

Engineering Management (2-1-0)



- Engineering management is the application of engineering principles to business and management, focusing on leading and overseeing technical projects, teams, and operations.

- It combines technical knowledge with business strategies to manage projects, improve processes, and develop new products.

Padma Jyoti

- *Has a degree in Mechanical Engineering from IIT Kanpur.*
- *Also an MBA graduate from Sloan School of Management, Massachusetts Institute of Technology (MIT).*
- *Chairman of Jyoti Group (now Padma Jyoti Group)*





Kul Man Ghising
**(Minister of Energy, Water Resources and
Irrigation of Nepal)**

- **Full Name:** *Kulman Ghising*
- **Birthdate:** *November 25, 1970*
- **Birthplace:** *Bethan, Ramechhap, Nepal*
- **Current Position:** *Managing Director, Nepal Electricity Authority (NEA)*
- **Known For:** *Ending Nepal's load-shedding crisis*
- **Education:** *Bachelor's in Electrical Engineering (NIT, Kurukshetra, India), Master in Power System from Pulchowk Campus, Kathmandu, MBA from Pokhara University.*

Meaning & Purpose of the Course

This course aims to:

- ***Bridge the gap between engineering and management.***
- ***Equip future engineers with managerial knowledge and skills necessary to lead and manage projects, teams, and organizations.***
- ***Help students understand management concepts and apply them in technology-based and ICT (Information and Communication Technology) environments.***



What It Covers



It teaches how to:

- **Plan, organize, lead, and control** activities within technical teams or engineering firms.
- Motivate and lead technical teams effectively.
- Manage **human resources** in an engineering setting.
- Understand and apply **emerging trends** such as **quality management, innovation, and change management** in tech-based industries.

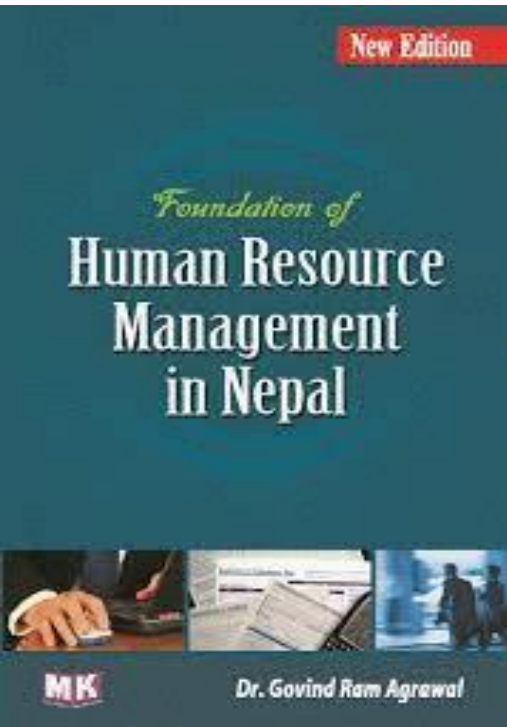
Why It Matters for Engineering Students

- Engineers often rise to leadership roles.
- This course helps them:
 - Leads to leadership roles
 - Bridges technical and business skills
 - Essential for project management
 - Prepares for industry challenges
 - Supports career growth
 - Adapts to changing technology

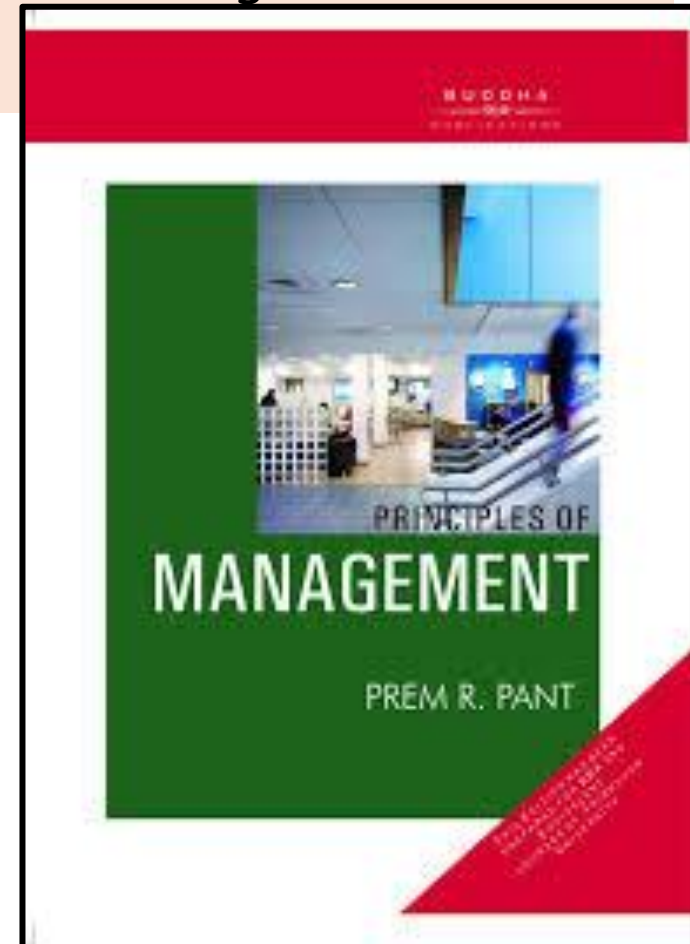
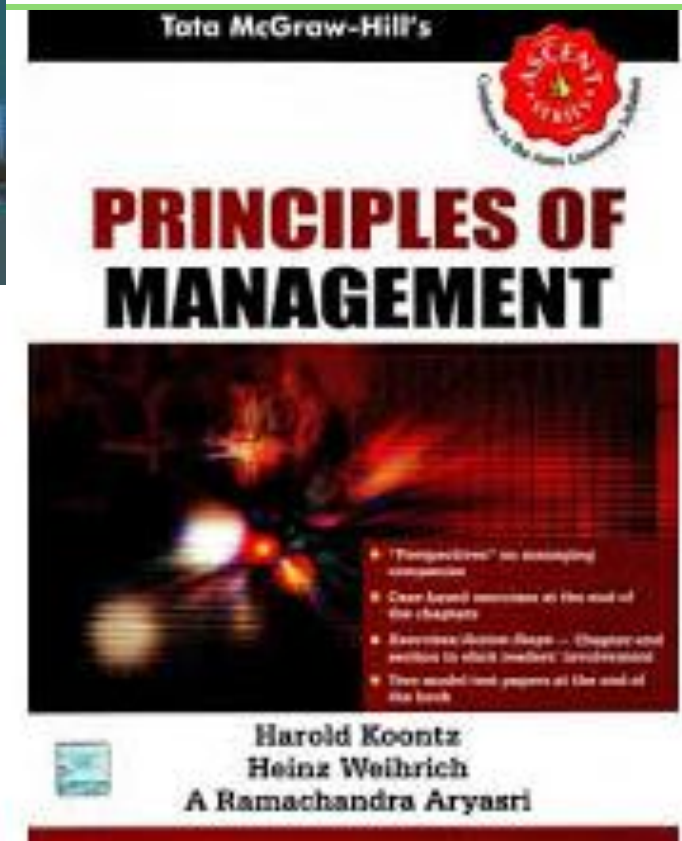


Unit	Title	Credit Hours(30)
I	Introduction	6 Hrs.
II	Planning and Organizing	6 Hrs.
III	Motivation and Leadership	6 Hrs.
IV	Human Resource Management and Control	8 Hrs.
V	Emerging Trends in Engineering Management	4 Hrs.

