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**Introduction to Ergonomics and
Industrial Safety**
Section one

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1. Introduction to Ergonomics

1.1 Historical background of ergonomics

- Ergonomics starts in the context of the culture of ancient Greece.
- In 1700s, **Ramazzini** describes relationship between physical labor and stress invoked in human body.
- In 1800s, **Taylor** develops methods & tools to reduce work fatigue.

Con...

- In 1920s and 1930s, **Frank** and **Gilbreth** provide the foundation for the science of Ergonomics.
- In 1949, discipline of ergonomics emerged in Great Britain.
- In 1960s and 1970s, ergonomics became familiar study in IE.
- In late 1970s, it was recognized as a multidisciplinary field at Michigan University

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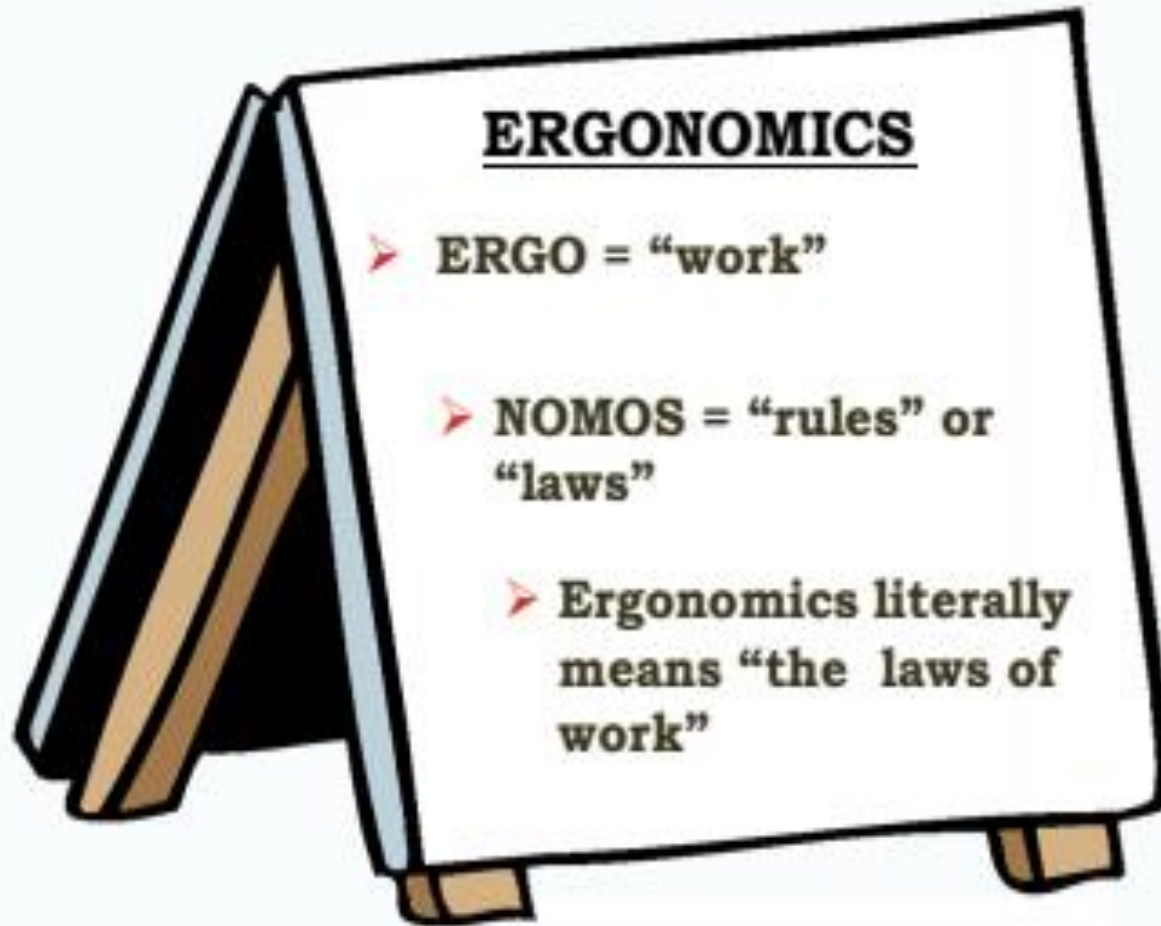
- Since the beginning of the history of ergonomics around 1950, society and technology have developed tremendously, and HFE has followed along. The following can characterize the development over the last 50 years.
- 1950s: Military ergonomics
- 1960s: Industrial ergonomics
- 1970s: Consumer products ergonomics
- 1980s: Human-computer interaction and software ergonomics
- 1990s: Cognitive ergonomics and organization ergonomics
- •2000s: Global communication, internet, and virtual collaboration

Con...

