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ERGONOMY AND THE ERGONOMIST. HISTORICAL AND CURRENT REFERENCES

Sabin Ioan IRIMIE, Sabina IRIMIE

Abstract: Ergonomics, as an interdisciplinary applied managerial science, is becoming more necessary and more visible. From micro-ergonomics - simple studies of analysis and organization of work, improvement of some components of the work system and up to macro-ergonomics - complex systems, large dynamics - urban ergonomics, organizational ergonomics, all demonstrate the great contribution of ergonomics to the improvement of human life, to his well-being at work and in daily life. This paper briefly presents the evolution of ergonomics in the world and of the main professional associations of ergonomics existing at present, with some reference points for the formation of specialists in ergonomics.

Key words: Ergonomics, the profession of ergonomist, professional associations of ergonomics, training specialists.

1. INTRODUCTION

The International Association of Ergonomics (IEA) defines ergonomics as a scientific discipline that studies the interaction between people and other elements of a system, as well as the profession that applies theories, principles, information and design methods to optimize the human activity and the performances of the system from which it does take part. [1], [2]

The most concise definition of ergonomics is the etymological transposition from the Greek language (ergos meaning work and nomos meaning law, norm). [3]

In 2000, Wilson considered Human Factors / Ergonomics (HFE) to be a multidisciplinary, „user-centric ‘bundling science,’” by applying theory, principles, and data from many relevant disciplines - called collaborative sciences, to design work systems, considering by the complex interactions between man and other people, the environment, tools and equipment and technology to improve performance and human well-being in the world of work. [4, p.1]

Aleksandar Zunjic [5, p. 5] following the analysis of over 100 definitions proposes a new definition that describes the essence of

ergonomics: „Ergonomics is a multidisciplinary science whose goal is to examine the impact of means of work, conditions of work, processes of work, and products as results of work on humans from the psychological, physiological, anatomical, biomechanical, sociological, organizational and physics aspect by applying the quantitative and qualitative research methods, as well as to adapt the design of the aforementioned elements to humans, with the aim of improving comfort, safety, efficiency and satisfaction, which are considered during their interaction with humans.”

Ergonomics, as a science and profession, has a long history in different corners of the world, where people from different fields have joined and laid the foundations of a new science that is concerned with the conservation of the energy of the employee, the performer, the increase of productivity, but maybe the most important feature of ergonomics is the avoidance of injury to employees and the maintenance of their health, both physical and mental for a longer period.

Therefore, the paper includes aspects related to the development of ergonomics and the profession of ergonomist in the world and in Romania.

2. ERGONOMY AND THE ERGONOMIST IN THE WORLD



The desire and the continuous struggle of the human "for the better", starting from survival and reaching comfort, are basic elements of the emergence of ergonomics.

Leonardo da Vinci (1452-1519), through his work and studies, is one of the world's first recognized ergonomists.

The first paper on the work was written by the Italian Bernardino Ramazzini (1633-1714), called "De Morbis Artificum Diatriba" [6] underlining the effects of chemicals, dust, repetitive or violent movements, poor posture and other destructive aspects of health, found in about 50 occupations during that period. The work, published in 1700, was reprinted and updated in 1713.

Less well known is the work of Polish biologist Wojciech Jastrzebowski, who created the term ergonomics in 1857 in a philosophical narrative based on "truths drawn from Nature Science" [7]. In the Netherlands, protecting the health of working children was the first step, through the article on Children's Health in 1874 from the Dutch Legislation. V.N. Myasishchev (1921) elaborated the idea of creating a scientific discipline called „ergology”, considering a systematization of human knowledge related to work [8].

Along with the scientific organization of the work, an ergonomic orientation of the studies in the field also appeared.

In the second part of the 19th century people's health became of great interest - public, political and social. After almost a century, the psychologist K.F.H. Murrell gives the name ergonomics, which is recognized as a science. The term was accepted in England, and in 1949 the Ergonomics Research Society (ERS) was founded, then transformed into IEA.

