

ERGONOMICS, PAST, PRESENT AND FUTURE

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Abstract The document marks the most important progress acquired, as well as the numerous pressing challenges in the area of Ergonomics and the ergonomist profession on the road to its development and consolidation. Beyond retrospective considerations, the work also reveals many concerns, scientific developments or practices used on Ergonomics. In this context, the manuscript also highlights our own experience, including the approaches or actions taken, which have ultimately achieved the Project's main objectives with regard to the "ergonomist" profession. To understand the present and future of ergonomics, we need to understand its past; to know the premises of Ergonomics in Romania; the world evolution of Ergonomics; the current stage of Ergonomics in our country; the future of ergonomics and the current contribution to Ergonomics by completing the Project objectives concerning the profession of ergonomist.

Keywords: Ergonomics; ergonomist; paradigm; training; research; skills; progress; sustainability.

1. EMERGENCE AND DEVELOPMENT OF ERGONOMICS

*“Learning for the future of Ergonomics
involves always an analysis of the present
based on the past.”*

KLAUS JOACHIM ZINK

In order to know about the emergence and development of Ergonomics we need to know how Ergonomics appeared and developed; like other sciences, Ergonomics did not occur unexpectedly; instead, it is the result of a long historic evolution. In other words, in order to understand the present and future of Ergonomics, we need to understand its past, first and foremost. Therefore, we ourselves adhere confidently and without reserve to the opinions of the specialists who emphasize the importance of a retrospect for an assessment as exhaustive as possible of the present and future of Ergonomics.

In the opinion of emeritus professor *Erik Hollangel* [1], internationally recognized Danish expert, Ergonomics, like any other science, needs to evaluate its past as objectively as possible, in order to obtain an analysis as pertinent as possible of the present, for the *identification of the future directions of development of Ergonomics*. Even more so, as we consider that it is not only wise, but also practical that the historic development of a scientific field should be an important reference for a better understanding of the future evolution of the said field.

For these reasons, the first part of the paper has sought to offer a *brief perspective on the past of Ergonomics*; it can be useful both for a better understanding of the present and for the shaping of an expectation of what needs to be done or of what could happen.

2. CURRENT STAGE OF ERGONOMICS

When we approach the current stage of Ergonomics and explore the literature, we find, however, that, at present, there is no completely drafted history of Ergonomics [2,3] and the questions that are raised exceed by far the offered answers.

At the same time, in the case of Ergonomics, like in many other new disciplines, we can identify a larger or smaller number of *precursors* or *fore-bearers* who readied the emergence, development, and subsequent recognition of Ergonomics. For example, *the first observations* of man's skills and movements or body segments were made by *Leonardo da Vinci, who is considered the first ergonomist*, in light of his scientific multidisciplinary and of his permanent concerns regarding the exercise, development, facilitation or simplification of human activities. *Da Vinci* tried to describe *the proportions of the "perfect" human being*, which should match an anthropometric vision: *the human being as center of the Universe* [3].

Furthermore, in a communication presented at the *French Academy* and called *Report on the strength of man*, physicist *Charles A. Coulomb* (1785) proposes a method for the assessment of the amount of work required in different professions. From this point of view, *Charles A. Coulomb* introduces the notion of *duration of effort*, he studies *work rhythms* and tries to identify the *optimal load* considering the work conditions.

From a *practical* point of view, it is also believed that the interests in the field of Ergonomics have been and are obvious, owing to the fact that, over time, *various civilizations have used and are using ergonomic methods in their projects*. Therefore, Ergonomics has always been an interest ever since the beginning of mankind: the interest in Ergonomics, in the simplification and facilitation of work may be observed throughout history, and *the emergence and development of Ergonomics are tightly linked with the evolution of the needs of the society*.

3. EVOLUTION OF ERGONOMICS AROUND THE WORLD

In order to be able to assess the evolution and stage of interests in the field of Ergonomics in our country, we need to describe several points of view and to obtain some assessments regarding the evolution of the interests in the field of Ergonomics around the world.

Ergonomics appeared in the middle of the 20th century and, in the beginning, in the first 10-12 years (1949-1961), it has a *slower evolution*, given the conservative views of the sciences participating to its establishment, which had created their own field of research and would not abandon easily the positions they had earned.

