

**1** Usability  
Introduction and historical background: **INTRODUCTION**



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Look on an everyday event: use of a new car



"Mike's new car" by Pixar



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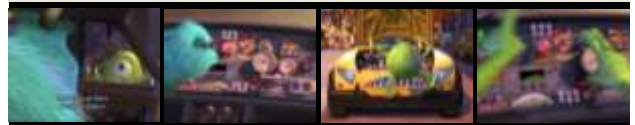


Sulley: "What was wrong with your old car?"  
Mike: "Three little words, Sulley: six wheel drive."  
Sulley doesn't feel comfortable.  
Mike: "It's adjustable." Sulley starts to adjust the seat playing with it.  
After switching on the car, appears a strange sound.  
Mike: "What? What? What?"  
Sulley fastens the belt easily, and Mike gets nervous.

- ▼ New product with "exaggerate, additional" functions
- ▼ Anthropometrical requirements
- ▼ Unknown automatism creates insicureness
- ▼ Frustration for common events leads to ...

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Look on an everyday event: use of a new car

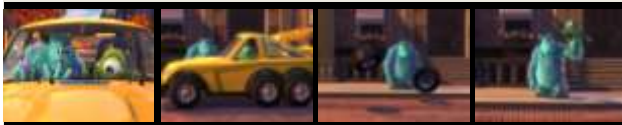


Mike falls out of the car.  
Mike: "Don't just sit there. Push the bottom."  
Sulley tries to interpret the complex interface of the car.  
Mike tries to close the motor cover  
Mike tries to switch off the wipers.

- ▼ ... emotive reaction.
- ▼ Usability and Cognitive Ergonomics
- ▼ Reduced mechanical usability of hi-tech products.
- ▼ Knowledge based human error ...

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Look on an everyday event: use of a new car



Car out of controll.  
Mike is angry about the insuccess of his presentation...  
... and destroys the car.  
Mike: "I miss my old car."

- ▼ ... leads to technology out of control.
- ▼ Emotive state leads to reactions out of control.
- ▼ Errate use of technology.
- ▼ Higher need of learning new technology.

**1** Usability  
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Look on an everyday event: use of a new car  
What is interesting for us, looking this short film?

- ▶ Customer **ask for more** as they need. Status symbol, curiosity, idea of innovation and technology Customer's input/needs
- ▶ Definition of **cultural background** of the user.
- ▶ The product has to fit to **anthropometrical requirements** (anyhow) Physical Ergonomics
- ▶ Physical interaction has to be related to **human capacity and size**
- ▶ **Automatism** to support complex systems. Define what can be done by man, and what by machine. However, correct feedback and control by the user Cognitive Ergonomics
- ▶ Interface which allows **control** also in "critical" situations
- ▶ **Intuitive interface** which self-communicate functions. Safety control and feedback Usability

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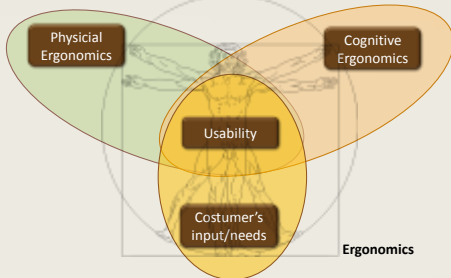
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Introduction and historical background: **INTRODUCTION**

Look on an everyday event: use of a new car  
What is interesting for us, looking this short film?

- Customer's input/needs
- Physical Ergonomics
- Cognitive Ergonomics
- Usability

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Look on an everyday event: use of a new car  
What is interesting for us, looking this short film?



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Introduction and historical background: **CONCEPT OF ERGONOMICS**

What means ERGONOMICS?  
When Ergonomics was introduced?  
What does it do with DESIGN ?

The word Ergonomics comes from the antique greek words **εργον**, which means *work, activity*, and **νομος**, which means *law, standard*.



Ergonomics is present in any item which man produces for his activities. As a scientific discipline it was born in **1945** in order to enhance the working conditions of the workers.

Ergonomics is a discipline wich describes our relation to the environment. Design deferns the forms of our live.