For much of Europe, the Center for Registration of European Ergonomists (CREE), created in 1994 by ergonomics companies recognized by the IEA, is the largest database of ergonomists in Europe. It currently comprises over 499 ergonomists from 20 countries (France, United Kingdom, Germany, Poland, Italy, Greece, Portugal, Iceland, Ireland, Switzerland, Belgium, Holland, Denmark, Austria, Hungary, Luxembourg, Spain, Slovenia, Baltic countries, etc.) (Figure 1), offering the title of "European Ergonomist" to prove their qualification and experience.

To be recognized and part of CREE, the following minimum requirements must be met:

- Education: three years of faculty, at least one to be dedicated to ergonomics;
- Supervised training: at least one year;
- Professional experience: two years after the supervised training.

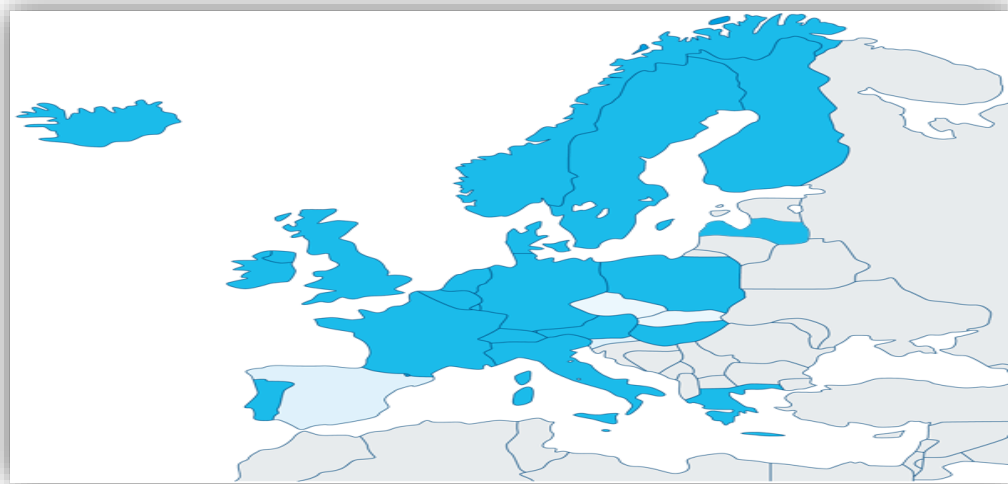


Fig. 1. CREE map - Centre for Registration of European Ergonomists

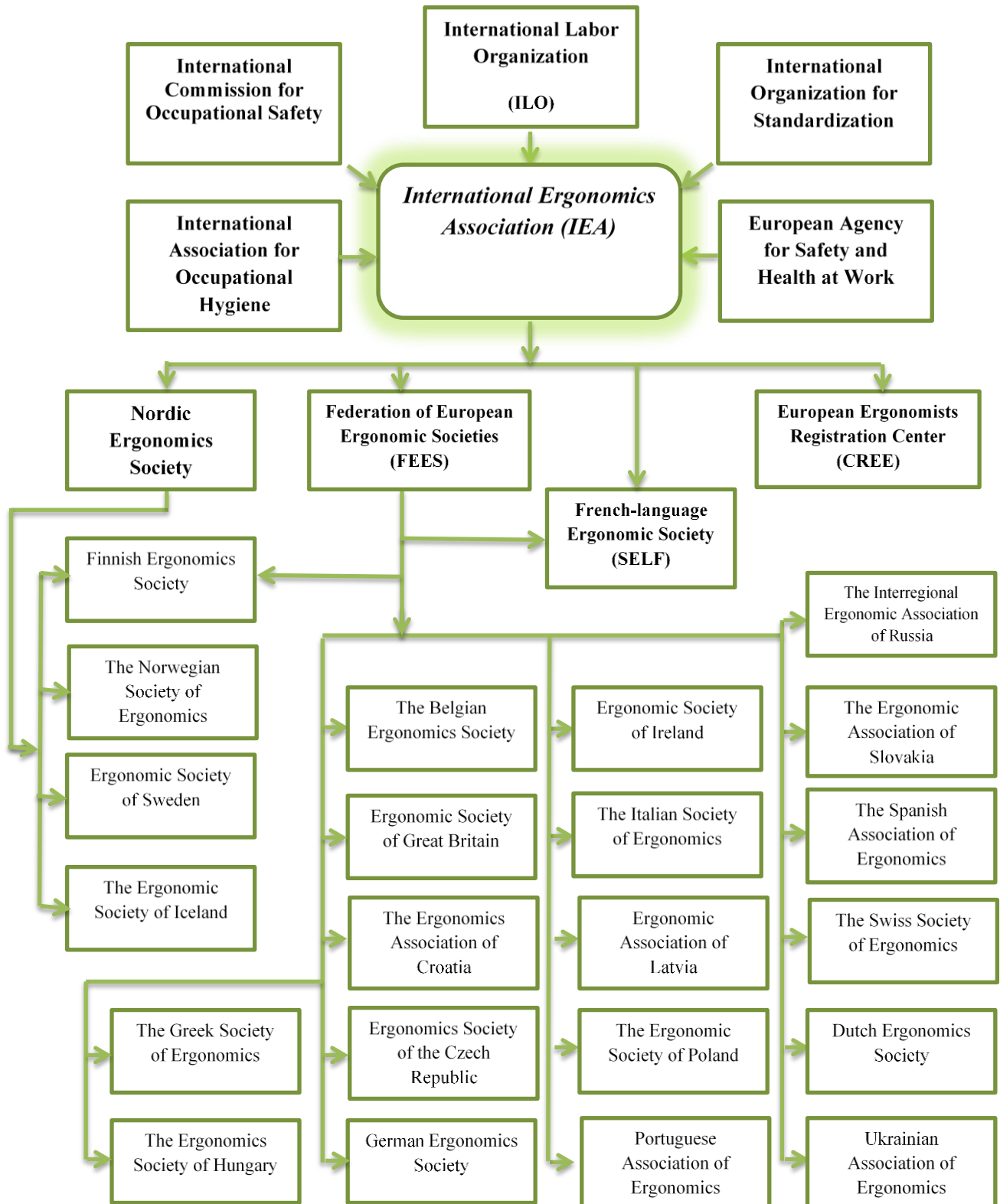


Fig. 2. Connections between international institutions with concerns about work, safety and health in the work and European structure of IEA

European ergonomists are professional ergonomists, who are knowledgeable about ergonomic principles and the relevance of human characteristics in areas such as anatomy, physiology, psychology and social organization,

as well as knowledge of how the work environment affects people.

Applicants for these qualifications must demonstrate knowledge in statistics, design, experimental design, equipment and methods of

