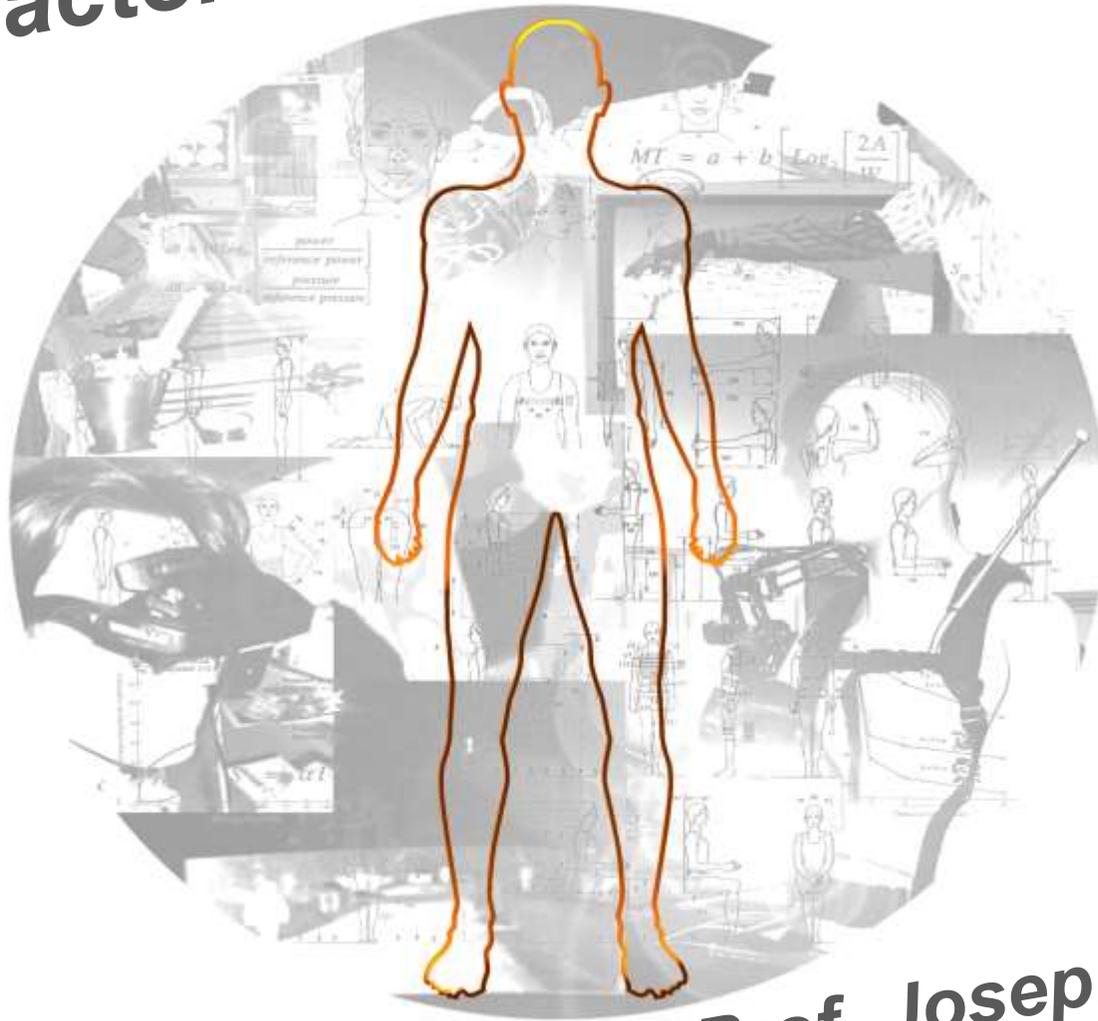


# Human Factors in Design



Prof. Joseph Giacomini

## **Gavriel Salvendy (1985)**

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

# History of Human Factors

Roman soldiers underwent 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 of military activity.

In 1713 Ramazzini published the book “*The Diseases of Artists and Artisans*” which linked 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.

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

# History of Human Factors

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).

# History of Human Factors

At the beginning of the 20<sup>th</sup> 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*. Productivity was enhanced by simplifying the movement patterns of the 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”.

# 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.

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.”**



**According to Brian Shackel (1991) Ergonomics and Human Factors have developed in stages:**

**1950s    ⇒    Military ergonomics**

**1960s    ⇒    Industrial ergonomics**

**1970s    ⇒    Consumer products ergonomics**

**1980s    ⇒    Human-computer interaction and software ergonomics**

**1990s    ⇒    Cognitive ergonomics and organizational ergonomics**

## So where are we now ?

The general trend is a reduced emphasis on matters of “physics”, which are now considered to be minimum requirements of good design, and a greater emphasis on matters of “metaphysics”.



