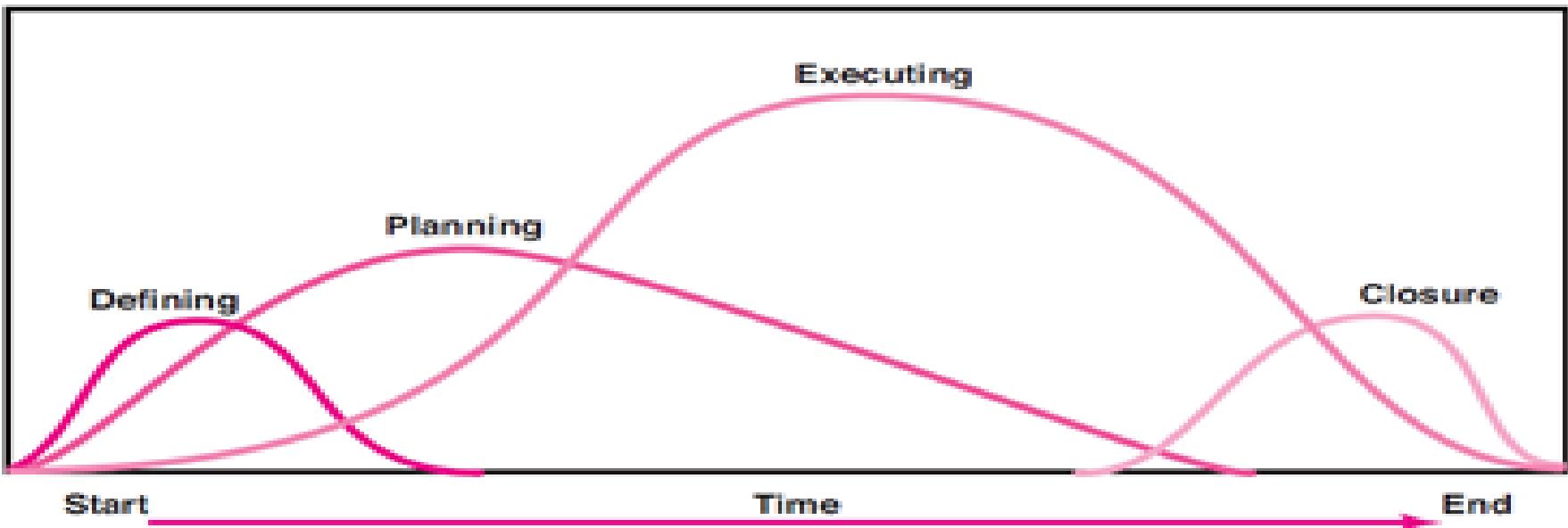
**Level
of
efforts**



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Defining

1. Goals
2. Specifications
3. Tasks
4. Responsibilities

Planning

1. Schedules
2. Budgets
3. Resources
4. Risks
5. Staffing

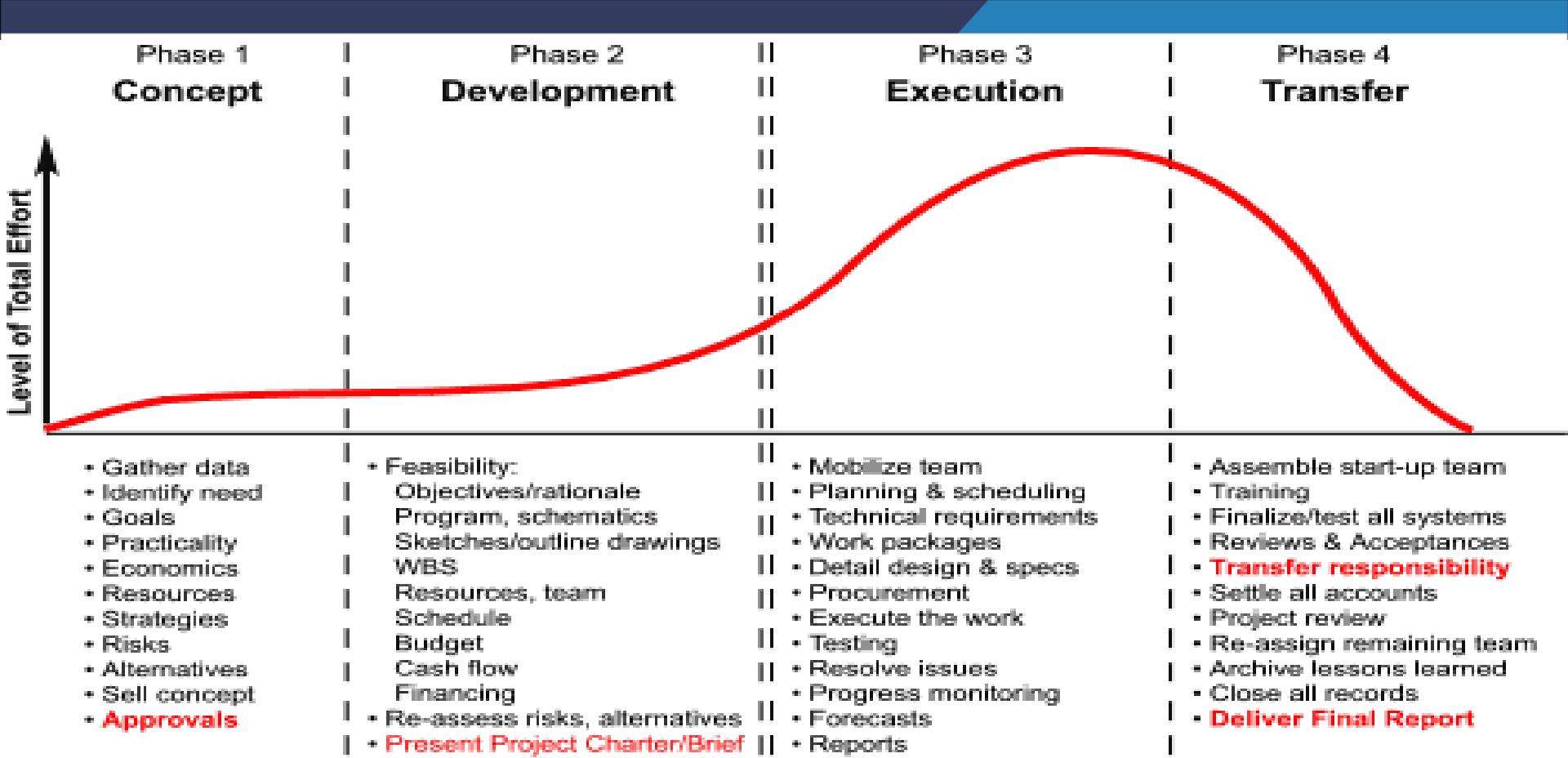
Executing

1. Status reports
2. Changes
3. Quality
4. Forecasts

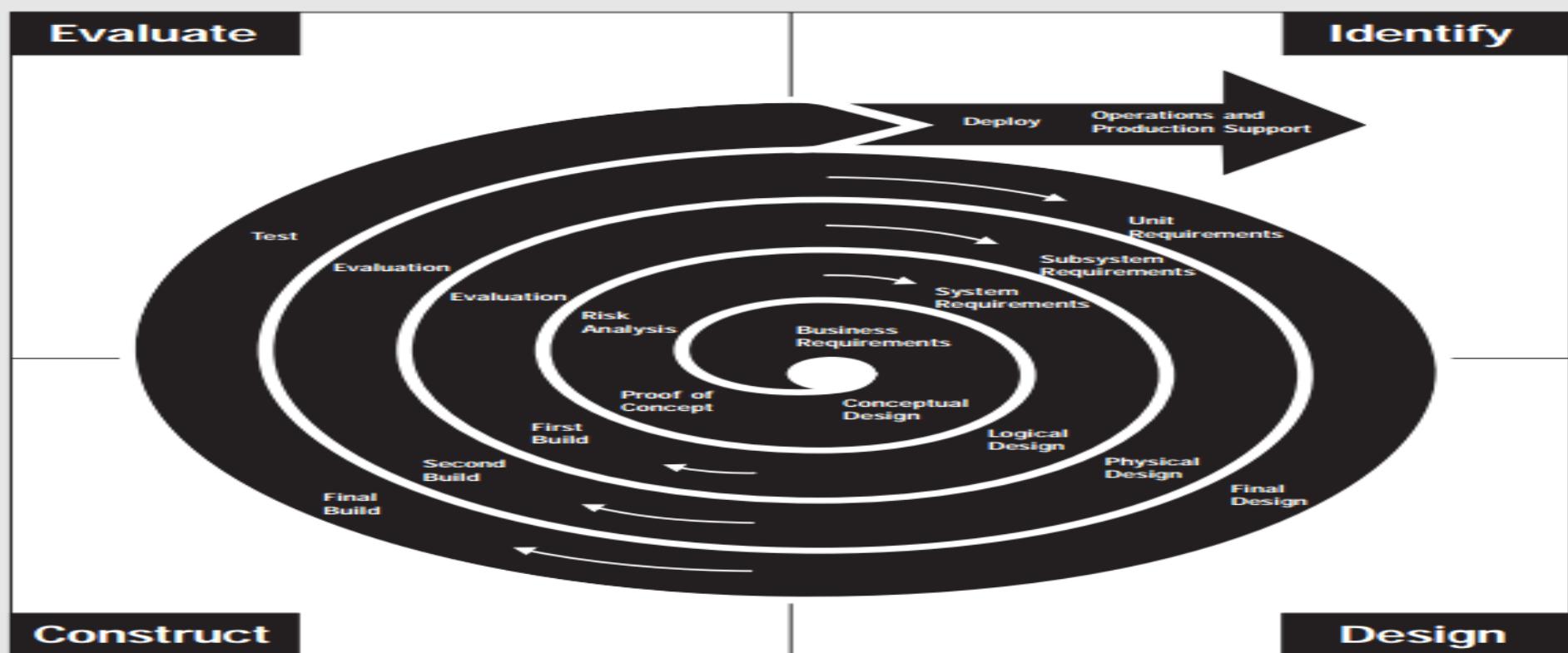
Closure

1. Train customer
2. Transfer documents
3. Release resources
4. Evaluation
5. Lessons learned





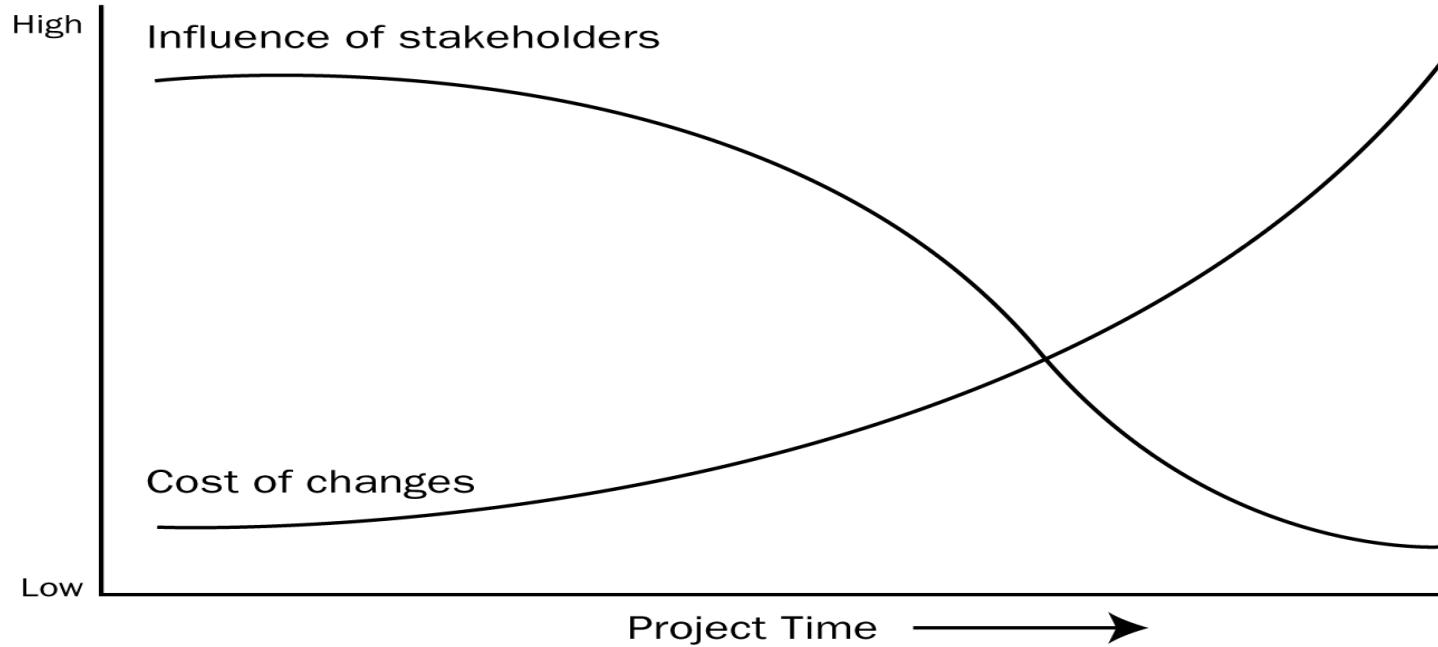
Representative Software Development life Cycle



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Stakeholders' Influence Over Time



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Project Management for Managers

Lec – 07

Project Life Cycle Phases & Project Appraisal

Dr. M.K. Barua

Department of Management
Indian Institute of Technology Roorkee



Project life cycle phases

1a. Conception phase

1b. Definition phase

Initiation phase or
Selection of a project

2. Planning and organizing

3. Implementation

4. Project clean-up phase



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

Project identification

Project appraisal

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



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Create a new product/ services through brainstorming.?????????????



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Ways to create new product development through brainstorming

Kodak - informal sessions- engineer and designer with customers- problems & needs.

- 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 .



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Forces fighting new ideas

I have got great idea



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Forces fighting new ideas

It wont work here



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Forces fighting new ideas

We have tried it before



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Forces fighting new ideas

This is not the right time



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Forces fighting new ideas

It can't be done



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Forces fighting new ideas

It's not the way we do things



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Forces fighting new ideas

We have done all right without it



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Forces fighting new ideas

It will cost too much



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Forces fighting new ideas

Let us discuss in our next meeting



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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)



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Ex: Reduce vehicular pollution in your city

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

Criteria for screening ideas

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



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Project appraisal

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



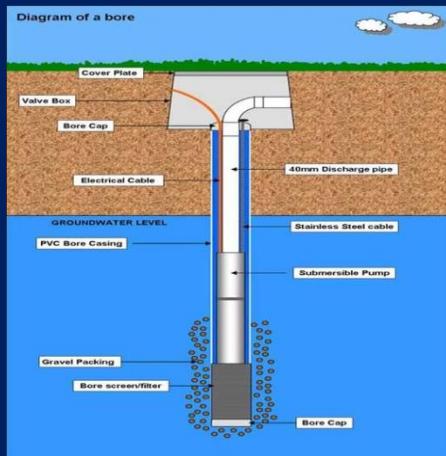
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Project appraisal

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



Financial factor?????



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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.



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Project appraisal

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

Economic?????????



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Project appraisal

Economic: Impacts of project on society. Benefits and costs, distribution of income in society, level of saving and investments, employment, etc.



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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:???????



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2. Planning and organizing



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



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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
- Updating 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



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4. Project completion and Review?????



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4. Project completion and Review

Disbanding project team

Handing over

Accounting and report writing

Learning from experience

What else ????????



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Project Management for Managers

Lec – 08

Methods of Project Selection - I

Dr. M.K. Barua

Department of Management

Indian Institute of Technology Roorkee



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



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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).



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- 3. Flexibility:** model should allow tax rate and tax laws, building codes.
- 4. Ease of use:** 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



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Methods of project selection/evaluation

- Sacred cow: Senior and powerful people
- Operating necessity: Shortage of power - power generation unit, effluent disposal issue – effluent treatment plant
- BCG
- CE/McKINSEY
- SPACE diagram



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Methods of project selection/evaluation

Boston Consulting Group (BCG) Matrix: is a four celled matrix ($2 * 2$ 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**.



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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.

Market Share???(Reltv)? = SBU Sales this year / leading competitors sales this year.

Market Growth Rate = Industry sales this year/ Industry Sales last year.

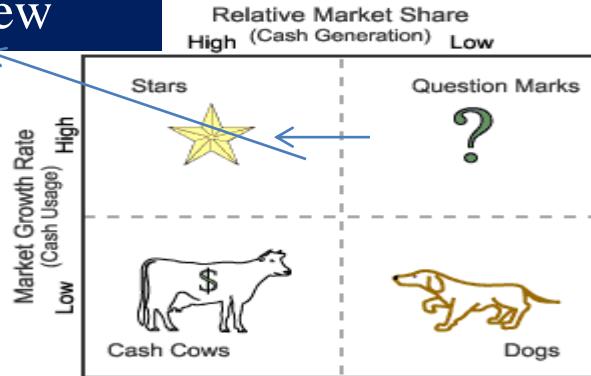


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Select few



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 leads**. Net cash flow is usually modest.

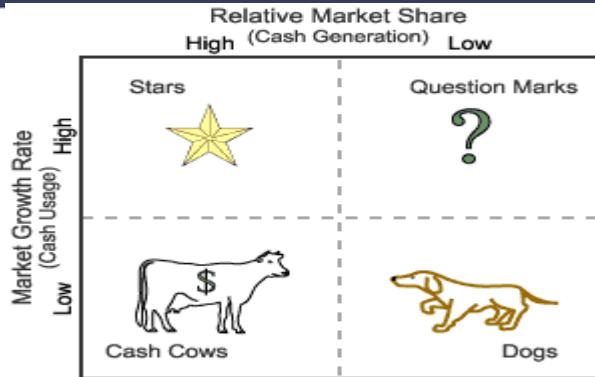
SBU's located in this cell are attractive as they are located in a robust industry and these business units are highly competitive in the industry. **If successful, a star will become a cash cow when the industry matures.**



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Cash Cows- Cash Cows represent 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.

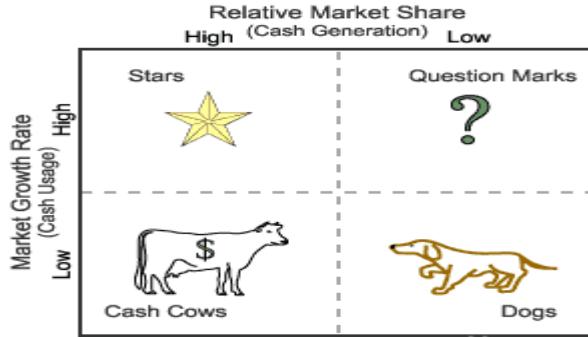
They are the base of an organization. **These businesses usually follow stability strategies.** When **cash cows loose their appeal** and move towards deterioration, then a **retrenchment policy** may be pursued.



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Divest others

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.

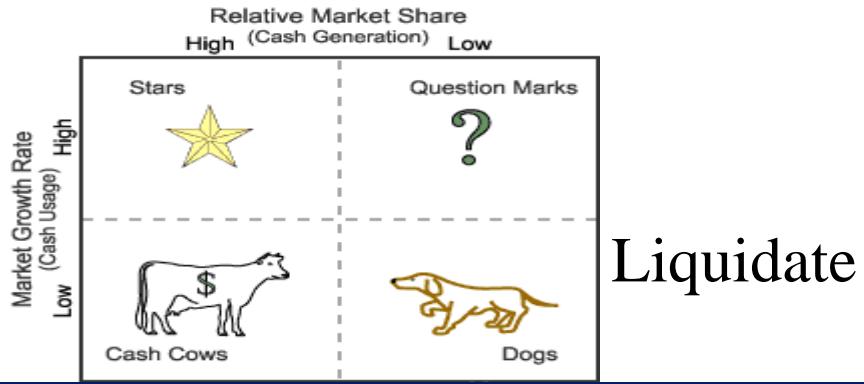
If ignored, then question marks may become dogs, while if huge investment is made, then they have potential of becoming stars.



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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.**



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As a particular industry **matures** and its growth slows, all business units become either *cash cows or dogs*.

The **natural cycle** for most business units is that they start *as question marks, then turn into stars*.

Eventually the market stops growing thus the business unit becomes a *cash cow*.

At the end of the cycle the cash cow turns into a *dog*.

BCG looks at only growth-share, ignores other elements.



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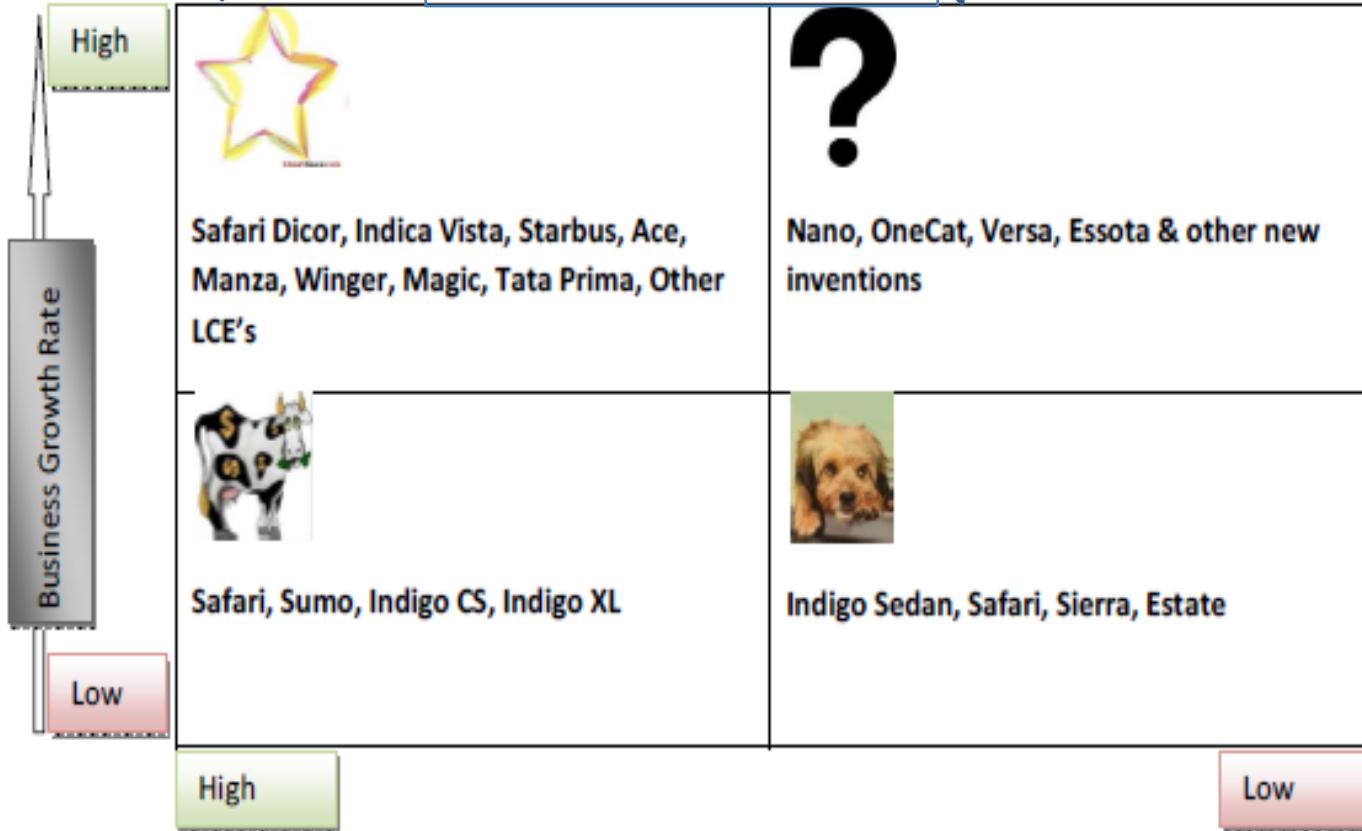


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		RELATIVE MARKET SHARE	
		Cash Generation	
			LOW
MARKET GROWTH RATE	HIGH	STARS	QUESTION MARKS
	HIGH	Earnings: <i>low, stable, growing</i> Cash flow: <i>neutral</i> Strategy: <i>invest for growth</i>	Earnings: <i>low, unstable, growing</i> Cash flow: <i>negative</i> Strategy: <i>invest ,if has potential, otherwise sell</i>
	LOW	CASH COWS	DOGS
		Earnings: <i>high & stable</i> Cash flow: <i>high & stable</i> Strategy: <i>invest to maintain current level or harvest</i>	Earnings: <i>low, unstable</i> Cash flow: <i>neutral or negative</i> Strategy: <i>divest</i>



