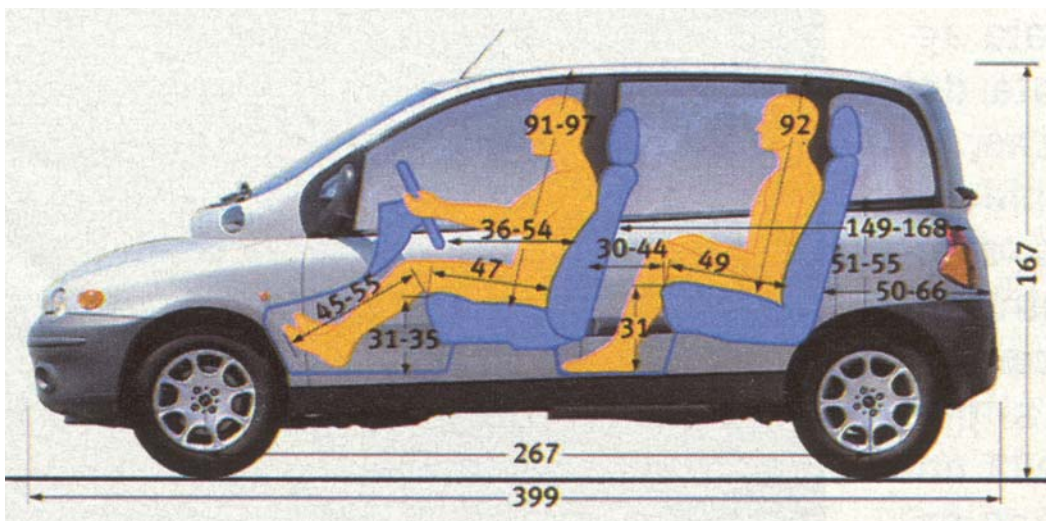
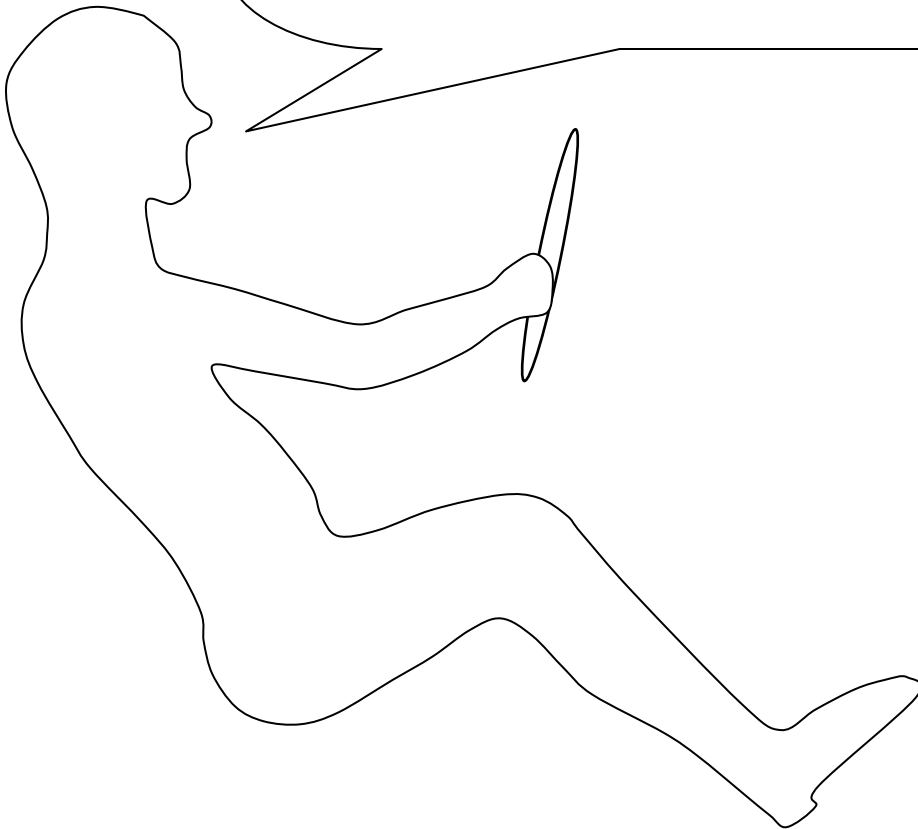


Physical Human Factors in Design



Prof. Joseph Giacomin
Brunel Design

Introduction



Gavriel Salvendy (1985)

“The word *ergonomics* implies the study of man at work while the word *human factors* implies the study of man in relation to equipment and environment.”

