

Industrial Engineering and Entrepreneurship

Definition/concept of Industrial Engineering

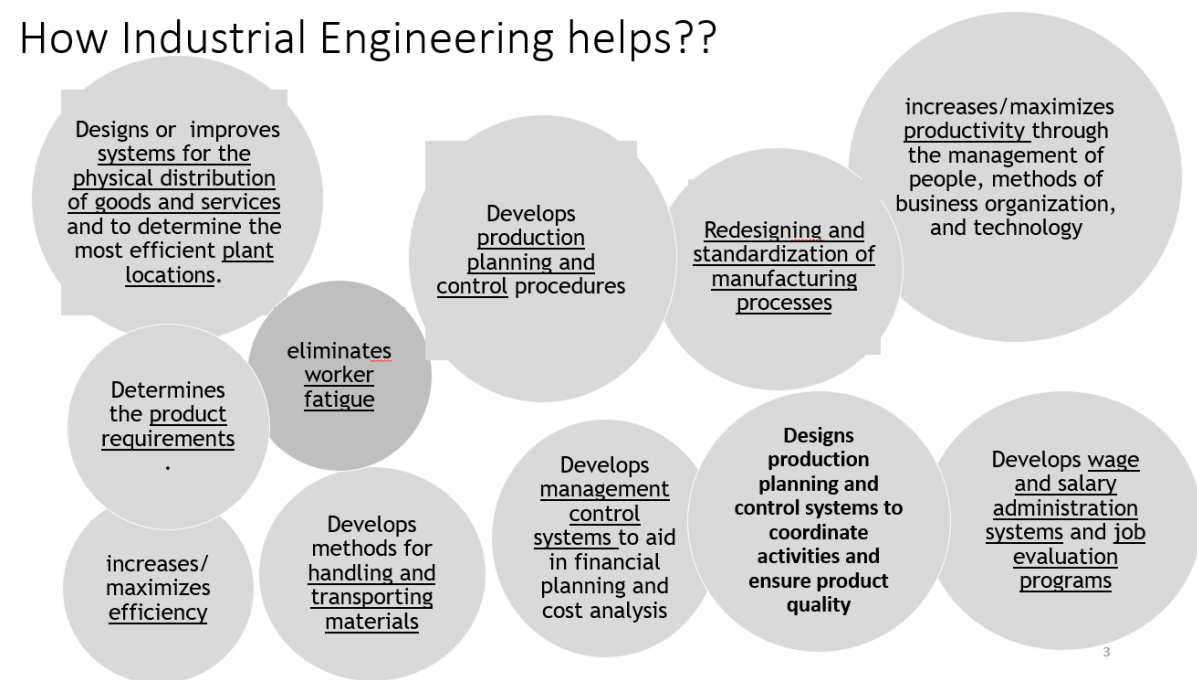
- The American institute of Industrial Engineers (AIEE) has defined the special field of industrial engineering as

“Concerned with the *design, improvement and installation of integrated systems of people, material, equipment and energy.*

- It draws upon the *specialized knowledge* and skill 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.
- The prime objective of industrial engineering is;
 - 1- To increase the productivity.
 - 2- Eliminating waste and non-value added activities.
 - 3- Improving the effective utilization of resources.

Uses of Industrial Engineering

How Industrial Engineering helps??



History of Industrial Engineering in brief...

