Virtual Life and Activity: New Challenges for Human Factors/Ergonomics

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ABSTRACT

Human work activity has an operator nature not only in critical occupations (aviation, power industry etc.), but in everyday life (home computers, education, leisure). Interactions among humans and other elements of the human-machine system have changed, because they coincide in the information habitat. This paper will introduce features of information society in respect of a human and corresponding changes in HF/E: (1) information becomes a tool, goal, mean and environment of a human activity, (2) it becomes a part of the human nature and this makes him unprotected, (3) human psycho-physiological status becomes not only a basis of effective activity, but an object of control, (4) means of the human security equipment should be a part of the information habitat, (5) network (information) environment becomes an independent actor in a human activity.

INTRODUCTION

It is generally recognized (UNO, 2005) that we live in time when the world becomes more and more digital one, i.e. "e-World", where difference between e-Work, e-Learning and e-Leisure disappears, because conditions of activity and nature of work's stress are more and more close. Human factors/ergonomics (HF/E) as a "meta"-discipline deals with different sites of a human life and activity. But its goal and tasks has changed over 60 years of existing, as well.

To date we are based on the definition: "Ergonomics (or human factors) 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" [1]. "Other elements of a system" are means of labour and tools as well as working environment.

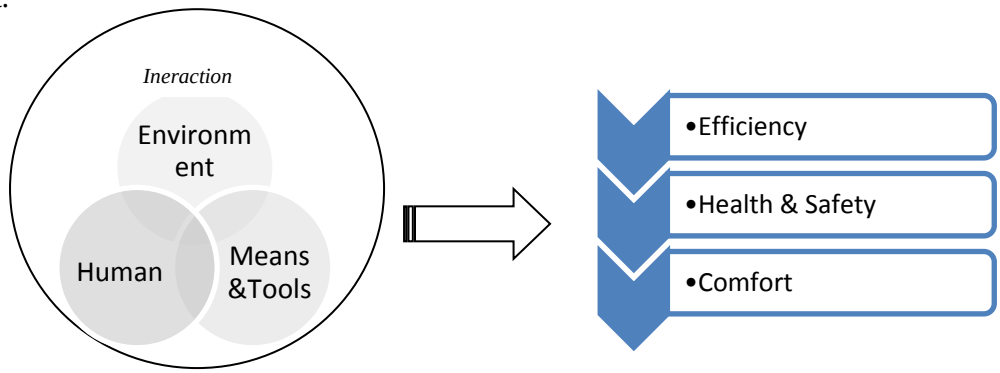

Fig 1: HF/E, its object and subject

[1] The Discipline of Ergonomics. http://www.iea.cc/ergonomics/

The human factors/ergonomics object is a system "human-tool-environment" (HTE) and the ergonomics subjects are ergonomic properties including interactions among all 3 system elements, where "interaction" is a core (main feature) of the discipline, because it is activity of the system. Thus HFE is a systems-oriented discipline that is changing with modifications in the system. Main goal of human factors'/ergonomists' activity was design and evaluation of tasks, jobs, products, environment and systems in order to make them compatible with the needs, abilities and limitations of people.

It was a natural goal in a "hard" system (relatively fixed in time and space) when working means and tools were material objects in comparison with a human (with his/her physical and psychic parameters) and general environment (including natural, social, informational and organizational) that were quite flexible [2].

1.0 TRANSFORMATION OF THE HTE SYSTEM ELEMENTS

Main goal of Ergonomists' activity was design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people. It was a natural goal in a "hard" system (relatively fixed in time and space) when working means and tools were material objects in comparison with a human (quite flexible with his/her physical and psychic parameters) and common environmental (Fig.2a). It was typical over previous ages of work (by J.M.Christensen [3]): manual labor age, machine age, energy age, new age - machines for mental work. At present we are already living in information age (information society) that gives rise to "soft" systems which all 3 elements are flexible in (Fig.2b).

