Engineering Management

Huthaifa Khalil

Engineering Management

- Engineer Management is concerned with the design, installation, and improvement of integrated systems of people, material, information, equipment, and energy by drawing upon specialized knowledge and skills in the mathematical, physical, and social sciences, together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such systems

- Scientific discipline, which designs, implements and/or develops models, processes and systems by taking into account the engineering relationships between the management tasks of planning, organizing, leading and controlling and the human element in production, research, marketing, finance and other services.

Engineering Management

- Engineering management is the fusion of business and engineering principles.

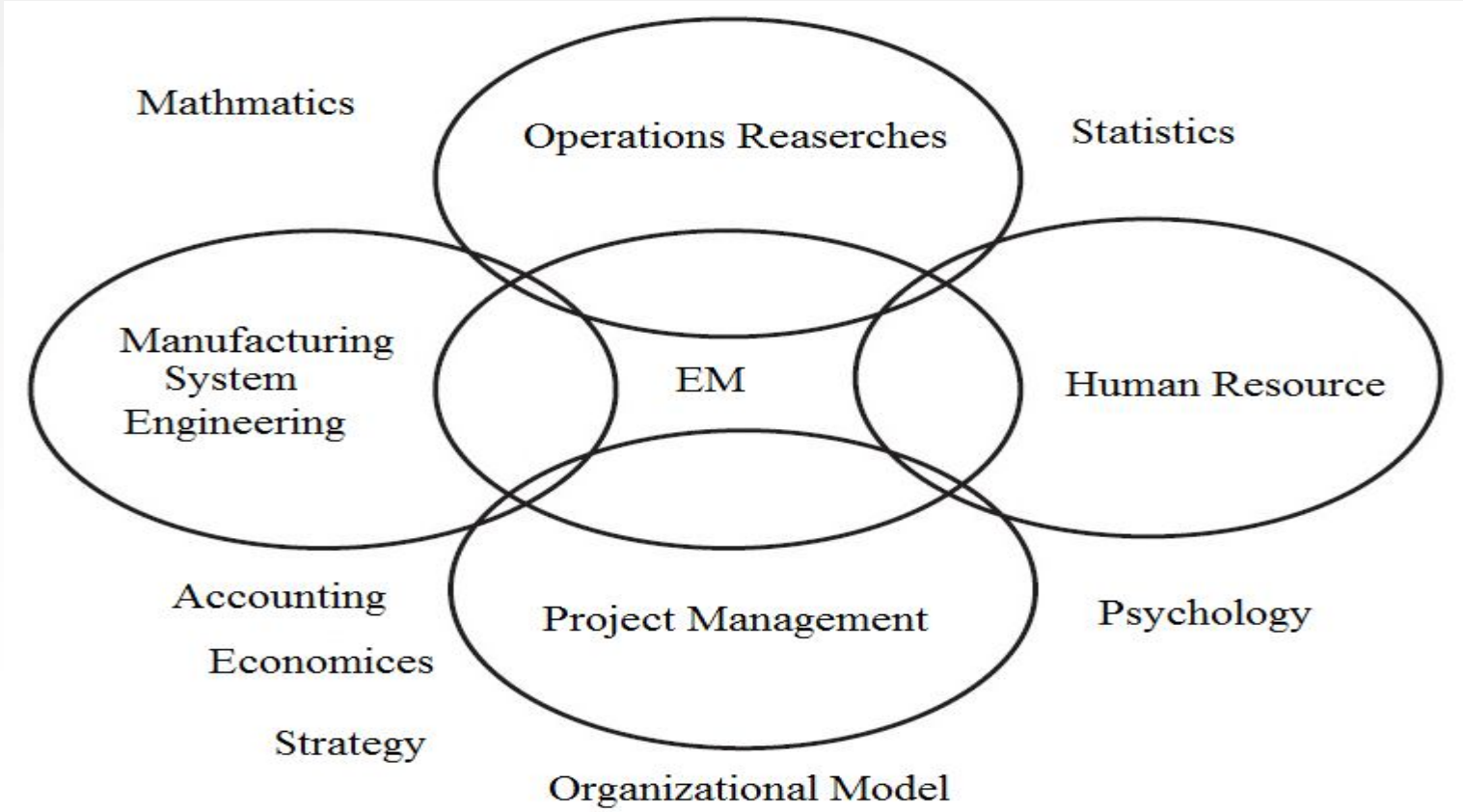
- By having knowledge of economics and management they can forecast or can predict the utility, advantages, disadvantages of the product. also get to know the scope of the product and it's contribution in growth.

- Specialized form of management that is concerned with the application of engineering principles to business practice.

- Career that brings together the technological problem-solving savvy of engineering and the organizational, administrative, and planning abilities of management in order to oversee complex enterprises from conception to completion.

Engineering Management

- **Engineering Management Domain**



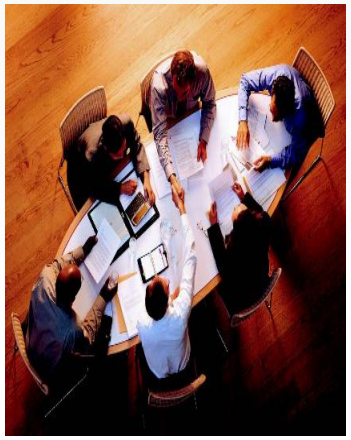
Engineering Management

- Example areas of engineering management area are:
  - Product development
  - Manufacturing
  - Construction
  - Design engineering
  - Industrial engineering
  - Technology
  - Production

- Successful engineering managers typically require training and experience in business and engineering to:
  - Operating effectiveness and efficiency is
  - Problem solving and operations improvement

- Managers within the field of engineering are trained to understand Human resource management, finances, industrial psychology, quality control, operations research and environmental management.

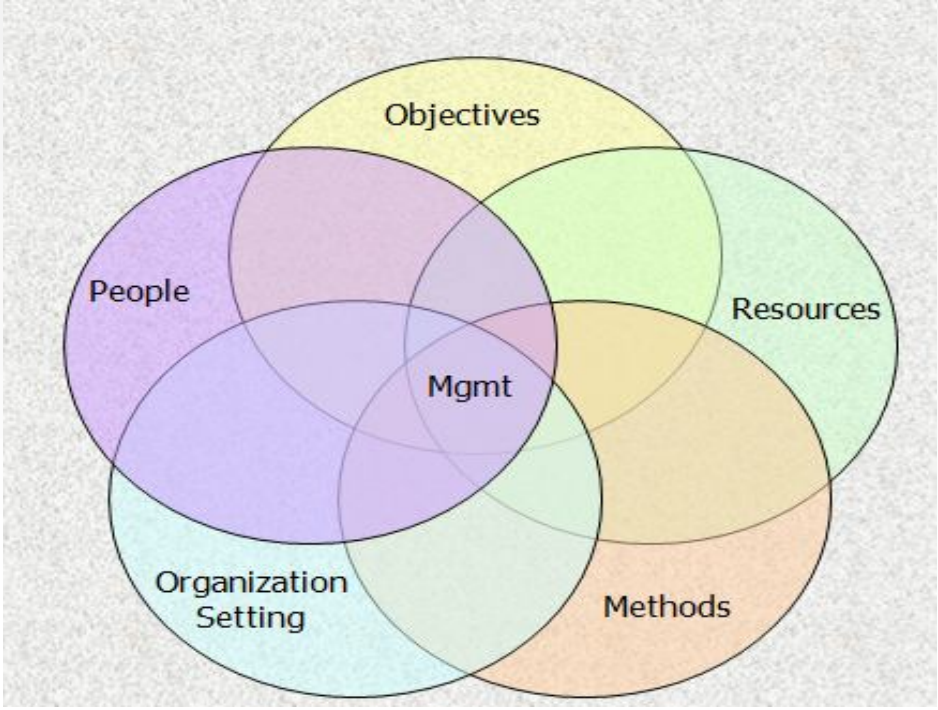
Engineering Management

Engineering	Management
The profession in which a knowledge of the mathematical and natural science gained by study, experience, and practice is applied with judgement to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind 	A set of activities (including planning and decision making, organising, leading and control) directed at an organisation's resources (human, financial, physical and informational) with the aim of achieving organisational goals in an efficient and effective manner. 

Engineering Management

- Management is getting things through others, Management needs:

  - Objective
  - Resources,
  - Methods,
  - Organization setting,
  - People



Engineering Management

- **Function of Manager**

  - Planning
  - Organizing
  - Directing
  - Controlling

Engineering Management

- **Planning**
  - Manager should have objective in mind
  - Planning help manager to do the right things
  - Well planning needs the following
  - Defining objectives,
  - Deciding what/when/how/who
    - ✓What is to be done,
    - ✓When it is to be done,
    - ✓How it is to be done,
    - ✓Who is to do it,

Engineering Management

- **Organizing**
  - Gathering and allocating resources,
  - Coordinating the work of the organization,
  - Deliberate creation a configuration that defines the followings:
    - ✓How authority is structured,
    - ✓How communication flows,
    - ✓How tasks are accomplished

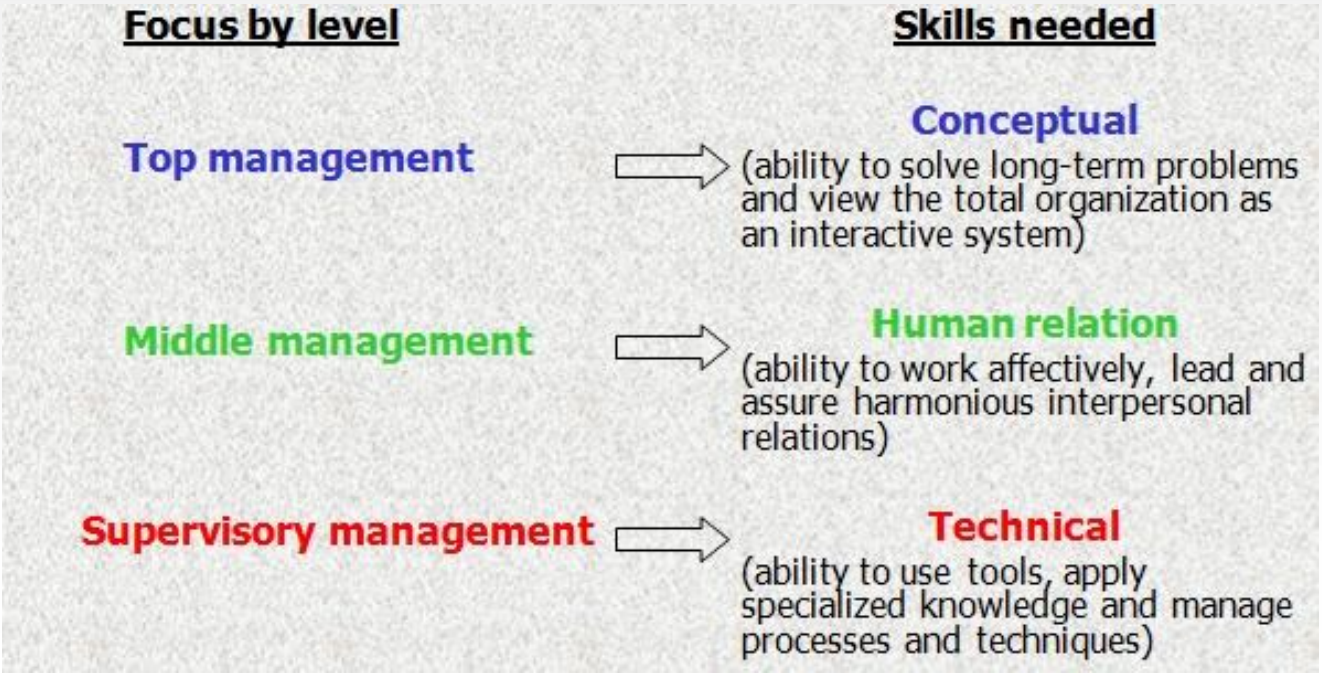
Engineering Management

- **Directing**
  - Redirecting human behavior to achieve objectives
  - Motivating others to produce,
  - Influencing subordinates

- **Controlling**
  - Keeping things on track,
  - Steering performance towards desired goal,
  - Coordinating monitoring and adjusting performance

Engineering Management

- **Managerial skills**



Engineering Management

- **Contrast between American and Japanese organizations**

American	Japanese
Mobile employees	Lifetime employment
Personal decision making	Collective decision making
Individual responsibility	Group responsibility
Rapid advancement	Slow and systematic advancement
Specialization in careers	General career perspective
Explicit control mechanisms	Implicit control system
Focused concern for employees	Holistic concern for employees.

Engineering Management

- **Difference Between Boss & Leader**

Engineering Management

- **Course Outline:**
  - ✓ **Engineering Management**
  - **• Marketing & Strategy**
  - **• Organizational Model & Human Resource**
  - **• Cost Management & Productivity**
  - **• Project Management**
  - **• Quality Control**
  - **• Operations Researches**
  - **•Supply Chain**
  - **•Industrial safety**

Engineering Management

▪ Reference Book

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Marketing

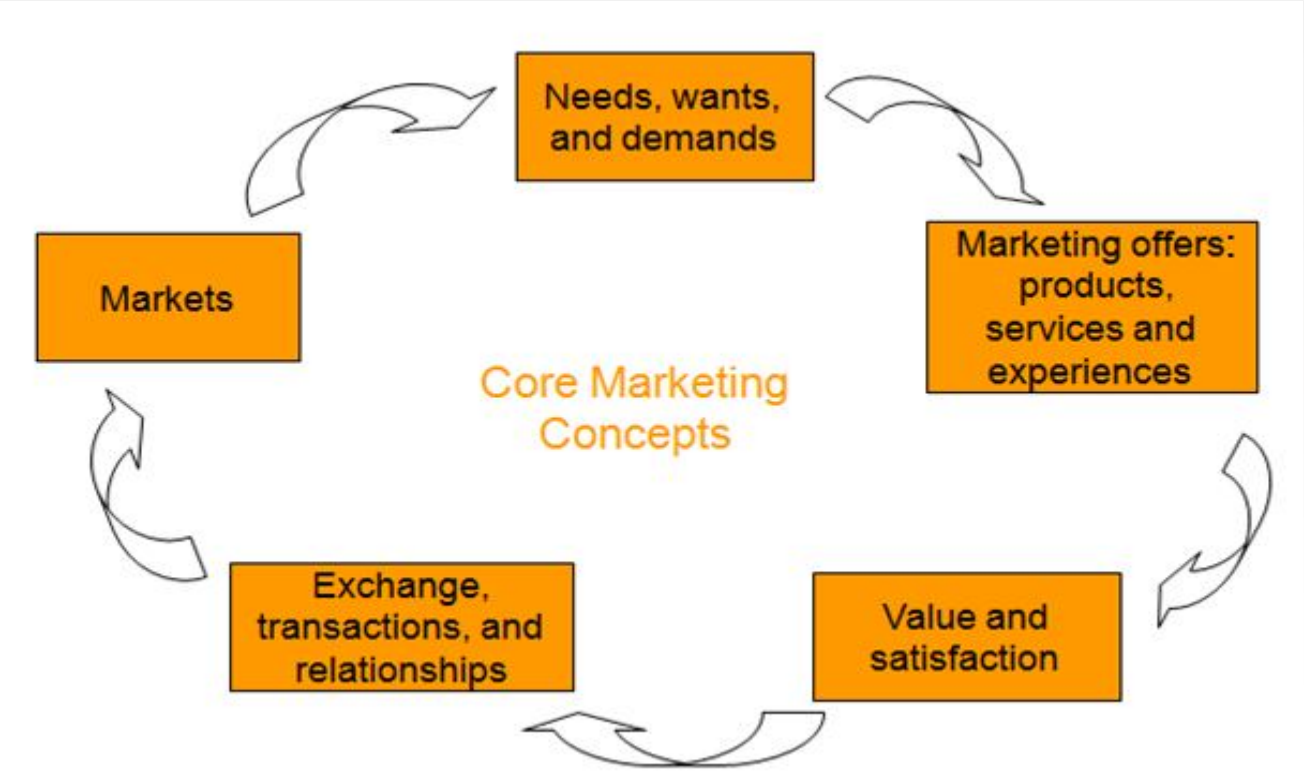
Huthaifa Khalil

Marketing

- **Market:** Collection of buyers and sellers, interaction, determine the prices of products
  - Buyers: consumers purchase goods, companies purchase labor and inputs
  - Sellers: consumers sell labor, resource owners sell inputs, firms sell goods
- **Arbitrage**: The practice of buying a product at a low price in one location and selling it for more in another location.
- **Product** is anything that can be offered to someone to satisfy a need or want
- **Market Price**: Transactions between buyers and sellers are exchanges of goods for a certain price.
- **Goods**: physical, tangible entities

Marketing

- **Core Market Concept**

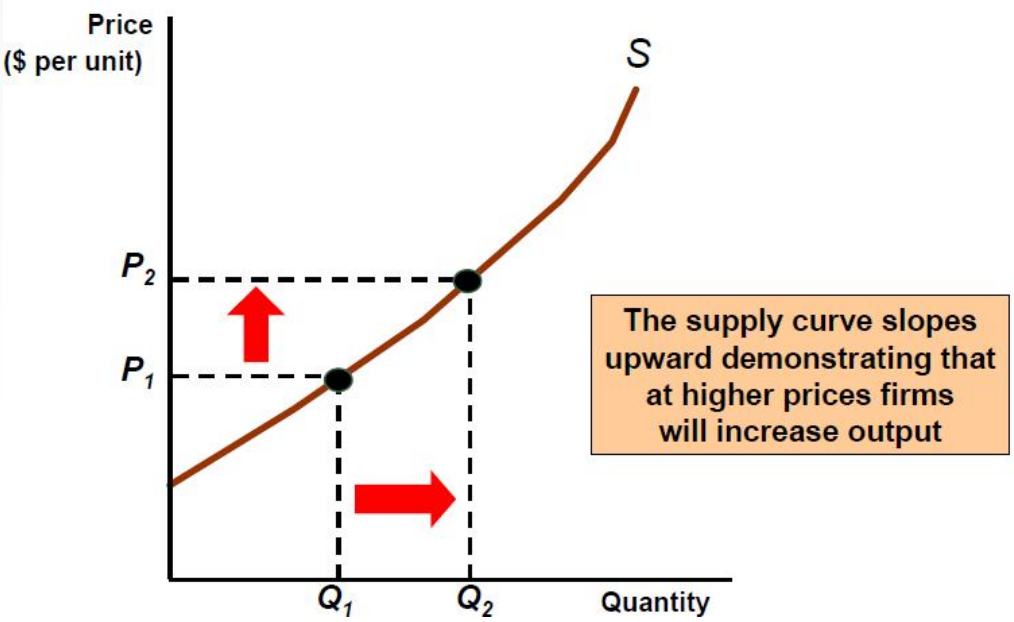


Marketing

- **Types of Markets:**
  - Perfectly competitive markets:
    - ✓ The large number of buyers and sellers
    - ✓ No individual buyer or seller can influence the price
    - ✓ Example: Most agricultural markets
  - Noncompetitive Markets
    - ✓ Markets where individual producers can influence the price
    - ✓ Example: OPEC dominates with world oil market

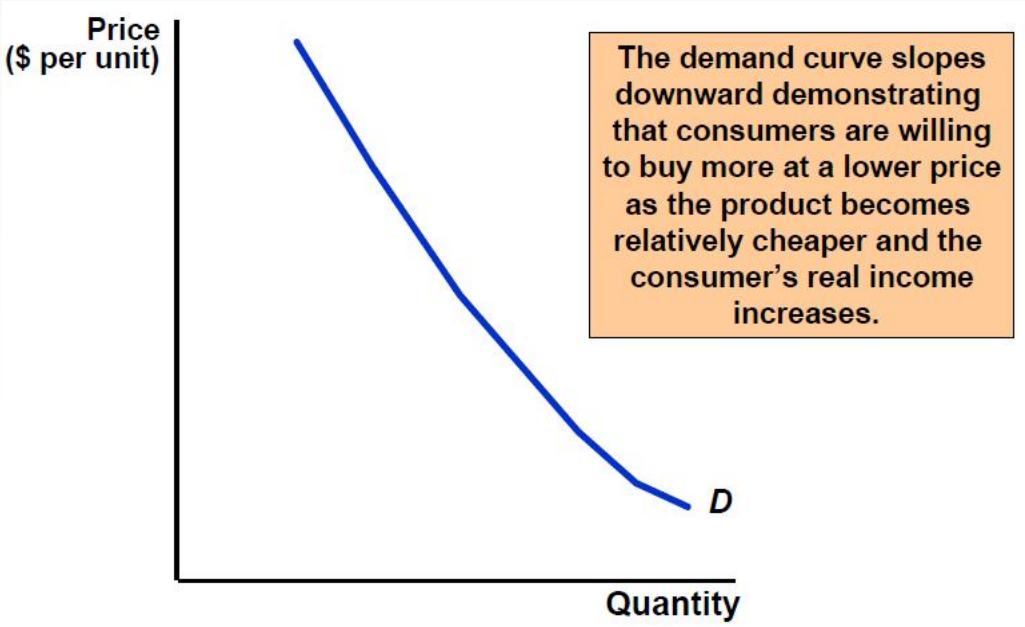
Marketing

- **The Supply Curve**
  - Shows how much of a good producers are willing to sell at a given price
  - This price-quantity relationship can be shown by the equation: $Q_s = Q_S(P)$
  - Variables of Demand: Costs of Production
    - ✓ Labor
    - ✓ Capital
    - ✓ Raw Materials



Marketing

- **The Demand Curve**
  - Shows how much of a good consumers are willing to buy as the price per unit.
  - This price-quantity relationship can be shown by the equation: $Q_D = Q_D(P)$
  - Variables of Demand
    - ✓ Income
    - ✓ Consumer Tastes
    - ✓ Price of Related Goods
      - ➢ Substitutes
      - ➢ Complements



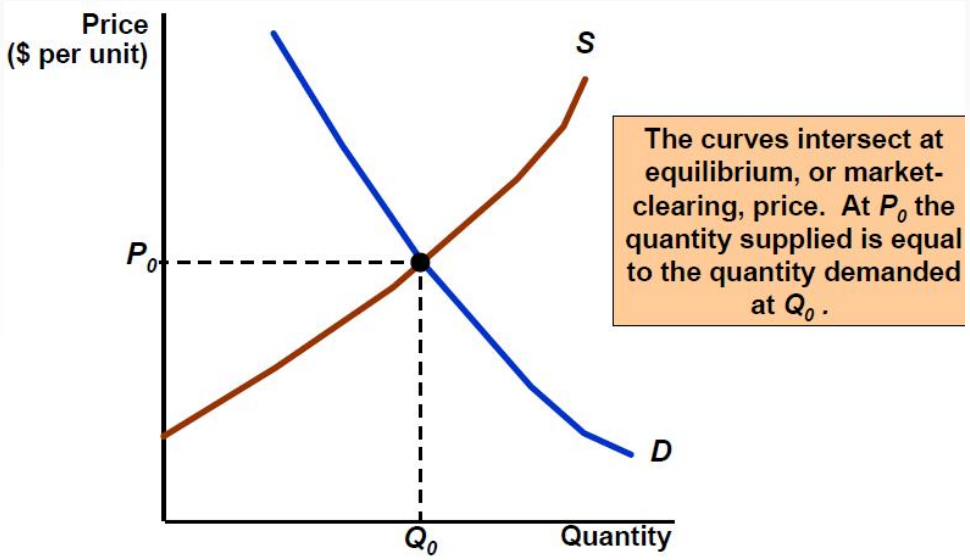
Marketing

- **The Market Mechanism**

  •Supply and demand interact to determine the market-clearing price.

