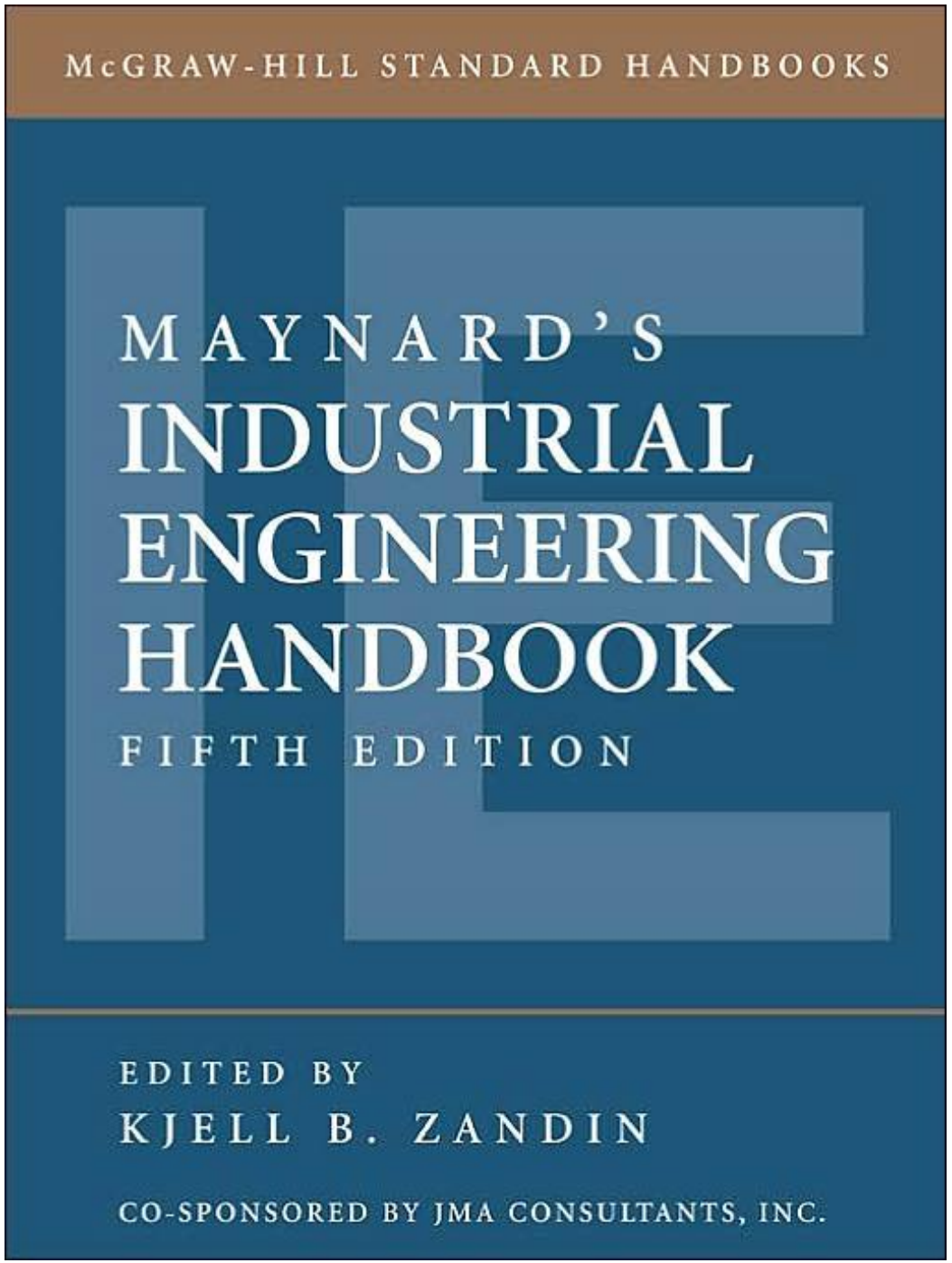
Problem Solving for Industrial Engineering

***By**: Abid Ali*


McGRAW-HILL STANDARD HANDBOOKS
MAYNARD'S
INDUSTRIAL
ENGINEERING
HANDBOOK
FIFTH EDITION
EDITED BY
KJELL B. ZANDIN
CO-SPONSORED BY JMA CONSULTANTS, INC.

