**The Origin and Evolution of Human Factors and Ergonomics**

The terms Human Factors and Ergonomics have much in common and are interchangeable in many cases, but their origins and scientific roots are a bit different.

**The origin of ergonomics**

The first industrial revolution transformed human labor and led to large-scale manufacturing. As people realized that productivity could be improved by redesigning the way work was organized, scientific management, developed by Frederick Taylor, and work study, developed by the Gilberths, emerged in the early 20th century. These studies became precursors of ergonomics.

The key feature of Taylor’s scientific management is efficiency through measurement, standardization, and optimization. One of his most famous studies is the shovel experiment. Taylor and his team studied the relationship between shovel load and worker productivity, finding that the optimal load a worker could handle without tiring too soon was around 9.5 kg. Then they standardized shovels to hold about 9.5 kg per load. As a result, fewer workers were needed and output dramatically increased (FREIVALDS, 1986). In the Gilbreths’ work study, they broke down tasks into the basic movements and procedures and removed those inefficient or unnecessary actions. Productivity could then be enhanced by reconfiguring the remaining essential motions (Gilbreth & Gilbreth, 1916).

While both approaches significantly influenced modern work organization, they were heavily criticized, mainly because they treated humans like machines and underestimated human motivation and social interaction.

In the 1920s, some of the most famous studies in organizational psychology and human factors were conducted at the Western Electric Company in the United States. The original purpose was to investigate the effects of physical conditions, such as lighting and work hours, on workers’ productivity. Researchers wanted to find an optimal working environment and increase productivity. However, these studies ended up offering valuable insights into how social interactions influence workers’ productivity (Hassard, 2012). For example, in the bank wiring room study. Researchers observed 14 male workers without manipulating any conditions. They found that workers developed an informal agreement on the level of productivity, and this level often differs from the manager’s expectations. Workers who exceeded this level were pressured to slow down, and workers who lagged behind were encouraged to catch up.

The Hawthorne study highlighted the importance of psychological and social factors in the workplace, inspiring further research in occupational and organizational psychology. Over time, the prevailing perspective shifted from “fitting the man to the job” toward “fitting the job to the man”. This latter principle serves as the guiding philosophy of modern Ergonomics (Bridger, 2018).

**The origin of Human Factors**

During World WarⅡ, the United States lost hundreds of planes due to pilot error. Those pilots were highly trained, yet many mistakes were surprisingly basic. In 1942, a psychologist joined the research team and noticed a critical design flaw: the flaps and landing gear had identical switches, placed side by side and operated in sequence in the cockpit. Pilots frequently confused the two, retracting the gear when they intended to adjust the flaps. The psychologist introduced a simple fix: attaching a small rubber wheel to the landing gear lever and a small wedge-shaped piece to the flap lever. This change almost eliminated this kind of pilot error.

A couple of years later, experimental psychologists Paul Fitts and Richard Jones expanded on this idea. They proposed the hypothesis that so-called “pilot error” was actually a mismatch between characteristics of the designed world and characteristics of human beings. After analyzing hundreds of aircraft-control errors through interviews and written reports, they concluded that aircraft accidents could be reduced substantially by designing and locating controls in accordance with human requirements (Fitts & Jones, 1947).

These studies marked a turning point. They showed that the design of tasks, equipment, and environments must align with human characteristics – a realization that laid the foundation for human-centered design and the modern field of Human Factors.

**The birth of discipline**

After World WarⅡ, human factors (US) and ergonomics (UK) gradually developed into a distinct discipline and established their own societies. In 1950, the Ergonomics Research Society was founded in the UK – the first academic association in the field. In 1957, the Human Factors Society was founded in the US.

Over time, these two traditions have converged into a single field. In the US, the Human Factors Society has changed its name to the Human Factors and Ergonomics Society. In the UK, the Ergonomics Research Society has changed its name to the Chartered Institute of Ergonomics and Human Factors. A concise definition of the field was provided by John Wilson:

“Understanding the interactions between people and all other elements within a system, and designing in light of this understanding (Wilson, 2014).”

Human Factors and Ergonomics has been interdisciplinary since the very beginning; drawing practitioners and researchers from psychology, engineering, biomechanics, kinesiology, and beyond. To describe the capability required for professionals in this the, Dr. Shorrock (2018) proposed four kinds of thinking:

* Systems thinking: understanding system goals, structure, boundaries, dynamics, and outcomes.
* Design thinking: understanding the principles and processes of designing for human use.
* Humanistic thinking: understanding human agency, awareness, intention, and responsibility.
* Scientific thinking: solving the problem through scientific methods.

In short, Human Factors and Ergonomics is the study of human characteristics and limitations, as well as the characteristics of the outside task, machines, and environments, with the goal of improving performance, safety, and overall well-being by aligning the designed world to human needs.

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