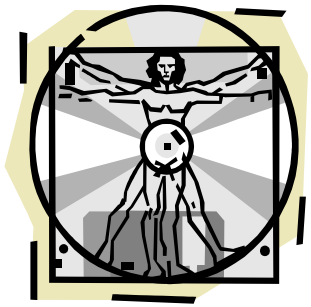
APPLIED WORKPLACE ERGONOMICS

AURA C. MATIAS, Ph.D.
Academician
University of the Philippines Diliman

What is Ergonomics?

Ergonomics

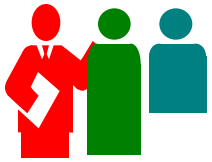


is the scientific study of human characteristics for the appropriate design of the living and work environment.

"Fitting the Task to the Man"

Ergonomics at the Workplace

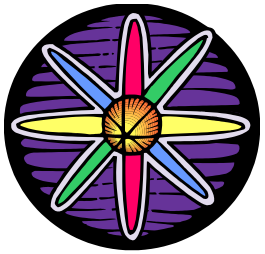
Designing Jobs to Fit People



It is concerned with ensuring that the work system is conducive to good performance and work effectiveness, and consequently that the work environment is compatible with the health, safety and comfort of the worker.

Characteristics

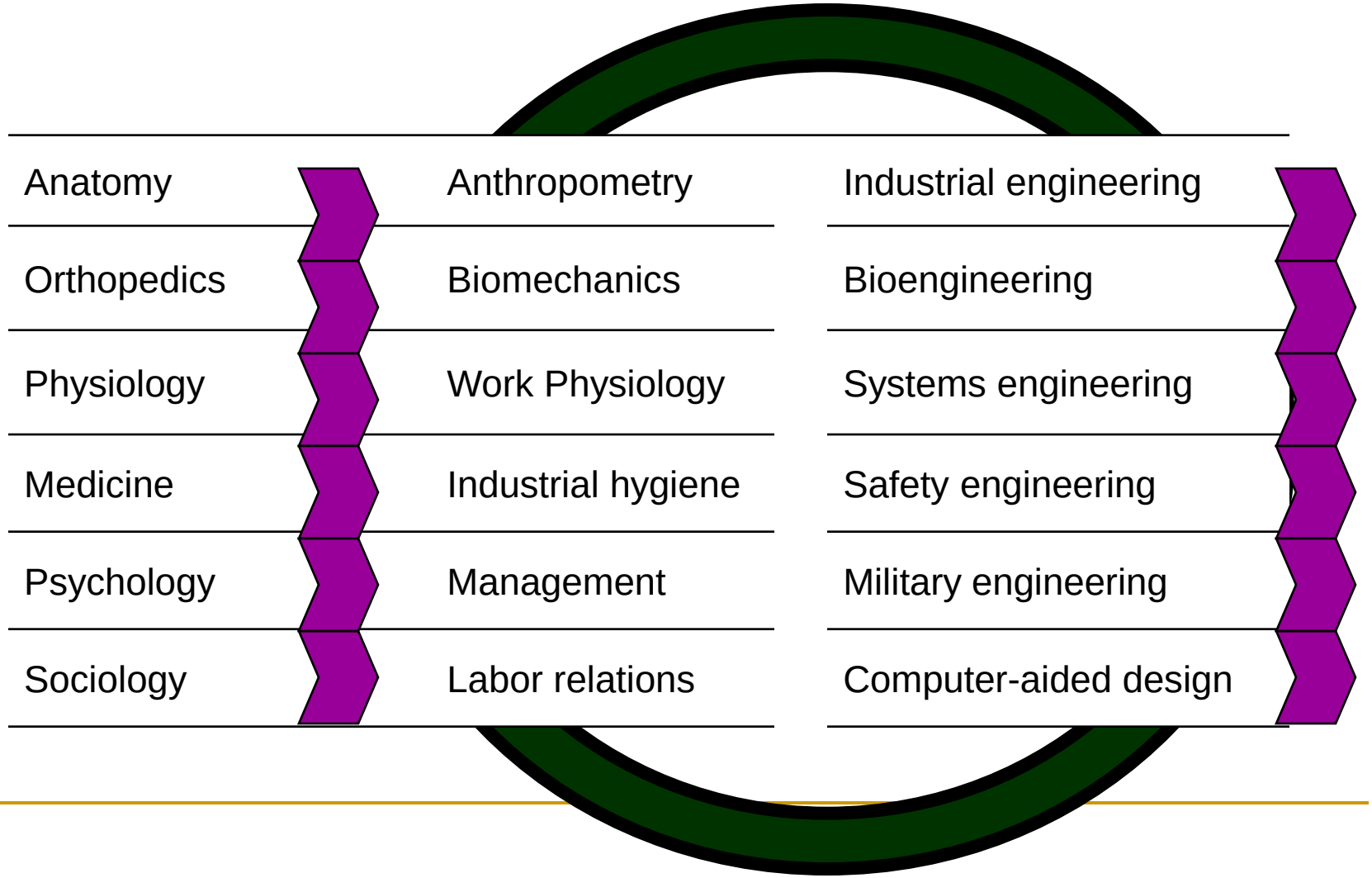
- **Human-centered**



- **Multi-disciplinary**

- **Application-oriented**

Developments & Applications



Benefits of Ergonomics

Ergonomics has existed as a profession for over 50 years, helping people to succeed in their jobs by means such as:

- *Reducing human error in system performance*
- *Reducing hazards to individuals in the work environment*
- *Improving system efficiency*
- *Designing systems with a user focus*

Why Ergonomics?

- Economic Advantages
  - Minimizing fatigue and overexertion
  - Minimizing absenteeism and labor turnover
  - Improving quality and quantity of output
  - Eliminating or minimizing injuries, strains and sprains
