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**Mygal V. P.,**
*Doctor of Technical Science, Professor,*
*Professor at the Department of Physics*
*National Aerospace University*
*Kharkiv, Ukraine*

**Mygal S. P.,**
*Candidate of Architecture, Professor,*
*Professor at the Department of Design*
*Ukrainian National Forestry University*
*Lviv, Ukraine*

**Mygal G. V.,**
*Doctor of Technical Sciences,*
*Professor at the Department of Automobile and Transport Infrastructure*
*National Aerospace University*
*Kharkiv, Ukraine*

## ERGO-DESIGN OF COGNITIVE SPACE – A TRANSDISCIPLINARY APPROACH

***Fundamentals of transdisciplinarity.*** The evolutionary ideas of V. I. Vernadsky are based on the ideas of the unity of the world, the universality of movement, the existence of unified fundamental laws of the universe. Today, his large-scale concepts of the biosphere and noosphere, which cover all nature: inanimate, living and space, are relevant. They are based on the ideas of the unity of the world, the universality of movement, the existence of unified fundamental laws of the universe. Regardless of the boundaries of individual sciences, V. I. Vernadsky implemented the ideas of a transdisciplinary approach, which is very important for education in the digital world [3, p. 7; 4, p. 387; 9, p. 37]. Transdisciplinarity is the basis for the transition to predictive safety management at various levels – environmental, economic, technological and social [2, p. 192; 5, p. 240].

***Risks generated by digitalization.*** The evolution of complex dynamic systems is accompanied by a constant increase in the number and complexity of information flows and, as a result, leads to a triad of security risks: "information overload of a person – an increase in the number and severity of errors – convergence of risks as a phenomenon of the human factor." After all, despite the processes of automation and the use of artificial

intelligence, the complexity of managing complex systems is increasing, which is confirmed by the statistics of the implementation of aviation and industrial risks. This can only be changed by managing the human factor.

***Ergo-design in a comfortable environment.*** Managing the human factor is taking into account the capabilities of a person, his cognitive, behavioral and psychophysiological characteristics at all stages of the life cycle of complex systems. Optimization of the working space and coordination of equipment designs and functionality with the psychophysical characteristics of workers turned out to be multifaceted tasks. To solve them, anthropometry, biomechanics, technical aesthetics, engineering psychology, etc. are used. Today, ergonomics / human factor is under the attention of psychologists, physiologists and other specialists. Therefore, ergo-design is in demand in the modern business environment, where it contributes to the integration of IT and ICT with Industry-4.0. In general, human creativity based on the basic foundations of the evolution of safety (reliability, efficiency and comfort) requires convergent thinking, high consciousness and a human-centric point of view from the designer.

***Transdisciplinary metaergonomics.*** The complementarity of engineering psychology and ergonomics is metaergonomics, which is based on the optimization of activities through the transition of the design of human-machine systems from technocentric to anthropocentric. Understanding the role of human features in ensuring the safety of the functioning of complex systems underlies the Japanese "economic miracle", based on the formation and development of certain thinking among all participants in the production process. Human Factors Engineering, Cognitive Ergonomics and Neuroergonomics have also shown the effectiveness of applying system-forming principles at the design stage to optimize interaction in a human-machine system and increase its safety [2, p. 192; 3, p. 7].

***Harmonization of human-computer interaction.*** When creating an interface based on knowledge in the field of human factors / ergonomics (usability engineering, UA / UX design), we tried to coordinate the characteristics of information systems with cognitive features, the psychology of perception and human behavior. Therefore, information load management has become relevant for ergonomics and engineering psychology. The increasing complexity of dynamic systems has given impetus to the idea of adaptive ergonomics and the emergence of flexible systems. The current state of ergonomics is associated with a shift in emphasis from the adaptation of man to technology or technology to man to the formation of a symbiosis "man – machine". Ergonomic thinking is based on the laws of mutual adaptation and transformation [2, p. 192; 3, p. 7]. In fact, it is an experience-based adaptation of activities to human capabilities. That is why the development of ergonomic thinking in future

engineers should be given considerable attention. Because it is a system of views of an individual on the development of complex man-machine systems and the role of man in them; it is an understanding of the complex processes of human-machine interaction; the ability to predict the risks in these systems and plan the development of systems with these risks in advance.