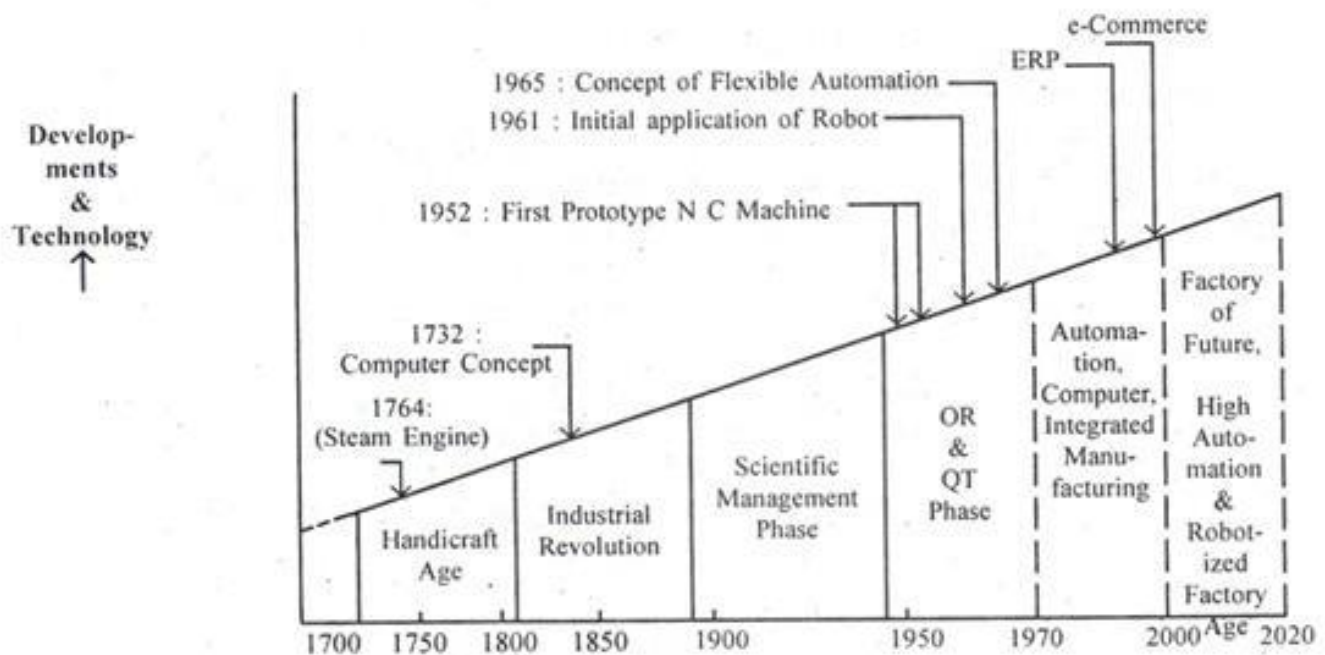
- It is linked with industrial revolution and passed through many phases to reach present advanced stage.
- Frederick Taylor is named as father of scientific management and industrial engineering.
- But before Frederick Taylor, Adam Smith gave concept of Division of Labour through his book *The Wealth of Nations*.
- Also James Watt, Boulton Mathew and Robinson obtained a place in the history of Industrial Engineering because of their work related with improvements in the performance of machines and industries.
- Period between 1882-1912 was the critical period in the history of Industrial Engineering.
- Important works during this period are;
 - Factory system, Owner, Engineer and Manager concept.
 - Equal work, equal pay and incentives.
 - Scheduling and Gantt Charts.
 - Engineers interest in cost control and accounting.