- Foundations of ergonomic science observed in Ancient Greece
 - Hippocrates
 - Egyptian Dynasties
- Term coined during World War II by Hywel Murell
- Continued with the space age

1.2 What is Ergonomics

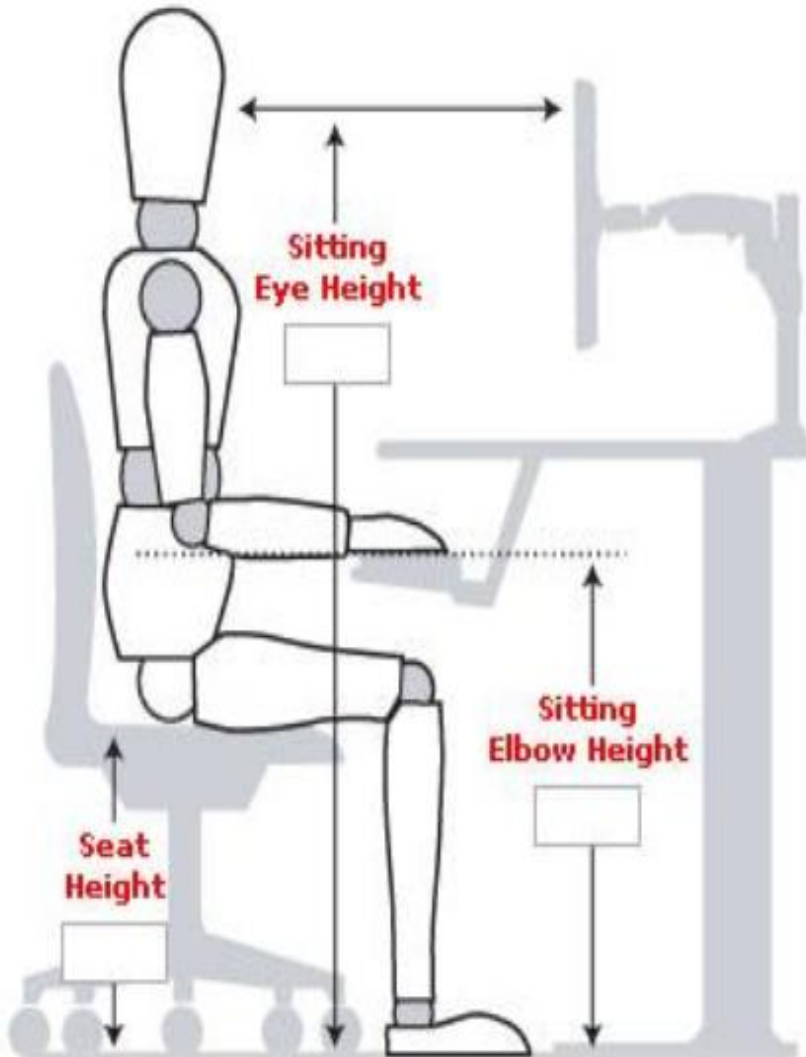
The word ergonomics comes from two Greek words:



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- According to the IEA(International Ergonomics Association), ergonomics is the **scientific discipline** concerned with **understanding** of interactions among **humans** and **other elements** of the system, and the profession that applies theory, principles, data and methods to design, in order to **optimize human** well being and overall system performance.

Con...



- **Ergonomics** is defined as the science the art of fitting the job and the work places to the worker.

- ✓ Use your brain, not your back.
- ✓ Work smarter, not harder.
- ✓ Fix the job, not the worker

