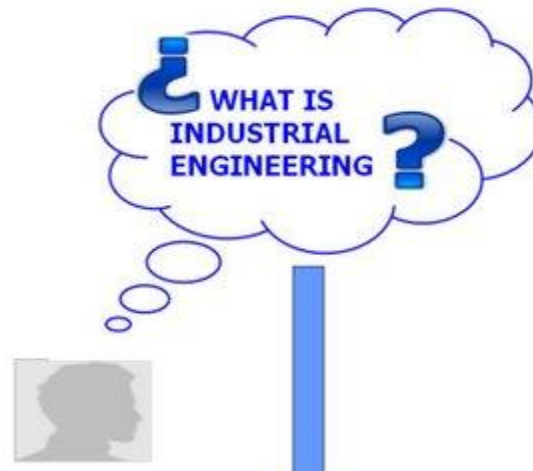


INDUSTRIAL ENGINEERING & ERGONOMICS (ME 392)



Industrial Engineering Defined

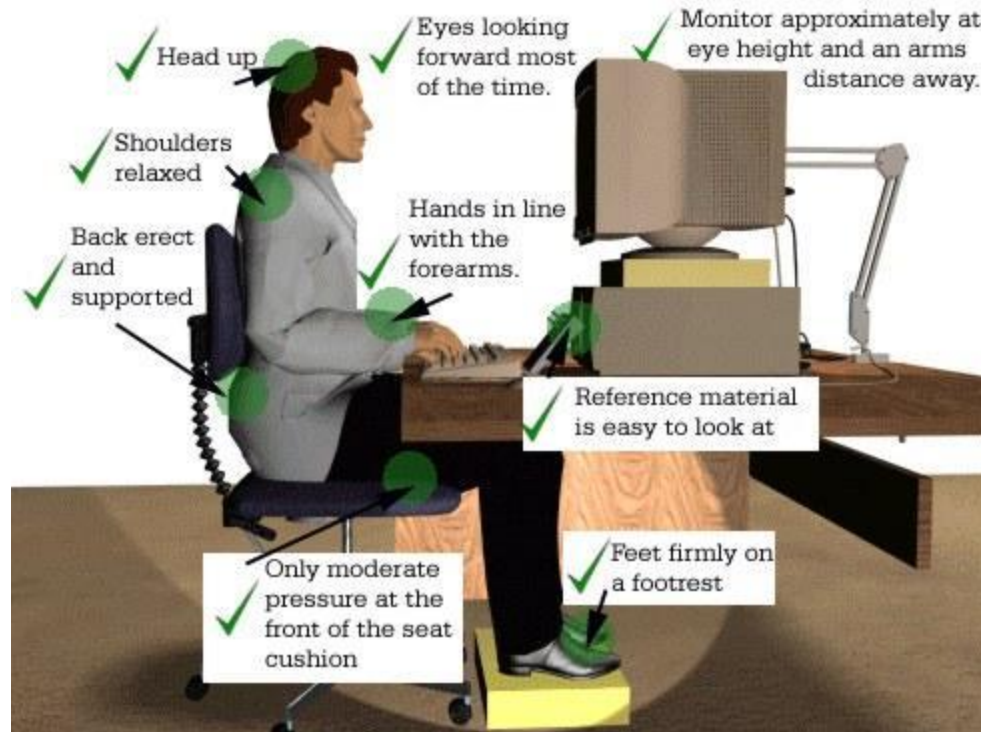
- **Industrial Engineering** is defined by the Institute of Industrial Engineers as :
- A **branch of Engineering** “concerned with the **design, installation, and improvement** of integrated systems of **people, material, equipment, and energy**.”
- It draws on **specialized knowledge** and **skills** 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.”

Basic Objectives



Ergonomics Defined

-The science of fitting
a job to a worker.



- It is mainly concerned with the field of the human operator and his working environment.



Course Overview

1. **Methods Engineering**- Planning, methods study, standardisation,

work measurement, control .
2. **Forecasting: Quantitative & Qualitative** -Times series models –Jury of executive opinions, Delphi methods, naïve, moving averages, trend projection, exponential smoothing etc
3. **Layout and Material Handling** - Product and Process layouts and Material Handling
4. **Ergonomics** — Psychological components of job design, labour standards
5. **Total Quality Management & Inventory Systems**



Course Objectives

Upon completion of this course, you would be able to:

1. State the basics of methods engineering;
2. Explain and apply approaches to forecasting and forecasting techniques;
3. Explain facility layout techniques (Process and Product Layout) and the techniques for their optimisation, and the role of material handling systems in them;
4. Explain ergonomics, describe work station design and job design;
5. Explain the techniques of total quality management and inventory planning and control.