A decisive part for a solution to this dispute was played by the cosmic flight that led to the *association of a number of scientific fields*: (biology, medicine, psychology, anthropology, etc.) for the *research of new, interdisciplinary issues* raised, as well as for the definition of the possibilities by which humankind could support cosmic flight.

This historic moment in the evolution of modern technology meant *a strong stimulation of ergonomic research*, which then extended to industry and stirred a general interest, shown through the *Congresses of the International Ergonomics Association – IEA*, which had been established in

Oxford, in April 1959, as well as the *annual congresses* of the French Ergonomics Society (*Société d'Ergonomie de Langue Française - SELF*), created in 1963, which counted approximately 350 members in 1986. In general, SELF organizes *specialized colloquia* [4].

Shortly thereafter, *similar societies were organized in a number of other countries*, such as the USA, France, Russia, Germany, Belgium, the Netherlands, Sweden, etc. In these conditions, in 1961, in Stockholm, *the International Ergonomics Association (IEA)* manages to organize *the first International Congress of Ergonomics* [3] where an agreement was reached with respect to the *term Ergonomics* and *some lines of action of Ergonomics* were drawn up, for example, the ergonomic analysis of the place of work and of the work environment.

In the following decades, *significant effort is engaged in the dissemination of this new interdisciplinary scientific field*, as well as *its integrative, holistic approach*. Therefore, *Ergonomics* is becoming *more and more global* as the *effect of several causes* and *the cause of new guidelines in older sciences*.

Thus, the International Association of Ergonomics held Congresses every three years, *whose topic marks the chronological evolution of the progress achieved on Ergonomics*. This is also illustrated by *the increasing worldwide concerns of Ergonomics*.

4. FUTURE OF ERGONOMICS

As regards the future of Ergonomics, the issues were a subject of debates also in the works of the *19th Triennial Congress of the International Ergonomics Association* (2015, Melbourne, Australia [5], given that the specialists in the field (*Robert and Brangier, 2015*), when talking about the perspectives of Ergonomics, stated: “In perspective, *the major objective of Ergonomics* is the *active participation to the definition and organization of future*, for its improvement or change.”

Concerns regarding the future of Ergonomics are also present in many works or relevant surveys, as well as in the most frequent opinions expressed by many authors who suggested a series of 14 *challenges that Ergonomics will face in the future* [6], for example:

- *global problems* have their importance for the future of Ergonomics (*Sugiyama, 1976*);
- *the future of Ergonomics* depends on *the consolidation* of what already happened or what was already obtained in this field (*IEA, 1976; Christiansen, 1976*);
- Ergonomics must improve its *image as discipline and profession*, it must extend its scopes and ensure the necessary human resources (*Singleton, 1976; Mital, 1987; Salvendy, 1989; Shackel, 1991*);
- *Ergonomics must do professionally* what it has already more than done with success (*Small, 1978*); due to these concerns and at *Arnold Small's* call, there was set up in 1978, *the Committee On the Future of Human Factors*.
- *future research* in the field of Ergonomics must be *relevant* and keep up with the development of technology (*Shackel, 1996*)
- *the future necessities* of Ergonomics need to *consider the requirement of adaptation* to the changes in technology and in the work methods (*IEA, 1976; Corlett, 1997*);

- Ergonomics needs to offer *a competitive advantage* in all the cases of its use (Broadbent, 1961);
- in perspective, Ergonomics will consider *the identification of human needs and the expectation for the design* of the products and services that could care satisfy the said needs (Robert and Brangier, 2015);
- the future *success* of Ergonomics will depend on the *specificity or particularities of the market on which it will be found* (Spencer, 1985)
- in the future, *Ergonomics will operate on a market that will stimulate human needs* and will demand multi-purpose, more efficient and more usable products (Robert and Brangier, 2015);
- drawing up a *model of Ergonomics maturity*, which should allow an assessment as relevant as possible of its sustainability;
- based on its history and contemporary inputs, *Ergonomics needs to develop and grow in the future*, as one of the most important modern sciences (Wilson, 2000);
- *the future consolidation of Ergonomics* as science and profession also required *the increase of the approaches and accentuation of the professionals' interest in the scientific bases of the human condition*, in general, *and of our work*, in particular (Chung and collab., 2015) [7];
- *in the future*, in the field of Ergonomics, *increased international cooperation* will be necessary (Kogi, 1991).