**1** Usability  
Introduction and historical background: **CONCEPT OF ERGONOMICS**

**Arens**



Physical factors (measurements, heights, biomechanics, etc) are indicated by "**physical ergonomics**"

Sensorial factors (view, hearing, feeling, smelling, and also thermal well being) are indicated by "**sensorial ergonomics**"

Cognitive factors (usability, delightfulness, perception, psychological reactions, etc) are indicated by "**cognitive ergonomics**"

Learning factors (symbols, significances, software etc) are indicated by "**Interface ergonomics**"

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Introduction and historical background: **CONCEPT OF ERGONOMICS**

**The applications of ergonomics today**

Ergonomics is an **interdisciplinary science**

Ergonomics is a "**soft science**"

Ergonomics is a "**science near to the praxis**"

**But it cannot offer an unique, optimal solution, but normally offers the best compromise for a problem among different alternatives.**



**1** Usability  
Introduction and historical background: **CONCEPT OF ERGONOMICS**

**Definizioni**

*"Adapt the work to human being"*  
(K.H.F. Murrel nel 1949)

Ergonomics is an corpus of interdisciplinary knowledge, which is able to analyse, design and evaluate simple or complex systems, **where man is operator or user.**

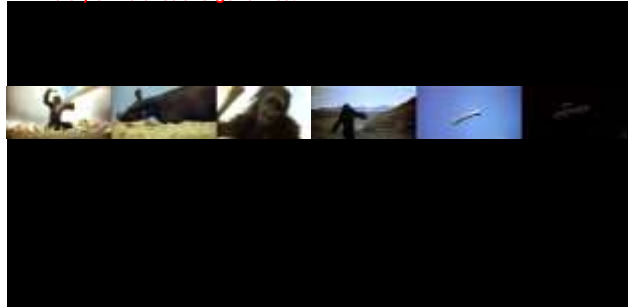
The goal of ergonomics is not to eliminate activities, but to create conditions which make these activities more comfortable and fast running.

**Any ergonomical improvement aims to a better condition of life.**

Definition of ergonomics by SE (Società italiana dell'Ergonomia)

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Introduction and historical background: **HISTORICAL BACKGROUND**

**History or Histories of ergonomics?**



**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**History or Histories of ergonomics?**

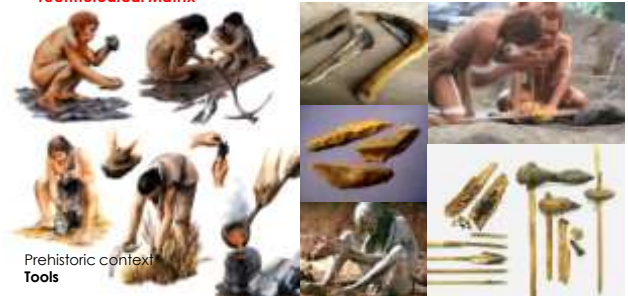
**Technological matrix**  
The technological development, both the industrial production and the **use of appliances** ( particularly the military ones) have contributed to the birth and development of research in ergonomics

**Multidisciplinary matrix**  
The evolution of any of the **involved sciences** (as biology, psychology, medicine etc) have contributed to the contents of ergonomics in different times and methods.

**Social matrix**  
Related to social groups, mainly involved in certain work processes, or related to parts of the population (workers, military, manager etc) , ergonomics has been dedicated to **specific activities** of the users.

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Introduction and historical background: **HISTORICAL BACKGROUND**

**Technological Matrix**



Prehistoric context  
Tools

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Introduction and historical background: **HISTORICAL BACKGROUND**

**Technological Matrix**

Prehistoric context  
**Weapons**



Coltello Freccia Lancia

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Introduction and historical background: **HISTORICAL BACKGROUND**

**Technological Matrix**



Inventions  
**Wheel, steam engine**

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Introduction and historical background: **HISTORICAL BACKGROUND**

**Technological Matrix**



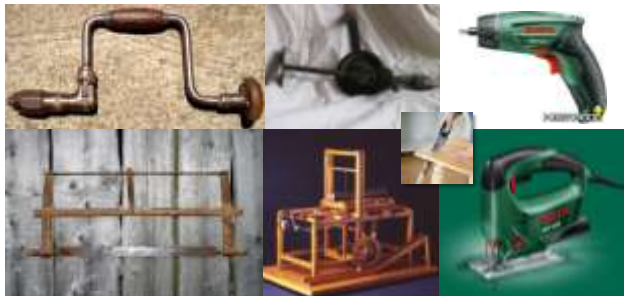
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Introduction and historical background: **HISTORICAL BACKGROUND**