CHAPTER 1.1

THE PURPOSE AND EVOLUTION OF INDUSTRIAL ENGINEERING

Purpose and Evolution

- Engineering is centuries-old
- First engineering schools appeared in France
- *military engineering*
- *civil engineering*
- *mechanical engineering*
- *industrial engineering*

*(I*nitially from empirical evidence and understanding and then from research to develop a more scientific base*)*

Industrial Revolution

- Roots of the profession date back to the Industrial Revolution
- Which began in England during the mid eighteenth century
- Helped mechanize many traditional manual operations in the textile industry

Industrial engineering is strongly linked to the history of manufacturing

The concept of a ***production system***, which lies at the core of modern industrial engineering practice and research

Labor Specialization

- Factory systems
- ***Management control systems*** to regulate production and the output of factory workers
- ***Well-organized*** factory to produce steam engines
- ***Control system*** designed to decrease waste and improve productivity and the institution of skills training for craftsmen

Economy of Machinery and Manufacturers

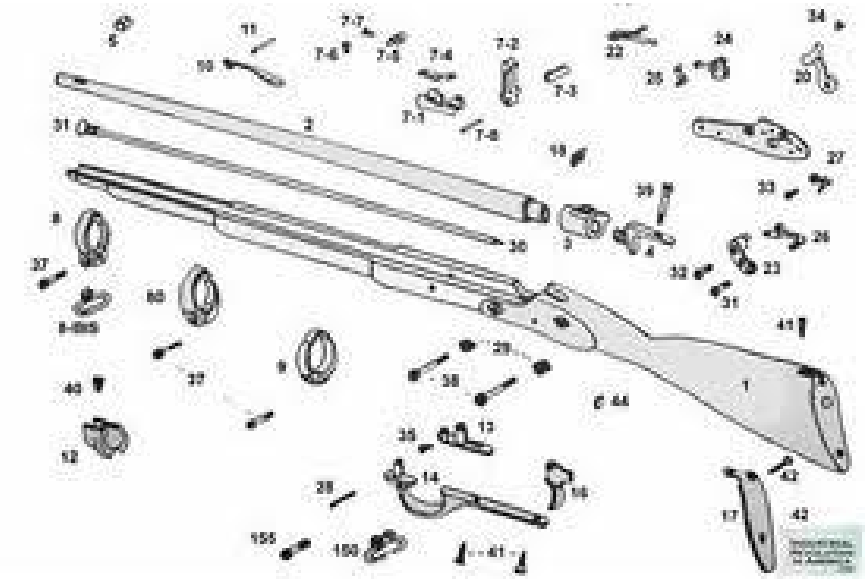
- Time required for learning a particular task
- Effects of subdividing tasks into smaller and less detailed elements
- The time and cost savings associated with changing from one task to another
- The advantages to be gained by repetitive tasks

*(*Charles Babbage*)*

Interchangeability of Parts

Another key development in the history of industrial engineering was the concept of inter-changeable parts

(manufacturing of muskets and pistols for the U.S. government)



PIONEERS OF INDUSTRIAL ENGINEERING…

Frederick W. Taylor

Frank and Lillian Gilbreth

(Science of planning)

(Time study)

(Motion study)

Scientific Management

- Breaking down the production process into its

component parts and improving the efficiency of each

- Examined each component separately and eliminated all false, slow, and useless movements
- jigs, fixtures, and other devices were used
- Empirical in nature, Based on the analysis and improvement of work methods, reduction of the time required to carry out the work

(Taylor**)**

Experiments in Shoveling Coal

Led to

- Development of standards
- Tool and storage rooms as service departments
- Inventory and ordering systems
- Departments for worker selection
- Training departments to instruct workers in the standard methods
- Layout of manufacturing facilities
- Incentive payment systems
- Production planning

No doubt about Taylor's impact on the birth and development of industrial engineering