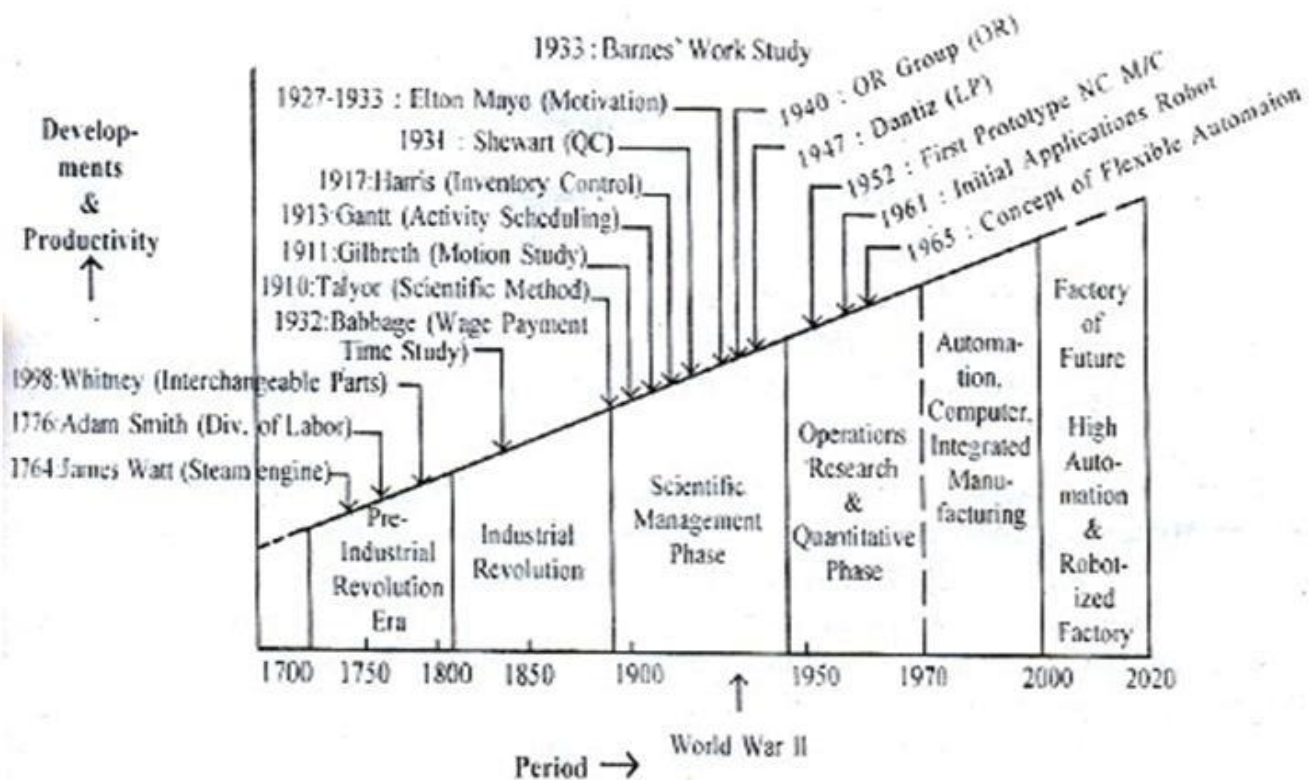
Contributions to Industrial Engineering

- Adam Smith (1776): through his book titled Wealth of Nations laid foundation to scientific manufacturing. Through his concept of division of labour which included the skill development, time savings and the use of specialized machine.
- James Watt (1864): Steam Engine advanced the use of mechanical power to increase productivity.
- Charles Babbage worked on the same line as Adam Smith.
- Frederick Taylor (1859-1915): was a mechanical engineer and initiated investigations of better work methods and develop an integrated theory of management principles and methodologies. He proposed following actions;
 - Data Collection and standards for workers.
 - Scientifically training of workers.
 - Cooperation between management and labour for better production.
 - Divide work between management and labour and assigning to those who are best suited.
- Henry L. Gantt (1993): His contributions are;

- Work in the area of motivation field, development of task and bonus plan.
 - Measurement of management results by Gantt Charts.
 - Recognition of social responsibility of business and industry.
 - Advocated training of workers by management.
- Frank and Lillian Gilbreth (1917): developed method study as a tool for work analysis.
- He developed micro-motion study, a breakdown of work into fundamental elements called therbligs.
 - Harrington Emerson(1913): Developed his managerial concepts simultaneously with Taylor, Gantt and Gilbreth.
 - Amongst his contributions is the Emerson’s Efficiency Bonus Plan, an incentive plan which guarantees the base day rate and pays a graduated bonus.
 - He also proposed twelve principles of efficiency.

8- L.H.C Tippet (1937): Developed the concept of work sampling to determine the equipment and manpower utilization and setting performance standards for long cycle, heterogeneous jobs involving team work.





Role Of Industrial Engineer

Who is an Industrial Engineer??