Relative market share

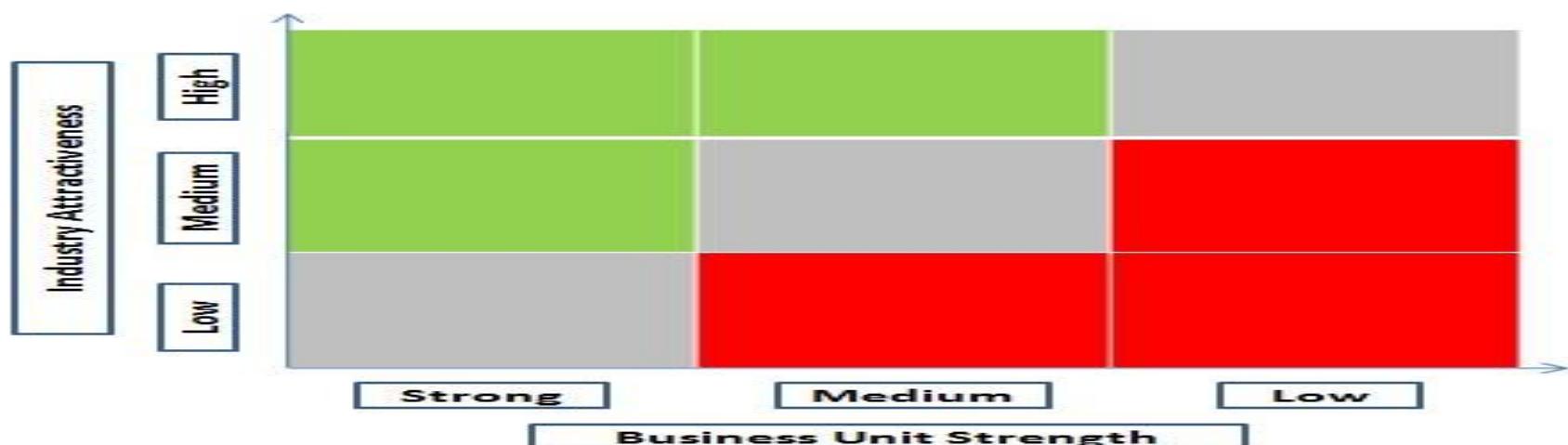


		High	Low
MARKET GROWTH	High	Star <ul style="list-style-type: none"> ▪ Agri Business ▪ Hotels ▪ Paperboards & Packaging 	Question mark <ul style="list-style-type: none"> ▪ FMCG-Foods ▪ ITC Infotech 
	Low	Cash Cow <ul style="list-style-type: none"> ▪ FMCG-Cigarettes 	Dog <ul style="list-style-type: none"> ▪ Branded Apparels ▪ Packaged foods 

McKINSEY/GE Matrix:

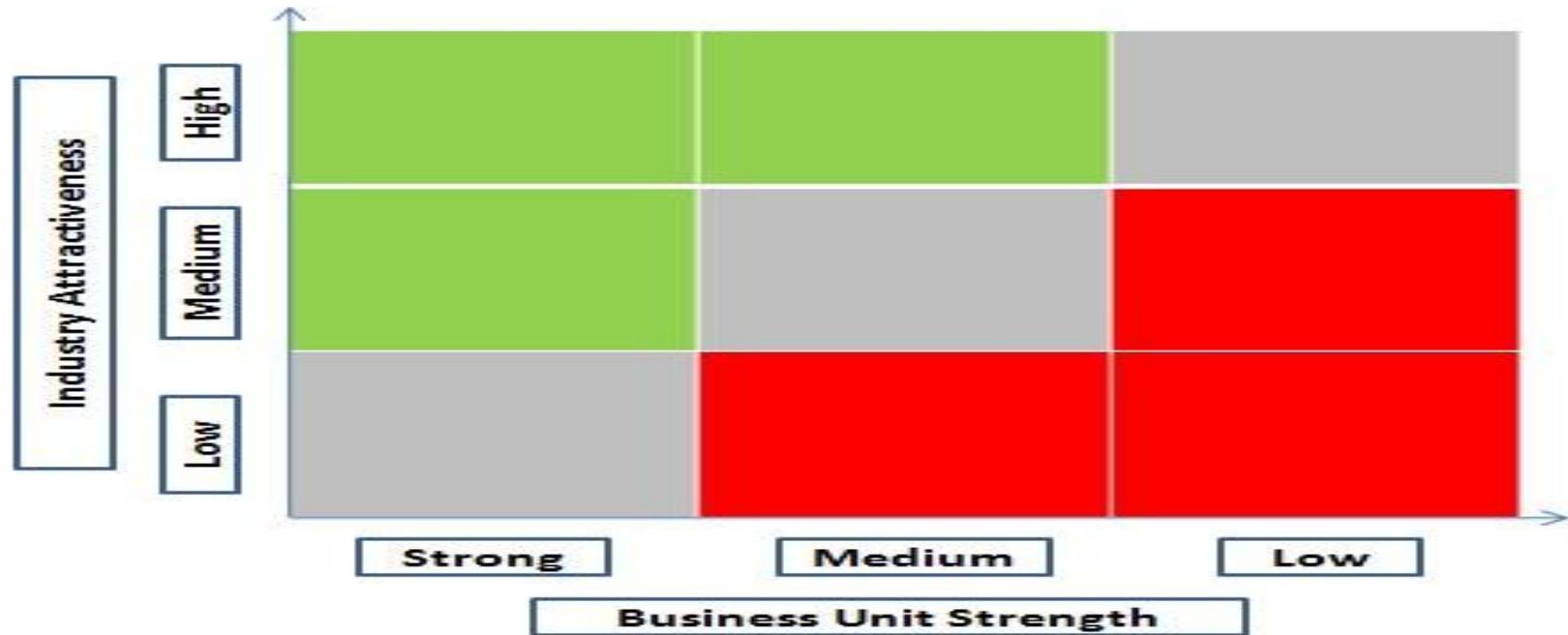
GE / McKinsey Matrix is an extension of the BCG Matrix. This tool compares different businesses on "**Business Strength**" and "**Industry/ Market Attractiveness**".

This 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.**



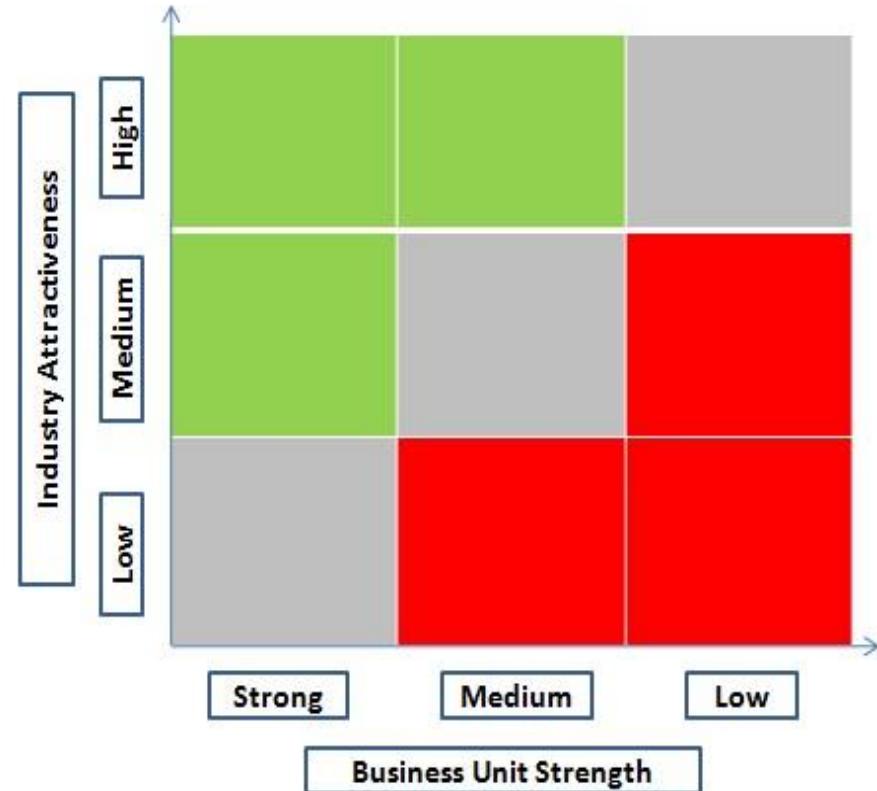
Industry Attractiveness??????

Business Unit Strength??????



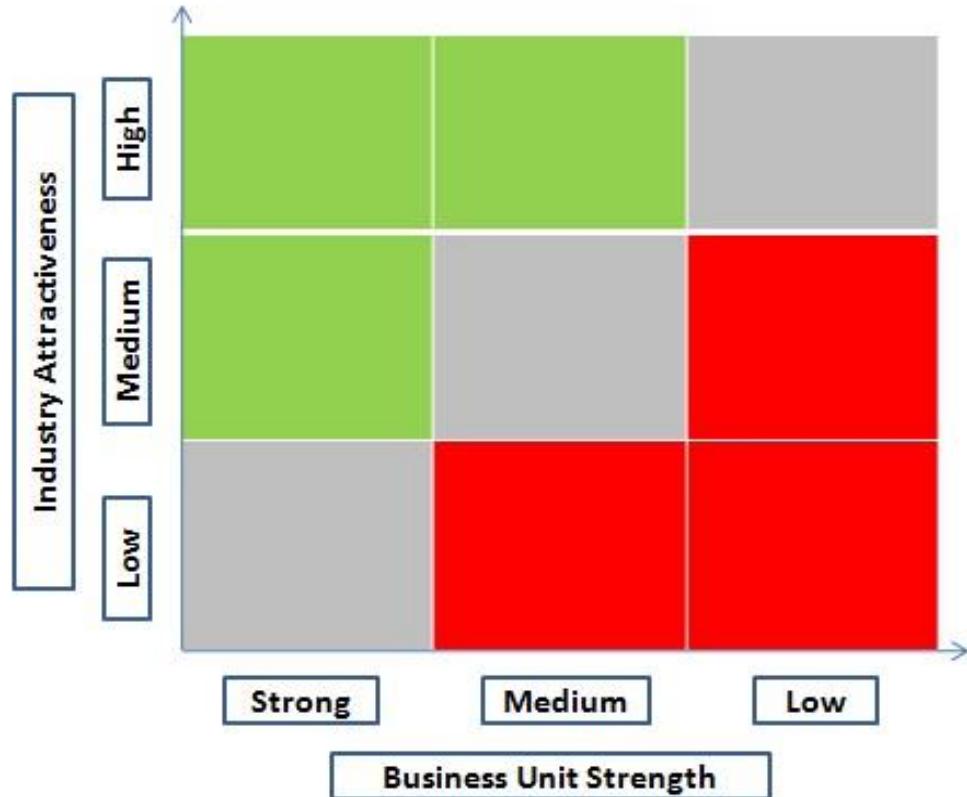
Industry Attractiveness

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



Business Unit Strength

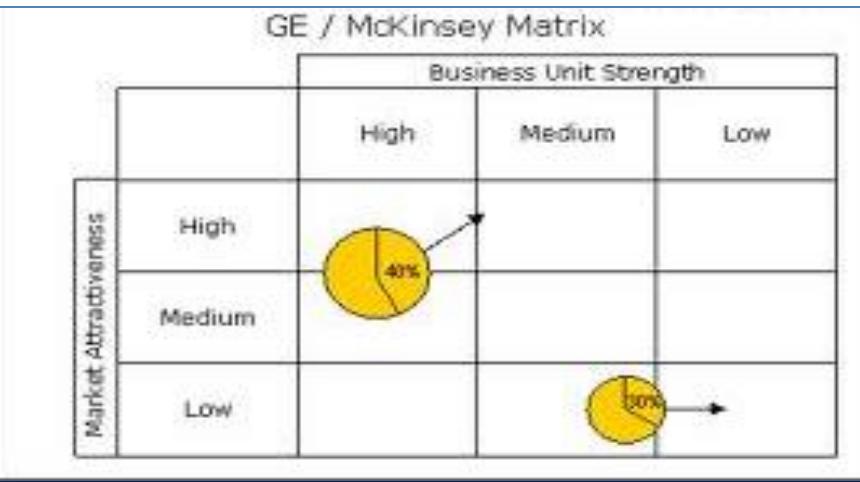
- Market share
- Growth in market share
- Customer loyalty
- Brand equity
- Distribution channel access
- Production capacity
- Profit/cost margins relative to competitors
- Financial and channels' strength



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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.** (Similar to which cell of BCG????)



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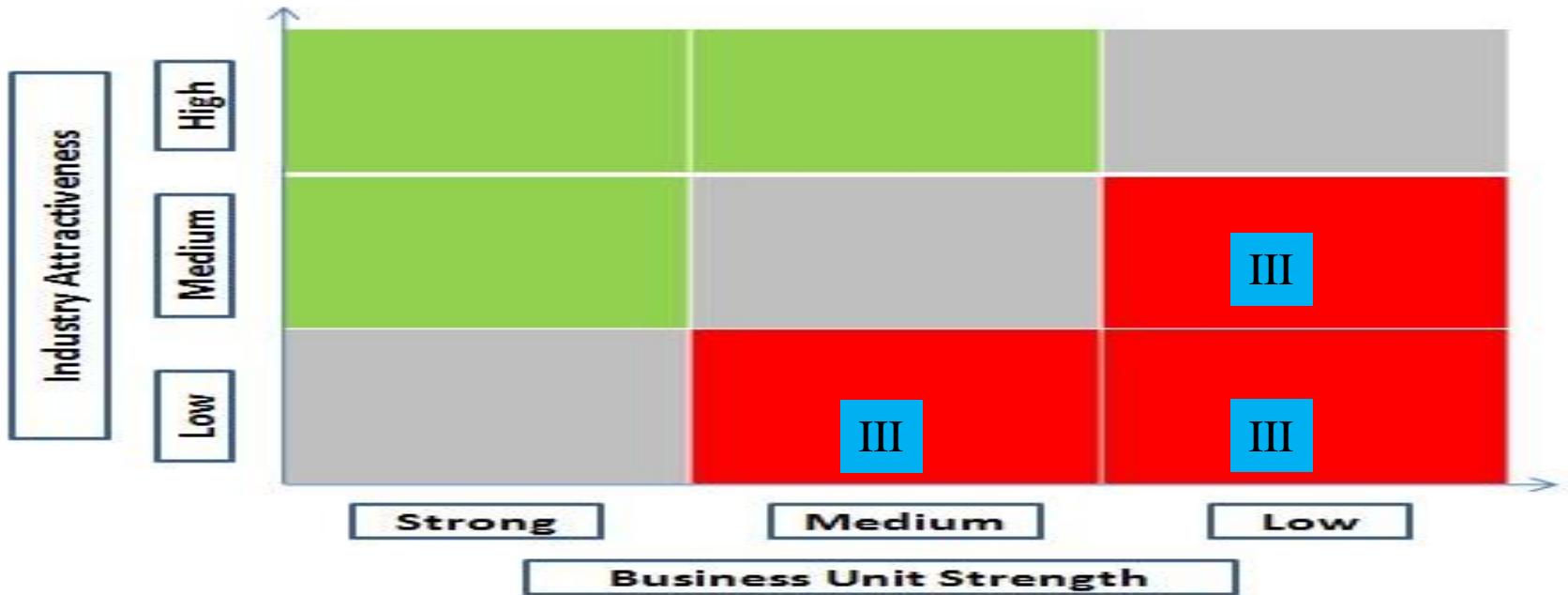
Segment II: The **business is either strong but the market is not attractive or the market is strong and the business is not strong** enough to pursue potential opportunities. **Decision makers should make judgment on how to further deal with these SBUs.** Some of them may consume too much resources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



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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 offering**, or **get rid of these SBUs and invest the resources into more promising and attractive SBUs**. (**Similar to which cell of BCG????**)

GE matrix

Industry attractiveness – Size, Market Growth, Pricing, Mkt. Diversity Competitive Structure, Industry Profitability				
Business strength <ul style="list-style-type: none">- Size- Growth- Share- Position- Profitability- Margins- Tech. Position<ul style="list-style-type: none">- Image- People	High	High	Medium	Low
	High	Investment and growth (G) SWIFT	Investment and growth (G) ALTO	Selectivity/ Earnings A STAR
	Medium	Investment and growth (G) SWIFT DEZIRE	Selectivity/ Earnings SX4	Harvest BALENO
	Low	Selectivity/ Earnings WAGON R	Harvest VERSA	Harvest OMNI

Prepare GE Matrix of ITC ??????



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Project Management for Managers

Lec – 09

Methods of Project Selection - II

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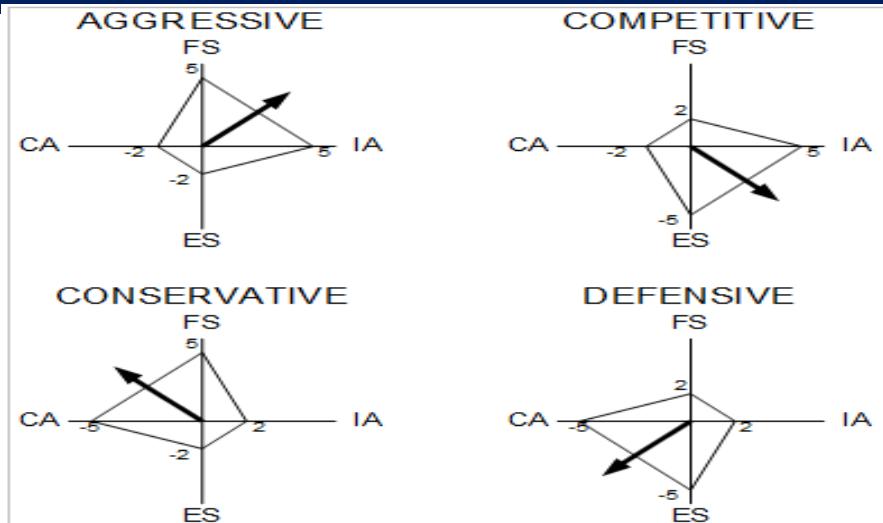
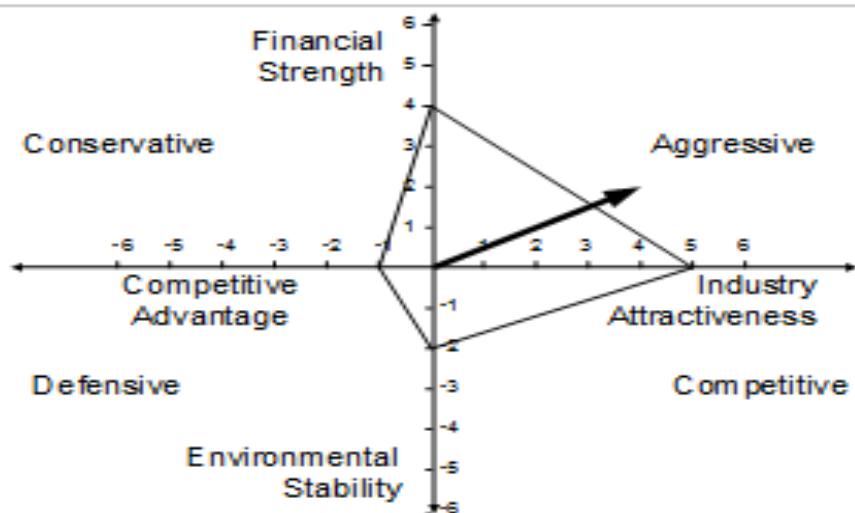


SPACE : (Strategic Position and Action Evaluation diagram): A management tool to analyse a company and decide its future strategy.

A set of variables should be selected to define:

- Financial strength,**
- Competitive advantage,**
- Environmental stability, and**
- Industry attractiveness.**

Internal
and External???



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The set of variables could be as follows: 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



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The set of variables could be as follows: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 attractiveness

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



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Criteria

Tangible:
Rs, %,
Rs/year

Commensurate

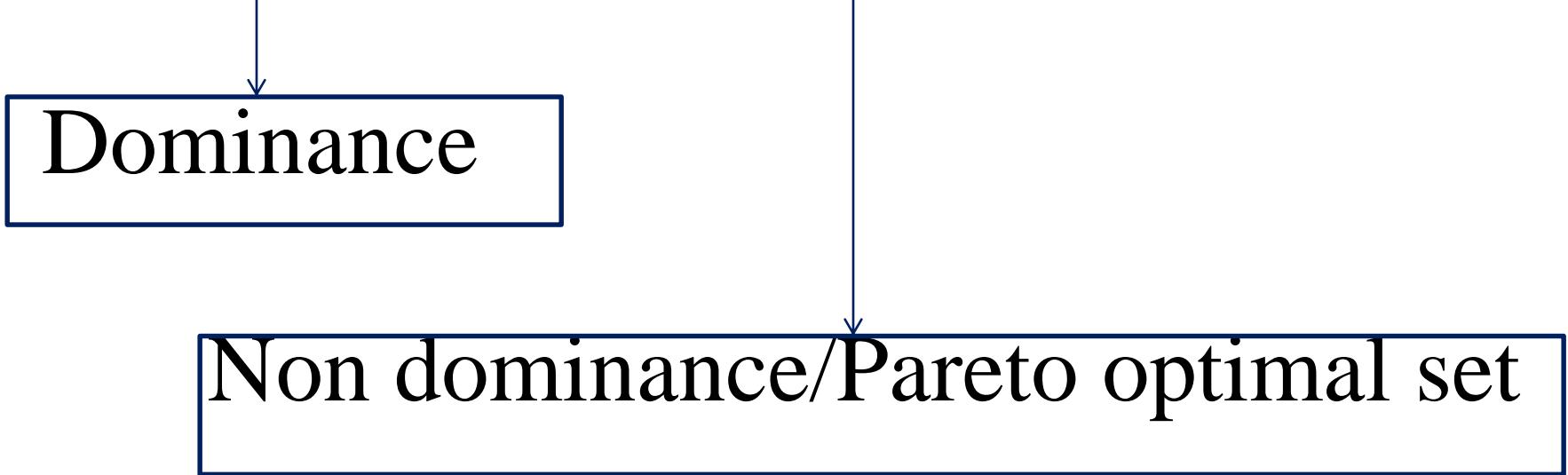
Incommensurate
(Rs for investment
& years for PBP)

Intangible: (Not
measurable on a
well
defined
scale)

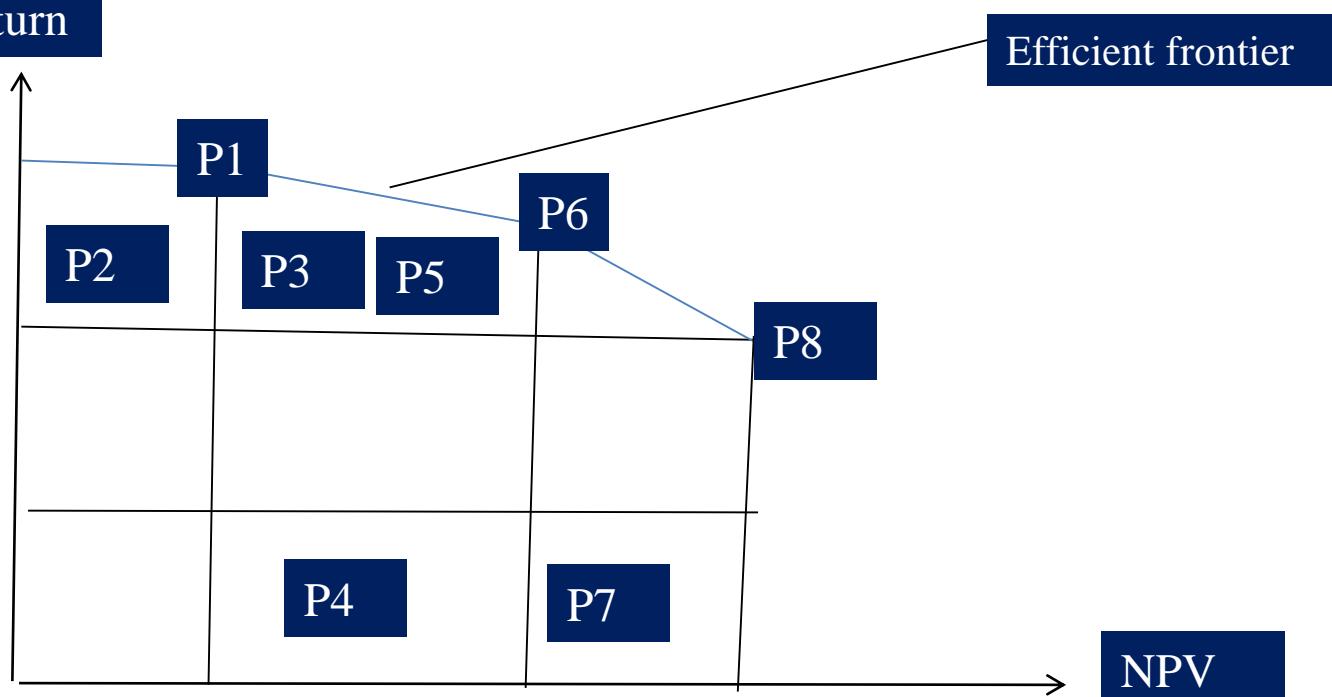
(Not measurable – Score on a
subjective scale ?????)



