

# The Three Guiding Principles Of Ergonomics

By Dean L. Smith, M.S., D.C., and Marvin J. Dainoff, Ph.D.

**E**rgonomics, like chiropractic, can be considered a science, philosophy and art (practice). The term "ergonomics" (ergon + nomos) means the science of work. Today, professional ergonomists work with a wide variety of systems. These systems range from simple hand-held tools to complex equipment and software in different environments in order to optimize human well-being and system performance.

The science of ergonomics is thus concerned with developing knowledge about performance capacities, constraints and other attributes as they impact the relationship between humans and their (work) environments.

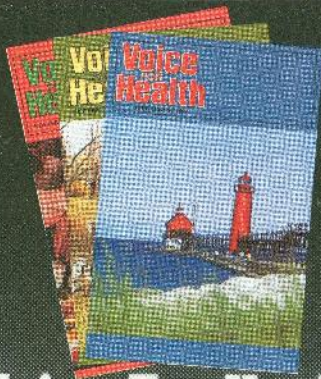
In fact, a fundamental principle of ergonomics is to optimize the fit between person and environment.<sup>1</sup> Because of this, ergonomics science is supported by thousands of scientists from diverse disciplines such as biomechanics, psychology, engineering and work physiology, to name a few.

Contemporary ergonomics, like chiropractic, means different things to different people. Just as some laypersons might perceive chiropractic as a "treatment" for various disorders, some perceive ergonomics as a discipline that aims to "treat" work-related maladies such as musculoskeletal disorders. Such a limited view, however, is not shared by all ergonomists.

## Toward A Proactive Approach

That ergonomists are not constrained by such tunnel vision to "treat" symptoms is reflected by many recent publications urging a more proactive, individual approach to performance and health enhancement.<sup>2,3</sup> This proactive approach seeks to optimize human-environment relations from the outset in addition to detecting and correcting the origins of ill-suited relations prior to the occurrence of problems.

The practice of ergonomics has tended to be technology oriented. Ergonomists are well aware that people work in complex sociotechnical systems that place enormous demands on them. Often the ergonomist, if consulted at all,



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is called in after the technology is selected in an effort to fit the human to the machine.

Although the technology-oriented approach has reduced accidents, and improved comfort and efficacy, it does have a problem. This approach is obviously *reactive* rather than *proactive*; the user of the technology is left to adapt to machine parameters rather than vice-versa. As a result, human performance is not optimized in the system. Thus, the person-oriented approach to ergonomic practice has become increasingly popular in recent years.

In general, efforts to investigate human interaction with complex systems is known as *macroergonomics*, while focus on the individual is termed *microergonomics*.

### Creating Optimal Worksites

Having reviewed some of the science, philosophy and art of the field, there are three guiding principles of ergonomics that can be surmised:

- **Principle 1:** Optimize the degree of "fit" between a person (intrinsic) and their environment (extrinsic). The degree of fitness can be operationalized by what is known as an *affordance*. Affordances represent a relation between a user and their environment, and affordances refer to properties in the world relative to the person's action capacity and goals. These affordances thus take into account the person, their environment and the interaction of person behaving in the environment.

- **Principle 2:** Optimize the intrinsic, "person" factors of the system. This means considering the individual constraints of how people can engage in safe and healthy behaviors. Several factors impinge on this principle.

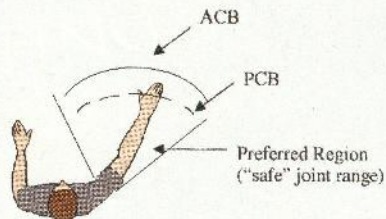
First, the boundaries of the functional behaviors must be demarcated. For example, you can obtain the boundaries

for a seated worker by determining the farthest (anatomically limiting) reach (known as the absolute critical boundary, ACB) and the most comfortable reach (located within the preferred critical boundary, PCB) that a person can make within the confines of their space (see figure).<sup>4</sup>

This reach "space" is often referred to as a reach *envelope*, because it encompasses all possible reaches. People don't prefer to operate near the extremes of their ranges of motion (ROM), as doing so may lead to inefficiency and ill-health.<sup>5</sup>

Indeed, it is often promoted that workers use the appropriate largest muscle groups to accomplish a task within "joint-safe" ROM. Other recommendations, such as performing contractions at the mid-point of their joint ROM, reducing repetitive motions and using rational lifting techniques, can be subsumed under this principle.

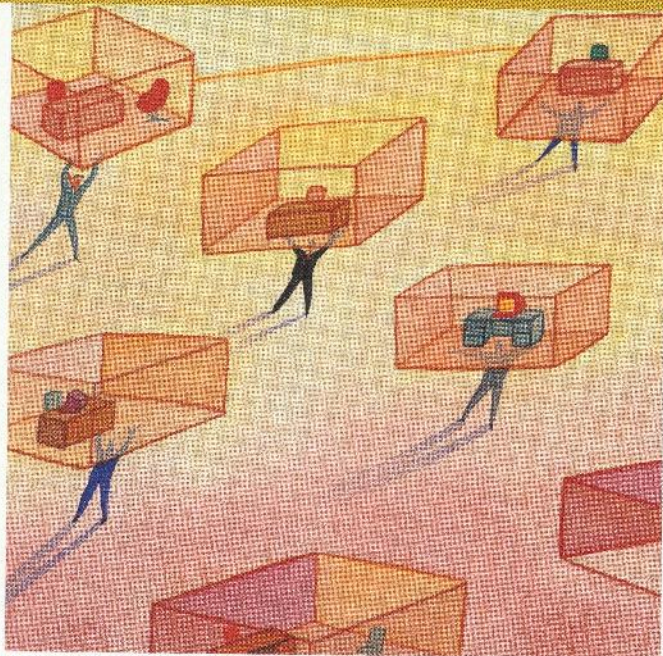
- **Principle 3:** Optimize the extrinsic, or "environment," factors of the system. This means considering how the environment influences person and system performance. For example, common approaches to workplace ergonomics



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programs emphasize prevention of work-related musculoskeletal disorders (WMSDs) through recognizing, anticipating and reducing risk factors. Other more proactive approaches are geared to preventing these kinds of problems from developing in the first place.

Proactive ergonomics begins with the design of work processes to recognize needs for avoiding risk factors that can lead to musculoskeletal problems. This means designing system functions that ensure proper selection and use of tools, job processes, workstation layouts and materials that impose no undue stress and strain on the worker. ■



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