Text and Reference Books



1. Harold Koontz and Heinz Weihrich – *Essentials of Management*
2. Prem Raj Pant – *Principles of Management*
3. Govinda Ram Agrawal – *Organization and Management in Nepal*



Course Outlook

Unit I: Introduction

(6 Hrs.)

- 1.1 Management
 - 1.1.1 Functions of management
 - 1.1.2 Level and scope of management
 - 1.1.3 Principles of management
- 1.2 Organization
 - 1.2.1 Characteristics of organization
 - 1.2.2 Types of organization: formal and informal organizations, virtual organization
- 1.3 Engineering Management
 - 1.3.1 Importance of management in technology-driven environments
 - 1.3.2 Engineering functions in organizations: product development, operations, IT systems, quality assurance and others
 - 1.3.3 Roles and responsibilities of an engineering manager

Definitions of Organization



- Organization is the **process of arranging people, resources, and activities** in a structured way to achieve goals.
- *“Organization is a system of consciously coordinated activities of two or more persons.”* - (Chester I. Barnard)

Organization = Structure + Coordination + Resources + People → Goals

Etymology of “Management”



- From **Italian**
 - *maneggiare* = “to handle (horses)”
- From **Latin**
 - *manus* (hand) + *agere* (to act/lead)
- Entered **French** as
 - *ménagement* = “art of conducting”
- Adopted in **English (17th c.)** as
 - “management”
 - **Literal Meaning:** “To handle/guide skillfully”

Meaning of Management

- “Management is the process of planning, organizing, leading, and controlling resources (people, technology, and information) to achieve specific objectives effectively and efficiently.”
- Efficient resource use, goal achievement, and adaptability in tech environments.
- Example: *Managing a software development team to deliver a product on time.*

- Management is knowing exactly what you want to do and then seeing that they do it in the best and cheapest way. - **F.W. Taylor**

Approaches for Studying Management :

Management as an activity

Management as a process

Management as a discipline

Management as a group

Characteristics of Management

Goals focused

Pervasive(Broad) function

Group activity

Efficiency and effectiveness

Works through and with other

Situational process

Multidisciplinary

Environmental influence

Intangible

Both Art and Science

Main Functions of Management

Time Period	Philosopher/Theorist	Main Functions of Management
Early 1900s	F.W. Taylor (Scientific Management)	Planning, Organizing, Selection/Training, Coordination
1916	Henri Fayol	Planning, Organizing, Commanding, Coordinating, Controlling
1937	Gulick & Urwick (POSDCORB)	Planning, Organizing, Staffing, Directing, Coordinating, Reporting, Budgeting
1953	George Terry	Planning, Organizing, Actuating, Controlling
1955+	Koontz & O'Donnell	Planning, Organizing, Staffing, Directing, Controlling
1980s+	Modern Authors (Koontz, Robbins, etc.)	Planning, Organizing, Leading, Controlling (POLC Model)

Functions of Management

- Harold Koontz and Cyril O'Donnell
- called the POCCC model

- Planning



- Organizing



- Staffing



- Directing



- Controlling



Planning



- Planning is the process of deciding in advance about what to do, how to do it, when and where to do it, who is to do it, etc.
- Planning is the process of setting goals and choosing actions to achieve them.

Organizing

- Organizing is the process of creating structure.
- It is a process of establishing working relationships among employees, jobs and units of organization to achieve goals.

ORGANIZING



- *Identifying and defining the activities to perform to attain organizational goals.*
- *Grouping similar activities in to job.*
- *Defining authority to each department and units.*
- *Assigning job to department and units.*
- *Fixing authority to each job responsibilities.*
- *Establishing formal relationship in horizontal and vertical levels.*

Directing

- Directing is a management function regarding instructing, guiding, inspiring, communicating and supervising subordinates for effective and efficient performance towards organizational interest.



- *Directing consists of*
 - *leadership,*
 - *motivation,*
 - *Communication*
 - *supervision.*

Controlling

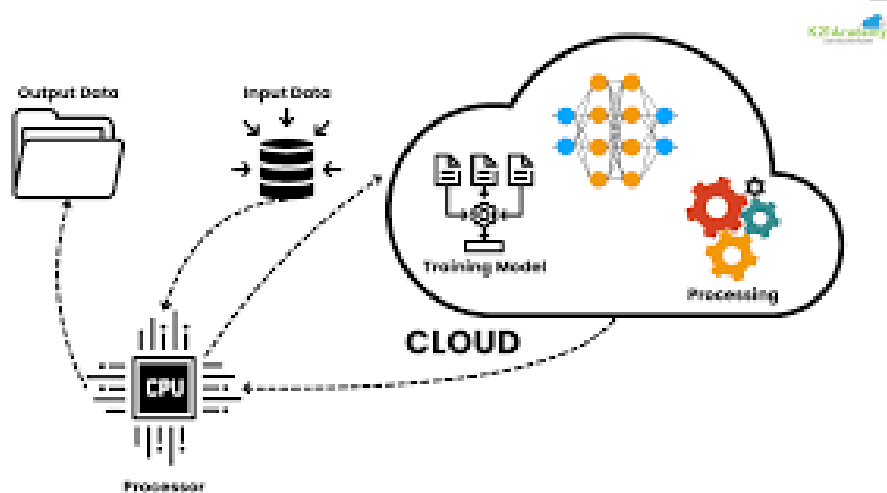
- Controlling is the process of correcting performance of individual, units, departments and whole organization to improve the overall organizational performance toward goal achievement.
- In simple words, controlling is a function for taking corrective action whenever and wherever required.



