Ergonomics, Environment and Sustainability

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ABSTRACT

The concept of environment is one with different scopes, accordingly to the theme in question. Seeing it from macro or global aspects, the main concerns addressed include pollution of air, water and land and ecosystem destruction, for its part at the micro or individual level, the areas of work and movement, proxemics or accessibility to spaces are points of interest more frequently addressed. This diversity of approaches and interests is due in part to the multiplicity of disciplines from which it is addressed the complex environmental concept, as each discipline given its specificity, manages technical terms and theories that are not always shared by other disciplines, affecting interrelationship of its objectives and methods when analyzing as more complex systems. Thereby, as an example, in ergonomic systems users are analyzed when performing specific activities with objects and spaces well defined. These spaces are the environment in which these users perform its activities, and are very important for them because they confer -or not- the conditions for an optimal ergonomic relationship. However, to adapt the environmental conditions for a User on a particular task have effects in broader systemic levels of analysis, usually in contrast of the ideal conditions needed by other users or (micro)ergonomic systems. Thus , to perform a given activity may require certain temperature, ventilation and lighting, while another may require different conditions for their achievement. This divergence of environmental conditions at micro level approach, have different intensities at either the environment within an organization and globally. When an ergonomic system is designed, the intention of achieving adequate levels of effectiveness, efficiency, health, comfort and satisfaction –just to mention few basic objectives of the ergonomics discipline, the object's variables, and those of the activity and the environment are manipulated in the search of a synergistic balance that drives through such ergonomic objectives, but several questions arises about what are the environmental impacts of these decisions into higher systemic levels. Based on macroergonomics concepts can be developed analysis strategies to determine actions to be taken in adapting the ergonomic system, not only pursuing its objectives per se, but in order to consider the best design practices in relation to the effects caused to the environment with this intervention, converging into a more sustainable development vision.

Keywords: Environmental, Surrounding Design, Macroergonomics Approach, Complex Systems.

INTRODUCTION

The environment concept is one with diverse reaches, accordingly to the theme in which is used. Based in the convincing evidences which shows how human activities are in large, responsible drives of global warming, it is increasingly frequent to look for linkages in everyday activities of each individual -like eating, working, moving from a place to another or even resting- , with the "side effects" or footprints each individual do on the planet and its equilibrium. As it is widely known, Global warming is increasingly affecting life over the Earth. Throughout the discussion and working over themes such a broad, typically comprised on the concept of Sustainability, specialists of a variety of field of knowledge do work in a search of elucidating, firstly the main effects global warming carries out, and secondly the main factors that impact on this phenomenon and are growing day by day. As consequence, it is also studied how to do substantial changes on many if not all human activities, in order to reduce, slow down and if possible, revert negative tendencies over the live species on the planet, over biodiversity on land, wind and water so very well documented. Thus, there are multiple spheres of study in which deep work are looking to give deal with Ergonomics In Design, Usability & Special Populations III

those global environmental problems we as humanity face. Because its complexity, the sustainable theme is considered "the problem of problems"; Meaning each activity or situation over the planet could be followed or tracked of into the global warming issues, or into social equity, cultural preservation or maybe, the more frequent and easily linkages are those of the economic matter, because it´s more developed indicators. During the past years, those "four pillars"-economic prosperity, cultural vitality, social Equity, environmental sustainability- gave base to the sustainable development concept. Such pillars were especially useful by grouping the attention of those who studies this problematic looking for equilibrium between its indicators when analyzing local, regional or global develop. Even this overview is still applicable to this issues, it worth to indicate that "The division of indicators along the lines of four 'pillars' (social, economic, environmental and institutional) is no longer explicit in the newly revised set. This change emphasizes the multi-dimensional nature of sustainable development and reflects the importance of integrating its pillars. Consequently, new cross-cutting themes such as poverty and natural hazards were introduced and existing cross-cutting themes such as consumption and production patterns are better represented."(United Nations, 2007). It is evident such task is an ambitious one, because it implies a lot of data, and tends to use diverse instruments, theories and indicators looking to support decisions in an approach to sustainable development; nonetheless, until today there is no one human activity that fulfills thoroughly this definition. This is, of course there have been great advances in multiple fields of assessing and reducing negative environmental impacts, such in social awareness, in danger of extinction species rescue and so on, but above all, it remains a lot of work to do in that direction. We emphasize the effects of reductionism when trying to deal with the net of interrelations among indicators and theories around this problematic. This brief description over the environment to sustainable relation is intended only to give the basis of the issues must be discussed -from an ergonomics or macroergonomics approach- when is planning systems optimization throughout environment modification. "Since the initial proposal and local development of the ergoecology approach, a movement has arisen explicitly linking ergonomics to sustainable development. This movement is associated with social sustainability, the balance between work and life and the balance between human life and nature" (García-Acosta et al., 2012)

