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# ADVANCED APPLICATION OF ERGONOMICS AND HUMAN FACTORS IN ACADEMIC AND SCIENTIFIC ACTIVITIES

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**Abstract** This research explores the advanced application of ergonomics and human factors (EHF) in academic and scientific activities. It has a pronounced overview character, covering the application of E/HF, Industry 5.0 and Society 5.0, the leading European and global ergonomics organizations, current university E/HF networks, examples of realized projects of scientific importance, leading world scientific conferences actively promoting E/HF and presenting the contribution of the scientific field in practice. The article provides data on the good results achieved, contributing to the upgrading of E/HF in line with modern features.

**Keywords:** Ergonomics; Human Factors; IEA; CREE; FEES; CEEPUS; BAEHF; Summer university; ErgoDesign; Industry 5.0; Society 5.0.

## 1. INTRODUCTION

The overview report examines significant points related to the development and application of ergonomics and human factors in academic and scientific activities. E/HF is a design-oriented framework for improving compatibility, effectiveness, safety, the ease of performance, human well-being, and quality of life [1-4]. E/HF has a significant presence in Industry 5.0 and Society 5.0. [5-9]. E/HF is closely related to technology and design that takes into account the needs and capabilities of industrial workers, minimises the risk of injury and optimises productivity. E/HF for Industry 5.0 ("Human-Centric Industry") focuses on integrating advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT) and robotics into the workplace, while keeping the human worker at the centre. Towards Society 5.0, E/HF supports a sustainable and inclusive society by integrating advanced technologies and human-centred values. E/HF engages an important role in designing and developing technologies and systems that are accessible, usable and safe for all citizens. In the field of E/HF, the leading global organization is the International Ergonomics Association - IEA [10]. The (IEA) defines ergonomics or human factors as follows:

Human factors are used to achieve occupational health and safety and productivity objectives. It is relevant in the design of safe furniture and user-friendly interfaces to machinery and equipment. Proper ergonomic design is necessary to prevent repetitive strain injuries and other musculoskeletal disorders that can develop over time and lead to long-term disability. Human factors and

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ergonomics deal with the interaction between the user, the equipment and the environment. It considers the capabilities and limitations of the user in an effort to ensure that the tasks, functions, information and environment are appropriate for that user.

Stakeholders of E/HF can be any person or group of people that can affect, be affected, or perceive themselves to be affected by an E/HF decision or activity is a stakeholder of E/HF [11-12]. Stakeholders are inter-related and include:

- System influencers – e.g., competent authorities such as governments, regulators, standardization organizations at national and regional levels.
- System decision makers – e.g., employers and managers, those who make decisions about requirements for the system design, purchasing system, implementation and use;
- System experts – e.g., professional HFE specialists, professional engineers and psychologists who contribute to the design of systems based on their specific professional backgrounds;
- System actors – e.g., employees/workers, product/service users, who are part of the system and who are directly or indirectly affected by its design and who, directly or indirectly, affect its performance.

Stakeholders for E/HF can represent many levels, domains, and types of influence and investment, such as:

- International level – regulatory officials and policy makers, International NGOs;
- National level – government, law and policy makers, regulators, national NGOs;
- Educational level – universities, applied sciences programs, vocational education, professors, teachers, students;
- Practice level – CEOs and managers in companies, designers of work and work systems in different fields, practitioners in domains relevant to E/HF.

## 2. APPLICATIONS

The application of E/HF is practically present in the overall 3D environment in which we live. In addition to the three-dimensional geometry of our surrounding environment, E/HF is characterized by the accompanying aspects of influence under the influence of psychophysiological human factors, cultural environment and community-specific features. The E/HF cover [13]:

Themes

- Healthy and safe working conditions;
- Health care;
- Bioengineering;
- Motor vehicles, ships and aircraft;
- Design;
- Management and administration;
- Working life;
- Computer skills;

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- Transport services.

Areas of Knowledge:

- Principles of ergonomics;
- Populations and general human characteristics;
- Inclusive health care;
- Bioengineering innovations;
- General engineering;
- Design of technical systems;
- Research, evaluation and investigative techniques.

Professional issues

- Ergonomics: Activity and work analysis;
- Ergonomic interventions;
- Ergonomics: physiological and physical aspects;
- Ergonomics: psychological and cognitive aspects;
- Ergonomics: social and organizational aspects.