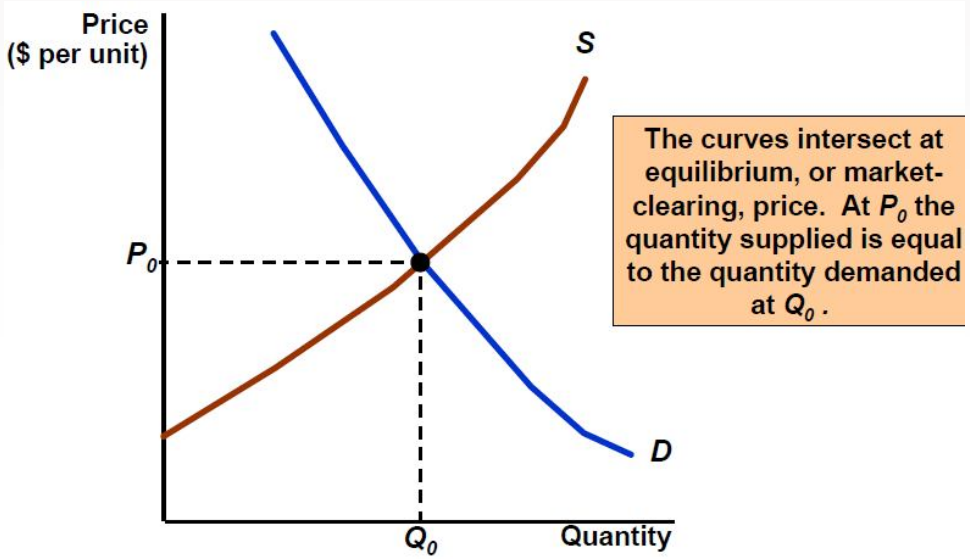
  •When not in equilibrium, the market will adjust to alleviate a shortage or surplus and return the market to equilibrium.

  •Markets must be competitive for the mechanism to be efficient.



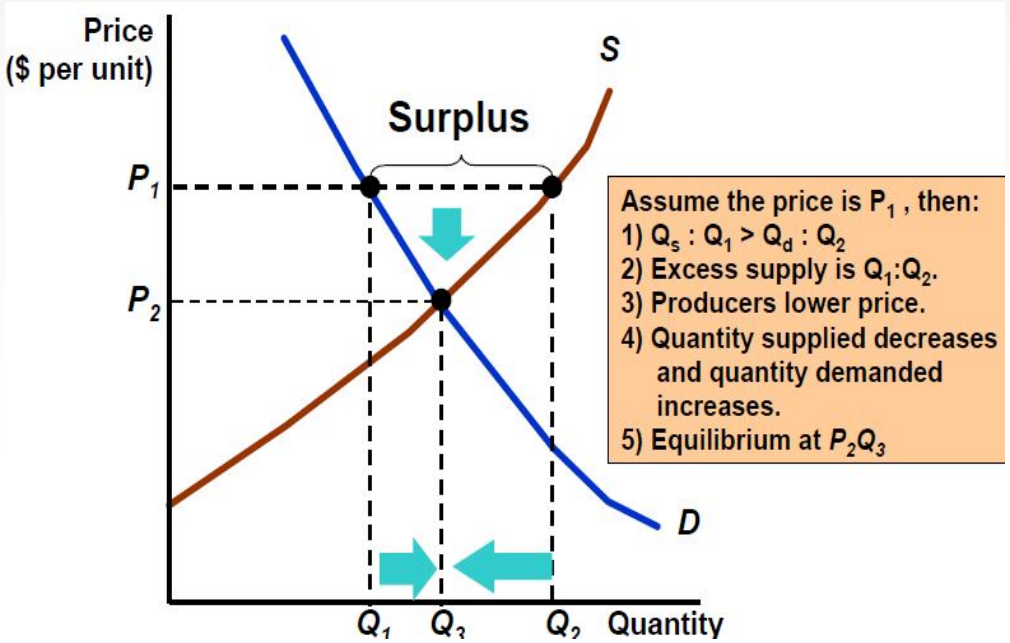
Marketing

- **The Market Mechanism**
  - Characteristics of the **equilibrium** or **market clearing price**:
    - ✓ QD = QS
    - ✓ No shortage
    - ✓ No excess supply
    - ✓ No pressure on the price to change



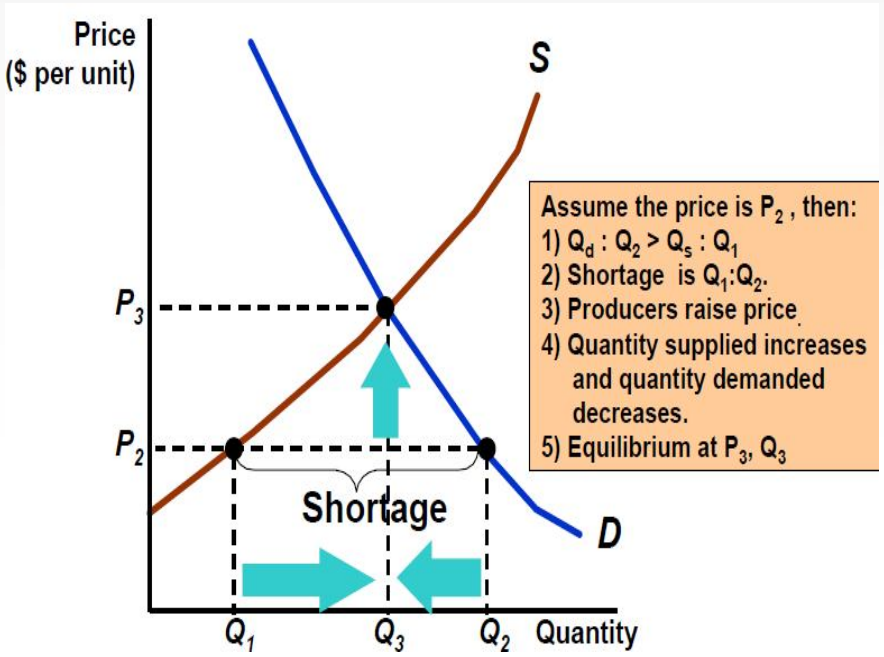
Marketing

- **Surplus**
  - The market price is above equilibrium
    - ✓ There is excess supply
    - ✓ Producers lower prices
    - ✓ Quantity demanded increases and quantity supplied decreases
    - ✓ The market continues to adjust until the equilibrium price is reached.



Marketing

- **Shortage**
  - The market price is below equilibrium:
    - ✓ There is a shortage
    - ✓ Producers raise prices
    - ✓ Quantity demanded decreases and quantity supplied increases
    - ✓ The market continues to adjust until the new equilibrium price is reached.



Marketing

- **Consumer Behavior**
  - The explanation of how consumers allocate income to the purchase of different goods and services.

Marketing

- **The Consumer Decision Process:**
  - Need recognition
    - ✓The first stage of the buyer decision process in which the consumer recognises a problem or need
  - Information search
    - ✓The stage of the buyer decision process in which the consumer is aroused to search for more information; the consumer may simply have heightened attention or may go into active information search

Marketing

- **The Consumer Decision Process:**

  •Evaluation of alternatives

  ✓ The stage of the buyer decision process in which the consumer uses information to evaluate alternative brands in the choice set

  •Purchase decision

  ✓ The stage of the buyer decision process in which the consumer actually buys the product

  • Post purchase behaviour

  ✓The stage of the buyer decision process in which consumers take further action after purchase based on their satisfaction or dissatisfaction

  ✓The **Cognitive Dissonance** is the buyers discomfort caused by post purchase conflict

Marketing

- **Stages in Adoption Process**
  - **Awareness**
    - ✓ The consumer becomes aware of the new product, but lacks information about it
  - **Interest**
    - ✓ The consumer seeks information about the new product
  - **Evaluation**
    - ✓ The consumer considers whether trying the new product makes sense

Marketing

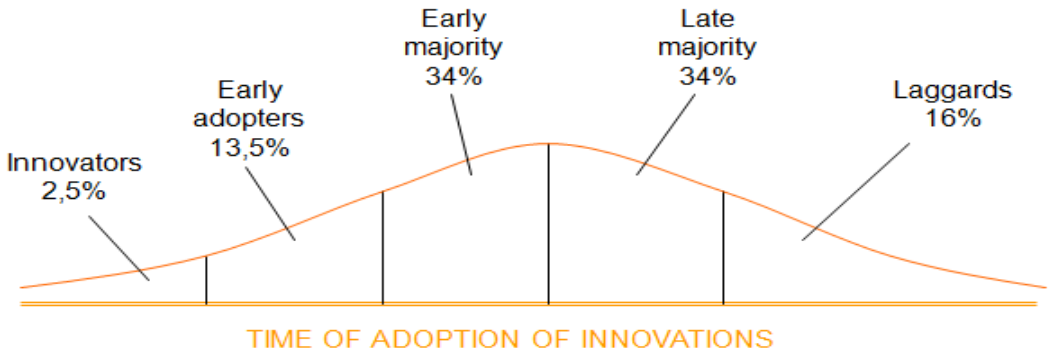
- **Stages in Adoption Process**
  - **Trail**
    - ✓ The consumer tries the new product on a small scale to improve his or her estimate of its value
  - **Adoption**
    - ✓ The consumer decides to make full and regular use of the new product

Marketing

- **Individual Differences in Innovativeness:**
  - **•Innovators:**
    - ✓adventurous: they try new ideas at some risk
  - **•Early Adopters**
    - ✓guided by respect: they are opinion leaders in their community and adopt new ideas early but carefully
  - **•Early Majority**
    - ✓deliberate: although they are rarely leaders, they adopt new ideas before the average person

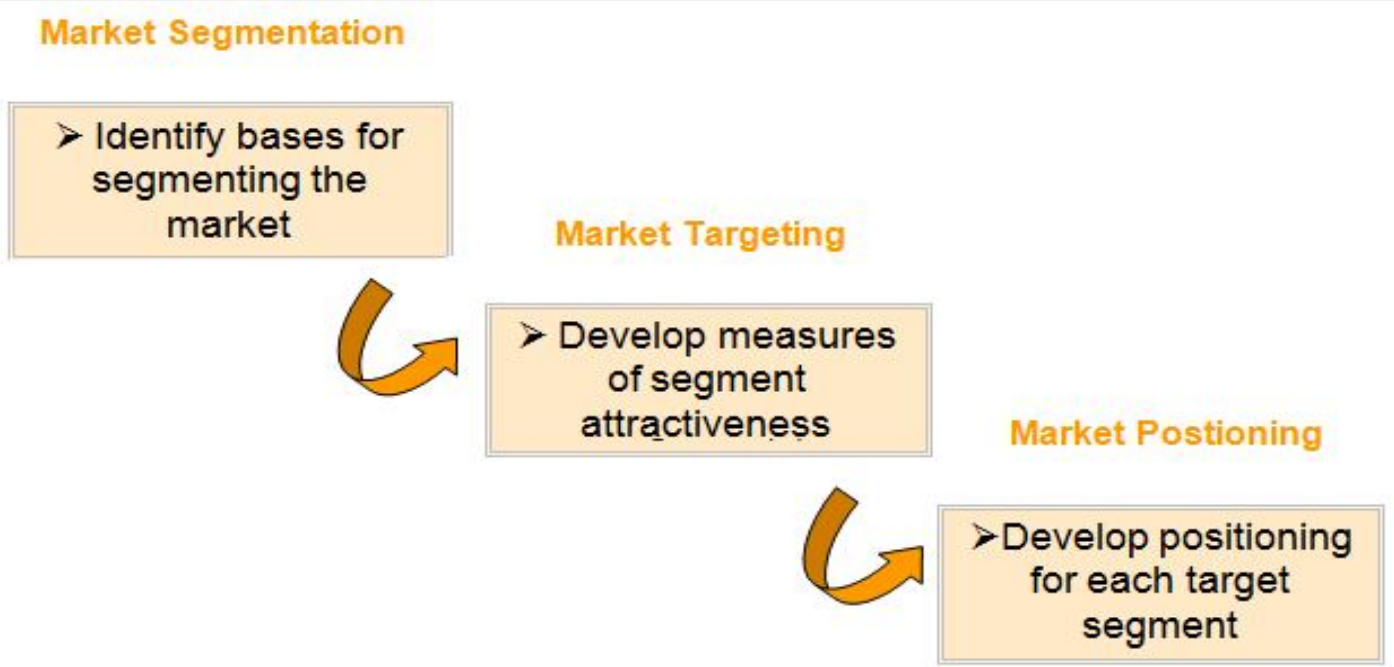
Marketing

- **Individual Differences in Innovativeness:**
  - **Late Majority**
    - ✓ sceptical: they adopt an innovation only after most people have tried it.
  - **Laggards**
    - ✓tradition-bound: they are suspicious of changes and adopt the innovation only when it has become something of a tradition itself



Marketing

- **Difference between Market Segmentation, Targeting and Positioning**



Marketing

- **Market Segmentation**
  - Process which involves subdividing the total market into groups or segments composed of people or organizations who share somewhat similar needs with regard to a given product, so as to be able to plan a marketing mix which will best satisfy those needs.

Marketing

- **Market Segmentation**
  - **•Segmentation Variables**
    - ✓The characteristics of individuals, groups or organizations which are used to subdivide the market into segments.
      - ➢Geographic
      - ➢Demographic
      - ➢Psychographic
      - ➢Behavioural

Demographic	***Socioeconomic***
• Age • Family size • Marital status • Gender	• Income • Class • Vocation • Education • Religion • Ethnicity
Geographic	***Lifestyle/personality***
• Global, hemispheric, national, state, city, postal code • Climate • Rural vs. urban	• Attitudes/opinions • Interests • Avocations • Tastes and preferences

Marketing

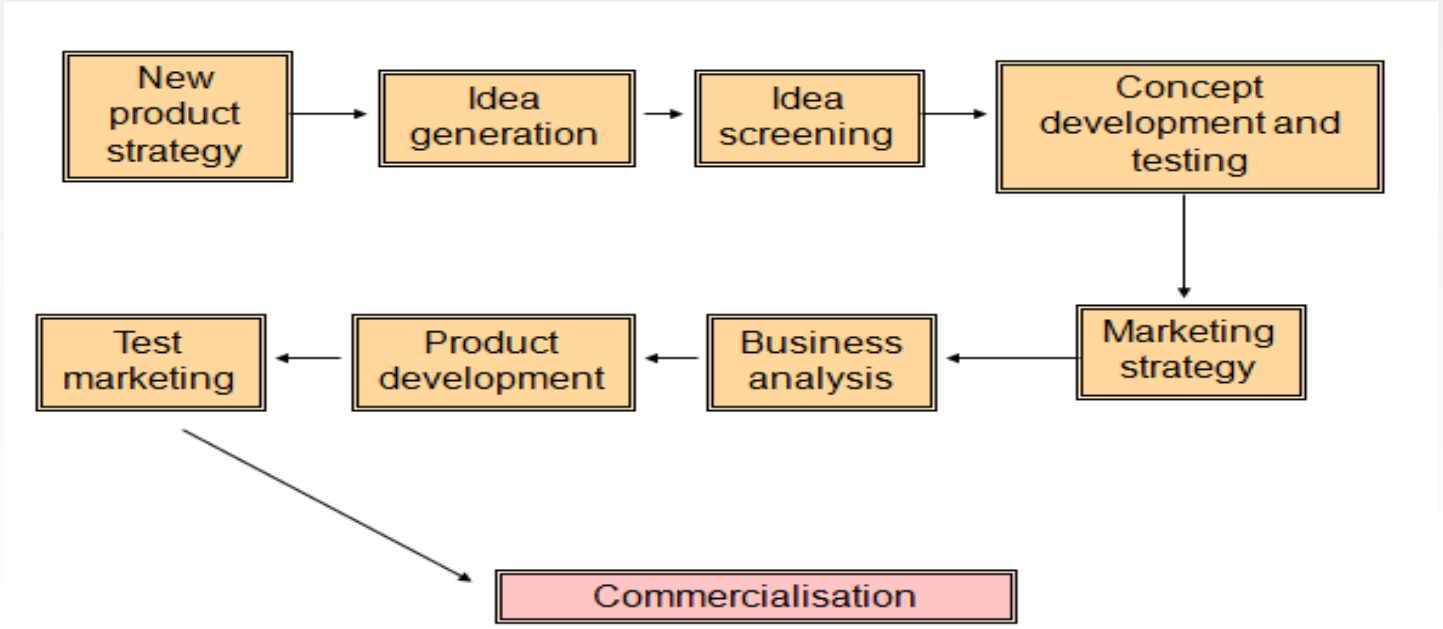
- **Market Targeting**
  - Targeting is the second stage and is done once the markets have been segmented, Organizations with the help of various marketing plans and schemes target their products amongst the various segments.

Marketing

- **Market Positioning**
  - The whole set of decisions and activities aimed at creating and maintaining a certain concept of the company's product (with respect to competing products) in the minds of prospective buyers.
  - When a company launches a new product, they try to position it so that it is seen has having the characteristics most desired by the target market

Marketing

- **New Product Development Process**

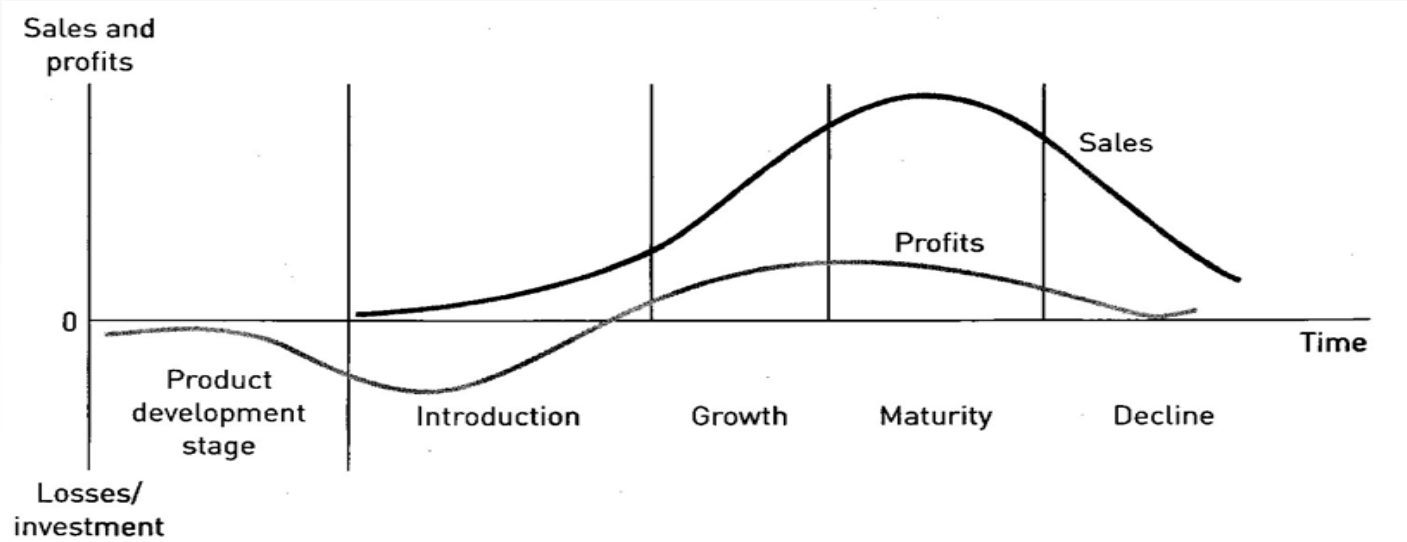


Marketing

- **Product Life-Cycle**

  •The course of a product's sales and profits over its lifetime.

  •It involves five distinct stages: product development, introduction, growth, maturity and decline.



Marketing

- **Product Life-Cycle**

	INTRODUCTION	GROWTH	MATURITY	DECLINE
SALES	Low sales	Rapidly rising sales	Peak sales	Declining sales
COSTS	High cost per customer	Average cost per customer	Low cost per customer	Low cost per customer
PROFITS	Negative	Rising profits	High profits	Declining profits
CUSTOMERS	Innovators	Early adopters	Middle majority	Laggards
COMPETITORS	Few	Growing number	Stable number beginning to decline	Declining number
MARKETING OBJESTIVES	Create product awareness and trial	Maximise market share	Maximise profit while defending market share	Reduce expenditure and milk the brand

Strategy

Huthaifa Khalil

Strategy

- A set of actions that managers take to increase their company's performance relative to industry rivals.
- A strategy is implemented to create a competitive advantage over other companies
- A company is said to have a competitive advantage when its profitability is greater than the average profitability for all firms in the industry
- A competitive advantage is considered sustained when it is maintained for several years
- The essence of strategy lies in creating tomorrow's competitive advantage faster than competitors mimic the ones you possess today.

Strategy

- **Stakeholders**
  - Individuals or groups with an interest, claim, or stake in the company and how well it performs
  - Anyone in an exchange relationship with the company

- **Corporate Governance:**
  - Mechanisms to monitor managers making sure they pursue strategies in the interest of Stakeholders

Strategy

- **Internal Stakeholders**
  - Stockholders
  - Employees
  - Executives and managers
  - Board members
- **External Stakeholders**
  - Customers and suppliers
  - Creditors
  - Governments
  - General public

Strategy

- **The Mission Statement**
  - To establish the guiding principles for strategic decision making
  - Includes 4 main elements:
    - ✓The Mission
    - ✓The Vision
    - ✓Values
    - ✓Goal of the Corporation
  - The mission statement is a key indicator of how an organization views the claims of stakeholders

Strategy

- **The Mission**
  - Describes what the company does
  - Can be product oriented:
  - Focus on the product the company
  - Can be customer oriented:
  - Focus on satisfying customers' needs
- **The Vision**
  - Tells what the company would like to achieve
  - Intended to stretch a company by articulating its ambitions
  - Meant to be an attainable goal that will motivate employees

Strategy

- **Values**
  - Tell how managers and employees should conduct themselves
  - Establishes the basis of the organizational culture
- **Major Goals**
  - A goal is a precise and measurable future state that a company attempts to realize
  - Good goal characteristics:
    - ✓ Precise and measurable
    - ✓ Address important issues
    - ✓ Challenging but realistic
    - ✓ Time period specified
  - Most companies operate with goals of profitability and profit growth.

Strategy

- **Industry**
  - A group of companies offering products or services that are close substitutes for each other.

Analysis of Industry

- Goals of industry analysis:
  - ✓To gain an understanding of the opportunities and threats confronting the firm
  - ✓To use this understanding to identify strategies that will enable the company to outperform rivals

Strategy

- **SWOT Analysis**

  • SWOT analysis is a distillation of the findings of the internal and external audits which draw attention to the critical organisational **strengths** and **weaknesses** and **opportunities** and **threats** facing the company.

Strategy

- **SWOT Analysis**
  - **Strengths**: internal factors which make it possible to exploit external opportunities and defend against threats.
  - **Weaknesses**: internal factors which may block an exploitation of external opportunities and render the company vulnerable to external threats
  - **Opportunities**: external factors which, if well managed, can reinforce the position of the product in the market.
  - **Threats**: external factors which, if managed poorly, can weaken the position of the product in the market.