Controlling includes four steps

- *Establishing the standard for performance,*
- *Measuring actual performance,*
- *Finding and analyzing the differences between standard and*
- *Actual performance and initiating the correcting actions.*

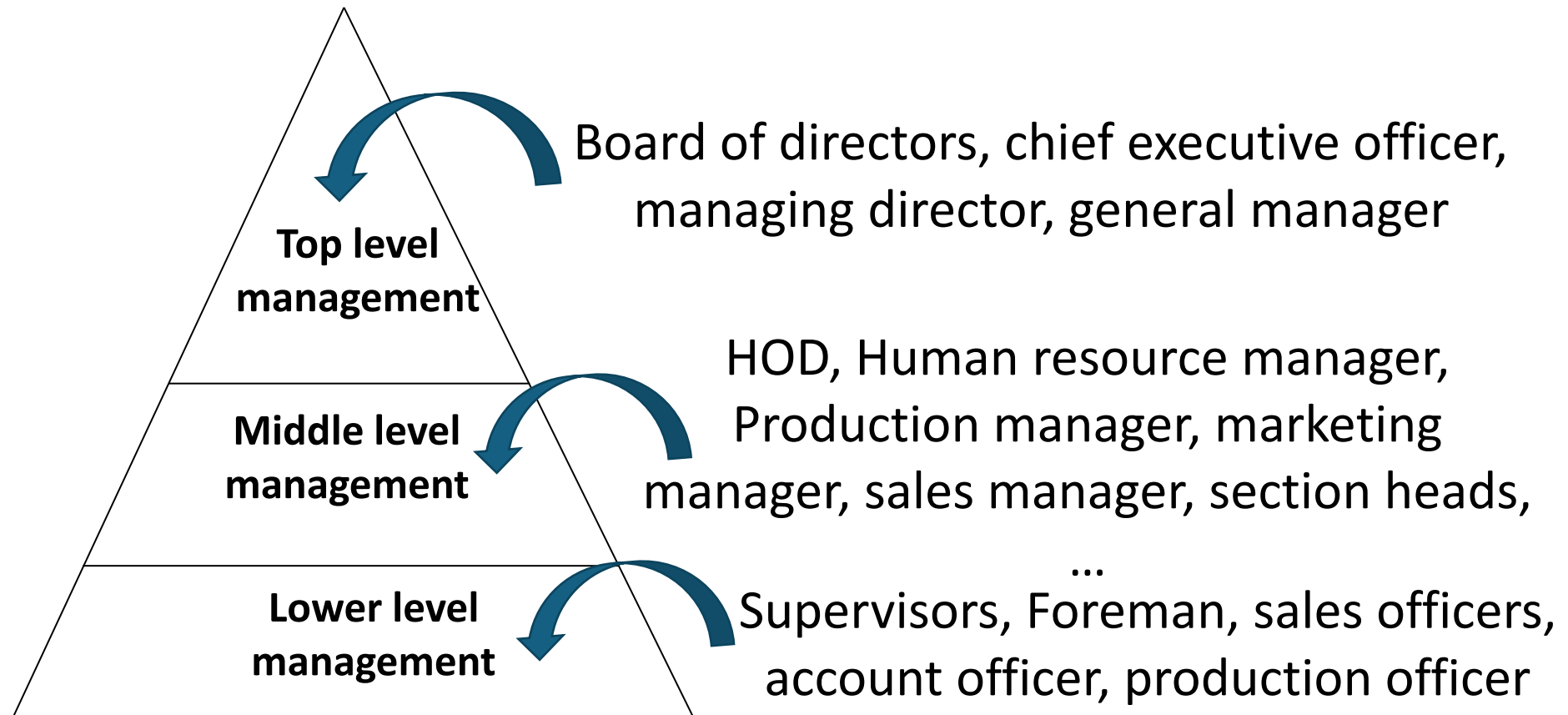
Practical Examples:



- **Planning:** Estimating compute costs for a cloud-based AI model.
- **Organizing:** Structuring a team to handle front-end, back-end, and database tasks.
- **Directing:** Motivating a team during a crunch to meet a client's deadline.
- **Controlling:** Using monitoring tools like Prometheus to track system performance.

Hierarchy of Management/ Management level

Hierarchy means a system with unbroken levels or status from the lowest to the highest and vice versa.



Functions of Top level management

- *Determining the overall organizational goals.*
- *Preparation of overall plans, policies and strategies to achieve the predetermined goals. Establishment the standards for controlling.*
- *Directing (leading, motivating, supervision, communication) employees for central plans and policies of organization.*
- *Assembling resources (human, capital, technology and information) and encouraging employees for wise utilization of such resources.*
- *Representing organization in external world. Interacting between organization and the external environment.*

Middle level management

- *Formulation of departmental goals, plans, policies and strategies for each department on the basis of overall goals.*
- *Interpretation of plans and policies developed by top level management to department level management.*
- *Guiding, instructing and controlling to the departments and lower level. Assigning duties and responsibilities for first line manager.*
- *Communicating plans, policies and guidelines set by top level management to lower level management.*
- *Recruiting and selecting the suitable staffs.*

Lower Level of Management

- *Arranging the necessary tools, equipments etc. for the workers.*
- *Maintaining a good human relations and discipline in the organization.*
- *Classifying and assigning the duties to first line employees. Directing for activities and solving the problems of workers.*
- *Improving morale of the workers. Arranging and providing training to workers.*
- *Reporting success or failure of the operation to the middle level management.*
- *Arranging job responsibilities in case of absenteeism.*

Scope of Management

1.Functional Management:

- Applying Planning, Organizing, Staffing, Leading, and Controlling to the entire Software/Hardware Development Life Cycle (SDLC) using methods like Agile and DevOps.

2.Resource Management:

- Strategic oversight of Human Resources (technical experts), Financial budgets (R&D, cloud costs), and managing proprietary Technology (IP, networks, systems).

3.Organizational & Sectoral Application:

- Applying management practices across diverse fields (Business, Government, Education, Defense) to lead projects involving IT infrastructure and embedded systems.

4.Strategic Decision-Making & Innovation:

- Guiding Strategic, Tactical, and Operational choices related to system architecture, ensuring security and compliance, and driving technological innovation (e.g., AI, high-performance computing).

Principles of Management

Principles are fundamental truths or what are believed to be truths at a given time, explaining relationships between two or more sets of variables.

Management principles are fundamental truth of general validity which has values in predicting the result of management action

Principles are derived through research, observation and practice. Principles can be descriptive or prescriptive.

Descriptive principle describes the relationship between variables while **prescriptive principle** regulates what one should to attain the goals.

