CONCEPTS OF ERGONOMICS, NATURE OF ERGONOMICS PROBLEM, AND IMPORTANCE OF HUMAN INTEGRATED DESIGN

What ERGONOMICS IS?

ERGONOMICS is the application of scientific principles, methods, and data drawn from a variety of disciplines to the development of engineering systems in which people play a significant role [Karl KROEMER et al.].

Among the basic disciplines are psychology, cognitive science, physiology, biomechanics, applied physical anthropometry, and industrial systems engineering.

The engineering systems, to be developed, range from the use of a simple tool by a consumer, to a multiperson sociotechnical system.

Success is measured by improved productivity, efficiency, safety, acceptance of the resultant system design and, last, but not least, improved quality of human life.

What ERGONOMICS Does?

The fundamental task is to generate "tolerable" working conditions that do not pose known dangers to human life or health. When this basic requirement is assured, the next goal is to generate "acceptable" conditions upon which the people involved can voluntarily agree, according to current scientific knowledge and under given sociological, technological, and organizational circumstances. Of course, the final goal is to generate "optimal" conditions which are so well adapted to human characteristics, capabilities, and desires, so that physical, mental, and social well-being is achieved [Karl KROEMER et al.].

C. D. WICKENS et al., defined the goal of human factors (i.e. ERGONOMICS) as making the human interaction with systems one that

- **Enhances performance.**
- **Increases safety**
- **Increases user satisfaction.**

Therefore, ERGONOMICS is the study of "human characteristics for the appropriate design of the living and working environment" [Karl KROEMER et al.]. Its fundamental aim is that all human-made tools, devices, equipment, machines, and environment should advance, directly or indirectly, the safety, well-being, and performance of human beings.

Thus ERGONOMICS has two distinct aspects:

1. **Study, research, and experimentation, in which we determine specific human traits and characteristics that we need to know for engineering design.**
2. **Application and engineering, in which we design tools, machines, shelter, environments, work tasks, and job procedures to fit and accommodate the human. This aspect includes, of course, the observation of the actual performance of humans and equipment in the environment, to assess the suitability of the designed human-machine system and to determine possible improvements.**

In summary, ERGONOMICS adapts the human-made world to the people involved because it focuses on the human as the most important component of our technological systems. Thus, its utmost goal is the "humanization" of work. This goal is symbolized by [Karl KROEMER et al.] as E & E that is ease and efficiency, for which all technological systems and their elements should be designed. Such design requires knowledge of the characteristics of the people involved, particularly of their dimensions, their capabilities, and their limitations.

Human Factors Research Methodology

Comprehensive human factors research spans a variety of disciplines, from a good understanding of the mind and how the brain processes information to a good understanding of the physical and physiological limits of the body. But the human factors researcher must also understand how the brain and the body work in conjunction with other systems [Christopher D. WICKENS et al.].

Research methods are used by the human factors researchers to gather evidence about the behavior of humans interacting with systems in the real world. Thus, research involves the scientific gathering of observations or data and the interpretation of the meaning of these data regarding the research questions involved.

Human factors use standard methods for developing and testing scientific principles that have been developed over the years in traditional physical and social sciences. These methods range from the "true scientific experiment" conducted in highly controlled laboratory environments to less controlled but more realistic observational studies in the real world.

It is important for researchers to understand how practitioners ultimately use their findings. This enables a researcher to direct his or her work in ways that are more likely to be useful to design, thus making the science applicable.

The scientific study relevant to human factors can range from basic to much applied research.

- **Basic research can be defined as the development of theory, principles, and findings that generalize over a wide range of people, tasks, and settings. An example would be a series of studies that tests the theory that as people practice a particular activity hundreds of times, it becomes automatic and no longer takes conscious, effortful cognitive processing.**
- **Applied research can be defined loosely as the development of theory, principles, and findings that are relatively specific with respect to particular populations, tasks, products, systems, and/or environments. An example would be measuring the extent to which the use of a particular cellular phone while driving on an interstate highway takes driver attention away from primary driving tasks.**

While some specialists emphasize the dichotomy between basic and applied research, it is more accurate to say that there is a continuum, with all studies falling somewhere along the continuum depending on the degree to which the theory or findings generalize to other tasks, products, or settings.

Basic research is conducted in rigorously controlled laboratory environments, an advantage because it prevents intrusions from other confounding variables, and allows us to be more confident in the cause-and-effect relationships we are studying. Conversely, such a research is often simplistic and artificial and may bear little resemblance to performance in real-world environments. So, caution is required in assuming that theory and findings developed through basic research will be applicable for a particular design problem. For this reason, people doing controlled research should conduct controlled studies with a variety of tasks and within a variety of settings, some of which must be conducted in the field rather than in the lab.

<u>Conclusion (C. D. Wickens et al.):</u>

Only applied research is valuable to the human factors designer. It yields principles and findings specific to particular tasks and settings. A designer needs only to locate research findings corresponding to the particular combination of factors in the current design problem and apply these findings.

In addition, applied research such as field studies is often very expensive. It often uses expensive equipment. Often there are so few funds available for answering human factors research questions, or the time available for such answers is so short, that is impossible to address the many questions that need asking in applied research designs. As a consequence, there is a need to conduct more basic, less expensive and risky laboratory research, or to draw conclusions from other researchers who have published their findings in journals and books. These research studies may no have exactly duplicated the conditions of interest to the human factors designer. But if the findings are strong and reliable, they may provide useful guidance in addressing that design problem.