

Introduction to Industrial Engineering

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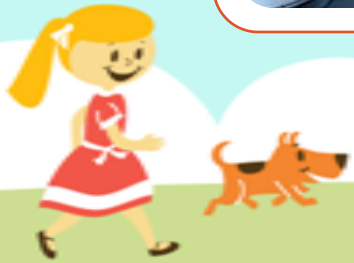
What is Engineering ?
What is Industry ?





Engineering

The application of scientific and mathematical principles to practical ends such as the design, manufacture, and operation of efficient and economical structures, machines, processes, and systems.





Industry

1. (Economics) organized economic activity concerned with manufacture, extraction and processing of raw materials, or construction.
2. (Business / Commerce) a branch of commercial enterprise concerned with the output of a specified product or service.



History of Industrial Engineering

Charles W. Babbage, a mathematics professor

- *Book : The Economy of Machinery and Manufacturers* in 1832.
- Developing **the learning curve, the division of task** and how learning is affected, and the effect of learning on the generation of waste.

Henry R. Towne and Fredrick A. Halsey

- Developing **wage incentive plans** to the ASME (American Society of Mechanical Engineers) increase the productivity of workers without negatively affecting the cost of production.

Fredrick Winslow Taylor

- The best known of **the pioneers in industrial engineering**. He was done potential improvements to be gained through analyzing the work content (minimum amount of work required to accomplish the task) of a job and designing the job for maximum efficiency.

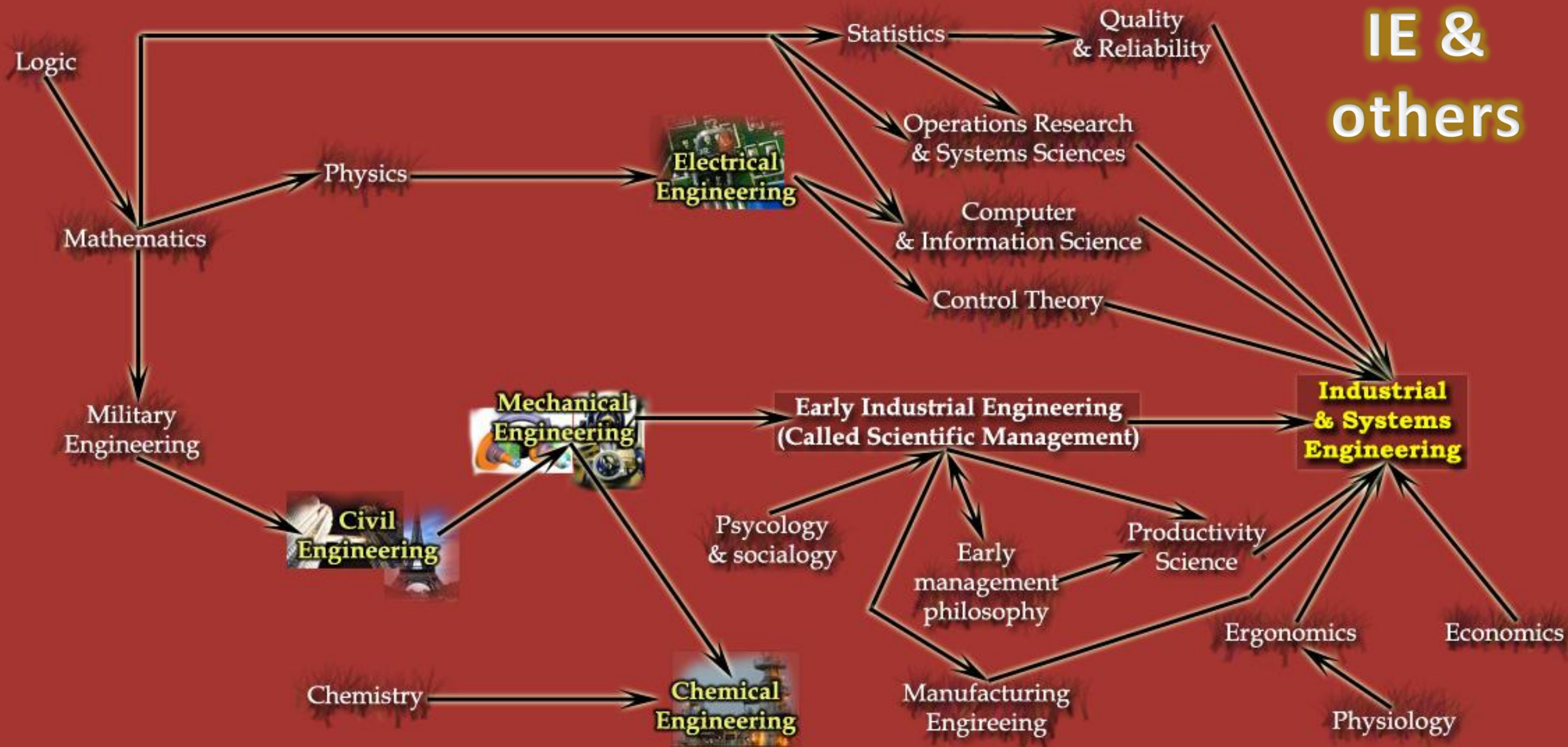
Frank Bunker Gilbreth and his wife Dr. Lillian M. Gilbreth