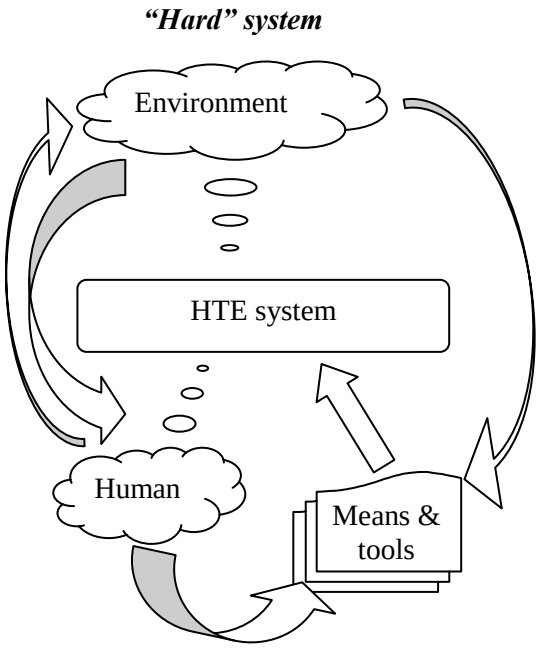

Fig. 2a: Ergonomics objects in industrial age

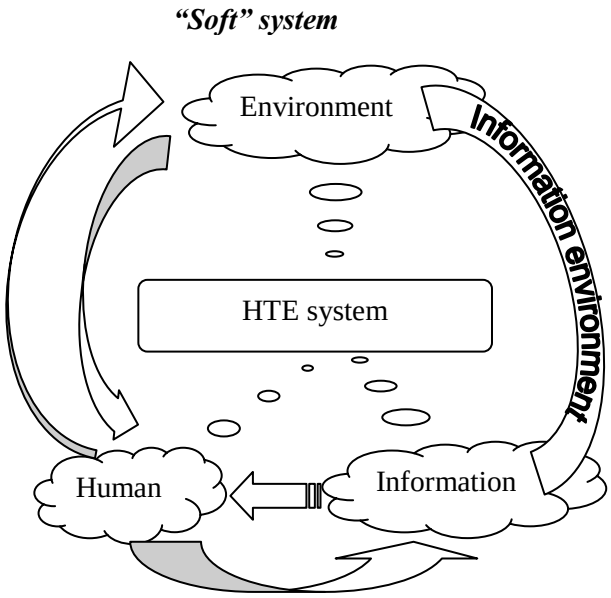

Fig. 2b: Ergonomics objects in digital age

[2] Burov O. Information environment: an opportunity for social albour rehabilitation *vs*. new ergonomic problems. *Ergonomia niepełnosprawnym w zmieniajacym sie otoczeniu I w rehabilitacji* / Pod red. J.Lewan-dowsciego, J.Lacewics-Bartoszew-skiej. – Łódź, Wydawnictwo Poli-techniki Łodzkiej, 2005. 98-105.

[3] Christensen J.M., 1987. Human factors engineering. *In*: Human Factors, 1. (Christensen J., Meister D., Fouly P. et al.). John Willey & Sons, Inc.

We have faced new life conditions :

- Today's work/education challenges correspond modern possibilities and tendencies to use electronic forms of activity.
- Human cognitive opportunities can vary from day to day depending on his/her functional state and fitness-for-work.
- Such changes can impact human ability to …
  - adapt in a particular activity environment,
  - perceive and to conceive new information,
  - use it,
  - get knowledge and skills,
  - to prevent its inefficiency.

1.1 Changes in HF/E object

New links within ergonomics object result in changes of the human factors/ergonomics object structure. Accordingly, the subject, methodology and methods of human factors/ergonomic science have to change as well, because human activity has changed in all aspects.

First of all, working (or rather, activity) means and tools have been transformed into information that became not simply an information, but means, tools, environment and a goal of activity at the same time. A human has started to act mainly:

- with information
- to change information
- to create new information as a product
- by means of information
- in information environment.

1.2 Changes in a human activity

- Activity is a main substance of our everyday life. But its scopes become relative, not clearly defined because of :
- changes in our goals and needs (earning, cognition, leisure),
- tools and facilities (electronic equipment in workplace, in office, at home),
- workplace design and construction (more ergonomic and comfortable),
- location (outsourcing job),
- increasing of mental component work (in contrast with physical one),
- day time span of the same or similar type of activity (work in office with computer can be continued at home with computer again, but as learning or leisure at the similar table).

2.0 HF/E RESULTS (CRITERIA) IN DIGITAL LIFE

The main task of ergonomics is "to design in order to optimize human well-being and overall system performance" [1], i.e. human *efficiency + safety + comfort*.

But in information environment *efficiency* ≈ *comfort* or, at least, approximates to it. F.e., when a human works and produces industrial (agriculture etc.) goods his/her efficiency can be described as:

- Efficiency = quality goods production + minimal workload efforts + minimal time loses.
- Safety = his/her safety (labour protection) + goods safety + environment safety.
- Comfort = optimal conditions (striking distance + microclimate + lack of time pressure).