Projects



Non dominance/Pareto optimal set



Selection method: (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				Weight
		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			

Low-1 Medium-2 High-3



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SIMPLIFIED SCORING MODEL (WEIGHTED)

Project	Criteria	Performance on criteria		
		High	Medium	Low
Alpha	Cost	3		
	Profit potential			1
	Time to market		2	
	Development risk			1
Beta	Cost		2	
	Profit potential		2	
	Time to market	3		
	Development risk		2	
Gamma	Cost	3		
	Profit potential	3		
	Time to market			1
	Development risk	3		
Delta	Cost			1
	Profit potential			1
	Time to market	3		
	Development risk		2	

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

Low-1 Medium-2 High-3
Alpha: $3*1+1*2+2*3+1*2=13$
Beta: $2*1+2*2+3*3+2*2=19$
Gamma: $3*1+3*2+1*3+3*2=18$
Delta: $1*1+1*2+3*3+2*2=16$



Optimization Techniques

Linear Programming: ??????????



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Optimization Techniques

Linear Programming: Optimization of a function of variables known as objective function, subject to a set of linear equations and/or inequalities known as constraints.



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Ex:

	Mobile	Laptop	
Assembly	6	3	90hrs
Finishing	3	6	72hrs
Profit	120	90	

Determine the best combination of mobile and laptops to realize maximum profit.



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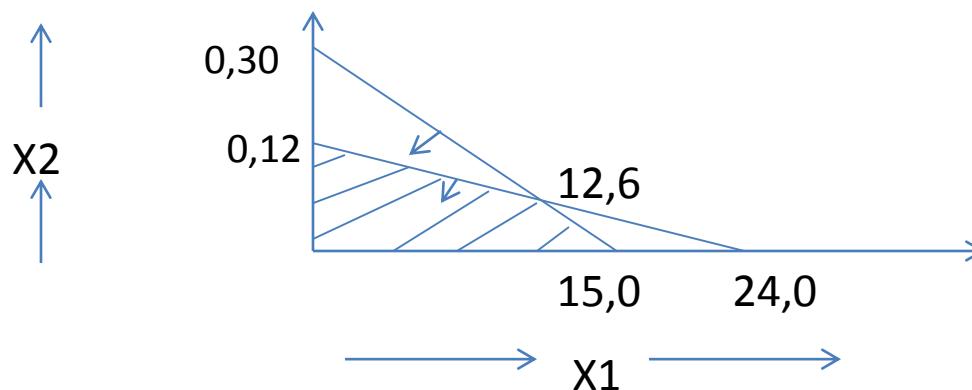
Maximize $Z = 120x_1 + 90x_2$

ST $6x_1 + 3x_2 \leq 90$

$$3x_1 + 6x_2 \leq 72$$

$$x_1, x_2 \geq 0$$

Answer: $x_1 = 12$ and $x_2 = 6$. Total profit = 1980



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Integer programming

A company is planning its capital spending for the **next T periods**. There are **N projects** that compete for the limited **capital Bi**, available for investment in **period "i"**.

Each project requires a certain investment in each period once it is selected.

Let “ a_{ij} ” be the required investment in project j for period i .

The value of the project is **measured in terms of NPV**. Let, V_j is NPV of project j .

The problem is to select the **proper project** for investment that will **maximize total NPV**.



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Integer programming : A company is planning its capital spending for the next T periods,. There are N projects that compete for the limited capital Bi, available for investment in period "i". Each project requires a certain investment in each period once it is selected. Let “aij” be the required investment in project j for period i. The value of the project is measured in terms of NPV. Let , Vj is NPV of project j. The problem is to select the proper project for investment that will maximize total NPV.

$x_j = 1$ if project j is selected

$x_j = 0$ if project j is not selected

$\text{Max } Z = \sum v_j x_j \quad (j=1 \text{ to } N)$

ST $\sum a_{ij} x_j \leq B_i$, for $i=1$ to T

$0 \leq x_j \leq 1$, x_j a binary and for all $j=1$ to N



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	Project 1	Project 2	Project 3	Project 4
Profit	105	140	80	100
Cash flow (first year)	60	108	200	90
Cash flow (second year)	160	40	150	70

Cash flows in first and second year should not exceed 600 and 700.

Project 1 and 3 are mutually exclusive.

Company wants to maximize profit.



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Max Z = 105x₁+140x₂+80x₃+100x₄

ST 60x₁+108x₂+200x₃+90x₄ <=600

160x₁+40x₂+150x₃+70x₄ <=700

x₁+x₃=1,

All 0<= x_i<=1



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Project Management for Managers

Lec – 10

Methods of Project Selection (MCDM – I)

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Department of Management
Indian Institute of Technology Roorkee



MCDM

- 1) Multi-Attribute Utility Theory,
- 2) Analytic Hierarchy Process,
- 3) Fuzzy Set Theory,
- 4) Case-based Reasoning,
- 5) Data Envelopment Analysis,
- 6) SMART (Simple Multi-Attribute Rating Technique),
- 7) Goal Programming,
- 8) ELECTRE (ELimination and Choice Translating Reality),
- 9) PROMETHEE (Preference ranking organization method for enrichment evaluation
- 10) Simple Additive Weighting, and
- 11) TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution)



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Goal programming??:

In LP, only one dimension of (Z), organizations often have several objectives (conflicting) and not measured in same units.

GP asks mgt to rank objectives.

GP tries to **minimize deviations** from the targets .



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Ex:

	Mobile	Laptop (lt)	
Assembly	6	3	90hrs
Finishing	3	6	72hrs
Profit	120	90	

If profit is Rs120 per mobile and Rs 90 per laptop, **determine the best combination of mobile and laptop to realize a profit of Rs 2100.**



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This is a single goal (profit) problem. Let

D_u = Amount by which profit goal is underachieved.

D_o = Amount by which profit goal is overachieved.

Minimize Z = D_u (underachievement of profit goal)

ST $120x_1 + 90x_2 + D_u - D_o = 2100$

$$6x_1 + 3x_2 \leq 90$$

$$3x_1 + 6x_2 \leq 72$$

$$x_1, x_2, D_u, D_o \geq 0$$

$$6x_1 + 3x_2 + s_1 = 90$$

$$3x_1 + 6x_2 + s_2 = 72$$

$$x_1, x_2, s_1, s_2 \geq 0$$



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D_u = Amount by which profit goal is underachieved.

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Minimize Z = D_u (underachievement of profit goal)

ST $120x_1 + 90x_2 + D_u - D_o = 2100$

$$6x_1 + 3x_2 \leq 90$$

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$$x_1, x_2, D_u, D_o \geq 0$$

$$6x_1 + 3x_2 + s_1 = 90$$

$$3x_1 + 6x_2 + s_2 = 72$$

$$x_1, x_2, s_1, s_2 \geq 0$$

c_B	Basis	x_1	x_2	s_1	s_2	D_u	D_o	b
1	D_u	0	0	$-\frac{50}{3}$	$-\frac{20}{3}$	1	-1	120
0	x_1	1	0	$\frac{2}{9}$	$-\frac{1}{9}$	0	0	12
0	x_2	0	1	$-\frac{1}{9}$	$\frac{2}{9}$	0	0	6
	Z_j	0	0	$-\frac{50}{3}$	$-\frac{20}{3}$	1	-1	
	\bar{c}_j	0	0	$\frac{50}{3}$	$\frac{20}{3}$	0	1	

Optimal basic feasible solution

After using simplex method, $x_1 = 12$, $x_2 = 6$, $D_u = 120$, Means actual profit earned is Rs= 2100-120=1980, underachieved by Rs 120.



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Ex: If the company sets two equally ranked goals, one to reach a profit of Rs 1500 and the other to meet the **mobile goal** of 10 units, find the optimal solution.???????



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Solution:

Dup= Amount by which profit goal is underachieved

Dop= Amount by which profit goal is overachieved

Dum= Amount by which mobile goal is underachieved

Dom= Amount by which mobile goal is overachieved

Minimize $Z = \text{Dup} + \text{Dum}$

ST $120x_1 + 90x_2 + \text{Dup} - \text{Dop} = 1500$

$$x_1 + \text{Dum} - \text{Dom} = 10$$

$$6x_1 + 3x_2 \leq 90$$

$$3x_1 + 6x_2 \leq 72$$

$$x_1, x_2, \text{Dup}, \text{Dop}, \text{Dum}, \text{Dom} \geq 0$$



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Solution:

Dup= Amount by which profit goal is underachieved

Dop= Amount by which profit goal is overachieved

Dum= Amount by which mobile goal is underachieved

Dom= Amount by which mobile goal is overachieved

Minimize $Z = \text{Dup} + \text{Dum}$

$$ST 120x_1 + 90x_2 + \text{Dup} - \text{Dop} = 1500$$

$$x_1 + \text{Dum} - \text{Dom} = 10$$

$$6x_1 + 3x_2 \leq 90$$

$$3x_1 + 6x_2 \leq 72$$

$$x_1, x_2, \text{Dup}, \text{Dop}, \text{Dum}, \text{Dom} \geq 0$$

	c_j	0	0	0	0	1	0	1	0	0
c_B	Basis	x_1	x_2	s_1	s_2	D_{up}	D_{op}	D_{ur}	D_{or}	b
0	D_{or}	0	$\frac{3}{4}$	0	0	$\frac{1}{120}$	$-\frac{1}{120}$	-1	1	$\frac{5}{2}$
0	x_1	1	$\frac{3}{4}$	0	0	$\frac{1}{120}$	$-\frac{1}{120}$	0	0	$\frac{25}{2}$
0	s_1	0	$-\frac{3}{2}$	1	0	$-\frac{1}{20}$	$\frac{1}{20}$	0	0	15
0	s_2	0	$\frac{15}{4}$	0	1	$-\frac{1}{40}$	$\frac{1}{40}$	0	0	$\frac{69}{2}$
Z_j		0	0	0	0	0	0	0	0	0
\bar{Z}_j	Basis	0	0	0	0	1	0	1	0	

Optimal b.f.s.

After using simplex method, $x_1 = 25/2$, $\text{Dom} = 5/2$, Means profit goal of Rs= 1500 achieved, since both Dup and Dop do not appear in final table.



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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 prioritizes 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



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- 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.



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

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

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

Where $W_i / W_j = a_{ij}$



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- Eigen value and eigen vector calculation

$$\lambda_{max} = \sum_{j=1}^n a_{ij} \frac{w_j}{w_i}$$

- Consistency test

CI (Consistency Index) =

$$\frac{\lambda_{max} - n}{n - 1}$$

CR (Consistency Ratio) =

$$CI$$

$$RI$$

✓ 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



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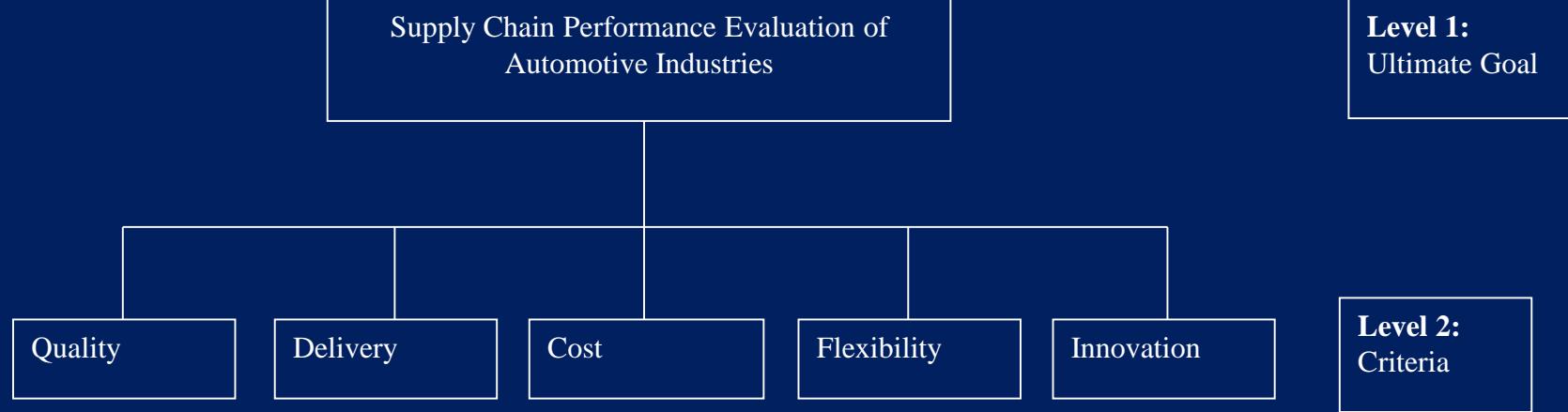


Figure : Hierarchical structure to evaluate the supply chain performance evaluation of automotive industries



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	Quality	Delivery	Cost	Flexibility	Innovation
Quality	1	3	1	1/3	9
Delivery		1	1/3	1/5	6
Cost			1	1/4	7
Flexibility				1	8
Innovation					1

Pair-wise comparison matrix of respondents (Either consensus or highest frequency) for all criteria.



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

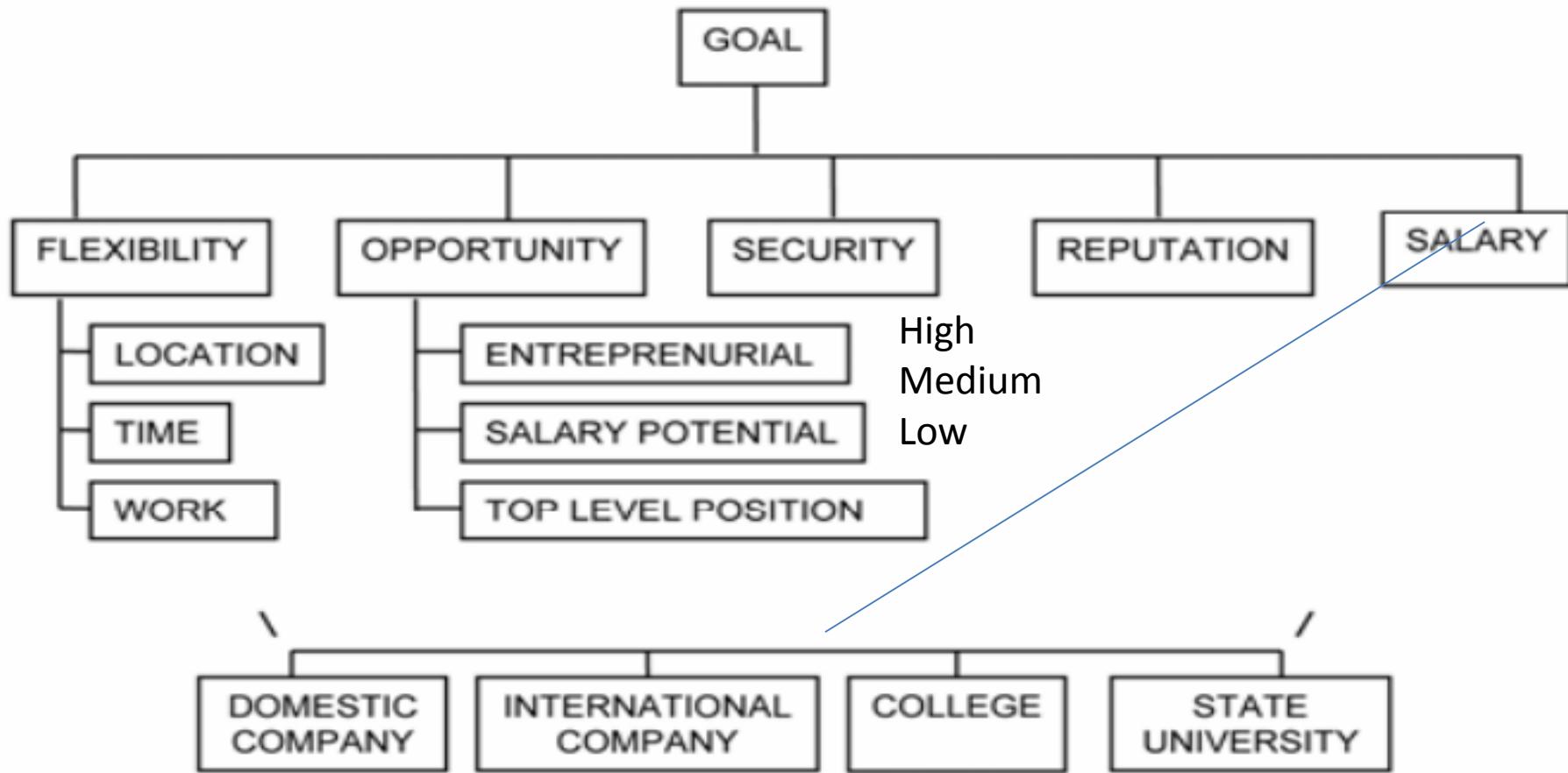
Table : Consistency index (CI) and consistency ratio (CR) of all respondents

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

Table : Relative weights of the criteria and global priority



SELECT THE BEST JOB



Level 1:
Goal

Select the Best
Supplier

Level 2:
Criteria

Quality

Cost

Delivery

Level 3:
Sub-Criteria

Remedy for
Quality
Problems

Rejection Rate
from QC

Cost Reduction

Compliance with
Due Date

Compliance with
Quantity

Level 4:
Rating Scale

1

2

3

4

5

Level 5:
Alternatives

Supplier 1

Supplier 2

Supplier 3

Supplier 4

Supplier 5

Supplier 6

Supplier 7

Supplier 8



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Project Management for Managers

Lec – 11

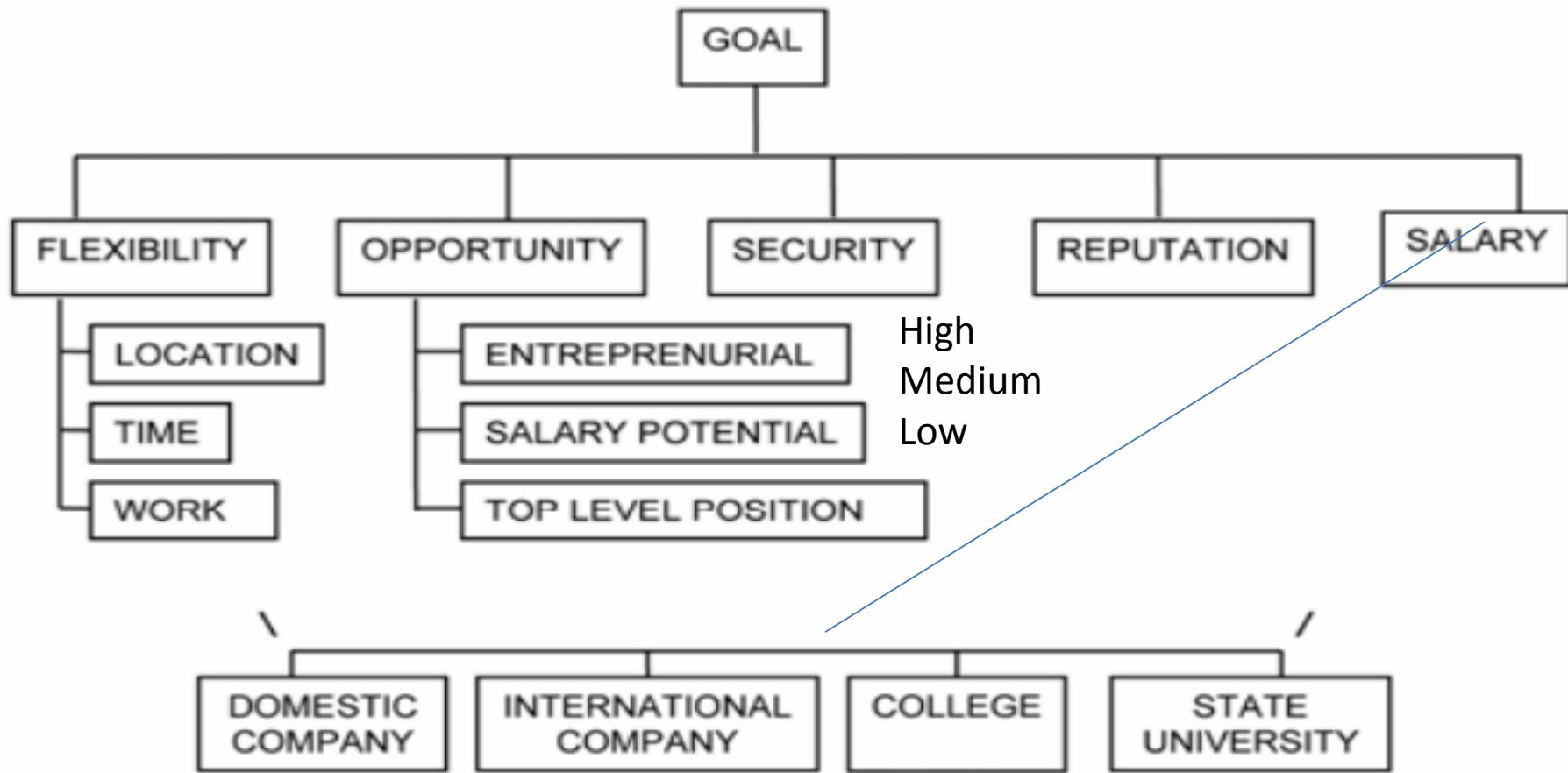
Methods of Project Selection (MCDM – II)

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SELECT THE BEST JOB



Level 1:
Goal

Select the Best
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Criteria

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2

3

4

5

Level 5:
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Supplier 1

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Supplier 4

Supplier 5

Supplier 6

Supplier 7

Supplier 8

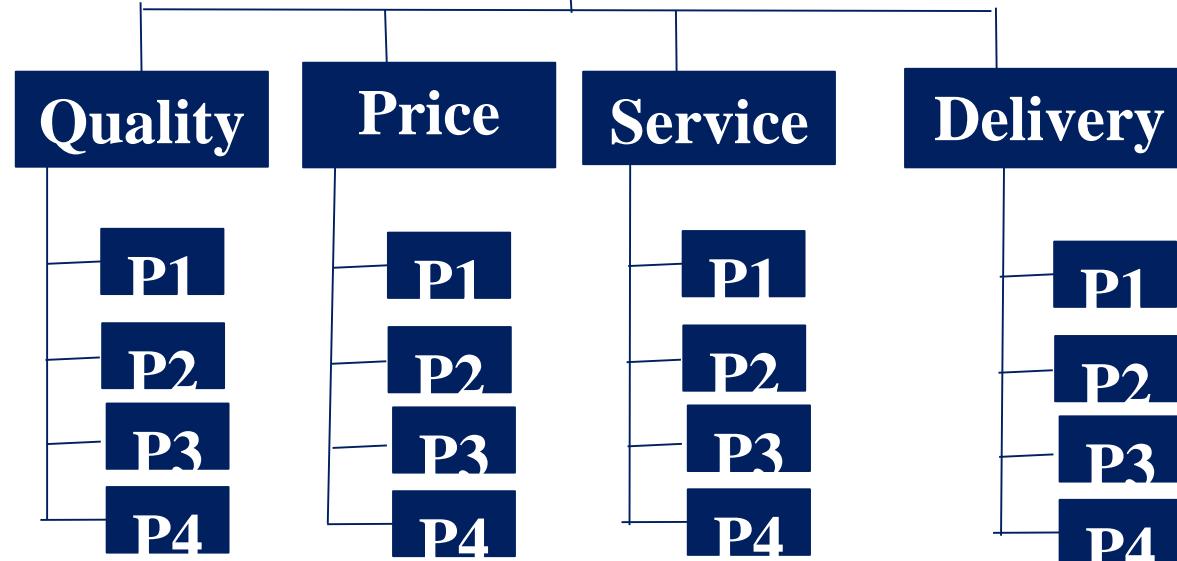


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Select the best project



Pair wise comparison matrix and computations: evaluation criteria

Original matrix	Quality	Price	Service	Delivery
Quality	1	2	4	3
Price		1	3	3
Service			1	2
Delivery				1



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Pair wise 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	Weights (row avg.)
Q	12/25	6/11	8/17	3/9	0.457
P	6/25	3/11	6/17	3/9	0.300
S	3/25	1/11	2/17	2/9	0.138
D	4/25	1/11	1/17	1/9	0.105
				Total	1.0



Supplier pair wise comparison matrices and priorities

A: wrt quality

	P1	P2	P3	P4	Wts
P1	1	5	6	1/3	?
P2		1	2	1/6	?
P3			1	1/8	?
P4				1	?

A: wrt price

	P1	P2	P3	P4	Wts
P1	1	1/3	5	8	?
P2		1	7	9	?
P3			1	2	?
P4				1	?



