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Conception of the quantification of subjective ergonomic criteria in the network thinking method

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Abstract

Expert method, which is the network method requires the subsequent stages of subjective measures based on expert opinion. It can also be used in the ergonomics analysis of complex production systems for weighting ergonomic criteria. One of the most important steps in the network method, is to determine the interactions and links between the ergonomics affect the level of production systems. Then, with the help of experts evaluated the relations and interactions between the test nature of an impact on the phenomenon (negative or positive), as well as their type (bi-directional or unidirectional) and intensity. In addition, the time horizon is evaluated influences on the point under consideration (from short-term to long-term). All the elements are the basis for the creation of a matrix of influence within which specifies the factors active, passive , lazy critical and there is a map detailing the intensity factors led and guided. Actions based on subjective expert opinion may be subject to high volatility resulting from the knowledge and experience of experts. Therefore proposes the concept of the individual steps of the method of quantification of the network and to lay the foundation of an expert system , which depends less on the level of expertise.

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Keywords: Ergonomic assessment criteria; Ergonomics of manufacturing systems; Network thinking method

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1. The nature of ergonomic assessment criteria

Employers and designers commonly resort to ergonomics to [1]:

- design products and/or workstations for prescribed specifications (such as forces, dimensions) and human capabilities,
- acquire a competitive advantage by fitting products with features that are of significance for users,
- meet regulatory requirements by incorporating the above into new workstations – this applies specifically to Directive 98/37/EC of the European Parliament and of the Council of 22 June 1998 on the approximation of the laws of the Member States relating to machinery – 1.1.2 d) "the discomfort, fatigue and physical and psychological stress faced by the operator must be reduced to the minimum possible, taking into account ergonomic principles"; Council Directive of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work (89/391/EEC) – "3. Without prejudice to the other provisions of this Directive, the employer shall, taking into account the nature of the activities of the enterprise and/or establishment: […] b) where he entrusts tasks to a worker, take into consideration the worker's capabilities as regards health and safety",
- boost productivity,
- identify causes of accidents and diseases involving workers (mainly occupational).

Ergonomic compliance denotes a match between a product or process and the psychophysical characteristics of man. The match ensures that such a product or process does not add to human discomfort or adversely affect human health. Such compliance may be viewed as a standard of modernity [1, 2].

Definitions of ergonomics vary widely in the interdisciplinary criteria of ergonomics assessment they propose. Such diversity has been reflected in standards such as [1]:

- the draft standard PN-88/N-08007: Ergonomic certification of machinery and equipment [15],
- the repealed standard PN-81/N-08010: Ergonomic principles of work system design [13],
- the repealed standard PN-83/N-08015: Ergonomics. Terminology. General concepts [14],
- PN-EN ISO 6385: 2005 Ergonomic principles for the design of work systems [19],
- PN-EN 614-1:2006+A1:2009: Machine safety – Ergonomic design principles – Part 1: Terminology and general principles [16],
- PN-EN 614-2+A1:2010: Machine safety – Ergonomic design principles – Part 2: Interactions between machine design and work tasks [17],
- PN-EN ISO 12100:2012: Machine safety – General design principles – Risk assessment and mitigation [18].

Researchers who set out on assessing products, workstations and complex manufacturing systems against multiple criteria are advised to employ quantifiable yardsticks to ensure comparability across successive scores and with other evaluated items. An issue commonly faced in this process is that of equivalence of the criteria used to evaluate and design mathematical models to bring together various aspects of working conditions. Many authors have approached the design of aggregated evaluation ratios by resorting to methods which, to a smaller or greater extent, rely on formal (mathematical) models [8, 10, 11]. The most critical stages of ergonomics assessment (Fig. 1) are to identify criteria and jointly evaluate economic quality against specified criteria. The classification of such criteria may substantially influence the end result. Where the criteria breakdown is too detailed, synergies will need to be sought. And conversely, overly general criteria may lead to overlooking essential parameters that affect the quality of working conditions.

The standard PN-83/N-08015 (implementing ISO 6385) distinguishes between: anthropometric, physiological, hygienic (physical parameters of work environment) and psychophysical criteria [14].

The existing standard PN-EN ISO 6385 distinguishes the following criteria for work system design: work organization, work tasks, jobs, work environment, work equipment, hardware and software and workplace and workstation [19].