Industrial Engineers *plan, design, implement and manage integrated production and service delivery systems that assure performance, reliability, maintainability, schedule adherence and cost control.*

In carrying out various activities, the industrial engineer;

- Gathers and analyses facts.
- Prepares the alternative solutions taking into consideration all the constraints both internal and external.
- Selects the best solution for implementation.

- **Henry Ford introduced mass production to the world.**
- **Mass production is a process that increased the speed of making automobiles.**
- **Henry also introduced the car company called Ford.**
- **Henry Ford was an industrial engineer because he improved daily objects.**

Role of Industrial Engineer

- Advisor and consultant : interpret data, review, etc. for others.
- Advocate/Activist: promote actively a process or approach.
- Analyst: separate a whole/problem into parts and examine them to explore for insights and characteristics.
- Boundary spanner: bridge the information/interest gap between industrial Engineer and user.
- Motivator: Provide stimulus and skill to a group or individual.
- Decision maker: selecting a preference among many alternatives for topic of concern
- Designer/planner: Produce the solution specifications.
- Coordinator and integrator.
- Innovator/inventor: seek to produce a creative or advanced technology solution.
- Project Manager: operate, supervise and evaluate projects.
- Trainer/educator: in the skills and knowledge of Industrial engineering.
- Data gatherer.
- Negotiator.

Industrial Engineers work to make things better, be they processes, products or systems.

Typical focus areas include:

- Project Management.
- Manufacturing, Production and Distribution.

- Supply Chain Management.
- Productivity, Methods and Process Engineering.
- Quality Measurement and Improvement.
- Program Management.
- Ergonomics/Human Factors.
- Technology Development and Transfer.
- Strategic Planning.
- Management of Change.
- Financial Engineering.

Work spheres of Industrial engineers

- Aerospace & Airplanes
- Aluminum & Steel
- Banking
- Materials Testing
- Medical Services
- Military
- Ceramics
- Construction
- Consulting
- Mining
- Oil & Gas
 - Plastics and forming.
 - Electronics assembly.
 - Retail.
 - Energy.
 - Ship building.
 - Entertainment.

- State and federal Govt..
- Forest and logging.
- Transportation.

Company Goals

- Every company has its company goals.
- examples of company goals include:
 - Maintain growth of 10% net profit for each year.
 - Provide reliable products to customers.
 - Establish favorable image with public
 - Managers therefore make use of a company's resources to efficiently and effectively achieve the company goals.

Difference between policy, goals and objective

	Goal	Objective
Meaning	The purpose toward which an endeavor is directed.	Something that one's efforts or action intended to attain or accomplish; pur target.
Example	I want to achieve success in the field of genetic research and do what no one has ever done.	I want to complete this thesis on gene research by the end of this month.
Action	Generic action, or better still, an outcome towards which we strive.	Specific action - the objective support attainment of the associated goal.
Measure	Goals may not be strictly measurable or tangible.	Must be measurable and tangible.
Time frame	Longer term	Mid to short term

Difference between objectives and policies

Objectives

- Basic purpose:** Organizations are basically goal attainment instruments. **Objectives are the purposes for which the organization exists.** Without objectives organization would be purposeless and chaotic.
- Focus:** Objectives are the end toward which organizations / individual efforts are directed.
- Philosophy:** Objectives reflect management philosophy in a broad way. They summarize the pious intentions of management in a general way.

Policies

- Policies **are not basic to the existence of an organization.** However, without policies to guide decision executive thinking and organization actions are bound to be less optimal.
- Policies are the means for the achievement of goals. They help achieve the objectives in a consistent way.
- Policies provide meaning and content to objectives. They provide standing answers to recurring questions.

Difference between objectives and policies cont...

