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Towards innovation and development in ergonomic design: insights from a literature review

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Abstract

The paper examines the characteristics of changes that are intentionally introduced by humans into their living environment. It shows that technical and organizational changes without taking into account human factors criteria - and thus also ergonomic criteria - are the source of many losses. Moreover, the paper contains a discussion of the sequence of actions that lead to relevant changes in the existing reality. It also illustrates innovative engineering applications in the field of ergonomics, known as ergonomic engineering and more extensively – "ergologic" engineering. The importance of heuristic techniques in supporting creative thinking, indispensable in ergonomic design is shown. A discussion of economic development, which is determined by actions of an innovative character, is also presented.

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Keywords: changes; development; ergonomics; ergonomic innovations; human factor

1. Introduction

The concept of change is intuitively obvious: it is the result of deliberate actions, carried out by a human (people) or natural forces provoked by people (the effects of air pollution, the consequences of hydroelectric power stations construction), or the effects of forces of nature (volcanic eruption, earthquake, tsunami, ocean tide, solar radiation). It is a mean to adapt to new conditions (Kubr, 2002) and may concern – and do concern – all aspects of reality, including those which determine the lives and welfare of people (Golembiewski, et al., 1976; Neylor, 1996). Referring to humans and technology, three clearly distinct periods in the social acceptance of technology as

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an engine of change can be distinguished in the last century. At first, it was a period of unbridled and uncritical optimism, due to ground-breaking achievements such as the splitting of the atom, landing men on the moon, automation and robotization of manufacturing processes. It seemed that science coupled with technology can achieve almost anything (Brown, 1982). Afterwards, the change started to be viewed as predictable and dangerous (Botes, 2009), or even as dispelling misconceptions due to disappointment resulting from the lack of breakthroughs in food production and energy, the fight against diseases, improvement of the quality of life on a global scale, awareness of the causes and results of environmental losses (Brown, 1982). Finally, it has become a period of cautious realism: the understanding that material, energy and intellectual resources at our disposal are limited and that the need for their rational management requires an increasing depth and breadth of knowledge and imagination and ethical evaluations (i.e. a sustainable development strategy) (Steurer, 2008; Waas et al. 2014; Radjiyev et al. 2015). From these considerations it may be concluded that a lack of change signifies stagnation and is not a good scenario for the future (Hirschberger & Shaham, 2012) and in turn changes made for the sake of change often bring more harm than good (Chuang, 2006). The introduction of changes must therefore be based on knowledge, experience and preceded by deep reflection – all the more since modern technology as the fulfilment of scientific concepts is becoming increasingly invasive in nature in relation to the determinants of human life and the environment, on which we are almost entirely dependent (Hall & Hord, 2006; Wyrwicka, 2011; Saravia-Pinilla et al. 2016).

The issue of intentional change resulting from deliberate actions of people, who perform them on the basis of an accepted system of values, is of great interest. Relying on a recognized system of values and acting in accordance with them it forms the basis for an ethical evaluation of actions and their effects. In the qualitative assessment of change a special place is held by non-technical knowledge, including the humanities. Since technology is created by the people and for the people – by nature it is humanistic and on these grounds it should be assessed. On the other hand, it is important – particularly for engineers and economists – to be efficient in introducing changes, which is assessed according to praxiological criteria.

A final assessment of the quality of changes is possible only after their completion. Evaluations carried out earlier are prognostic and feature errors – which are larger, the longer the horizon (temporal, spatial, and factual) of prediction. The accuracy of prediction is increased by experience and verifiable knowledge about the effects of similar changes introduced earlier in similar fragments of reality. In order to implement any changes, they must first be planned (designed). This conceptual work must be based on decisional criteria belonging to a particular system of values. It is described by the concise definition: "design is the conceptual preparation of a relevant change" (Gasparski, 1978). This "relevancy" of changes can be fully achieved by using appropriate methods of design that take into account desirable quality criteria, for example:

- Concurrent design, which involves the co-participation of future users in the product design process (Parsaei & Sullivan, 2012)
- Universal design, which aims to design a technical object taking into account the characteristics of all people, including disabled users (Steinfeld & Maisel, 2012)
- Ergonomic design, where the structure of the design process is adapted to the nature of the designed object, i.e. the human – technical object system (Tytyk, 1991; 2001).

For the designed relevant change to become an innovation it has to be implemented, introduced for general use and acceptable to users or customers. Desirable innovations are those that contribute to the growth of civilization: economically, socially, culturally – that is, those that increase the welfare of the people. The benefit of economic development is the increase in the relevant civilization variables: standard of living of society, scale and quality of production and public safety.

The main driving force that shaped society since the beginning of the Industrial Revolution is the ethics of growth. Prior to that the ethics of immutability dominated. One measure of the ethics of innovation should be its ergonomics – compliance with the principles of ergonomics as a sign of the humanization of technology. Growth (in the material sense), due to the depletion of resources (material, energy, human), cannot last indefinitely. It is necessary to adapt to the realistic possibilities that determine growth, that is – to change to the ethics of sustainable growth.

The paper gives an overview of changes that are purposefully introduced by human lives. In particular, it concerns introduction of technical and organizational changes where human factor criteria - and thus also ergonomic