investigation, modifications or situational design and equipment with ergonomic benefits. All accepted applicants will demonstrate that they have experience in being responsible for applying the knowledge of ergonomics and the methods of putting into practice for a period of at least two years beyond their education and training in ergonomics.

European ergonomists accept and respect the CREE Code of Conduct. Ergonomists working in research fields related to practical applications are also accepted in CREE (consulting or other occupational fields).

There is a good collaboration between international bodies with concerns about work, safety and health at work promoting an integrative vision on synergistic improvements / ergonomic interventions. Figure 2 reflects the connections between these international institutions and structure of the IEA, with European National Societies of ergonomics.

In Canada, the Association of Canadian Ergonomists (ACE) [9] is an association created in 1968 that aims to promote human-centered projects to optimize performance and ensure that high-quality ergonomics are delivered to businesses and people to reduce accidents and work-related diseases [10].

With the increasing recognition of ergonomics and its importance in the field of work, the demand for ergonomics services has increased. The ACE recognizes the need for accreditation of ergonomists to ensure the quality of ergonomic services that are delivered to companies. In response to this need, the Canadian College for the Certification of Professional Ergonomists (CCCPE) was created in 1998 (Figure 3) [11].

In CCCPE there are two categories of certification, professionally differentiated. Both categories it must include the minimum educational requirements and experience of working in the field [12].