Strategy

- **Porter's Five Forces Model**

1. Risk of entry by potential competitors

- Function of the height of barriers of entry
  - Economies of Scale
  - Brand Loyalty
  - Absolute cost advantage
- Superior production operations and processes
- Control of particular inputs
- Access to cheaper funds to lower risk of existing cost
  - Customer switching costs
  - Government regulation

Strategy

- **Porter's Five Forces Model**

2. The intensity of rivalry among established companies

- The competitive struggle for market share that depends on:
  - The industry's competitive structure
  - Industry demand

3. Bargaining power of buyers

- The ability of buyers to drive prices down or quality up.
- Bargaining power of buyers is greatest when:
  - buyers are large and few and suppliers fragmented
  - buyers purchase in large quantities
  - when economically feasible to have many suppliers

Strategy

- **Porter's Five Forces Model**

4. Bargaining power of suppliers

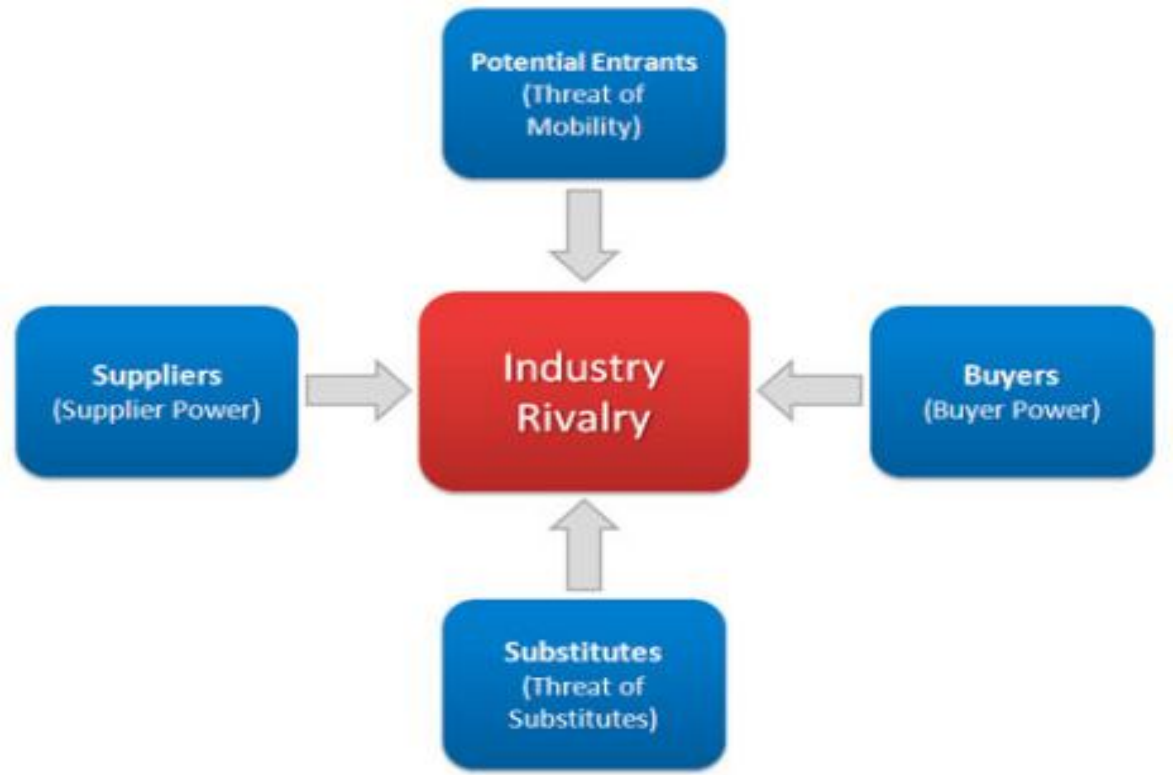
- The ability of suppliers to raise the costs of the industry.
- Suppliers are most powerful when:
  - few substitutes and vital
  - industry not important customer

5. Threat of Substitutes (Closeness of product substitutes)

- Other products can satisfy the same customer need.

Strategy

- **Porter's Five Forces Model**

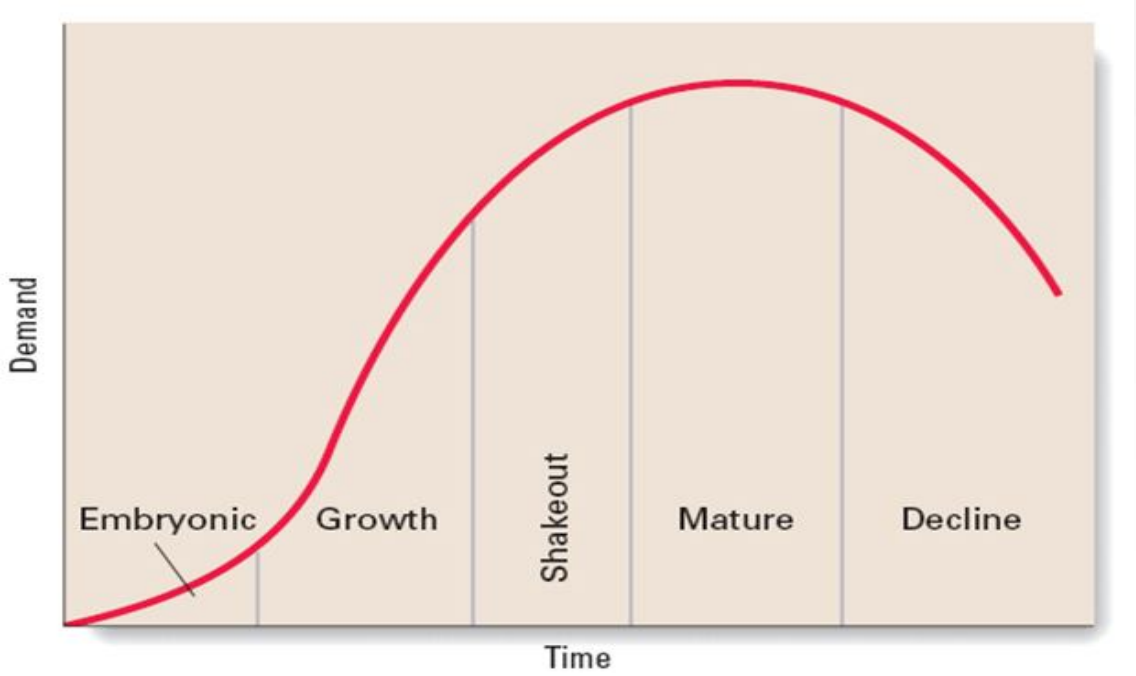


Strategy

- **Stages in the Industry Life Cycle**
  - An important determinant of the strength of the competitive forces in an industry is the changes that take place over time.
  - The industry life cycle is a useful tool for analyzing the **effects of industry evolution** on competitive forces.
  - Competition increases as the industry progresses through the cycle.

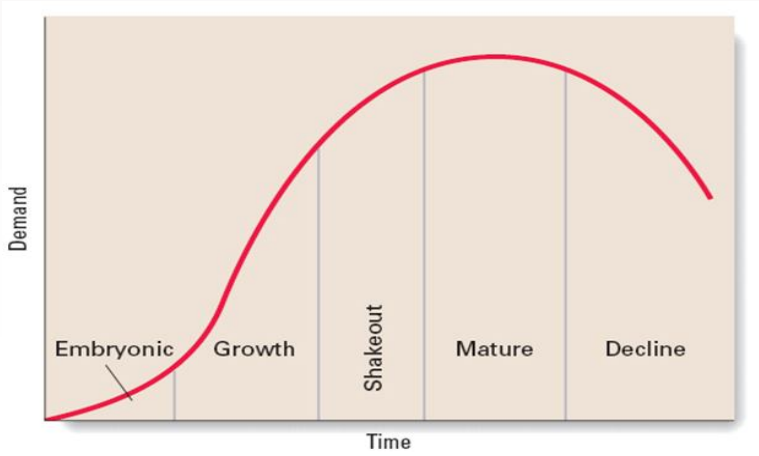
Strategy

- **Stages in the Industry Life Cycle**
  - There are five sequential stages:
    - ✓ Embryonic
    - ✓ Growth
    - ✓ Shakeout
    - ✓ Mature
    - ✓ Decline



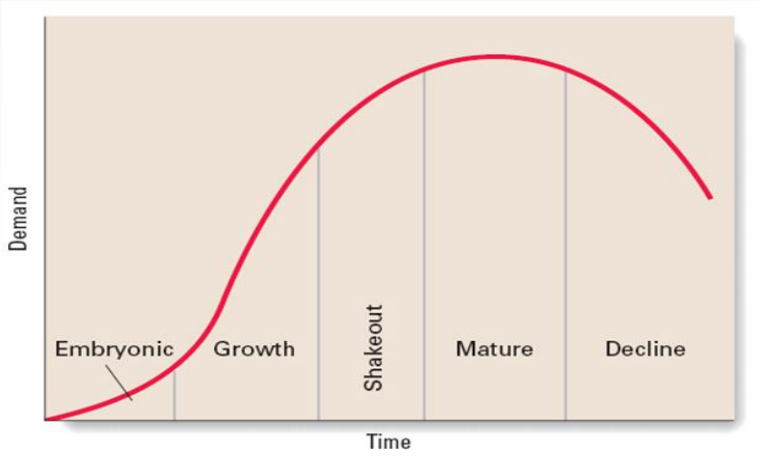
Strategy

- **Stages in the Industry Life Cycle**
  - **Embryonic**:
    - ✓ The industry is just beginning to develop ,
    - ✓ Development is slow
    - ✓ Buyers are unfamiliar with product ,
    - ✓ High prices



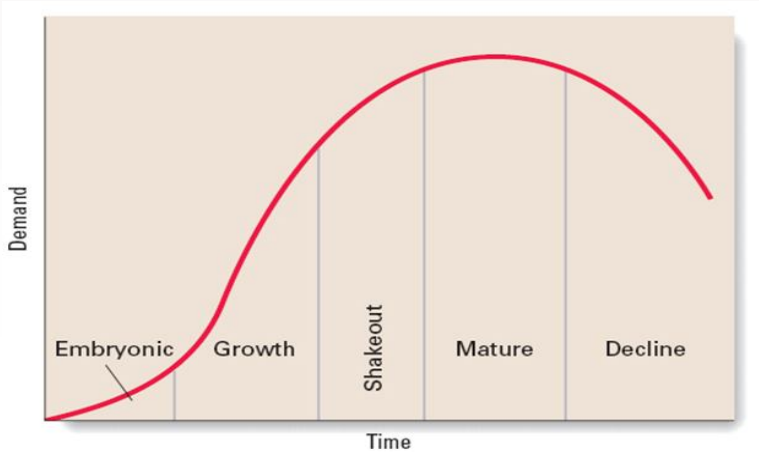
Strategy

- **Stages in the Industry Life Cycle**
  - **Growth**:
    - ✓ Demand takes off
    - ✓ Many new customers
    - ✓Prices fall with development and higher volume
    - ✓ Entry barriers are relatively low
    - ✓ Relatively low competition



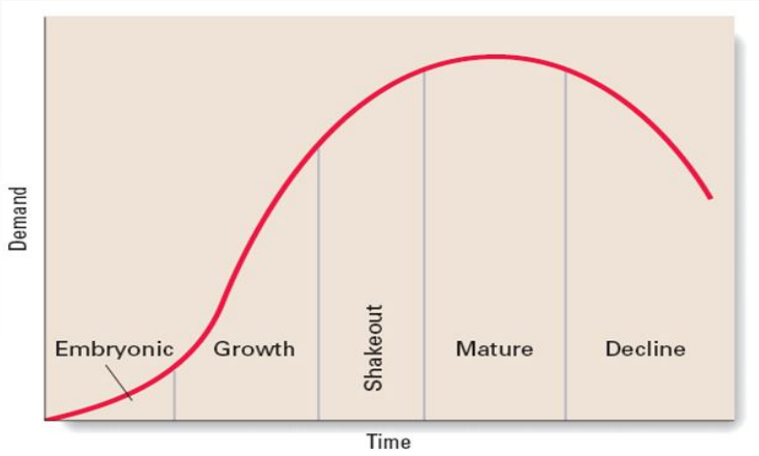
Strategy

- **Stages in the Industry Life Cycle**
  - **Shakeout**:
    - ✓ Rate of growth slows
    - ✓ Demand approaches saturation levels
    - ✓ Few potential first-time buyers
    - ✓ Rivalries become intense



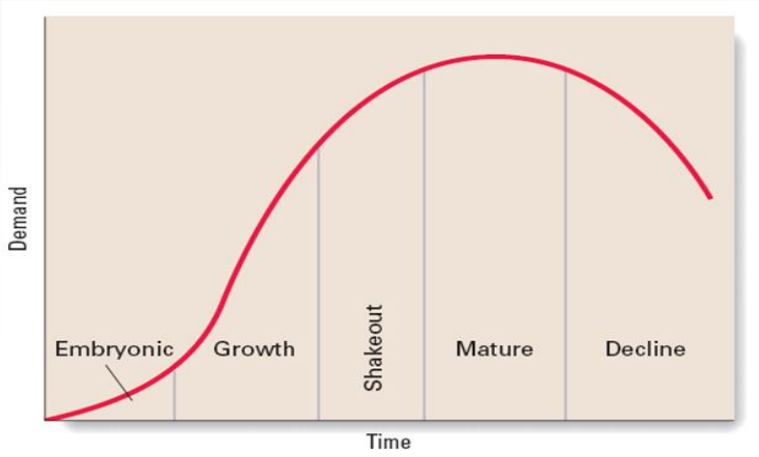
Strategy

- **Stages in the Industry Life Cycle**
  - **Mature**:
    - ✓ Market is totally saturated
    - ✓ Demand is limited to replacement demand
    - ✓ Growth is low or zero
    - ✓ Barriers increase
    - ✓ Threat of new entries decrease
    - ✓ Competition drives prices down



Strategy

- **Stages in the Industry Life Cycle**
  - **Decline**:
    - ✓ Falling demand = Excess capacity
    - ✓ Growth becomes negative due to
      - ➢ Technology substitution
      - ➢ Demographics

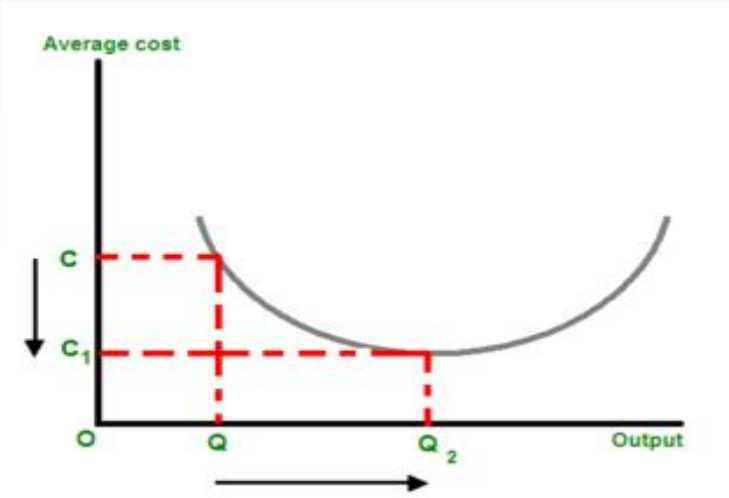


Strategy

- **Company Profitability**
  - Amount of Value that customers place on a good or service
    - ✓ Value creation is the heart of competitive advantage
    - ✓ The greater the value customers place on a product, the more the company can charge.
    - ✓ A product's price is usually less than the value placed on it by the average customer.

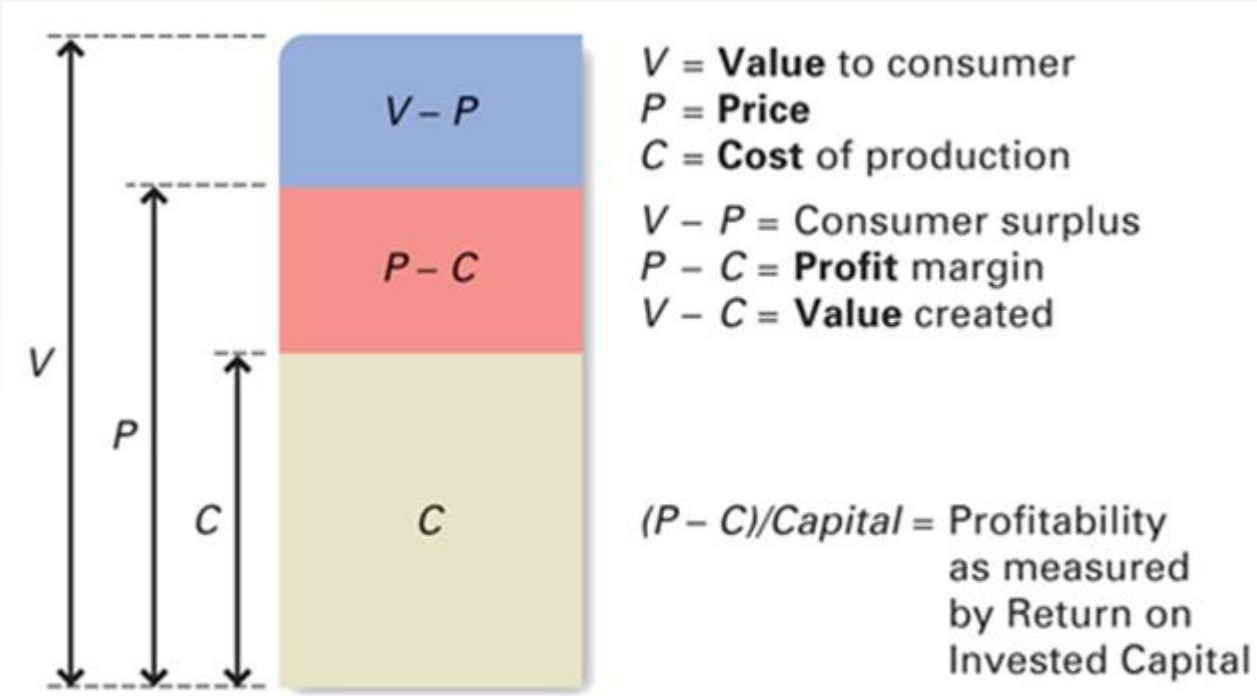
Strategy

- **Company Profitability**
  - A company will look for ways to increase productivity of capital and labor through:
    - ✓ Economies of Scale
      - ➢ The increase in efficiency of production as the number of goods being produced increases.
    - ✓ Spread fixed cost over large product volume
    - ✓ Greater division of labor
    - ✓ and specialization



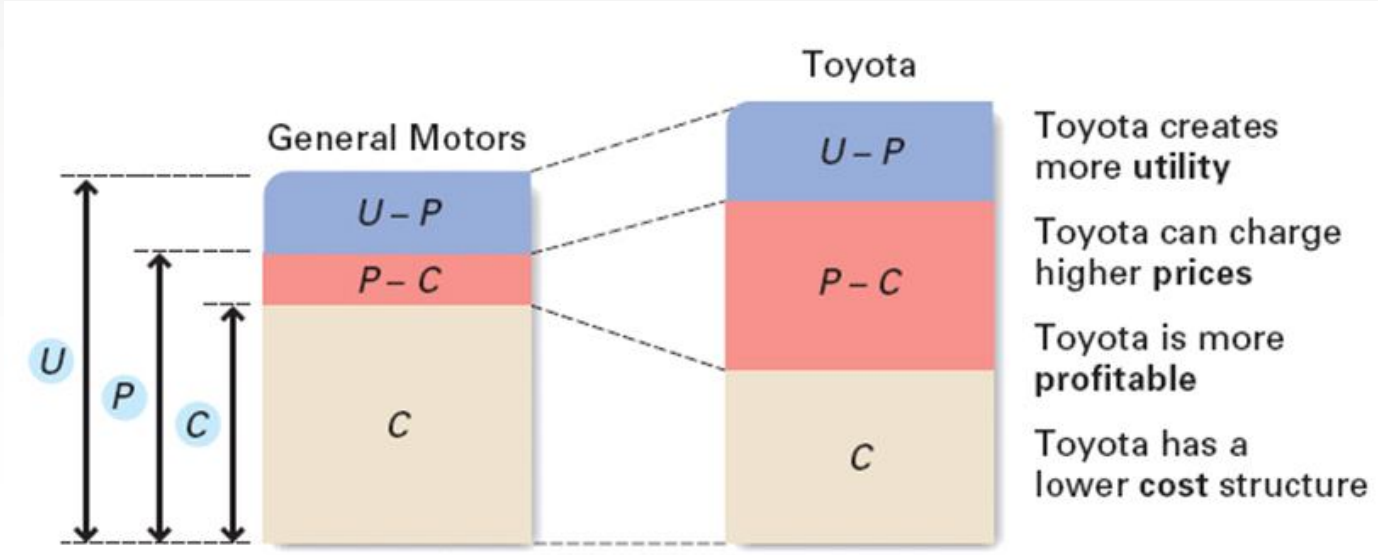
Strategy

- **Value Creation**
  - Two Basic Strategies for Creating Value:
    - ✓ Low Cost- Drive down cost structure
    - ✓ Differentiation



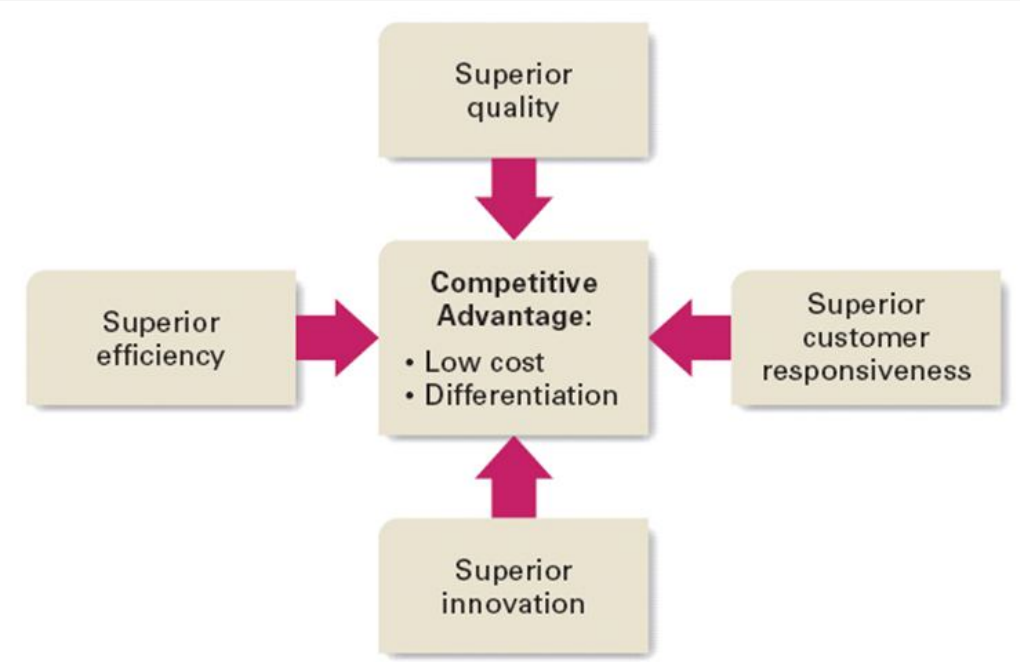
Strategy

- **Value Creation**
  - A company that has high profitability = competitive advantage, when it creates more value for its customers than do rivals.



