

From the Guest Editor

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# Ergonomics in Design and Design in Ergonomics

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## 1. Introduction

The aim of Ergonomics in Design is to evaluate and design the global quality of systems which people enter into a relationship with during their work activities and daily life. Quality involves the globality of people's experience - physical, sensory, cognitive and emotional. To do this, all variables that define the context in which that relationship is implemented, their reciprocal conditioning and their variability over time, should be accurately evaluated and designed.

The International Ergonomics Association (IEA) defines Ergonomics as *“the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. Practitioners of ergonomics and ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people”*.

The central focus of Ergonomics, therefore, is the interaction that people establish, or can establish, with other elements of the system in which, and with which, they work and carry out daily activities.

“Ergonomics and Human Factors are now terms, synonymous and accepted throughout the world, that describe the theory and practice of study-

ing human characteristics and abilities, and then using that knowledge to improve people's interactions with the things they use and the environments in which they do it”. [1]

Interactions take place within a complex system, in which each element conditions and modifies the others and which people, with their characteristics, abilities, needs and expectations, form an integral part of.

The goal of Ergonomics is to optimise, that is, improve to the highest possible degree, both the well-being of people and the overall performance of the system, through evaluation and design activities that aim to make systems and environments compatible with people's needs, abilities and limitations.

## 2. The Ergonomics-Design relationship: Designing product quality

The basis for the relationship between Ergonomics and Design, and its growth over time, is the definition of Human-Centred Design. Today, this is largely comparable to the definition of Ergonomics; it represents its most recent component and is the closest to the culture and practice of design.

According to ISO standards, *“Human-centred design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and*

*usability knowledge and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance”*<sup>[1]</sup>.

User/Human-Centred Design (HCD) describes a design approach that is aimed at the quality of the interaction between people and systems they come into contact with, based on collecting and processing essential data so as to understand people’s needs through structured and verifiable methods for study and evaluation.

HCD, therefore, is an approach to design that uses the person as a point of departure and goal for any intervention and, at the same time, is a methodological approach to the study, evaluation and interpretation of the people’s needs and expectations – both conscious and unexpressed – and their translation into the design process.

The concept of “product quality” coincides in Ergonomics with the quality of the interaction that the user establishes - or can establish - with that product, and can be defined in terms of compatibility between people characteristics and capabilities and product characteristics, according to the different conditions of use, and the needs of the user who actually uses - or can use - that product. Needs that must be identified and evaluated taking into account all the elements that define the interaction, and finally the value, which it can be attributed to the relationship with the product and to the experience that derives from it, that is to say the judgment that each of us expresses, consciously or not, in terms of annoyance, appreciation, extraneousness or familiarity.

The quality evaluation and design do not refer therefore to the product itself but, on the contrary, to the system of relationships that the user establishes - or can establish - with that product, within the different - and possible - contexts in which such relationships can be realized.

Applied to the design sector, and in particular to the processes of design and development of industrial products, the concept of ergonomic quality therefore takes on a broader and more concrete meaning than the now consolidated usability one, involving the compliance of the product with the needs of physical compatibility (anthropometric, biomechanical and perceptive) of safety, well-being, and finally of value

- emotional and subjective - that the individual-user attributes to his relationship with the product.

In other words, the ergonomic quality of the product summarizes the subjective dimension of interaction and presupposes the compatibility of the product with its physical and perceptive dimension evaluated on the basis of the contents and methods of the so-called traditional ergonomics.

The concept of ergonomic “product quality” coincides with the meaning of user experience as “person’s perceptions and responses resulting from the use and/or anticipated use of a product, system or service. User experience includes all the users’ emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during and after use”<sup>2</sup>.

Similarly, the Ergonomics in Design’s take on the User/Human Centered approach, and in particular its theoretical and methodological tools, setting them in the complexity of the relationship between people and product, evaluating it in all dimensions (physical, perceptive, cognitive and emotional) in which this relationship takes place, and on the basis of the equally complex system of constraints and priorities that characterizes the process of designing and manufacturing products.

The content of Ergonomics in Design is in fact on two non-separable levels: the first is constituted by usability and user experience evaluation methods, which can identify and evaluate people needs and expectations; the second, by the basic interdisciplinary knowledge concerning people’s characteristics and capabilities.

Its innovative value is the organic nature of the two cognitive levels - assessment methods and basic interdisciplinary knowledge - which constitute both the methodological and operational tools able to guide the entire product development.

**Thus**, Ergonomics – and Ergonomics in Design - are based on a complex approach to the evaluation and design of the interaction between people and the systems they come into contact with, one that does not focus on the quality of the system itself but on the quality that is actually experienced by the specific group of people who have contact with it, depending on their characteristics, abilities, needs and expectations, the activities they perform and the collection of variables (physical, technological, environmental,

<sup>1</sup>ISO 9241-210: 2010, Ergonomics of human-system interaction. Human-Centred design for interactive systems.

<sup>2</sup>ISO 9241-210: 2010, Ergonomics of human-system interaction. Human-Centred design for interactive systems.

organisational, cultural) that may affect that interaction on a case-by-case basis.

This special section in *WORK* proposes a broad reading of the main topics of Ergonomics in Design. All articles represent interesting examples of a proactive and design ergonomic approach. The articles present, first of all, have a highly iterative approach to design, based on the assessment of people's needs through the application of survey methods specific to Human-Centred Design. In all the articles we can read, in fact, a strongly methodological approach in which the usability and User experience evaluation methods are the basis of both the evaluation phase and the design phase.

The article "**Design of an ergonomic gestural interface for professional road cycling**" explores the design of an ergonomic interface based on micro-gestures that can allow cyclists to interact with a device while holding the handlebar. Of great interest is the methodological approach: three different studies were conducted with seven professional cyclists adopting the gesture-elicitation technique.

The article "**The user experience (UX) on female apparel e-commerce websites in Brazil**" presents the results of an investigation concerning the user experience (UX) resulting from the interaction with female e-commerce websites.

The theme of ergonomics education is the subject of the article "**Ergonomics in design and design**

**in ergonomics: Issues and experience in design and ergonomics education**" with an approach oriented to design innovative solutions. The article is focused on evaluation aimed at new pedagogical settings, enabling students of both fields to develop their abilities and equip them to take action in concrete design situations.

The origin of the articles from very different countries is also very interesting. In all these countries the methodological and design approach is common to research in Ergonomics and Design.

## References

- [1] Rubin J, Chisnell D. Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests, John Wiley, Indianapolis USA 2011.
- [2] Shorrock S, Williams C. (edited by – 2017), Human Factors and Ergonomics in Practice: Improving System Performance and Human Well-Being in the Real World, CRC press, Boca Raton.
- [3] Stanton NA, Young MS, Harvey C. Guide to Methodology in Ergonomics: Designing for Human Use, (2<sup>o</sup> Edition) Boca Raton Florida, CRC Taylor & Francis group 2014.
- [4] Tosi F. Design for Ergonomics, Cham, Switzerland: Springer 2020
- [5] Wilson JR, Sharples S, editors. Evaluation of Human Work, (4<sup>o</sup> ed.) Boca Raton Florida: CRC Taylor & Francis group. 2015 Apr 16.