Why Fayol Matters to Engineers



- *Jules Henri Fayol(1841-1925), French mine engineer*
- *Fayol, a mining engineer and executive himself, developed these principles based on his experience managing a complex technical organization.*
- *He understood the need to bridge technical work with effective administration.*
- *For engineers, these principles provide the "operating system" for any project or team.*
- ***father of modern management and administrative management***

Henry Fayol's 14 Principals of Management

1. Centralization

2. Initiative

3. Division of work

4. Unity of command

**5. Subordination of individual
interest**

6. Equity

7. Remuneration of personnel

8. Unity of direction

9. Scalar chain

10. Esprit de Corps

11. Stability of Tenure

12. Order

13. Discipline

14. Authority and Responsibility

- **Centralization** - Refers to the extent to which authority is concentrated or dispersed. Circumstances of organization e.g. size will determine the extent to which an organization is centralized.
- **Initiative** -All levels of personnel should be encouraged to show initiative as it is a source of satisfaction.
- **Division of work** - Necessary to efficiency of labour as it reduces span of attention or effort hence increasing specialization.
- **Unity of command** - One person, one superior, employees should receive orders from one superior only to reduce confusion.
- **Scalar Chain** - “Chain of Superiors” or line of authority from top to bottom.
- **Equity** - Refers to loyalty and devotion from personnel by use of kindness and justice on the part of managers.
- **Remuneration** - Pay should be fair to both worker and firm.

- **Unity of Direction** - One head, one plan for a group of activities with the same objective.
- **Subordination of the individual interest to general interest**
-The interests of one individual or one group should not prevail over the general good.
- **E-spirit de corps** -“In union there is strength”. This is an emphasis on teamwork, harmony and communication.
- **Stability or Tenure of Personnel** -Refers to the costs and dangers of turnover due to bad management.
- **Order** - A place for everything i.e. the right person in the right job or place.
- **Discipline** -Respect for formal and informal agreements between firm and workers and obedience to rules and regulations.
- **Authority and Responsibility** - The right to give orders.

Pros

- *Provides a clear framework for organizing a company.*
- *Improves efficiency and stability.*
- *Foundation for modern management.*

Limitations

- *Can be rigid and bureaucratic.*
- *Ignores informal relationships and human emotions.*
- *Top-down approach can demotivate employees.*

Concept of Organization

- **Structure:** A framework that defines roles, responsibilities, and relationships.
- **Purpose:** A shared objective or set of goals that the organization aims to achieve.
- **People:** Individuals working collectively to contribute their efforts and skills.
- **Process:** The methods and systems used to coordinate activities and achieve goals.
- **Environment:** The external factors (economic, social, political, technological) that influence the organization.

Definitions of Organization

- *Organization is the form of every human association for the attainment of a common purpose.*
- **Mooney and Railey**
- *An organization is a system of consciously coordinated activities of two or more than two people.*
- **Chester Bernard**
- *Organization is a group of people working together in structured and coordinated fashion to achieve a set of goals.*
- **Ricky W. Griffin**



Characteristics of organization

- ***Common Goal***
- ***Structure***
- ***People***
- ***Deliberate Structure***
- ***Division of Labor***
- ***Hierarchy of Authority***
- ***Coordination***
- ***Communication***
- ***Rules and Regulations***

- **Common Goal:** Organizations are formed to achieve specific, shared objectives.
- **Structure:** A defined framework of relationships among individuals and tasks. This includes division of labor, hierarchy of authority, and coordination mechanisms.
- **People:** A group of individuals who interact and collaborate to achieve organizational goals.
- **Deliberate Structure:** Organizations are consciously designed and maintained, not random gatherings.
- **Division of Labor:** Tasks are divided into smaller, specialized jobs to increase efficiency.
- **Hierarchy of Authority:** A chain of command that defines reporting relationships and levels of authority.
- **Coordination:** Processes and mechanisms to integrate the activities of different individuals and departments to ensure unified effort.
- **Communication:** The flow of information between different parts of the organization.
- **Rules and Regulations:** Formal or informal guidelines that govern behavior and decision-making.

Culture of Organization

- **Organizational culture** refers to the shared values, beliefs, and practices that shape the behavior of members within an organization.
- Organizational culture is the collection of values, expectations, and practices that guide and inform the actions of all team members.
- Organizational culture is often described as "how things are done around here."
- It influences how employees interact and work together.

Components of Culture of Organization

- **Values:** Guiding principles, ethics.
- **Beliefs:** Perceived truths about the organization.
- **Norms:** Accepted behavioral standards.
- **Symbols:** Reflective visual/verbal cues.
- **Language:** Internal communication specifics.
- **Stories/Myths:** Value-reinforcing narratives



Types of organization: formal and informal organizations, virtual organization

Formal Organization:

- Structured entities established by management to achieve specific goals, governed by rules and regulations.
- **Characteristics:**
 - Defined hierarchy and roles.
 - Official communication channels.
 - Focus on authority and responsibility.

Types:

- **Hierarchical Organizations:** Traditional structure with a clear chain of command.
- **Matrix Organizations:** Employees report to multiple managers, promoting flexibility.
- **Flat Organizations:** Fewer levels of management, encouraging employee empowerment.



Informal Organizations

- **Definition**
- Spontaneously formed groups based on personal relationships and social interactions among employees.
- **Characteristics:**
 - Fluid and flexible structure.
 - Based on personal connections and common interests.
 - Informal communication often occurs through social networks (grapevine).



- **Types:**
 - **Friendship Groups:** Formed based on personal relationships.
 - **Interest Groups:** Arise from shared interests or hobbies.
 - **Work Teams:** Informal collaborations that may cross departmental lines.

Virtual Organization

- A virtual organization is a modern, network-based structure where geographically dispersed individuals and teams are connected through technology to achieve common goals.
- Boundaries are fluid, and the organization often relies on outsourcing and strategic alliances.
- **Characteristics:**
 - **Geographical Dispersion:** Members work from different locations (*home offices, different cities/countries*).
 - **Technology-Dependent:** Heavily reliant on communication and collaboration tools (*e.g., Slack, Microsoft Teams, Zoom, GitHub, Jira*) to function.
 - **Network-Based Structure:** A core organization often coordinates a network of freelancers, contractors, and partner companies.
 - **Fluid and Boundaryless:** Team composition can change rapidly based on project needs.
 - **Output-Focused:** Evaluation is based on results and deliverables, not on hours spent in an office.

Comparison Table

Type	Core Idea	Structure	Best For
Network-Based	"Orchestrate, don't own."	Hub-and-Spoke	Project-based work, startups, flexible manufacturing.
Parallel	"Temporary team for a special project."	Overlay/Project Team	Solving complex, cross-functional problems within a larger traditional company.
Modular/Ecosystem	"Provide the platform."	Decentralized Network	Technology platforms, open-source projects, community-driven innovation.
Fully Distributed	"Work is an activity, not a place."	Can Vary	Knowledge-work companies that want to access global talent and max

- **Advantages:**

- **Access to Global Talent:** Can hire the best people for the job, regardless of their physical location.
- **Reduced Overhead Costs:** Significant savings on physical office space, utilities, and related expenses.
- **Flexibility and Agility:** Can quickly form and disband teams to respond to market opportunities.
- **Increased Employee Autonomy:** Often leads to higher job satisfaction for self-motivated individuals.