In digital environment:

- Efficiency = quality of information goods and services production + minimal mental workload efforts + minimal time loses.
- Safety = his/her safety + information product safety + information environment safety.
- Comfort = optimal conditions (human friendly interface + reliable information).

Both a human and information environment takes on new significance (Fig.3). It is especially important because of his/her personal safety and safety of his/her activity results. Being open when working in information environment, a human becomes not only a subject, but an object (target) of activity from other participants of information space. A human openness is a result of activity goals: to use information as a tool, a human has to "touch" it, to contact with it. At this moment he/she becomes open for information and vulnerable from it.

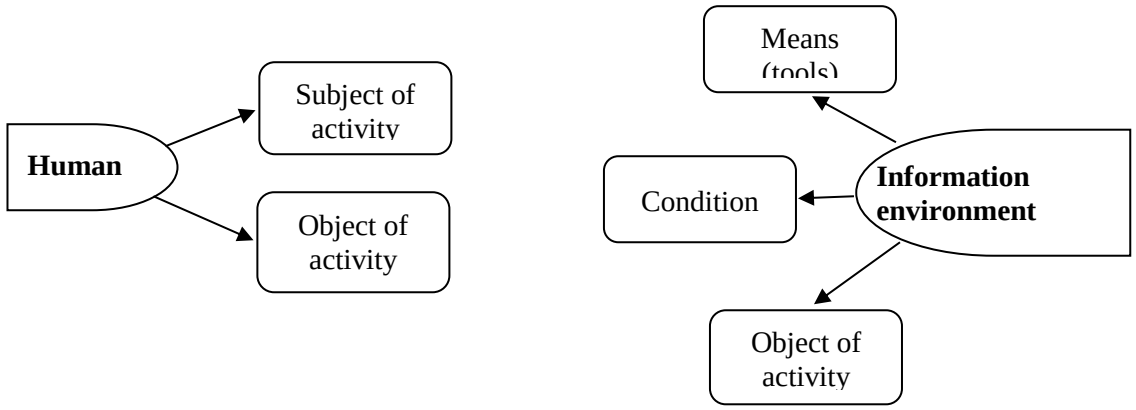

Fig. 3: Roles of a human and information in information society

In addition, in large nets (Internet, corporate nets) a human is open for contacts with information, because the latter is a goal and meaning of the human activity (motivation coincides with them). Moreover, it is a part of a human. Not a physical part, but a physiological one because of influencing through the human psychic on the physiology. Opportunities occur to control and to run a human activity and behavior virtually (distantly).

2.1 New safety problem in digital world

We face a new safety problem in information society. It was possible for traditional activity to standardize a duration of working time, dozes and levels of affecting factors, efforts etc., to protect a human by personal and common protective equipment, to make tasks, jobs, products, environments and systems compatible with the needs, abilities and limitations of people, to adapt and to adjust tools to a human physical possibilities.

But in the information environment the questions are:

- What should be protective means ?
- What should they protect from ?
- In what way is it possible to protect a human from information that is a goal, mean, tool and condition of activity, a part of a human at the same time ?

We strongly believe that psychophysiology is not only a basis of the human working effective activity, but a goal of activity (of information habitat impact) of the human himself. Because his/her tool becomes a part of his nature, first of all his brain, and this makes him unprotected, psychophysiological features and limitations have to be protected in education and training process, work and leisure (it is more and more deal with information surroundings).

2.2 New HF/E component in digital world

Material object, nature, information, social environment, organization of activity and communication have changed and had new features in digital world, especially in networks (social, education/training etc.). In both activity, physical and mental, human parameters of activity are affected by internal and external factors (Fig.4).

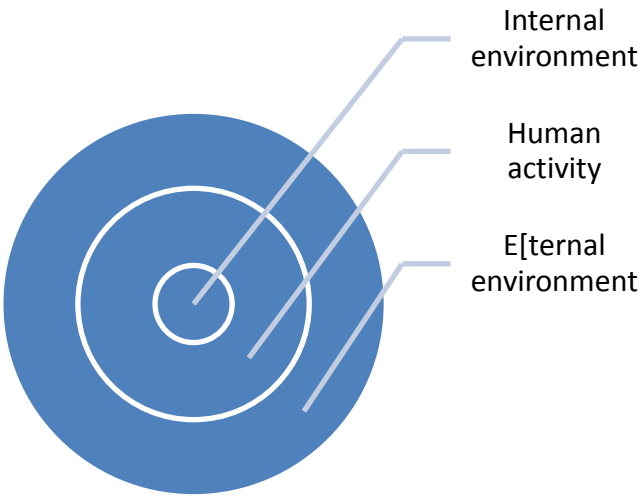

Fig. 4: Roles of a human and information in information society

1. *External environment*

- Material objects: ergonomic design of work place, facilities, clothes, classroom (micro- and midi-ergonomics).
- Nature: conditions in workplace.
- Information: general and specific awareness concerned opportunities and benefits of learning, process and content of subject studied, related issues.
- Social environment: country, school, out-of-school, home, friends.
- Organization of learnin/teaching activity: task planning and allocation in space and time,
- Communication: opportunity to ask question, coaching etc.