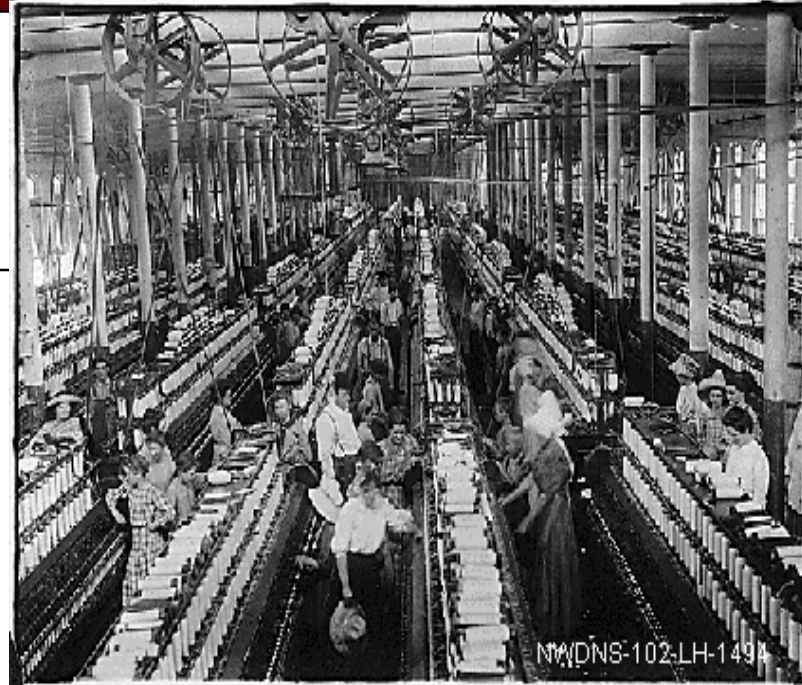


Reading List

1. Barry Render and Jay Heizer (1995), Principles of Operations Management: Building and Managing World Class Operations.
2. Benjamin Niebel (1982), Motion and Time Study, Richard Irwin INC, USA
3. Fred Meyers, (1999), Motion and Time Study for Lean Manufacturing, Prentice Hall Press, 2nd Edition.
4. Fred Meyers and Matthew Stephens (?) Manufacturing Facilities Design and Material Handling
5. David Osborne (1985), Ergonomics at Work, Wiley & Son Ltd, New York

BACKGROUND

- ❑ The advent of **industrial engineering** is frequently associated with the **industrial revolution** (1760-1820).
- ❑ It was during this period that household production was replaced by production in factories.





BACKGROUND-INDUSTRIAL REVOLUTION -1

Before the Industrial Revolution: **every thing was done manually.**

E.g. Clothing and textiles, furniture, tools for working on farms etc

- **Distributions:** Goods produced could only be distributed in the locality in which they were produced;
- **Communication:** Messages had to be sent through travelers to other countries;
- **Fuel:** Wood was being used as fuels;
- **Transportation:** horses were used

Limitations of producing everything manually??



Limitations of Producing Manually

BACKGROUND-INDUSTRIAL REVOLUTION -2

Industrial Revolution (IR): Brought a transition to new production and manufacturing processes