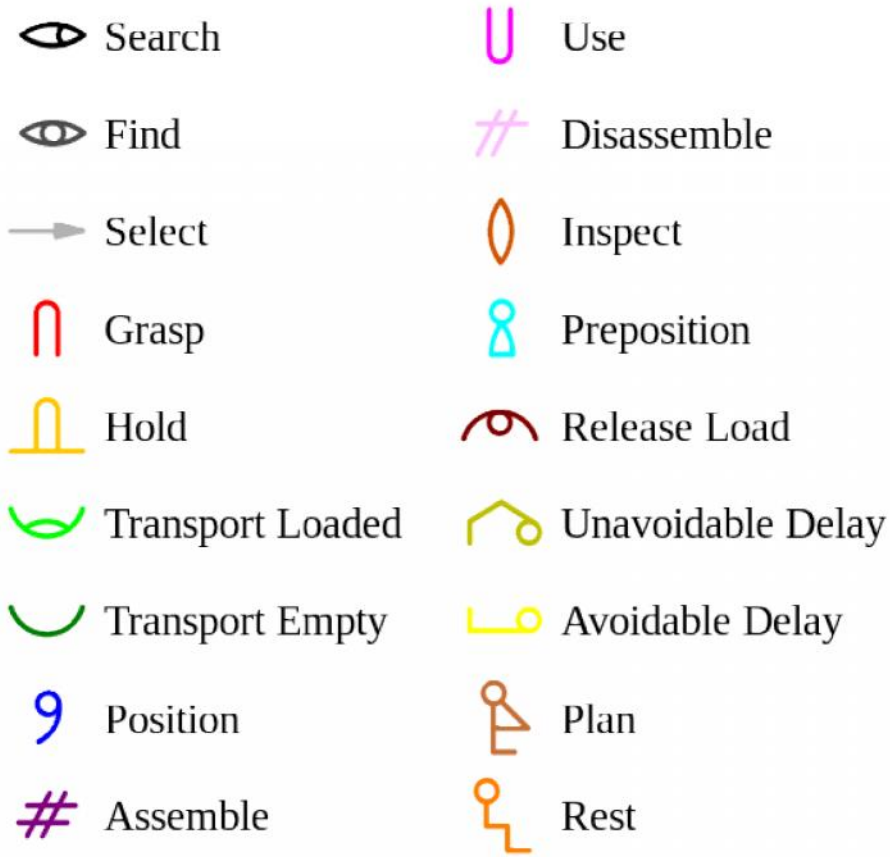
PIONEERS OF INDUSTRIAL ENGINEERING

Frank and Lillian Gilbreth

- Identification, analysis, and measurement of fundamental motions involved in performing work
- Applied the motion-picture camera to the task
- Categorize the elements of human motions to 18 basic elements (*therbligs*)

Therbligs

First time permitting analysts to design jobs with knowledge of the time required to perform the job



- Ergonomics

- Henry Towne
- Henry Gantt

THE POST–WORLD WAR I ERA

Methods Engineering and Work Simplification

- *Time and Motion Study, emphasizing* the importance of motion study and good methods

"Elimination of every unnecessary operation"

A. H. Mogenson

The people who know any job best are the workers doing that job (Training)

- First Ph.D. ***industrial engineering*** motion study***1933

Psychological issues associated with worker motivation were still missing

The Hawthorne Experiment

- Studies conducted at the Western Electric Hawthorne plant in Chicago

Origin?

workplace illumination

- Effect of rest periods
- length of work week,
- incentive plans
- free lunches
- supervisory styles

Hawthorne effect

End of THE POST–WORLD WAR I ERA

- Budgets and cost control
- Manufacturing engineering
- Systems and procedures management
- Organization analysis
- Wage and salary administration

1943, still focused was dispersed

THE POST–WORLD WAR II ERA

1948

- American Institute of Industrial Engineers (AIIE)
- American Society for Quality Control
- Emergence of a more quantitative approaches

The Emergence of Operations Research

The methods used by the industrial engineers

- Statistical analysis,
- Project management techniques,
- Network-based and graphical means

Used in planning military operations.

Modeling, analysis, and general understanding of operational problems (*operations research*).

1950s

Transition of industrial engineering from its prewar ***empirical*** roots to an era of ***quantitative*** methods.

1960s

- Linear programming
- Queuing theory
- Simulation

Understanding the behavior of large problems and systems developed

- The ability to ***experiment with large systems*** also placed industrial engineers on a more ***equal footing*** with their engineering counterparts

Computer age and Engineers

Absence of Fast Computers

- Limited the work of Industrial Engineers
- large-scale manufacturing was impossible to study

Other engineers had not such limitations.