A Conventional History of Human Factors

Roman soldiers underwent well-organised training and conditioning until they could perform military exercises without sweating. “*Drying the Legions*” adapted the physiological capabilities of the recruits to the physical requirements.

In 1713 Ramazzini published the book “*The Diseases of Artists and Artisans*” which linked many occupational hazards to the work performed. *Cumulative Trauma Disorder* was first described, and believed to be caused by repetitive motions of the hand, by constrained body posture and by excessive mental stress.

A Conventional History of Human Factors

LaMettrie's 1748 book *L'Homme Machine* compared human capabilities to those of machines, a sensitive issue from as early as the beginning of the industrial revolution.

In the early 1800s Lavoisier, Duchenne, Amar and Dunod researched the *energy capabilities of the working human body*.

The word “*ergonomics*” was first used by Wojciech Jastrzebowski in a Polish newspaper in 1857. The word comes from the Greek *ergo* (work) and *nomos* (rules, law).

A Conventional History of Human Factors

At the beginning of the 20th century Frank and Lillian Gilbreth developed the concept of *time-and-motion study* and divided human movement into small micro-elements called “therbligs”.

In 1903 Frederick Taylor defined the scientific study of work in his publication *Shop Management*. Tasks were analysed and productivity enhanced by simplifying the movement patterns of workers.

In 1921 the National Institute of Industrial Psychology (NIIP) was founded in Great Britain under the direction of C.S. Myers. It conducted research into problems of general interest and published results in its Journal “*The Human Factor*”.

A Conventional History of Human Factors

During WWII human factors emerged as a separate discipline. The “*human factor*” as a part of a “*man-machine system*” became a major concern of the war effort, particularly in the design of aircraft.

Numerous *engineering psychology laboratories* were established immediately after WWII, both for military and commercial research.

The *Ergonomics Research Society* (now called the Ergonomics Society) was formed in 1950 in Great Britain.

The *Human Factors Society* was formed in the United States in 1957.

Has Human Factors Changed Over the Years ?

Chapanis, A.R. (1959)

“Human engineering is concerned with the engineering of machines for human use and the engineering of human tasks for operating machines.”

Behan, R.A. and Wendhausen, H.W. (1973)

“The main goals in human factors engineering are to consider any man/machine combination as a total system to insure that the equipment operational requirements do not exceed human abilities.”

Edwards, E. (1985)

“The most appropriate definition of the applied technology of Human Factors is that it is concerned to optimize the relationship between people and their activities by the systematic application of the human sciences, integrated within the framework of systems engineering.”

Has Ergonomics Changed Over the Years ?

Edholms, O.G. (1961)

“Ergonomics is fitting the job to the worker...”

Wolman, B.B. (1973)

“Ergonomics is the scientific study of the relationships between men and machines, particularly the psychological, biological and the cultural, with the purpose of adapting machines and jobs to meet the needs of men and of choosing suitable persons for particular jobs or machines.”

Harre, R. and Lamb, R.. (1983)

“The application of the human sciences to the study of work, including domestic and leisure activities. The core human sciences are anatomy, physiology and psychology, but there are also contributions from other subjects such as medicine, sociology and cybernetics.”

What does a Human Factors group at an automotive company do ?



... basically take responsibility for any aspect of the design which requires knowledge about the physical, perceptual or cognitive characteristics of humans.

Data Collection Methodologies

- Accident/injury records
- Cognitive ability testing
- Critical incident techniques
- Direct observation methods
- Environmental testing (noise, vibration, temperature, humidity, illumination, etc.)
- Interviews
- Mechanical work (HR, EKG, EMG, O₂ uptake)
- Psychological work (EEG, GSR, HR)
- Surveys/questionnaires
- Task performance measurements
- Time and motion measurements
- Time lapse photography
- Usability tests
- Verbal protocol analysis
- Visibility/legibility tests
- Vision/hearing tests

Human Factors Input to the Product Development Process