Strategy

- **Building Competitive Advantage:**
  - 4 Factors – building blocks of competitive advantage:
    - ✓ Efficiency
    - ✓ Innovation
    - ✓ Quality
    - ✓ Customer Responsiveness



Strategy

- **Efficiency**
  - Efficiency = outputs/inputs
  - 2 of the most important component of efficiency are:
    - ✓ Employee Productivity: output per employee
    - ✓ Capital Productivity: Output per unit of investment capital
  - High Productivity = greater efficiency and low costs

Strategy

- **Innovation:**
  - The act of creating new products or processes
  - Product Innovation- The development of products that are new to the world or have superior attributes to existing products.
  - Process Innovation-The development of a new process for producing products and delivering them
  - Competition can be seen as a process driven by innovation
    - ✓ Innovations give a company something *unique* that their competitors lack : diving either differentiation or cost advantage

Strategy

- **Quality:**
  - Customers perceive attributes of a product to be better than rival's attributes
  - 1° type of quality: Excellence, when excellence is built into product offering, consumers have to pay more to own or consume the product:
    - ✓ Design
    - ✓ Style
    - ✓ Aesthetic appeal
    - ✓ Features and functions
    - ✓ Level of service that comes with the product

Strategy

- **Quality:**

• 2° type of quality: Reliability ,

✓A product is reliable if it:

- ➢ Consistently does the job it was designed for
- ➢ Does the job well
- ➢ Rarely breaks down
- ➢ Less time is spent of defective products and fixing mistakes

✓ Reliability increases the value a consumer gets from the product and increases the price that the company can charge

Strategy

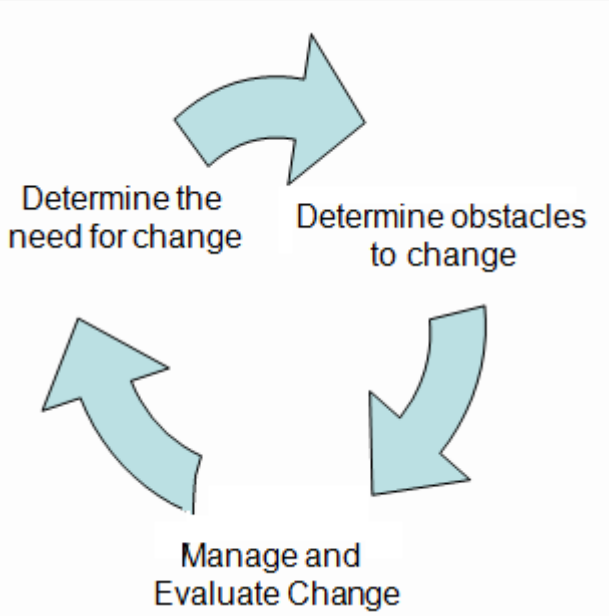
- **Customer Responsiveness**
  - Superior customer responsiveness implies being better than competitors at identifying and satisfying customers' needs, thus;
    - ✓ If a customer's need is satisfied better by a certain product, the customer will attribute more value to the product. therefore:
      - ➢ More value creates a differentiation and ultimately a competitive advantage

Strategy

- **Strategic Change**
  - The movement of a company away from its present state toward some desired future state to increase its competitive advantage and profitability.
  - Reengineering:
    - ✓ Focus not on company's functional activities but on the business processes underlying the value creation process
  - Restructuring:
    - ✓ Process by which managers simplify organizational structures by eliminating divisions, departments or levels in the hierarchy and downsize by terminating employees, thereby lowering operating costs.

Strategy

- **Change Process**
  - Determining the need for change
    - ✓ Identify a gap between desired and actual performance
  - Determining the obstacles to change
    - ✓ Change is frequently (always) resisted by people and groups inside an organization
    - ✓ Identify your obstacles
  - Manage and evaluate Change



Strategy

- **Course Outline:**
  - ✓ **Engineering Management**
  - ✓ **Marketing & Strategy**
  - **• Organizational Model & Human Resource**
  - **• Cost Management & Productivity**
  - **• Project Management**
  - **• Quality Control**
  - **• Operations Researches**
  - **•Supply Chain**
  - **•Industrial safety**

Organizational Model

Huthaifa Khalil

Organizational Model

- **Organization**

  • Any collection of persons, materials, procedures, ideas or facts so managed & ordered that in each case the combination of parts makes a meaningful whole that at achieving organization objectives.

  • In other words the process of organization implies the arrangement of human & nonhuman resources to make a meaningful whole that accomplishes organizational objectives.

  • Every employee must be informed of what is expected of him (responsibility) & what is within his power (authorities), This is usually found in the "job description".

Organizational Model

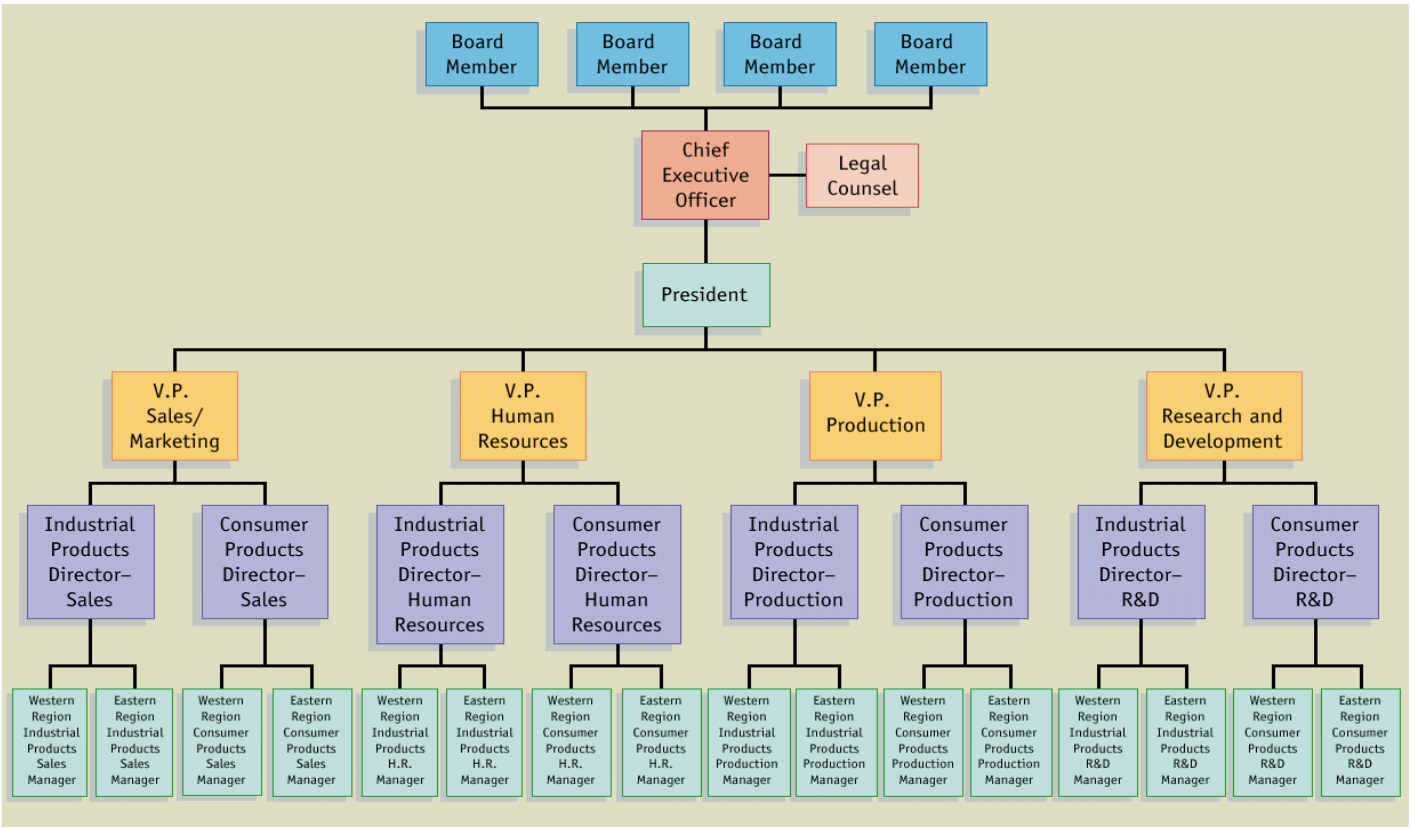
- **Organization**
  - Managers decide how to
    - ✓ Divide the overall task into successively smaller jobs
    - ✓ Decide the bases by which to group the jobs
    - ✓ The appropriate size of the group reporting to each superior
    - ✓ Distribute authority among the jobs
  - After deciding on the major operating units & departments the required resources must be acquired & fitted in the right place.

Organizational Model

- **Organizational Charts**
  - Formal relationship between people in various positions in the organization.
  - They shown who supervises whom & how various jobs & departments are linked together to make achieve coordinated system.
  - Main channels of communication (downward, upward , horizontal, and diagonal)

Organizational Model

- **Organizational Charts**



Organizational Model

- **Organization Structure**
  - Organization structure designates formal reporting relationships, including the number of levels in the hierarchy and the span of control of managers and supervisors.
  - Organization structure identifies the grouping together of individuals into departments and of departments into the total organization.
  - Organization structure includes the design of systems to ensure effective communication, coordination, and integration of effort across departments

Organizational Model

- **Elements Organization Structure**
  - Division of Labor
  - Departmentalization
  - Span of Control
  - Delegation of Authority

Organizational Model

- **Division of Labor**
  - It is the process of dividing work into relatively specialized jobs to achieve advantages of specialization.
  - Subdivision of work into separate jobs assigned to different people
  - Division of Labor Occurs in Three Different Ways:
    1. Personal specialties
       - ✓e.g., accountants, software engineers, graphic designers, scientists
    2. Natural sequence of work
       - ✓ e.g., dividing work in a manufacturing plant into fabricating and assembly (*horizontal specialization*)

Organizational Model

- **Division of Labor**

  3. Vertical plane

     ✓ e.g., hierarchy of authority from lowest-level manager to highest-level manager

- **Coordination**

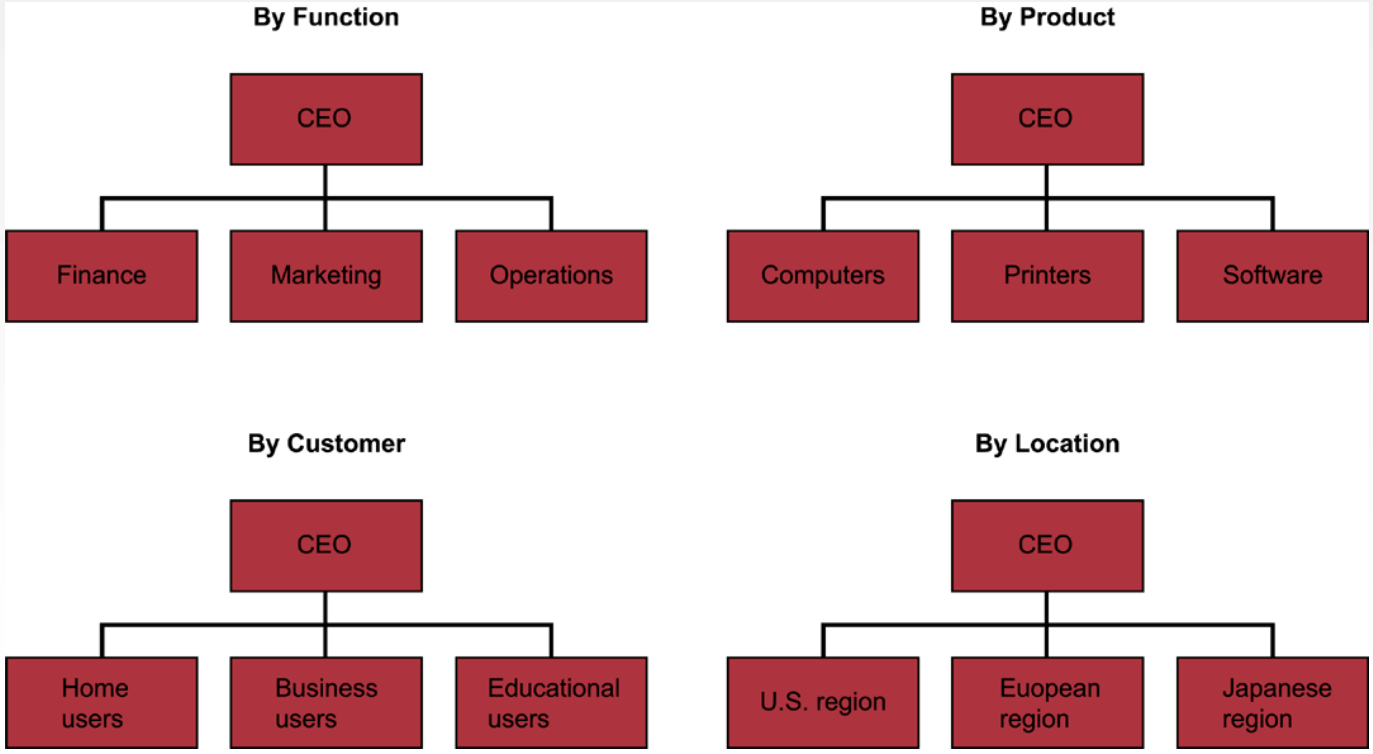
  • Coordination means assembling & synchronizing work efforts so that they function harmoniously to attain organizational objectives.

Organizational Model

- **Departmentalization**
  - Departmentalization is the (horizontal) differentiation of the organization in departments. Departments are organizational units that share a common supervisor and common resources, are jointly responsible for performance, and tend to identify and collaborate with one another.
  - The process of grouping activities into units for purposes of administration.
  - It can be grouping by services, location, or by geographic area.

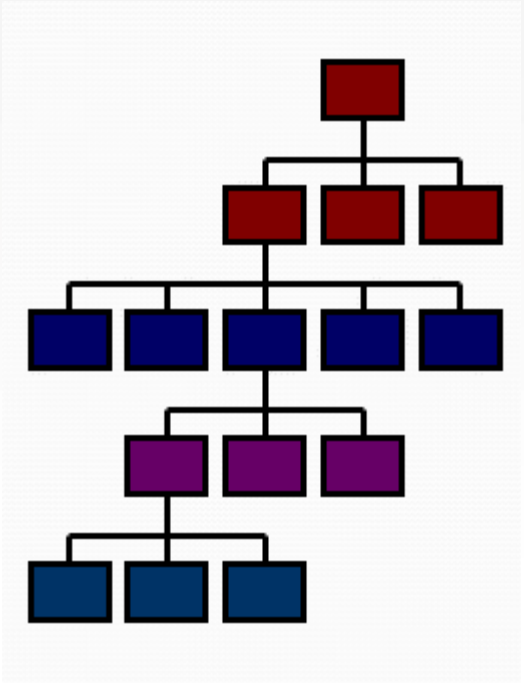
Organizational Model

- **Departmentalization**



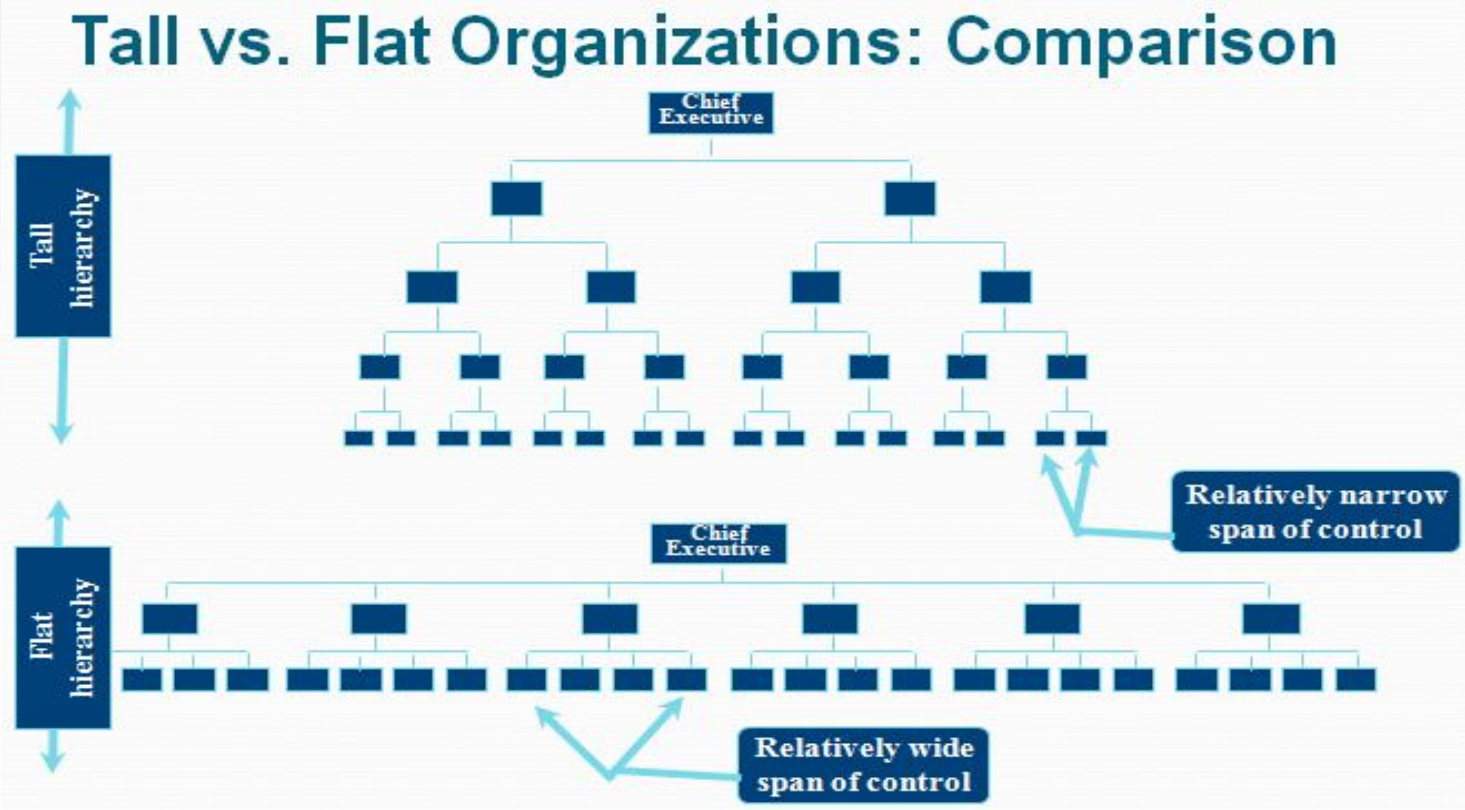
Organizational Model

- **Span of Control**
  - Number of individuals who report to a specific manager.
  - Number of people directly reporting to the next level.



Organizational Model

- **Span of Control**



Organizational Model

- **Delegation of Authority**
  - Process of distributing authority downward in an organization.
  - Managers decide how much authority should be delegated to each job and to each jobholder
  - Three Forms of Authority:
    - ✓ **Line authority** flows up and down the chain of command
    - ✓**Staff authority** is based on expertise that usually involves counseling and advising line managers
    - ✓**Committee and team authority** is granted to committees or work teams involved in a firm's daily operations

Organizational Model

- **Centralization and Decentralization**
  - Refers to the level at which most or the operating decisions will be made.
  - The greater the number of decisions made lower down the management Hierarchy the greater the degree of decentralization.
  - Generally speaking, it is advisable that decisions concerning day- today matters should be pushed down the organization structure and not be handled by top management.

Organizational Model

- **Advantages of Decentralization**
  - Quick action regarding specific problems.
  - Facilitates adaptation of decisions according to local needs.
  - Relieves top management from involvement in routine decisions thus saving time and energy.
  - Increases flexibility of action as junior staff are allowed to make Prompt decisions without having to wait for approval from to management.
  - Effective in developing the junior staff to hold top management Positions.

Organizational Model

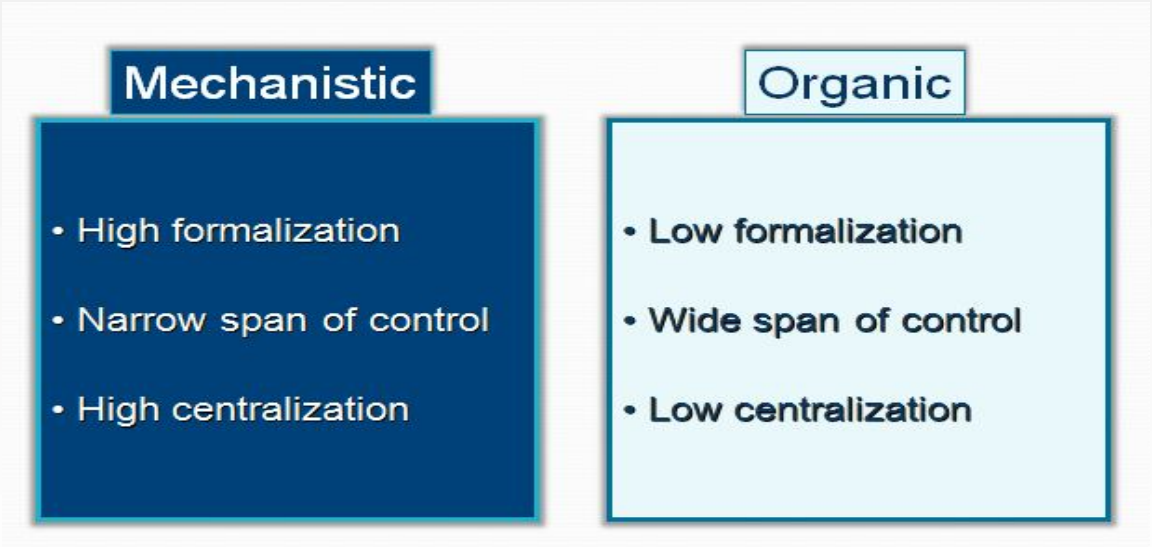
- **Advantages of Centralization**
  - Uniformity of policy and action.
  - Enables maximum use of the skills and knowledge of centralized Staff.
  - Fosters better control of the organizations activities.
  - Enables the use of not highly skilled subordinates since every little detail is set by the top management.
  - Unity of Command – The classical principle of command suggested that each individual in the Organization should be directly responsible to, and receive orders from, Only ONE supervisor and through this ultimately answerable to the head Of the organization.