**Technological Matrix**

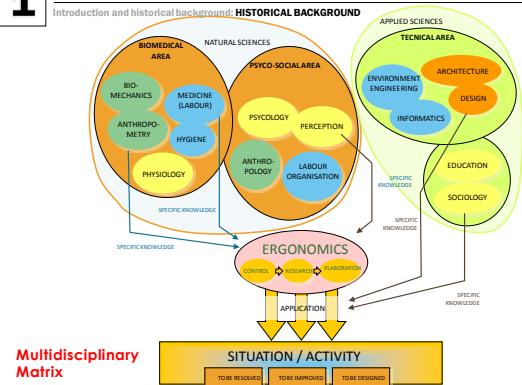


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Introduction and historical background: **HISTORICAL BACKGROUND**

**Technological Matrix**



**1** Usability  
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**Social Matrix**



**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**Social Matrix**



**1**

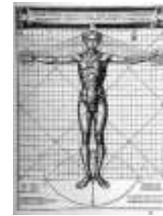
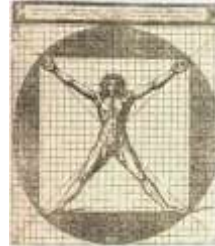
Usability

Introduction and historical background: **HISTORICAL BACKGROUND****The Vitruvian Figure**

"The **center** of the human body is naturally the **navel**. If a man would lie on his back with his hands and feet stretched out, pointing then the compass on the navel, one might describe a **circle** where you will touch the tips of the fingers of both **hands and feet**. Also by measuring the distance from the feet to the top of his head, comparing it to the measure between both open hands, one will find that height and width are the same as in a **square area**."

*De Architectura, III libro di Vitruvio***1**

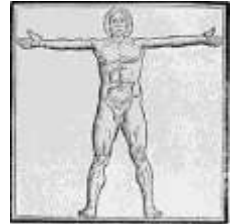
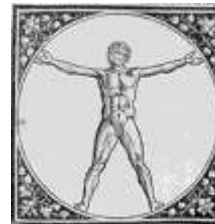
Usability

Introduction and historical background: **HISTORICAL BACKGROUND****The Vitruvian Figure***Figura Vitruviana, Cesare Cesariano 1521***1**

Usability

Introduction and historical background: **HISTORICAL BACKGROUND****The Vitruvian Figure***De Architectura, Francesco Giorgi 1525***1**

Usability

Introduction and historical background: **HISTORICAL BACKGROUND****The Vitruvian Figure***De Architectura, Fra Giovanni Giocondo, 1511***1**

Usability

Introduction and historical background: **HISTORICAL BACKGROUND****The Vitruvian Figure***Uomo vitruviano, Mariano di Iacopo, detto Taccola***1**

Usability

Introduction and historical background: **HISTORICAL BACKGROUND****The Vitruvian Figure***Trattato di architettura by Francesco di Giorgio Martini 1521*

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

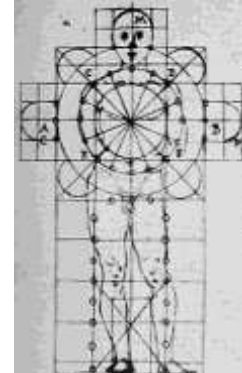
**The Vitruvian Figure**



*Trattato di architettura* by Francesco di Giorgio Martini 1521

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

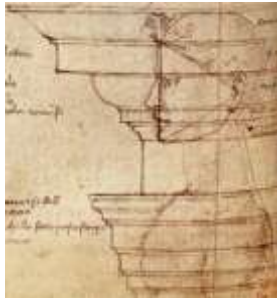
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**1** Usability  
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**The Vitruvian Figure**



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**The Vitruvian Figure**



*Figura Vitruviana* by Leonardo da Vinci, 1490

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**The anatomical studies by Leonardo**