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|--|--|
| 1. Objectives are the goals to be achieved. | 1. Policies are the broadways of achieving business objectives. |
| 2. Objectives are the <i>foundations of a business</i> . A business without objective is like a directionless passenger who does not know where to go. | 2. Policies provide only the <i>means of reaching goals</i> . These may be essential but not indispensable. |
| 3. Objectives <i>decide the purpose of an organization</i> . They are the path setters for other actions. | 3. Policies are not of primary importance. These <i>only provide guideline for reaching the objectives</i> . |
| 4. Objectives are set at top level of management | 4. Policies are determinant at all levels of management |

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Management

Definition of Management

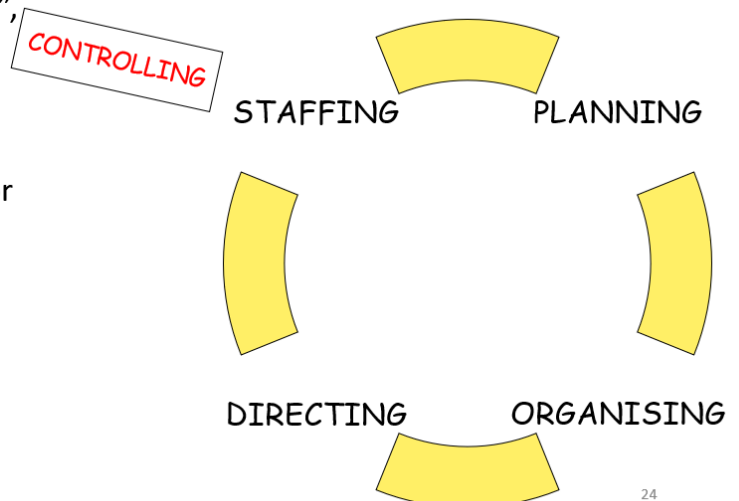
- Management can be defined as *the art of getting work done through people*, with satisfaction from employer, employees and the public.
 - To achieve the above, it is necessary to *guide, direct, coordinate and control human efforts towards fulfilment of enterprise goals*.
 - The *goals of the enterprise are fulfilled through utilization of resources like money, materials, people and machines*.
- Management may be called as Art as well as Science.
- The process of achieving **company goals** effectively and efficiently by engaging in the four major functions of **planning, organising, leading, and controlling** of company's resources.
- *Process designed to achieve an organization's objectives by using its resources effectively & efficiently in a changing environment.*

Resources include:

- Human resources e.g. employees
- Financial resources e.g. bank loan or investment from shareholders
- Physical resources e.g. machinery, inventory- raw materials, tools and spare parts
- Information resources e.g. knowledge

Management Process

- To manage is to forecast and plan, to organize, to command, & to control", Luther Gullick has given a keyword '**POSDCORB**'
- where P stands for Planning, O for Organizing, S for Staffing, D for Directing, Co for Co-ordination, R for reporting & B for Budgeting.
- But the most widely accepted are functions of management given by KOONTZ and O'DONNELL i.e. **Planning, Organizing, Staffing, Directing and Controlling.**



Process of Management



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- **PLANNING** ...Forecasting, decision making, strategy, formulation
policy-Making, programming, scheduling, budgeting
problem solving, innovation, investigation and Research
- . **ORGANISING**...Functionalization, divisionalization, departments,
Decentralization, activity, analysis, task, span of
management, task allocation
- STAFFING**..... Manpower planning, Recruitment, selection, training,
placement, compensation, promotion, appraisal
- DIRECTING**.....Supervision, motivation, communication, leadership.
- CONTROLLING**..... Fixation of standards, recording, measurement
reporting, corrective action.



Planning

Definition

Planning is deciding in advance what is to be done in the future.

“According to koontz and O ‘Donnell defines planning is deciding in advance what to do, how to do it, when to do it and who is to do it. Planning bridges the gap from where we are to where we want to go. It makes it possible for things to occur which would not otherwise happen”.

Features of planning

- ✓ Planning seeks to achieve certain objectives.
- ✓ Planning is oriented towards the future.
- ✓ Planning is a mental exercise
- ✓ Planning involves choices from alternatives.
- ✓ Planning is the basics for all other functions.
- ✓ It is a continuous function
- ✓ Planning is directed towards efficiency.

Steps in planning

- Collecting information about past.
- Defining objectives.

- Developing planning premises.
- Discovering alternative courses of action.
- Evaluating alternatives.
- Choosing the best alternatives.
- Defining subsidiary plans.
- Periodic revision and review of plans.