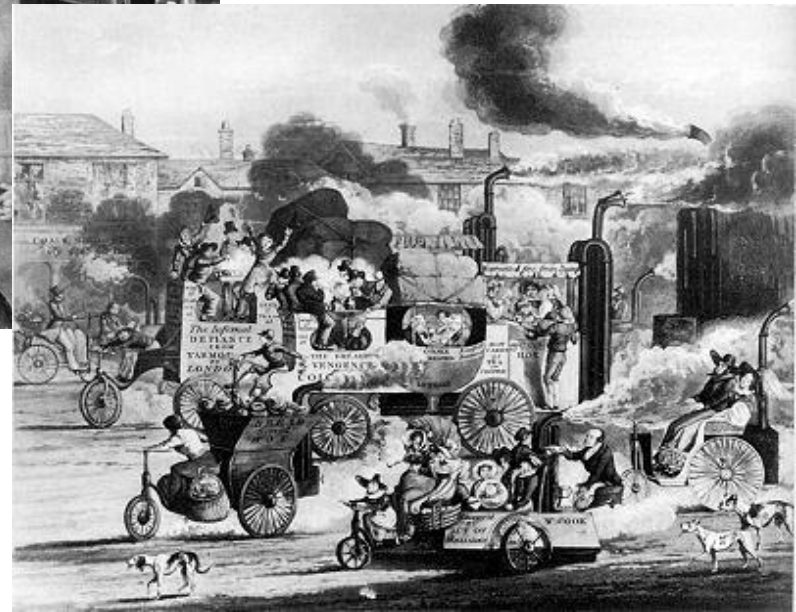
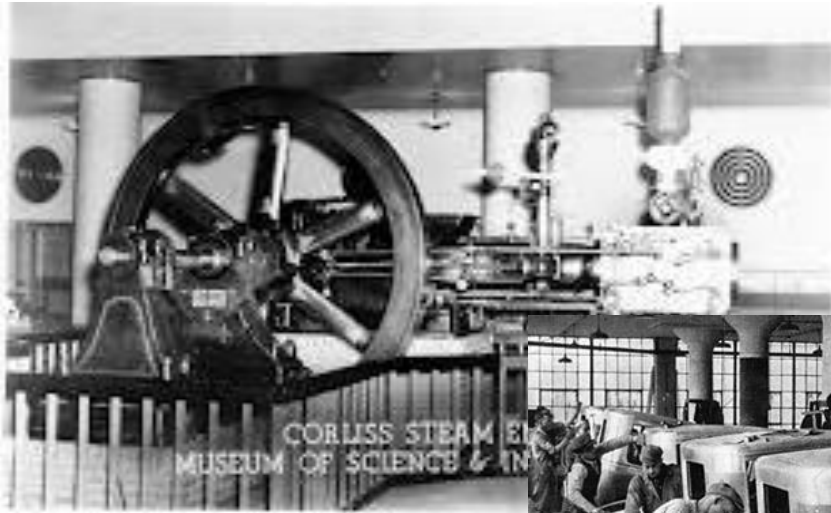
- Business men harnessed the power of rivers and streams to mechanise particular sectors
- Three main **innovations** were associated with the **IR**:
 - **Mechanised cotton spinner** powered steam or water
 - The **efficiency of steam engines** improves so that they no longer required a lot of fuel.
 - **Charcoal was substituted for coke with** for iron making (reduced fuel costs)

BACKGROUND-INDUSTRIAL REVOLUTION -3

- A gentleman by name **Samuel Slater** stole the technology and travelled to America.
- Today, almost everything is being mechanised:
 - Shoe manufacturing
 - Food manufacturing
 - Automobile manufacturing
 - Electronics manufacturing
 - Fuel production

What can we say about Ghana and manufacturing?

Effects of Industrial Revolution





Industrial Revolution – A Video

<http://www.youtube.com/watch?v=d4joqYycnqM>

BACKGROUND-IE - 1

- Frederick Winslow Taylor : founder of Industrial Engineering and Scientific Management.
- His pioneering work in:
 - design,
 - measurement planning and scheduling (1880-1915)
 - This work was the impetus for the conceptualising and growing industrial engineering.



BACKGROUND – IE- 2

- ❑ **Taylor** introduced the concept of, methods engineering, time study, tool standardization, costing methods, employee job selection, and incentives, among others.
- ❑ Frank and Lilian Gilbreth also made significant contributions to IE



BACKGROUND – IE- 3

Frans & Lillian critiqued the formulation of IE & SM provided by Winslow

According to the couple:

- The formulation of IE and SM provided by Winslow would be difficult to follow and,
- was also incomplete because it did not consider the human element on the shop floor.

The Gilbreth's are also recognised with the introduction of 'therbligs'

The term 'classical' has been applied to the traditional industrial engineering activities of Fred W. Taylor and Frank and Lillian Gilbreth.



Effective Industrial Engineer

- Has **capability of evaluating and utilizing** the appropriate **classical and more sophisticated management-science operations research** techniques in solving unstructured real life problems.
- Has good **interpersonal skills** and be very observant.



Classical Activities - 1

Industrial engineering is similar to civil, electrical and chemical

- IE is concerned with analysis and design
- the application of laws and material of nature for useful and constructive purposes.

IE is also **different** because it is concerned with equipment and systems in which people are an integral part.

An **industrial engineer must be able to integrate people** into designs and must know their physical, physiological and psychological and other characteristics –singly or in groups.

Activities

□ The early, and still major, activities if industrial engineers include

- work methods analysis and improvement,
- work measurement and the establishment of standards, wage rates and incentives
- job and workplace design,
- plant layout, assembly line balancing
- material handling,
- cost reduction
- production planning and scheduling,
- inventory control,
- maintenance scheduling, equipment evaluation,
- overall productivity improvement

Activities

- ❑ All these activities were done, almost exclusively in the early days, in manufacturing industries.
- ❑ As technology evolved, additional activities were added to this list. These include:
 - Machine tool analysis,
 - Numerically controlled machine installation and programming,
 - Linear programming
 - Queuing theory



Activities

- Simulations,
- Management information systems,
- Human/machines systems design,
- Ergonomics,
- Biomechanics, and
- the use of robots and automation



Activities

Industrial engineering techniques that were used to successfully run a factory could also be applied

- in the office,
- laboratory,
- classroom,
- hospital (including the operating room),
- banks,
- the government, the military and,
- other non-industrial sectors.