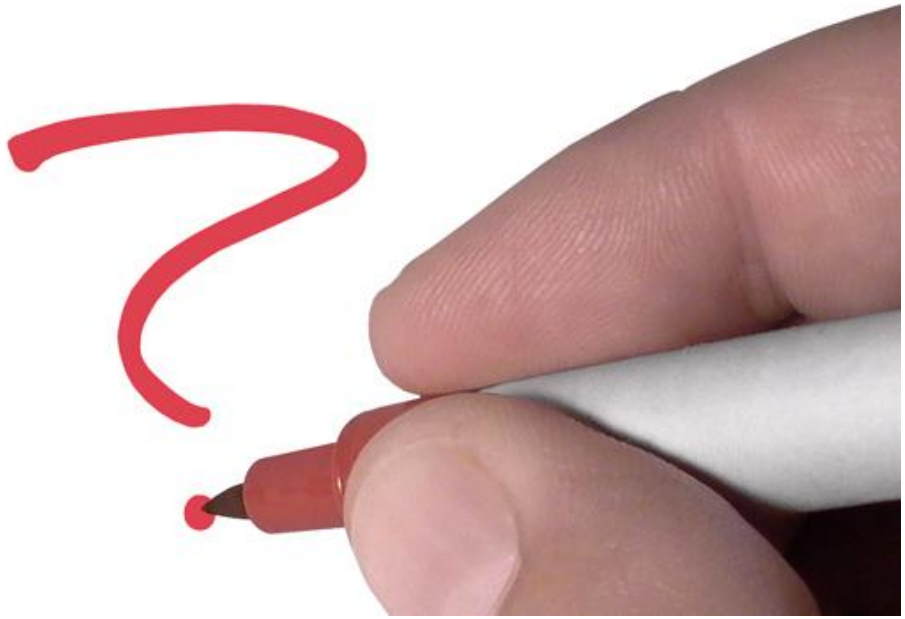
Computer age Revolutionized IE

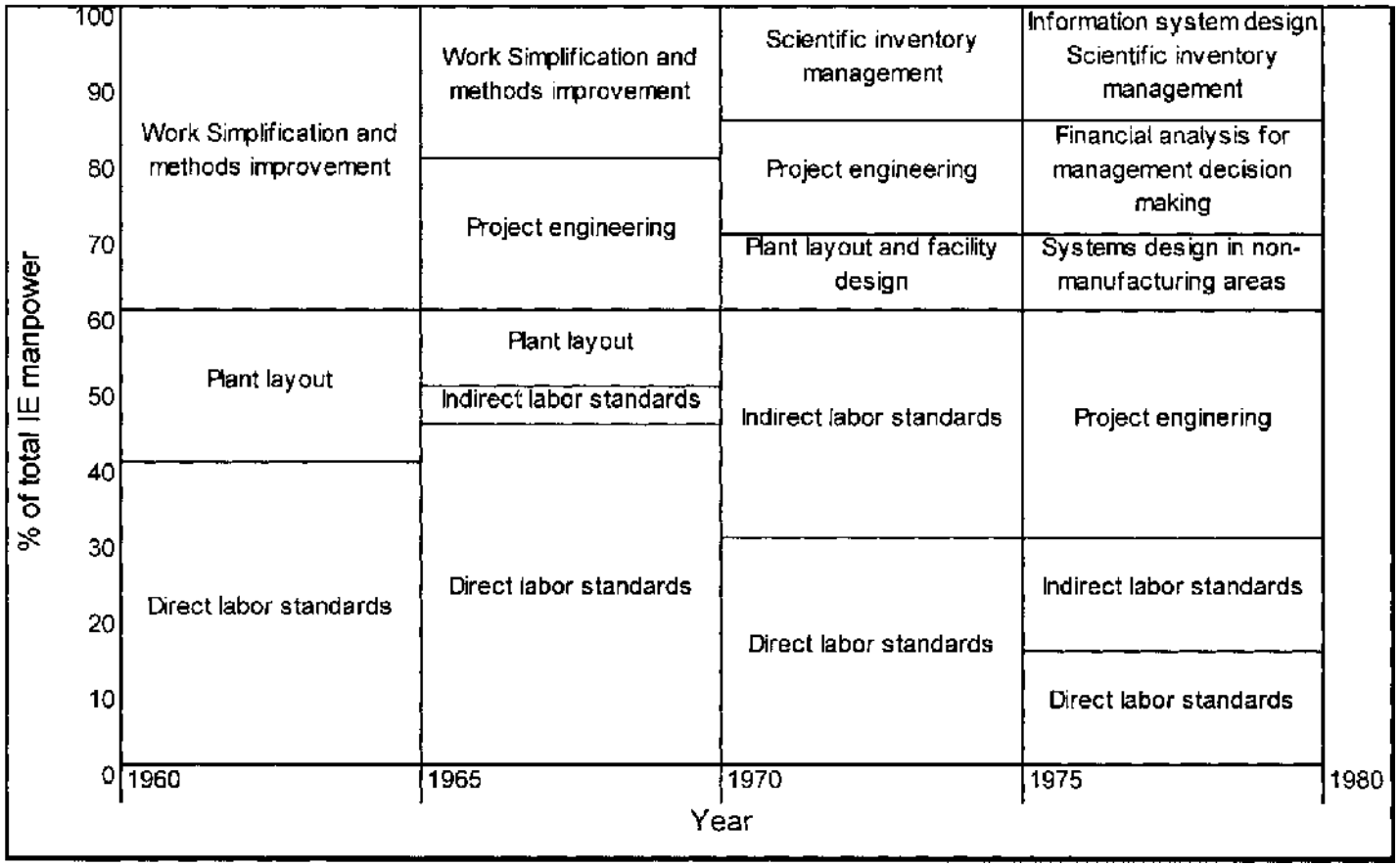
individual human task to *performance of human organizations*