The accentuation of such challenges facing Ergonomics requires the *promotion of authentic scientific or academic debates regarding the future of Ergonomics* which, in our country, will reach dimensions sensibly amplified by the theory and practice existing in the field of Ergonomics.

5. PREMISES OF ERGONOMICS IN ROMANIA

The premises of Ergonomics in Romania are marked by plenty of *research in traditionally established fields*, such as: labor medicine, labor physiology and psychology, sociology, labor hygiene and protection, occupational safety and health, organization of production and labor, which led to *practical solutions and applications of an ergonomic nature* many years before the appearance of the term of ergonomics, but which maintained the tendency of data accumulation and separate adding and formulation of the results, without any congruence between them.

The first *psycho-technical* laboratories were organized, between 1924 and 1925, in the proximity of the Universities of Cluj and Bucharest, by professors *F.I. Ștefănescu-Goangă and C. Rădulescu-Motru*. One of the first psycho-technical laboratories was also the one established in 1925 by the Bucharest Tramway Company (STB).

In 1927, at the initiative of the *General Union of Industrialists in Romania (UGIR)*, the *Romanian Institute for the Scientific Organization of Labor (IROM)* is founded. The first issue of the IROM bulletin, which was published in the same year, opened the possibility of debates on the problems relating to the scientific organization of labor and was also a method of information about the outcomes obtained in Romania and abroad.

In 1935, the *Psycho-technical Service of the Central Fund of Social Security for the Prevention of Labor Accidents* was established. After the 1950s, new problems occurred, relating to the introduction

of modern technology and gradual transition to automated production, in many factories, which led to the initiation of *Ergonomic and engineering psychology studies and research*.

Then, *the first psycho-technical institutions* were established, in the largest university hubs of that period, *i.e.* Bucharest, Cluj, Iași, and Timișoara. In 1968, the *Laboratory of Psychology at the Reșița Steel Mill* was established; in several years, it became *one of the greatest laboratories in South-East Europe*, which continue to operate, without interruption. Many of the methods used in *these laboratories of industrial psychology*, which, gradually, were established in the branches of steelworks (Galați, Tîrgoviște, Slatina, Cluj-Napoca, Bucharest), chemistry (Făgăraș, Sinești), light industry (Timișoara, Bucharest, Brașov), Energetics (Bucharest, Craiova, Pitești). In 1970, the *Laboratory Human Factors and Ergonomics* was founded in the Research Institute of the MTTc.

The first *courses of Ergonomics* having a dedicated name and content were taught, widely, in our country, with support from the *International Bureau of Labor*, in 1967, *at the Center for the improvement in the training of economy and administration management staff (CEPECA)*. In the same period, the students of the Faculty of Industrial Economics in the *Bucharest Academy of Economic Studies* received *the first notions of Ergonomics*, a concern that is still present, *following the introduction of the "Organizational Ergonomics" module, for the first time in the higher education system of our country, in the MA programs of the Faculty of Management*, which means the official recognition not only of the new requirements and demands in the field of Ergonomics knowledge and development, but also of the importance of *education and training programs in the field of Ergonomics*, promoted by important universities around the world.

Nationally, in February 1968, the *first symposium of Ergonomics* was organized in Bucharest, while in 1969, IDT published the *first documentary syntheses in the field of Ergonomics*. Moreover, in 1971, *the first courses of specialization in Ergonomics* were organized for physicians, psychologists, economists, production organizers, ending with projects with ergonomic contents. In September 1971, the necessity of joining the efforts of all those who were interested in the field of Ergonomics led to the organization of the first *National Conference of Ergonomics*, which gave a great push to the research and concern for the field of Ergonomics.