  - Minimizing lost time and costs associated with injuries and accidents

Why Ergonomics?

- Moral Imperative
  - Maximizing safety, efficiency, comfort and productivity
  - Improving human condition and quality of life

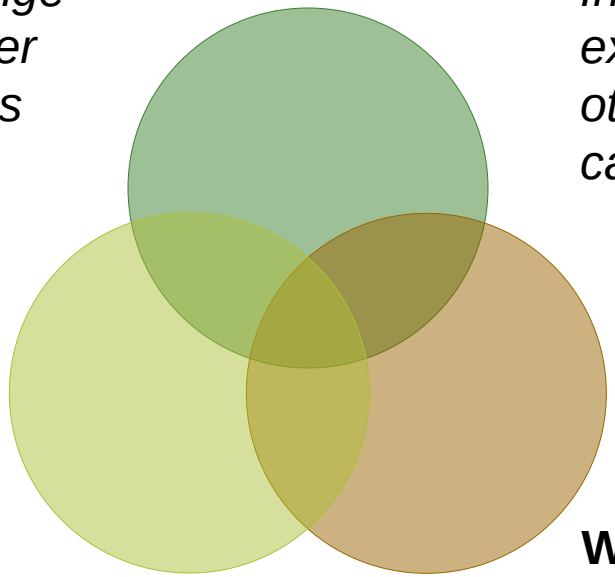
Elements of an Ergonomics Program

Workplace Description

Worker

Size, strength, range of motion and other physical capacities

Intellect, education, expectations and other mental capacities



Work Setting

Parts, tools, furniture, control/display panels and other physical objects

Work Environment

Climate, lighting, noise, vibration and other atmospheric qualities

Hazards at the Workplace

35%

34%

- **Ergonomic risk factors**
  - Prolonged standing (43%)
  - Excessive physical work (19%)
  - Unfavorable work postures (11%)
  - Static monotonous work (8%)
- **Chemical Exposures**
  - Dust, Liquid, Mists and Gas

Hazards at the Workplace

25%

6%

- **Physical Hazards**
  - Noise (55%)
  - Temperature (29%)
  - Pressure, Radiation, Illumination
- **Biological Agents**
  - Virus (25%)
  - Bacteria (24%)
  - Fungus (21%)
  - Parasite (18%)

Understated Report of Work-related Disorders in Developing Countries

Numbers look small for a number of reasons:

- Inadequate or non-existent reporting mechanisms
- a lack of occupational health facilities
- a lack of health care practitioners who are trained to recognize work-related diseases.