THE ENVIRONMENT

Global Warming and Ergonomics Concerns

Global warming is maybe, the concept more widely known about the human activities consequences. It is because all biosphere depends on the environmental conditions (temperature, chemical stability, levels of pollutants, etc.) must be appropriate for the large diversity of species that inhabit the planet, avoiding loss of species and ecosystems. In the ergonomic field, by its side, historically has been considered the relationship of the environment with the user activities in a smaller and more elemental scale. The surrounding[1] or micro space is acceptable if do not interfere negatively with the development of the activity a person does. Following the principal objectives that ergonomics discipline pursue –safety, satisfaction, efficiency and efficacy when doing a task, it is evident that the evaluation point of view about the environment is reduced to some few indicators, related to that activity or task, to that user or group or users, aided with the specific objects used when the interaction is being in process. Obviously, a task must be done in a place. That place or surrounding in ergonomics are defined as the workstation plus the area of use, were the activity take place and in consequence, there must be adequate environment conditions in order to complete that activity in a safety, satisfactory, and efficient manner. Usually, these are the environment factors analyzed in an ergonomic intervention: "Physical factors: Noise, vibration, Illumination and color, ionizing and no ionizing radiations, humidity, ventilation, temperature and (atmospherical) pressure; Chemical factors: fumes, dust, mists, dew, vapor and gases; Biological factors: Viruses, bacteria, fungi". (Flores, 2001) It also could be considered other like distractors or mechanical elements that could affect the interaction. By its counterpart, environment (ecological factors) in a global analysis, would focus on biotic and abiotic factors. The first ones are living beings, meanwhile the second ones are geological, geographical, hydrological and climatological parameters. When distinguishing the differences in scale between both level of analysis, in one hand the ergonomics or microergonomics and in the other the (global, regional or local) sustainable approach, arises several questions about how to match both studies and

[1] The 'built environment' refers to the spaces, materials and physical components that are the products of human beings' transformation and intervention, i.e. a street, a house, a factory, a chair, a car, etc. 'Surroundings' refer to factors that condition or frame the ES as a whole when operated in a certain way. (García-Acosta et al., 2012)

work related to be congruent and not having holes or gaps in between of what is considered desirable in environmental conditions.