An important contribution to a large exchange of information, opinions, and experiences in the field of Ergonomics was also offered by *the first International Conference of Ergonomics, in Bucharest*, in September 1974, organized by the Ministry of Labor, in cooperation with the *International Bureau of Labor*. Then, *main scientific events of an ergonomic nature* were pursued.

The aspects we described show that, *in our country*, some *structural changes* in the Ergonomics interests and in the *order of priority* of their fields occurred and there were some *similarities in the orientation by field*, as compared with the worldwide situation. From this perspective, it is also significant that after 1989, a teaching staff of the Board of Management from the Academy of Economic studies in Bucharest was among the 1200 participants from 55 countries at the IEA's 17th World Congress on Ergonomics.

Nevertheless, in *our country*, the level of interest in the field of Ergonomics is rather low; and yet, the results are not only a *positive experience*, but also a *point of reference* wherefrom we could go to a programmed, systematic action of knowledge, development, and implementation of Ergonomics in modern organizations.

Furthermore, among the many issues described in the paper, we believe that completing *the Romanian Classification of Occupations (COR) with the profession/occupation of "Ergonomist"* is also justifiable; this position is already recognized by international associations or societies of Ergonomics in numerous countries around the world.

At the basis of these initiatives of to completing *the Romanian Classification of Occupations* lies the paper *Ergonomie organizațională ("Organizational Ergonomics")* [8], coordinated by *the Emeritus Prof. univ. PhD Aurel Manolescu*, work dedicated to a unitary, but particularly complex disciplinary scientific field. The contents of the paper *try to satisfy the need of information* in the field of organizational Ergonomics, *to cover a near-void or to contribute to the filling of a gap strongly felt* in the specialized literature of our country and, thus, to materialize our own interests in this scientific field that is well-shaped, but which poses *issues that are less known and sometimes interpreted erroneously or approached insufficiently*.

Likewise, the paper applied the *positive experience* of the Romanian school where valuable input has been offered by numerous specialists in this field, for example: *V. Anghelescu, G.H. Iosif, I. Mihăilă, L. Popescu, I. Pugna, G. Rangu* and now *C. Roșca, A. Dragici, V. Firescu, S. Irimie, A. Manolescu* and, in particular, the late *Prof. Univ. PhD Petre Burloiu*, founders recognized by the *ergonomic school*. By evoking these precursors that contributed to the appearance of Ergonomics, we make a natural and pleasant duty to feel the wealth of meanings and significance of the fact that, in general, where we are today, is largely due to our forefathers.

The efforts used for *Ergonomie organizațională ("Organizational Ergonomics")* were largely encouraged by the special support from the *Faculty of Management* and the *Department of Management* that agreed with the introduction of the subject matter "*Organizational Ergonomics*" in the MA study programs; this means an official recognition of the new requirements and demands in the field of knowledge and education quality, which should be as harmonized as possible with contemporary scientific thought.

At the same time, *at national level, the Association ECOFOREST Neamț - NGO*, has had support, ever since 1985 and even now, via *the President of the Association, Ms. PhD economist Susana Geangalău, Permanent Member of the Academy of Romanian Scientists*; every year, she defended scientific papers in various fields, mainly in Ergonomics, in the Scientific Sessions organized by the Management of the Academy of Romanian Scientists and by its Branch in Piatra Neamț.

6. PILOT PROJECT REGARDING THE „PROFESSION OF ERGONOMIST”

*“The mission of Ergonomics is eternal.
It will never end, as long as there are people on Earth”
PhD EC. SUSANA GEANGALĂU*

a) *The option* for such a *Project* is the result of the following aspects:

- *Recent evolutions* in the fields of micro-, meso- and macro-ergonomics
- *Systematic concerns* in the world, regarding the potential and value of Ergonomics for the competitive and sustainable success of modern organizations

- *Recognition*, by an increasingly higher number of companies or businesses, of the need to train the employees on Ergonomics
- *Proven interest* from numerous academics, researchers, contractors, professional associations, practitioners, as well as business environment representatives, in relation to the issues of Ergonomics.