***Design thinking.*** Today, more and more attention is paid to design thinking. Design thinking is based on the cognitive, predictive and practical knowledge and skills of the designer. Design thinking is a methodology for solving engineering, business and other problems based on a creative rather than an analytical approach [1, p. 9; 2, p. 192]. It is impossible not to notice that the iterative design thinking process consists of five stages, essentially corresponding to the stages of the Deming quality cycle: empathy, definition, idea, prototype, and testing or verification. It is this cyclical process that is the key to solving "evil" problems, i.e., poorly defined/unknown problems. Design thinking is a certain analogue of the analysis of human errors and risks in the human factor (for example, the "black swan" theory).

***Complementarity between ergonomic thinking and design thinking.*** With design thinking, designers have the freedom to create innovative solutions. N. Cross in his book “The Designerly Ways of Knowing” [1, p. 9] says: “… The ability to design is, in fact, one of the three main aspects of human intelligence. Design, science and art are in an AND, not an OR relationship, creating incredible human cognitive abilities":

– Science is the search for similarities between things that are different;
– Art – finding differences between things that are similar;
– Design – creating a possible "whole" from impossible "parts".

The design thinking cycle involves observing to discover unmet needs within the context and constraints of a given situation, setting scope and scope for innovation, generating ideas, testing, and finalizing solutions”.

***Harmonization of human-computer interaction.*** From a cognitive, ergonomic and psychological point of view, it is important to strike a balance between expediency and necessity, between human involvement and automation, between design and user support. Therefore, the formation of systems thinking is the recognition of the exceptional priority of the problems of human-machine interaction [2, p. 192; 5, p. 109]. An effective tool for harmonizing human-computer interaction is the mastery of the principles of ergonomics and human factor engineering, biomemetics and biological adaptation of living organisms to the conditions of existence; psychological laws and patterns of human existence as an element of the sociosystem. They combine the principles of functioning of human-machine

systems and include information about human resources, the technical capabilities of equipment, the safety of the workplace and the environment. That is, the main goal of acquiring such knowledge is based on quality assurance, fault tolerance, mastering the human factor and risk management [6, p. 395; 7, p. 1; 8, p. 37; 9, p. 37].

Indeed, according to V. I. Vernadsky, one of the basic principles of the emergence of the noosphere is reasonable human activity, which becomes the determining factor in development. The "thinking shell" formed by human consciousness – this is how the professor of mathematics at the Sorbonne Édouard Le Roy described the noosphere. And the very rebirth of human consciousness is the "geological force" of the development of the noosphere.

***Conclusions.*** From the point of view of scientific directions – architectural, metaphysical and ergonomics, the evolution of transdisciplinary ideas of ergonomics shows that the only way to safety is to get out of the concept of divided sciences and develop transdisciplinary research to promote innovation. Our motivation is to draw attention to the educational component of the formation of ergonomic thinking and the conceptual path to the creation of a cognitive space. In this regard, the role of cognitive space ergo-design in ensuring the safety of complex systems is shown.

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**Скаленко О. К.,**
*доктор філософії PhD,*
*академік МА інформатизації при ООН,*
*член Асоціації футурологів ФТ,*
*президент Міжнародного фонду «ЄДНАННЯ»,*
*провідний науковий дослідник*
*Національної академії наук України*
*м. Київ, Україна*

## ГЕНІЙ ВЕРНАДСЬКОГО В СУЧАСНІЙ ГЛОБАЛІЗАЦІЙНІЙ СИСТЕМІ «ЛЮДИНА, ЕКОСФЕРА ТА ІНФОРМАТИЗАЦІЯ СВІТУ»

Господарство – це знання в діях,
а знання – це господарство в ідеях.
Із книги *«Філософія господарства»*

«Упровадженням символів, літер і чисел людство осягнуло циклічність та інтенсивність впливу впливу природних явищ на своє життя, навчилося користуватися цими знаннями та передавати їх прийдешнім поколінням, фактично започатковуючи цим свою цивілізаційну історію». Ця цивілізаційно новоісторична думка, та й ще одна, глобально передбачувальна – «Розповсюдження наукового знання та освіти є найважливішим чинником спайки людства в єдине ціле» [1], складають найцінніший скарб, який залишив український