Supplier pair wise comparison matrices and priorities

A: wrt service

	P1	P2	P3	P4	Wts
P1	1	5	4	8	?
P2		1	1/2	4	?
P3			1	5	?
P4				1	?

A: wrt delivery

	P1	P2	P3	P4	Wts
P1	1	3	1/5	1	?
P2		1	1/8	1/3	?
P3			1	5	?
P4				1	?



Calculation of the weights A: wrt quality

	P1	P2	P3	P4
P1	1.00	5.00	6.00	0.33
P2	0.20	1.00	2.00	0.17
P3	0.17	0.50	1.00	0.13
P4	3.00	6.00	8.00	1.00
Column total	4.37	12.50	17.00	1.63

	P1	P2	P3	P4
P1	1/4.37	5.00/12.50	6.00/17	0.33/1.63
P2	0.20/4.37	1.00/12.50	2.00//17	0.17/1.63
P3	0.17/4.37	0.50/12.50	1.00//17	0.13/1.63
P4	3.00/4.37	6.00/12.50	8.00//17	1.00/1.63

	P1	P2	P3	P4	Row Sum	Normalized
P1	0.229008	0.4	0.352941	0.205128	1.187077	0.296769
P2	0.045802	0.08	0.117647	0.102564	0.346013	0.086503
P3	0.038168	0.04	0.058824	0.076923	0.213915	0.053479
P4	0.687023	0.48	0.470588	0.615385	2.252996	0.563249



A wrt Price

	P1	P2	P3	P4
P1	1.00	0.33	5.00	8.00
P2	3	1	7	9
P3	0.166667	0.142857	1	2
P4	0.125	0.111111	0.5	1
Column Sum	4.29	1.59	13.50	20.00

	P1	P2	P3	P4	Row Sum	Normalized
P1	0.23301	0.21	0.37037	0.4	1.213380079	0.30334502
P2	0.699029	0.63	0.518519	0.45	2.297547645	0.574386911
P3	0.038835	0.09	0.074074	0.1	0.302909026	0.075727256
P4	0.029126	0.07	0.037037	0.05	0.186163251	0.046540813



Supplier pair wise comparison matrices and priorities

A: wrt quality

	P1	P2	P3	P4	Wts
P1	1	5	6	1/3	0.297
P2		1	2	1/6	0.08
P3			1	1/8	0.53
P4				1	0.563

A: wrt price

	P1	P2	P3	P4	Wts
P1	1	1/3	5	8	0.303
P2		1	7	9	0.573
P3			1	2	0.078
P4				1	0.046

A: wrt service

	P1	P2	P3	P4	Wts
P1	1	5	4	8	0.597
P2		1	1/2	4	0.140
P3			1	5	0.214
P4				1	0.050

A: wrt delivery

	P1	P2	P3	P4	Wts
P1	1	3	1/5	1	0.151
P2		1	1/8	1/3	0.060
P3			1	5	0.638
P4				1	0.151



Computation of weights: supplier alternatives

Adjusted matrix	Weights (row avg.)
Quality	0.457
Price	0.300
Service	0.138
Delivery	0.105

	Quality	Price	Service	Delivery	Wts (Q*P*S*D)
P1	.457*.297	.300*.303	.138*.597	.105*.151	.325
P2	.457*.087	.300*.573	.138*.140	.105*.060	.237
P3	.457*.053	.300*.078	.138*.214	.105*.638	.144
P4	.457*.563	.300*.046	.138*.050	.105*.151	.294



TOPSIS METHOD



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TOPSIS METHOD

Technique of Order Preference by Similarity to Ideal Solution

This method considers three types of attributes or criteria

- Qualitative **benefit** attributes/criteria
- Quantitative **benefit** attributes/criteria
- **Cost** attributes or criteria



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- In this method **two artificial alternatives** are hypothesized:
- **Ideal** alternative: the one which has the **best level** for all attributes considered.
- **Negative** ideal alternative: the one which has the worst attribute values.
- TOPSIS selects the alternative that is **closest** to the **ideal** solution and **farthest** from **negative** ideal alternative.



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Input to TOPSIS

- TOPSIS assumes that we have m **alternatives** (options) and n **criteria** and we have the **score** of each option with respect to each criterion.
- Let x_{ij} score of option i with respect to criterion j
We have a matrix $X = (x_{ij})$ $m \times n$ matrix.
- Let J be the set of **benefit attributes** or criteria (more is better???)
- Let J' be the set of **negative attributes** or criteria (less is better???)



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Steps of TOPSIS

- Step 1: Construct **normalized** decision matrix.
- This step transforms various attribute dimensions **into non-dimensional attributes**, which allows comparisons across criteria.
- Normalize scores or data as follows:

$$r_{ij} = x_{ij} / (\sum x_{ij}^2) \text{ for } i = 1, \dots, m; j = 1, \dots, n$$



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- Step 2: Construct the **weighted** normalized decision matrix.
- Assume we have a set of weights for each criteria w_j for $j = 1, \dots, n$.
- Multiply each column of the **normalized** decision **matrix** by its associated **weight**.
- An element of the new matrix is:

$$V_{ij} = w_j r_{ij}$$



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- Step 3: Determine the **ideal and negative** ideal solutions.
- **Ideal** solution.

$A^* = \{ v_1^*, \dots, v_n^* \}$, where

$$v_j^* = \left\{ \max_i (v_{ij}) \text{ if } j \in J ; \min_i (v_{ij}) \text{ if } j \in J' \right\}$$

- **Negative** ideal solution.

$A' = \{ v_1', \dots, v_n' \}$, where

$$v' = \left\{ \min_i (v_{ij}) \text{ if } j \in J ; \max_i (v_{ij}) \text{ if } j \in J' \right\}$$



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- Step 4: Calculate the **separation** measures for each alternative.
- The separation from the **ideal** alternative is:
$$S_i^* = \left[\sum_j (v_j^* - v_{ij})^2 \right]^{1/2} \quad i = 1, \dots, m$$
- Similarly, the separation from the **negative ideal** alternative is:
$$S'_i = \left[\sum_j (v_j' - v_{ij})^2 \right]^{1/2} \quad i = 1, \dots, m$$



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- Step 5: Calculate the relative closeness to the ideal solution C_i^*

$$C_i^* = S'_i / (S_i^* + S'_i) , \quad 0 < C_i^* < 1$$

Select the option with C_i^* closest to 1.



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Applying TOPSIS Method to Example

Weight	0.1	0.4	0.3	0.2
	Style	Reliability	Fuel Eco.	Cost
Civic	7	9	9	8
Saturn	8	7	8	7
Ford	9	6	8	9
Mazda	6	7	8	6



Applying TOPSIS to Example

- $m = 4$ alternatives (car models)
- $n = 4$ attributes/criteria
- $x_{ij} = \text{score of option } i \text{ with respect to criterion } j$
 $X = \{x_{ij}\}$ 4×4 score matrix.
- J = set of **benefit** attributes: style, reliability, fuel economy
(more is better)
- J' = set of **negative** attributes: cost (less is better)



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Steps of TOPSIS

- Step 1(a): calculate $(\sum x_{ij})^{1/2}$ for each column

	Style	Rel.	Fuel	Cost
Civic	49	81	81	64
Saturn	64	49	64	49
Ford	81	36	64	81
Mazda	36	49	64	36
$\sum x_{ij}$	230	215	273	230
$(\sum x)^{1/2}$	15.17	14.66	16.52	15.17



Steps of TOPSIS

- Step 1 (b): divide each column by $(\sum x_{ij}^2)^{1/2}$ to get r_{ij}

	Style	Rel.	Fuel	Cost
Civic	0.46	0.61	0.54	0.53
Saturn	0.53	0.48	0.48	0.46
Ford	0.59	0.41	0.48	0.59
Mazda	0.40	0.48	0.48	0.40

????



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Steps of TOPSIS

- Step 1 (b): divide each column by $(\sum x_{ij}^2)^{1/2}$ to get r_{ij}

	Style	Rel.	Fuel	Cost
Civic	0.46	0.61	0.54	0.53
Saturn	0.53	0.48	0.48	0.46
Ford	0.59	0.41	0.48	0.59
Mazda	0.40	0.48	0.48	0.40

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- Step 2 : multiply each column by w_j to get v_{ij} .

Weight	0.1	0.4	0.3	0.2
	Style	Rel.	Fuel	Cost
Civic	0.046	0.244	0.162	0.106
Saturn	0.053	0.192	0.144	0.092
Ford	0.059	0.164	0.144	0.118
Mazda	0.040	0.192	0.144	0.080



- Step 3 (a): determine ideal solution A^* .

$$A^* = \{0.059, 0.244, 0.162, 0.080\}$$

	Style	Rel.	Fuel	Cost
Civic	0.046	0.244	0.162	0.106
Saturn	0.053	0.192	0.144	0.092
Ford	0.059	0.164	0.144	0.118
Mazda	0.040	0.192	0.144	0.080



- Step 3 (a): find negative ideal solution A'.

$$A' = \{0.040, 0.164, 0.144, 0.118\}$$

	Style	Rel.	Fuel	Cost
Civic	0.046	0.244	0.162	0.106
Saturn	0.053	0.192	0.144	0.092
Ford	0.059	0.164	0.144	0.118
Mazda	0.040	0.192	0.144	0.080



- Step 4 (a): determine separation from ideal solution

$$A^* = \{0.059, 0.244, 0.162, 0.080\}$$

$$S_i^* = [\sum (v_j^* - v_{ij})^2]^{1/2} \quad \text{for each row}$$

	Style	Rel.	Fuel	Cost
Civic	$(.046-.059)^2$	$(.244-.244)^2$	$(.162-.162)^2$	$(.106-.080)^2$
Saturn	$(.053-.059)^2$	$(.192-.244)^2$	$(.144-.162)^2$	$(.092-.080)^2$
Ford	$(.059-.059)^2$	$(.164-.244)^2$	$(.144-.162)^2$	$(.118-.080)^2$
Mazda	$(.040-.059)^2$	$(.192-.244)^2$	$(.144-.162)^2$	$(.080-.080)^2$



- Step 4 (a): determine separation from ideal solution S_i^*

	$\sum(v_j^* - v_{ij})^2$	$S_i^* = [\sum(v_i^* - v_{ij})^2]^{1/2}$
Civic	0.000845	0.029
Saturn	0.003208	0.057
Ford	0.008186	0.090
Mazda	0.003389	0.058



- Step 4 (b): find separation from negative ideal solution $A' = \{0.040, 0.164, 0.144, 0.118\}$

$$S_i' = [\sum_j (v_i' - v_{ij})^2]^{1/2} \text{ for each row}$$

	Style	Rel.	Fuel	Cost
Civic	$(.046-.040)^2$	$(.244-.164)^2$	$(.162-.144)^2$	$(.016-.0118)^2$
Saturn	$(.053-.040)^2$	$(.192-.164)^2$	$(0)^2$	$(.092-.118)^2$
Ford	$(.059-.040)^2$	$(.164-.164)^2$	$(0)^2$	$(0)^2$
Mazda	$(.040-.040)^2$	$(.192-.164)^2$	$(0)^2$	$(.080-.118)^2$



- Step 4 (b): determine separation from negative ideal solution S_i'

$$\sum(v_j' - v_{ij})^2 \quad S_i' = [\sum(v_j' - v_{ij})^2]^{1/2}$$

Civic	0.006904	0.083
Saturn	0.001629	0.040
Ford	0.000361	0.019
Mazda	0.002228	0.047



- Step 5: Calculate the relative closeness to the ideal solution $C_i^* = S'_i / (S_i^* + S'_i)$

	$S'_i / (S_i^* + S'_i)$	C_i^*		
Civic	0.083/0.112	0.74	←	BEST
Saturn	0.040/0.097	0.41		
Ford	0.019/0.109	0.17		
Mazda	0.047/0.105	0.45		





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Project Management for Managers

Lec – 12

Methods of Project Selection (MCDM – III)

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Solve by TOPSIS

Fighter Aircraft Selection

	Speed	Range	Payload	Cost	Reliability	Maneuverability
	X1	X2	X3	X4	X5	X6
A1	2	1500	20000	5.5	5	9
A2	2.5	2700	18000	6.5	3	5
A3	1.8	2000	21000	4.5	7	7
A4	2.2	1800	20000	5.5	5	5



Data available

	Speed	Range	Pay load	Cost	Reliability	Maneuverability
	X1	X2	X3	X4	X5	X6
A1	2	1500	20,000	5.5	5	9
A2	2.5	2700	18,000	6.5	3	5
A3	1.8	2000	21,000	4.5	7	7
A4	2.2	1800	20,000	5	5	5

$m = 4$ alternatives (Aircraft models)

$n = 6$ attributes/criteria



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Step 1: Obtain the decision matrix

- In-order to make calculations easier, replace the higher values with its equivalent power

	Speed	Range(x10^3)	Pay load (x10^4)	Cost	Reliability	Maneuverability
	X1	X2	X3	X4	X5	X6
A1	2.0	1.5	2.0	5.5	5	9
A2	2.5	2.7	1.8	6.5	3	5
A3	1.8	2.0	2.1	4.5	7	7
A4	2.2	1.8	2.0	5.0	5	5



$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}}$$

Step 1(a): calculate $(\sum x_{ij}^2)^{1/2}$ for each column

	x1	x2	x3	x4	x5	x6
A1	4.0	2.25	4.0	30.25	25	81
A2	6.25	7.29	3.2	42.25	9	25
A3	3.24	4.0	4.4	20.25	49	49
A4	4.84	3.24	4.0	25.0	25	25
$\sum x_{ij}^2$	18.33	16.78	15.65	117.75	108.00	180.00
$(\sum x^2)^{1/2}$	4.28	4.096	3.956	10.851	10.392	13.416



Step 1 (b): divide each column by
 $(\sum x_{ij}^2)^{1/2}$ to get R_{ij}

	X1	X2	X3	X4	X5	X6
A1	0.4672	0.3662	0.5056	0.5063	0.4811	0.6708
A2	0.5839	0.6591	0.4550	0.5983	0.2887	0.3727
A3	0.4204	0.4882	0.5308	0.4143	0.6736	0.5217
A4	0.5139	0.4392	0.5056	0.4603	0.4811	0.3727



Step 2 : Obtain the weighted decision matrix V_{ij} by multiplying each column of R_{ij} by the corresponding weight

$$V_{ij} = W_{ij} \times R_{ij}$$

Weight	0.2	0.1	0.1	0.1	0.2	0.3
	X1	X2	X3	X4	X5	X6
A1	0.0934	0.0366	0.0506	0.0506	0.0962	0.2012
A2	0.1168	0.0659	0.0455	0.0598	0.0577	0.1118
A3	0.0841	0.0488	0.0531	0.0414	0.1347	0.1565
A4	0.1028	0.0439	0.0506	0.046	0.0962	0.1118



Ideal and Negative Ideal solution

- Step 3: Obtain the ideal (A^*) and the negative ideal (A^-) solutions from the weighted decision matrix V .

	X1	X2	X3	X4	X5	X6
A1	0.0934	0.0366	0.0506	0.0506	0.0962	0.2012
A2	0.1168	0.0659	0.0455	0.0598	0.0577	0.1118
A3	0.0841	0.0488	0.0531	0.0414	0.1347	0.1565
A4	0.1028	0.0439	0.0506	0.046	0.0962	0.1118

- $A^* = (0.1168, 0.0659, 0.0531, 0.0414, 0.1347, 0.2012)$
- $A^- = (0.0841, 0.0366, 0.0455, 0.0598, 0.0577, 0.1118)$



Step 4 : Separation Measures

Determine **separation** from ideal solution

$$A^* = (0.1168, 0.0659, 0.0531, 0.0414, 0.1347, 0.2012)$$

$$S_i^* = [\sum (v_i^* - v_{ji})^2]^{1/2} \text{ for each row}$$

Ideal solution	Ideal solution
$S1^* = 0.0545$	$S1^- = 0.0983$
$S2^* = 0.1197$	$S2^- = 0.0439$
$S3^* = 0.0580$	$S3^- = 0.0920$
$S4^* = 0.1009$	$S4^- = 0.0458$



Step 5: Relative closeness to the Ideal Solution

For each alternative, calculate the relative closeness to the ideal solution

$$C_i^* = S'_i / (S_i^* + S'_i)$$

$S'_i / (S_i^* + S'_i)$	C_i^*	
$0.0983/(0.0545+0.0983)$	0.6433	← BEST
$0.0439/(0.1197+0.0439)$	0.2683	
$0.092/(0.058+0.092)$	0.6133	
$0.0458/(0.1009+0.0458)$	0.3122	



Ranking/Preference Order

NOTE : The closeness rating is a number between **0** and **1**, with **0 being the worst possible** and **1 the best possible solution**)

Thus the ranks for the alternatives in the fighter aircraft selection problem using TOPSIS as

A1, A3, A4, A2



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Market and Demand Analysis

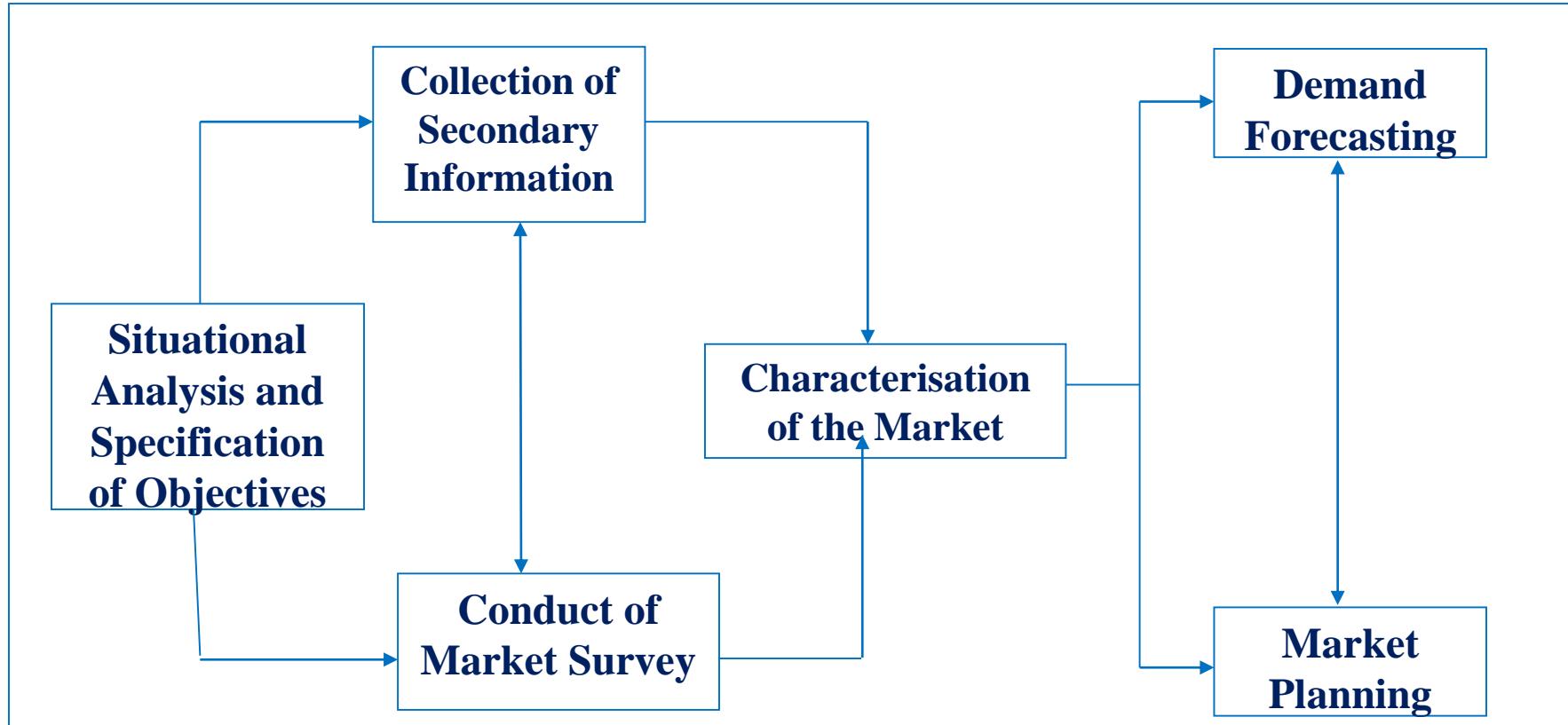


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Key Steps in Market and Demand Analysis and their Inter-relationships



Situational Analysis

In order to get a “feel” of the relationship between the product and its market, the project analyst may informally talk to customers, competitors, middlemen, and others in the industry.

Wherever possible, he may look at the experience of the company to learn about the preferences and purchasing power of customers, actions and strategies of competitors, and practices of the middlemen.



Collection of Secondary Information

- Secondary information is information that has been gathered in some other context and is readily available.
- Secondary information provides the base and the starting point for the market and demand analysis. It indicates what is known and often provides leads and cues for gathering primary information required for further analysis.



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Sources of secondary data???????????



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Evaluation of Secondary Information

Criteria	Issues	Remarks
Specifications & Methodology	Data collection method, response rate, quality & analysis of data, sampling technique & size, questionnaire design, fieldwork.	Data should be reliable, valid, & generalizable to the problem.
Error & Accuracy	Examine errors in approach, research design, sampling, data collection & analysis, & reporting. Time lag between collection & publication, frequency of updates.	Assess accuracy by comparing data from different sources.
Currency		Census data are updated by syndicated firms.
Objective	Why were the data collected?	The objective determines the relevance of data.
Nature	Definition of key variables, units of measurement, categories used, relationships examined.	Reconfigure the data to increase their usefulness.
Dependability	Expertise, credibility, reputation, & trustworthiness of the source.	Data should be obtained from an original source.



Evaluation of Secondary Information

While secondary information is available economically and readily (provided the market analyst is able to locate it), its reliability, accuracy, and relevance for the purpose under consideration must be carefully examined.



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Market Survey

- Secondary information, though useful, often does not provide a comprehensive basis for market and demand analysis.
- It needs to be supplemented with primary information gathered through a market survey.
- The market survey may be a census survey or a sample survey; typically it is the latter.



What Information is Sought in a Market Survey?????



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Information Sought in a Market Survey

The information sought in a market survey may relate to one or more of the following:

- Total demand and rate of growth of demand
- Demand in different segments of the market
- Income and price elasticities of demand
- Motives for buying
- Purchasing plans and intentions
- Satisfaction with existing products
- Unsatisfied needs
- Attitudes toward various products
- Distributive trade practices and preferences
- Socio-economic characteristics of buyers



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Steps in a Sample Survey

Typically, a sample survey involves the following steps:

1. Define the target population (elements, sampling unit, extent, time: Men's DO).
2. Select the sampling scheme and sample size.
3. Develop the questionnaire.
4. Recruit and train the field investigators.
5. Obtain information as per the questionnaire from the sample of respondents.
6. Scrutinize the information gathered.
7. Analyze and interpret the information.



Characterization of the Market

Based on the information gathered from secondary sources and through the market survey, the market for the product/service may be described in terms of the following:

- Effective demand in the past and present
- Breakdown of demand
- Price
- Methods of distribution and sales promotion
- Consumers
- Supply and competition
- Government policy





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Project Management for Managers

Lec – 13

Market and Demand Analysis - I

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Methods of Demand Forecasting

I Qualitative Methods : These methods rely essentially on the judgment of experts to translate qualitative information into quantitative estimates. The important qualitative methods are :

- Jury of executive method
- Delphi method

II Quantitative Methods: These methods generate forecasts on the basis of an analysis of the historical time series . The important time series projection methods are :

- Trend projection –method
- Exponential smoothing method
- Moving average method

III Causal Methods : More analytical than the preceding methods, causal methods seek to develop forecasts on the basis of cause-effect relationships specified in an explicit, quantitative manner. The important causal methods are :

- Chain ratio method
- Consumption level method
- End use method
- Leading indicator method
- Econometric method

IV Simulation



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Qualitative Methods

Jury of Executive Opinion Method

This method involves soliciting the opinion of a group of managers on expected future sales and combining them into a sales estimate

Pros

- It is an expeditious method
- It permits a wide range of factors to be considered
- It appeals to managers

Cons

- The biases cannot be unearthed easily
- Its reliability is questionable



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Qualitative Methods

Delphi Method

This method is ??????????????



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Delphi Method

This method is used for eliciting the opinions of a group of experts with the help of a mail survey. The steps involved in this method are :

1. A group of experts is sent a questionnaire by mail and asked to express their views.
2. The responses received from the experts are summarised without disclosing the identity of the experts, and sent back to the experts, along with a questionnaire meant to probe further the reasons for extreme views expressed in the first round.
3. The process may be continued for one or more rounds till a reasonable agreement/disagreement emerges in the view of the experts.