Therefore, following the *Cooperation Protocol* made on 23.01.2017, between the *Association ECOFOREST Neamț (AEN)* represented by *Ms. PhD ec. Susana Geangalău* as *President* and *Project Coordinator*, and the *Bucharest Academy of Economic Studies (ASE)* represented by *Prof. univ. PhD Nicolae Istudor* as *Rector* and by the *Emeritus Prof. univ. PhD Aurel Manolescu* as *Project Coordinator*, as well as following the approaches undertaken in the recent years, the following objectives of the “*Project regarding the profession of ergonomist*” were reached:

- *Introduction of the profession/occupation of “ergonomist” in the Romanian Classification of Occupations. The code of the profession of “ergonomist” is 226309.*
 - *Decision of the Directorate for Occupational Policies, Skills and Professional Mobility (Decision no.2155/12.01.2017)*
 - *Joint Order of the Minister of Labor and Social Justice and of the President of the National Institute of Statistics (M.O. Part I/No.229/04.04.2017)*
- *Drawing up the “Occupational Standard - OS” for the profession of „ergonomist”*
 - *Validation of the standard – Romanian National Association of Sector Committees – ANCSR (Validated on 06.10.2017)*
 - *Approval of the standard – National Authority for Qualifications – ANC (Decision no. 1385 of 18.12.2017)*
- *Professional certification in Ergonomics, considering the provisions of the Education and Training Committee of the International Ergonomics Association; Board of Certification in Professional Ergonomics; Model for the training of the ergonomist.*
 - *Order no. 1151/4115/2018 of the Minister of Labor and Social Justice and of the Minister of National Education on the list of specializations and improvements allowing the organization of professional training programs completed by the award of Graduation Certificates with national recognition for graduates of academic studies.*
 - *In the annex that is an integral part of this ORDER, the profession/occupation of “ergonomist” is at position 126.*

At present, we are in the process of fulfilling another equally important objective, in the said Project, namely “*Professional certification in Ergonomics*”. Throughout the manuscript, we also consider it justified to set up “*the Society of Ergonomics and the management of working environment*” which would provide the institutional and organizational framework necessary to achieve a permanent scientific and behavioral education on Ergonomics.

In this context, we mentioned that, one of the grounds of the cooperation under the said Project between the *Association ECOFOREST Neamț (AEN)* represented by *Ms. PhD ec. Susana Geangalău* as *President* and *Project Coordinator*, and the *Bucharest Academy of Economic Studies* was also the paper “*Organizational Ergonomics*” (*Ergonomia Organizațională*), published at *Editura Economică*

under the coordination of *the Emeritus Prof. univ. PhD Aurel Manolescu*, an exceptional paper, awarded by the *Romanian Academy*, on an interdisciplinary scientific, particularly complex field that approaches relatively new issues, and holds international recognition and, especially, a definite future. In their approach, the authors show their belief that the performance, success and sustainable competitiveness of modern organizations depend increasingly more on the *integration of Ergonomics*, in general, and of organizational Ergonomics, in particular, in their business strategy.

b) *Sustained support at local level*, for the promotion of Ergonomics

Locally, we obtained support for the constant promotion of ergonomics, from the *Chamber of Commerce and Industry of county Neamț*, at the general meetings and other events notified to the members of the Chamber. We debated on the advantages European and other enterprises may obtain. At the same time, the *Association ECOFOREST Neamț* promoted Ergonomics in the courses of professional training for adults, by introducing in the course materials, information and specific examples for the application of Ergonomics in all the fields of activity: economic units, institutions, NGOs, civil society and population's households, considering that ergonomics means a "*science for all*".

c) *At national level*

At national level, we worked closely with and received *effective support from the most important national institutions or professional association*, who argued for or substantiated, in our actions or approaches, the necessity of promoting and developing ergonomics on strictly objective scientific grounds, for example: Bucharest Academy of Economic Studies (ASE); Academy of Romanian Scientists (AOȘR) and the Piatra Neamț Branch of AOȘR; General Association of Romanian Economists (AGER); General Association of Romanian Engineers (AGIR); National Institute of Scientific Research for Labor and Social Protection (INCSMPS); "Alexandru Darabont" National Institute of Research-Development for Labor Protection (INGDPM); Petroșani National Institute of Mining Research Development and Explosive Protection (INCDINSEMEX); Romanian National Association of Sector Committees (ANCSR); National Authority for Qualifications (ANC); Ministry of National Education (MEN); Ministry of Labor and Social Justice (MMJS). We are grateful to the prestigious Academies, Associations, Institutes, National Authorities for Qualifications (ANC) and Ministries for supporting the profession of ergonomist, without which our chances would have been left ineffective.