Associated Risk Factors

- Posture
- Force
- Repetition
- Duration
- Recovery Time

POSTURE

- Awkward posture is associated with an increased risk of injury.
- It is believed that the more a joint is deviated from the neutral position, the greater the risk of injury.
- Posture issues are created by work methods (bending and twisting) or work dimensions (extended reaching or kneeling)

Postures Associated with Injury

- At the wrist:
  - Flexion and extension position: CTS
  - Ulnar deviation of >20 degrees: pain and pathological findings
- At shoulder:
  - Abduction or flexion >60 degrees maintained for more than 1 hr/day: acute shoulder and neck pain
  - Hands at or above shoulder height: tendinitis and various shoulder pathologies
- At the low back:
  - Trunk sagittal angle: low back disorder

Back Pain

- The spinal column is often the location of injury, pain and discomfort because it continuously transmit internal and external strains.
- Back pain results from a combination of repetitive trauma and the normal aging process.
- Overexertion injuries have been traced to the compression of spinal discs, particularly in the lumbar area

FORCE

- Effect of an exertion on internal body tissues
  - Compression on a spinal disc from lifting
  - Tension within a muscle/tendon unit from a pinch grip
- Effect of physical characteristics associated with an object(s) external to the body
  - Weight of a box
  - Pressure required to activate a tool
  - Pressure necessary to snap two pieces together

Force and Injury

- Generally the greater the force, the greater the degree of risk.
- High force has been associated with risk of injury at the shoulder/neck, low back, and the forearm/wrist/hand.
- Relationship between force and degree of injury of risk is modified by other risk factors
  - posture, acceleration/velocity, repetition, duration

HEAVY DYNAMIC EXERTION

- Tasks requiring long term and repetitive muscle contraction
  - Walking great distances
  - Heavy carrying
  - Repeated lifting
- Localized fatigue
  - increased breathing and heart rate
  - tire and sore muscles
- Whole body fatigue
  - May result in a cardiovascular accident

REPETITION

- Repetitive motion has been associated with injury and worker discomfort.
- Generally, the greater the repetitions, the greater the degree of risk. However, the relationship between repetition and degree of injury risk is modified by other risk factors such as force, posture, duration and recovery time.
- No specific repetition threshold value is associated with injury (ex. cycles/unit time, movements/unit time)

DURATION

- Exposure time to a risk factor
- In general, the greater the duration of exposure to a risk factor, the greater the degree of risk.

RECOVERY TIME

- Time quantification of rest, performance of low stress activity, or performance of an activity that allows a strained body area to rest.
- Short work pauses have reduced perceived discomfort and rest periods between exertions have reduced performance decrement
- The recovery time needed to reduce the risk of injury increases as the duration of risk factor increases.
- Specific minimum recovery times have not been established.

Ergonomic Risk Assessment

Evaluation of ergonomic risk conditions generally involve two steps:

1. Identification of the existence of ergonomic risks
   - Checklists or surveys
2. Quantification of the degree of ergonomic risk
   - Ergonomic Analytical Tools
   - Guidelines and/or Standards

Ergonomic Analysis Strategy

A systematic analysis involves:

- Applying passive surveillance methods to determine if ergonomics risk factors may exist in the workplace.
  - This is done by utilizing already existing data and records.
- Applying active surveillance methods to acquire more information about the presence of worksite risk factors and to determine if the job/task risk should be quantified.
  - These surveys involve direct knowledge of or interaction with the worksite.
- Applying specific analytical tools to obtain a quantitative evaluation of the task/job risk.