- **Fitting the Human**

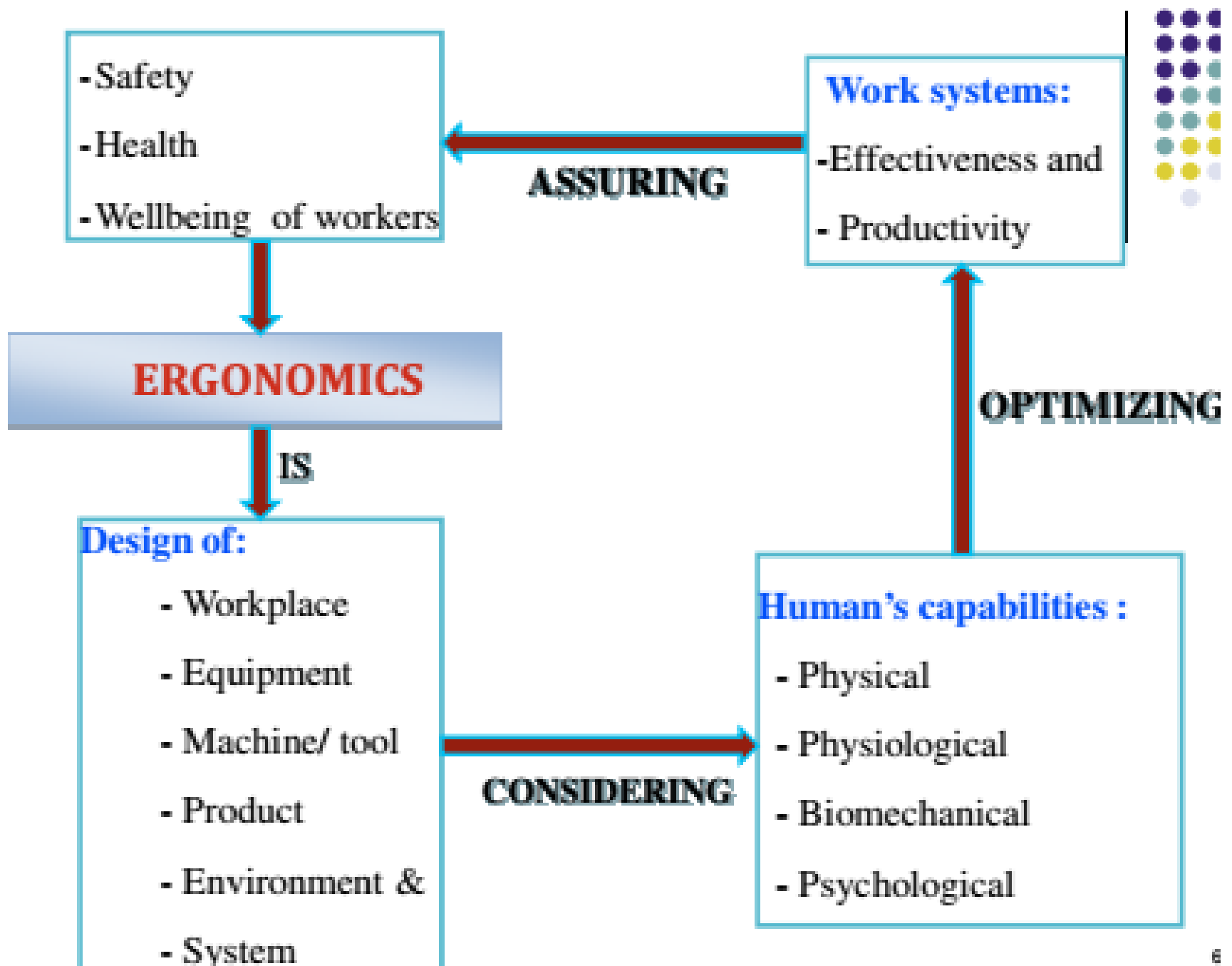
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➤ **Ergonomics** Main focus is the **safety of the person**