Advantages of planning

- It focuses attention on desired objectives.
- It helps to minimize risk.
- It improve efficiency.
- It avoids confusion.
- It encourage innovation and creativity.
- It enables co operation and group work.
- It serves as the basis of control.

Limitations

- Lack of accurate information.
- Time consuming.
- Expensive.
- Rigidity due to strict compliance with plans.
- Unwillingness to people change.
- External limitations(political).

Organizing

According to **Henri fayol** "To organize a business means to provide it with everything useful to its functioning-raw materials, tools, capital and personnel".

Steps in organizing

- Identifying the activities required for achieving objectives.

- Classifying these activities in to convenient groups
- Assigning the group of activities to appropriate persons.
- Delegating authority and fixing responsibilities.
- Coordinating Authority Responsibility relationship throughout the enterprise.

Importance of organizing

- Sound organization facilitate growth and diversification.
- Optimum use of human resources by matching work with talent.
- Maintain good harmonious structure in the office.
- Group activity is equivalent to social structure of organization.
- It is a mechanism of management and also means to direct, control and coordinate the activities of enterprise.

Staffing

Definition of Staffing

According to koontz and O Donnel “The managerial functions of staffing involves manning the organizational structure through proper and effective selection, appraisal and development of personnel to fill the roles designed in to the structure.

- It is concerned with the Human resources of the enterprise.
- It is concerned with acquiring, developing, utilizing and maintaining human resources.
- It is a process of matching jobs with individuals to ensure right man for the right job.

Steps in staffing

- Manpower planning.
- Recruitment, selection,placement.
- Training and development.
- Appraisal, promotion and transfer.
- Employee remuneration.
- Promotions & Transfer.

Features of staffing

- It is a function of management.
- It is an integral part of the process of management.
- It is concerned with the human resources.
- Aims at optimum utilization of human resources.

Importance of staffing

- It helps in discovering and obtaining competent employees for various job.
- It improve the quantity and quality of output by putting right man for right job.
- It improves job satisfaction of employees.
- It reduces cost of personnel by avoiding wastage of human resource.
- It facilitates the growth and diversification.

Directing

Definition

“Direction consist of the process and techniques utilized in using instructions and making certain that operations are carried out as planned”

- Motivating and leading employees to achieve organizational objectives.
- It is concerned with the execution of plans through organized action.
- It is also known as commanding or actuating

Controlling

Process of evaluating and correcting activities to keep organization on course,

- Measuring performance.
- Comparing performance against standards.
- Identifying and pinpointing any deviations from standards, if any.
- Investigating causes of deviations.
- Taking corrective action.

Characteristics of management

- Management is goal oriented. It achieves the organizational goals through co-ordination of the efforts of the personnel.
- It works as a catalyst to produce goods/services using labour, material and capital.
- Management is a distinct process comprising of functions (POSDC).
- Management represents a system of authority.
- Management harmonizes the individual's goals with the organizational goals.
- Management is a multi-disciplinary subject.
- Management is universal in character.

Importance of management

- No enterprise can survive without management.
- It co-ordinates activities of various departments in an enterprise and establishes team spirit among the people.
- It provides new ideas and vision to the organization to do better.
- It can only meet the challenge of change.
- Management tackles business problems and provides a tool for the best way of doing things.
- Management helps personality development thereby raising efficiency and productivity.

Difference and relationship between management, administration and organization

- Administration determines the objectives and policies of the enterprise, management carries out these policies to achieve objectives of the enterprise.
- For any administration and management to function effectively, there must be proper structuring of the enterprise and this known as organization (structure).
- Administration gives proper direction; it is a directing (or direction) function. Management properly executes; it is an execution function and organization is an effective machinery for accomplishing company objectives in a team spirit.
- In brief, it may be said that "*Management carries out the policies of administration through the framework of the organization*".

Levels of management

- Top management.
 - Upper middle management.
- Middle management.
- Lower management.

Operating force or Rank and file workman.