At the same time, *at national level*, the *Association ECOFOREST Neamț* - NGO has had the support of its President, *Ms. PhD ec. Susana Geangalău*, ever since 1985, *i.e.* from when the *Piatra Neamț Branch of the Academy of Romanian Scientists – AOȘR* was founded; she contributed as active scientific secretary, and in 2007 she was granted the position of *Permanent Member of AOȘR*. In this period, she presented scientific works [9-12] in various fields of scientific activity based on the studies and daily activity at AEN; however, the priority has always been the field of *ERGONOMICS*, sector of theoretical and applied MANAGEMENT.

Scientific works were presented in the Section IX – Economic, legal and sociological sciences, with the Section President *Prof. univ. PhD Marius Băcescu* and then *Prof. univ. PhD Nicolae Dănilă* who is also a president now. In this Section, they received encouragements and suggestions of solutions regarding the continued interest in the ergonomic field, as a science for the future.

But the major support came from the President of the Academy of Romanian Scientists, *Gen (r) Prof. univ. PhD Vasile Căndea* from whom professional-scientific encouragements were received, claiming works of high intellectual rank. At least once a year, it was at the office of our association, where he held authentic seminars with the employees of AEN and where the *field of Ergonomics was a priority*. He was a modest, very kind and appreciative person in relation to AEN. He has passed away recently, and he is dearly missed, but we continue, respectfully, his stories: *“do not divert from Ergonomics, this is something for the long term”*. This is the cooperation that the Association ECOFOREST Neamț has been having for years with the Academy of Romanian Scientists.

d) *At a diversified level*

At a diversified level, *we had close connections with important Universities across the country*, for example in Timișoara, Iași, Cluj, including with *business environment representatives* interested in knowing and promoting the ergonomic profession and sector and in the application of ergonomics in their households, in cities and communes/villages. In the same time, our deep gratitude goes to the prestigious *Universities of Timișoara, Cluj-Napoca, Iași*, which we had good collaboration with during the project's development period, as well as to those we consulted with on the phone or by e-mail concerning the profession of ergonomist from *Universities of Petroșani, Suceava, Faculty of Forestry, “Alexandru Ioan Cuza” University of Iași*, etc.

Locally we are willing to express our appreciation for the real and continuous support we have received from *the Chamber of Commerce and Industry of county Neamț* represented by *Mr. President, Mihai Apopii* and *Mrs. Elena Miron, General Manager*, for their attitude to promote Ergonomics in both business environment and in all fields of activity. We also thank them for the good collaboration and support of the Association ECOFOREST Neamț as active members.

7. CONCLUSIONS

Our initiatives and actions within *the National Movements in the field of Ergonomics* and succinctly shown in the paper were materialized with a team effort and in collaboration with the *Academy of Economic Studies of Bucharest* in developing the *Occupational Standard for education and training programs on the profession of ergonomist* approved by the *National Qualifications Authority*, which is published on the ANC website. We mention that the above *Occupational Standard* has been *favorably approved* by the most important *National Institutes of Research*, as well as by the most representative *Professional Associations of Romania*.

Furthermore, beyond the *permanent interest in education and training in Ergonomics*, at present, there is another equally important objective within the profession of ergonomist, namely, “the introduction into the Labor Law of appropriate and explicit provisions regarding the implementation of requirements in Ergonomics, which is an expression of the efforts to modernize and Europeanize the activities of our national economy”. Consequently, the option for *the ergonomist profession Project* is based on *scientific reasons*, strictly objective, and achieving all the goals is a major challenge that should animate us, motivate us, honor us, and not in the least, make us accountable.

In this respect, we express our professional appreciation, gratitude and due thanks to all the specialists in the various fields of activity, who, through their honest, proactive attitude and making relevant remarks and proposals, have supported and are still supporting us with determination and proficiency.

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