- **Disadvantages:**

- **Communication Challenges:** Time zones, lack of face-to-face interaction, and technology glitches can hinder communication.
- **Building Trust and Culture:** Difficult to foster a strong company culture and build deep trust among team members who rarely meet in person.
- **Management Complexity:** Requires managers to be highly skilled in remote leadership, communication, and using digital tools to track progress.
- **Potential for Isolation:** Employees may feel disconnected from the organization and their colleagues.

- **Examples in Engineering:** An open-source software project with contributors from around the world, a tech startup with a fully distributed team using Slack and cloud-based IDEs, or a consulting firm that assembles specialized project teams from a global pool of experts.

Engineering Management



Engineering Management is the application of management principles to guide technical teams and resources, bridging the gap between technical work and business strategy.

- A specialized branch of management that applies engineering principles to leadership and administration.
- Focuses on planning, organizing, directing, and controlling technical activities.
- Acts as a bridge between engineering functions and organizational goals.
- Ensures projects, teams, and resources are managed efficiently.
- Aims to deliver innovation, quality, and business value through technical work.

Importance of Management in Technology-Driven Environments

- Helps navigate complex and interconnected technical systems.
- Breaks large technical problems into manageable tasks.
- Accelerates innovation and reduces time-to-market.
- Uses Agile, DevOps, and modern practices to speed development.
- Optimizes use of limited resources: engineers, time, and budget.
- Prioritizes high-value projects and prevents team burnout.
- Identifies and mitigates technical, security, and market risks.
- Creates a safe culture where risks and issues can be openly discussed.
- Improves collaboration across software, hardware, QA, and product teams.
- Ensures smooth communication and alignment toward shared goals.
- Translates business vision into actionable technical roadmaps.
- Ensures daily engineering work supports strategic organizational objectives.

Why Management Matters in Tech Environments ?

- **Navigate Complexity:** Provides structure to manage intricate, interconnected systems.
- **Accelerate Innovation:** Implements agile methods to speed up development cycles.
- **Optimize Resources:** Strategically allocates budget, time, and skilled engineers.
- **Mitigate Risk:** Identifies and addresses technical, project, and market risks early.
- **Foster Collaboration:** Breaks down silos and ensures cross-functional alignment.
- **Translate Vision to Execution:** Turns high-level business goals into actionable technical roadmaps.

Core Engineering Functions in an Organization

- **Product Development (R&D):**

- Designing, developing, and testing new products or improving existing ones to meet market needs.
- The creative engine for designing and prototyping new products.

- **Operations / Manufacturing:**

- Managing the actual production or service delivery process, ensuring efficiency and resource optimization.
- Produces products efficiently at scale and consistent quality.



- **IT Systems & Infrastructure:**

- Developing and maintaining information technology infrastructure, software systems, and digital tools supporting business and engineering activities.
- Manages the company's internal technology backbone (networks, cloud, security).

- **Quality Assurance (QA):**

- Ensuring products and processes meet defined quality standards and regulatory requirements through systematic testing and inspection.
- The gatekeeper of quality, ensuring products are defect-free.

- **Other Key Functions:**

- Sales Engineering
- Technical Support
- Maintenance & Field Service
- Sustainability Engineering



Roles and Responsibilities of an Engineering Manager

1. People Management (Coach)

- Hires and onboards engineers
- Mentors and develops team members
- Sets expectations and reviews performance
- Builds team culture and resolves conflicts



2. Project & Technical Management (Conductor)

- Plans and executes projects
- Guides technical decisions, removes roadblocks
- Allocates resources, ensures quality and best practices
- Manages risks and project delivery

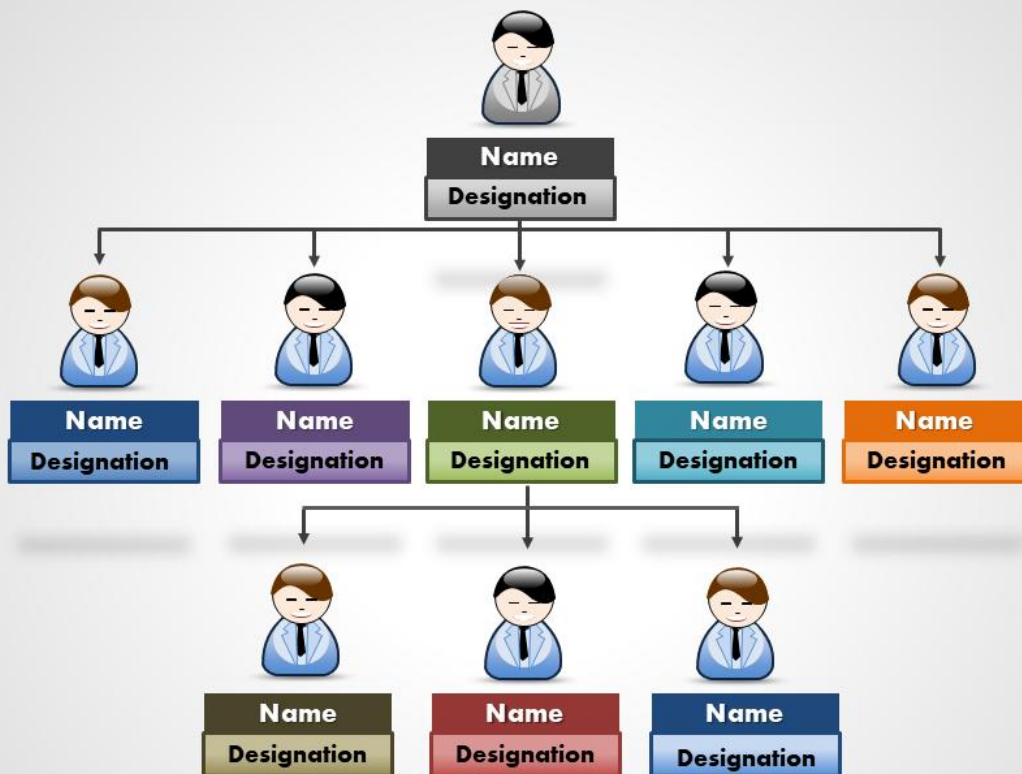
3. Strategic & Business Management (Ambassador)

- Aligns team with business goals
- Communicates with stakeholders and other departments
- Manages team budget and resources
- Improves processes, reports performance