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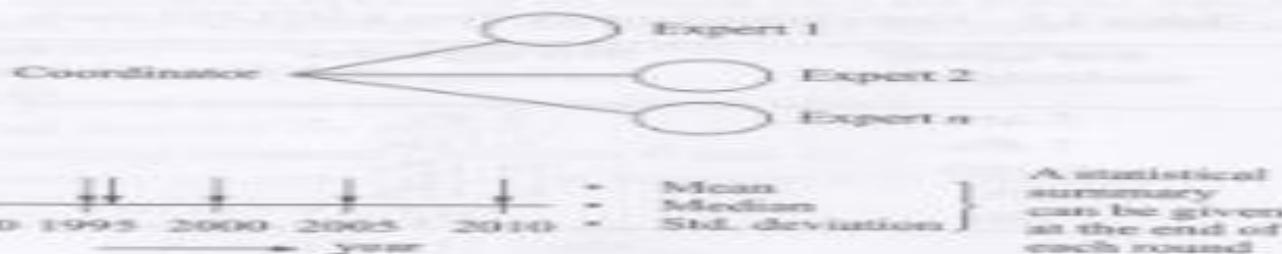


Fig. 3.2 Composition of a DELPHI panel with initial responses.



Fig. 3.3 DELPHI panelists moving successively towards consensus.



Fig. 3.4 Emergence of diverging viewpoints in DELPHI.



Pros

- It is intelligible to users
- It seems to be more accurate and less expensive than the traditional face-to-face group meetings

Cons

There are some question marks: What is the value of the expert opinion? What is the contribution of additional rounds and feedback to accuracy?



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Quantitative Methods

Trend Projection Method

The trend projection method involves:

- (a) determining the trend of consumption by analysing past consumption statistics and
- (b) projecting future consumption by extrapolating the trend.



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Trend Projection Method

Linear relationship: $Y_t = a + bt$

Exponential relationship: $Y_t = ae^{bt}$

Polynomial relationship: $Y_t = a_0 + a_1 t + a_2 t^2 \dots \dots a_n t^n$

Cobb Douglas relationship: $Y_t = at^b$



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Age (x)	Repair expenses (y)
5	7
3	7
3	6
1	4

What would be expenses for a 4 years old truck.



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	Age (x)	Repair expenses (y)	xy	x ²
	5	7	35	25
	3	7	21	9
	3	6	18	9
	1	4	4	1
Total	12	24	78	44

$$\bar{x} = 3, \bar{y} = 6$$

$$a = \bar{Y} - b\bar{X} = 3.75$$

$$b = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum X^2 - n\bar{X}^2} = 0.75$$



$$Y = 3.75 + 0.75(4) = 6.75$$



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Moving Average Method

As per the moving average method of sales forecasting, the forecast for the next period is equal to the average of the sales for several preceding periods.

In symbols,

$$F_{t+1} = \frac{S_t + S_{t-1} + \dots + S_{t-n+1}}{n}$$

Where F_{t+1} = forecast for the next period

S_t = sales for the current period

n = period over which averaging is done



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Moving Average

Year	Demand	4 MA
2010	32	
2011	36	
2012	40	
2013	35	
2014	32	35.75
2015	35	35.75
2016	45	35.5
For 2017		36.75



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Project Management for Managers

Lec – 14

Market and Demand Analysis - II

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Exponential Smoothing Method

In exponential smoothing, forecasts are modified in the light of observed errors. If the forecast value for year t, F_t , is less than the actual value for year t, S_t , the forecast for the year t+1, F_{t+1} , is set higher than F_t . If $F_t > S_t$, F_{t+1} is set lower than F_t . In general.

$$F_{t+1} = F_t + \alpha e_t$$

where F_{t+1} = forecast for year $t + 1$

α = smoothing parameter (which lies between 0 and 1)

e_t = error in the forecast for year t = $S_t - F_t$



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Determine the forecast for 2017 by exponential smoothing method. Given $\alpha = 0.6$. Assume forecast for 2010 as 32.

Year	Demand
2010	32
2011	36
2012	40
2013	35
2014	32
2015	35
2016	45



Determine the forecast for 2017 by exponential smoothing method. Given $\alpha = 0.6$

Year	Demand	Forecast	Error (e)	$e^*\alpha$
2010	32	32	0	0
2011	36	32	4	2.4
2012	40	34.4	5.6	3.36
2013	35	37.76	-2.76	-1.66
2014	32	36.10	-4.10	-2.46
2015	35	33.64	1.36	.82
2016	45	34.46	10.54	6.33
For 2017		34.46+6.33=40.79		

$$32+2.4=34.4$$



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Measures of Forecast Error

- Forecast error = $E_t = F_t - D_t$

- Mean squared error (MSE)

$$MSE_n = (\text{Sum}_{(t=1 \text{ to } n)} [E_t^2]) / n$$

MSE - estimates the variance of the error

- Absolute deviation = $A_t = |E_t|$

- Mean absolute deviation (MAD)

$$MAD_n = (\text{Sum}_{(t=1 \text{ to } n)} [A_t]) / n$$

- Mean absolute percentage error (MAPE)- is the **average absolute error as a % of demand** and is as follows



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MAPE by SA

Year	Demand	4MA	Error (e)	Absolute error	MAD	% Error (Abs Error/Dema nd) *100	MAPE
2008	32						
2009	36						
2010	40						
2011	35						
2012	32	35.75	-3.75	3.75	3.75	11.71	11.71
2013	35	35.75	-0.75	0.75	2.25	2.14	6.92
2014	45	35.5	9.5	9.5	4.66	21.11	11.65
For 2015		36.75					



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MAPE by SES

Year	Demand	Fore cast	Error (e)	Absolute error	MAD	% Error (Abs Error/Demand) *100	MAPE
2008	32	32	0	0	0	0	0
2009	36	32	4	4	2	11.11	5.55
2010	40	34.4	5.6	5.6	3.2	14	8.37
2011	35	37.76	-2.76	2.76	3.1	7.8	8.22
2012	32	36.10	-4.10	4.10	3.3	12.8	9.14
2013	35	33.64	1.36	1.36	3	3.8	8.25
2014	45	34.46	10.54	10.54	4.1	23.42	10.41
For 2015		34.46+6.33 =40.79					



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Example: Sales of wrist watches 25,32,24,28,26,27

Answers:

26,26,26 (Avg last 3,trend, outlier)

27,27 (avg of all, weights (1,2,3) to last 3)

28, (last 2 data show increase)

30 (population is increasing)

Depending on trends, use appropriate method and select the one which gives minimum error.



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Causal Methods

Chain Ratio Method

The potential sales of a product may be estimated by applying a series of factors to a measure of aggregate demand. For example, a company estimated the potential sales for a new product, a freeze-fried instant coffee (Maxim), in the following manner :

- Total amount of coffee sales : 174.5million units
- Proportion of coffee used at home : 0.835
- Coffee used at home : 145.7 million units
- Proportion of non-decaffeinated coffee used at home : 0.937
- Non-decaffeinated coffee used at home : 136.5 million units
- Proportion of instant coffee : 0.400
- Instant non-decaffeinated coffee used at home : 54.6 million units
- Estimated long-run market share for Maxim : 0.08
- Potential sales of Maxim : 4.37 million units



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Population: 130 crore

Proportion of Male:51%

Proportion of adult: 63%

Proportion of adults not shaving: 10%

Proportion of people using premium quality shaving blades : 20.5%

No of shaving per year:183

No of shaving per blade: 3

What is the demand of premium quality shaving blades?



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Consumption Level Method

The method estimates consumption level on the basis of elasticity coefficients, the important ones being the income elasticity of demand and the price elasticity of demand.



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Income Elasticity of Demand

The income elasticity of demand reflects the responsiveness of demand to variations in income. It is measured as follows :

$$E_I = \frac{\frac{Q_2 - Q_1}{Q_1} \times \frac{I_1 + I_2}{I_1}}{\frac{I_2 - I_1}{Q_2 + Q_1}}$$

where E_I = income elasticity of demand

Q_1 = quantity demanded in the base year

Q_2 = quantity demanded in the following year

I_1 = income level in the base year

I_2 = income level in the following year.



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Income Elasticity of Demand

Example: The following information is available on quantity demanded and income level: $Q_1 = 50$, $Q_2 = 55$, $I_1 = 1,000$ and $I_2 = 1,020$. What is the income elasticity of demand? The income elasticity of demand is :



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Income Elasticity of Demand

Example The following information is available on quantity demanded and income level: $Q_1 = 50$, $Q_2 = 55$, $I_1 = 1,000$ and $I_2 = 1,020$. What is the income elasticity of demand? The income elasticity of demand is :

$$E_I = \frac{\frac{55 - 50}{x}}{\frac{1,000 + 1,020}{55 + 50}} = 4.81$$
$$E_I = \frac{\frac{5}{x}}{\frac{2,020}{105}} = 4.81$$



Price Elasticity of Demand

The price elasticity of demand measures the responsiveness of demand to variations in price. It is defined as :

$$E_p = \frac{\frac{Q_2 - Q_1}{Q_1}}{\frac{P_2 - P_1}{P_1}}$$

where E_p = price elasticity of demand

Q_1 = quantity demanded in the base year

Q_2 = quantity demanded in the following year

P_1 = price per unit in the base year

P_2 = price per unit in the following year



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Price Elasticity of Demand

Example The following information is available about a certain product :

P_1 = Rs.600, Q_1 = 10,000, P_2 = Rs. 800, Q_2 = 9,000.

What is the price elasticity of demand? The price elasticity of demand is :



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Price Elasticity of Demand

Example The following information is available about a certain product :

P_1 = Rs.600, Q_1 = 10,000, P_2 = Rs. 800, Q_2 = 9,000. What is the price elasticity of demand? The price elasticity of demand is :

$$E_p = \frac{\frac{9,000 - 10,000}{10,000}}{\frac{600 - 800}{600 + 800}} = \frac{-1}{\frac{-200}{1400}} = \frac{-1}{-\frac{1}{7}} = 7$$



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End Use Method

Suitable for estimating the demand for intermediate products, the end use method, also referred to as the consumption coefficient method, involves the following steps:

1. Identify the possible uses of the product.
2. Define the consumption coefficient of the product for various ses.
3. Project the output levels for the consuming industries.
4. Derive the demand for the product.



End Use Method

Projected Demand for Indchem

This method may be illustrated with an example. A certain industrial chemical, Indchem is used by four industries Alpha, Beta, Gamma, and Kappa.

The consumption coefficients for these industries, the projected output levels for these industries for the year X , and the projected demand for Indchem as shown in the following slide



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	<i>Consumption Coefficient *</i>	<i>Projected Output in year X</i>	<i>Projected Demand for Indchem in year X</i>
Alpha	2.0	10,000	20,000
Beta	1.2	15,000	18,000
Kappa	0.8	20,000	16,000
Gamma	0.5	30,000	15,000
		<i>Total</i>	<i>69,000</i>

**- This is expressed in tonnes of Indchem required per unit of output of the consuming industry*



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Leading Indicator Method

Leading indicators are variables which change ahead of other variables, the lagging variables. Hence, observed changes in leading indicators may be used to predict the changes in lagging variables.

For example, the change in the level of urbanisation (a leading indicator) may be used to predict the change in the demand for air conditioners (a lagging variable)

Ex: Temperatures- Demand of invertors.



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Leading Indicator Method

Two basic steps are involved in using the leading indicator method:

- (i) First, identify the appropriate leading indicator(s).
- (ii) Second, establish the relationship between the leading indicator(s) and the variable to be forecast.

The principal merit of this method is that it does not require a forecast of an explanatory variable. Its limitations are that it may be difficult to find appropriate leading indicator(s) and the lead-lag relationship may not be stable over time.



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Econometric Method

- An econometric model is a mathematical representation of economic relationship(s) derived from economic theory.
The primary objective of econometric analysis is to forecast the future behavior of the economic variables incorporated in the model.
- Two types of econometric models are employed: the single equation model and the simultaneous equation model.



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Single Equation Model

The single equation model assumes that one variable, the dependent variable (also referred to as the explained variable), is influenced by one or more **independent variables** (also referred to as the explanatory variables). In other words, one-way causality is postulated. An example of the single equation model is given below:

$$D_t = a_0 + a_1 P_t + a_2 N_t$$

where D_t = demand for a certain product in year t

P_t = price for the product in year t

N_t = income in year t



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Simultaneous Equation Model

The simultaneous equation model portrays economic relationships in terms of two or more equations. Consider a highly simplified three-equation econometric model of Indian economy.

$$\begin{aligned} GNP_t &= G_t + I_t + C_t \\ I_t &= a_0 + a_1 GNP_t \\ C_t &= b_0 + b_1 GNP_t \end{aligned}$$

where GNP_t = gross national product for year t

I_t = gross investment for year t

C_t = consumption for year t

G_t = governmental purchases for year t



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Strategic advantage approach:

International price

Export potential

Domestic Price

Domestic Price

Import threat

International price

Price

Quality

Value addition

Brand image



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Uncertainties in Demand Forecasting

Demand forecasts are subject to error
and uncertainty which arise from
?????????



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Uncertainties in Demand Forecasting

- **Data about past and present market:** Lack of standardization, few observations, influence of abnormal factors
- **Methods of forecasting:** Inability to handle unquantifiable factors, Unrealistic assumptions, Excessive data requirements.
- **Environmental change:** technological change, shift in Govt. policy, development of international scene (OPEC), discovery of sources of raw material, quality of Monsoon.



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Project Management for Managers

Lec – 15

Financial Analysis

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Financial Analysis



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Financial Feasibility : Ratio Analysis

Return on investment: This measures overall return on overall investments.

$$\text{ROI} = (\text{EBIT} - \text{Tax}) / (\text{Investment})$$

EBIT= Earning before interest and taxes.

Return on equity: This measures return for shareholders.

$$\text{ROE} = (\text{EAT} - \text{Preferential dividend}) / (\text{Equity})$$

EAT= Earning after tax

Operating profit margin: This measures the profitability in its gross terms.

$$\text{OPM} = \text{EBIT} / \text{Sales}$$

Net profit margin: This measures profitability in its true terms.

$$\text{NPM} = \text{EAT} / \text{Sales}$$

Rs.1000 today or next month.



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Ex: 1000 today or next month.

Ex: 1000 today or next month if
“interest rate” = 20 %



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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



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Capital budgeting, or **investment appraisal**, is the planning process used to determine whether an organization's long term **investments such as**

- new **machinery**,
- **replacement machinery**,
- new **plants**,
- new **products**, and
- research **development** projects

are worth the funding of cash through the firm's capitalization structure.



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CAPITAL BUDGETING TECHNIQUES

Non discounting

PBP

ARR

Discounting

Discounted PBP

NPV

Profitability index

Internal rate of return

Discounting techniques **take time value of money** into account.

Non-discounting techniques are those techniques which do **not consider time value of money**.



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PBP ???????



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

Example (PBP)

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

Find : PBP ??



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$$PBP = Y_0 - \frac{(CuCF_0)}{(CF_1)}$$

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

$CuCF_0$ = cumulative cash flow of Y_0

CF_1 = cash flow of pay back year



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Initial investment		300000
Annual cost of operation		20000
Expected annual revenues		
	first two years	100000
	next three years	200000
Planning horizon		5 yrs
Year	Cash flow	CuCF0
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



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Payback Period

Payback period is the length of time required to recover the initial outlay on the project

XYZ Enterprise's Capital Project

Year	Cash flow	Cumulative cash flow
0	-100	-100
1	34	- 66
2	32.5	-33.5
3	31.37	- 2.13
4	30.53	28.40

Find PBP



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$$\text{PBP} = 3 - (-2.13/30.53) = 3.06 \text{ yrs}$$



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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 5th 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??**



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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??**

Year	Cash flow	CuCF0
0	-140	-140
1	30	-110
2	40	-70
3	50	-20
4	60	40
5	45	85

$$BPB = 3 - (-20/60) = 3.33 \text{ yrs or } 3 \text{ yrs } 4\text{months}$$



Example: Compare following projects using PBP

Year	Project A (CuCF0)	Project B (CuCF0)	Project C (CuCF0)
0	-110	-110	-110
1	20	20	0
2	30	30	0
3	40	40	90
4	30	30	30
5	20	20	20
6	20	10	20

Which project is best and why???



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Project A			Project B			Project C		
Year	Cash flow	(CuCF0)	Year	Cash flow	(CuCF0)	Year	Cash flow	(CuCF0)
0	-110	-110	0	-110	-110	0	-110	-110
1	20	-90	1	20	-90	1	0	-110
2	30	-60	2	30	-60	2	0	-110
3	40	-20	3	40	-20	3	90	-20
4	30	10	4	30	10	4	30	10
5	20	30	5	20	30	5	20	30
6	20	50	6	10	40	6	20	50

$$\text{PBP} = 3 - (-20/30) = 3.33 \text{ yrs}$$



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

A better than B, additional 10 lac, PBP is same for all three projects 3yrs and 8 months

A better than C, **early recovery**. 20lac in first year will fetch interest for 2 years and 30 lac (second year) will fetch interest for 1 year. An example depicts drawback of PBP



Pros

- Simple
- Rough and ready method for dealing with risk
- Emphasizes earlier cash inflows



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Drawbacks of PBP

1. Does not consider WC and salvage value
2. Does not consider cash flows after the PBP
3. Does not consider time value of money
4. No consideration for risk
5. Ignores cost of capital
6. It measures project's capital recovery, not profitability



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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

$$= \frac{1}{2} (\text{initial investment} + \text{terminal cash flow})$$

$$= \frac{1}{2} \{(\text{fixed investment} + \text{WC}) + (\text{WC} + \text{SV})\}$$

$$= \text{WC} + \frac{1}{2} (\text{FI} + \text{SV})$$

FI= fixed investment, WC =working capital, SV =salvage value



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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



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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
Total earnings	36,875	36,875
Estimated life	5 years	5 years
Estimated salvage value	3,000	3,000

Which investment is better????



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ARR = Annual average net earnings after taxes X 100
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 = (Initial investment - Salvage Value) / 2 + Working capital + 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 : $7375/29562.50 * 100 = 24.95\% \text{ or } 25\%$

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

Machine A would be preferred as ARR is higher. However, if we use previous method , then machine B is better.



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Project Management for Managers

Lec – 16

Capital Budgeting techniques- I

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Average income after tax but before interest

D : **Average investment**

Average income before interest and taxes

E : **Initial investment**

Average income before interest and taxes

F : **Average investment**

Total income after tax but before depreciation
– Initial investment

G : **(Initial investment / 2) x years**



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Year	Investment (Book value)	Depreciation	Income before Interest and Taxes	Interest	Income before Tax	Tax	Income after Tax
1	1.00	0.20	0.30	0.10	0.20	0.100	0.100
2	0.80	0.20	0.35	0.10	0.25	0.125	0.125
3	0.60	0.20	0.40	0.10	0.30	0.150	0.150
4	0.40	0.20	0.40	0.10	0.30	0.150	0.150
5	0.20	0.20	0.35	0.10	0.25	0.125	0.125
Sum	3.00	1.00	1.80	0.50	1.30	0.650	0.650
Average	0.60	0.20	0.36	0.10	0.26	0.130	0.130



Year	Investment (Book value)	Depreciation	Income before Interest and Taxes	Interest	Income before Tax	Tax	Income after Tax
1	1.00	0.20	0.30	0.10	0.20	0.100	0.100
2	0.80	0.20	0.35	0.10	0.25	0.125	0.125
3	0.60	0.20	0.40	0.10	0.30	0.150	0.150
4	0.40	0.20	0.40	0.10	0.30	0.150	0.150
5	0.20	0.20	0.35	0.10	0.25	0.125	0.125
Sum	3.00	1.00	1.80	0.50	1.30	0.650	0.650
Average	0.60	0.20	0.36	0.10	0.26	0.130	0.130

Measures

A: $\frac{\text{Average income after tax}}{\text{Initial investment}} = \frac{0.13}{1.00} = 13.0\%$

B: $\frac{\text{Average income after tax}}{\text{Average investment}} = \frac{0.13}{0.60} = 21.7\%$

C: $\frac{\text{Average income after tax but before interest}}{\text{Initial investment}} = \frac{0.13 + 0.10}{1.0} = 23.0\%$

D: $\frac{\text{Average income after tax but before interest}}{\text{Average investment}} = \frac{0.13 + 0.10}{0.60} = 38.3\%$

E: $\frac{\text{Average income before interest and tax}}{\text{Initial investment}} = \frac{0.36}{1.0} = 36\%$

F: $\frac{\text{Average income before interest and tax}}{\text{Average investment}} = \frac{0.36}{0.60} = 60\%$

G:
$$\begin{aligned} &\text{Total income after tax but before depreciation} \\ &= \frac{-\text{Initial investment}}{(\text{Initial investment} / 2) \times \text{years}} = \frac{0.65 + 1.00 - 1.00}{1/2 \times 5} = 26.0\% \end{aligned}$$



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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

Discounted PBP

Profitability index

NPV

Internal rate of return



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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: ??????????????



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Future value: The **last cash flow** is generally called future value, it can be understood as 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: ??????????????????????



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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.



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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.



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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.



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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.



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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?

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



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



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

Period	Present value of an annuity of ₹ 1 paid for period t at a rate $k = [1 - 1/(1 + k)^t]/k$																			
	Rate																			
Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870

Solution: $120000 * 6.145$ (from table) = 737400.



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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



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Ex: Find DPBP ????, if discount factor is 10%

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

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Ex: FIND DPBP, if discount factor is 10%

Year	Cash flow	PVF	PV	CuPV
0	-140	1	-140	-140
1	30	$1/(1+0.10) = 0.90$	27	-113
2	40	$1/(1+0.10)^2 = 0.82$	33.04	-79.96
3	50	$1/(1+0.10)^3 = 0.75$	37.55	-42.41
4	60	$1/(1+0.10)^4 = 0.68$	40.98	-1.43
5	45	$1/(1+0.10)^5 = 0.62$	27.94	26.51

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



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Ex: Find DPBP ????, if DF=10%

Year	Cash flow
0	-300
1	80
2	80
3	180
4	180
5	180



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Net Present Value

NPV: NPV is the most common approach used in the field of financial investment analysis.

It is very **simple** to use and evaluate 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 **outflows** .



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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

1. Requires pre-determination of DF.
2. Does not consider risk factors.



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

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



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Determine PI and NPV, assuming DF as 10%

Year	Cash flow	PVF (10%)	PV
	-160	1	-160
1	30	$1/(1+0.10) = 0.9091$	27.27
2	40	$1/(1+0.10)^2 = 0.826$	33.06
3	0	$1/(1+0.10)^3 = 0.751$	37.57
4	60	$1/(1+0.10)^4 = 0.683$	40.57
5	100	$1/(1+0.10)^5 = 0.621$	62.09
Total			40.56

$$PI = 200.56/160 = 1.25$$

$$NPV = 200.56 - 160 = 40.56,$$

We should accept project.



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

Should we accept this project????



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Project Management for Managers

Lec – 17

Capital Budgeting techniques- II

Dr. M.K. Barua

Department of Management
Indian Institute of Technology Roorkee



Ex: Find DPBP ????, if discount factor is 10%

Year	Cash flow
0	-140
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Year	Cash flow	PVF	PV	CuPV
0	-140	1	-140	-140
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$$DPBP = 4 - (-1.43/27.94) = 4.05 \text{ yrs}$$



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Year	Cash flow
0	-300
1	80
2	80
3	180
4	180
5	180



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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
$DPBP = 3 - (-26.02/122.94) = 3.21\text{yrs}$				



Profitability index

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

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

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



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Net Present Value

NPV: NPV is the most common approach used in the field of financial investment analysis.

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It is defined as the **difference** b/w the **present value of cash inflows** and **present value of cash outflows** .



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

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



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Determine PI and NPV, assuming DF as 10%

Year	Cash flow	PVF (10%)	PV
	-160	1	-160
1	30	$1/(1+0.10) = 0.9091$	27.27
2	40	$1/(1+0.10)^2 = 0.826$	33.06
3	0	$1/(1+0.10)^3 = 0.751$	37.57
4	60	$1/(1+0.10)^4 = 0.683$	40.57
5	100	$1/(1+0.10)^5 = 0.621$	62.09
Total			40.56

$$PI = 200.56/160 = 1.25$$

$$NPV = 200.56 - 160 = 40.56,$$

We should accept project.



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Ex: Determine PI and NPV, assuming DF as 10%

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

Should we accept this project????



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Ex: Determine PI and NPV, assuming DF as 10%

Year	Cash flow	PVF	PV
0	-140	1	-140
1	30	$1/1.10 = 0.90$	27
2	40	$1/(1.10)^2=0.82$	33.04
3	50	0.75	37.55
4	60	0.68	40.98
5	45	0.62	27.94
Total			26.51

$$PI = 166.51/140 = 1.189$$

$$NPV = 166.51 - 140 = 26.51. \text{ Should we accept project????}$$



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Internal Rate of Return (IRR): IRR is defined as the discounting rate which delivers a Net Present Value equal to zero.

