

APPLIED ERGONOMICS

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SUBTOPICS IN ERGONOMICS

PHYSICAL ERGONOMICS

- Physiology
 - Musculoskeletal system
 - Metabolism & digestive system
 - Cardiovascular system
 - Respiratory system
- Anthropometry
 - Design principles
 - Collection of data & statistical tools
- Biomechanics

COGNITIVE ERGONOMICS

- Human Sensory system
 - Vision
 - Hearing
 - Tactile Sense
 - Olfactory Sense
 - Taste
- Perception
 - Detection
 - Recognition

COGNITIVE ERGONOMICS (CONTD.)

- Attention resources
 - selective, focused, divided, sustained etc.
- Memory
 - Sensory memory
 - Working memory
 - Long term memory
- Response selection & execution

COGNITIVE ERGONOMICS (CONTD.)

- Common Cognitive tasks
 - Decision Making
 - Planning
 - Problem Solving
- Design guidelines

RESEARCH METHODS

- Experimental Methods
- Analytical Tools
- Numerical Methods
- Ergonomics softwares

ERGONOMICS APPLICATION AREAS

- Work system design
 - Objectives: safety, accident avoidance, improved functional performance
 - Also includes environment such as lighting
- Product design
 - Objectives: safety, comfort, user-friendly, mistake proof, avoidance of liability lawsuits

ERGONOMISTS – WHAT THEY DO

- Research on human capabilities and limitations
 - Discover the characteristics of human performance, e.g., how much can an average worker lift?
- Design and engineering applications
 - Use the research findings to design better tools and work methods

Emphasis in Ergonomics

Safety

Comfort

Interaction between human and equipment

Workplace environment

Fitting the work to the individual

Reduction of human errors

Accident avoidance

FITTING THE PERSON TO THE JOB

- Considers worker's physical and mental aptitudes in employment decisions
 - For example, using worker size and strength as criteria for physical work
- Common philosophy prior to ergonomics
- FPJ is still important
 - For example, educational requirements for technical positions

FITTING THE JOB TO THE PERSON

- 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
 - Demographic changes (e.g. more women in the workforce)
 - Social and political changes (e.g., equal opportunity laws)

ERGONOMIC SYSTEM

CREATING AN ERGONOMIC SYSTEM

- A work system consists of
 - Human (H)
 - Machine (M)
 - Environment (E)
- Studying about the interactions between them is crucial for making a work system ergonomic. Six possible cases of interactions are possible (3C_2).

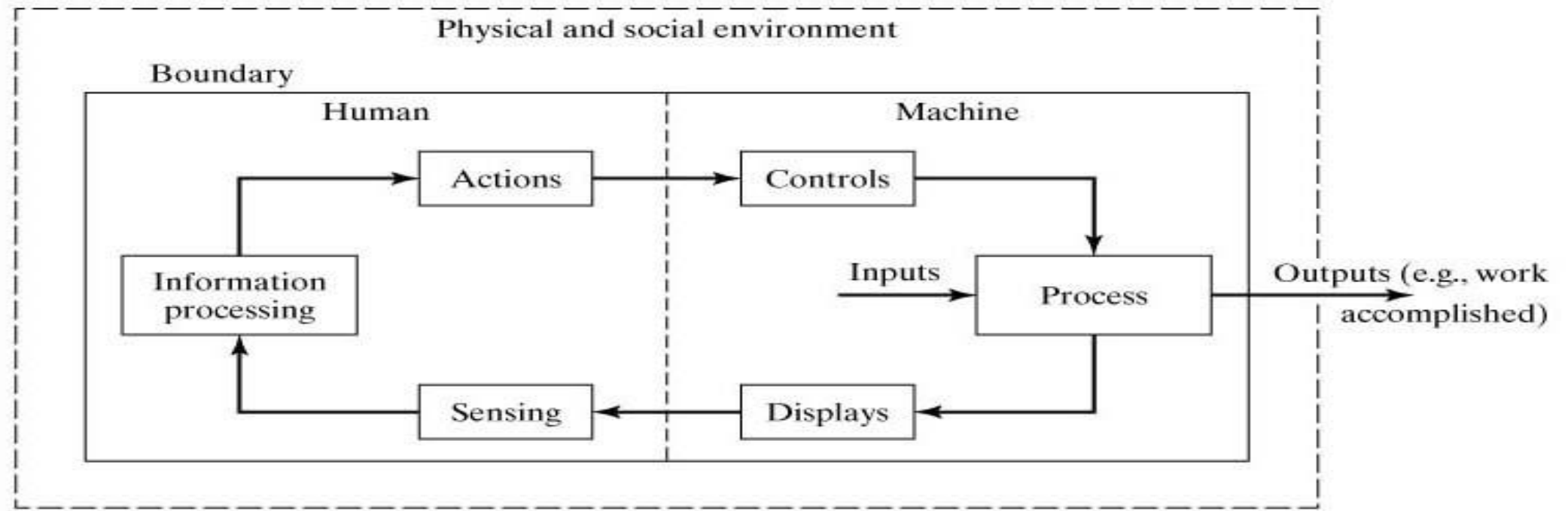
TYPES OF INTERACTIONS IN WORK SYSTEM AND THEIR EVALUATION