# Customer Needs

**Eric Von Hippel of the MIT Business School has noted that “70% to 80% of new product development that fails does so not for lack of advanced technology, but because of a failure to understand users’ needs.”**

**Von Hippel, E. 2007, An emerging hotbed of user-centered innovation, Breakthrough ideas for 2007, Harvard Business Review, Article R0702A, February.**

# Customer Experience

**The importance of customer experience is clear from the economic performance of companies ranked using the Customer Experience Index.**

**Companies achieving high levels of customer experience (e.g. those in the index's top quartile) enjoy revenue gains of up to €70 million while companies characterised by low levels of customer experience suffer losses of up to €110 million.**

**Temkin, B.D., Manning, H., Melnikova, O. and Geller, S. 2008, The Business Impact of Customer Experience, Forrester Research.**



# Some Human Centred Design Tools

## Facts Regarding Humans and Society

- Anthropometric data sets and models
- Biomechanical data sets and models
- Psychophysical data sets and models
- Cognitive data sets and models
- Emotional data sets and models
- Psychological data sets and models
- Sociological data sets and models
- Philosophical data sets and models

## Capture of Meanings and Needs

### Verbally based

- Ethnographic interviews
- Questionnaires
- Day-in-the-life analysis
- Activity analysis
- Cognitive task analysis
- The five whys
- Conceptual landscape
- Think aloud analysis
- Metaphor elicitation
- Be your customer
- Customer journey
- Personas
- Scenarios
- Extreme Users

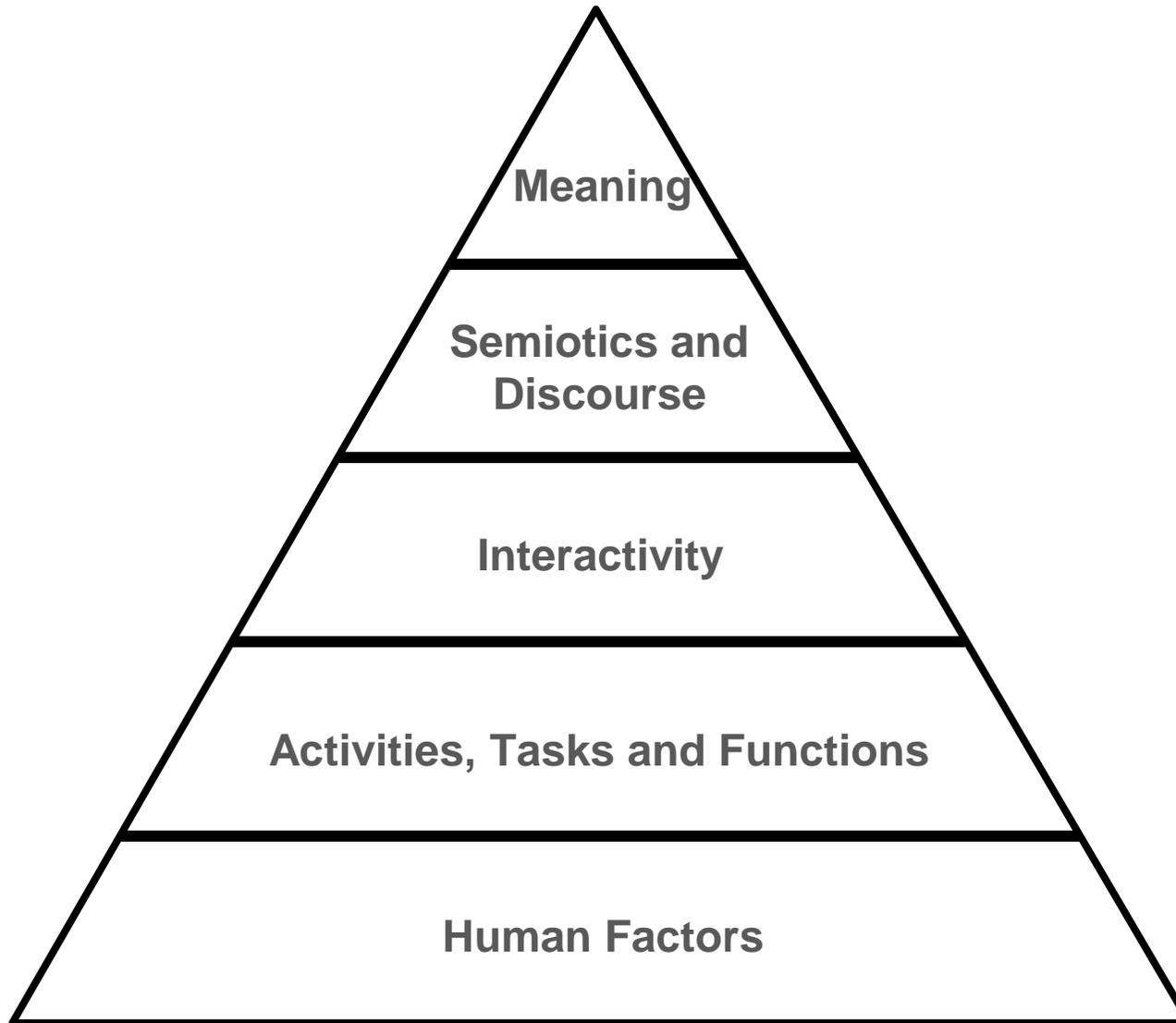
### Non Verbally based

- Game playing
- Cultural Probes
- Visual journals
- Error analysis
- Fly-on-the-wall observation
- Customer Shadowing
- Body language analysis
- Facial coding analysis
- Physiological measures
- Electroencephalograms

## Simulation of Possible Futures

- Word concept association
- Role playing
- Focus groups
- Co-design
- Experience prototype
- Real fictions
- Para-functional prototypes

# The Human Centred Design Pyramid



*Thank you.*