- Hospitals
- Airlines
- educational institutions

Define it

“Industrial engineering is concerned with the design, improvement, and installation of integrated systems of men, materials, equipment and energy”

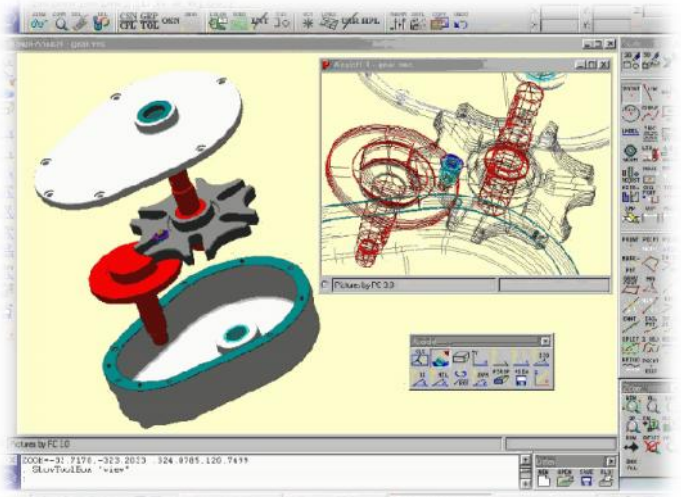



% of total IE manpower
100
90
80
70
60
50
40
30
20
10
0
Work Simplification and methods improvement
Plant layout
Direct labor standards
Work Simplification and methods improvement
Project engineering
Plant layout
Indirect labor standards
Direct labor standards
Scientific inventory management
Project engineering
Plant layout and facility design
Indirect labor standards
Direct labor standards
Information system design
Scientific inventory management
Financial analysis for management decision making
Systems design in non-manufacturing areas
Project enginering
Indirect labor standards
Direct labor standards
1960
1965
1970
1975
1980
Year

THE ERA FROM 1980 TO 2000

- CAD
- CAM
- CIM

Sophisticated tools of the industrial engineering toolkit were applied to nonmanufacturing environments also.



Challenges of This Era

- Non-U.S. competitors
- Automobile industry, machine tooling and electronic industry
- More emphasis on tools and techniques than the problems it was intending to solve
- ***Toyota , Sony*** challenged underlying manufacturing systems

Evolution of the Role of the IE During This Era

- Problem of using excessive technologies without proper integration led to the creation of many “islands of automation”
- Integration of shop floor activities
- Distributed decision making and coordination
- Integration of manufacturing decision processes

Growing role of IE in…

- Flexible manufacturing
- Agile manufacturing
- Intelligent manufacturing systems
- Assembly lines
- Concurrent engineering
- Rapid prototyping
- Operational modeling
- Factory simulation

Role of IE is spread over service sectors in similar way

- Financial services
- Product development
- Process improvement
- Distribution and logistics services

Through the development of new software and operational modeling, analysis, and design capabilities

- The industrial engineer as a ***systems designer***, software developer, systems integrator, entrepreneur, consultant, and/or manager is now a common place occurrence and reflects the growing maturity of this vibrant and dynamic profession.

Reading Assignment

FUTURE CHALLENGES AND OPPORTUNITIES

SUMMARY AND CONCLUSIONS

- Desire to increase productivity
- Issues associated with human performance, ergonomics, and safety as part of the scope of the profession
- Operations research
- Product design
- Quality management

Much of the attractiveness of industrial engineering lies in the fact that it is an engineering field that provides its members with a broad spectrum of career options

Assignment 1

What is…?

- Taylor's "Differential piece rate"
- Henry Gantt's "Task work with bonus"

7=> Assignment pages >=5

Violation of above page limit will result in marks deduction.

Submission Date = **19.11.2013**