## 3. ERGONOMICS AND HUMAN FACTORS OVERVIEW AND WORLD LEADING ORGANIZATIONS, SCIENCE, ACADEMIC AND EDUCATION NETWORKS

There are leading international organizations in the world driving the progress of E/HF in the scientific, academic, educational and other fields. Relevant to them are business representatives, other relevant organizations and other stakeholders. The International Ergonomics Association (IEA, 2003) defines ergonomics (or human factors) as the scientific discipline concerned with the understanding of the 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. Human factors professionals 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. Ergonomics discipline promotes a holistic, human-centered approach to work systems design that considers the physical, cognitive, social, organizational, environmental, and other relevant factors. The role of ergonomics in the improvement of quality of education is significant as it offers solutions to enhance student learning [14]. By creating appropriate ergonomic solutions, existing problems in education can be solved, ultimately leading to improved education quality for students. The word ergonomics —“the science of work” — is derived from the Greek ergon (work) and nomos (laws). The terms ergonomics and human factors are often used interchangeably or as a unit (e.g., human factors / ergonomics – H/FE or E/HF) a practice that is adopted by the IEA [11]. The definition of ergonomics (or human factors) adopted by the IEA in 2000 is 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[12].

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Within Europe at the university level, the main network with headquarters in CEEPUS Austria is the international consortium CEEPUS Regional Educational Network "Ergonomics and Human Factors" (CIII-HU-1506-01-2021 Ergonomics and Human Factors Regional Educational CEEPUS Network) https://sites.google.com/view/ceepusergohf/home with participants Óbuda University (General Coordinator), Budapest, Hungary, IMC University of Applied Sciences Krems, Austria, Technical University of Varna, Bulgaria, University of Zagreb, Croatia, Poznan University of Technology, Poland, Politehnica University of Timisoara, Romania, University of Belgrade, Serbia, University of Maribor, Slovenia, Constantine The Philosopher University in Nitra, Slovakia, Silance Partner The Centre for Registration of European Ergonomists (CREE) [15, 16]. E/HF CEEPUS Network contributes to the competitiveness of the Danube region, providing leading competence for products, processes and human-centered organizational innovation. The aim is to strengthen the cooperation of those involved institutions and organizations, to create a formal academic structure for the exchange of undergraduate students, master's and doctoral level, to participate in joint master's and doctoral programs and in long-term plan to develop shared learning. The priority of the program is the implementation of the European System for credit transfer – ECTS. The newly created network aims to facilitate the process of regional development cooperation in the thematic areas of higher education and related scientific research within the framework of inter-university cooperation. The coordinators of the network "Ergonomics and human factors" work together in various international organizations on ergonomics [17-20] - the International Association of Ergonomics (IEA) (www.iea.cc), The Centre for Registration of European Ergonomists (CREE) (www.eurerg.eu) and the Federation of the European Ergonomics Societies (FEES) (https://www.ergonomics-fees.eu/). The European FEES Community's representative on the Bulgarian side is the Bulgarian Association of Ergonomics and Human Factors (BAEHF) (https://baehfofficial.wixsite.com/baehf) which has solid organizational experience. BAEHF is constantly in an active working mode, which is steadily developing in collaboration with local and international students, teachers, laboratory assistants, experts, at all levels and areas relevant to the objectives of this project proposal. BAEHF promotes the exchange of experience, international mobility and open public action, through which development activities and results are beneficial for all stakeholders.

## 4. PUBLIC AND DISSEMINATION OF ERGONOMICS AND HUMAN FACTORS (E/HF)

Knowledge and understanding of ergonomics and human factors is of great importance. This places a certain responsibility on leading organizations, academics and experts to seek ways of wide publicity, awareness and experience sharing with all stakeholders. The last years are characterized by the successful holding of E/HF activities.

### 4.1. Summer University on Ergonomics

Summer University (SU) of Ergonomic program follows the usual SU structure: professional lectures and good practices. For example in 2021 year, 34 SU started with introducing EU-OSHA "Lighten the Load" campaign; ergonomics beyond the prevention of musculoskeletal disorders. The SU participants: Austrian Ergonomics Society, the Hungarian Ergonomic Society, the Ergonomics & Workplace Management Society (ERGOWORK) from Romania, the Bulgarian Association of Ergonomics and Human Factors (BAEHF). Up to the shared English sessions, there are tracks for

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each language, i.e. a Bulgarian one on Artificial Intelligence and ergonomics, a Hungarian on Office and sedentary work, Polish on mental workload, Romanian on service ergonomics. Several universities contribute to this summit university working together in the Ergonomics and Human Factors Regional Educational CEEPUS Network [21-24].

### 4.2. Science E/HF conferences and congresses

Some of the popular and important conferences in the field of ergonomics and the human factor are [25-29]:

- Triennial congresses of the International Ergonomics Association (IEA) [25];
- Applied Human Factors and Ergonomics conference (AHFE) [26];
- International Conference on Human Systems Engineering and Design (IHSED) [27];
- Intelligent Human Systems Integration conference (IHSI) [28];
- International Conference on Human Interaction and Emerging Technologies (IHIET) [29];
- Other related.