Studies on the upper limbs



Royal Collection (RLW), 19003v; K/P 137v

Royal Collection (RLW), 19000v; K/P 135v

**1** Usability  
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**The anatomical studies by Leonardo**

Studies on the upper limbs

Royal Collection (RLW), 19008r; K/P 140r



Studies on the backbone structure

Royal Collection (RLW), 19007v; K/P 139v



**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**The anatomical studies by Leonardo**

Studies on the cervical backbone  
Royal Collection (RLW), 19075v; K/P 179v



"You will make the first draft of the neck with the use of ropes like the tree of a ship near to the coast... Then fix the head with the ropes in order to give movement!"

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**The machines by Leonardo**



Measurement of the static forces of arm muscles  
Ms.H (IFP), cc. 43r e 44r



Flying machine for man

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Introduction and historical background: **HISTORICAL BACKGROUND**

**The machines by Leonardo**



Meccanismo  
Codice del Volo degli Uccelli

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**The machines by Leonardo**



The heart as oven  
Codice Arundel (BL), c. 24r (particolare)



Turnable joint  
Codice di Madrid I (BNM), c. 62r (detail)

Turnable joint  
Codice di Madrid I (BNM), c. 172r (detail)

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Introduction and historical background: **HISTORICAL BACKGROUND**

**The machines by Leonardo**



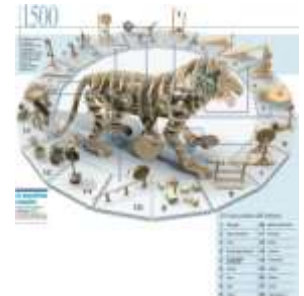
System of trasmission of legs of a robot  
Codice di Madrid I (BNM), c. 90v-91r



Modern prototype of a robot by Leonardo da Vinci

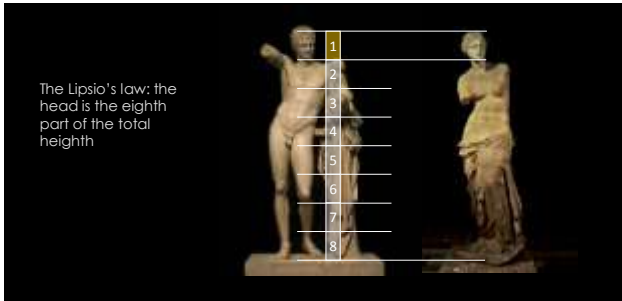
**1** Usability  
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**The machines by Leonardo**



**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**Proportions**



**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**

**Proportions**



The sculpture *Doriforo* shows the application of the canon, by Policleto.

3 dancing girls, Pablo Picasso

"[...] Knowing that goodness of figure can be done by imitation of live, but the movement of this figure must be born from great discretion of genius"  
Leonardo da Vinci



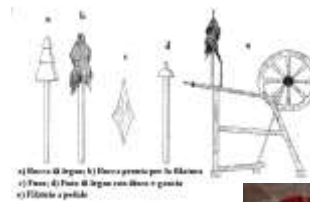
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**Industrial Revolution**



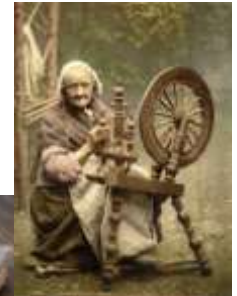
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**Industrial Revolution**



a) Marco di legno b) Marco grande per la filatura  
c) Fuso; d) Fuso di legno con il filo e grande  
e) Filatura a pedale

The traditional cotton spinning



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Introduction and historical background: **HISTORICAL BACKGROUND**

**Industrial Revolution**

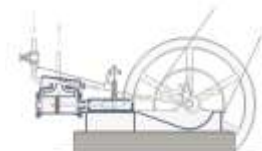
James Hargreaves's Spinning Jenny



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**Industrial Revolution**

The Spinning Jenny, with water frame, invention by Sir Richard Arkwright (1769)



In 1787 a steam machine is installed instead of the hydraulic wheel, which rises up definitely the industrial production: the physical man's force has been replaced by a machine.