Top level management

- a) Board of Directors.
- b) Managing Directors.
- c) Chief executives.
- d) General Managers.
- e) Owners.
- f) Share-holders/Financiers.

Functions of Top management

- ✓ Setting basic goals and objectives.
- ✓ Expanding and contracting activities.
- ✓ Establishing policies.
- ✓ Monitoring performance.
- ✓ Designing/redesigning organization system.
- ✓ Shouldering financial responsibility.

Upper middle management

- Sales executive (manager).
- Production executive.
- Finance executive.
- Accounts executive.
- R&D executive.

Functions of upper middle management

- Establishment of the organization.
- Selection of staff for lower levels of management.

- Installing various departments.
- Designing operating policies and routines.
- Assigning duties to their subordinates, etc.

Middle management

- Branch managers.
- General foremen, etc.

Their functions include,

- To cooperate to run organization smoothly.
- To achieve co-ordination from different parts of the organization.
- To conduct training for employee development.
- To build an efficient company team spirit.

Lower management

- Foremen.
- Supervisors.
- Office superintendent.
- Inspectors, etc.

Their function include,

- Direct supervision of workers and their work.
- Developing and improving work methods and operations.
- Inspection function.
- Imparting instructions to workers.
- To act as a link as well as communication point between top management and operating force.

Operating force

- Workers.
- Rank and file workman.
- Skilled, semi-skilled and unskilled workers.

Their functions include,

- To do work on machines or manually, using tools, etc.

- To do work independently or under the guidance of supervisor.

Scientific management

Introduction to scientific management

- The purpose of the scientific management is to introduce a *rational, systematic approach to work and to the management of work*.
- The *primary emphasis* of scientific management was *on planning, standardizing and improving human effort* at the operative level in order to *maximize output with minimum input*.
- Scientific management is the result of *applying scientific knowledge and scientific methods to the various aspects of the management* and the problems that arise from them.

Contribution of F.W. Taylor

- Fredrick Winslow Taylor is known as the founder of scientific management.
- He laid the foundation for modern scientific management between 1880 and 1890.
- Taylor tried to work out some system whereby the interests of management and the workers may be the same.

The various contributions of Taylor were as follows,

- He developed the *principle of breaking a task/job into elements* for timing the same.
- He involved himself in exploring the causes of inefficiency and labour difficulties in the industry.
- Through time studies he experimented to recognize losses of efficiency in industrial operations.
- He evolved certain principles of - investigating work on scientific basis, selecting the best worker for a task and training him\her further to acquire desired skill, developing co-operative spirit between management and workers, etc. which led to the concept of scientific management.
- He undertook *studies on fatigue incurred by the workers* and the *time necessary to complete a task*.
- He *developed functional organization* in which one foreman was made in charge for each function.
- He *established work standards* through investigations done by time studies.
- He introduced and operated various costing systems.

- He suggested a wage *incentive scheme* known as *Taylor's differential piece rate plan*.

The Scientific Principles of Management by F.W.TAYLOR

➤ **I – Science, not Rule of Thumb**

- Taylor mentioned that the rule of thumb should be replaced by scientific knowledge. While rule of thumb emphasizes mere estimation, scientific method denotes precision in determining any aspect of work. This should be done with the help of careful scientific investigation.

II –Harmony, not discord

- Taylor emphasized that harmony rather than discord should be obtained in group action. Harmony means that a group should work as a unit and contribute to the maximum. Within it there should be mutual give and take situation and proper understanding.

➤ **III Cooperation, not individualism**

- Scientific management requires that parts of industrial body co-operate with each other, scientific management is based on mutual confidence, co-operation and goodwill. It requires a complete mental revolution on the part of both workers and management.

IV - The Development of each man to his greatest efficiency and prosperity

In order to maximize production all possible efforts are made to increase the efficiency of workers. Workers are selected according to the nature of work. It includes

- a) Scientific training
- b) Scientific allotment of work
- c) Implementation of incentive wage plan above all,
- d) Development of workers to the fullest extent for themselves and also for the companies highest prosperity.