Organizational Model

- **Dimensions of Structure**
  - **Formalization** – the extent to which expectations regarding the means and ends of work are specified, written, and enforced
  - **Centralization** – the location of decision-making authority in the hierarchy
  - **Complexity** – the direct outgrowth of dividing work and creating departments

Organizational Model

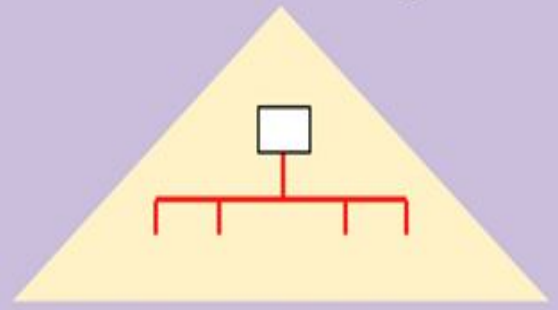
- **Mechanistic vs. Organic Structures**



Organizational Model

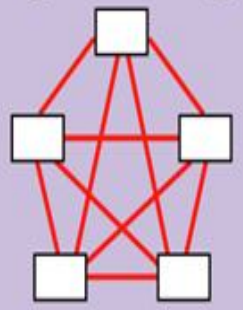
- **Mechanistic vs. Organic Structures**

Mechanistic Designs



- Work efforts centrally coordinated.
- Standard interactions in well-defined jobs.
- Limited information-processing capability.
- Best at simple and repetitive tasks.
- Good for production efficiency.

Organic Designs

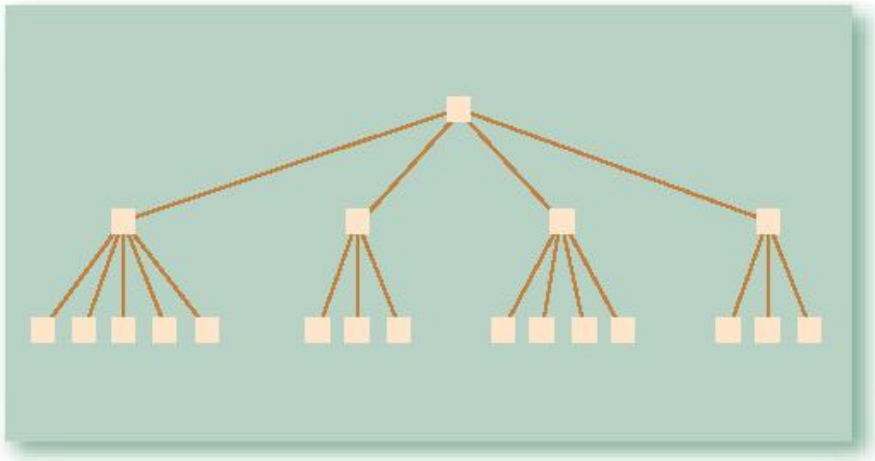


- Work efforts highly interdependent.
- Intense interactions in self-defined jobs.
- Expanded information-processing capability.
- More effective at complex and unique tasks.
- Good for innovation and creativity.

Organizational Model

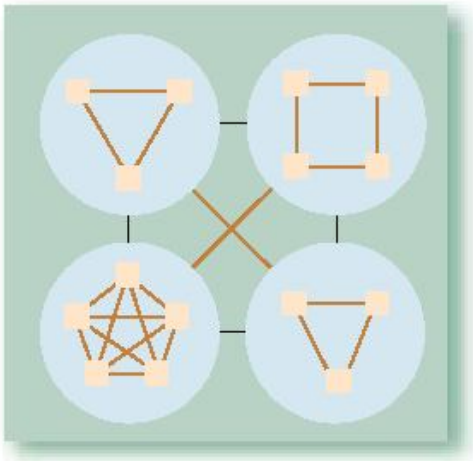
- **Mechanistic vs. Organic Structures**

The mechanistic model



- High specialization
- Rigid departmentalization
- Clear chain of command
- Narrow spans of control
- Centralization
- High formalization

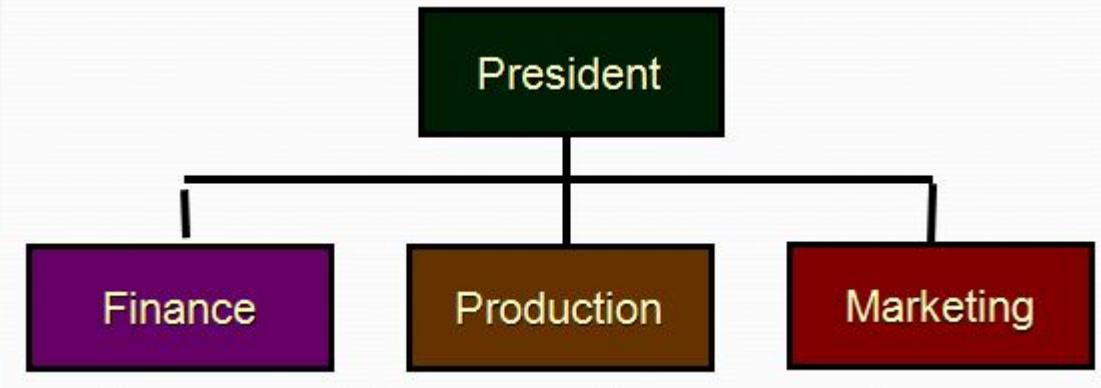
The organic model



- Cross-functional teams
- Cross-hierarchical teams
- Free flow of information
- Wide spans of control
- Decentralization
- Low formalization

Organizational Model

- **Functional Organizational Structure**
  - Organizes employees around skills or other resources (marketing, production)
  - Create subordinate goals.

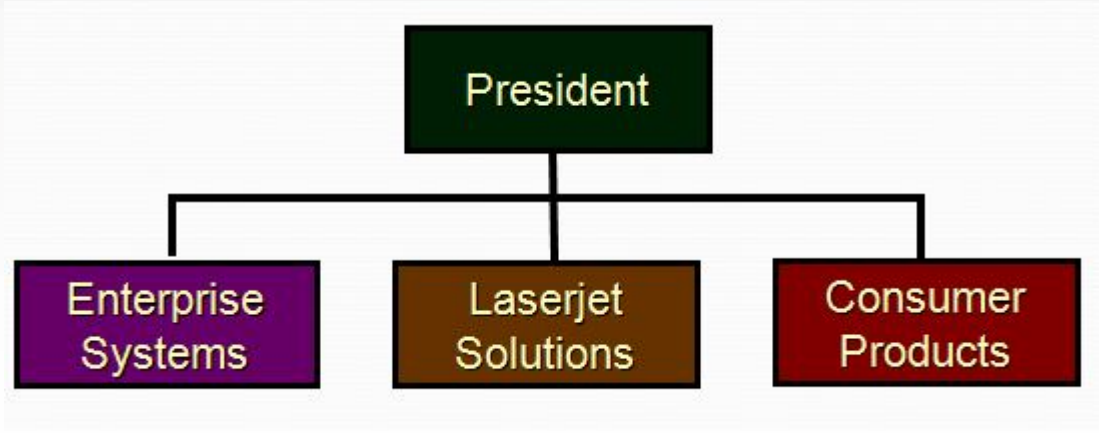


Organizational Model

- **Functional Organizational Structure**
  - Benefits
    - ✓ Supports professional identity and career paths
    - ✓ Permits greater specialization
    - ✓ Easier supervision --similar issues
    - ✓ Creates an economy of scale --common pool of talent
  - Limitations
    - ✓ More emphasis on subunit than organizational goals; failure to develop broad understanding of the business
    - ✓ Higher dysfunctional conflict because emphasized differences across subunits
    - ✓ Poorer coordination -- requires more controls

Organizational Model

- **Divisional Organizational Structures**
  - Organizes employees around outputs, clients, or geographic areas



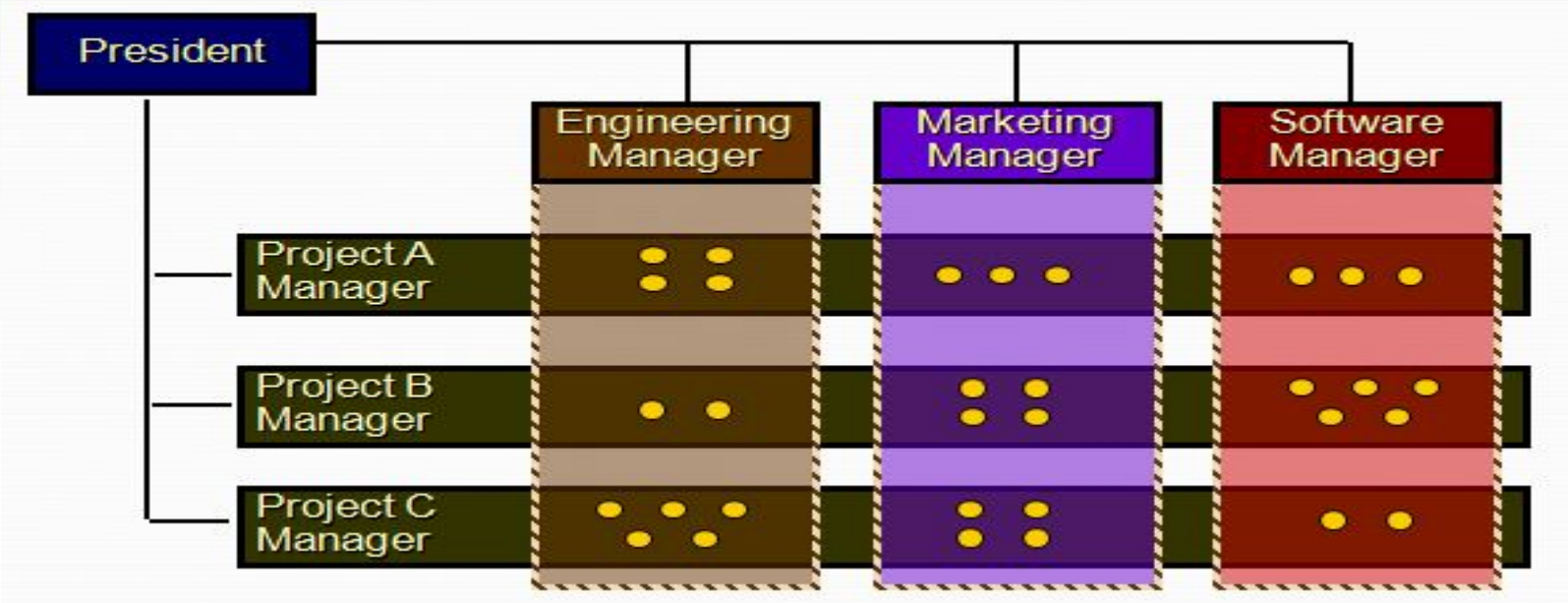
Organizational Model

- **Divisional Organizational Structures**
  - Benefits
    - ✓ Building block structure -- accommodates growth
    - ✓ Better coordination in diverse markets
  - Limitations
    - ✓ Duplication and inefficient use of resources
    - ✓ Specializations are dispersed, creating silos of knowledge

Organizational Model

- **The Matrix Organizational Structures**

  • Employees are temporarily assigned to a specific project team and have a permanent functional unit

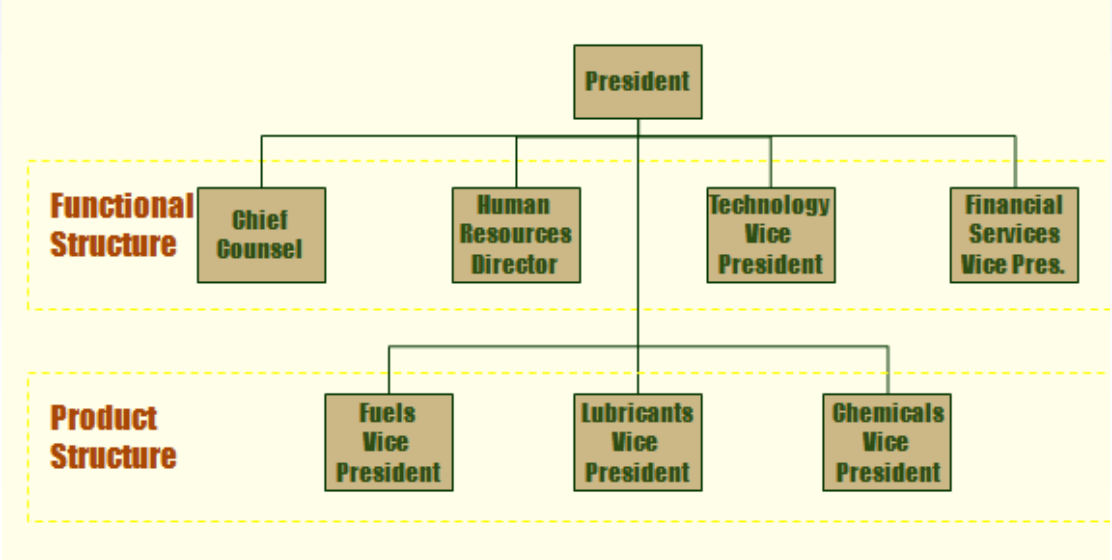


Organizational Model

- **The Matrix Organizational Structures**
  - Attempts to maximize the strengths and minimize the weaknesses of both the functional and product bases
  - Superimpose a horizontal structure of authority, influence, and communication on the vertical structure
  - Facilitates the utilization of highly specialized staff and equipment

Organizational Model

- **Hybrid Organizational Structures**
  - Parts are combined to maintain balance of power and effectiveness across functional, product, geographic and client focused units.



Organizational Model

- **Organizational Culture**
  - A system of shared values, assumptions, beliefs, and norms that unite the members of an organization.
  - Reflects employees' views about "the way things are done"
  - The culture specific to each firm affects how employees feel and act and the type of employee hired and retained by the company

Organizational Model

- **Characteristics of Organization Culture**
  - It is distinctive
  - It is based on certain Norms
  - It promotes Stable values
  - It leads to common behavioral aspects
  - It shapes philosophy and rules
  - Its strength varies

Human Resource Management

Huthaifa Khalil

Human Resource Management

- **Human Resource**
  - The science and the practice that deals with the nature of the employment relationship and all of the decisions, actions and issues that relate to this relationship.
  - The process of attracting, developing and maintaining a talented and energetic workforce to support organizational mission, objectives and strategies
  - It involves an organization's acquisition, development and utilization of employees, well as the employee relationship to an organization and its performance.

Human Resource Management

- **Human Resource**
  - The resource that lies within employees and how they are organized is critical to strategic success and competitive advantage.
  - The overall purpose of HRM is to ensure that the organization is able to achieve success through people.
  - Managers must find ways to get the highest level of contribution from their workers. And they will not be able to do that unless they are aware of the many ways that their under-standing of diversity relates to how well, or how poorly, people contribute

Human Resource Management

- **HRM Includes:**
  - Equal Employment Opportunity
  - Health and Safety
  - Industrial Relations
  - Recruitment / Selection
  - Induction / Orientation
  - Training and Professional Development
  - Performance Appraisal and Management
  - Quality of Work Life

Human Resource Management

- **Principles of HRM**
  - Strategic integration
    - ✓ Treat all labour management processes in a strategic fashion by integrating them with the broader business.
  - Organisational flexibility
    - ✓ Highly skilled knowledge workers with full time jobs.
  - Commitment
    - ✓ Through changing the organisation's culture.
  - Quality
    - ✓Quality work, quality workers, quality products and services.

Human Resource Management

- **HRM Activities**
  - **Job analysis** defines a job in terms of specific tasks and responsibilities and identifies the abilities, skills and qualifications needed to perform it successfully.
  - **Human resource planning** or **employment planning** is the process by which an organisation attempts to ensure that it has the right number of qualified people in the right jobs at the right time.
  - **Employee recruitment** is the process of seeking and attracting a pool of applicants from which qualified candidates for job vacancies within an organisation can be selected.

Human Resource Management

- **HRM Activities**
  - **Employee selection** involves choosing from the available candidates the individual predicted to be most likely to perform successfully in the job.
  - **Performance appraisal** is concerned with determining how well employees are doing their jobs, communicating that information to the employees and establishing a plan for performance improvement.
  - **Training and development** activities help employees learn how to perform their jobs, improve their performance and prepare themselves for more senior positions.

Human Resource Management

- **HRM Activities**
  - **Career planning and development** activities benefit both employees (by identifying employee career goals, possible future job opportunities and personal improvement requirements) and the organisation (by ensuring that qualified employees are available when needed).
  - **Employee motivation** is vital to the success of any organisation. Highly motivated employees tend to be more productive and have lower rates of absenteeism and turnover.

Human Resource Management

- **Human Resource Development**

  • A set of systematic and planned activities designed by an organization to provide its members with the necessary skills to meet current and future job demands.

Human Resource Management

- **Training and Development**
  - **Training**
    - ✓ improving the knowledge, skills and attitudes of employees for the short-term, particular to a specific job or task
  - **Development**
    - ✓ preparing for future responsibilities, while increasing the capacity to perform at a current job

Human Resource Management

- **The Tangible vs. Intangible Assets**
  - The tangible assets of the firm are visible and quantified, can be easily duplicated, depreciate with use
    - ✓ Ex: manufacturing plant, equipment, buildings and other physical infrastructure
  - The intangible assets are invisible, difficult to quantify, must be developed over time, appreciate with purposeful use
    - ✓ Ex: technological know-how, customer loyalty, branding, business processes

Human Resource Management

- **Firm Capital**
  - Human Capital
    - ✓ Knowledge, skills, abilities of individuals
  - Social Capital
    - ✓ Relationships in social networks
    - ✓ Structural, cognitive, relational dimensions
  - Intellectual capital
    - ✓ Knowledge and knowing capability of social collectivities
    - ✓ Procedural/declarative; tacit/explicit; individual/social

Human Resource Management

- **Human Capital**
  - The Human Capital of an organization consists of the people who work for it and on whom the success of the business depends.
  - Human Capital represents the human factor in the organization: the combined intelligence, skills and expertise that give the organization the distinctive character
  - The human elements are those that are capable of learning, changing, innovating.

Human Resource Management

- **Knowledge Economy**

  • The Knowledge Economy encompasses all jobs, companies and industries in which the knowledge and capabilities of people, rather than the capabilities of machines or technologies, determine competitive advantage.

- **Knowledge Workers**

  • Knowledge workers have high degrees of expertise, educations or experience and the primary purpose of their jobs involves the creation, distribution of application of knowledge.

Human Resource Management

- **Challenges for HR**
  - Competing in the Global Economy
    - ✓ New technologies
    - ✓ Need for more skilled and educated workers
    - ✓ Cultural sensitivity required
    - ✓ Team involvement
    - ✓ Problem solving
    - ✓ Better communications skills

Human Resource Management

- **Challenges for HR**
  - Need for Learning
    - ✓ Organizations change
    - ✓ Technologies change
    - ✓ Products change
    - ✓ Processes change
    - ✓ PEOPLE must change!!

Human Resource Management

- **Reward and Recognition System Management**
  - By valuating and recognizing people, you harness the power of motivation, which is the single most powerful strategy used to promote performance and positive behaviors

Human Resource Management

- **Reward and Recognition System Management**

  • A reward is given by an “organization” to value something it already has or it ascribes a value to a particular job / event

  • A recognition is just an expression of feeling. It happens when a person is impacted by another person and he / she expresses it openly

Human Resource Management

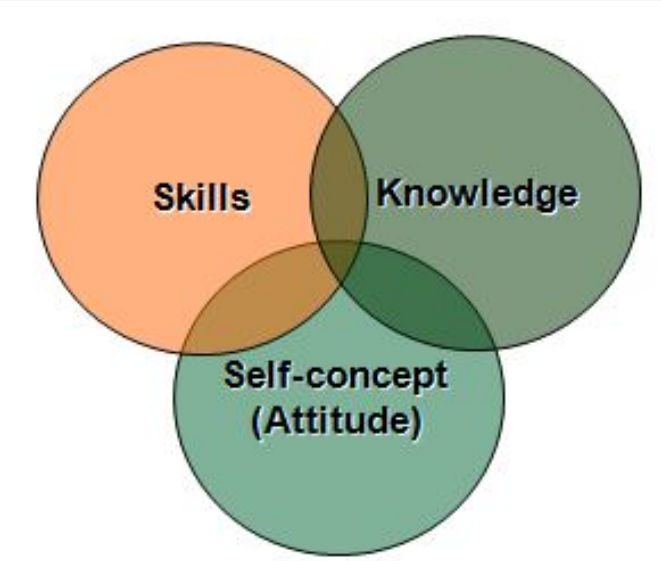
- **Human Resource Analysis**
  - To identify the size, skills and structure surrounding current employees
  - To identify future human resource needs of the organization
  - Obtain some basic information on the people
  - Explore in detail the role and contribution of the human resources management function in the development of strategy

Human Resource Management

- **Coaching and Mentoring**
  - **Mentoring**
    - ✓ Concerned with supporting practitioners whilst they make a significant career transition
    - ✓ Mentoring in intended to be supportive of the individual and occurs ‘at need’.
  - **Coaching**
    - ✓ Used to support the process of reviewing established or emerging practices. It is focused on innovation, change or specific skills.
    - ✓ Conceived as a more structured learning process aimed at explicit professional development in an agreed area of performance.

