



Introduction

Chapter 1

Sections:

1. The Nature of Work
2. Defining Work Systems
3. Types of Occupations
4. Productivity
5. Organization of the Book



Historical Figures Related to Work

- Eli Whitney (1765-1825)
 - Interchangeable parts manufacture
- Henry Ford (1863-1947)
 - Moving assembly line
- Frederick W. Taylor (1856-1915)
 - Scientific management
 - Time study
- Frank (1868-1924) & Lillian Gilbreth (1878-1972)
 - Motion study



Work

- Is our primary means of **livelihood**
- Serves an important **economic** function in the global world of **commerce**
- Creates opportunities for **social interactions** and friendships
- Provides the **products and services** that sustain and improve our standard of living



Introduction

1. The Nature of Work



The Nature of Work

Work is an activity in which one exerts **physical and mental effort** to accomplish a given **task** or perform a **duty**

- Task or duty has some **useful objective**
- Worker **applies skills and knowledge** for successful completion
- The activity has **commercial value**
- The worker is **compensated**



Work (Physics Definition)

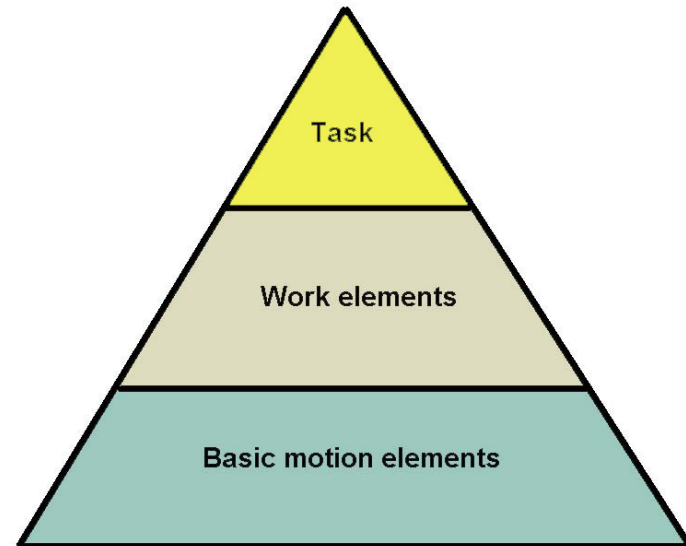
The **displacement** (distance) that an object moves in a **certain direction** multiplied by the **force** acting **on the object** in the same direction.

- Units of measurement:
 - Newton-meters (N-m) in the International System of Units (metric system)
 - Foot-pounds (ft-lb) in U.S. customary units



The Pyramidal Structure of Work

- Work consists of **tasks**
 - Tasks consist of work **elements**
 - Work elements consist of **basic motion elements**





Task

An amount of work that is assigned to a worker or for which a worker is responsible

- **Repetitive task** – as in mass production
 - Time required = 30 seconds to several minutes
- **Non-repetitive task** – performed periodically, infrequently, or only once
 - Time required usually much longer than for repetitive task



Work Element

A series of work **activities** that are **logically grouped** together because they have a **unified function** in the task

- Example: assembling a component to a base part using several nuts and bolts
- Required time = six seconds or longer