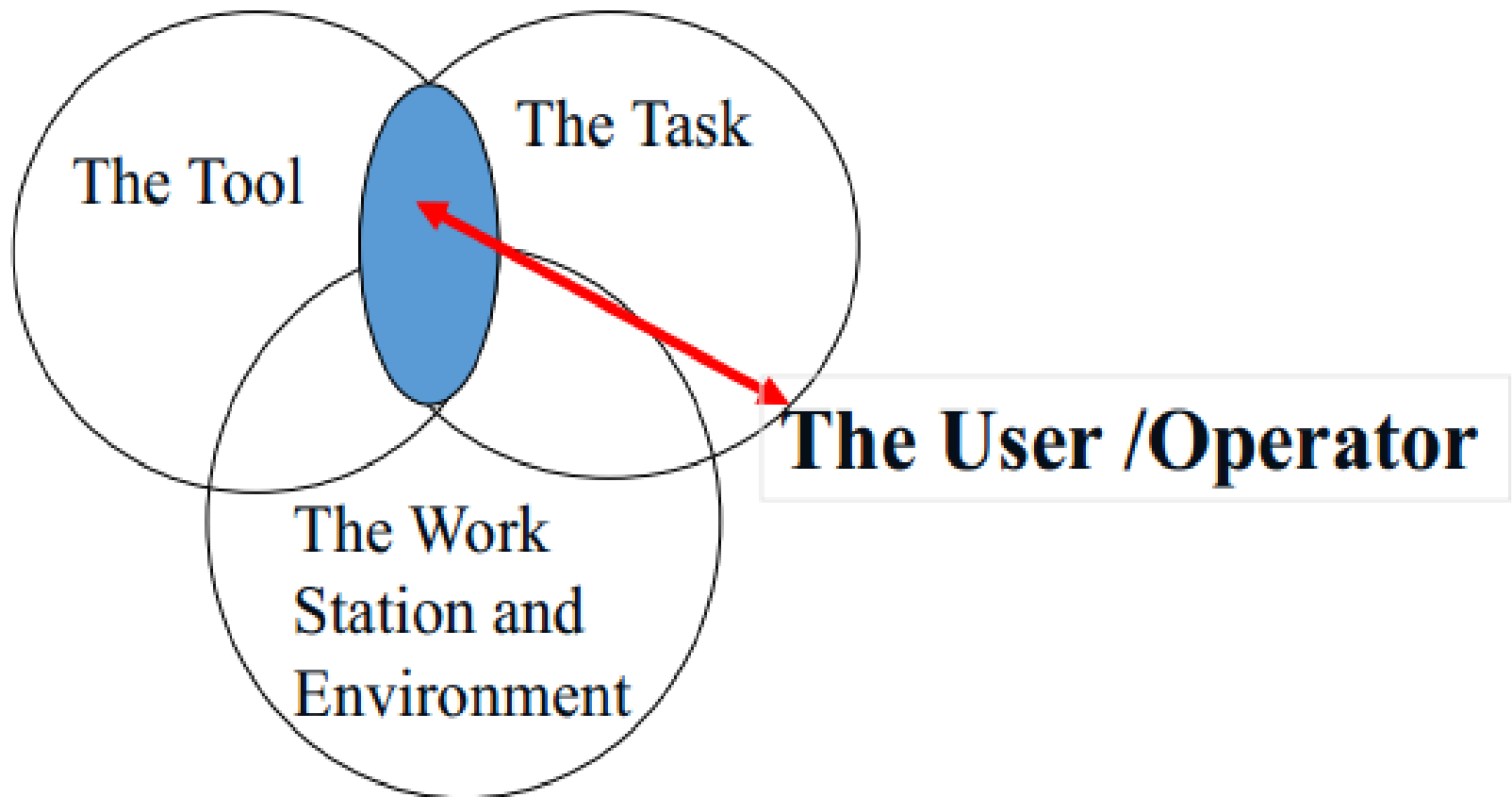
➤ Factors:

- ✓ Body posture and movement
- ✓ Environmental factors
- ✓ Work Organization

➤ An applied scientific discipline concerned with **how humans interact** with tools and equipment they use while performing tasks