Human Resource Management

- **Competencies**
  - A collection of characteristics (i.e. skills, knowledge and self-concept, traits, behavior, motivation, etc.), that enables someone to successfully complete a given task



Human Resource Management

- **Course Outline:**
  - ✓ **Engineering Management**
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  - • **Cost Management & Productivity**
  - • **Project Management**
  - • **Quality Control**
  - • **Operations Researches**
  - •**Supply Chain**
  - •**Industrial safety**

Cost Management

Huthaifa Khalil

Cost Management

- **Cost Terminology**
  - **Cost** – sacrificed resource to achieve a specific objective
  - **Actual Cost** – a cost that has occurred
  - **Budgeted Cost** – a predicted cost
  - **Cost Object** – anything of interest for which a cost is desired

Cost Management

- **Cost Terminology**
  - **Direct Costs**: can be conveniently and economically traced (tracked) to a cost object
    - ✓ Parts, Assembly line wages
  - **Indirect Costs**: cannot be conveniently or economically traced (tracked) to a cost object.
    - ✓ Electricity, Rent, Property taxes

Cost Management

- **Cost Terminology**
  - **Variable Costs**: changes in total in proportion to changes in the related level of activity or volume
  - **Fixed Costs**: remain unchanged in total regardless of changes in the related level of activity or volume

	Total Dollars	**Cost per Unit**
Variable Costs	Change in proportion with output **More output = More cost**	Unchanged in relation to output
Fixed Costs	Unchanged in relation to output	Change inversely with output **More output = lower cost per unit**

Cost Management

- **Types of Inventories**
  - **Direct Materials**: resources in stock and available for use
  - **Work-in-Process (or progress)**: products started but not yet completed. Often abbreviated as WIP
  - **Finished Goods:** products completed and ready for sale

Cost Management

- **Types of Product Costs**
  - Direct Materials
  - Direct Labor
  - Indirect Manufacturing – factory costs that are not traceable to the product. Also known as Manufacturing Overhead costs or Factory Overhead costs

Cost Management

- **Cost-Volume-Profit (CVP) Analysis**
  - Changes in production/sales volume are the sole cause for cost and revenue changes
  - Total costs consist of fixed costs and variable costs
  - Revenue and costs behave and can be graphed as a linear function (a straight line)
  - Selling price, variable cost per unit, and fixed costs are all known and constant

Cost Management

- **Cost-Volume-Profit (CVP) Analysis**
  - Basic Formulae

$$\text{Operating income} = \text{Revenues} - \text{Variable costs} - \text{Fixed costs}$$

$$\text{Operating income} = \left(\begin{matrix}\text{Selling}\\ \text{price}\end{matrix} \times \begin{matrix}\text{Quantity of output}\\ \text{units sold}\end{matrix}\right) - \left(\begin{matrix}\text{Variable cost}\\ \text{per unit}\end{matrix} \times \begin{matrix}\text{Quantity of output}\\ \text{units sold}\end{matrix}\right) - \text{Fixed costs}$$

$$\text{net income} = (\text{ operating income }) (1 - \text{Tax rate})$$

$$\text{Revenues} - \text{Variable costs} - \text{Fixed costs} = \frac{\text{net income}}{1 - \text{Tax rate}}$$

Cost Management

- **Contribution Margin**
  - Contribution Margin equals sales less variable costs
    - ✓ CM = S – VC
  - Contribution Margin per unit equals unit selling price less variable cost per unit
    - ✓ CMu = SP – VCu
  - Contribution Margin also equals contribution margin per unit multiplied by the number of units sold
    - ✓ CM = CMu . Q

Cost Management

- **Contribution Margin**
  - Contribution Margin Ratio (percentage) equals contribution margin per unit divided by selling price
    - ✓ CMR = CMu ÷ SP
  - A horizontal presentation of the Contribution Margin Income Statement:
    - ✓Operating Income (OI) = Sales – VC – FC
    - ✓ OI= (SP x Q) – (VCu x Q) – FC
    - ✓ OI= Q (SP – VCu) – FC
    - ✓ OI = Q (CMu) – FC

Cost Management

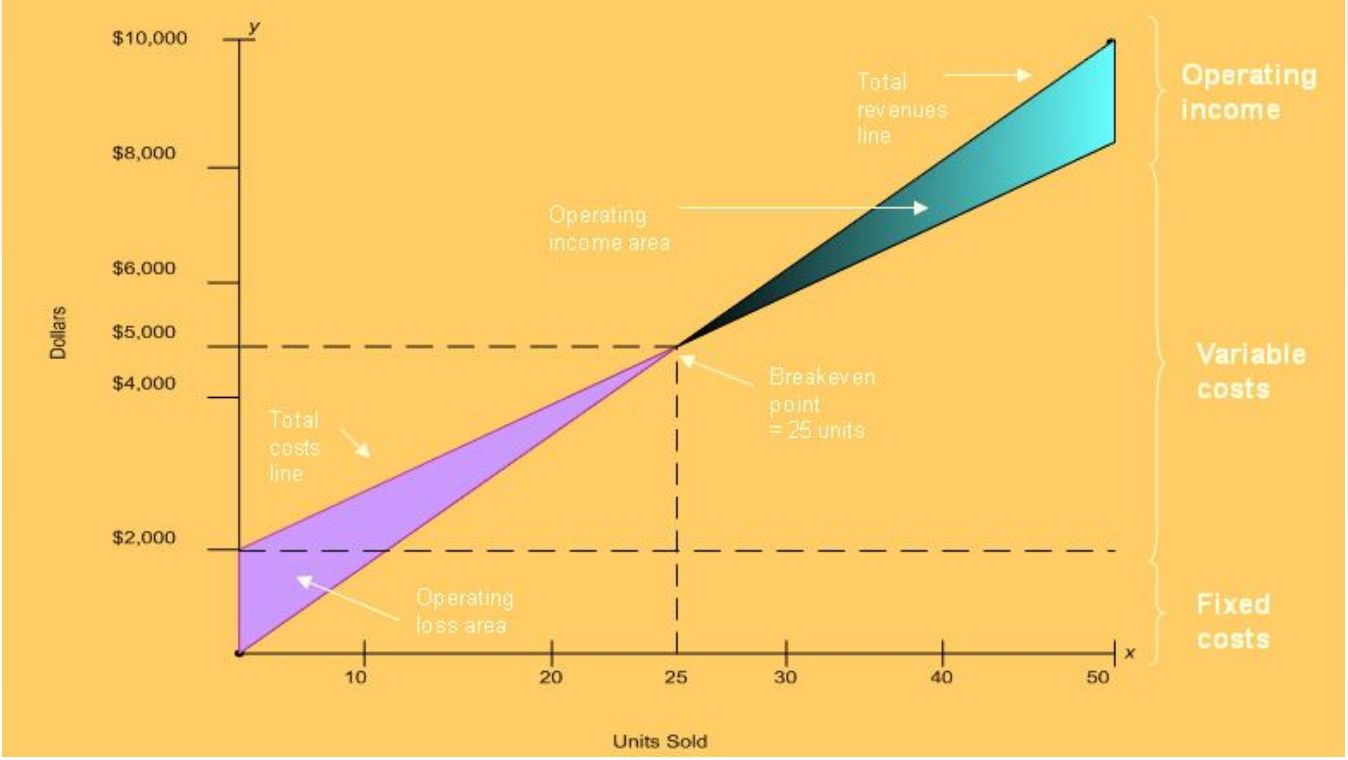
- **Breakeven Point**
  - Recall the last equation in an earlier slide:
    - ✓ Q (CMu) – FC = OI
  - A simple manipulation of this formula, and setting OI to zero will result in the Breakeven Point (quantity):
    - ✓ BEQ = FC ÷ CMu
  - At this point, a firm has no profit or loss at a given sales level

Cost Management

- **Breakeven Point**
  - If per-unit values are not available, the Breakeven Point may be restated in its alternate format:
    - ✓ BE Sales = FC ÷ CMR
  - With a simple adjustment, the Breakeven Point formula can be modified to become a Profit Planning tool
    - ✓ Q = (FC + OI)/CMu

Cost Management

- **CVP, Graphically:**



Cost Management

- **CVP and Income Taxes**
  - From time to time it is necessary to move back and forth between pre-tax profit (OI) and after-tax profit (NI), depending on the facts presented
  - After-tax profit can be calculated by:
    - ✓ NI = OI x (1-Tax Rate)
  - NI can substitute into the profit planning equation through this form:
    - ✓ OI = NI / (1-Tax Rate)

Cost Management

- **Operating Leverage:**
  - Operating Leverage (OL) is the effect that fixed costs have on changes in operating income as changes occur in units sold, expressed as changes in contribution margin
    - ✓ OL = Contribution Margin / Operating Income

Cost Management

- **Effects of Sales-Mix on CVP:**
  - The formulae presented to this point have assumed a single product is produced and sold, A more realistic scenario involves multiple products sold, in different volumes, with different costs
  - For simplicity's sake, only two products will be presented, but this could easily be extended to even more products, A weighted-average CM must be calculated (in this case, for two products)

$$\text{Weighted Average CMu} = \frac{(\text{Product \#1 CMu} \times \text{Product \#1 Q}) + (\text{Product \#2 CMu} \times \text{Product \#2 Q})}{\text{Total Units Sold (Q) for Both Products}}$$

Cost Management

- **Example:** Fill in the blanks of the following

Case	Revenues	Variable Costs	Fixed Costs	Total Costs	Operating Income	Contribution Margin Percentage
a.	—	$500	—	$ 800	$1,200	—
b.	$2,000	—	$300	—	$ 200	—
c.	$1,000	$700	—	$1,000	—	—
d.	$1,500	—	$300	—	—	40%

- **Example:** Patel Manufacturing sold 180,000 units of its product for $25 per unit in 2005. Variable cost per unit is $20 and total fixed costs are $800,000.

  Calculate (a) contribution margin and (b) operating income.

Cost Management

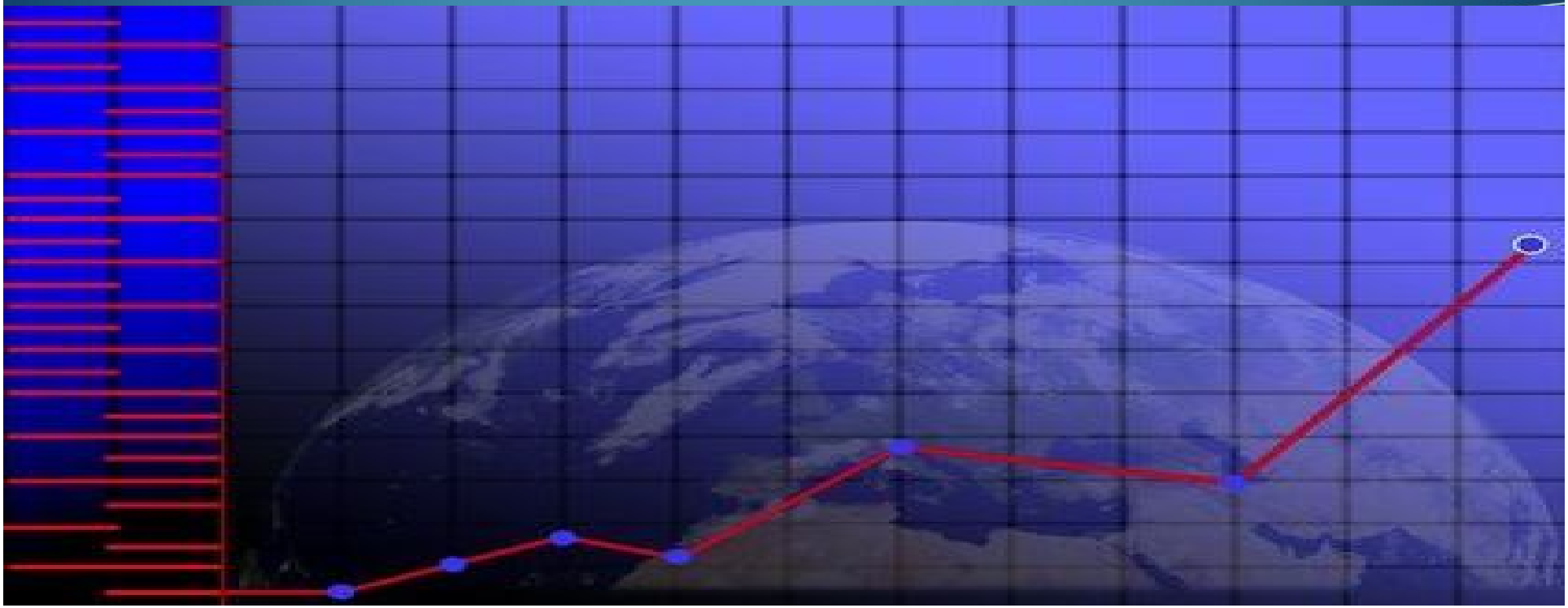
- **Example:** Company produces two different software product

	Do-All	Superword	Total
Units sold	60	40	100
Revenues	$12,000	$4,000	$16,000
Variable costs	7,200	2,800	10,000
Fixed costs			4,500

What is the Operating income , breakeven point?

Quality Control

Huthaifa Khalil



Quality Control

- **Quality**

  • Quality of a product or service refers to the degree to which the product or service is able to satisfy (stated or implied) needs.

  • Quality is the degree to which a product/service conforms to its requirements.

  • Every product posses a number of characteristics that are critical to quality (for the user/consumer):

    ✓ Length of mechanical components

    ✓ Duty of batteries

    ✓ Thickness of the coat of paint

    ✓ Amount of material in a tube of toothpaste

Quality Control

- **Quality**

  • Most organizations find it difficult (and expensive) to provide the customer with products that have quality characteristics, which are always identical from unit to unit.

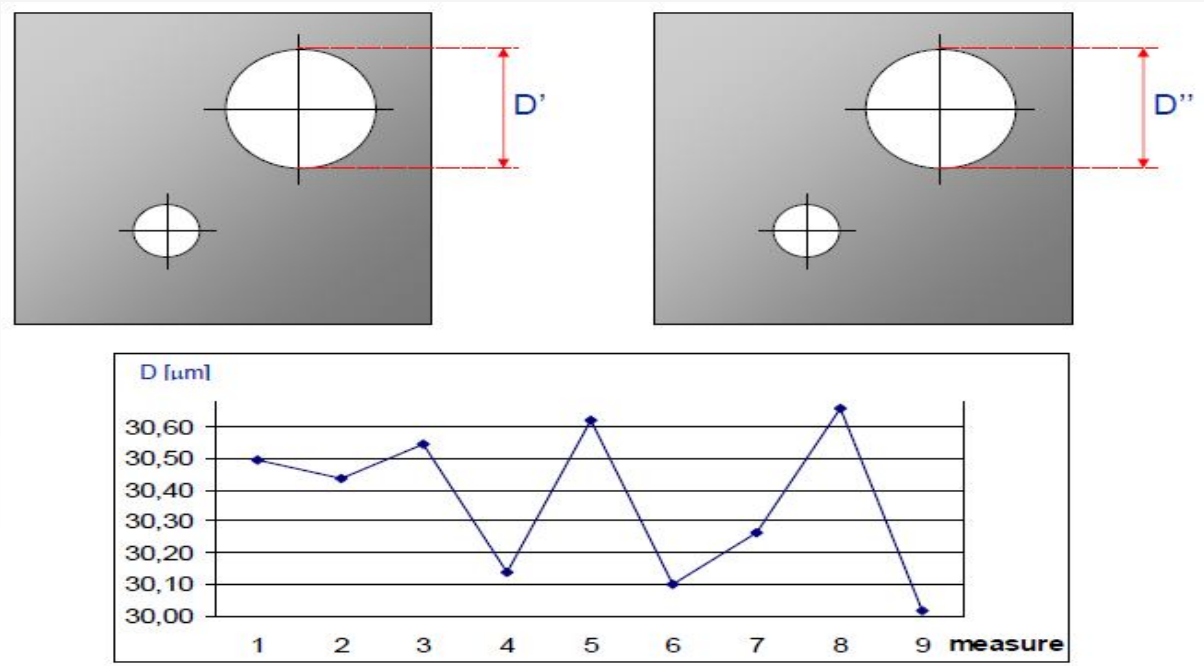
  • Charts are a major component of quality control. They help to visualize calculations and relationships between the processes and the measurements of their quality.

Quality Control

- **Variability**
  - Two products cannot be ever identical (e.g. the diameter of a screw).
  - If the variation is large, the customer may perceive the unit to be undesirable and unacceptable.
  - Beyond this, if the variation is large, these units cannot be interchangeable (e.g. problems in the assembly process).
  - Most common sources of variability:
    - ✓ Differences in materials.
    - ✓ Differences in the performance of the manufacturing equipment.
    - ✓ Differences in the way operators perform their tasks.

Quality Control

- **Variability**
  - Example the diameter (D) of a work piece manufactured hole cannot be identical in all the products.



Quality Control

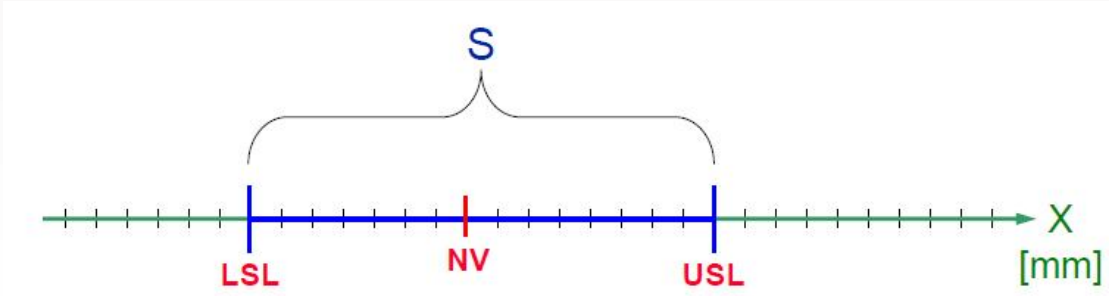
- **Specifications**

  • Quality characteristics are evaluated relative to specifications, a value of a measurement that corresponds to the desired value is called the Nominal (or target) Value;

  • These values are usually bounded by a range of values that we believe will be sufficiently close to the target so as to not impact the function or performance of the product if the quality characteristic is in that range.

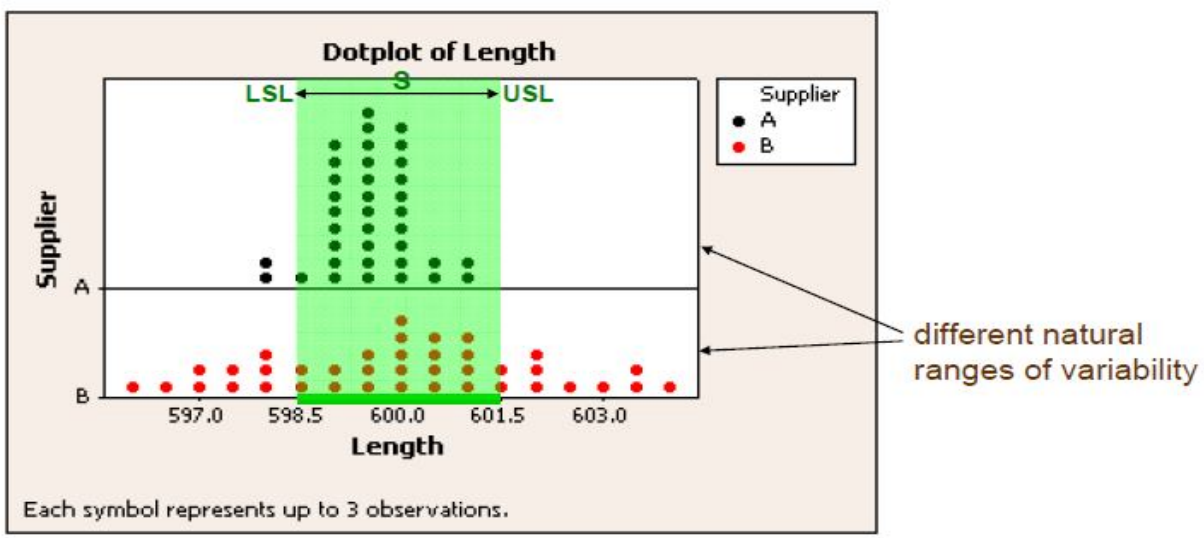
Quality Control

- **Specifications**
  - Specification Limit
    - ✓ USL (Upper Specification Limit): the largest allowable value;
    - ✓ LSL (Lower Specification Limit): the smallest allowable value.



Quality Control

- **Natural Variability**
  - Process tendency towards producing (in normal conditions) products with quality characteristics different from target values.
  - It is an internal characteristic of the process.

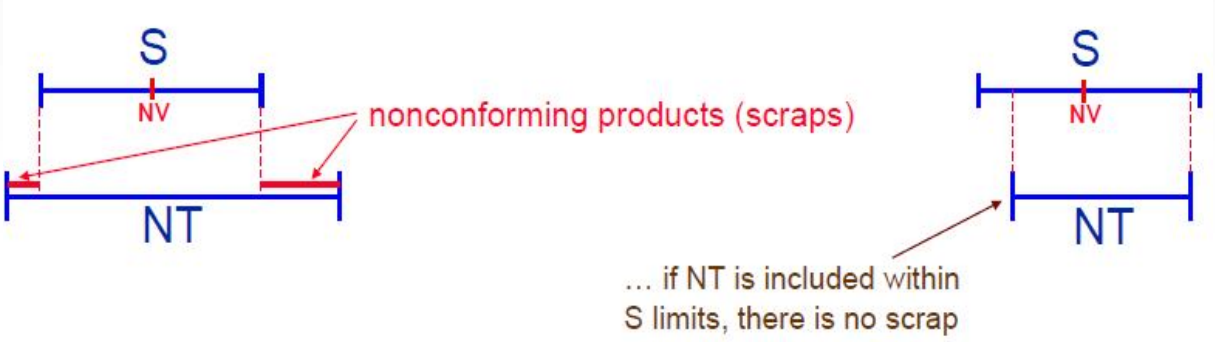


Quality Control

- **Statistical Process Control**
  - Methods make it possible to control quality characteristics during production (on-line), in order to maintain the process under-control and to detect and correct possible abnormalities.

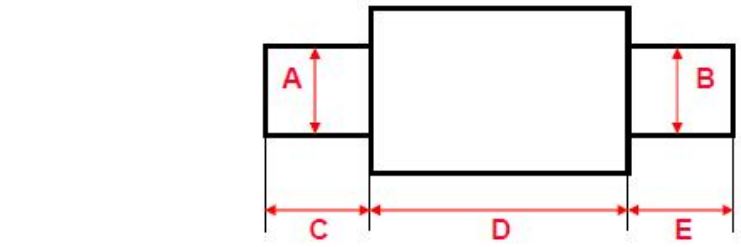
Quality Control

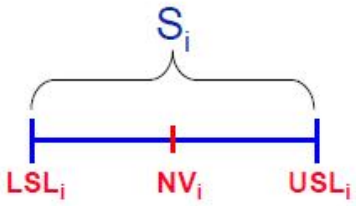
- **Specification and Natural Tolerance Limits**
  - Natural Tolerance (NT) range is a measure of the natural variability of the process.
  - The process variability is usually measured by the standard deviation (σ).
  - (σ), an index of the natural dispersion of the process.
  - Specification range (S) is determined "externally" (usually set by product designers).



Quality Control

- **Specification and Natural Tolerance Limits**
  - For every product quality characteristic (e.g. geometrical dimensions) we define the specification limits (USL, LSL).

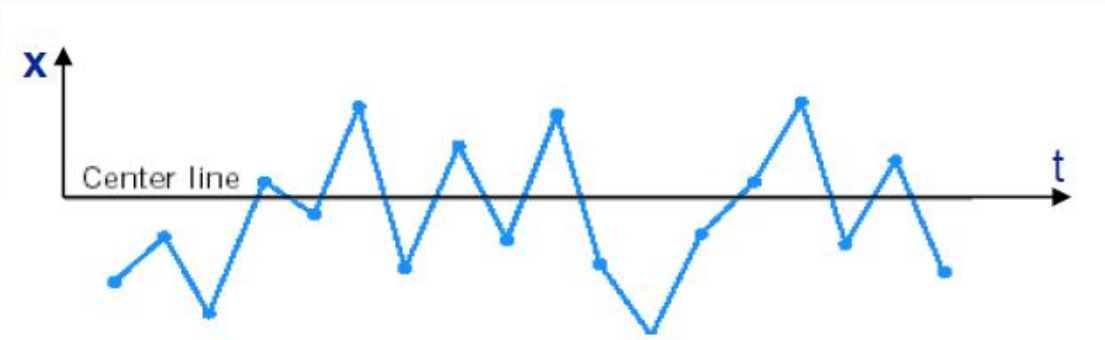




$A \rightarrow LSL_A, NV_A, USL_A$
$B \rightarrow LSL_B, NV_B, USL_B$
$C \rightarrow LSL_C, NV_C, USL_C$
$D \rightarrow LSL_D, NV_D, USL_D$
$E \rightarrow LSL_E, NV_E, USL_E$

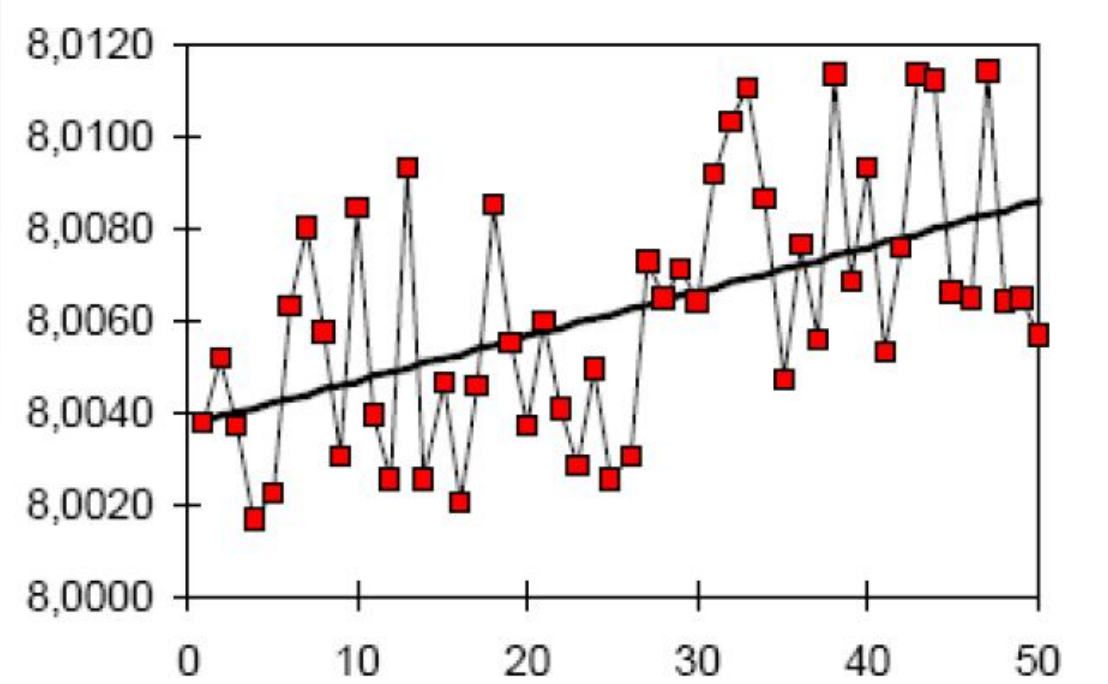
Quality Control

- **Specification and Natural Tolerance Limits**
  - A process operating with only chance causes of variation (not other assignable causes) generally show a random pattern (also defined as white noise).
    - ✓ Typically it follows a Normal Distribution.