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**Industrial Revolution**

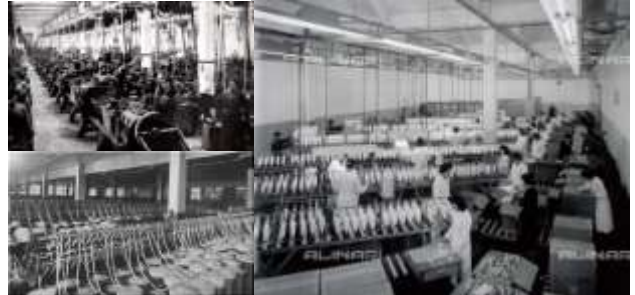


The only surviving example of a Spinning Mule built by the inventor Samuel Crompton (a combination of the Spinning Jenny and the Water Frame)

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**Industrial Revolution**



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**Industrial Revolution**



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**Industrial Revolution**



Many children work in the fabrics



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**Industrial Revolution**

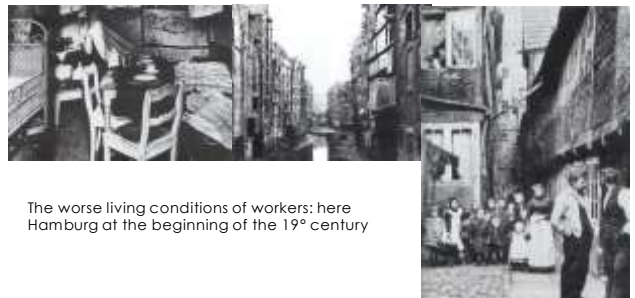


Over London by Rail  
Gustave Doré c. 1870.  
Shows the densely populated and polluted environments created in the new industrial cities

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Introduction and historical background: **HISTORICAL BACKGROUND**



**Industrial Revolution**



The worse living conditions of workers: here Hamburg at the beginning of the 19° century

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Introduction and historical background: **HISTORICAL BACKGROUND**  2012\_2013

### The rise of occupational medicine



Charles Turner Thackrah  
1795 - 1833

Born in the first half of the nineteenth century the **occupational medicine** as a discipline, Thackrah help to implement the **Factory Act of 1833**, which prohibited employment of children under nine years in the textile mills, forbade night work and reduced working hours for enable young people from 8 to 13 years to attend school.

Thackrah suggested some corrective measures, claiming for the adoption of working tables with a larger circumference and more comfortable seats, which allow the workers to operate with their eyes and their hands closer to the work surface, the spine not curved and body relaxed

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**  2012\_2013

### The rise of occupational medicine

**The Factory Act 1833** (3 & 4 Will. IV) c103 was an attempt to establish a regular working day in the textile industry. The act had the following provisions:

- **Children (ages 14–18) must not work more than 12 hours a day** with an hour lunch break. Note that this enabled employers to run two 'shifts' of child labour each working day in order to employ their adult male workers for longer.
- **Children (ages 9–13) must not work more than 8 hours** with an hour lunch break.
- **Children (ages 9–13) must have two hours of education per day.**
- Outlawed the employment of children under 9 in the textile industry.
- Children under 18 must not work at night.
- provided for routine inspections of factories.

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**  2012\_2013

### The rise of occupational medicine

**The Factories Act 1844** (citation 7 & 8 Vict c. 15) further reduced hours of work for children and applied the many provisions of the Factory Act of 1833 to women. The act applied to the textile industry and included the following provisions:

- Children 9–13 years could work for 9 hours a day with a lunch break.
- Women and young people now worked the same number of hours. They could work for no more than 12 hours a day during the week, including one and a half hours for meals, and 9 hours on Sundays.
- **Factory owners must wash factories with lime every fourteen months.**
- **Ages must be verified by surgeons.**
- Accidental death must be reported to a surgeon and investigated.
- Thorough records must be kept regarding the provisions of the act.
- **Machinery was to be fenced in.**

**1** Usability  
Introduction and historical background: **HISTORICAL BACKGROUND**  2012\_2013

### Taylor and the chain assembly



Frederick Winslow Taylor  
(1856 - 1915)

The method of Taylor provided the accurate study of the individual movements of the worker in order to optimize the working time.