Activities

- ❑ The production function is **dynamic by its inherent** activities .
- ❑ Traditional industrial engineers are frequently called upon to determine the impact of product mix variances, and equipment additions or deletions on facilities arrangement and line balancing on the manufacturing area.

Activities

- ❑ The production function has **become more complex** with the additional energy computations and pollution level considerations.
- ❑ As a result, it is almost impossible to evaluate manually;
- ❑ However, through the use of simulation on a computer, answers to “what if” types of questions which provide significant inputs to the decision maker are able .



METHODS ENGINEERING

- A technique used by progressive management to improve productivity and reduce costs in both direct and indirect operations of manufacturing and non-manufacturing business organisations.
- Methods engineering is applicable to any enterprises where human effort is required.

METHODS ENGINEERING

- ❑ It can be defined as the **systematic procedure** for subjecting all direct and indirect operations to **close scrutiny** in order to **introduce improvements** that will make work easier to perform and will allow work to be done smoother, in less time, with less energy, effort, and fatigue, and with less investment per unit.
- ❑ The ultimate objective of methods engineering is **profit improvement**.



METHODS ENGINEERING - OBJECTIVES

Main Objectives:

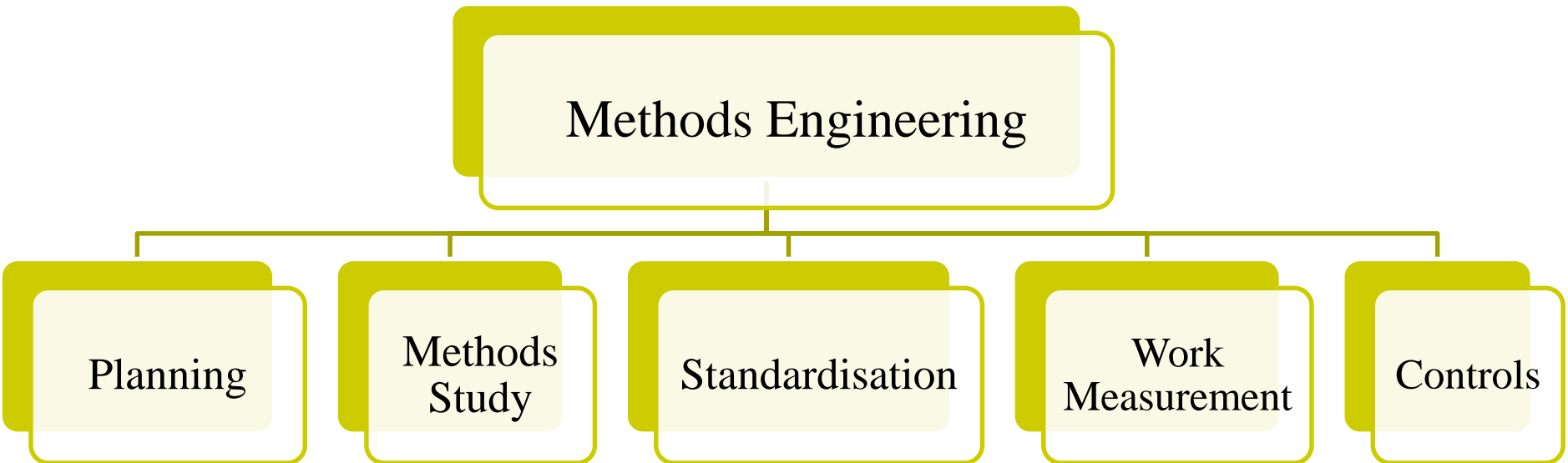
- Increase productivity and efficiency
- Reduce cycle time
- Reduce product cost
- Reduce labor content

Other Objectives :

- Improve customer satisfaction
- Improve product and/or service quality
- Reduce lead times and improve work flow
- Increase flexibility of work system
- Improve worker safety
- Apply more ergonomic work methods
- Enhance the environment (both inside and outside the facility)

METHODS ENGINEERING

- Methods engineering includes five activities:





PLANNING

- Identify the amount of time that should be spent on a project so as to get as much of the potential savings as is practical.



METHODS STUDY

Through methods study:

- What is currently being done is observed;
- Better ways of executing functions are developed.