Ergonomic focus

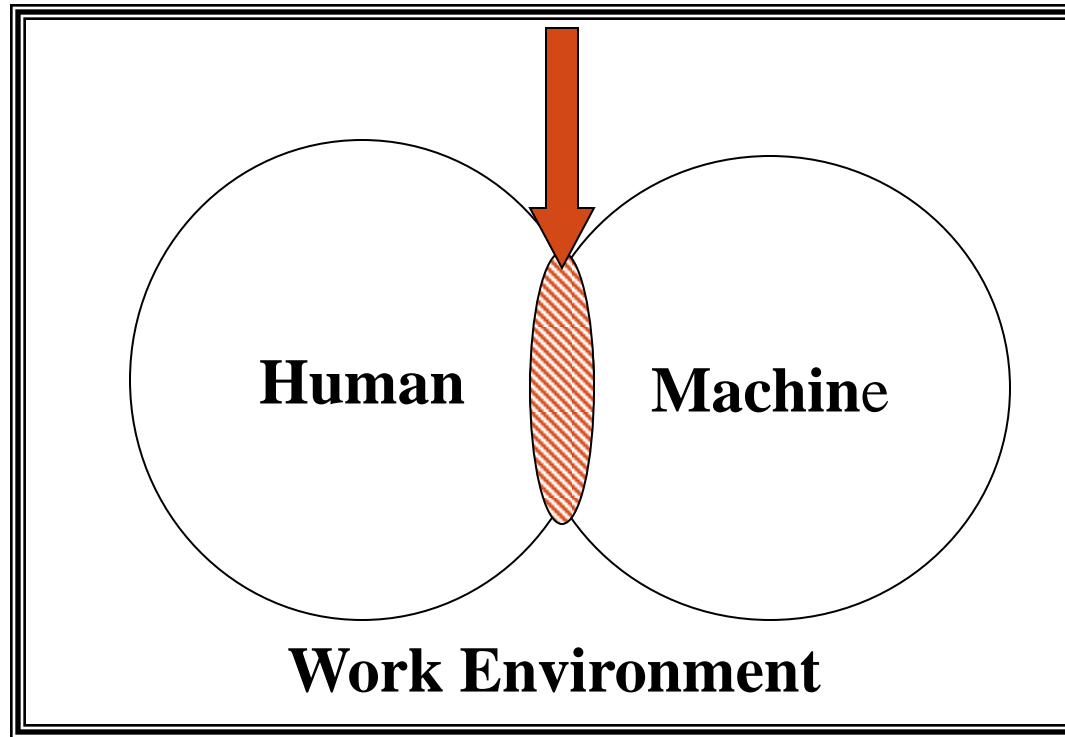


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- Ergonomics can be an **integral part of design**, manufacturing, and use. Knowing how the study of **anthropometry**, posture, repetitive motion, and workspace design affects the **user** is critical to a better understanding of ergonomics as they relate to end-user needs.

Con....

The Goal of Ergonomics : is to make the work fit the operator, not make the operator fit the work.



Utmost Goal: “Humanization” of Work



Design with “E & E”: Ease and Efficiency

1.3 Basic aims of ergonomics

- Greater ease of interaction b/n user and machine
- Greater comfort and satisfaction in use of equipment
- Reduce stress and fatigue
- Safer operation
- Avoid accidents and injuries
- Efficiency in purposeful activity
- To achieve desired result without
 - Waste
 - Error
 - Damage to persons
- Working situation in harmony with worker activities

1.4 Difficulties in achieving ergonomics aims

- Human operator is flexible and adaptable
- Large individual differences
 - Obvious differences: --> Physical size, strength
 - Not obvious differences --> Culture, style, level of skill
- Thus a systematic approach and theory are necessary.
There should be measurable objectives to be checked and remedial action to be taken.
- A detailed study of the science of ergonomics provides these approaches and theories

1.5 Human Factor and Engineering factor

Human Factors

- Physical and mental work capacity
- Fatigue
- Body forces, strength and posture
- Body sizes
- Thermal comfort/ heat stress/cold stress
- Vision
- Hearing
- Perception
- Information processing
- Performance and efficiency
- Decision making
- Adaptation and rehabilitation
- Behavior & social relations

Engineering

- Industrial design
- Work place design
- Product design
- Furniture design
- Machine design
- Ventilation
- Lighting
- Acoustics
- Engineering control (Chemical & Physical)
- Building orientation
- Maintenance

1.6 FPJ Vs FJP

1.6.1 Fitting the Person to the Job (FPJ)

- Common philosophy prior to ergonomics
- Considers worker's physical and mental aptitudes (skills) in employment decisions
 - Psychometric testing (e.g., tests for intelligence and personality characteristics)
 - For example, using worker size and strength as criteria for physical work
- FPJ is still important
 - For example, educational requirements for technical positions

1.6.2 Fitting the Job to the Person (FJP)

- Ergonomics follow and opposite of FPJ
- **Philosophy:** design the job so that any member of the work force can perform it
- Why the FJP philosophy has evolved:
 - Changes in worker skill requirements
 - Today, since workers are much more educated, companies spend time to train the new workforce
 - Demographic changes (e.g. more women in workforce, recruiting fewer people of youths)
 - Social and political changes (e.g., equal opportunity laws, trade unions, collective bargaining)
 - Hiring handicapped worker is encouraged by laws.

1.7 Benefits of an ergonomic

- Decreased injuries, illnesses, and workers' compensation costs.
- Increased efficiency at work - productivity.
- Increased physical well being – work satisfaction.
- Decreased absenteeism and turnover.
- Increase in employee morale.
- Higher Quality
- Lower medical & insurance costs
- Reduced lost time