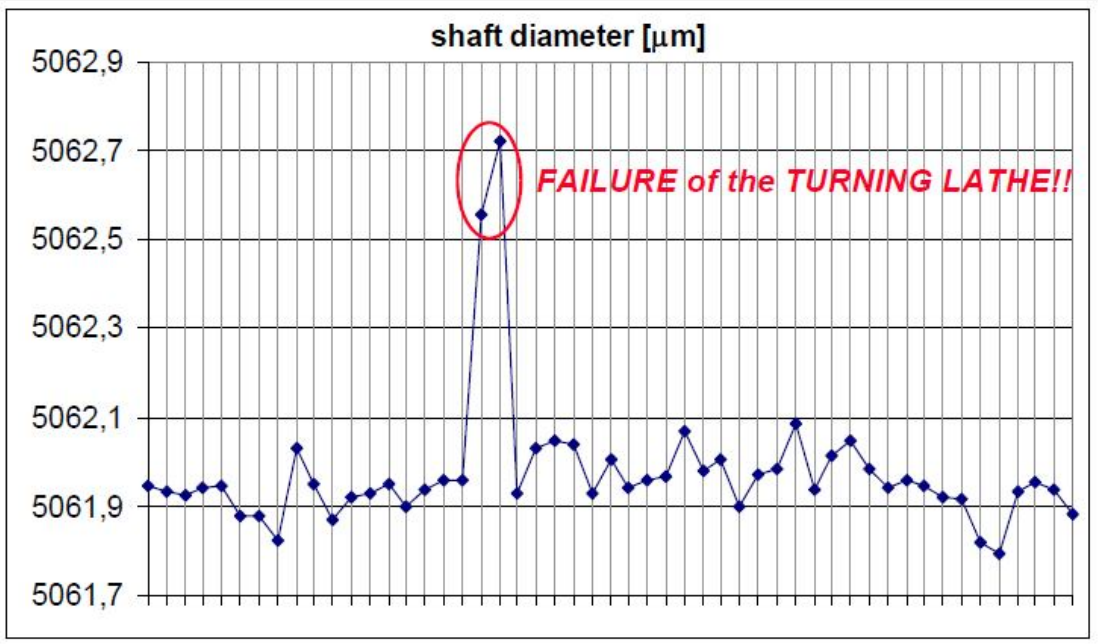
Quality Control

- **Specification and Natural Tolerance Limits**
  - Example: non random pattern (RUN), due to the presence of assignable causes (e.g. thermal expansion, tool wear…)



Quality Control

- **Specification and Natural Tolerance Limits**
  - Example: non random pattern, due to the presence of two points related to assignable causes (e.g. failures in the process).



Quality Control

- **Specification and Natural Tolerance Limits**

  • It is customary to define the upper and lower natural tolerance limits, say UNTL and LNTL, as 3σ above and below the process mean.

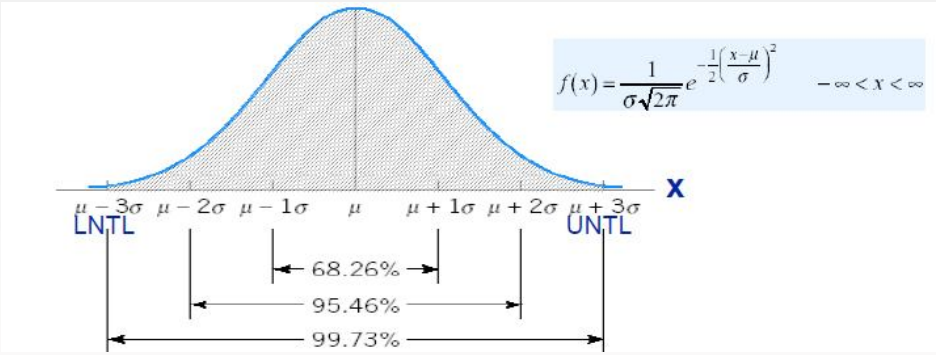
$$NT \equiv 6\sigma \qquad \pm 3\sigma \Rightarrow \begin{cases} UNTL = \mu + 3\sigma \\ LNTL = \mu - 3\sigma \end{cases}$$

  • To calculate the natural tolerance NT ≡ 6σ, we should know the standard deviation (σ) of the population.

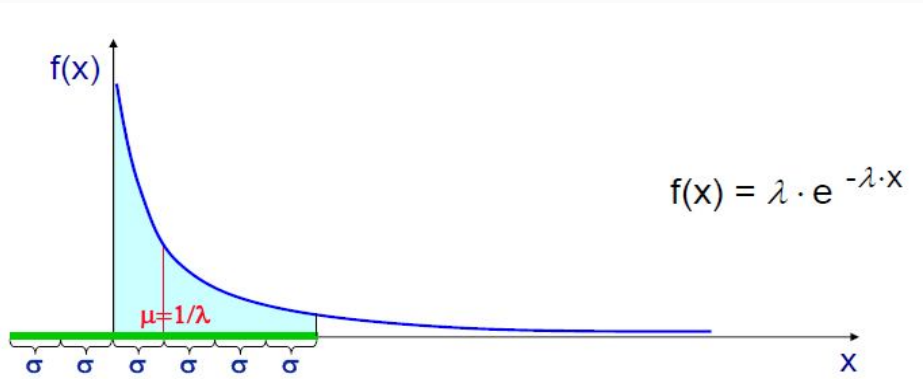
  ✓ σ can be estimated by using the sample standard deviations (s) or the sample ranges (R), related to several samples extracted from the population.

Quality Control

- **Specification and Natural Tolerance Limits**
  - Normal Distribution:



  - Exponential Distribution:



Quality Control

- **Specification and Natural Tolerance Limits**

  • Example: m samples are extracted from the population; each sample is made of n observations.

  ✓ Standard deviation of the population (σ) can be estimated using (sj) or (Rj).

1) $x_{11}, x_{12}, \dots, x_{1n}$	$\bar{x}_1$	s_1	R_1
2) $x_{21}, x_{22}, \dots, x_{2n}$	$\bar{x}_2$	s_2	R_2
⋮	⋮	⋮	⋮
m) $x_{m1}, x_{m2}, \dots, x_{mn}$	$\bar{x}_m$	s_m	R_m

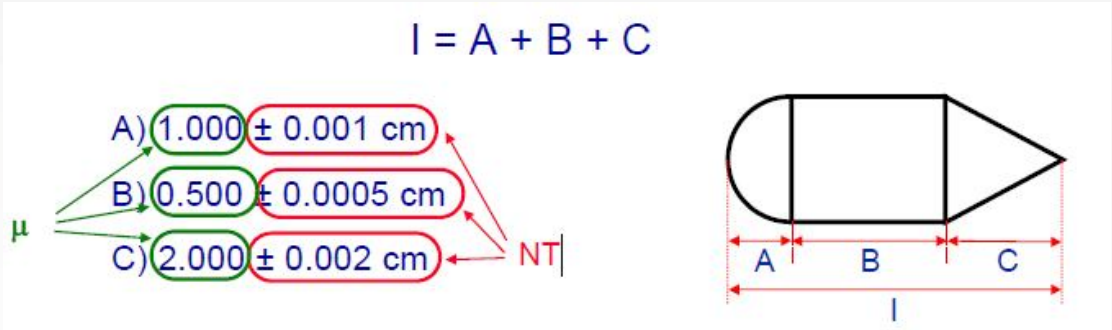
$$\text{sample standard deviation} \rightarrow s_j = \sqrt{\frac{\sum_{i=1}^{n}(x_{ji} - \bar{x}_j)^2}{n-1}}$$

$$\text{sample range} \rightarrow R_j = \max(x_{ji}) - \min(x_{ji})$$

j generic sample number
i generic observation number

Quality Control

- **Assembled Components: Linear Function**
  - **Example**: Dimensional quality characteristics of 3 components assembled together, What is the NT of the product ?



✓ The average value of product I is given by the sum of A, B and C average values → I = 1.000+0.500+2.000 = 3.500 cm

Quality Control

- **Assembled Components: Linear Function**

  ✓ If the different quality characteristics (A, B, C) are statistically **independent** (the occurrence of one event occurs does not affect the outcome of the occurrence of the other event) and normally distributed, then we can use the following formula:

$$\sigma_I^2 = \sigma_A^2 + \sigma_B^2 + \sigma_C^2$$

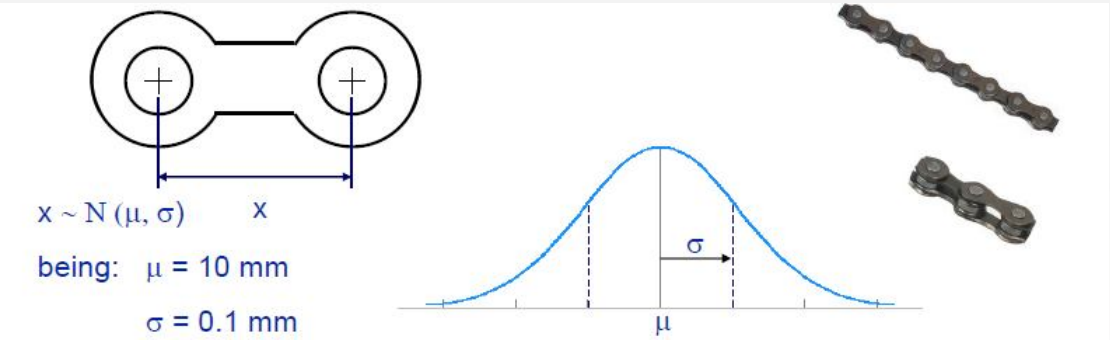
As a consequence, considering that NTi = ±3·σi:

$$NT_I^2 = NT_A^2 + NT_B^2 + NT_C^2$$

$$NT_I = \sqrt{NT_A^2 + NT_B^2 + NT_C^2} = \pm 0.0023 \text{ cm}$$

Quality Control

- **Assembled Components: Linear Function**
  - **Example:**



✓Assuming that a chain is made of 100 chain rings, the chain average length is given by:

$$\mu_{chain} = \sum_{i=1}^{100} \mu_i = 100 \cdot 10 = 1000 \text{ mm}$$

Quality Control

- **Assembled Components: Linear Function**

✓ σ, chain can be correctly calculated by applying the following formula (probabilistic method): $\sigma^2_{chain} = \sum \sigma^2 \rightarrow \sigma_{chain} = \sqrt{100 \cdot \sigma^2} = 10 \cdot \sigma = 1\ mm$

✓ The lengths of the parts can be assumed independent. When the process is operating in regular conditions, the length of one part is not influenced by the length of the previous, consequently: $NT_{chain} = \pm 3 \cdot \sigma_{chain} = \pm 3\ mm$

✓ Let notice that – in this case – the global variability (σ chain) is much lower than in the previous one. This is due to a sort of compensation among the variations in the parts assembled together

Quality Control

- **Assembled Components: Linear Function**
  - In a more general case:

$$Z = n \cdot X + m \cdot Y$$

(X and Y statistically independent)

$$\sigma_Z^2 = n^2 \cdot \sigma_X^2 + m^2 \cdot \sigma_Y^2$$

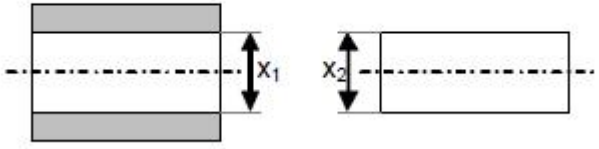
  - If X and Y are not statistically independent, all the previous equations are not valid. Additional terms should be introduced (Covariance).

Quality Control

- **Assembled Components: Linear Function**

  • **Example:** A shaft is to be assembled into a bearing. The internal diameter of the bearing is a normal random variable – say x1 – with mean (**μ1=1.500**) inches and standard deviation (**σ1=0.002**) inches. The external diameter of the shaft – say x2 – is normally distributed with mean (**μ2=1.480**) inches and standard deviation (**σ2=0.004**) inches. When the two parts are assembled, interference will occur if the shaft diameter is larger than the bearing diameter – that is, if:

$$y = x_2 - x_1 > 0$$



Quality Control

- **Assembled Components: Linear Function**

  ✓ The distribution of y is normal, with mean:

$$\mu_y = \mu_2 - \mu_1 = 1.480 - 1.500 = -0.020$$

  ✓ Variance

$$\sigma^2_y = (1^2)\cdot\sigma^2_2 + (-1^2)\cdot\sigma^2_1 = (0.004)^2 + (0.002)^2 = 0.00002$$

  ✓ Therefore, the probability of interference is:

$$P\{\text{interference}\} = P\{y > 0\} = P\left\{z > \frac{0 - \mu_y}{\sqrt{\sigma_y{}^2}}\right\} = 1\text{-}\Phi\left(\frac{0 + 0.020}{\sqrt{0.00002}}\right) = 1\text{-}\Phi(4.47) = 0.000004$$

Quality Control

- **Assembled Components: Non Linear Function**
  - So far, we have been considering linear functions only (among the assembled component and the parts).
  - In some problems, the dimension of interest may be a nonlinear function of the part dimensions (x1, x2, … , xn)

$$Z = nX + mY \rightarrow \sigma_Z^2 = n^2 \cdot \sigma_X^2 + m^2 \cdot \sigma_Y^2$$

variance

Quality Control

- **Assembled Components: Non Linear Function**
  - For non linear functions, Considering a first order Taylor series (truncated) development of the previous function, in the neighborhood of the mean values of the parts:

$$y = g(\mu_{X_1}, \mu_{X_2}, \dots, \mu_{X_n}) + \sum_{i=1}^{n} (x_i - \mu_{X_i}) \cdot \left.\frac{\partial g}{\partial x_i}\right|_{\mu_{X_1}, \mu_{X_2}, \dots, \mu_{X_n}} + \cancel{\cdot}$$

partial derivative

second and higher order terms are neglected

Quality Control

▪ Assembled Components: Non Linear Function

• From statistics, we can apply the following (approximate) formulas:

$$\mu_Y \cong g(\mu_{X_1}, \mu_{X_2}, \dots, \mu_{X_n})$$

number of independent variables

$$\sigma^2_Y \cong \sum_{i=1}^{n} \left(\left. \frac{\partial g}{\partial x_i} \right|_{\mu_{X_1}, \mu_{X_2}, \dots, \mu_{Xn}} \right)^2 \cdot \sigma^2_{X_i}$$

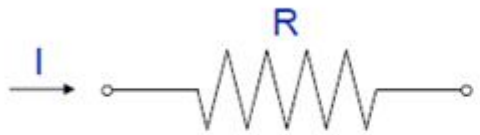
• Let notice that the previous formulas can be applied assuming:

✓ Normal Distribution of the quality characteristics,

✓Statistical independence of the quality characteristics(we intuitively mean that knowing something about the value of one of them does not yield any information about the value of the others

Quality Control

- **Assembled Components: Non Linear Function**
  - **Example:** Evaluate μV and NTV of V?



being: $I = 25 \pm 1\ A$
$R = 4 \pm 0.06\ \Omega$

$V = R \cdot I$ (Ohm law)

✓ Supposing the distributions of R and I to be normal, we can calculate:

$$\mu_V = g(\mu_R, \mu_I) \cong \mu_R \cdot \mu_I = 100\,V$$

Quality Control

- **Assembled Components: Non Linear Function**

  ✓ To calculate NTV, we need:

$$\sigma_V^2 \cong \left(\left. \frac{\partial V}{\partial I} \right|_{\mu_I, \mu_R} \right)^2 \cdot \sigma_I^2 + \left(\left. \frac{\partial V}{\partial R} \right|_{\mu_I, \mu_R} \right)^2 \cdot \sigma_R^2$$

$$\sigma_V^2 \cong \left(R\big|_{\mu_I, \mu_R} \right)^2 \cdot \sigma_I^2 + \left(I\big|_{\mu_{X_I}, \mu_R} \right)^2 \cdot \sigma_R^2 = \mu_R^2 \cdot \sigma_I^2 + \mu_I^2 \cdot \sigma_R^2$$

$$= 4^2 \cdot (0.33)^2 + 25^2 \cdot (0.02)^2 = 2.0277\,V^2$$

$$\sigma_V = 1.41V$$

$$NT_V = \pm 3 \cdot 1.41 = \pm 4.23\,V$$

Quality Control

- **Control Charts:**
  - Control charts are practical tools to monitor the evolution of production processes.
  - In any production process a certain amount of natural variability will always exist (this is the cumulative effect of small and unavoidable causes).
  - A process that is operating in the presence of chance causes of variation only is said to be in statistical control.
  - Control charts are not designed to provide any information about the process conformity with specification limits.

Quality Control

- **Control Charts:**

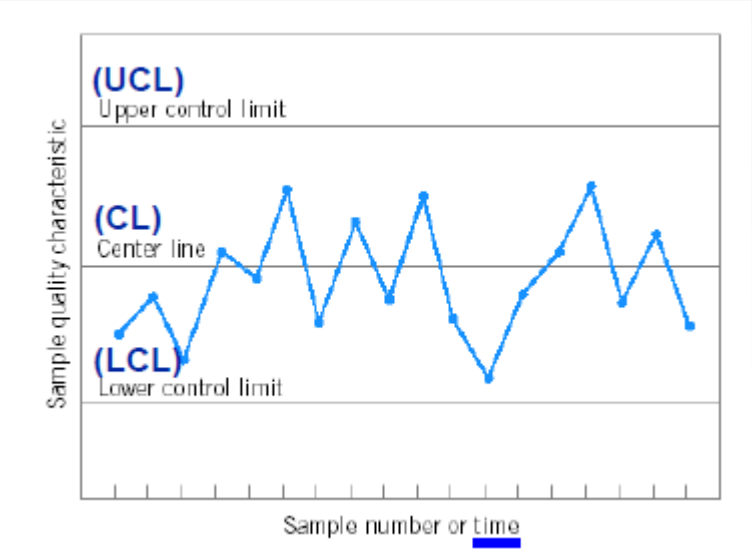
  • A process that is operating in the presence of assignable causes (sources of variability that are not part of the chance causes) is said to be out of control, Three main sources of assignable causes:

  - ✓ Improperly adjusted or controlled machines (or failures);
  - ✓ Operator errors;
  - ✓ Defective raw materials.

  • In other terms, a process is out of control when it does not follow a random pattern and the reason of this can be univocally associated to one of the previous causes.

Quality Control

- **Control Charts:**
- **Control Chart** Contains:
  - ✓ A center line (CL)
  - ✓ An upper control limit (UCL)
  - ✓ A lower control limit (LCL)



Quality Control

- **Control Charts:**
  - **Basic Criteria:**
    - ✓A point that plots within the control limits indicates that the process is in control → no action is necessary
    - ✓A point that plots outside the control limits is evidence that the process is out of control
    - ✓Furthermore, in the presence of chance causes of variation only, plotted points should exhibit a random pattern

Quality Control

- **Control Charts:**
  - **Model of Control Chart**
    - ✓ Let w be sample statistic with mean μ_w, and the standard deviation of w is σ_w:

$$\text{UCL} = \mu_w + L\sigma_w$$
$$\text{Center line} = \mu_w$$
$$\text{LCL} = \mu_w - L\sigma_w$$

    - ✓ Where L is the distance of the control limits from the center line, in general we use L=3

Quality Control

- **Control Charts:**
  - There are **Two Main Types** of control charts**:**
    - ✓ For **Variables** (quality characteristics measured on a numerical scale; e.g. geometrical dimensions, weights, …)
      - ➢ $\overline{X}$ (mean) control charts
      - ➢ R (range) control charts
      - ➢ S^2 (sample variance) control charts
      - ➢ S (sample standard deviation) control charts
      - ➢ X_i (control charts for individual measurements)

Quality Control

- **Control Charts:**
  - There are **Two Main Types** of control charts**:**
    - ✓ For **Attributes** (quality characteristics assuming only 2 states: defective/non-defective, conforming/non-conforming)
      - ➢ control charts for nonconforming (defective):
        - ❖ p (percentage of defective units)
        - ❖ np (number of defective units)
      - ➢ control charts for noncomformities (defects):
        - ❖ u (number of defects per unit)
        - ❖ c (number of defects per sample)

Quality Control

- **Control Charts:**
  - Control charts make it possible to identify when the process is out of control (abnormal conditions) not out of specifications.
  - These conditions are not correlated
    - ✓ A process can be out of control, but within specification limits (typically if NT<<S);
    - ✓A process can be in control, but out of specification limits (typically when the process natural variability is too large)
  - A control chart may indicate an out-of-control condition:
    - ✓When one (or more) point falls beyond the control limits;
    - ✓When the plotted points exhibit some nonrandom pattern (even inside the control limits).