2.5 Organization Chart

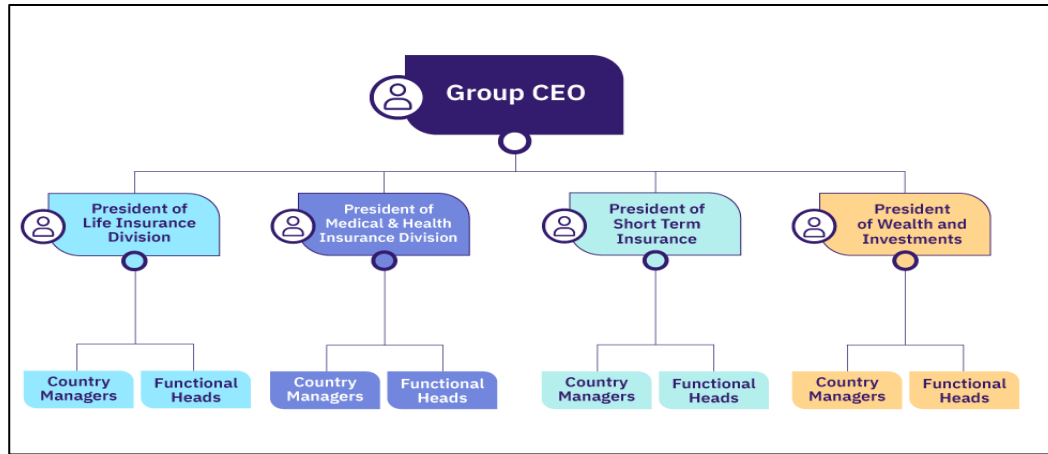
- A **visual diagram** showing the structure, positions, and relationships within an organization.
- An organization chart, also known as an **organogram**, is a diagram that visually represents the structure of an organization.

Organization Chart

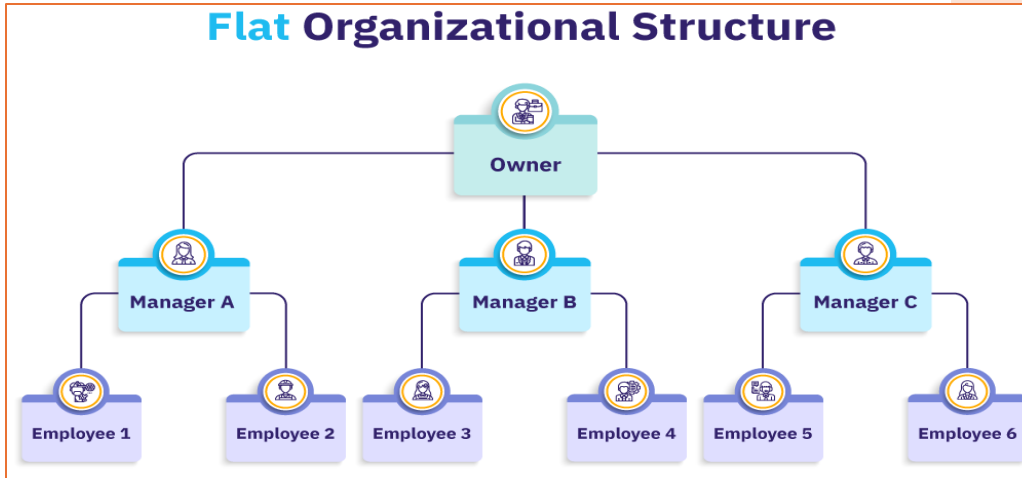


- *It outlines the roles, responsibilities, and relationships between individuals within the organization.*
- *Shows **lines of authority, communication, and responsibility.***

Types of Organization Charts:



Flat Organizational Structure



• Vertical Chart:

- *Top-down structure (e.g., CEO at top → Managers → Employees).*

• Horizontal Chart:

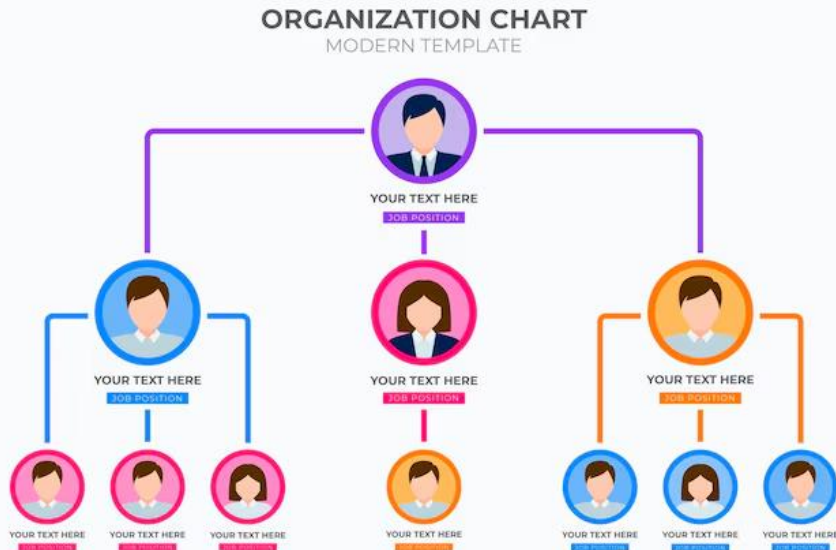
- *Structure shown left to right (suitable for smaller or project-based organizations).*

• Circular Chart:

- *Central figure in the middle with branches spreading out (good for team-based organizations).*

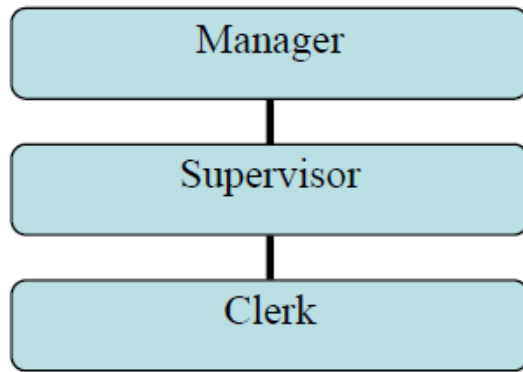


Importance of Organization Chart



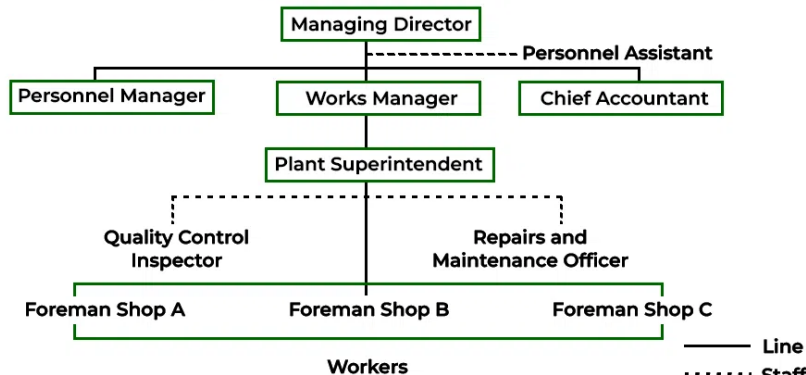
- Easy to understand the structure.
- Defines clear authority and reporting lines.
- Helps in identifying roles and gaps.
- Assists in managing workforce efficiently.