Global vs individual environment

At a macro or global level environment is analyzed, caring about air, water and land pollution, which could influence ecosystems and species trough physical, chemical or any other pollutant. Meanwhile, at all different branches of ergonomic approach (such as physical, cognitive or organizational), environmental issues are about "optimizing the layout of workspaces and the design of work furniture and associated ergonomic accessories to improving the ambient conditions (heat, light, sound, vibration and air quality) in the workplace" (HFES Environmental Design Technical Group, 2012), and also the ways of circulation, proxemics and accessibility. Such diversity of focus and interests is on part because of the multiplicity of disciplines that faces the complex environmental concept, so each one, giving its specialty, have generated technical terms and theories not always known or compatible with another disciplines, and as a result, it affects how in a greater in complexity system it is tackled. As an example, ergonomics systems are about specific users doing particular activities with certain objects in a defined space (environment or surrounding).This surrounding, is of great importance because confer the user – or not- proper conditions so the ergonomic relation is done properly. But, at higher in complexity system analysis, "to appropriate" surrounding conditions for a user in a particular task, usually conflicts with those ideal conditions for other users or microergonomic systems[2]; that way, doing specific activities would maybe require temperature, ventilation or illumination levels different to other tasks or users would need. Such divergence of surrounding conditions, at a micro level, would impact in local and global levels. Analogous, in natural environments, there are needed different conditions in order to living beings coexist symbiotically. It is common knowledge that such complex interrelations analysis go beyond a punctual task one, but even knowing such distances, it seems evident everyday efforts must look for an approximation to make bridges among those analyses. In 2013, during the 15th International Conference on Envoronmental Ergonomics, celebrated in Queenstone, New Zealand, Tord Kjellström (2013) presented the paper Climate Change and Environmental Ergonomics, in which was mentioned some of the duties humanity has to do in direction to address Climate Change. The central idea of this paper focuses on impacts of occupational heat exposures, how these can be reduced and how climate change may increase the exposures in different localities around the world, especially in not developed countries, in Tropical or sub-tropical areas or in places where air conditioner are not accessible or is not used to exist because poverty or under-privileged conditions. This issue arises based on the problem of controlling body temperature by sweat evaporation in such conditions. In its statements, he describes how "the heat health hazards can create major ergonomic problems, and when the workers protect themselves from over-heating by taking more rest or working more slowly, the labour productivity is reduced, leading to lower incomes or lower economic outputs for enterprises and communities." Such approach to the environmental issues, related of course to climate change, may be quite specific but important, because such problematic will increase over the years, and let us to identify clearly several branches in social, economic and development issues -as well as people health-, but its lacking on focusing "the other side of the coin" which is how increasing the use of air conditioners or other ways of environmental thermal control in the user surrounding would impact on global scale?.

Putting that way, easily this issue will take us to fields of study like energy saving systems or many other fields which focuses directly in dropping down global warming, but why not taking it into account from an environmental ergonomics perspective since the beginning? Of course, as ergonomics main objective is related to the adjustment of the ergonomic system´s components to the Users capabilities and limitations, attempting to tackle these other environmental issues may become opposite or at best, a tangential aspect to attend. So, How symbiotic, or in a term used by Hendrick compatible[3], could be this way of procedure when valuating global sustainability issues? Based on the Systems Analysis principles[4] could be developed acceptable approaches to this and other questions.

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[2] (Micro)ergonomics is a "human-system interfaced technology, (meanwhile) macroergonomics is "Human-organization interface technology". (Hendrick and Kleiner, 2001)

[3] "In summary, effective macroergonomic design drives a number of aspects of the micro-ergonomic design of the work system and thus ensures ergonomic compatibility of the system components with the work system´s overall structure." (Hendrick,and Kleiner, 2001)

[4] "Systems analysis, developed independently of systems theory, applies systems principles to aid a decision-maker with problems of identifying, reconstructing, optimizing, and controlling a system (usually a socio-technical organization), while taking into account multiple objectives, constraints and resources". (Heylighen and Cliff, 1992)

CONCLUSIONS

Macroergonomics as Instrument of Complex Analysis

The macroergonomics sociotechnical analysis concepts could aid the development of strategies to determine which actions must be follow on a (macro)ergonomic organizational intervention, not only with the aim of ergonomics issues, but considering the best design practices related to the effects on global environment such interventions would induce, converging into a thicker sustainable development vision. In attempting to contribute in that direction, macroergonomics practitioners could approach to larger environmental issues with some initial questions like: how ergonomics focus are been relating environment with surrounding distribution?; how the environment is adjusted to ideal characteristics of surrounding when doing specific activities by individuals?; How, throughout the use of specific terms and objectives related to the environment and/or surrounding, a multidisciplinary work can promote turns (positively or negatively) at every macro or micro level of human activities, stressing systems more and more complex?

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