A simple criterion can be stated to **accept a project if its rate of return exceeds the cost of capital and rejected if this IRR is less than cost of capital.**

IRR may result in number of complexities: Neglects the **size** of the project and **assumes** that cash flows are **reinvested at constant rate**.

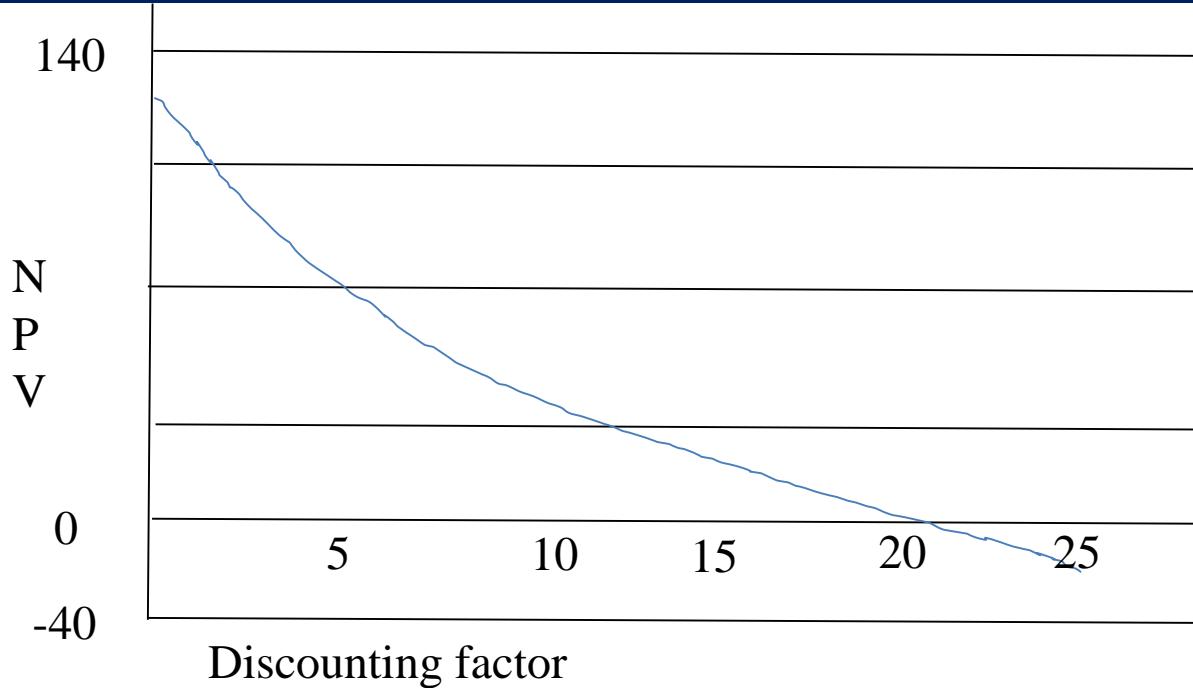


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The relationship b/w discounting rates and NPV is not a linear, and for calculation of exact IRR, this should be linear, can be assumed linear, if we take small piece.



Calculating IRR is a **tedious process**. It should be done with the help of **trial and error method**.

Continue **increasing “r” to decrease NPV till it reaches negative**.

And then interpolate b/w the consecutive “r” values where it is positive and negative, respectively.

The interpolation formula:

$$\text{IRR} = r_0 + (\text{NPV}_0) / (\text{NPV}_1 - \text{NPV}_0), \text{ Where}$$

r_0 = is the rate at which NPV is just positive,

NPV_0 = is just positive NPV,

NPV_1 = is just negative NPV



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Calculate IRR??

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

Let us try at 18% and then 17% , at 18% NPV is just negative.



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Year	Cash flow	18%		17 %	
		PVF	PV	PVF	PV
0	-160	1	-160	1	-160
1	30	1/1.18=.847	25.42	.855	25.64
2	40	1/(1.18) ² . = 718	28.73	.731	29.22
3	50	.609	30.43	.624	31.22
4	60	.516	30.95	.534	32.02
5	100	.437	43.71	.456	45.61
Total			-0.76		3.71

$$\text{IRR} = r_o + \frac{(\text{NPV}_o)}{(\text{NPV}_1 - \text{NPV}_o)},$$

$$\text{IRR} = 17 + 3.71 / (3.71 - (-0.76)) = 17.83\%$$



Discount rate 8%

Year	Cash Flow	PVF	PV
0	-1,000,000	1	-1,000,000
1	450,000	$1/(1+0.08)=0.92$	414000
2	400,000	$1/(1+0.08)^2=0.85$	340000
3	350,000	$1/(1+0.08)^3=0.79$	276500
4	300,000	$1/(1+0.08)^4=0.73$	219000
5	250,000	$1/(1+0.08)^5=0.68$	170000
NPV			419500

In the above example if you replace the 8% with a 25% the NPV will become zero, and that's your IRR. Hence, **the statement that IRR is the discount rate at which the NPV of a project becomes zero is true.**



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Discount rate 25%

Cash flow			PVF	PV
-10,00,000	1	1	1	-1000000
4,50,000	1	1.25	0.8	360000
4,00,000	1	1.5625	0.64	256000
3,50,000	1	1.953125	0.512	179200
3,00,000	1	2.44140625	0.4096	122880
2,50,000	1	3.051757813	0.32768	81920
NPV				0



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Selection of capital budgeting technique (NPV vs IRR) :
In capital budgeting , there are number of **different approaches** that can be used to **evaluate** any given project, and each approach has its own distinct **advantages and disadvantages** as discussed earlier.

All other things being equal, using IRR and NPV measurements to evaluate projects often results in the **same findings**.



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- Over time, discounted cash flow methods have gained importance and internal rate of return is one of the most popular evaluation methods.
- Firms typically use multiple evaluation methods.
- Accounting rate of return and payback period are widely employed as supplementary evaluation methods.



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However, there are number of projects for which **using IRR is not as effective as using NPV** to discount cash flows.

While **ranking** the various techniques, **NPV stands on top priority**, followed by IRR.

Why IRR is not as good as NPV is?

-IRR presumes that the same rate of return is available in other projects as well.

-If cash flows are not normal, IRR may arrive at multiple solutions.



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Assessment of Basic Evaluation Methods

	<i>Net present value</i>	<i>IRR</i>	<i>Payback period</i>	<i>Accounting rate of return</i>
<i>Theoretical considerations</i>				
1. Does the method consider all cash flows	Yes	Yes	No	?
2. Does the method discount cash flows at the opportunity cost of funds ?	Yes	No	No	No
3. Does the method satisfy the principle of value additivity ?	Yes	No	?	?
4. From a set of mutually exclusive projects, does the method choose the project which maximize shareholder wealth ?	Yes	No	?	?



Assessment of Basic Evaluation Methods

	<i>Net present value</i>	<i>Internal rate of return</i>	<i>Payback period</i>	<i>Accounting rate of return</i>
<i>Practical considerations</i>				
1. Is the method simple ?	Yes	Yes	Yes	Yes
2. Can the method be used with limited information ?	No	No	Perhaps	Yes
3. Does the method give a relative measure ?	No	Yes	No	Yes



Survey: Evaluation Techniques in India

- Internal rate of return
- Payback period
- Net present value
- Break-even analysis
- Profitability Index



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Financing of Projects



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Project Management for Managers

Lec – 18

Financing of Projects

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The two broad sources of finance available to a firm are : shareholders' funds (equity funds) and loan funds (debt funds).

Basic Differences between Equity and Debt?????????????????????????



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Equity

- Equity shareholders have a residual claim on the income and the wealth of the firm
- Equity ordinarily has indefinite life
- Equity investors enjoy the prerogative to control the affairs of the firm
- Dividend paid to equity shareholders is not a tax deductible payment

Debt

- Creditors (suppliers of debt) have a fixed claim in the form of interest and principal payment
- Debt has a **fixed maturity**
- Debt investors play a passive role – of course, they impose certain restrictions on the way the firm is run to protect their interest
- Interest paid to creditors is a **tax deductible payment**



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Key Factors in Determining the Debt - Equity Ratio

The key factors in determining the debt-equity ratio for a project are:

- **Cost:** lenders require a lower rate of return compared to equity share holder. **Debt is cheaper but riskier source of finance, whereas equity is a costlier but safer source of finance.**
- **Nature of assets:** (tangible-electricity-more of debt, intangible-brand & software-less of debt)
- **Business risk:** Refers to the variability of earning power (demand variability, price variability, variability of input prices, proportion of fixed operating cost (of the total cost –risk is higher))



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The key factors in determining the debt-equity ratio for a project are:

Norms of lenders: DER= 2:1, 1:1, for high capital incentive project (power) 2.33:1

Control considerations: Capital structure depends on **extent of equity stake** want by **promoters**. If cost of project is 10000, promoters can invest 2000. If they want minimum 50% of stake in the equity of the project, **the total equity cannot exceed 4000**. Hence, balance 6000 in debt form (1.5:1). If they want a minimum stake of 40% in the equity of the project, **the total equity cannot exceed 5000 (1:1)**.

Market conditions: if equity mkt is **buoyant** and equity shares can be issued at an attractive premium the project may rely more **on equity**. If **equity mkt is depressed**, the project may depend on **debt**.



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A Checklist

Use more equity when

- The **corporate tax rate applicable is negligible**
- Business risk exposure **is high**
- Dilution **of control is not an important issue**
- The **assets** of the project are mostly **intangible**
- The project has many valuable **growth options**

Use more debt when

- The corporate tax rate applicable is **high**
- Business risk exposure **is low**
- Dilution of control is an **issue**
- The assets of the project are mostly **tangible**
- The project has **few growth options**



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Sources of Finance

Part A

Sources of Finance

Internal
Accruals

Securities

Term loans

Working capital advances

Miscellaneous sources

- Equity
- Preference
- Bonds

Part B

Sources of Finance

Equity

- Equity
- Preference
- Internal accruals

Debt

- Bonds
- Term loans
- Working capital advances
- Miscellaneous sources



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Public and Private Sources of Capital: A firm can raise **equity and debt capital** from both **public and private sources**. Capital raised from public sources is in the form of **securities offered to public** through **an offer document filed with SEBI**.

Private capital comes either in the form of loans given by banks and financial institution or in the form of issue of securities like shares, preference shares, and debentures which are privately placed with a small group of sophisticated investors like PE funds, VC firms, financial institutions, insurance companies, mutual funds, and wealthy individuals.



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The typical pattern of financing: When a company is formed, it first issues equity shares to the promoters (founders) and also, in most cases, to a select group of investors.

As the company grows, it may rely on the following methods of raising equity capital: initial public offering, seasoned offering, rights issue, private placement, and preferential allotment.



Internal Accruals

Internal accruals of a firm consist of depreciation amortization, and retained earnings (that portion of equity earning which are ploughed back in the firm) (part of equity earnings- 30 to 80% of profit after tax for financing growth)

Ex. Cost of m/c 10,000, life 5 yrs, no salvage value after 5 yrs, annual depreciation charges 2,000, Each year a depreciation cost of Rs 2,000 will be shown in PLA. It is non-cash charge.

Pros

- **Readily** available (management need not talk to shareholder or lenders)
- No dilution of control

Cons

- Opportunity cost of retained earning is **high as it** is equal to the cost of equity –remember the retained earnings, in essence, **dividend forgone by equity shareholders**.
- Limited amount.



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Equity Capital

Equity capital represents ownership capital as equity shareholders collectively own the company. They enjoy the rewards and bear the risks of ownership

Authorized, Issued, Subscribed, and Paid up Capital:

The amount of capital that a company can potentially issue, as per its memorandum, represents the *authorized* capital.

The amount offered by the company to the investors is called the *issue* capital.

The part of issued capital which has been subscribed by the investors represents the *subscribed* capital.

The actual amount paid up by the investors is called the *paid up* capital-typically the Issued, Subscribed, and Paid-up are the same .



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Rights of Equity Shareholders

- Right to Income: PAT-preferred dividend
- Right to Control: Select board of directors, right to vote on a resolution, etc
- Pre-emptive Right: Shareholders maintain their proportional ownership by purchasing the additional equity shares issued by the firm . (Ex. 1000,000 outstanding shares, proposes to issue 200,00, equity SH has 100 shares has right to)
- Right in Liquidation: As in case of income, equity shareholders have a residual claim over assets of the firm , after settling claims of (Debenture holders, secured and unsecured lender, other creditors, preferred share holders).



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Advantages of equity capital:

1. Long term source of finance.
2. In case of **insufficient** cash - no need to pay **dividend**.
3. Presently, equity dividends are tax-exempt in the hands of investors.
4. Equity capital **has no maturity** date and hence the firm has no obligation to redeem.

Disadvantages equity capital :

1. Sale of equity shares to outsider dilutes the control of existing owners.
2. The cost of equity capital is high, **usually the highest**. The rate of return required by equity SH is higher than the rate of return required by any other investors.
3. The cost of **issuing equity shares is generally higher** than the cost of issuing other types of securities. Underwriting commission, brokerage costs, and other issue expenses are high for equity issues.



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Preference Capital

Preference capital represents **a hybrid form of financing**. It partake some characteristics of **equity** and some attributes of **debt**.

It resembles **equity**

- (i) preference dividend is payable only out of distributable profits
- (ii) preference dividend **is not an obligatory payment**
- (iii) preference dividend **is not a tax deductible** payment

It resembles **debenture**

- (i) the **dividend rate** of preference capital is **fixed**
- (ii) the claim of preference SHs is **prior** to the claim of equity SHs
- (iii) preference SHs **do not normally enjoys the right to vote.**



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Preference Capital

Pros

- No legal obligation to pay dividends
- Enhances creditworthiness
- No dilution of control

Cons

- **Costly source**
- Skipping preference dividends adversely affects image
- **Voting rights under certain conditions**



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Debentures (or Bonds)???????



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For large publicly traded firms, debentures are a viable alternative to term loan. Akin to promissory notes, debentures are instruments for raising debt finance. Debenture holders are the creditors of the company. The obligation of a company toward its debenture holders is similar to that of a borrower who promises to pay **interest and principal at specified times**. Debentures often provide **more flexibility than term loans** as they offer greater choice with respect to **maturity, interest rate, security, repayment, and special features**.



- **Trustee:** Appointed through deed, bank, or FI or Insurer, the borrowing firm will fulfill contractual obligations.
- **Security:** Debenture issues in India are typically secured by **mortgage/charges on the immovable properties** of the company and a floating charge on its other assets. Occasionally, companies issue **unsecured debentures**, not backed by specific assets of the firm, but by its general credit.
- **Maturity:** Corporate debt may be short term , medium term (1- 5 yrs) or long term (5-12 yrs) . Corporate debt of **less** than one year is called **commercial paper** .



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- **Redemption:** Debentures are typically redeemable in nature.
- **Fixed rate vs. floating rate:** Debenture may carry fixed or floating or zero rate of interest.
- **Embedded options:** Debenture may carry a “call” feature (redemption at certain price before maturity period), “put” feature (at specified time and predetermined prices)



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Advantages and Disadvantages of Debt Financing

Advantages

- Interest on debt is a tax deductible expense, whereas equity and preference dividends are paid out of profit after tax.
- No **dilution** of control: because debt holder are not entitled to vote
- **Lower** issue costs
- Debt servicing burden is generally fixed in nominal terms
- Tailor-made maturity: to the needs of borrowing firm



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Advantages and Disadvantages of Debt Financing

Disadvantages

- Fixed interest and principal repayment obligation, failure to this may lead to bankruptcy.
- Debt financing increases financial leverage which, according to CAPM, raises the cost of equity to the firm.
- Debt contracts impose restrictions that limit the borrowing firm's financial and operating flexibility, which may impair firm's ability to resort to value maximizing behavior.



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The following are the main difference between a debenture and a share:

1. A person having the debentures is called debenture holder whereas a person holding the shares is called shareholder.
2. Debenture holder is a creditor of the company and cannot take part in the management of the company while a shareholder is the owner of the company. It is the basic distinction between a debenture and a share.
3. Debenture holders will get interest on debentures and will be paid in all circumstances, whether there is profit or loss will not affect the payment of interest on debentures.
4. Shareholder will get a portion of the profits called dividend which is dependent on the profits of the company. It can be declared by the directors of the company out of profits only.
5. Shares cannot be converted into debentures whereas debentures can be converted into shares.



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The following are the main difference between a debenture and a share:

6. Debentures will get priority in getting the money back as compared to shareholder in case of liquidation of a company.
7. There are no restriction on issue of debentures at a discount, whereas shares at discount can be issued only after observing certain legal formalities.
8. Convertible debentures which can be converted into shares at the option of debenture holder can be issued whereas shares convertible into debentures cannot be issued.
9. There can be mortgage debentures i.e. assets of the company can be mortgaged in favour of debenture holders. But there can be no mortgage for shares. Assets of the company cannot be mortgaged in favour of shareholders.



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Methods of Offering

There are different ways in which a company may raise finances in the primary market

Public offering: Sale of security to the members of the public. IPO (The first public offering of equity shares of a company , which is followed by a listing of its shares on the stock market.).

Benefits

- **Access to a larger pool of capital**
- **Respectability**
- **Lower cost of capital**
compared to private placement
- **Liquidity**

Costs

- Dilution
- Loss of flexibility
- Disclosures and accountability
- Periodic costs



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Methods of Offering

Seasonal equity offering (as companies need more finances, they are likely to make further trip to capital market also called secondary offerings) .

Bond offering (similar to IPO with some differences- the prospectus for a bond offering typically emphasis on a company 's stable cash flow whereas prospectus for an equity offering highlights the company's growth prospects., etc)



Methods of Offering

There are different ways in which a company may raise finances in the primary market

Rights issue: Involves selling securities in the primary market by issuing rights to the existing SHs.

When a company issues **additional equity capital**, it has to be offered in the first instance to the existing SHs on pro rata basis.

SHs may forfeit this right, partially or fully, to enable company to issue additional capital to public.



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Methods of Offering

Private placement: Issue of securities to a select group of persons not exceeding 49. Private placement of shares and convertible debentures by a listed company can be of two types.

Preferential allotment: When a company issues shares or debentures to select group of persons in terms of provisions (pricing, disclosures, lock-in period) of chapter XIII of SEBI (DIP) guidelines.

Qualified Institutional Placement (QIP): A QIP is an issue of equity shares or convertible securities to Qualified Institutional Buyers in terms of the provisions of Chapter XIII A of SEBI (DIP) guidelines.



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Summary Comparison of the Various Methods

	Public Issue	Rights Issue	Private Placement	Preferential Allotment
• Amount that can be raised	Large	Moderate	Moderate	Moderate
• Cost of issue	High	Negligible	Negligible	Negligible
• Dilution of control	Yes	No	Yes	Depends
• Degree of underpricing	Large	Irrelevant	Small	No
• Market perception	Negative	Neutral	Neutral	Neutral



Term Loans

Term loans, also referred to as term finance, represent a source of **debt finance which is generally repayable in less than 10 years.**

Features of term loans (IFCI, ICICI, IDBI, SFCs, Commercial Banks)

1. **Currency:** Rupee (for land , building, miscellaneous fixed assets, margin money for working capital, etc) and foreign currency.
2. **Security:** Term loans typically represent secured borrowings. Usually the assets, which are financed with the term loan, provide the prime security .
3. **Interest payment and principal repayment:** Are definite obligations that are payable irrespective of the financial situation of the firm.
4. **Restrictive covenants:** Term loan providers put certain conditions; Broad-base its board of directors and team in consultations with them, bring additional funds in the form of unsecured loans, refrain from undertaking new projects, obtain clearances and NOCs from respective agencies, seek their consent if going for extra borrowings)



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Working Capital Advances

WC advance by commercial banks represents the most important source for financing current assets.

- **Cash credits / overdrafts:** a predetermined limit is for borrowing is specified by the bank. A borrower can draw as often as required subject to a limit and adequate security. Interest is charged on running balance not on the limit sanctioned.
- **Loans :** These are advances of fixed amounts to the borrower. Interest is on entire amount irrespective of how much he draws.
- **Purchase / discount of bills:** A bill usually arises out of transaction. The seller of goods draws the bill on the purchaser . On acceptance of the bill by the purchaser , the seller offers it to the bank for discount/purchase. When the bank discount/purchases the bill, it releases the funds to the seller. The bank presents the bill to the purchase on the due date and gets its payment
- **Letter of credit:** A letter of credit is an arrangement whereby a bank helps its customer to obtain a credit from its (suppliers). Bank undertakes responsibility to honor the obligation of its customer, should the customer fail to do so.



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Miscellaneous Sources

- **Deferred credit:** When supplier of machinery offers deferred credit facility, a bank guarantee should be furnished by the buyer.
- **Lease and hire purchase finance:**
- **Lasing** (The lessee cannot claim depreciation. The entire lease rental is a tax – deductible expense for the lessee. The lessee, not being the owner of the asset, does not enjoy the salvage value of the asset.)
- **Hire-Purchase** (The hirer is entitled to claim depreciation. Only the interest component of the hire purchase installment is a tax-deductible expense for the hirer. The hirer, being the owner of the asset, enjoys the salvage value of the asset)
- **Unsecured loans and deposits:** Are typically provided by the promoters to fill the gap between the promoters' contribution required by the financial institutions and the equity capital subscribed by the promoters.



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Project Management for Managers

Lec – 19

Risk Management- I

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Process of Risk Management

- What is likely to happen? (The probability and impact)
- What can be done to minimize probability or impact of these events?
- What are the warning signs (clues one should look for?)
- What are the likely outcomes of these problems and my actions?

Project Risk = (Probability of Event)(Consequences of Event)

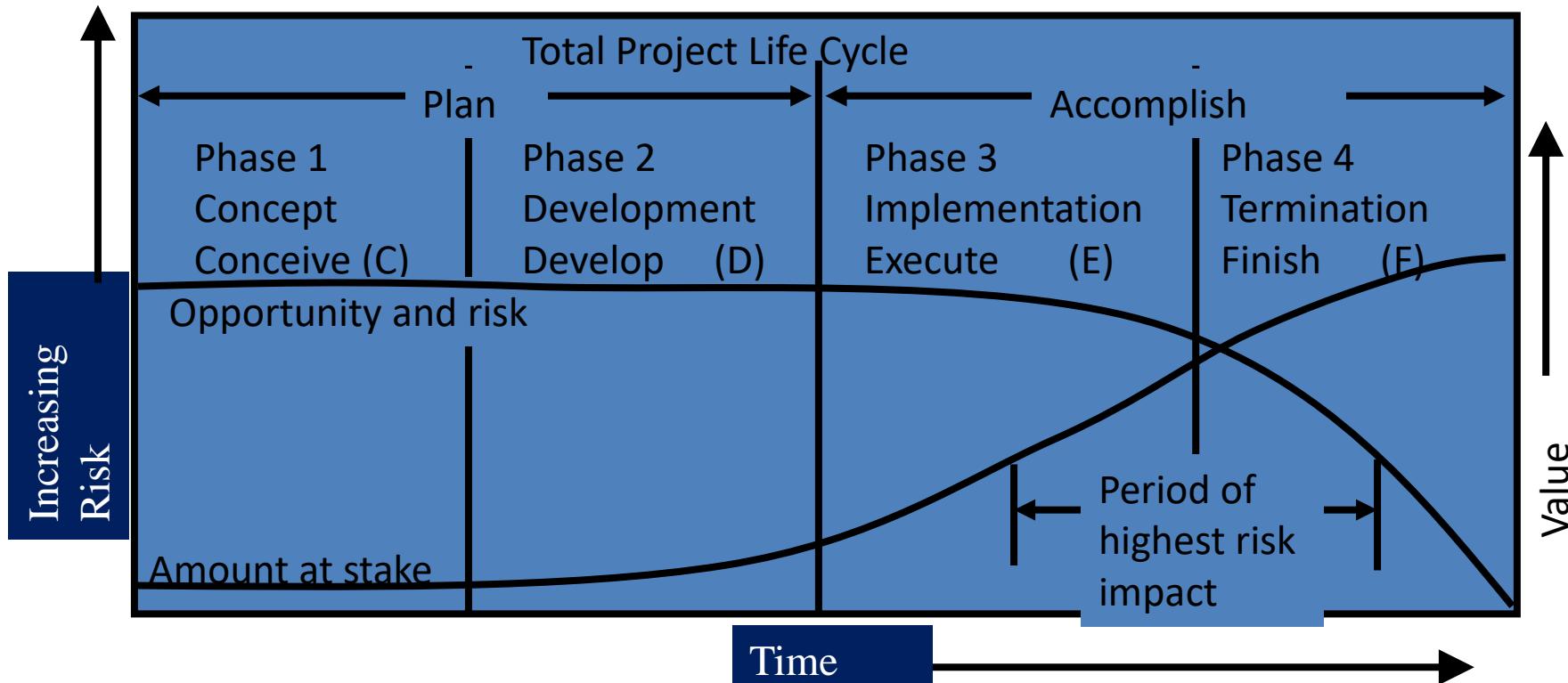


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Risk Vs Amount at Stake



Four Stages of Risk Management

1. Risk **identification**: determine specific risk factors.
2. **Analysis** of probability and consequences: the potential impact of these risk factors, determined by how likely they are to occur and the effect they would have on the project if they did occur.
3. Risk **mitigation** strategies: steps to minimize the potential impact of those risks.
4. **Control** and documentation: creating a knowledge base for future projects based on lesson learned.