Basic Motion Elements

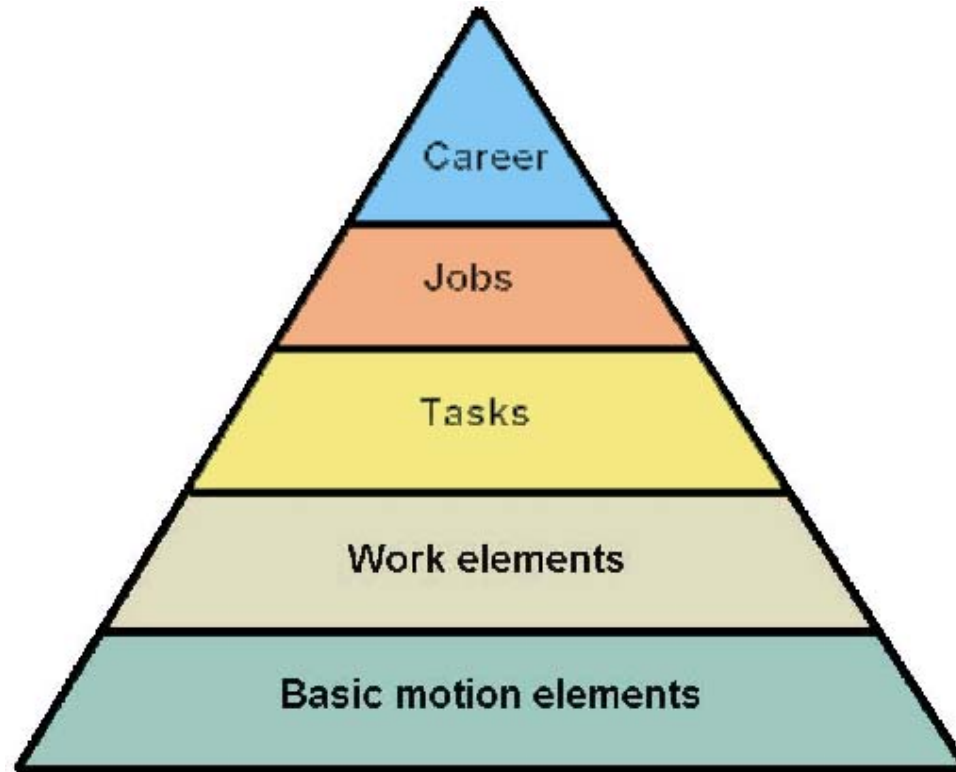
Actuations of the limbs and other body parts

- Examples:
 - **Reaching** for an object
 - **Grasping** the object
 - **Moving** the object
 - **Walking**
 - **Eye movement**
- A work element consists of multiple basic motion elements



Pyramidal Structure of Work

- Extended to a worker's career





Importance of Time

- In many human endeavors, **“time is of the essence”**
 - In sports
 - In daily living
 - In business and industry
 - In work



Time in Business and Industry

- **New product** introduction
- Product **cost**
- **Delivery** time
- Overnight delivery
- Competitive **bidding**
- Production **scheduling**



Importance of Time in Work

- **Time** is the **most frequently used measure of work**
 - How many minutes or hours are required to perform a given task?
- Most workers are **paid** by the **time** they work
 - Hourly wage rate
 - Salary
- Workers must **arrive** at work **on time**
- **Labor and staffing requirements** computed in units of time