Passive Surveillance Methods

- OSHA 200 log
  - Fatality
  - Lost work days
  - Transfer to another job
  - Termination of employment
  - Medical Treatment (other than first aid)
  - Loss of consciousness or restriction of work or motion

Passive Surveillance Methods

- **Workers' Compensation Records**
  - The workers' compensation claim file of a worker will contain records/reports that state a diagnosis and history of how an injury/illness occurred.
  - The diagnosis or area of injury can be a clue to the examiner.
- **Worker Satisfaction Indices**
  - The existence of ergonomics risk factors usually makes a job difficult to perform and can contribute to worker fatigue/irritability and dislike of a job.
  - The worker's physical/emotional state can affect workplace statistics such as absenteeism, worker turnover, and product quality.
  - High absenteeism, high worker turnover, and poor quality do not automatically mean that ergonomics risk factors are present in the workplace. However, these indices can be a signal that job design is an issue.

Active Surveillance Methods

- **Supervisor and Worker Interviews**

Suggested questions include:

- What are the hardest tasks?
- What are the least favorite tasks?
- What tasks are complained about the most?
- What tasks pose the highest risk of injury?
- What tasks does the person with least seniority perform?
- What tasks does the person with most seniority perform?
- What tasks seem to cause worker injury/symptoms?

Active Surveillance Methods

- **Checklists**
  - Symptoms Survey
  - Lifting/Manual Material Handling Checklist
  - Checklist for Upper Extremity Cumulative Trauma Disorders
  - Detailed Checklist for Computer (VDT) Workstations

Quantification of Ergonomic Risks

- The tools are frequently orientated to a specific type of work (e.g., manual material handling) or a particular body part (e.g., wrist, low back).
- Analytical tools also vary greatly in their style of conclusions.
  - They may provide job prioritization for intervention, quantification of activities associated with increased risk of injury, or recommendation for a load weight limit for lifting.
- The examiner determines which analytical tool is best for evaluation of the identified risks based on an understanding of the tool's applications, strengths, and weaknesses.

Quantification of Ergonomic Risk

- An analytical tool can, at best, provide an approximation of the degree of risk.
  - Variation in individual physiology, history of injury, work methods, and numerous other factors influence whether a person will sustain an injury.
- Further, many tools have not been tested adequately for reliability and validity.
  - This status reflects the youth of the profession.
  - Despite these shortcomings, tools still offer a standard method of analysis and reasonable assessment of risk.

Analytical Tools

Examples of analytical tools include:

- Revised NIOSH Lifting Equation (1991)
  - Evaluates the risk of a lifting task based on expanded NIOSH parameters.
- RULA Rapid Upper Limb Assessment and
- REBA Rapid Entire Body Assessment
  - Assesses the risk of cumulative trauma disorder through posture, force, and muscle-use analysis.
- Detailed Checklist For Computer (VDT) Workstation Risk Analysis
  - Presents the recommended characteristics of a VDT workstation.

Other Analytical Tools

- OWAS (Ovako Working Posture Analysis System)
- Utah Back Compressions Force Model
- Utah Shoulder Moment Model
- Liberty Mutual Tables
- AAMA Metabolic Model
- Anthropometry Analysis

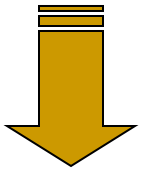
Prevention & Control

Three types of solutions reduce the magnitude of risk factors:

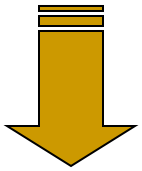
1. Engineering
   - Altering physical conditions and environment
2. Administrative
   - Job rotation, work-break schedule, conditioning, etc.
3. Work Practice
   - Training and education

Guiding Principles

"Fitting the task to the Man"



Health & Safety, Productivity



"Sustainable quality of work life"

Thank you for your attention.