WELCOME

IE-341
Work Study
Fall 2016

Instructor: Dr. Abdulrahman Basahel

GRADES

Attendance	= 5 Marks
Quiz	= 5 Marks
Assignments	= 10 Marks
Lab Reports	= 10 Marks
Major I	= 15 Marks
Major II	= 15 Marks
Final Project	= 10 Marks
Final Exam	= 30 Marks
Total	**= 100 Marks**

Syllabus

Introduction

Chapter 1

Sections:

1. The Nature of Work
2. Defining Work Systems
3. Types of Occupations
4. Productivity

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 of a task
- The activity has commercial value (means that the task activity contributes to buying or selling something).
- The worker is compensated for the task performing.

Work (Physics Definition)

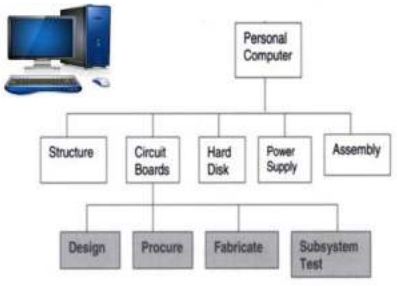
The displacement (distance) that an object moves in a certain direction multiplied by the force acting on the object in the same direction.

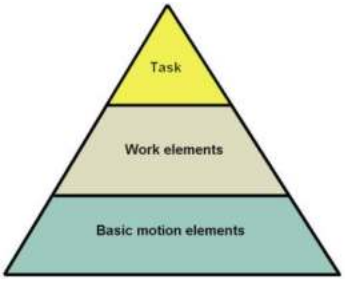
$$W = F \bullet d$$

- 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

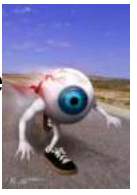
- **Example:** assembling a component to a base part using several nuts and bolts
- Required time = six seconds or longer

Basic Motion Elements

Actuations of the limbs and other body parts

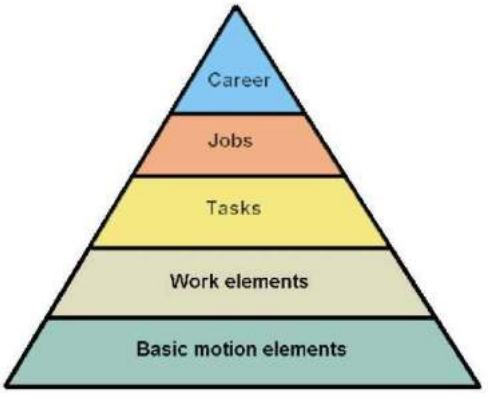
- **Examples:**
  - Reaching for an object
  - Grasping the object
  - Moving the object
  - Walking
  - Eye movement

- A work element consists of multiple basic motion elements



Pyramidal Structure of Work

- Extended to a worker's career

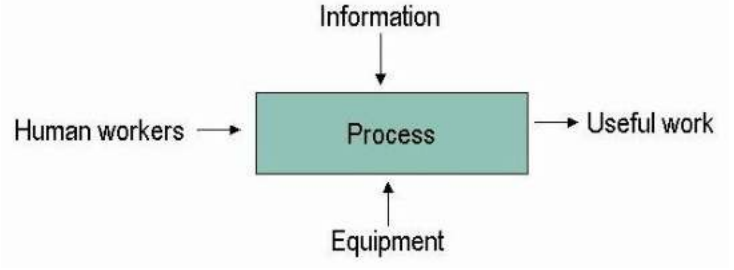


Importance of Time in Work

- 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

Work System Defined

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



Examples of A Work System

Examples:

1. Worker operating a machine tool in a factory
2. An assembly line consists of a dozen of workers at seperate work stations along a moving conveyor
3. Parcel service agent driving a delivery truck to make customer deliveries
4. Designer working at a CAD workstation

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 Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.

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

Examples

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

Productivity

Productivity is the level of output of a given process relative to the level of input

- Process can refer to
  - Individual production or service operations

- 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

Factors Impact on Productivity

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

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

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 = 86.3%

- Comment: productivity went down in the second year.

Productive Work Content

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

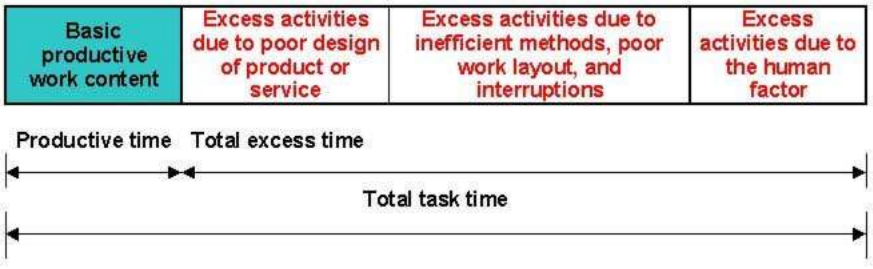
- **Basic productive work content**
  - Theoretical minimum amount of work required to accomplish the task
- **Excess nonproductive activities**
  - Extra physical and mental actions of worker
  - Do not add value to the task
  - Do not facilitate the productive work content
  - Take time

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 cause by *the human factor*

Allocation of Total Task Time



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
- Frequent equipment breakdowns
- Workers waiting for work

The Human Factor

- Absenteeism
- Tardiness
- Workers deliberately working slowly
- Inadequate training of workers
- Industrial accidents caused by human error
- Hazardous materials that cause occupational illnesses

Work Systems and the Methods, Measurement, and Management of Work
by Mikell P. Groover, ISBN 0-13-140650-7.