- Consider a group of 10-15 workers, engaged in work to be analyzed;
- Studying the precise series of movements that make up the work that each worker applies to the state of departure;
- Determine the time required for each movement and see if there is a more rapid way of acting;
- Eliminate all slow movement or unnecessary;
- describe an optimized sequence of movements so determined.

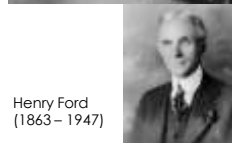
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### Taylor and the chain assembly



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(1856 - 1915)

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Henry Ford  
(1863 - 1947)

**1** Usability  
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### Taylor and the chain assembly

Modern Times, Charlie Chaplin, 1936



**Taylor and the chain assembly**



**The rise of ergonomics as a discipline**

In 1857 an article by the Polish scientist Jastrzebski (1799 - 1882) carries the title "The place of ergonomics or the rule of work based on truth found in natural history"



Wojciech Jastrzebski (1799 – 1882)



**The rise of ergonomics as a discipline**

Deutscher Werkbund  
Caricature of Karl Arnold on the controversy of the 1914 Werkbund Congress: Van de Velde offers an individual chair, Muthesius offers a chair "type", while the craftsman makes the chair to sit.



Peter Behrens (1868 – 1940)



Walter Gropius (1883 – 1969)

**The rise of ergonomics as a discipline**



...from factory with manual labor to automated plant

**The rise of ergonomics as a discipline**

**WEAKNESSES IN MODERN WORK**

- **job search**  
aid from the state: the introduction of the labor exchange
- **hiring and firing**  
rights of the workers, company and individual contract
- **inappropriate activities**  
job interview, placement and training plan
- **low wages**  
guarantee of minimum wages, adequate professional training
- **long hours**  
Daily Working Hours 8 hours max, to insert recreation pauses
- **poor working conditions**  
cleanliness, order, ventilation and lighting of working environments

**The rise of ergonomics as a discipline**

**WEAKNESSES IN MODERN WORK**

- **accidents**  
job security, adequate first aid
- **working diseases**  
appropriate equipment, work shifts and different jobs
- **Unemployment**  
aid from the state: the introduction of the labor exchange
- **inadequate management (work and personal)**  
work plan, tasks defined, coherent governance and equal for all
- **hygiene and nutrition for the workday**  
adequate facilities (toilets, drinks machines, canteen etc)

### The rise of ergonomics as a discipline

#### OCCUPATIONAL SAFETY

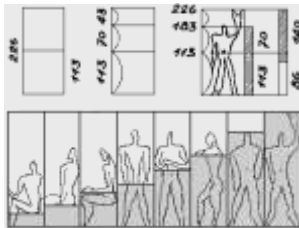
- machinery and equipment checked and certified
- mechanical protection of the worker
- appropriate clothing
- protective shielding
- alternate activities to avoid monotony and early fatigue
- support by machines and equipment for repetitive and heavy work
- protection against toxic elements
- medical surveillance (preventive and emergency services)

### The rise of ergonomics as a discipline

Ergonomics applies today especially in the following areas and follow certain methods:

Set **product development** around the operational tools of ergonomics. The productive sectors particularly involved are:

- > Furniture industry (domestic, work and public), particularly office.
- > Computer products (hard-and software)
- > Appliances, hi-fi and technology (DVD-player, TV, phone, etc.)
- > Cars, transport vehicles of all kinds, including caravan, motorhome
- > Public environments (for guidance, security, etc)
- > Equipment and machinery, especially for leisure and business
- > Clothing (shipbuilding, domestic, etc)
- > Medical devices (chairs for dentists etc)



The Modulor of Le Corbusier, 1946  
The Golden Section



"I go there, where things are ordered in the great conflict man and nature, in the battle for survival and pleasure in the fruits of their work, under the vault of heaven, and the laws of the seasons and the song of the sea."

"... It is time to get back to the basics, which found the human. The man is again recognized as a value psycho-physiological and environment is searched for its nature. It's important that the laws of nature between man and environment are perceived again and that we are engaged for an unity. To have harmony the same spirit that is present in nature must be present in humans. "

The Modulor of Le Corbusier, 1947-1952  
Bassorilievo Unité d'Habitation. Marseilles