Fig. 3. Logo of the Faculty of Professional Certification of Ergonomists in Canada

1. Associate Ergonomist (AE):

- Based on Educational Requirements and field work;
- An AE must act to meet the requirements of professional experience for the status of Certified Canadian Professional Ergonomist (CCPE) within five years.

2. Certified Canadian Professional Ergonomist (CCPE):

- Meets all the educational requirements of an AE;
- At least 4 years of supervised experience or 5 years of experience in the field of Ergonomics;
- Must meet the minimum requirements of Competence through Experience;
- It must maintain its certification through a continuous process of accreditation and accumulation of knowledge in the field through practice.

As defined by ACE, Ergonomics is a scientific system, which aims to optimize the well-being and ultimately, the performance of the system by examining the interactions between humans and other elements of a system (environment, people and objects).

To implement recommendations and solutions efficiently and properly at workplaces/stations, a thorough understanding of the man and the work system is required. That is why the educational requirements of CCCPE mention not only a diploma for 4 years of studies in disciplines related to Ergonomics, but also working hours in different fields of ergonomics, which must be proven.

Once an AE has worked in the field for 5 years, or 4 years under the supervision or mentorship of an CCCPE, they are eligible for the role of CCPE. To be certified as an CCPE throughout the faculty, the applicant must prove his or her competence in a minimum of 12 to 17 competencies identified by CCCPE, which covers the multidisciplinary nature of ergonomics.

The rigorous criteria described above are imposed by CCCPE and ACE for quality assurance, ergonomics services being protected.

The purpose of the certification process underlined by CCCPE is that applicants who have been admitted will have a wide range of knowledge and skills required for ergonomics

work, will have the skills and will be familiar with the tools and methods necessary to successfully complete their work and to provide effective solutions. This is not just to protect the reputation of ergonomists, but also to protect the quality of work that companies receive when they hire the services of an ergonomist.

In Australia, the fundamental beliefs of the founder of the Ergonomics Society of Australia [13] were, as to combat certain issues; the complementarity of the most relevant combinations of disciplines should be applied. It was thought that if the experts have an interest in the needs of the performer and an understanding for solving them, they will come up with a solution to solve a work problem and lay the groundwork for a new science.

One of the first papers written in Australia on ergonomics was written by Dr. J.C. Lane in 1953, called "Human Engineering: A New Technology". His definition of human engineering was that it is multidisciplinary, mixing several physiological sciences, psychology, anatomy, physical anthropology, and especially experimental psychology along with other branches of engineering.

Works on ergonomics in Australia have also been written by various government departments, creating ergonomic research groups in the Australian Defense Service Aeronautical Research Laboratories in 1957.

Mentions from the Australian Royal Navy and Australian Royal Air Force military service history revealed that aircraft pilots were trying to find out in the 1930s whether, such as reaction speed, concentration and coordination, could affect a pilot's ability to learn to fly.

The initiators of the Ergonomics Society of Australia are Cameron, Cummings and Lane, from the Psychology Department of the University of Queensland. In addition, the collaboration of the medical service with health executives, psychologists together with the engineers provide constructive results for the development of ergonomics.

The most important way in which the principles of ergonomics can be applied are through design. The founders of the Ergonomics Society saw the design because of the work of the ergonomist.

Interest in ergonomics in Australia has a relatively long history and design has made a breakthrough in different areas targeting human performance. The development of ergonomics has been associated with occupational health and safety, largely due to the large number of musculoskeletal disorders in the workplace. Although many demands are beyond human performance, the challenges of ergonomists have mixed with ever-changing technology and the need for a holistic approach to the work system to counter the rapid impact of technological change.

The purpose of ergonomics has become more diverse, the mechanisms for quality control must be considered. The issues before the Ergonomics Society of Australia refer to ensuring a high-quality continuous practice in the workplace, directing and supporting research, developing an optimal approach to ergonomic education, applying the standards of competence expected of ergonomists, and perfecting the appropriate professional certification method.

The certified ergonomists have been authorized by Human Factors and Ergonomics Society of Australia Inc (HFESA) and have demonstrated the skills and experience to provide dedicated, high quality and supportive advice in the field of Ergonomics and Human Factors. The HFESA Certified Professional Ergonomists (CPE) program is supported by the International Association of Ergonomics.