Types of Organization line

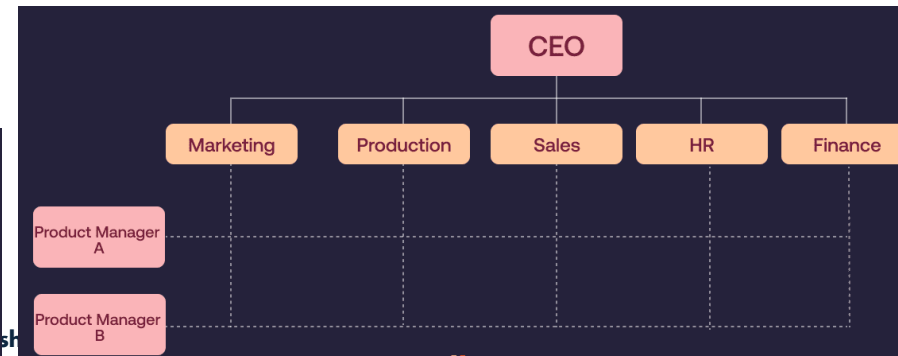
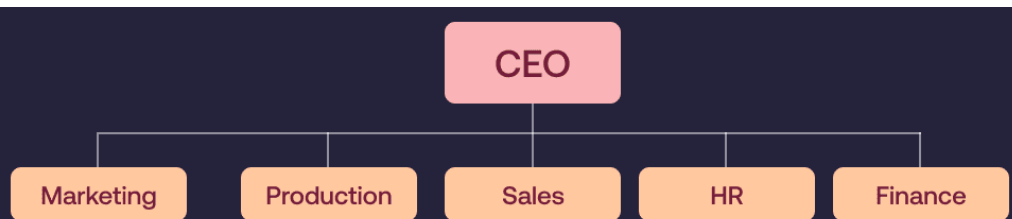


- **Line Organization:** Direct, vertical flow of authority (simple and oldest type).
- **Line and Staff Organization:** Line managers make decisions; staff offer advice and support.
- **Functional Organization:** Employees are divided based on specialized functions (*e.g., finance, marketing*).

Line and Staff Organisation



- **Matrix Organization:**
- A hybrid model where employees report to two bosses functional manager and project manager.



Line Organization

- Simple, direct chain of command.
- Authority flows from top to bottom.
- **Example:** *Small manufacturing units.*

Line and Staff Organization

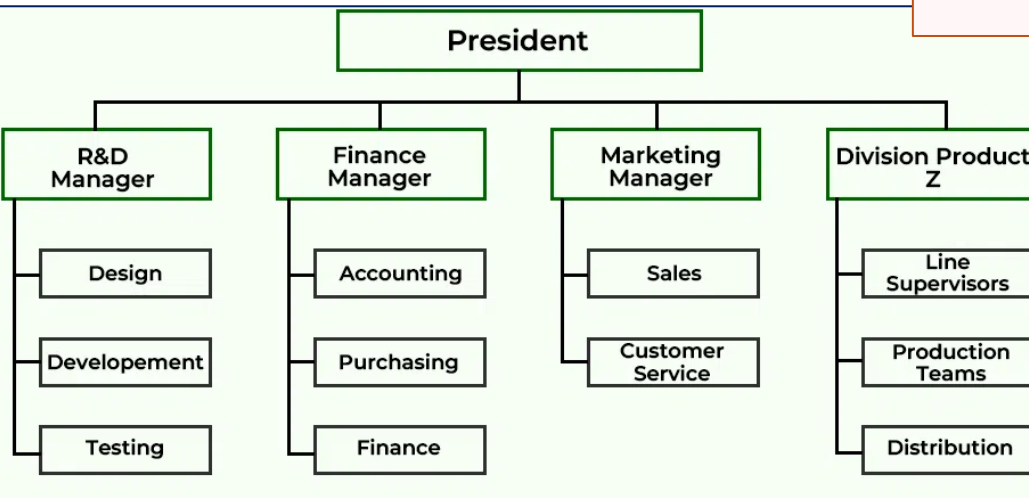
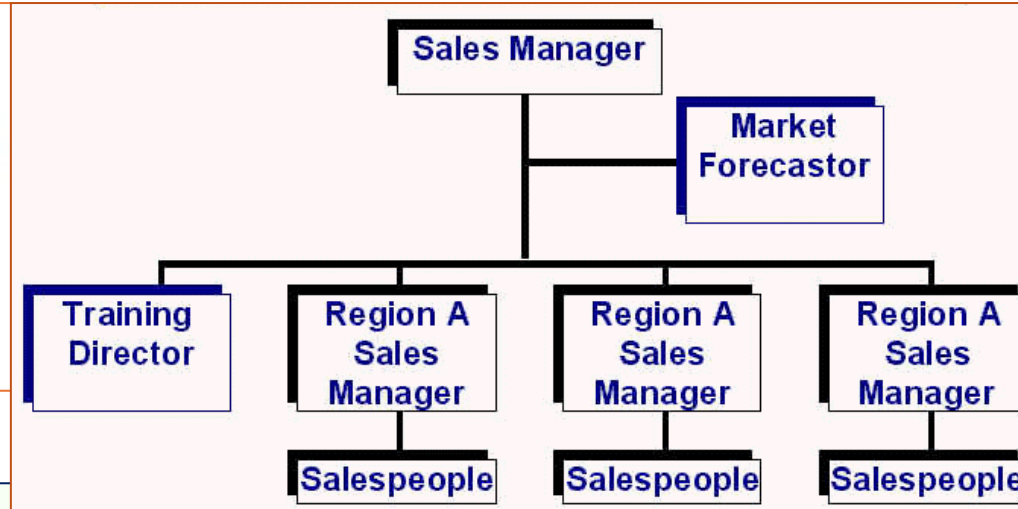
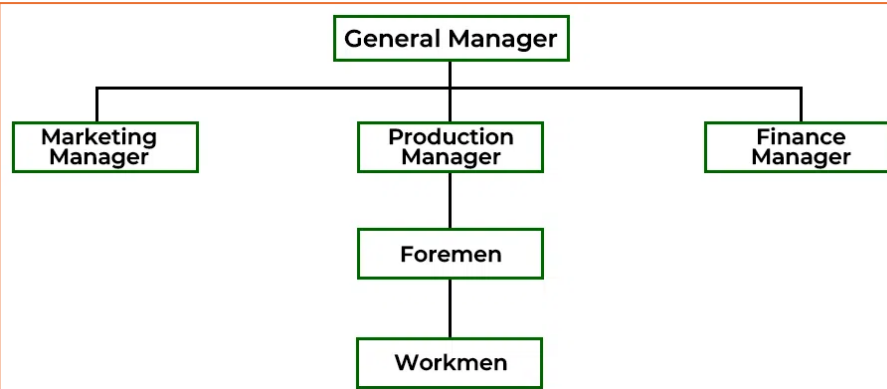
- Line managers have direct control.
- Staff specialists provide advice and support.
- **Example:** *Large corporations with HR, Legal, Finance departments.*