Quality Control

- **P - Control Charts:**

  • The fraction nonconforming (p) is defined as the ratio of the number of defective items in a population to the total number of items in that population

$$p = \frac{D_{TOT}}{N}$$

  • If we want to consider the sample (n) fraction nonconforming $p_i = \frac{D_i}{n}$

  •The average of these individual fraction

$$\bar{p} = \frac{\sum_{i=1}^{m} D_i}{mn} = \frac{\sum_{i=1}^{m} \hat{p}_i}{m}$$

No. of defectives in the (m) samples

No. of units in the (m) samples

Estimate of *p*, to construct the control chart

Quality Control

- **P - Control Charts:**
  - The control chart is

$$\text{UCL} = \overline{p} + 3\sqrt{\frac{\overline{p}(1-\overline{p})}{n}}$$

$$\text{Center line} = \overline{p}$$

$$\text{LCL} = \overline{p} - 3\sqrt{\frac{\overline{p}(1-\overline{p})}{n}}$$

Since *p* represents a probability, negative values of LCL are senseless

→ If calculated LCL<0, then we just use LCL=0

Quality Control

- **P - Control Charts:**

Example Data for Trial Control Limits, Sample Size $n = 50$

Sample Number	Number of Nonconforming Cans, D_i	Sample Fraction Nonconforming, $\hat{p}_i$	Sample Number	Number of Nonconforming Cans, D_i	Sample Fraction Nonconforming, $\hat{p}_i$
1	12	0.24	17	10	0.20
2	15	0.30	18	5	0.10
3	8	0.16	19	13	0.26
4	10	0.20	20	11	0.22
5	4	0.08	21	20	0.40
6	7	0.14	22	18	0.36
7	16	0.32	23	24	0.48
8	9	0.18	24	15	0.30
9	14	0.28	25	9	0.18
10	10	0.20	26	12	0.24
11	5	0.10	27	7	0.14
12	6	0.12	28	13	0.26
13	17	0.34	29	9	0.18
14	12	0.24	30	6	0.12
15	22	0.44		347	$\bar{p} = 0.2313$
16	8	0.16			

Quality Control

- **P - Control Charts:**

$$\overline{p} = \frac{\sum_{i=1}^{m} D_i}{mn} = \frac{347}{(30)(50)} = 0.2313$$

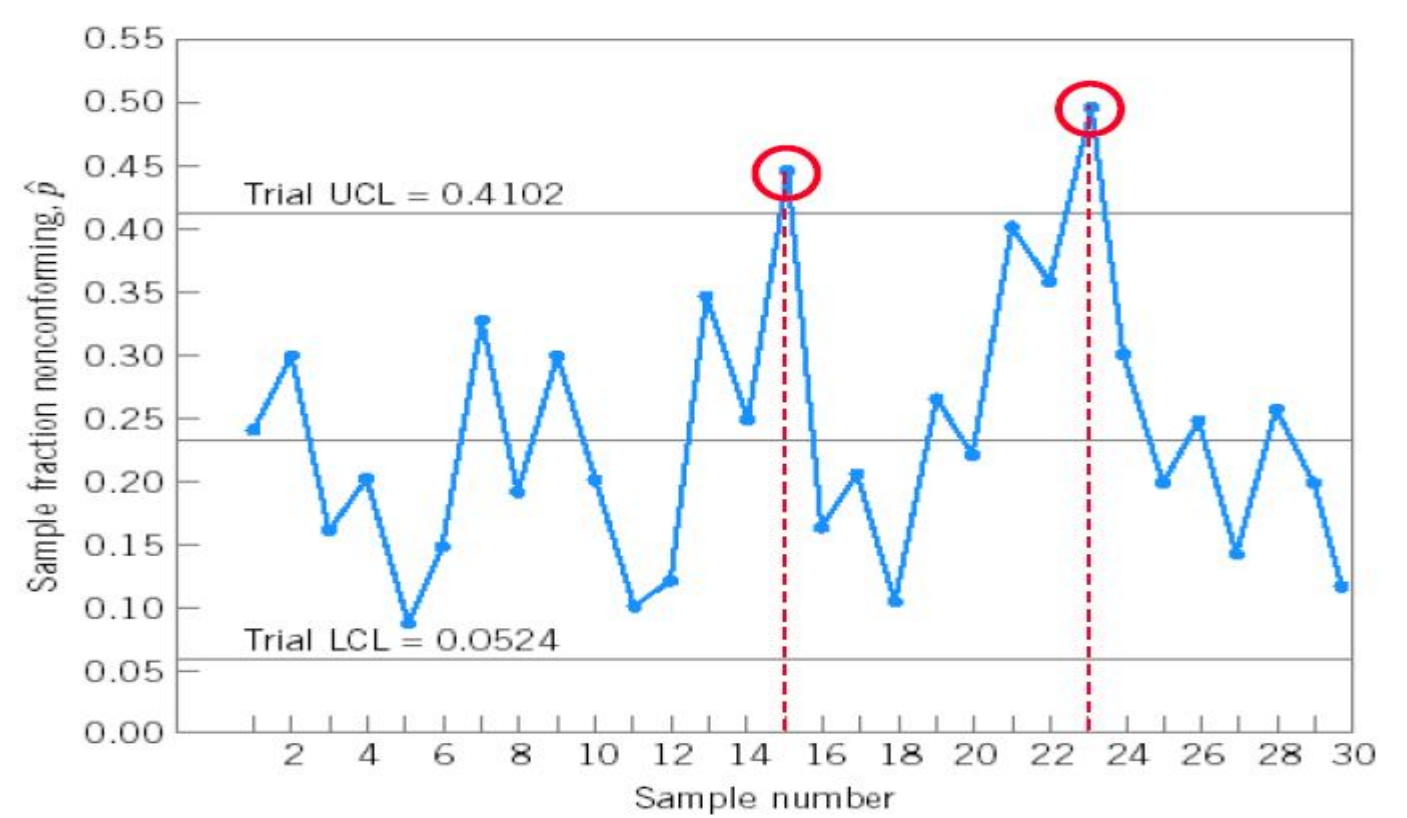
$$\overline{p} \pm 3\sqrt{\frac{\overline{p}(1-\overline{p})}{n}} = 0.2313 \pm 3\sqrt{\frac{0.2313(0.7687)}{50}}$$
$$= 0.2313 \pm 3(0.0596)$$
$$= 0.2313 \pm 0.1789$$

$$\text{UCL} = \overline{p} + 3\sqrt{\frac{\overline{p}(1-\overline{p})}{n}} = 0.2313 + 0.1789 = 0.4102$$

$$\text{LCL} = \overline{p} - 3\sqrt{\frac{\overline{p}(1-\overline{p})}{n}} = 0.2313 - 0.1789 = 0.0524$$

Quality Control

- **P - Control Charts:**



Project Management

Huthaifa Khalil

Project Management

- Project management is the art of directing and coordinating human and material resources throughout the life of a project by using modern management techniques to achieve predetermined objectives of scope, cost, time, quality and participation satisfaction.
- Project management involves planning, monitoring, and control of people, process, and events that occur during the project development.
- Project management: is the application of knowledge, skill, tools, and techniques to project activities in order to meet or exceed stakeholders' needs and expectation from a project.

Project Management

- Project manager will typically be involved in:
  - Ensuring progress of the project according to defined metrics
  - Identifying risks
  - Ensuring progress toward deliverables within time and resource constraints
  - Negotiation for resources on behalf of the project

Project Management

- **Project:**
  - The process required to produce a new product, new system or other specified.
  - The activities which is planned for a finite duration with a specific goal to be achieved.
- **Project objectives:**
  - Performance
  - Time
  - Cost
- **Project Life Cycle**
  - Defining
  - Planning
  - Executing
  - Delivering

Project Management

- **Defining**
  - Is the first phase of the a project life cycle and its where the project requested & approved and Feasibility Analysis.
  - Its involved:
    - ✓ Set main goals , the specification in general,
    - ✓ Define tasks, responsibility
    - ✓ Assigning project manager:
  - In the defining stage we have to make an initial estimation for time and cost.
  - Defining stage means that the project has been formally started.

Project Management

- **Planning**

•The primary purpose of planning is to establish a set of direction (in enough detail) to tell the project team exactly what must be done, It tells everyone involved where you are going and how you are going to get there.

•Its consist of:

✓Scheduling: identify the start, and schedule for each phase for the whole project.

✓Budgeting: estimate the cost of each phase/task for the whole project.

✓Resources: define resources and allocate them.

✓ Plan for risk: Identify source of risk, Set each risk probability and impact, Minimize, avoid or accept each risk.

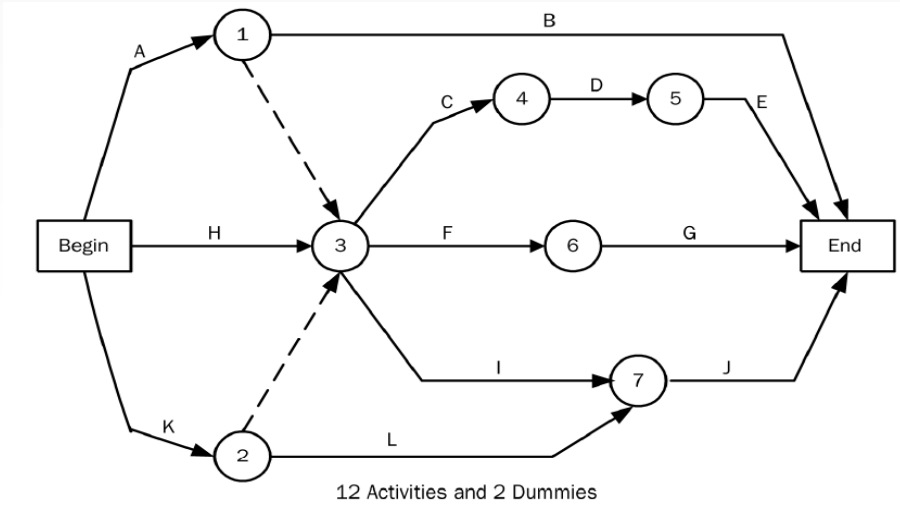
✓Staffing

Project Management

- **Executing**
  - We'll put all the plans into action.
  - Most of the project resources are utilized and most of the budget is spent.
  - Executing activities:
    - ✓Status reports, Quality assurance, Forecasts
- **Delivering**
  - Closing down: delivering before normal end.
  - Delivering Activities:
    - Train customers , Transfer documents, Release resources, Release staff, Lessons learned

Project Management

- **Precedence Diagramming Method (PDM)**
  - PDM is a method of constructing a project schedule network diagram that uses boxes or rectangles, referred to as nodes, to represent activities and connects them with arrows that show the dependencies
  - This technique is also called activity-on-node (AON), and is the method used by most project management software packages.



12 Activities and 2 Dummies

Project Management

- **Precedence Diagramming Method (PDM)**
  - PDM includes four types of dependencies or precedence relationships:
    - ✓ **Finish-to-Start.** The initiation of the successor activity depends upon the completion of the predecessor activity.
    - ✓ **Finish-to-Finish.** The completion of the successor activity depends upon the completion of the predecessor activity.
    - ✓ **Start-to-Start.** The initiation of the successor activity depends upon the initiation of the predecessor activity.
    - ✓ **Start-to-Finish.** The completion of the successor activity depends upon the initiation of the predecessor activity.
  - In PDM, finish-to-start is the most commonly used type of precedence relationship. Start-to-finish relationships are rarely used.

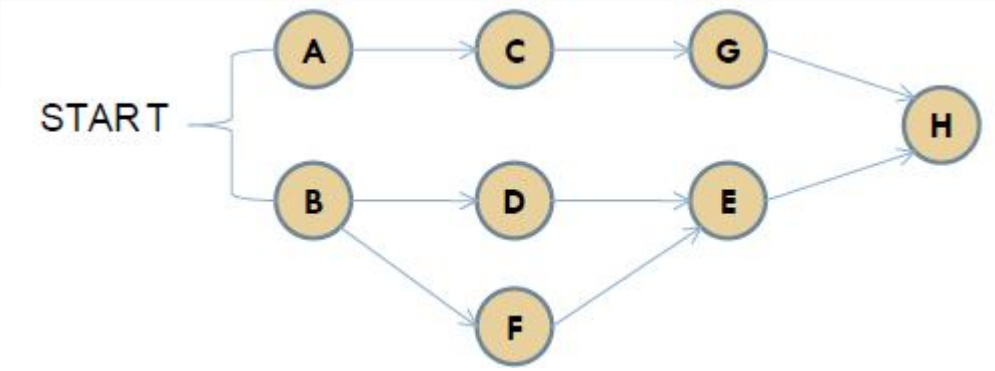
Project Management

- **Critical Path Method**
  - A mathematically based algorithm for scheduling a set of project activities.
  - It is an important tool for effective project management
  - The essential technique for using CPM is to construct, a model of the project that includes the following:
    - ✓ A list of all activities required to complete the project
    - ✓ The time (duration) that each activity will take to completion
    - ✓ The dependencies between the activities.
  - CPM calculates:
  - ✓The longest path of planned activities to the end of the project
  - ✓ The earliest and latest that each activity can start and finish without making the project longer

Project Management

- **Critical Path Method**
  - Example:

Activity ID	Duration	Dependency
A	7	
B	3	
C	6	A
D	3	B
E	3	D,F
F	2	B
G	3	C
H	2	E,G



Project Management

- **Critical Path Method**

Example: The software project consists of a list of tasks along with their estimated durations which are shown in the estimation table below.

Find the critical path ?

Tasks	Dependency	Duration
A		4
B		3
C	A	8
D	A	7
E	B and C	9
F	B and C	12
G	D and E	2
H	D and E	5
I	F and G	6

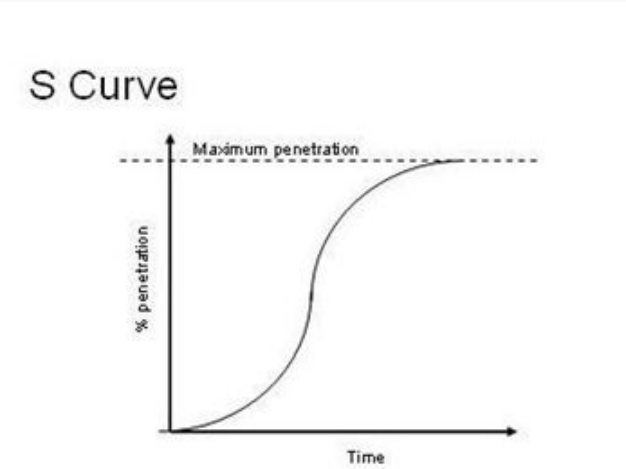
Project Management

- **S-Curve Concept**

  • An understanding of S-Curve theory and its analyses will help learners and team members grasp the importance of monitoring the progress and growth of an ongoing project—at a specific stage or percentage of completion.

  • The S-Curve model simply makes use of the projected number of man-hours and costs to complete the project vs. the actual number of hours and costs incurred within the same time frame.

  • The proposed time, man-hour and cost data are referred to as the “baseline” data.

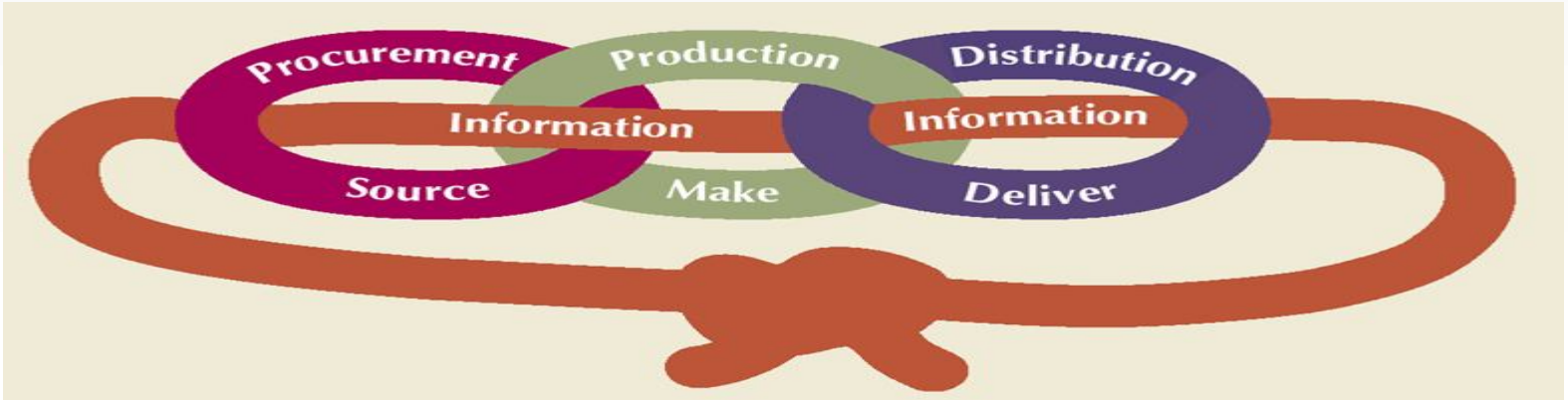


Supply Chain Management

Huthaifa Khalil

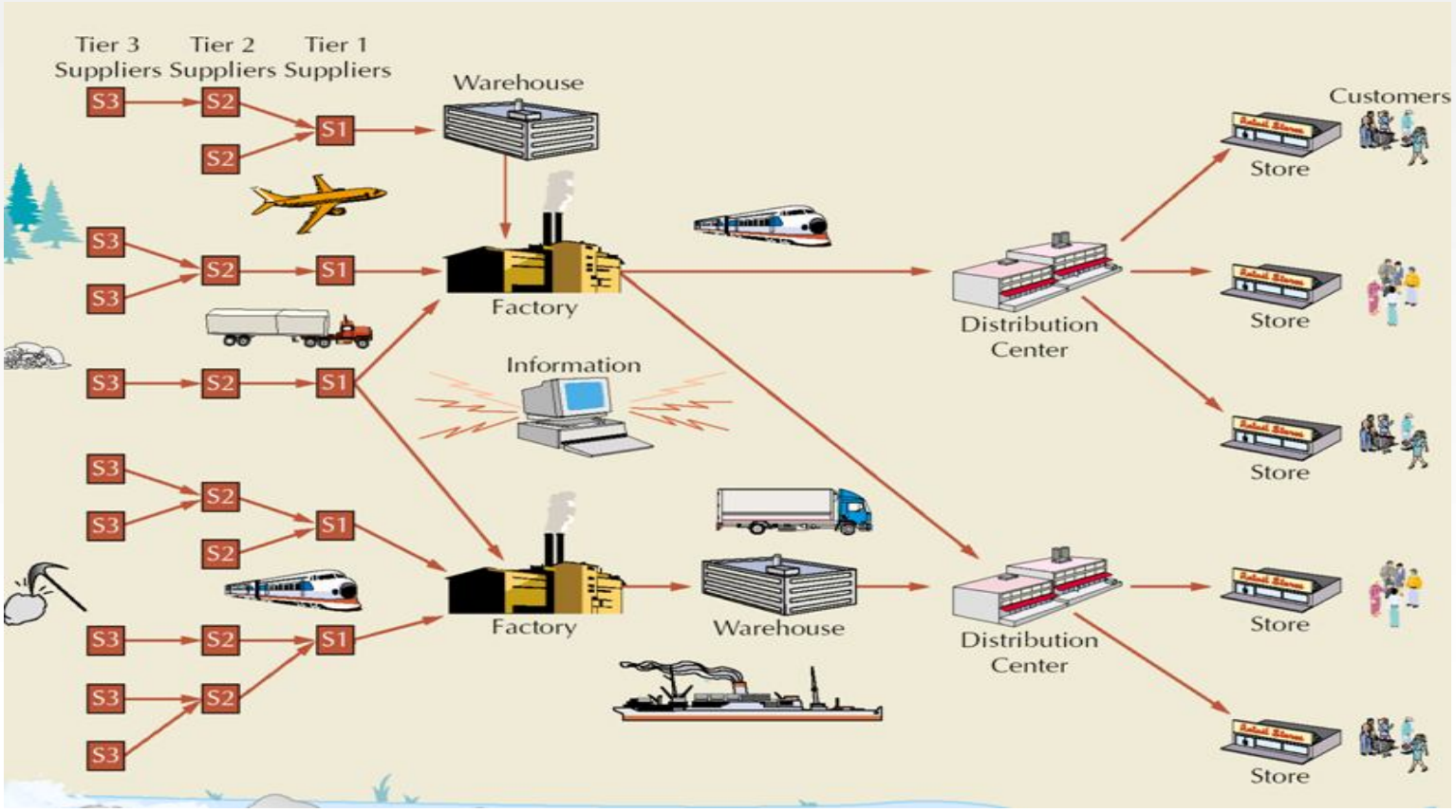
Supply Chain Management

- Supply Chain
  - All facilities, functions, activities, associated with flow and transformation of goods and services from raw materials to customer, as well as the associated information flows
  - An integrated group of processes to “source,” “make,” and “deliver” products



Supply Chain Management

- Supply Chain Illustration



Supply Chain Management

- Value vs. Supply Chain
  - Value chain
    - ✓ every step from raw materials to the eventual end user
    - ✓ ultimate goal is delivery of maximum value to the end user
  - Supply chain
    - ✓ activities that get raw materials and subassemblies into manufacturing operation

Supply Chain Management

- Supply Chain Management (SCM)
  - Managing flow of information through supply chain in order to attain the level of synchronization that will make it more responsive to customer needs while lowering costs
    - ✓One goal in SCM: respond to uncertainty in customer demand without creating costly excess inventory
  - Keys to effective SCM
    - ✓information
    - ✓communication
    - ✓cooperation
    - ✓trust

Inventory Control

Huthaifa Khalil

Inventory Control

- Inventory systems are one of the most established subjects in engineering management, Focus on studying inventory dynamics, with inventory viewed as a buffer between supply production and customer demand.
- Inventory exists because of a mismatch between supply and demand.
- Inventory: Stock of items kept to meet future demand
- A high level of product availability requires large inventories, which raises supply chain costs.
- A balance must be achieved between the level of availability and the cost of inventory.
- However, it is a risk for highly customized products with short life cycles.

Inventory Control

- When the supply and demand is variable and uncertain the company should consider the following approaches:
  - Safety Inventory to guarantee the product availability
  - Product Substitution: use of one product (generally with higher value) to satisfy demand for a different product not in inventory
- Trade-off :
  - If responsiveness is a strategic competitive priority, a firm can locate larger amounts of inventory closer to customers.
    - ✓more inventory: greater responsiveness but greater cost
  - If cost is more important, inventory can be reduced to make the firm more efficient.
    - ✓ less inventory: lower cost but lower responsiveness

Inventory Control

- Purpose of inventory management:
  - how many units to order
  - when to order

- Types of Inventory
  - Raw materials
  - Purchased parts and supplies
  - Work-in-process (partially completed) products (WIP)
  - Items being transported
  - Tools and equipment

Inventory Control

- Inventory Costs:
  - Carrying cost
    - ✓ Cost of holding an item in inventory
  - Ordering cost
    - ✓Cost of replenishing inventory
  - Shortage cost
    - ✓ Temporary or permanent loss of sales when demand cannot be met

Inventory Control

- Inventory Control Systems:
  - Continuous system (fixed-order-quantity)
    - ✓constant amount ordered when inventory declines to predetermined level
  - Periodic system (fixed-time-period)
    - ✓order placed for variable amount after fixed passage of time

Inventory Control

- **The ABC Classification**
  - The ABC classification system is to grouping items according to annual sales volume, in an attempt to identify the small number of items that will account for most of the sales volume and that are the most important ones to control for effective inventory management.
  - The finished products classified into three categories:
    - ✓A: outstandingly important;
    - ✓ B: of average importance;
    - ✓ C: Relatively unimportant as a basis for a control scheme.

Inventory Control

- **The ABC Classification**
  - Each category can and sometimes should be handled in a different way, with more attention being devoted to category A, less to B, and less to C.

- Class A
  - ✓ 5 – 15 % of units
  - ✓ 70 – 80 % of value
- Class B
  - ✓ 30 % of units
  - ✓ 15 % of value
- Class C
  - ✓50 – 60 % of units
  - ✓ 5 – 10 % of value