In America, the Human Engineering Society of San Diego and the Association of Aeromedical Engineering of Los Angeles, which preceded the Human Factors and Ergonomics Society (HFES) [14], became the first two US institutions in the field of ergonomics.

The HFES, founded in 1957, is the largest scientific association for human/professional factors in the field of ergonomics. HFES serves the needs of members and the public by promoting and advancing discoveries and knowledge exchange regarding the characteristics of human beings that apply to the design of systems, products, tools and environments of any kind. The HFES foresees a future in which the impact, relevance and quality of human factors/ergonomics are much more

extended by enriching the science and increasing its impact on solving social problems by integrating external collaborations.

The terms HRE have been defined in many ways over the years, but this definition in the Computer Ergonomics for Elementary School (CergoS) captures the essence of the field in a concise way: Ergonomics and human factors use knowledge of human abilities and limitations for designing systems, organizations, jobs, machines, tools and consumer products for safe, efficient and comfortable human use.

The most recognized official certification body for ergonomists in the United States is the Board of Certification in Professional Ergonomics (BCPE) [15], (Figure 4), which offers the designation of the Certified Professional Ergonomist (CPE) degree.

To obtain this designation, a practitioner must meet the following requirements [15]:

- A master's degree in ergonomics or an equivalent teaching environment in the life sciences, engineering sciences and behavioral sciences;
- Three years of full-time professional practice in the field of ergonomics;
- An CPE written exam (an 8-hour comprehensive test).

Ergonomists can perform their activity in a variety of situations, depending on the specific requirements of the activity they have must perform. They can spend their time in places such as offices, laboratories, industrial spaces, teaching environments, retail spaces and others. They can also spend their time working with a wide variety of people, including workers, union officials, managers, other professionals, students and the public.



Fig. 4. The Certification Board of Professional Ergonomists logo (BCPE)

The duties of an ergonomist:

- Observes human systems to evaluate and measure how people interact with each other

and things such as work equipment, workspaces and environments;

- Assessing the adequacy of products and systems in relation to the motor, sensory and cognitive capabilities of users and operators;
- Conducts audits to get a perspective on how to improve systems;
- To advise the management of organizations on human factors in the design, evaluation and exploitation of products and systems;
- To teach the workers about the body mechanics and the correct working practices;
- Consult with other specialists on design and development issues;
- Evaluation of physical environments using measuring instruments, subjective evaluations, performance and response measurements, modeling and simulations.

In Japan, ergonomics is a practical, interdisciplinary science that meets modern needs, for example, diverse and sophisticated needs for safety, security, comfort and health, through comprehensive approaches based on the combination of specialized disciplines. Ergonomic theoretical studies and practical ergonomic activities are now taking place worldwide [16].

Expectations for ergonomics are high in Japan as well. The Japan Ergonomics Society (JES) [17] (Figure 5) was founded in 1964 to promote ergonomics research and business. At present, the company has around 2000 members.

These members are specialists in various fields, from specialists from faculties or research institutes to practitioners in industries, who have carried out varied and interdisciplinary activities.



Fig. 5. Logo of the Institute of Ergonomics in Japan.

An example is the promotion of international standardization. In 1986, when Japan became a member of the veto in ISO (International Organization for Standardization)/TC159 (the ergonomics technical committee), JES was appointed to deliberate internally all aspects of

TC159 by the Agency of the Institute of Science and Technology (now the National Institute of Advanced Industrial Science and Technology) within the Ministry of Economy, Exchange and Industry. To complete this task, the Japan Ergonomics National Committee (JENC) was formed in the JES in the same year. Since then, JENC has continued its activity, or rather, progressed for more than 10 years, launching a special committee or working group one after another to keep up with the demand [18].