### 4.3. E/HF professional certification

The Centre for Registration of European Ergonomists (CREE) confers the professional title "European Ergonomist" to designate qualified and experienced members of the profession. The quality of their professional practice and their education has been peer-reviewed and they must adhere to a professional Code of Conduct" [18]. On the official website it is noted that: „CREE is the only body endorsed by the International Ergonomics Association to certify professional ergonomists in Europe. Applications are welcomed from any qualified ergonomist, provided that he or she works at least some of the time within the member countries of the Council of Europe."

### 4.4. E/HF projects - examples

Examples of significant ergonomic projects where the author team is involved are local and international collaborative projects such as [30-32]:

- „ErgoDesign" – Improving digital skills for Ergonomics and Bioengineering Innovations for inclusive Health Care" 2021 – 2024. The Scientific-Research Project Erasmus + project KA220-HED-000031182 - Cooperation partnerships in higher education [30]
- Technical University of Varna, Bulgaria 2022 NP10 "Ergonomic and design research of auxiliary furniture as part of the learning environment of students in junior high school" [31].
- Technical University of Varna, Bulgaria, Scientific-Research Project TUV 2016 NP/18. Ergonomics study-design options for the design of a multifunctional complex adaptive modular lecture hall for interdisciplinary teaching [32].
- Other.

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## 5. CONCLUSION

This research covers significant advanced application of E/HF in academy and science activities. The data presented in this research directs the attention of society and all stakeholders to the activities related to E/HF, which collected in a single resource helps to confirm the good practices and applications for the needs of the modern academy and science. The authors of the study present the advanced application of E/HF, the current challenges and means for establishing E/HF as a significant fields of science and academic life. The examples given in the overview study emphasize the increasingly strong presence of ergonomics and human factors, which will have an increasingly significant importance in the development of modern society. The information presented in the report is of interest to learners, teachers, scientists and experts as well as all stakeholders related to E/HF.

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## References

[1] Reiman A., Kaivo-oja J., Parviainen E., Takala E. and Lauraeus T., 2021, Human factors and ergonomics in manufacturing in the industry 4.0. Elsevier, *Technology in Society*, Vol. 65, May 2021, 101572.
[2] Cardoso A., Colim A., Bicho E., Braga A.C., Menozzi M. and Arezes P., 2021, Ergonomics and Human Factors as a Requirement to Implement Safer Collaborative Robotic Workstations: A Literature Review, MDPI, Safety, 7(4):71.
[3] Stern H. and Becker T., 2019, Concept and Evaluation of a Method for the Integration of Human Factors into Human-Oriented Work Design in Cyber-Physical Production Systems, MDPI, *Sustainability*, 11(16),4508.
[4] Bridger R., 2003, *Introduction to Ergonomics*, Taylor & Francis Inc.
[5] Nahavandi S., 2019, Industry 5.0 - A Human-Centric Solution, *Sustainability*, 11(16), 4371.
[6] Zizic M.C., Mladineo M., Gjeldum N. and Celent L., 2022, From Industry 4.0 towards Industry 5.0: A Review and Analysis of Paradigm Shift for the People, Organization and Technology, *Energies*, 15(14), 5221.
[7] Tavares M.C., Azevedo G. and Marques R.P., 2022, The Challenges and Opportunities of Era 5.0 for a More Humanistic and Sustainable Society—A Literature Review, *Societies*, 12(6), 149.
[8] Mulaomerovic E., Wang E.M.-y. Challenges and Opportunities for Human Factors/Ergonomics as a Strategic Partner for Business Managers: In-Depth Research of Experts' Visions, *Sustainability*, 15(4), 3078.
[9] Pizoń J and Gola A., 2023, Human–Machine Relationship—Perspective and Future Roadmap for Industry 5.0 Solutions, *Machines*, 11(2), 203.

2023, Volume 7, Issue 1, 49-56, DOI: 10.6722/TES.202304_7(1).0005.