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Risks commonly fall into one or more of the following classification Clusters

- Financial
- Technical
- Contractual/Legal
- Common Types
 - Absenteeism
 - Resignation
 - Staff pulled away
 - Time overruns
- Commercial
- Execution
 - Skills unavailable
 - Ineffective Training
 - Specs incomplete/initial specs poorly specified
 - Change orders



1. Risk Factor Identification

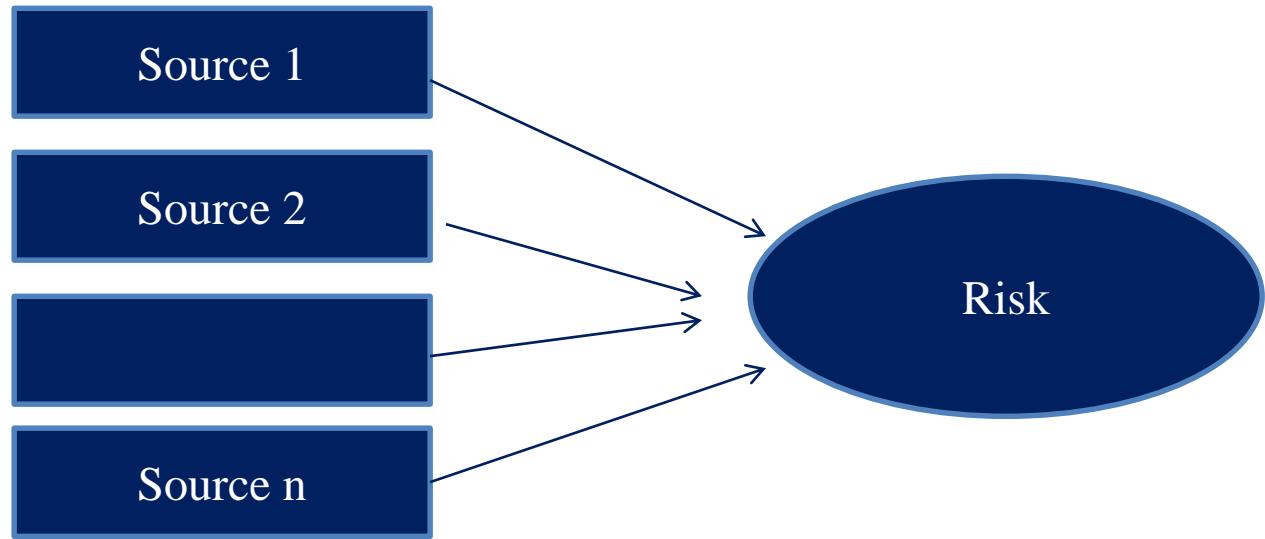
- Brainstorming meetings
- Expert opinion (or Delphi)
- Past history
- Multiple (team based) assessments



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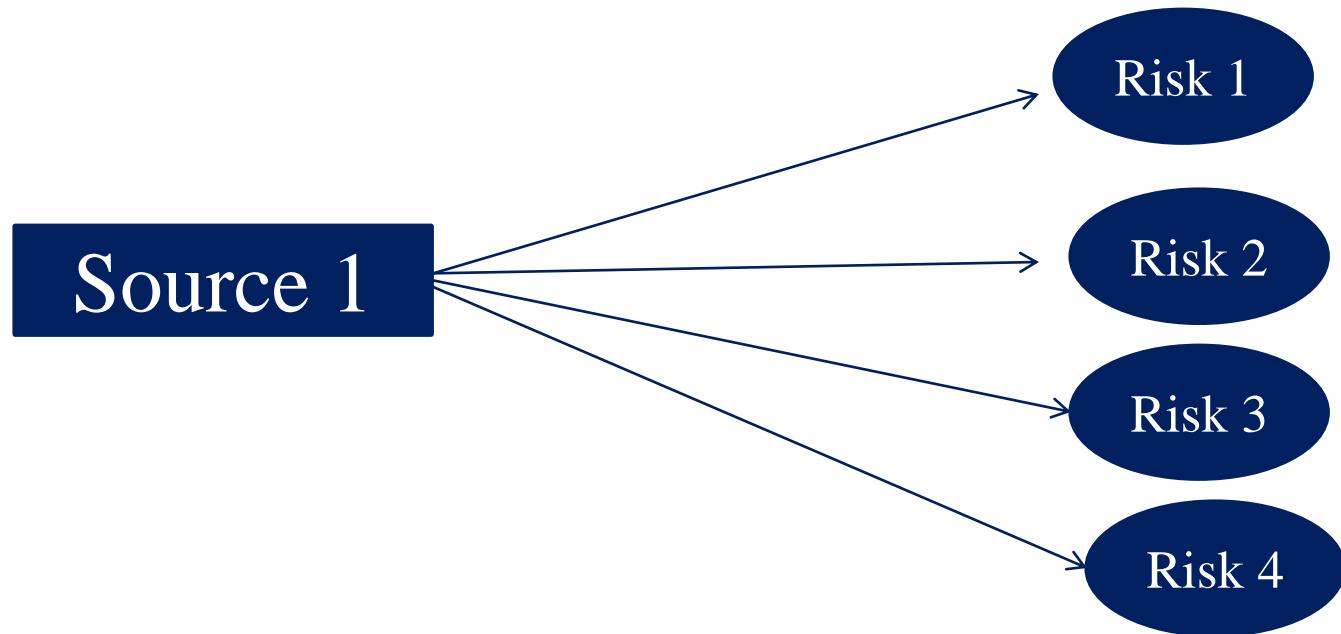
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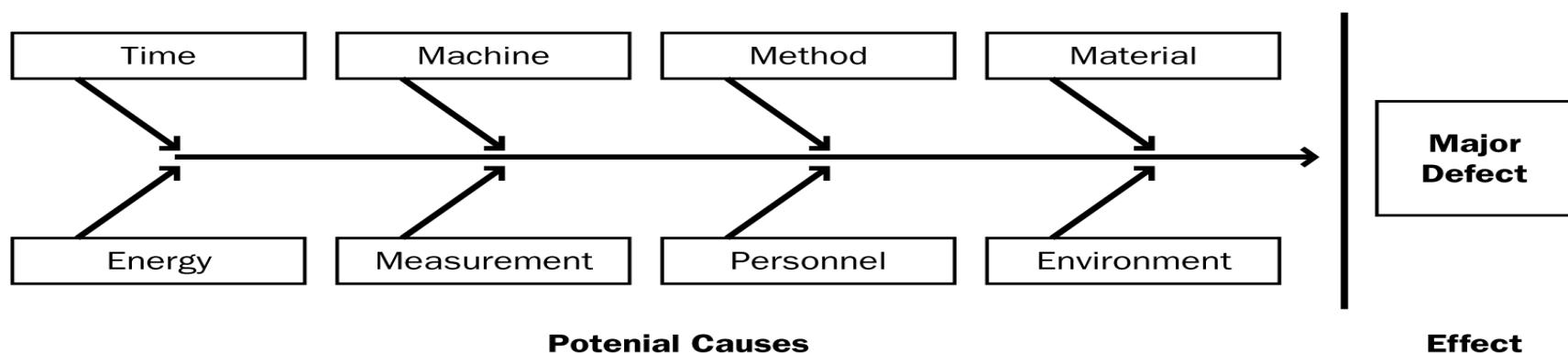


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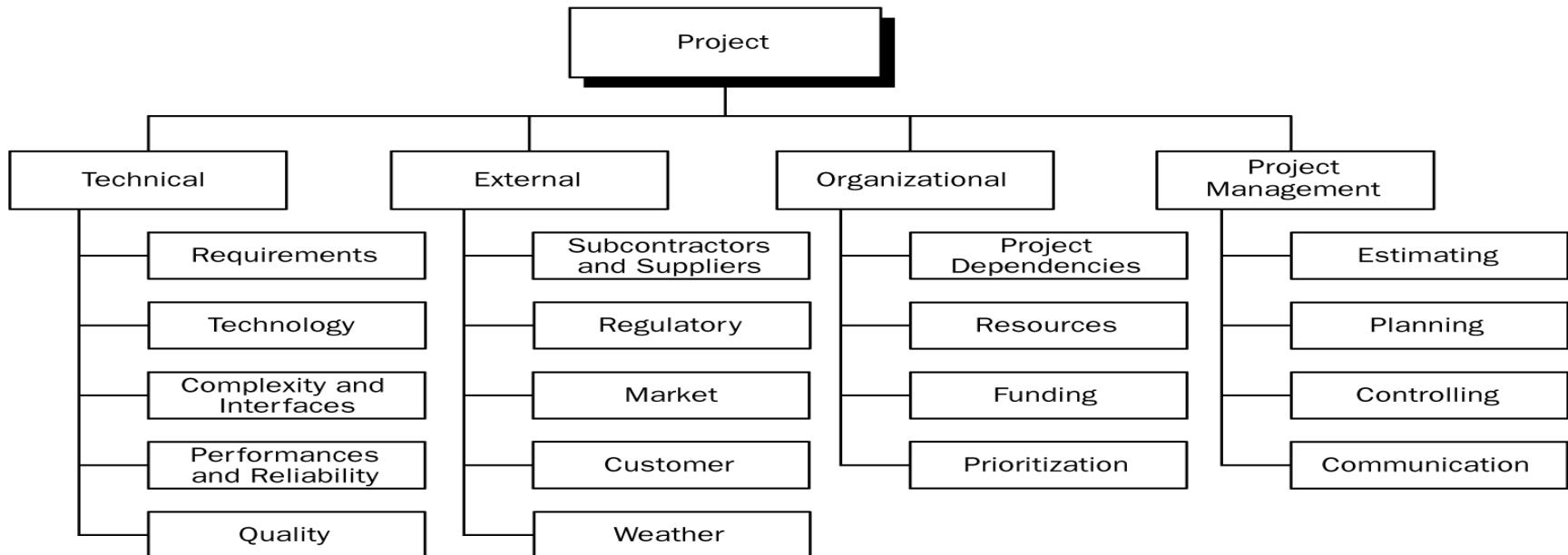


1. Risk Factor Identification

- Documentation Reviews
- Sensitivity analysis
- Assumptions Analysis
- Decision tree analysis
- Simulation
- Diagrammatic technique



Similar to WBS



The Risk Breakdown Structure (RBS) lists the categories and sub-categories within which risks may arise for a typical project. Different RBSs will be appropriate for different types of projects and different types of organizations. One benefit of this approach is to remind participants in a risk identification exercise of the many sources from which project risk may arise.



2.Risk Management Assessment Matrix

		Consequences	
		Low	High
Likelihood	Low		FDI policy
	High	RM (Soya bean - high production cost) but less impact on oil	Raw material from abroad

Can be a 3*3 matrix also or more. Consequences can be sever, moderate, and slight.



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Project Management for Managers

Lec – 20

Risk Management- II

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A firm developing a new software product for the retail market.

The scenario considers both the probability of failure and consequences of failure.

In probability of failures, we are interested in identifying any factors that can significantly affect the probability that the new product can be successfully completed.

The potential causes of failure are:

1.Maturity of the software design- It is a new product or based on existing software platform.

2.Complexity of the product: Is the design relatively simple or it is highly complex in structure.

3.Dependency- Can the product be developed independently on any system currently in place in the company or is it slaved to current operating systems or practices.



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Under the consequences of failures, we are concerned with the issues that will highlight the effects of project failure; that is, consequences of failure require us to critically evaluate the results of project's success or failure along a number of key dimensions.

- 1. Cost - budget adherence versus overruns**
- 2. Schedule - on time verses severe delay**
- 3. Reliability - the usefulness and quality of finished product and**
- 4. Performance - how well it is performing**



Probability of Failure (P_f)

Score	Maturity	Complexity	Dependency
Low (0.1)	Existing software	Simple design	Not limited to existing system or clients. No external or uncontrollable events are likely to impact the project.
Minor (0.3)	Minor redesign	Minor increase in complexity	Schedule or performance depend on an existing system. Effect on cost or schedule is minor.
Moderate (0.5)	Major change	Moderate increase	Moderate risk to schedule or performance due to dependence on existing system, facility, or processes. Effect on cost is moderate.
Significant (0.7)	Technology is available, but complex design	Significant increase	Schedule or performance depend on new system or process. Significant cost or schedule risk.
Major (0.9)	State of art, some research complete	Extremely complex	Schedule and performance depend on new system and process. Very high cost or schedule risk.



Consequence of Failure (C_f)				
Score	Cost	Schedule	Reliability	Performance
Low (0.1)	Budget estimate not exceeded	Negligible impact on program, no impact on critical path	Minimal or no reliability consequence	Minimal or no performance consequence.
Minor (0.3)	Cost estimate exceeds budget by < 5%	Minor slip in schedule (less than 5%)	Small reduction in reliability	Small reduction in system performance
Moderate (0.5)	Cost estimate exceeds budget by < 15%	Small slip in schedule starting to impact critical path	Some reduction in reliability performance	Some reduction in system performance May require moderate debugging.
Significant (0.7)	Cost estimate exceeds budget by < 30%	Development time slips in excess of 1 month, requires readjustment of critical path	Significant degradation in reliability performance	Significant degradation in system performance. Guarantees are at risk. Serious debugging required.
Major (0.9)	Cost estimate exceeds budget by > 50%	Large schedule slips ensure the system will miss client timeframe	Reliability goals cannot be achieved under current plan	Performance goals cannot be achieved. Results may not be usable.



Project Risk Scoring

1. Identify factors and assess the probability (P_f) and consequences (C_f) of failure
2. Calculate overall probability & consequence

$$P_f = \frac{\sum P_i}{n}$$

$$C_f = \frac{\sum C_i}{m}$$

3. Calculate overall risk factor

$$RF = P_f + C_f - (P_f)(C_f)$$

Rule of thumb

Low risk $RF < 0.30$

Medium risk $= 0.30$ to 0.70

High risk > 0.70



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Score	Maturity	Probability of Failure (P_f)		
		Complexity	Dependency	
Low (0.1)	0.10	0.15	0.13	$0.38/3 = 0.12$
Minor (0.3)	0.30	0.20	0.25	= 0.25
Moderate (0.5)	0.50	0.45	0.40	=0.45
Significant (0.7)	0.72	0.75	0.65	=0.70
Major (0.9)	0.95	0.92	0.90	=.92

Score	Cost	Consequence of Failure (C_f)		
		Schedule	Reliability	Performance
Low (0.1)	0.11	0.18	0.15	0.18
Minor (0.3)	0.32	0.25	0.25	0.29
Moderate (0.5)	0.52	0.47	0.44	0.49
Significant (0.7)	0.75	0.70	0.60	0.72
Major (0.9)	0.95	0.92	0.90	0.93



0.10	0.15	0.13	0.38/3 = 0.12
0.30	0.20	0.25	= 0.25
0.50	0.45	0.40	= 0.45
0.72	0.75	0.65	= 0.70
0.95	0.92	0.90	= .92
			0.48

0.11	0.18	0.15	0.18	0.15
0.32	0.25	0.25	0.29	0.27
0.52	0.47	0.44	0.49	0.48
0.75	0.70	0.60	0.72	0.69
0.95	0.92	0.90	0.93	0.92
				.50

$$RF = P_f + C_f - (P_f)(C_f)$$

Rule of thumb

Low risk $RF < 0.30$

Medium risk $= 0.30$ to 0.70

High risk > 0.70

$$RF = 0.48 + 0.50 - (0.48 * 0.50) = 0.74 \text{ (high risk)}$$



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3.Risk Mitigation Strategies

- Accept - minor in nature, occurrence and consequences both are small.
- Minimize - next option is minimize risk. Boeing – millions of parts from thousands of vendors, direct contact of vendors with quality assessment team of Boeing. Right to intervene in the production process of vendors.



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3.Risk Mitigation Strategies

- Share - ??????????



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3.Risk Mitigation Strategies

- Share - Risk may be allocated proportionately among **multiple** members of the project. European Space Agency and Airbus consortium - (huge capital and technical skills). BOOT is another example.
- Transfer - Insurance. Fixed price contacts (fixed price for the project upfront and if overruns builder will bear).



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3.Risk Mitigation Strategies

- Use of Contingency Reserves: Depends on project. 10-15 % in construction projects.(Funds).
 - Task contingency (use to offset budget cutbacks, schedule overruns, or other unforeseen circumstances accruing to individual tasks or project work packages).
 - Managerial contingency (client asks for changes which require change in technology, or acts of God).
- Mentoring of project managers and tam members.
- Cross training- one can handle other members duties.



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Project Management for Managers

Lec – 21

Risk Management (Control & Documentation)

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4. Control & Documentation

Help managers classify and codify risks, responses, and outcomes.

Customer	Project name
Budget No	Project team
Date of Most Recent Evaluation	
Risk Description	
Risk Assessment	Risk Factor
Discussion	
Risk Reduction Plan	Owner
Timeframe to net assessment	
Expected outcome	

Risk Management Report Form



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Control & Documentation

Change management report system answers

- What?: Source of risk
- Who?: Assign a team member
- When?: Time frame to mitigate the risk
- Why?: Find reasons/causes of the risk
- How?: Plan to abate the risk. Charting of method for closing a particular “risk window”.? Do they seem reasonable or far-fetched?. Too expensive in terms of money of time.



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Project Risk Analysis & Management (PRAM): An integrated Approach



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The Eurasian Association for PM has developed an integrated program of risk management, based on efforts to extend risk management to cover a project's entire life cycle.

This program, known as Project Risk Analysis and Management (PRAM).

PRAM: Is logical and sequential method for analyzing and addressing risk.

Key Features of PRAM

Risk management follows a **life cycle**

Risk management **strategy changes** over the project life cycle

Synthesized, coherent approach, tools of RM to be used as they are needed.

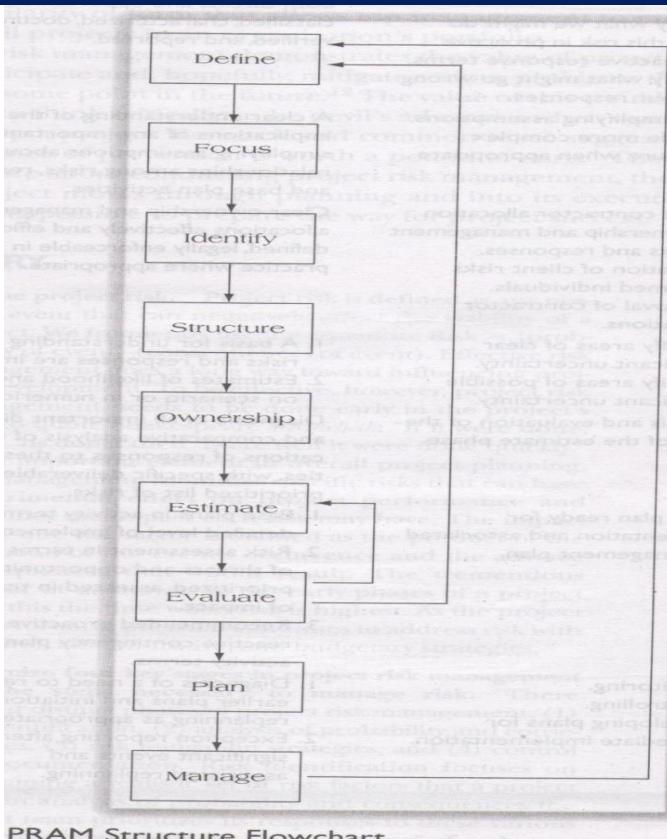


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Nine Phases of Risk Assessment



Define	Project is well defined, deliverables, statement of work, project scope
Focus	Begin to plan the risk management process as a project in its own right. Apply best methods for addressing risk
Identify	Sources of risk and their responses, prioritize risks
Structure	Find out commonalities across sources of risks , so that it can be handled separately.
Clarify ownership of risks	Whether project origination or clients risks
Estimate	The impact of risk and solution proposed
Evaluate	Critically evaluate the results of the estimate phase to determine the most likely plan for realizing potential risks
Plan	Produce risk mgt plan that proactively offers risk mitigation straggles
Manage	Respond to any variance in theses plans



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A Generic Risk Management Process (RMP) Following the PRAM Methodology

Phases	Purposes	Deliverables
Define	Consolidate relevant existing information about the project.	A clear, unambiguous, shared understanding of all key aspects of the project documented, verified, and reported.
Focus	<ol style="list-style-type: none"> 1. Scope and provide a strategic plan for the RMP 2. Plan the RMP at an operational level. 	A clear, unambiguous, shared understanding of all relevant key aspects of the RMP, documented, verified, and reported.
Identify	<ol style="list-style-type: none"> 1. Identify where risk might arise. 2. Identify what we might do about this risk in proactive and reactive response terms. 3. Identify what might go wrong with our responses. 	All key risks and responses identified; both threats and opportunities classified, characterized, documented, verified, and reported.
Structure	<ol style="list-style-type: none"> 1. Test simplifying assumptions. 2. Provide more complex structure when appropriate. 	A clear understanding of the implications of any important simplifying assumptions about relationships among risks, responses, and base plan activities.
Ownership	<ol style="list-style-type: none"> 1. Client contractor allocation of ownership and management of risks and responses. 2. Allocation of client risks to named individuals. 3. Approval of contractor allocations. 	Clear ownership and management allocations effectively and efficiently defined, legally enforceable in practice where appropriate.

A Generic Risk Management Process (RMP) Following the PRAM Methodology

Phases	Purposes	Deliverables
Estimate	<ol style="list-style-type: none">1. Identify areas of clear significant uncertainty.2. Identify areas of possible significant uncertainty.	<ol style="list-style-type: none">1. A basis for understanding which risks and responses are important.2. Estimates of likelihood and impact on scenario or in numeric terms.
Evaluate	Synthesis and evaluation of the results of the estimate phase.	Diagnosis of all important difficulties and comparative analysis of the implications of responses to these difficulties, with specific deliverables like a prioritized list of risks.
Plan	Project plan ready for implementation and associated risk management plan.	<ol style="list-style-type: none">1. Base plans in activity terms at the detailed level of implementation.2. Risk assessment in terms of threats and opportunities prioritized, assessed in terms of impact.3. Recommended proactive and reactive contingency plans in activity terms.
Manage	<ol style="list-style-type: none">1. Monitoring.2. Controlling.3. Developing plans for immediate implementation.	<ol style="list-style-type: none">1. Diagnosis of a need to revisit earlier plans and initiation of replanning as appropriate.2. Exception reporting after significant events and associated replanning.

Stand- Alone Risk Analysis

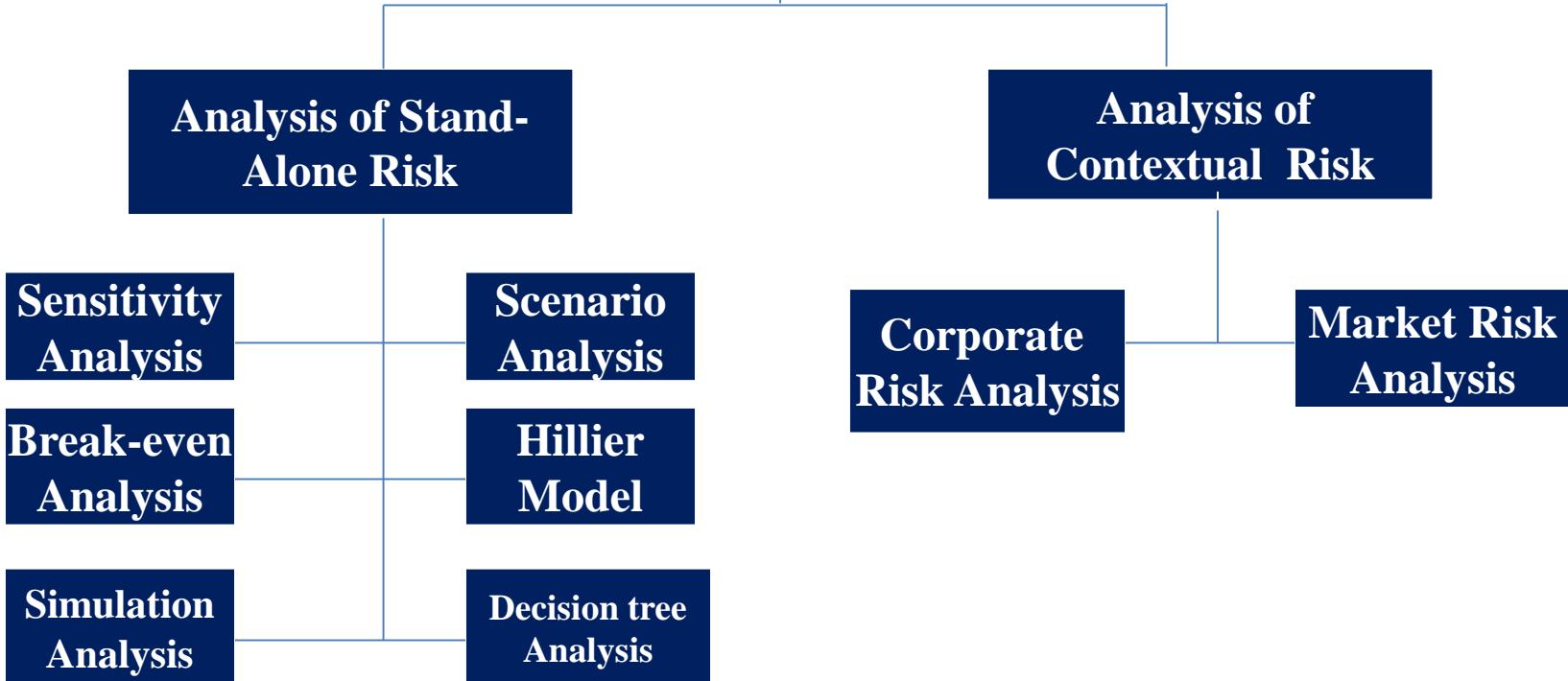


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Techniques for Risk Analysis



Perspectives on Risk

Standalone risk: For that project at hand only.