- Worked on understanding **fatigue, skill development, motion studies**, as well as time studies.

Henry L. Gantt

- Developing cost, selection of workers, training, good incentive plans, and scheduling of work. He is the originator of **the Gantt chart**.

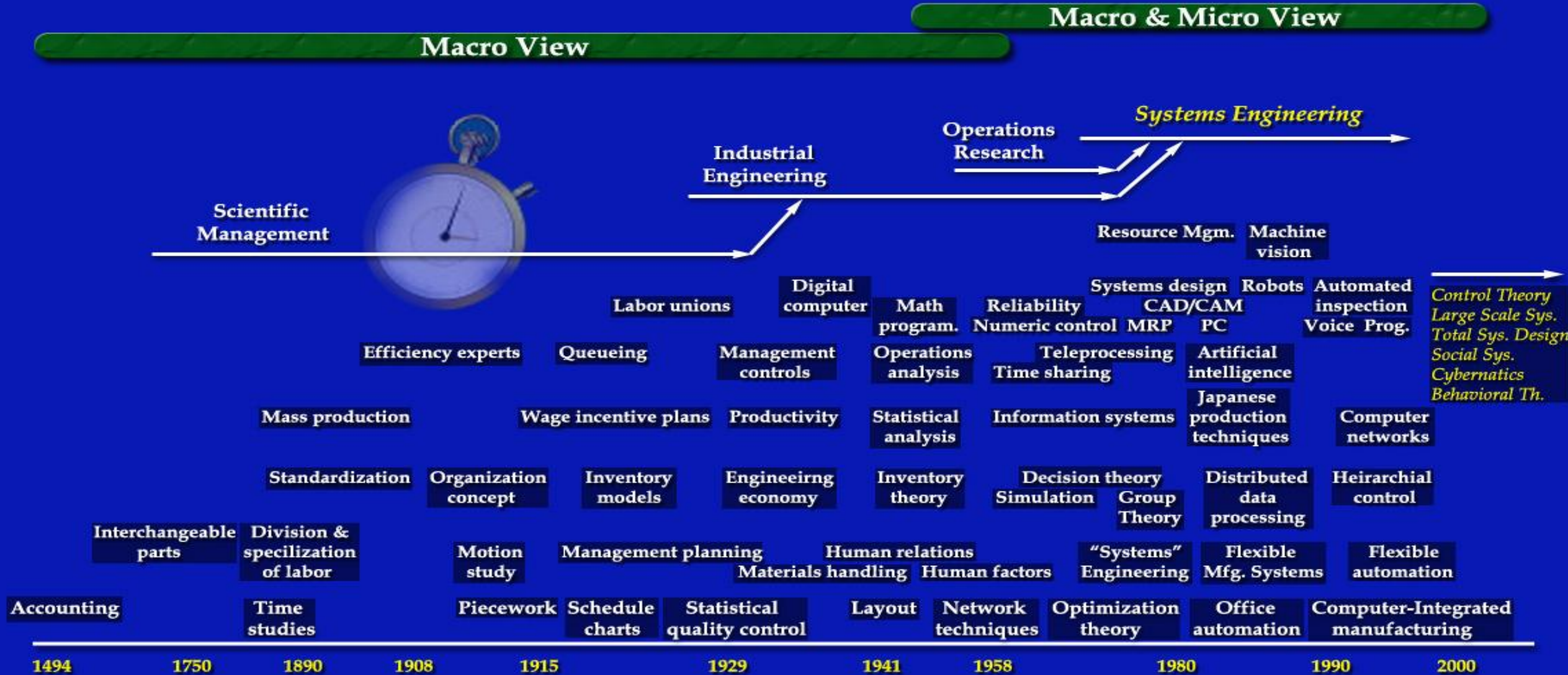




IE & others

Industrial & Systems Engineering

Chronology of significant events and developments in the evolution of "INDUSTRIAL & SYSTEMS ENGINEERING"