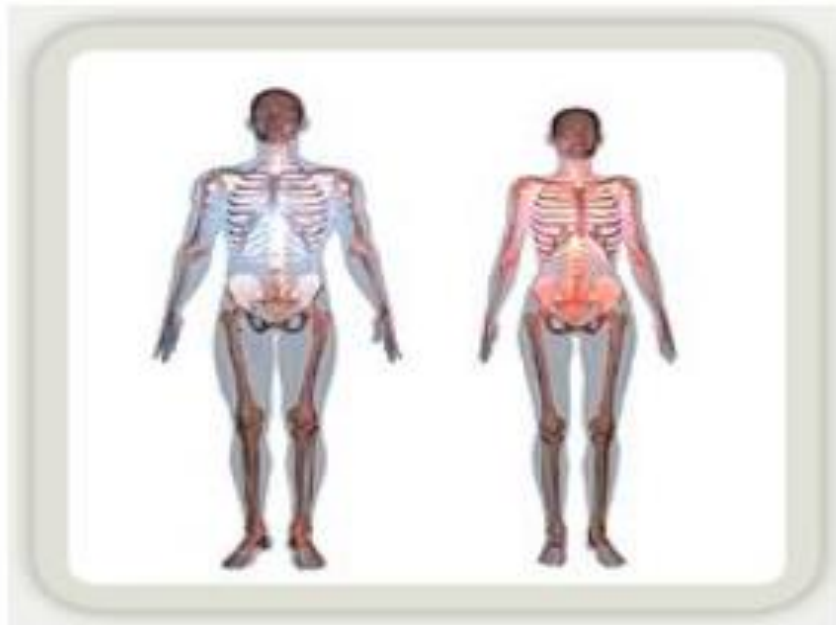


1.8 Ergonomics Approaches

- According to IEA, ergonomics broadly divide into three domains:

1.8.1 Physical ergonomics

- ✓ is concerned with human **anatomical**, **anthropometric**, **physiological** and **biomechanical** characteristics as they relate to physical activity.



Con...



- are concerned with the **interaction** of the **body** with the **equipment** and the tools, starting right from the chair to the computer.
- It also studies its **effect on the body**, for example, repetitive disorder, workplace safety, health and layout, musculoskeletal disorder and posture

1. 8.2 Cognitive ergonomics

- Cognitive science is the INTERDISCIPLINARY scientific study of mind and its processes.



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*How does
it work?*

COGNITION

*What does
it do?*

Con...

How is information processed?

emotion

reasoning

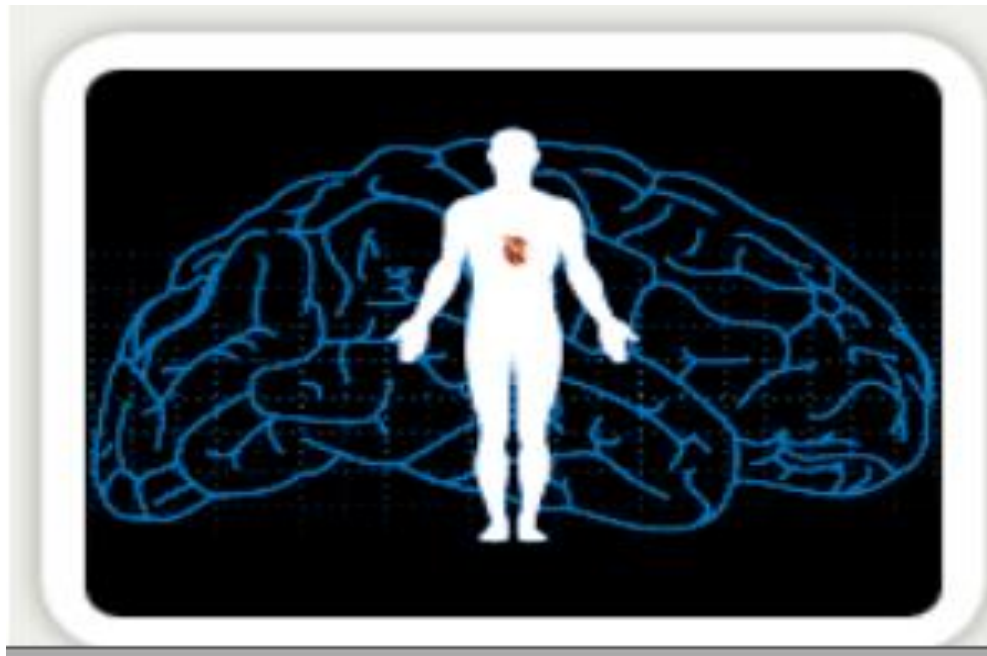
memory

language

perception

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It is concerned with **mental processes**, such as **perception**, **memory**, **reasoning**, and **motor response**, as they affect interactions among humans and other elements of a system.



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- Cognitive Science can be used to **analyze**, **describe**, **predict**, or even correct, augment, if not create minds. Some specific applications are:

❑ Human-Computer Interaction



Cognitive Science could lead to more effective and efficient Human Computer Interaction

Con...

Cognitive Robotics



Robocup



Hand-Eye system in RPI's
Cognitive Robotics Lab

Con...