2. *Internal environment*

   - Physiological: health level, general and current conditions, fitness-to-do.
   - Psychological: motivation (to learn, to work environment), activity satisfaction, life satisfaction, self-recognition …

3. *Human activity*

   - Working : workplace condition, job organization, facilities, professional awareness, inter-personal relations and communication.
   - Learning : workplace condition at work and at home, access to information needed, working (learning) process organization, task planning and allocation, out-of-school activity, self-evaluation , achievements recognition and success.
   - Means & Tools : workplace organization and design, facilities, IT, communication technologies, teaching aids, curriculum, ….

3.0 VIRTUAL LIFE AND ACTIVITY: BENEFITS AND DRAW-BACKS

New features of life in digital world have as benefits, as draw-backs and some risks for a human in such an environment, because information space and especially networks become independed factors, even more: independed actor of activity. F.e., in cloud technology, social networks etc. where information allocated there become distributed, not-controlled and lives independently on the person that gave birth to it. Such an information begins to live its own life. The network begins to be "owner" of that information and can impact on a human (humans) life. Wikileak and other similar scandals can be examples of this. Such information exists beyond time and space since it was created.

Thus a human has to balance benefits, disadvantages and risks when opening himself to information space.

3.1 Benefits

- Extended information resources with faster access.
- Opportunity to communicate with a great number of colleagues and experts worldwide, including on-line.
- Quick information exchange.
- Opportunity for long-distance "brain-storming".
- Opportunity to involve people with disabilities.
- Higher opportunity to control own functional state.
- Better time self-management.
- More direct time-on-job, less disturbances.
- Individual adjustment in the workplace (physical, psychic, informational).
- Individual adjustment of the secondary (out-of-workplace) environment.

3.2 Draw-backs

- A human "openness" for external impact through information flow.
- Not everyday communication face-to-face with project members.

- "Artificial" environment of communication.
- Lower social-psychological life.

3.2 Potential risks

- A human vulnerability from information.
- Lack of protection means from digital environment as a risk factor.
- Static posture, hypodynamia and accompanying diseases.
- Syndrome of "operator diseases", in general.
- Loss of interest in team communication.

4.0 HF/E TASKS TO BE SOLVED

Ten years ago participation of a human in networks could be described as a terminal element (node) linked to other elements with its specific interface (having human and technical parameters). Currently, when a human life and activity has more virtual nature, information environment (network) becomes independed factor, because process of a human presence as well as results of his/her activity loses their localization in space and in time, as well as could be affected at any time and anywhere. Even more, those results could «live» inside the network «infinitely», because technical resources holding them are distributed, flexible and supported continuously.

HF/E tasks to be solved in this context are as follows:

- design the information habitat (working, everyday, recreation, general use) as a working tool and as a environment at one time (design aspect);
- flexible adaptability of the information habitat depending on a human individual abilities and functional state (exploitation aspect);
- assessment, prediction and correction of a human functional state and fitness-for-duty (serviceability aspect, for a *human* as an object of activity).

Recommendations for improving a human psychophysiological security was developed and described [4]. The further development of ergonomics criteria can be developed accounting the new human activity nature and a multiaspect ergonomic analysis [5].

CONCLUSIONS

- Digital life and activity gives new opportunities for people and new problems for ergonomists.
- Lists of draw-backs and risks can and will be enlarged according new experience to use eWorld.
- New opportunity of eWorld rises new challenges for ergonomics/human factors as scientific and practical discipline .
- HF/E object and subject is changing in information age.
- Human being in networks could be described by four types of attributes: node, interface, link, network.

[4] Burov O. 2005. Ergonomics, functional state and human fitness-for-duty. *Zastosowania Ergonomii*. 1-3 (57-59), 203-214.

[5] Pacholsky L. 2004. A new methodological paradigm of a multiaspect ergonomic analysis. *In*: Dilemmas and issues of modern ergonomics and work safety education and researches. Editors: L.M.Pacholski, J.S.Marcinkowski, W.M.Horst. Poznzn, 2004. 413-426.