Interaction	Evaluation
H>M : the basic control action performed by the humans on the machine.Applications of large forces, 'fine tuning' of controls, stocking raw materials, maintenance, etc.	Anatomical: body and limb posture and movement, size of forces, cycle time and frequency of movement, muscular fatigue. Physiological: work rate(oxygen consumption, heart rate), fitness of workforce, physiological fatigue. Psychological: skill requirements, mental workload, parallel/sequential processing of information, compatibility of action modalities
H>E: effects of human on the local environment. Human emit heat, noise, carbon dioxide, etc.	Physical: objective measurement of working environment. Implications for compliance with standards.
M>H: feedback and display of information. Machine surfaces may be excessively hot or cold and a threat to the health of the human	Anatomical: design of controls and tools. Physical: Objective measurement of vibrations, reaction forces of powdered machines, noise and surface temperatures in the workspace. Physiological: does sensory feedback exceed physiological threshold? Psychological: application of grouping principles to design of faceplates, panels and graphic displays, Information load. Compatibility with user expectations
M>E: Machine may alter working environment by emitting noise, heat, noxious gases	Mainly by industrial/site engineers and industrial hygienists
E>H:The environment, in turn, may influence the human's ability to interact with the machine or to remain part of the work system (owing to smoke, noise, heat, etc.)	Physical/ physiological: noise lighting and temperature surveys of entire facility
E>M: the environment may affect the functioning of the machine. It may cause overheating or freezing of components, for example. Many machines require oxygen to operate. Oxygen is usually regarded as unlimited and freely available rather than part of the fuel.	Industrial/ site engineers, maintenance personnel, facilities management, etc.

HUMAN-MACHINE SYSTEMS

- Basic model in ergonomics
- Defined as a combination of humans and equipment interacting to achieve some desired result
- Types of human-machine systems:
 1. Manual systems
 2. Mechanical systems
 3. Automated systems

HUMAN-MACHINE INTERACTIONS



HUMAN COMPONENTS

- Human senses - to sense the operation
 - Vision, hearing, touch, taste, and smell
- Human brain - for information processing
 - Thinking, planning, calculating, making decisions, solving problems
- Human effectors - to take action
 - Fingers, hands, feet, and voice

*Work Systems and the Methods,
Measurement, and Management of
Work*

by Mikell P. Groover, ISBN 0-13-
140650-7.

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MACHINE COMPONENTS

- The process – function or operation performed by human-machine system
- Displays - to observe the process
 - Direct observation for simple processes
 - Artificial displays for complex processes
- Controls - to actuate and regulate the process
 - Steering wheel, computer keyboard

ENVIRONMENTAL COMPONENTS

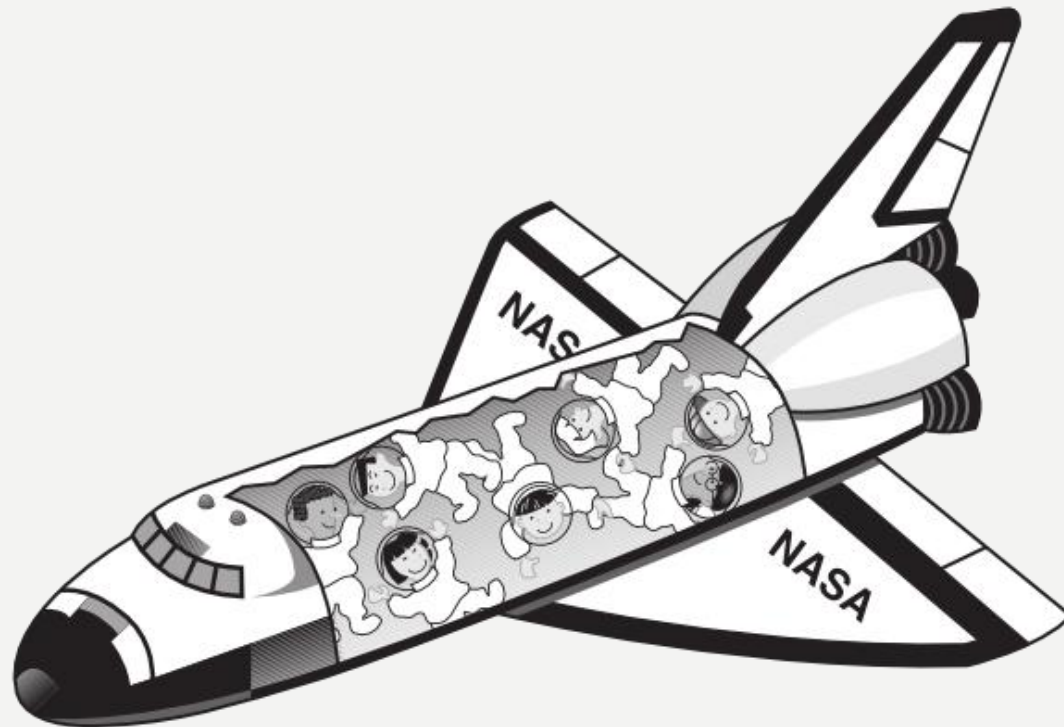
- Physical environment
 - Location and surrounding lighting, noise, temperature, and humidity
- Social environment
 - Co-workers and colleagues at work
 - Immediate supervisors
 - Organizational culture
 - Pace of work

OBJECTIVES OF ERGONOMICS

- Greater ease of interaction between user and machine
- Avoid errors and mistakes
- Greater comfort & satisfaction
- Reduce stress & fatigue
- Greater efficiency & productivity
- Safer Operations
- Avoid accidents and injuries

IF YOU WERE.....?????

- If you were an engineer in NASA, what factors will you consider and stress upon, while designing an space-craft which will be used by astronauts to travel in space.....???





THANK YOU ...



PLEASE READ HUMAN MACHINE SYSTEM
FROM RECOMMENDED REFERENCE BOOKS
FOR A BETTER UNDERSTANDING OF NEXT
LECTURE