Introduction

2. Defining Work Systems



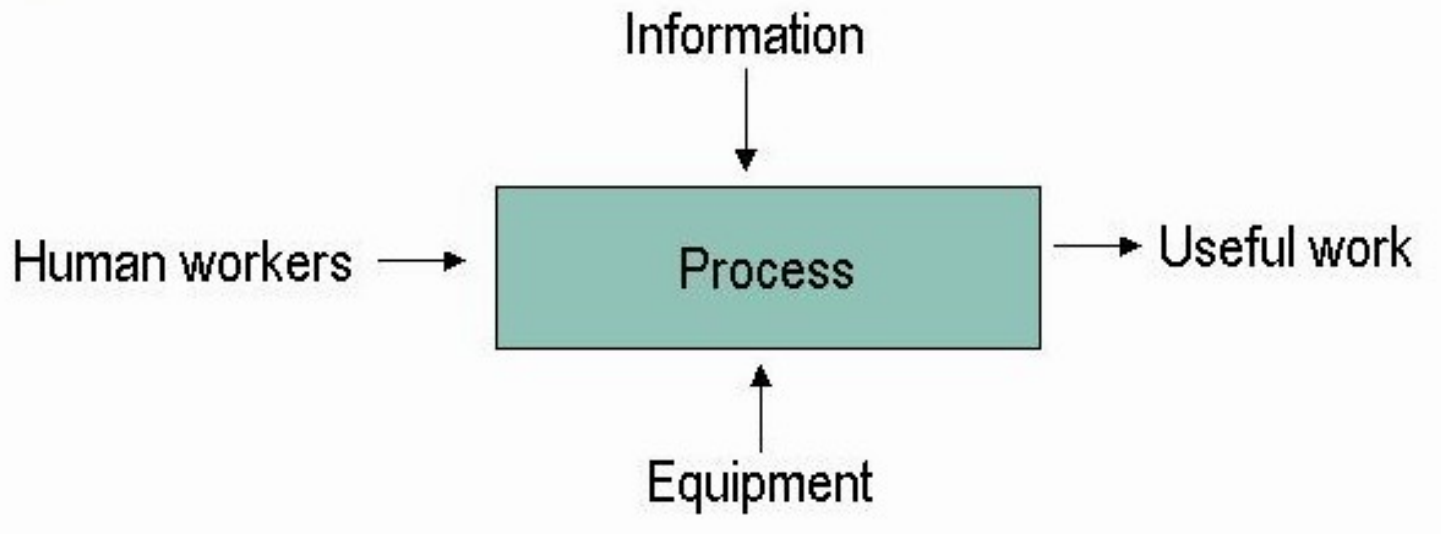
Work System Defined

As a physical entity, a work system is a system consisting of **humans, information, and equipment** designed to perform useful work

- Contributes to the **production of a product or delivery of a service**
- Examples:
 - Worker operating a machine tool in a factory
 - Robotic welding line in an automobile plant
 - Parcel service agent driving a delivery truck to make customer deliveries
 - Designer working at a CAD workstation



A Work System as a Physical Entity





Work System Defined

As a field of professional practice, work systems include:

- **Work methods** – analysis and design of *tasks and jobs* involving human work activity
- **Work measurement** – analysis of a task to determine the *time* that should be allowed to perform the task
- **Work management** – organizational and administrative *functions* that must be accomplished to achieve high productivity and effective supervision of workers



Introduction

3. Types of Occupations



Jobs and Occupations

- Bureau of Labor Statistics of the U.S. Department of Labor identifies 821 occupations in its **Standard Occupational Classification (SOC)**
- The SOC covers virtually every type of work performed for pay or profit in the United States
- Occupations are organized into **23 major groups**
- Groups are established on the basis of **type of work** and/or the **industry** in which it is performed



Jobs and Occupations

- Four broad **categories** that reflect the work content and job function:
 1. **Production** workers - make products
 2. **Logistics** workers - move materials, products, or people
 3. **Service** - provide a service, apply existing information and knowledge, communicate
 4. **Knowledge** workers - create new knowledge, solve problems, manage



Comparisons: Industries and Workers

- 1. Production workers**
 - Manufacturing, construction, agriculture
- 2. Logistics workers**
 - Transportation, distribution, material handling
- 3. Service workers**
 - Banking, retail, government, health care
- 4. Knowledge workers**
 - Management, engineering, legal, consulting, education



Comparisons: Worker Discretion

Refers to the need to make **responsible decisions** and exercise **judgment** in carrying out duties of the position

- Jobs that are highly standardized and routine require **minimum worker discretion**
 - Typical for **production and logistics workers**
- Jobs in which workers must adapt their behavior in response to variations in the work situation require **high discretion**
 - Typical for **service and knowledge workers**



Introduction

4. Productivity



Productivity

The **level of output** of a given **process** relative to the **level of input**

- Process can refer to
 - Individual **production** or **service** operations
 - A **national economy**
- Productivity is an **important metric** in work systems because
 - Improving productivity is the means by which worker **compensation can be increased** **without** increasing the **costs** of products and **services** they produce



Labor Productivity

- The most common productivity measure is **labor productivity**, defined by the following ratio:

$$LPR = \frac{WU}{LH}$$

where,

- LPR = labor productivity ratio,
- WU = **work units** of output,
- LH = **labor hours** of input



Labor Factor in Productivity

- **Labor** itself does **not contribute much** to improving productivity
- More important factors:
 - **Capital** - substitution of machines for human labor
 - **Technology** - fundamental change in the way some activity or function is accomplished



Examples of Technology Changes

Horse-drawn carts
Steam locomotive
Telephone operator
Dial phone
Manually operated
milling machine
DC-3 passenger
airplane (1930s)



Railroad trains
Diesel locomotive
Dial phone
Touch-tone phone
Numerically controlled
(NC) milling machine
Boeing 747 passenger
airplane (1980s)





Capital versus Technology

- **Distinctions** between capital improvements and technology improvements **are often subtle**
 - New technologies almost always require capital investments
- Important to recognize important gains in productivity are more likely to be made
 - By the introduction of capital and technology in a work process
 - Than by attempting to get more work in less time out of the workers