[10] International Ergonomics Association (IEA), 2023, Mission, Strategies and History, https://iea.cc/about/introduction/ (Access March 2023).
[11] International Ergonomics Association (IEA), 2023, What is ergonomics (HFE)? https://iea.cc/about/what-is-ergonomics, (Access March 2023).
[12] International Ergonomics Association (IEA), 2018, On the IEA Definition of Human Factors and Ergonomics, https://secureservercdn.net/45.40.153.46/m4v.211.myftpupload.com/wp-content/uploads/2014/10/Interview-with-Ian-Noy-Aug28-2018.pdf , (Access March 2023).
[13] Technical University of Varna, 2020, Technical University – Varna: Central European Academic Exchange Program CEEPUS, CIII-HU-1506-01-2021 Ergonomics and Human Factors Regional Educational CEEPUS Network, https://www1.tu-varna.bg/tu-varna/images/international/CEEPUS_TUV_2020.pdf (Access March 2023).
[14] Zunjic A., Papic G., Bojovic B., Matija L., Slavkovic G., Lukic P., 2015, The Role of Ergonomics in the Improvement of Quality of Education, *FME Transactions*, Vol. 43, No. 1, pp. 82-87.
[15] CEEPUS Regional Educational Network, "Ergonomics and Human Factors, https://sites.google.com/view/ceepusergohf/home (Access March 2023).
[16] Szabó G., Balogh Z., Dovramadjiev T., Draghici A., Gajšek B., Lulić Jurčević T., Reiner M., Mrugalska B., Zunjic A., 2021, Introducing the Ergonomics and Human Factors Regional Educational CEEPUS Network, *Acta Technica Napocensis, Series: Applied Mathematics, Mechanics, and Engineering*, 64 (1), pp. 201-212.
[17] International Association of Ergonomics, www.iea.cc (Access March 2023).
[18] The Centre for Registration of European Ergonomists (CREE), www.eurerg.eu (Access March 2023).
[19] Federation of the European Ergonomics Societies (FEES), https://www.ergonomics-fees.eu/ (Access March 2023).
[20] Bulgarian Association of Ergonomics and Human Factors (BAEHF). https://baehfofficial.wixsite.com/baehf (Access March 2023).
[21] European Agency for Safety and Health at Work - EU-OSHA, 2021, 34 Summer University on Ergonomics, https://osha.europa.eu/bg/user/login?destination=bg/oshevents/34th-summer-university-ergonomics (Access March 2023).
[22] Magyar Ergonómiai Társaság – MET. 34. ERGONÓMIAI NYÁRI EGYETEM https://met.ergonomiavilaga.hu/wp/2021/06/28/ergonomics-redefined/ (Access March 2023).
[23] Bulgarian Association of Ergonomics and Human Factors – BAEHF, 2021, 34 Summer University on Ergonomics 2021 https://baehfofficial.wixsite.com/baehf/about-3 (Access March 2023).
[24] Poznań University of Technology – PUT, 2021, 34 Summer University on Ergonomics, https://fem-old.put.poznan.pl/sites/default/files/aktualnosci/Summer%20University%20on%20Ergonomics.pdf (Access March 2023).
[25] International Ergonomics Association (IEA), IEA2021: 21$^{ST}$ Triennial congress of the International Ergonomics Association, https://easychair.org/smart-program/IEA2021/ (Access March 2023).
[26] Applied Human Factors and Ergonomics (AHFE), International Conference, https://ahfe.org/ (Access March 2023).
[27] International Conference on Human Systems Engineering and Design (IHSED), https://www.ihsed.org/ (Access March 2023).
[28] Intelligent Human Systems Integration (IHSI), http://www.ihsint.org/ (Access March 2023).
[29] International Conference on Human Interaction and Emerging Technologies (IHIET), https://ihiet.org/ (Access March 2023).
[30] ErgoDesign. Improving digital skills for Ergonomics and Bioengineering Innovations for inclusive Health Care“ 2021 – 2024, http://ergodesigner.eu & http://ergodesigner.tu-varna.bg/ (Access March 2023).
[31] Dobreva, D., Dovramadjiev, T., Murzova, T., Tachev, M., Iliev, I., Cankova, K., Jecheva, G., Murzova, M. and Staneva, G., 2022, Ergonomic and Design Research of the Auxiliary Furnishings in High School

2023, Volume 7, Issue 1, 49-56, DOI: 10.6722/TES.202304_7(1).0005.

of Education in the City of Varna, In: Tareq Ahram and Redha Taiar (Eds.), *Human Interaction & Emerging Technologies (IHIET 2022): Artificial Intelligence & Future Applications, AHFE 2022 International Conference*, Vol. 68, pp. 839–848, AHFE Open Access, AHFE International, USA.

[32] Technical University of Varna, Bulgaria, Scientific-Research Project TUV 2016 NP/18, Ergonomics study-design options for the design of a multifunctional complex adaptive modular lecture hall for interdisciplinary teaching. https://www1.tu-varna.bg/tu-varna/images/izdatelska_deinost/god/godishnik_2016/Godishnik_TU_2016_tom_II.pdf (Access March 2023).