Cognitive Prosthetics



Former blind, Jens Naumann can now see good enough to 'drive slowly around in a parking lot' thanks to a brain vision implant



Using EEG's (brain waves measured at scalp), patients that can't move their arms learn to control a cursor on a screen
- Wadsworth Research Lab, Albany, NY

Sensory Substitution



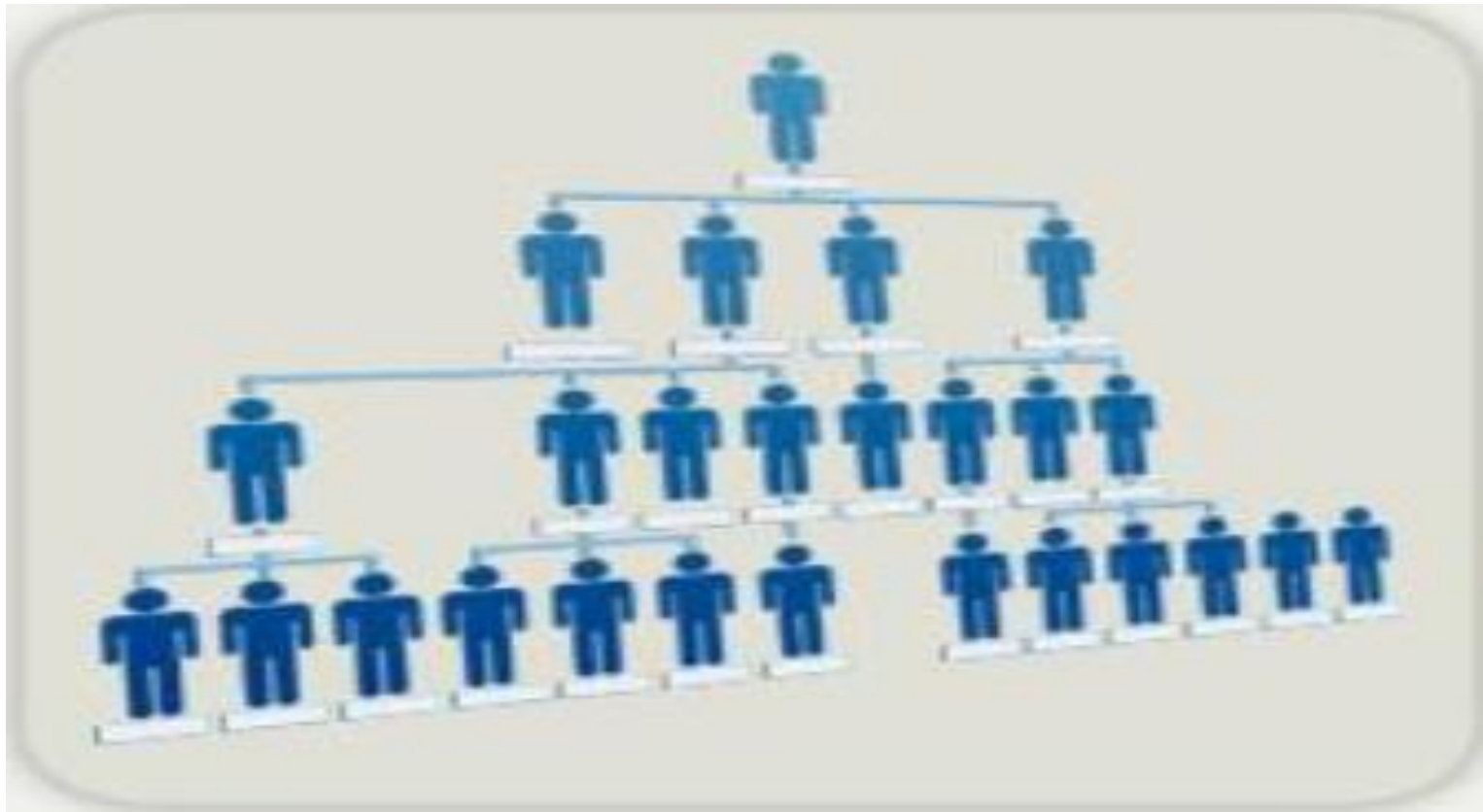
Seeing with Sound



See with tongue

1.8.3 Organizational ergonomics

- It is concerned with the optimization of socio-technical systems, including their organizational structures, policies, and processes