• **V - Separate Planning from Execution.**

"In almost all the mechanic arts the science which underlies each act of each workman is so great and amounts to so much that the workman who is best suited to actually doing the work is incapable of fully understanding this science.." To apply this solution, Taylor created planning departments, staffed them with engineers, and gave them the responsibility to:

1. Develop scientific methods for doing work.
2. Establish goals for productivity.
3. Establish systems of rewards for meeting the goals.

4. Train the personnel in how to use the methods and thereby meet the goals.

VI - Most strongly propagated Incentive Wage System

Taylor for the first time advocated an incentive wage system in the form of differential piece wages instead of time wages. Under differential piece system two wage rates are prescribed, i.e. one lower and the other higher. Those who are unable to perform standard work within standard time are paid wages at lower rate per unit.

Contribution of Henry Fayol (1841-1925)

- Henri Fayol, the *father of principles of management* was born in 1841 in France and graduated as a mining engineer in 1860 from the national school of Mining at St. Etienne.
- In contrast to Taylor's emphasis on first line supervision in production areas, *Fayol's work was concerned with the highest levels of organization.*
- Fayol analyzed the process of management and he concluded that the business enterprise can be divided into six groups.
 - Technical activities (production, manufacturing, adaptation).
 - Commercial activities (buying, selling, exchange).
 - Financial activities (optimization of capital).
 - Security activities (protecting of property and persons).
 - Accounting activities (stock taking, balance sheet, costs, statistics)
 - Managerial activities (planning, organizing, controlling, coordinating and directing).

The principles laid down by Henri Fayol were as follows,

- Division of work.
- Authority and responsibility.
- Discipline.
- Unity of command.
- Unity of direction.
- Subordination of individual to general interest.
- Remuneration.
- Centralization of authority.
- Scalar chain.

- Order.
- Equity of treatment.
- Stability.
- Initiative.
- Esprit de corps...

- **Division of work:** it means dividing the work on the principle that different workers are best fitted for different jobs depending upon influences arising from geography, natural conditions, personal aptitude and skills.
- **Authority and responsibility:**
 - Authority and responsibility must go together, hand in hand and must be related.
 - Responsibility without authority or vice-versa is meaningless.
- **Discipline:**
 - It is absolutely necessary for efficient functioning of all enterprises.
 - It may be defined as respect for agreement that are directed at achieving obedience, application and the outward marks of respect.
- **Unity of command:**
 - It means that, employees should receive orders and instructions from one boss only.
 - Unity of command avoids confusion, mistakes and delays in getting the work done.
- **Unity of direction:**
 - Unity of direction implies that there should be one plan and one head for each group of activities having the same objective.
 - In other words it implies that there should be one common plan for an enterprise as a whole.

6. Subordination of individual to general interest:

- a) The interest of an individual should not be permitted to supersede or prevail upon for general interests of the enterprise.
- b) This is necessary to maintain unity and to avoid friction among employees.

7. Remuneration:

- a) It is the price paid to the employees for the services rendered by them for the enterprise.
- b) Remuneration should be fair and bring maximum satisfaction to both employee and employer.

8. Centralization of authority:

- a) It means that the authority is in the hands of center and not dispersed among sections.
- b) The degree of centralization is decided by keeping in view the nature, size and complexity of the enterprise.

9. Scalar chain:

- a) Managers may be regarded as chain of superiors. There should be unbroken line of authority and command through all levels from the highest to the lowest rank

10. Order:

- a) This promotes the idea that everything and everyone has his place in the organization.

11. Equity of treatment:

- a) Managers should have fair, kind and be just while dealing with all subordinates.
- b) This will make the employees more loyal and devoted towards management/enterprise

12. Stability:

- a) Stable and secure work force is an asset to the enterprise.
- b) Instability is a result of bad management.

13. Initiative.

- a) Managers should permit and encourage subordinates to take initiative.

14. Esprit de Corps:

- a) It emphasizes the need for teamwork among the employees and shows the importance of communication in obtaining such team work.