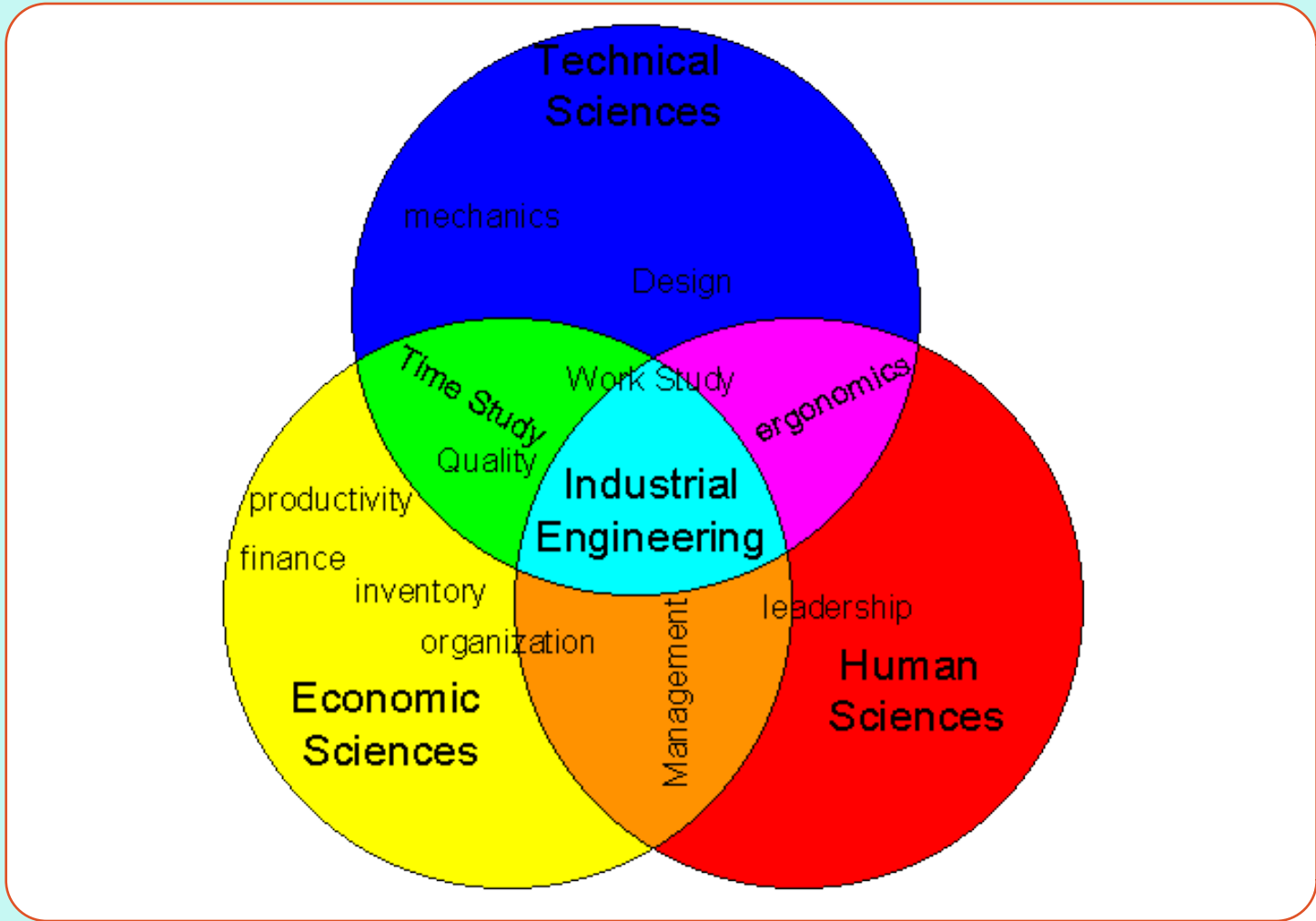


Industrial Engineering (IE) is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical and social sciences together with the principles and methods of engineering analysis and