Firm risk: Risk of a project in context of firm.

Market risk :Risk of a project in context of market.



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Sources of Risk

- Project specific risk: **Earning** and **cash** flows down (estimation **error** or quality of management)
- Competitive risk: Earning and cash flows down (unanticipated action of **competitors**)
- Industry-specific risk: Unexpected **technological** development and **regulatory** changes that are specific to industry to which the project belongs.
- Market risk: Changes in **macroeconomic** factors (GDP, Interest rates, inflation)
- International risk : In case of foreign projects (**exchange** rates)



Measures of Risk

Risk refers to variability. It is a complex and multi-faceted phenomenon. A variety of measures have been used to capture different facets of risk. The more important ones are:

- Range
- Standard deviation
- Coefficient of variation
- Semi - variance



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NPV	Probability
200	0.3
600	0.5
900	0.2

What is the final NPV???

Find Range???

Find Standard Deviation???

Find risk?



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NPV	Probability
200	0.3
600	0.5
900	0.2

What is the final NPV: $200*.3+600*.5+900*.2 = 540$

Find Range: $900-200 = 700$

Find Standard Deviation =

$$\{ .3 (200-540)^2 + .5 (600-540)^2 + .2(900-540)^2 \}^{1/2} = 249.8$$

$$\text{Variance} = (249.8) * (249.8) = 62400$$



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Coefficient of variation (CV) : SD is not adjusted for scale.

NPV = 10 and SD 4 would be more risky than

NPV = 1 and SD 2.

$$\text{CV} = \text{SD} / \text{Expected value} = 249.8 / 540 = 0.46$$

Semi variance = Another problem with SD is, it considers positive and negative variations, but we have to worry about only negative variations.

$$\begin{aligned}\text{SV} &= \{0.3 (200-540)^2\}^{1/2} \\ &= 186\end{aligned}$$



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Project Management for Managers

Lec – 22

Stand-Alone Risk Analysis- I

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Sensitivity Analysis :

Since future is uncertain, we want to know the effect of input on output



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Sensitivity Analysis

(‘000)

	YEAR 0	YEARS 1 - 10
1. INVESTMENT	(20,000)	
2. SALES		18,000
3. VARIABLE COSTS (66 2/3 % OF SALES)		12,000
4. FIXED COSTS		1,000
5. DEPRECIATION		2,000
6. PRE-TAX PROFIT		3,000
7. TAXES		1,000
8. PROFIT AFTER TAXES		2,000
9. CASH FLOW FROM OPERATION		4,000
10. NET CASH FLOW	(20,000)	4,000

Find NPV? Given Salvage Value =0, and cost of capital = 12%



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Present value of an annuity of ₹ 1 paid for period t at a rate $k = [1 - 1/(1 + k)^t]/k$

Period	Rate																			
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870

Sensitivity Analysis

(‘000)

	YEAR 0	YEARS 1 - 10
1. INVESTMENT	(20,000)	
2. SALES		18,000
3. VARIABLE COSTS (66 2/3 % OF SALES)		12,000
4. FIXED COSTS		1,000
5. DEPRECIATION		2,000
6. PRE-TAX PROFIT		3,000
7. TAXES		1,000
8. PROFIT AFTER TAXES		2,000
9. CASH FLOW FROM OPERATION		4,000
10. NET CASH FLOW	(20,000)	4,000

$$NPV = -20,000,000 + 4,000,000 (5.650) = 2,600,000$$

If we change sales from 18 to 15, and keep Investment 20, variable cost 66.67% of sales , FC = 1000.



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Sensitivity Analysis

	YEAR 0	YEARS 1 - 10
1. INVESTMENT	(20,000)	
2. SALES		18,000
3. VARIABLE COSTS (66 2/3 % OF SALES)		12,000
4. FIXED COSTS		1,000
5. DEPRECIATION		2,000
6. PRE-TAX PROFIT		3,000
7. TAXES		1,000
8. PROFIT AFTER TAXES		2,000
9. CASH FLOW FROM OPERATION		4,000
10. NET CASH FLOW	(20,000)	4,000

$$NPV = -20,000,000 + 4,000,000 (5.650) = 2,600,000$$

RS. IN MILLION

<i>KEY VARIABLE</i>	<i>RANGE</i>			<i>NPV</i>		
	<i>PESSIMISTIC</i>	<i>EXPECTED</i>	<i>OPTIMISTIC</i>	<i>PESSIMISTIC</i>	<i>EXPECTED</i>	<i>OPTIMISTIC</i>
INVESTMENT (RS. IN MILLION)	24	20	18	-0.65	2.60	4.22
SALES (RS. IN MILLION)	15	18	21	-1.17	2.60	6.40
VARIABLE COSTS AS A PERCENT OF SALES	70	66.66	65	0.34	2.60	3.73
FIXED COSTS	1.3	1.0	0.8	1.47	2.60	3.33



Merits:

1. How robust or vulnerable the project is.
2. It indicates where future work may be done. If NPV is highly sensitive to the changes in some factor, it may be worthwhile to explore how the variability of the critical factors may be contained.



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Shortcomings:

- Only one variable is considered.
- Subjectivity in interpretation of different projects.
- Shows change in NPV, does not show how likely that change would be.



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Scenario Analysis: More than one variable can be changed simultaneously.

How many scenarios???



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Scenario Analysis

Procedure

1. Select the factor around which scenarios will be built.
2. Estimate values of each of the variables for each Scenario
3. Calculate NPV / IRR under each scenario



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Merits:

1. Better than sensitivity analysis.
2. Many variables can be considered.

Demerits:

1. Economy can not always be recession, stability and boom (no discrete scenario). It varies on continuum.
2. If 10 inputs, then the analysis has to estimate $3*10=30$ scenario analysis



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Break Even Analysis

As a manager you should know how much should be produced and sold at a minimum to ensure that the project does not lose money. Point of no profit no loss.

BEA: Two types (1) Accounting BEA (2) Financial BEA



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In the example we know that ratio of variable cost to sales is 0.667 (12/18).

This means that every rupee of sales makes a profit of Re 0.333 .



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Break-Even Analysis

- Accounting Break –Even Analysis level for sales will be

$$\frac{\text{Fixed Costs} + \text{Depreciation}}{\text{Contribution margin ratio}} = \frac{1 + 2}{0.333} = \text{Rs. 9 million}$$

	('000)	Year 0	Year 1 - 10
1. Investment		(20,000)	
2. Sales		18,000	
3. Variable costs ($66\frac{2}{3}\%$ of sales)		12,000	
4. Fixed costs		1,000	
5. Depreciation		2,000	
6. Pre-tax profit		3,000	
7. Taxes		1,000	
8. Profit after taxes		2,000	
9. Cash flow from operation		4,000	
10. Net cash flow		(20,000)	4,000



Financial BEA: The focus is on NPV not on accounting profit.



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Project Management for Managers

Lec – 23

Stand-Alone Risk Analysis- II

Dr. M.K. Barua

Department of Management
Indian Institute of Technology Roorkee



Simulation Analysis

Sensitivity analysis indicates the sensitivity of the criterion of merit (NPV, IRR or any other) to variations in basic factors.

Though useful, such information may not be adequate for decision making.

The decision maker would also like to know *the likelihood of such occurrences.*

This information can be generated by simulation analysis which may be used for developing the probability profile of a criterion of merit by *randomly combining values of variables that have a bearing on the chosen criterion.*



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Before explaining Hillier's model

As risk is the outcome of probability and its consequence, any technique applied to measure the **risk** involved should necessarily measure the **probability of outcomes**.

There are two major categories of probabilistic distributions, continuous and discontinuous probability.

An example of risk with **discontinuous probability** is when there are three outcomes with some expected probability in each event as given below.



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	Probability	Profit
Favourable situation	20%	40 lacs
Average situation	50%	20 lacs
Unfavourable situation	30%	-10 lacs
Expected profit	?????	



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Probability	Profit	Probability * Profit
Favourable situation	20%	40 lacs
Average situation	50%	20 lacs
Unfavourable situation	30%	-10 lacs
Expected profit	?????	15 lacs



An example of risk with **continuous probability** is normal distribution where **average profit** is 15 lacs with a **standard deviation** of 6 lacs.

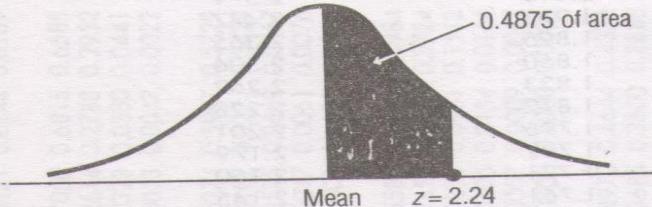
The probability of earning at least 10 lacs can be calculated as ???



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Appendix Table 1

Areas under the Standard Normal Probability Distribution between the Mean and Positive Values of z

Example:

To find the area under the curve between the mean and a point 2.24 standard deviations to the right of the mean, look up the value opposite 2.2 and under 0.04 in the table: 0.4875 of the area under the curve lies between the mean and a z value of 2.24.

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

An example of risk with continuous probability is normal distribution where average profit is 15 lacs with a standard deviation of 6 lacs.

The probability of earning at least 10 lacs can be calculated as $50+29.67= 79.67\%$.



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Hillier Model

It can be used for both **continuous** and **discontinuous** probabilistic events.

Discontinuous probabilistic events: The **probability** of individual year's cash flow is **multiplied** with the corresponding **cash flow** and **summed** to determine the average cash flow for the year and then overall Net Present Value (NPV) is determined with standard deviation, making it **continuous type probabilistic outcome**.



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A project with the initial investment of 100 lacs with a lifespan of four years has the following probabilistic outcomes in different years.

Year 1		Year 2		Year 3		Year 4	
NCF (lacs)	Prob.						
50	20%	60	25%	70	40%	60	30%
30	50%	40	50%	40	50%	40	55%
10	30%	10	25%	-10	10%	20	15%

Determine the expected net present value of the project and its standard deviation.

Also, determine the probability of (i) positive NPV of 30 lacs and (ii) loss. Assume 10% as discounting factor.



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Solution:

Year 1		Year 2		Year 3		Year 4	
NCF (lacs)	Prob.						
50	20%	60	25%	70	40%	60	30%
30	50%	40	50%	40	50%	40	55%
10	30%	10	25%	-10	10%	20	15%

Projected cash flow of first year = $50 * 20\% + 30 * 50\% + 10 * 30\% = 28 \text{ lacs}$

Projected cash flow of second year = $60 * 25\% + 40 * 50\% + 10 * 25\% = 37.5 \text{ lacs}$

Projected cash flow of third year = $70 * 40\% + 40 * 50\% - 10 * 10\% = 47 \text{ lacs}$

Projected cash flow of fourth year = $60 * 30\% + 40 * 55\% + 20 * 15\% = 43 \text{ lacs}$

$$\text{NPV} = (28/1.1) + (37.5/1.1^2) + (47/1.1^3) + (43/1.1^4) - 100 = 21.13$$

$$\sigma_1^2 = 0.2(50 - 28)^2 + 0.5(30 - 28)^2 + 0.3(10 - 28)^2 = 196$$





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Project Management for Managers

Lec – 24
Hillier Model

Dr. M.K. Barua

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A project with the initial investment of 100 lacs with a lifespan of four years has the following probabilistic outcomes in different years.

Year 1		Year 2		Year 3		Year 4	
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Determine the expected net present value of the project and its standard deviation.

Also, determine the probability of (i) positive NPV of 30 lacs and (ii) loss. Assume 10% as discounting factor.



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$$\sigma_1^2 = 0.2(50 - 28)^2 + 0.5(30 - 28)^2 + 0.3(10 - 28)^2 = 196$$



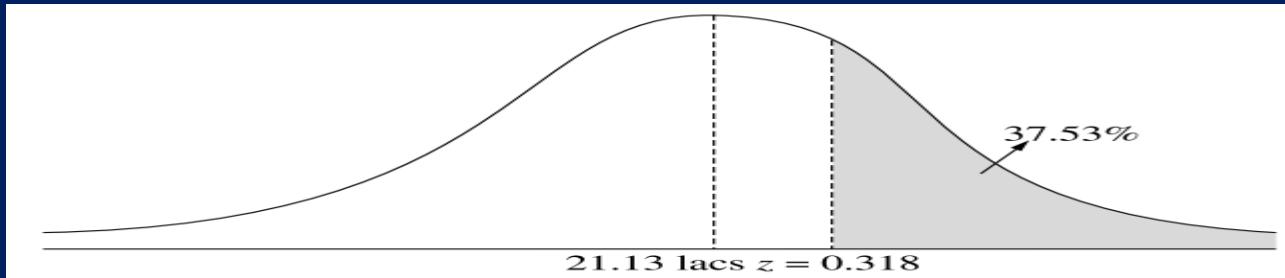
Similarly, $\sigma_2^2 = 318$, $\sigma_3^2 = 561$, $\sigma_4^2 = 171$

$$\sigma(\text{NPV}) = \left[\sum \frac{\sigma_t^2}{(1+i)^{2t}} \right]^{1/2}$$

$$\sigma(\text{NPV}) = (196/\{1.1\}^2) + (318/\{1.1\}^4) + (561/\{1.1\}^6) + (171/\{1.1\}^8) = 27.86$$

(i) Prob of positive NPV of 30 lacs and more

$$Z = (30 - 21.13) / 27.86 = 0.318, \text{ area under curve is } 0.12$$



37.53%



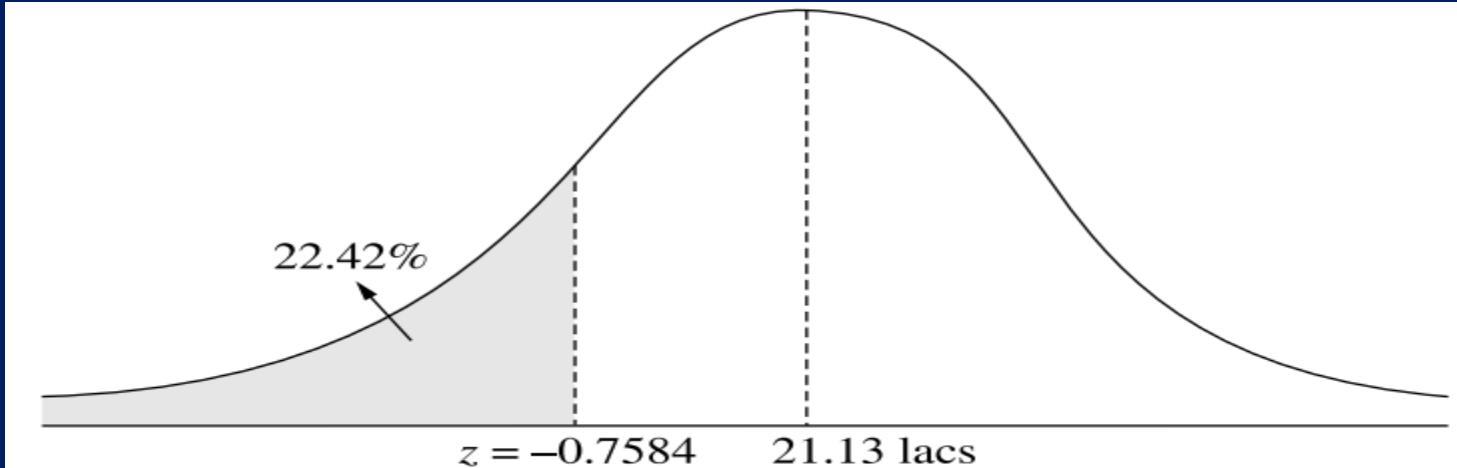
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(ii) probability of loss

$$Z = (0 - 21.13) / 27.86 = -0.75 \text{ (area under curve .2734)}$$



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Determine the expected NPV and the probability of earning at least ₹ 50 lacs and the probability of making at least no loss with the following information. Initial investment is ₹ 150 lacs and discounting factor is 12%.

Year	1	2	3	4	5
Expected cash flow(in lacs)	40	60	80	70	50
Standard deviation(in lacs)	6	8	10	9	7

Determine the expected NPV and the probability of earning at least ₹ 50 lacs and the probability of making at least no loss with the following information. Initial investment is ₹ 150 lacs and discounting factor is 12%.

Year	1	2	3	4	5
Expected cash flow(in lacs)	40	60	80	70	50
Standard deviation(in lacs)	6	8	10	9	7

Solution

$$NPV = \frac{40}{1.12} + \frac{60}{(1.12)^2} + \frac{80}{(1.12)^3} + \frac{70}{(1.12)^4} + \frac{50}{(1.12)^5} - 150 = ₹ 63.34 \text{ lacs}$$

$$\sigma(NPV) = \left[\frac{6}{(1.12)} + \frac{8}{(1.12)^2} + \frac{10}{(1.12)^3} + \frac{9}{(1.12)^4} + \frac{7}{(1.12)^5} \right] = ₹ 28.40 \text{ lacs}$$

Probability of earning at least 50 lacs

$$z = \frac{(50 - 63.34)}{28.4} = -0.468$$

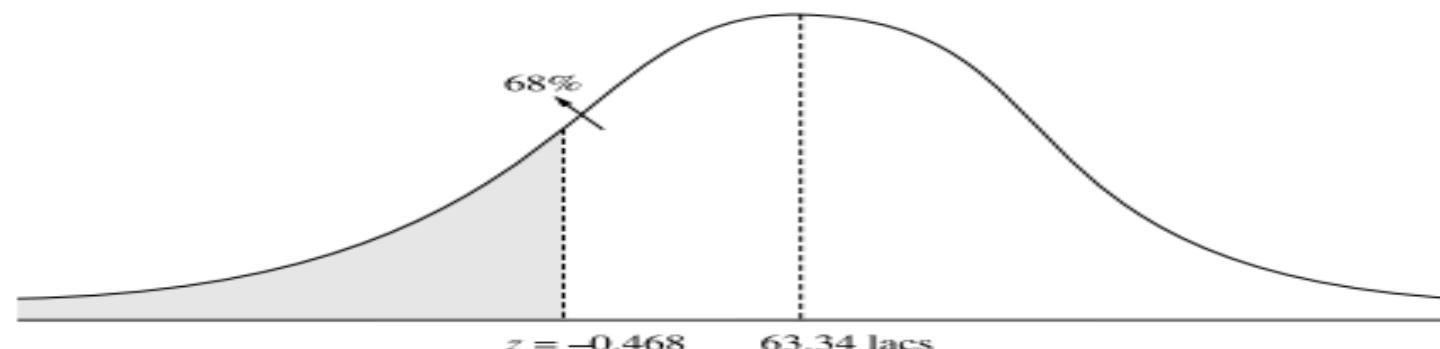


Figure 9.3(a) Solution to Example 9.2(a).

Corresponding probability of earning ₹ 50 lacs is .68 or 68%.

Probability that the project will not suffer a loss.

$$z = \frac{(0 - 63.34)}{28.4} = -2.23$$

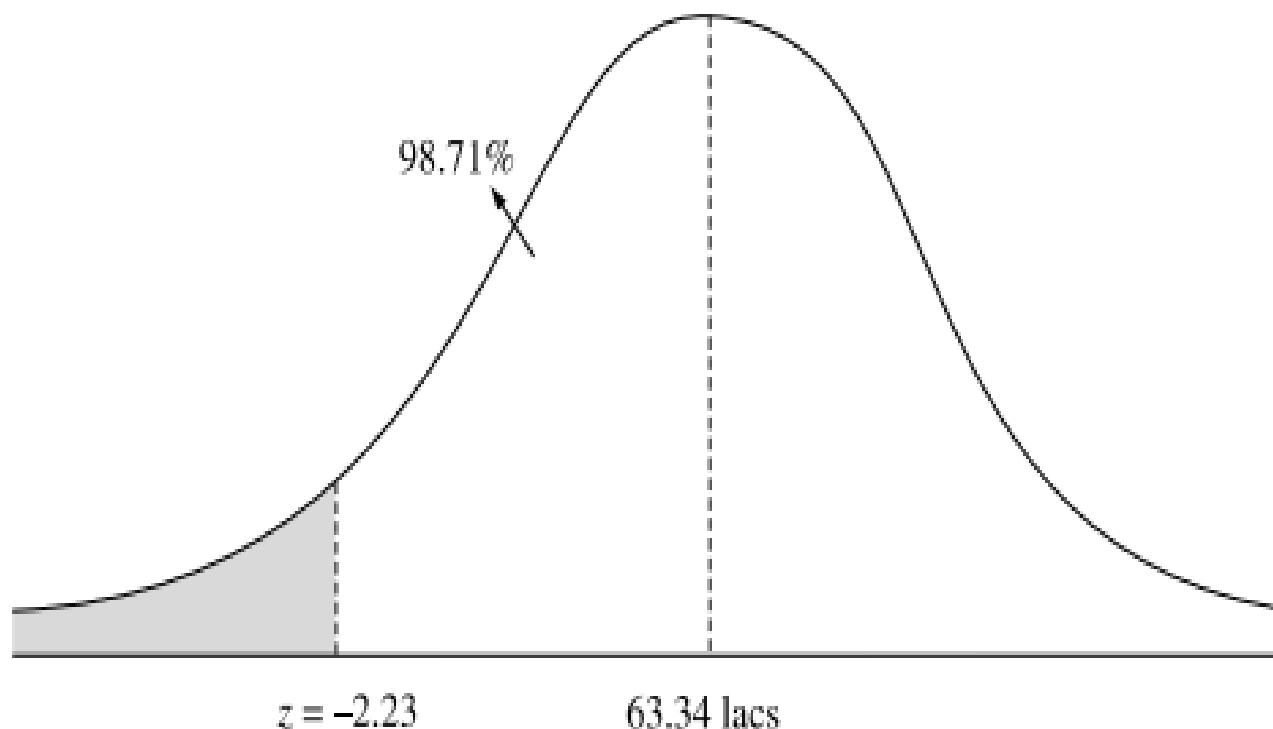


Figure 9.3(b) Solution to Example 9.2(b).

Corresponding probability of at least making no loss is 98.71%.



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Project Management for Managers

Lec – 25

Simulation Analysis

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Simulation Analysis

Sensitivity analysis indicates the sensitivity of the criterion of merit (NPV, IRR or any other) to variations in basic factors.

Though useful, such information may not be adequate for decision making.

The decision maker would also like to know *the likelihood of such occurrences.*

This information can be generated by simulation analysis which may be used for developing the probability profile of a criterion of merit by *randomly combining values of variables that have a bearing on the chosen criterion.*



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Procedure:

1. Model the project-How NPV is related to parameters (variables held constant by decision makers) and exogenous variables (stochastic in nature and not controllable).
2. Specify the value of parameter and probability exogenous variables.
3. Select a value, at random, from Probability Distribution of exogenous variable.
4. Determine the value of NPV for set parameter and exogenous variable generated randomly.
5. Repeat steps 4and 5 a number of times.
6. Plot frequency distribution of NPV.



$$NPV = \text{Sum } t=1 \text{ to } n \left\{ \frac{\text{Annual cash flow}}{(1 + \text{risk free return})^t} - \text{In.Invs} \right\}$$

Risk free return = 10% initial investment = 13000.

The exogenous variable having following probability distribution



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