MATERIALS
OF THE XV INTERNATIONAL SCIENTIFIC AND PRACTICAL CONFERENCE

FUNDAMENTAL AND APPLIED SCIENCE - 2019

October 30 - November 7, 2019

Volume 13

SHEFFIELD
SCIENCE AND EDUCATION LTD
2019

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Materials of the XV International scientific and practical Conference
Fundamental and applied science - 2019 , October 30 - November 7, 2019:
Sheffield. Science and education LTD -72 p.

Date signed for printing ,
For students, research workers.
Price 3 euro

ISBN 978-966-8736-05-6

TECHNICAL SCIENCE

Occupational safety

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ANALYSIS OF KNOWN STUDIES ON THE ETIOLOGY OF EMERGING HAZARDS (RISKS)

In practice there are approximate methods of risk assessment, both direct and indirect. The most commonly used direct risk assessment techniques include: British standard BS-8800 (Great Britain) risk assessment based on probability-loss matrix (Great Britain, France, Latvia, USA, Australia), construction of risk assessment scales (Germany, Finland), Risk assessment code (Great Britain); verbal functions (European Union). According to the BS-8800 standard, the risk level (R) shall be calculated as follows:

$$\sum_{i=1}^{n} \text{Pi x Si} \quad (1)$$

where Pi – probability of each hazard realization, Si - severity of the consequences of each variant realization.

Such calculations are made for each of the identified hazards at each workplace. The coefficients from 1 to 5 are used to determine the hazard probability Pi (A - high, B - average and C - low probability) and severity of the consequences Si (I - high, II - average and III - low severity of consequences). Herewith the risk level increases proportionately with the event probability Pi and the severity of the consequences Si and is determined according to the matrix of the risk category (5 - very high risk, unacceptable, 4 - high risk, unacceptable, 3 - average risk, acceptable with control, 2 - low risk, acceptable; 1 - very low risk). If the risk is estimated at levels 4 and 5, the company shall implement preventive measures. The positive side of this technique is its ease of use in practice. And the disadvantage can be the absence of evaluation criterion of possible manifestations of the "human" factor in the structure of derivates of the risk calculating formula. The possibility of direct quantitative assessment of risk without calculating event probabilities is realized in the well-known method of risk

assessment based on the "probability-loss" matrix. The principle of the method is that the expert determines the rank of the probability of occurrence for each situation (for example: low probability, average probability, high probability) and a potential damage corresponding to this situation (for example: small, medium, large). This method is most commonly used in developed countries because of its simplicity. In addition, since in most developed countries, risk assessment in the workplace is a statutory obligation of the employer, its application allows the employer to comply with state regulatory requirements for occupational safety as economically as possible. The obvious drawback of this method is its exceptional subjectivity (the "human" factor). The use of this method is more appropriate in cases where enterprises with a large number of identified hazards have already developed a hazard list(register) and when there is evidence of injuries for a long period of time. Risk assessment scale. According to this method, the level of risk shall be determined as follows:

$$R = S \times E \times B \times P, \quad (2)$$

where R – risk level; S – expected loss; E - tendency towards hazard; B – the effectiveness of protection against hazards; P – hazard proneness.

The methodology for constructing the risk assessment scales is based on the BS-8800 standard recommendation, yet the positive feature is the introduction to the calculation formula of derivatives such as the propensity to hazard (E) and the effectiveness of protection against hazard (B), which is an attempt to take into account a possible mistake ("human" factor). However, the practical definition of risk in accordance with this methodology is a rather inaccurate and difficult task from a practical perspective.

Risk score method – Risk accounting. This method was developed in the USA and according to it the risk shall be calculated as follows:

$$R = S \times E \times P, \quad (3)$$

where: R – risk; S – potential consequences of hazard; E – hazard exposure time; P - hazard occurrence probability.

Risk assessment code methods shall determine risk as follows:

$$R = S \times P, \quad (4)$$

where R – risk; S – potential losses; P – probability. There are four degrees for the likelihood of event occurrence according to this method P (probable, remote, extremely remote and extremely improbable and potential losses – S (unacceptable, unfavorable, low and acceptable).

The risk assessment code methods and risk accounting methodology is a reflection of the classical risk assessment methodology in the BS-8800 standard. Verbal functions method consists in the fact that each quantitative value of the likelihood of event occurrence is put in correspondence with a verbal description of the completely particular situation. Herewith every time while describing any given likelihood one must be guided by the following rules: any situation that does not correspond to this description corresponds to another description, in other words the same situation can lead to various consequences: from light injury to death. There are only two results taken into account while calculating: the most probable and most unfavorable ones. The risks are evaluated for each result. The calculation takes a greater risk. If reducing of both risks requires different protective measures, then both risks need to be taken into account. In this case, the risk is assessed without estimating the frequency of the probable event. The matter point of the approach is as follows: if the exception of the unfavorable result is not guaranteed, then this result is bound to come sooner or later. The advantage of this technique is the practical exclusion of subjectivity in assessing the likelihood of events occurrence and their consequences, but this method requires very careful preliminary work and very high qualifications of experts. Moreover, it is arguable that this evaluation will be consciously overestimated, and the complete elimination of risk can only be achieved by eliminating the source of risk. Indirect risk assessment methods do not involve the direct detection and identification of hazards in the workplace and in carrying out the production operations. The most common indirect methods for assessment of hazard occurrence risk include the assessment of occupational risks under the Elmeri system; risk assessment based on ranking of requirements level (OIR index). Elmeri system is the easiest indirect method of quantitative risk assessment, which does not directly affect the detection of workplace hazards. The disadvantage of the method is that all factors that affect the work safety are assumed to be equivalent. Despite this, the use of Elmeri's system allows planning of occupational safety measures to eliminate identified inconsistencies. For a more adequate risk assessment, an improved version of the Elmeri system - the OIR index is used. By analogy with the Elmeri index, the index that is being investigated is expressed as the ratio of "corresponds" - "does not correspond" The discrepancies are classified by three ranks: items O – contain obligatory safety requirements, the non-compliance of which can directly lead to the hazard; items I – contain important safety requirements, the failure to comply with which does not directly lead to hazards, but

can lead to the encumbrance of the consequences of a hazardous event; Points with index R contain recommendations on work places arrangement and working process. The implementation of each item O, I, R is estimated at 3, 2, and 1 points, respectively. Risk assessment by the OIR index allows you to more accurately assess the actual rick level and indicate the measures to be taken first of all, as well as measures with the most expected effectiveness. The OIR index, as well as the Elmei's index, is not directly related to the presence and assessment of specific risks in the workplace and is based on the assumption that the severity of the consequences associated with potential hazards is already taken into account in health and safety requirements by referring them to certain levels of the labor protection system (state, industry, inter-industry normative legal acts, etc.).

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