design to specify, predict and evaluate the results to be obtained from such systems.

Definition of Industrial Engineering

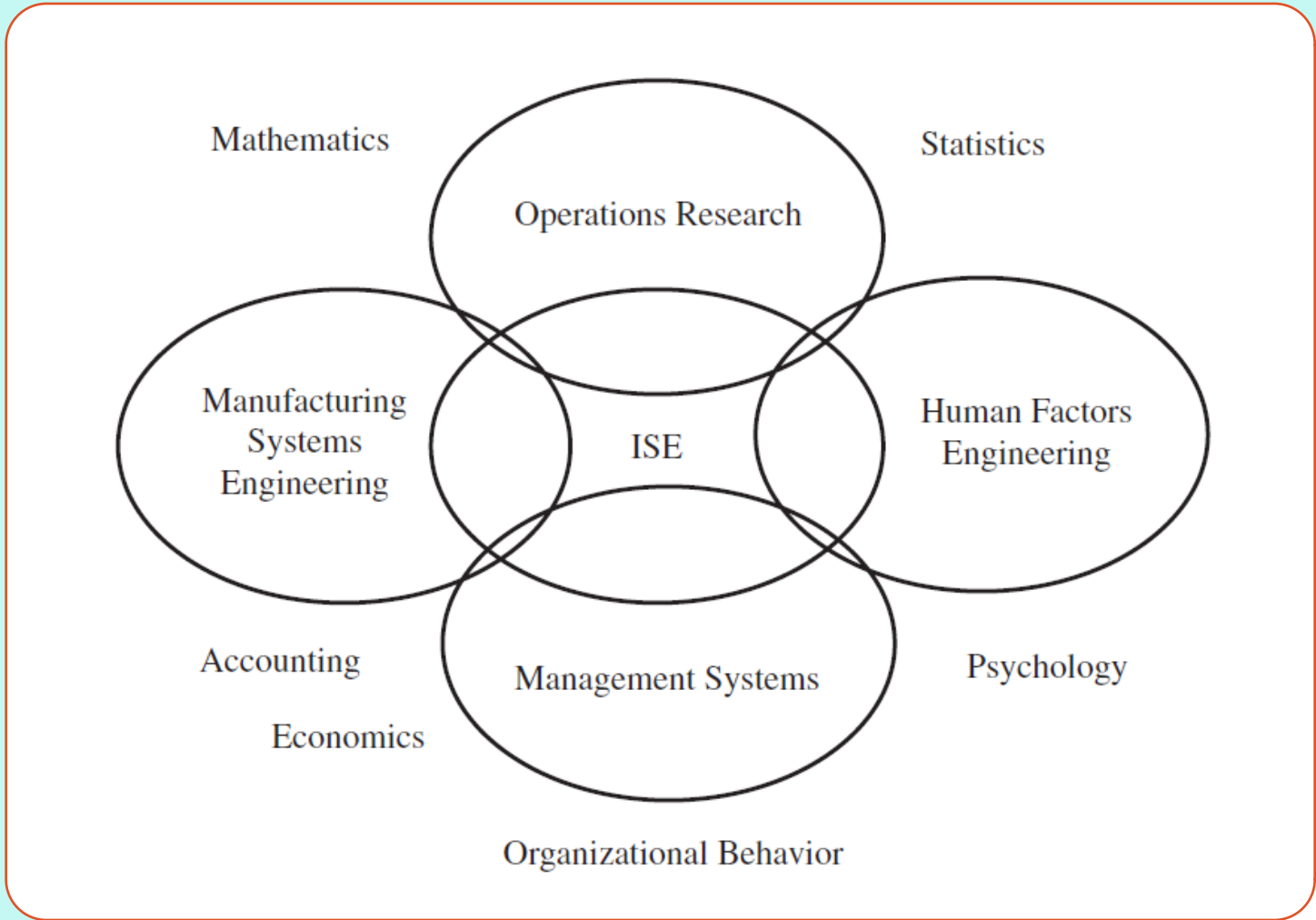
(Based on Institute of
Industrial Engineering)