Functional Organization

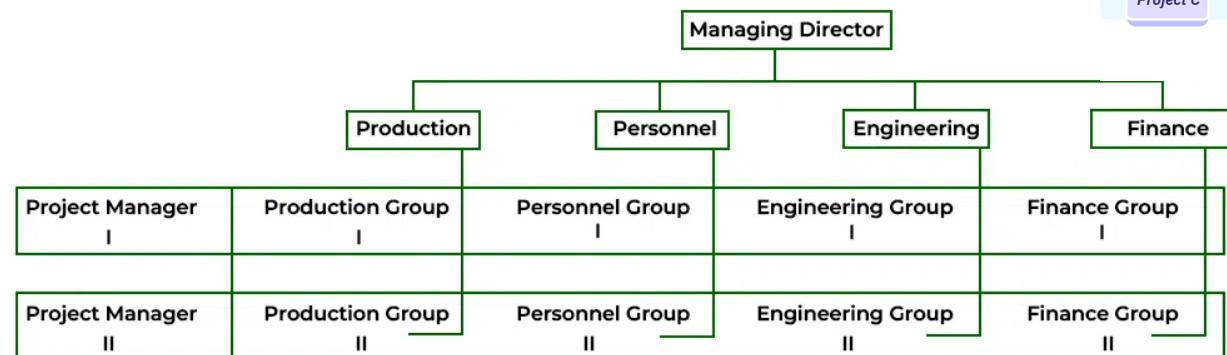
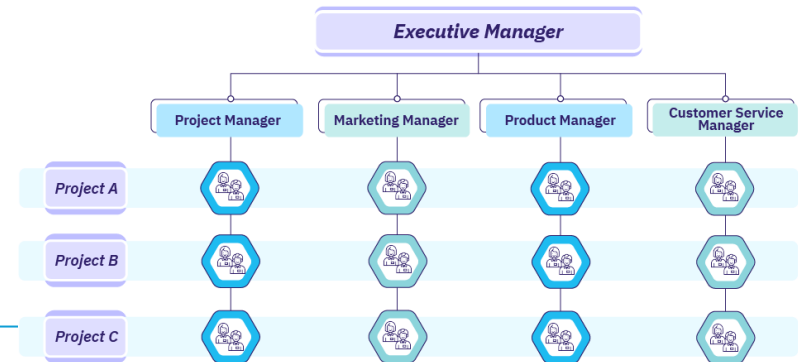
- Work divided based on functions like marketing, finance, production.
- Employees report to multiple managers.
- **Example:** *Multinational corporations.*

Matrix Organization

- Combination of functional and project-based structures.
- Employees have dual reporting relationships (functional manager and project manager).
- **Example:** *IT companies, Construction companies.*



Matrix Organizational Structure



Authority and responsibility and their interrelationships

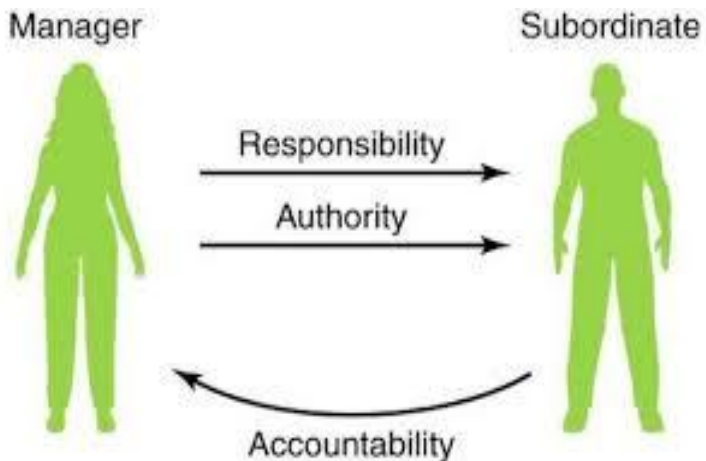
Authority:

- **Authority** is the **legal or official power** to give orders, make decisions, and control resources.
- It allows a manager to **direct the actions** of subordinates.
- **Example:** A manager has authority to assign tasks to employees.



Responsibility:

- **Responsibility** is the **obligation** to perform assigned tasks correctly and effectively.
- It is the **duty** to complete work as expected.
- **Example:** An employee is responsible for completing the report assigned by the manager.



Accountability

- The obligation to answer for results to explain, justify, and accept consequences (positive or negative).
- The manager is accountable to the CEO: if the budget is blown, the manager must explain and may be disciplined.

Interrelationship between Authority and Responsibility

- **Balance Needed:**

- *Authority and responsibility must go together.*
- *If a person has **authority without responsibility**, they might misuse power.*
- *If a person has **responsibility without authority**, they cannot complete tasks properly.*

- **Delegation:**

- *When managers delegate tasks, they must also delegate enough authority to complete those tasks.*

- **Accountability:**

- *Even if authority is delegated, the person who assigned the task (manager) is still accountable for the results.*

Relationship Between Organization and Management



- An organization is ***a structured group of people working together to achieve specific goals.***
- Management is ***the process of planning, organizing, leading, and controlling these efforts to achieve those goals efficiently and effectively.***
- management cannot exist without an organization, and an organization cannot function effectively without management.



Organization	Management	Example
<ul style="list-style-type: none"> Provides structure 	<ul style="list-style-type: none"> Provides direction 	<ul style="list-style-type: none"> <i>A hospital has departments (structure); management schedules doctors and resources.</i>
<ul style="list-style-type: none"> Defines roles and relationships 	<ul style="list-style-type: none"> Allocates tasks and resources 	<ul style="list-style-type: none"> <i>In a company, HR defines roles; management assigns people to projects.</i>
<ul style="list-style-type: none"> Static (relatively fixed) 	<ul style="list-style-type: none"> Dynamic (adapts to change) 	<ul style="list-style-type: none"> <i>A school keeps the same departments yearly; management updates teaching methods.</i>
<ul style="list-style-type: none"> Exists independently 	<ul style="list-style-type: none"> Operates actively within organization 	<ul style="list-style-type: none"> <i>An army has a fixed rank system; officers (management) lead and command missions.</i>