Measuring Productivity

- **Not as easy** as it seems because of the following problems:
 - **Nonhomogeneous** output units
 - **Multiple input factors**
 - Labor, capital, technology, materials, energy
 - **Price and cost changes** due to economic forces
 - **Product mix** changes
 - Relative proportions of products that a company sells change over time



Labor Productivity Index

Measure that compares **input/output ratio**
from one year to the next

$$LPI = \frac{LPR_t}{LPR_b}$$

Where

- LPI = labor productivity index,
- LPR_t = labor productivity ratio for period t ,
and
- LPR_b = labor productivity ratio for base period



Example: Productivity Measurement

- During the base year in a small steel mill, 326,000 tons of steel were produced using 203,000 labor hours. In the next year, the output was 341,000 tons using 246,000 labor hours.

Determine: (a) the labor productivity ratio for the base year, (b) the labor productivity ratio for the second year, and (c) the productivity index for the second year.



Example: Solution

- (a) In the **base year**, $LPR = 326,000 / 203,000$
= 1.606 tons per labor hour
- (b) In the **second year**, $LPR = 341,000 / 246,000$
= 1.386 tons per labor hour
- (c) **Productivity index** for the second year
 $LPI = 1.386 / 1.606 = 0.863$
- Comment: No matter how it's measured, productivity went down in the second year.



Productive Work Content

A given **task** performed by a worker can be considered **to consist of**

- **Basic productive work content**
 - *Theoretical minimum amount of work* required to accomplish the task
- **Excess nonproductive activities**
 - Extra *physical and mental actions* of worker
 - *Do not add value* to the task
 - *Do not facilitate* the productive work content
 - *Take time*



Excess Nonproductive Activities

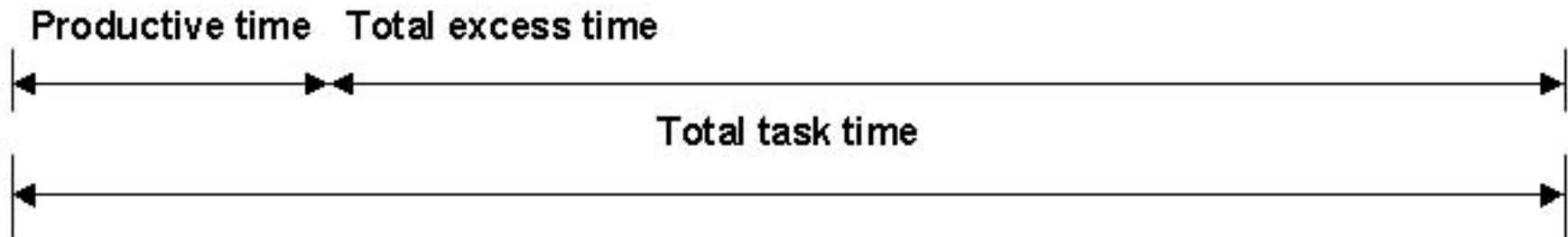
Can be classified into three categories:

- Excess activities **due to poor design** of product or service
- Excess activities caused by **inefficient methods, poor workplace layout, and interruptions**
- Excessive activities caused by the **human factor**



Allocation of Total Task Time

Basic productive work content	Excess activities due to poor design of product or service	Excess activities due to inefficient methods, poor work layout, and interruptions	Excess activities due to the human factor
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Poor Design of Product or Service

- Products with **more parts than necessary**, causing excess assembly time
- Product **proliferation**
- Frequent **design changes**
- **Waste** of materials
- **Quality standards** too stringent



Inefficient Methods, Layout, Etc.

- Inefficient layout that increases **material handling activities**
- Inefficient workplace layout that increases **hand, arm, and body motions**
- Methods that include unnecessary **work elements that waste time**
- **Long setup times** in batch production
- Frequent **equipment breakdowns**
- **Workers waiting** for work



The Human Factor

- **Absenteeism**
- **Tardiness**
- Workers spending too much time **socializing**
- Workers deliberately **working slowly**
- **Inadequate training** of workers
- Industrial **accidents** caused by human error
- **Hazardous materials** that cause occupational illnesses



Introduction

5. Organization of the Book



Organization of the Book