Academics Domain of IE





Academics Domain of IE



DIVERSITY

- IE is a **diverse (various) discipline** concerned with the **design, improvement, installation, and management of integrated systems** of people, materials, and equipment for all kinds of manufacturing and service operations.
- IE is concerned with **performance measures and standards, research of new products and product applications, ways to improve use of scarce (limited) resources and many other problem solving adventures.**
- An Industrial Engineer may be employed in **almost any type of industry, business or institution, from retail establishments to manufacturing plants to government offices to hospitals.**



Efficient and Effective

- Industrial engineers determine **the most effective ways** for an organization to use the basic factors of production - people, machines, materials, and energy. They are more concerned with people and methods of business organization than engineers in other specialties.
- To **solve** organizational, production, and related problems **most efficiently**, industrial engineers **design data processing systems and apply mathematical analysis** such as operations research.
- They also **develop management control systems** to help in financial planning and cost analysis, design production planning and control systems to coordinate activities and control product quality, and design or improve systems for the physical distribution of goods and services.
- Industrial engineers **conduct surveys** to find plant locations with **the best combination** of raw materials, and transportation.
- They also **develop wage and salary administration systems and job evaluation programs**.



Activities of IE

- ✓ Install data processing, management information, wage incentive systems.
- ✓ Develop performance standards, job evaluation, and wage and salary programs.
- ✓ Research new products and product applications.
- ✓ Improve productivity through application of technology and human factors.
- ✓ Select operating processes and methods to do a task with proper tools and equipment
- ✓ Design facilities, management systems, operating procedures
- ✓ Improve planning and allocation of limited resources
- ✓ Enhance plant environment and quality of people's working life
- ✓ Evaluate reliability and quality performance
- ✓ Implement office systems, procedures, and policies
- ✓ Analyze complex business problems by operations research
- ✓ Conduct organization studies, plant location surveys, and system effectiveness studies
- ✓ Study potential markets for goods and services, raw material sources, labor supply, energy resources, financing, and taxes.



Impact of Operations Research in Industry

- The development of IE has been greatly influenced by the impact of an analysis approach called operations research.
- This approach originated in England and the United States during 2nd World War and was aimed at solving difficult war-related problems through the use of science, mathematics, behavioral science, probability theory, and statistics.
- This approach is used to determine the optimal solution from some alternatives.
- Give your example about application of OR in your daily life !



Impact of Digital Computers in Industry

- Another development that had a significant impact on the IE profession is the digital computer. Digital computers permit the rapid and accurate handling of huge quantities of data, so permitting the IE to **design systems for effectively** managing and controlling large, complex operations.
- The digital computer also permits the IE to **construct computer simulation models of manufacturing facilities** in order to evaluate the effectiveness of alternative facility configurations.
- Computer simulation is emerging most widely used IE technique. The development and widespread utilization of personal computers is having an exciting impact on the practice of industrial engineering.





Emergence of Service Industries

- In the early days of the IE profession, IE practice was applied almost fully in manufacturing organizations. After the 2nd World War there was a growing awareness that the principles and techniques of IE were also applicable in **non-manufacturing environments**.
- Thousands of Industrial Engineers are employed by government organizations to increase efficiency, reduce paperwork, design computerized management control systems, implement project management techniques, monitor the quality and reliability of vendor-supplied purchases, and for many other functions.