STANDARDISATION

- ❑ The standardisation phase includes training of the operator to follow the standard method.
- ❑ Standardisation of
 - equipment,
 - methods, and
 - working conditions .

WORK MEASUREMENT

- The number of standard hours in which operators, working on standardised job or working with standardised method is determined by measurement.
- Work Measurement methods
 - stop-clock time studies
 - Work sampling

CONTROLS

- ❑ The established method is periodically audited, and various management controls are adjusted with the new time data.
- ❑ The system may include a plan for compensating labour that encourages attaining or surpassing a standard performance.

METHODS ENGINEERING

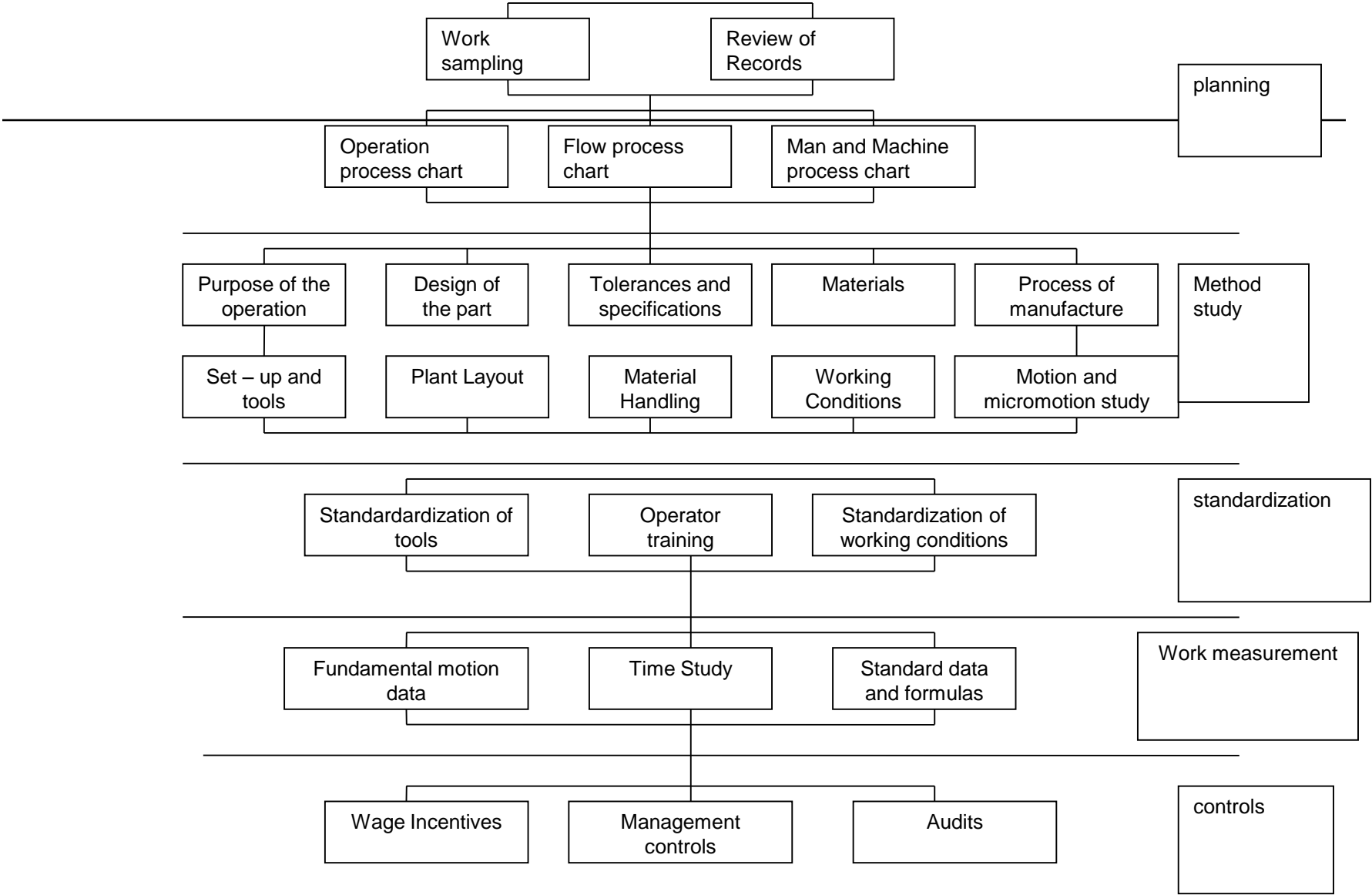


Fig. 1 – Elements of Methods Engineering