The Ergonomics Society of Japan conducted the following events and activities:

- Held annual conferences to give researchers the chance to present their study results;
- Published the JES magazine "Ergonomics" (every month);
- Created local offices or interest groups, and promoted research in each area;
- Promoted the activities of the ISO committee and the specialized ergonomists committees;
- Collaborates and cooperates with international companies such as IEA;
- Provides consulting or practical applications related to ergonomics;
- Offers courses and training programs on the methodology and application of ergonomics.

The professional ergonomists certified by the JES are those practitioners who have adequate knowledge, skills and competences related to solving ergonomic problems. Certified professional ergonomists, benefiting from the credibility offered by their certification, play active roles in their jobs. The JES certification is approved by the IEA.

The role of ergonomists is to create a safe and comfortable society and to maintain and promote people's health.

To be certified in Japan as an Ergonomist you must follow the Certified Professional Ergonomist (CPE), the Certified Associate Ergonomics Professional (CAEP), the Certified Ergonomics Assistant (CEA), the studies and evaluations are presented in the table 1 [19].

Asia has more than half of the world's population. However, ergonomics has not been

widely applied, except for Japan and Korea. Recently, the enthusiasm of ergonomics has spread to other countries and big cities, such as Hong Kong, Taiwan and Indonesia [20].

Therefore, the objectives are to provide them with opportunities to discuss the current state of ergonomic efforts and, possibly, the promotion of ergonomics in Asia.

At the same time, it intends to introduce ergonomic activities in Asia to Western and non-Asian ergonomists and seek new directions to intensify their activities from world-renowned experts who have experienced working in Asia with Asian ergonomists.

3. ERGONOMY AND THE ERGONOMIST IN ROMANIA

Many specialists from Romania (Rangu, Mihăilă, Anghelescu, Burloiu, Manolescu, Dumitrescu, Seracin, etc.) - some trained abroad, were concerned with the introduction of ergonomics in the programs of university studies (economic specializations and some engineering ones). But, apart from the theoretical contributions, the practical ones must be emphasized especially - from the conception and to the successive, continuous improvements of the work and of the ergonomic organization from different sectors of activity.

However, only in 2017, the profession of "ergonomist" appeared in Romania. This action was possible through the partnership between the Bucharest Academy of Economic Studies, Faculty of Management and Ecoforest Association Neamț – Pilot Unit who have requested updating the Classification of Employment in Romania (COR) by introducing this occupation. Employment Policies Directorate, Competencies and Professional Mobility (DPOCMP) within the Ministry of Labor and Social Justice (MLSJ) approved the respective request. Communication no. 2155/DPOCMP/12.01012017 states that the „ergonomist” occupation has the code 226309.

Certification of ergonomist in Japan

Type of certification	Certified Professional Ergonomist (CPE)		Certified Associate Ergonomics Professional (CAEP)	Certified Ergonomics Assistant (CEA)
	Option A	Option B		
Evaluation	Written exam, essay, interview	portfolio review	portfolio review	portfolio review
Requirements	(I) faculty/diploma of graduation of the faculty + education in ergonomics (at least 3 years) + Practice in ergonomics (job) (at least 2 years) (II) faculty/diploma of graduation of the faculty + experience in an ergonomist position (at least 7 years)	faculty/diploma of graduation of the faculty + full-time experience as an ergonomist (at least 10 years) + at least 3 demonstrable ergonomics projects in which he was fully involved	(I) faculty/diploma of graduation of the faculty + education in ergonomics of at least 3 years (with a minimum of 12 credits) (II) faculty/diploma of graduation of the faculty + experience in an ergonomist position (at least 5 years)	At least 6 credits in ergonomics at a college, technical college or institution of the same level, or equivalent education in a training program of a corporation.

The DPOCMP decision was followed by the Joint Order of the Ministry of MLSJ and the President of the National Institute of Statistics regarding the modification and completion of the COR with a new occupation practiced in the national economy called „ergonomist” [21].