Professional Ethics of an Engineer



Professional Ethics

- Engineering ethics is the study of the moral values, issues, and decisions involved in engineering practice.
- Morality is reasons centered in respect for other people as well as for ourselves, reasons that involve caring for their good as well as our own.
- Engineers are frequently involved in decisions that have a reflective (deep) effect on society.
 - The design of particular devices almost always involves the safety of the user.
 - The design and location of a factory affect the community and its citizens.
 - The design of a management system greatly affects the individuals working for the organization – their comfort, their sense of worth, their financial status, and so on.
- The engineering profession enjoys a very favorable status regarding its devotion to professional ethics.



Illustrative Cases

- An inspector discovered faulty construction equipment and applied a violation tag, preventing its continued use. The inspector's supervisor, a construction manager, viewed the case as a minor violation of safety regulations and ordered the tag to be removed so the project would not be delayed. The inspector objected and was threatened with disciplinary action. The continued use of the equipment led to the death of a worker on a tunnel project.
- An electric utility company applied for a permit to operate a nuclear power plant. The licensing agency was interested in knowing what emergency measures had been established for human safety in case of reactor break down. The utility engineers described the alarm system and arrangements with local hospitals for treatment. They did not emphasize that these measures applied to plant personnel only and that they had no plans for the surrounding population. "That is someone else's responsibility, but we don't know whose," they answered upon being questioned about this.



Illustrative Cases

- A chemical plant dumped wastes in a landfill. Dangerous substances found their way into the underground water table. The plant's engineers were aware of the situation but did not change the disposal method because their competitors did it the same cheap way, and no law explicitly forbade the practice. Plant supervisors told the engineers it was the responsibility of the local government to identify any problems.
- The ABC Company began selling its latest high-tech product before it had been fully checked out in beta tests that are, used on real applications by a group of knowledgeable users. It was not really ready for distribution, but clients were already tempted to this product by glossy advertising designed to win the market by being first to capture clients' attention.
- *These examples show how ethical problems arise most often when there are differences of judgment or expectations as to what constitutes the true state of affairs or a proper course of action.*





ENGINEERING CODES OF ETHICS

- The Canon (standard) of Ethics provided by the Accreditation Board for Engineering and Technology (ABET).



THE FUNDAMENTAL PRINCIPLES

Engineers support and advance the truth, honor and dignity of the engineering profession by:

- Using their knowledge and skill for the enhancement of human wellbeing;
- Being honest and neutral, and serving with loyalty to the public, their employers and clients;
- Striving to increase the competence and prestige (status) of the engineering profession;
- Supporting the professional and technical societies of their disciplines.



Homework

1. What is system? What is the 5Ms of manufacturing?
2. Choose a company, and mention its 5Ms of manufacturing!
3. Draw the relationship for the components using mind mapping!



Branding



Syllabus of Introduction to Industrial Engineering

- Wk 1-5 : Performance Improvement Management
- Wk 7-10 : Management-Planning-Design-Control
- Wk 12-14 : Methods for Decision Making

Wk	Subject	Wk	Subject
1	Introduction to IE	9	Facilities and Layout Design (Salvendy Ch.4D)
2	Industrial System Engineering	10	Quality (Salvendy Ch.4F)
3	Organization and Manpower Management (Salvendy Ch.3A)	11	2 nd QUIZ
4	Human Factors and Ergonomics (Salvendy (Ch.3B)	12	Statistics for Engineers (Salvendy Ch.5A)
5	Work Design and Measurement (Salvendy Ch.4C)	13	Economic Evaluation (Salvendy (Ch.5B)
6	1 st QUIZ	14	Optimization and Simulation (Salvendy Ch.5D)
7	Project Management (Salvendy Ch.4A)	15	Final Project & Presentation
8	Production Planning and Control (Salvendy Ch.4E)	16	Final Project & Presentation



References

- Salvendy, Gavriel. *Handbook of Industrial Engineering*. New York: John Wiley & Sons. 2001.
- Wignjosoebroto, Sritomo. *Pengantar Teknik dan Manajemen Industri*. Jakarta: Guna Widya. 1996.
- Turner, Wayne C., et.al. *Introduction to Industrial and Systems Engineering*. Englewood Cliffs, N.J.; Prentice-Hall, Inc. 1993.



Almost all quality improvement comes via simplification of design,
manufacturing... layout, processes, and procedures.

(Tom Peters)