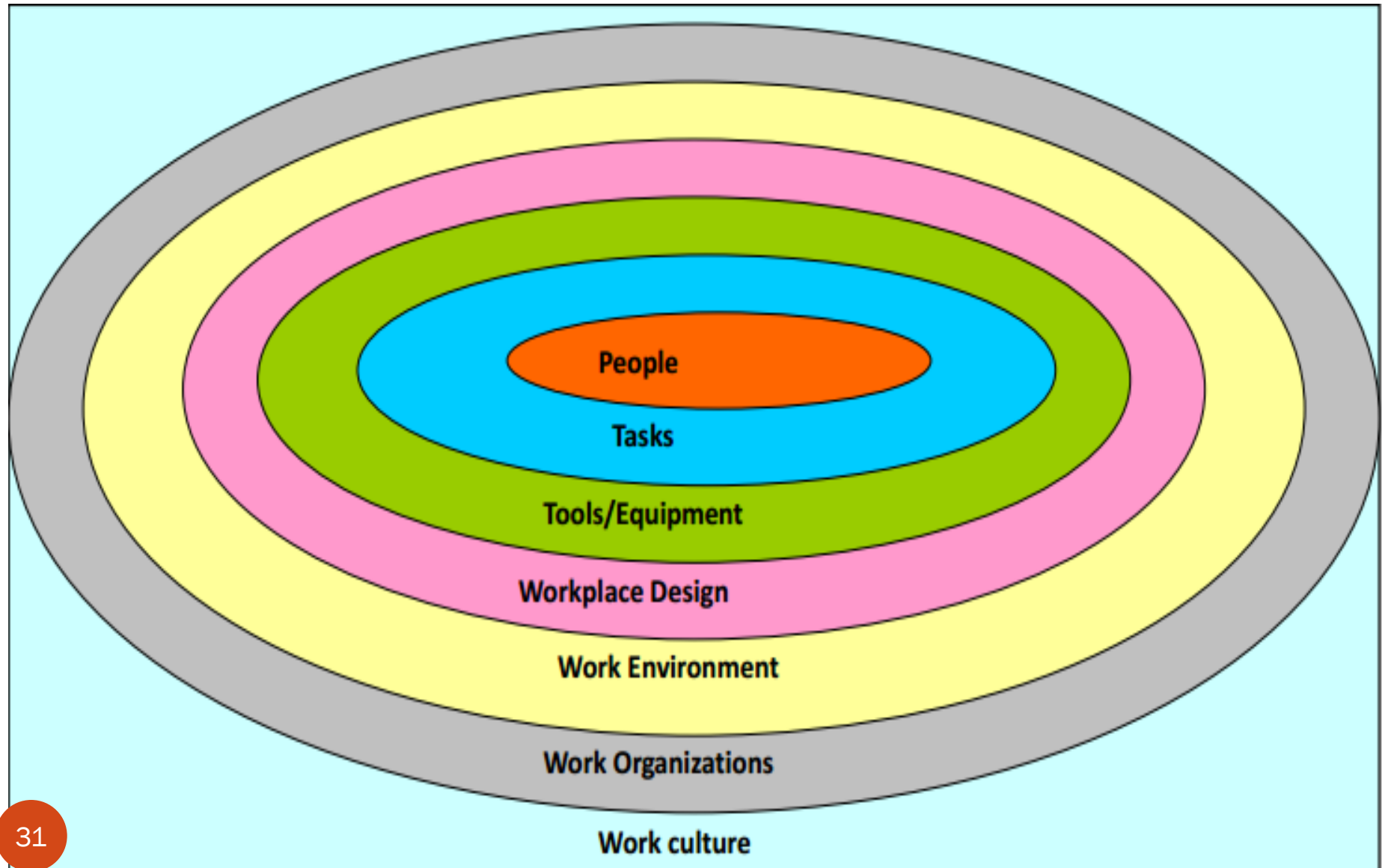


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- **Organizational ergonomic** works on complete optimization of the workplace, right from quality management to teamwork.
- It includes managing **everything** in the organization to make it a better place to work.



1.9 Ergonomics system Dimensions



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- **People** consider points about physical capacities, psychological drivers, expectations and individual differences.
- **Task Analysis** considers points about performance measures, quality requirements & what, how, when details.
- **Tools & Equipment** considers points about design of tools to suit (Persons and Tasks).
- **Workplace design** consider points about layout of workplace, workstation design, adjustability / adaptability and storage / transport of items.

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- **Work Environment** considers points about physical, psychological, chemical and biological.
- **Work Organization** consider points about job design, team based requirements, working hours / shift work, rest breaks and task specialization.
- **Workplace culture** consider points about management commitment / leadership, communication / consultation processes and feedback / performance management.

Con...

- **Effects of poor Ergonomics**

- ✓ Discomfort
- ✓ Accidents and injuries
- ✓ Fatigue
- ✓ Errors
- ✓ Illness
- ✓ Annoyance
- ✓ Productivity down

THANK YOU...!!