Introducing the COR of the „ergonomist” profession/occupation is a challenge and opens new perspectives [22], which generated the expansion of teams of specialists concerned with concrete actions for consolidation and development in a modern vision of ergonomics. Thereby, a second action in this respect is the elaboration of the occupational standard for the ergonomist occupation. This initiative was attended by initiating specialists from the ECOFOREST Association Piatra Neamț (Neamț County) and the Bucharest Academy of Economic Studies (ASE) and from National Institute for Research and Development in Mine Safety and Protection to Explosion – INSEMEX Petroșani, the University of Petroșani, the General Association of Economists from Romania (AGER), the General Association of Engineers in Romania (AGIR), the National Scientific Research Institute for Labour and Social Protection (I.N.C.S.M.P.S.) and the National Research and Development Institute of Occupational Safety (INCDPM) “Alexandru Darabont”.

Therefore, the framework for training and specialization of human resources in terms of ergonomic requirements in Romania is created

by acquiring the nine competencies specific to ergonomic occupation [23].

As for the future stages of developing ergonomics as a profession, three professional associations are underlined: the Romanian Society of Dental Ergonomics (SRED, Cristian Comes, president, 2006), the Romanian Society of Ergonomics (SRE, Veronica Argeșanu, president, 2011) and the Ergonomics and Workplace Management Society in Romania (ErgoWork, Anca Drăghici, president, 2019).

The final objective is the possibility to train and recognize the Romanian specialists and the accession/affiliation of the national societies to the international ones: Federation of European Ergonomics Societies (FEES) and IEA [24].

7. CONCLUSIONS

The fundamental concerns of HFE are for safety and well-being [23].

In the world of work, lately, there have been at least two major challenges for HFE, namely:

- „Technological advances, such as new information and communication technologies, robotics, artificial intelligence and digitalization” [4, p.1];
- COVID-19 virus pandemic.

Thus, there have been major changes in jobs and people are the most affected because people are the essence of any change process. For people, the transition is a psychological process, a difficult psychological reorientation, a painful

and long-lasting abandonment that people go through to accept the new situation [25; 26]. „Humans are teaming with robots or automation rather than other humans” [4, p.2]. Therefore, they are subject to increasing mental and physical demands, in fact the diseases caused by psychosocial risks have reached almost the level of musculoskeletal disorders.

To design and build efficient and sustainable work systems, Mosier & Hiba, emphasizes that: HFE contributes through a unique combination of three intervention factors: (1) it adopts a systematic approach; (2) is designed; and (3) focuses on optimizing two closely related outcomes, performance and well-being [4, p.1].

Due to these new challenges, to ensure the sustainability of workers, people-centered and job-sustainable, ILO and professional ergonomics associations (IEA, FEES) will work together for structural changes and new projects to respond and find solutions to them.

Currently, ergonomics through the innovative approach responds to human concerns in a world in search of new benchmarks, the application of the new paradigm of integrating ergonomics in the management of the organization and even of emergencies or disasters.

In special situations, such as the case of a pandemic, aligning the objectives and actions of the various institutions, organizations lead rapid results, reducing the risks precisely through the interdisciplinary approach and teamwork of the specialists specific to ergonomics.

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Ergonomia și ergonomistul – repere istorice și actuale

Rezumat: Ergonomia, ca știință interdisciplinară managerială aplicativă este tot mai necesară și tot mai vizibilă. De la microergonomie - simple studii de analiză și organizare a muncii, îmbunătățirea unor componente ale sistemului de muncă și până la macroergonomie – sisteme complexe, dinamice mari - ergonomie urbană, ergonomia organizațională, toate demonstrează aportul deosebit adus de ergonomie la îmbunătățirea vieții omului, la bunăstarea lui la locul de muncă și în viața de zi cu zi. Această lucrare prezintă pe scurt evoluția ergonomiei în lume și a principalelor asociații profesionale de ergonomie existente în prezent, cu câteva repere de formare a specialiștilor în ergonomie.

Sabin Ioan Irimie, PhD Eng., University of Petrosani, Department of Management and Industrial Engineering, 20 Universității Str., Petrosani, Romania, nibas8511@yahoo.com, +40-254 542580
Sabina Irimie, PhD Eng., Professor, University of Petrosani, Department of Management and Industrial Engineering, 20 Universității Str., Petrosani, Romania, sabina.irimie@gmail.com, +40-254-542580