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THE OVERVIEW OF APPLIED METHODS FOR OCCUPATIONAL RISK ASSESSMENT

8.1   INTRODUCTION

The assessment of occupational risk in a modern enterprise is becoming increasingly challenging due to the multitude of existing hazards and the increase of awareness among employees. The obligation to conduct assessment of occupational risk is imposed on the employer under art. 226 of the Labor Code, which states that: "The Employer shall assess and document occupational risk related to the performed work and shall apply all necessary precautions to lower that risk" [10]. Apart from the statutory obligation of performing assessment of occupational risk, it is the interest of the employer to conduct such reviews, since he or she might acquire many essential pieces of information, which include a comprehensive analysis of risks and exposures related to specific positions with the possible methods for reducing them, the reasons for purchasing personal protection items, as well as the direction the enterprise is or should be modernized in. Unfortunately, it is crucial to choose the correct method of assessment, depending on the characteristics of work environment. Nowadays, there are many various methods applied. This overview is to indicate the advantages and irregularities of individual methods and propositions for changes in that aspect of business management. The methods presented in this work are indicative, i.e. they determine the level of occupational risk through calculation of an equation characteristic for each method being the product of weighs of respective parameters [8]. Values of parameters are determined in an empirical manner by the teams that assess the risk based on tables specifying the possible values attributed by a particular component parameter. The resulting values of the indicator enable determination of risk acceptability in order to specify whether there is a necessity of taking steps to reduce the risk, as well as to specify the scope of such actions. The assessment of occupational risk is, then, a process that requires to be verified and updated (if necessary) [2]. The results of the occupational risk assessment must be presented to the employees of the enterprise. Very often, consulting issues with employees helps in pointing out the most efficient activities that decrease the risk potential.

8.2 THE CHARACTERISTICS OF EXEMPLARY METHODS FOR OCCUPATIONAL RISK ASSESSMENT

8.2.1 Risk Score method

The Risk Score method, also called Score Risk, is a 3-parameter method. The risk indicator is the product of probability of event occurrence marked as (P), time of exposure to hazard (E), and the size of potential outcome of such an event. Parameter (P) may take 7 possible values from 0.1, in case of events that are theoretically possible, to 10 for highly probable events according to 8.1. There are six values from 0.5 (exposure once a year) to 10 (constant exposure). The potential outcome of events is determined in two ways – regarding the damage to human's health or with regard to the possible material losses. Parameter (S) may have values from 1, when there are minor injuries, to 100, when there is a possibility of fatal accidents [5]. The equation of the risk indicator is as follows:

$$R_{RS} = P \cdot E \cdot S \tag{8.1}$$

where:

R_{RS} – risk indicator in the Risk Score method,

E – assessment of exposure to hazard,

P – assessment of probability of hazard occurrence,

S – assessment of potential outcome of the risks [3].

Table 8.1 Values of parameters and classification of the risk indicator for the Risk Score method

L.p.	Parameter (P)	Parameter (E)	Parameter (S)	Risk indicator R_{RS}	Risk category
1	10	10	100	$R_{RS}>1440$	Unacceptable
2	6	6	40	$270<R_{RS}\leq1440$	Serious
3	3	3	15	$48<R_{RS}\leq270$	Average
4	1	2	7	$1,5\leq R_{RS}\leq48$	Acceptable
5	0,5	1	3	$R_{RS}< 1,5$	Negligible
6	0,2	0,5	1	-	
7	0,1	-	-	-	

Source: own analysis based on [3]

8.2.2 Risk Level Indicator (WPR) method

A method more extended than the Risk Score method is the four-parameter risk level indicator method (WPR). In this case, similarly to the previous method, the components are the probability of event occurrence and the frequency, while potential effects are divided into two individual components: type of damage and scope of damage [1]. The probability of event occurrence identified as parameter (A) amounts from 0, in case of impossible events, to 15, in case of events that are certain to take place. Parameter (B) that determines the frequency of exposure to risk takes values from 0.1, when the exposure is very rare, to 5, in the case of constant exposure. The type of damage identified as parameter (C) is assessed within the range from 0.1 for abrasion and bruises to 15 in the case of employee's death. The last parameter (D) determines the range of damage from 1, in the case of one or two persons, to 12,

when the number of affected persons might be over 50. The formula of the WPR risk indicator takes the following form:

$$WPR = A \cdot B \cdot C \cdot D \tag{8.2}$$

where:

WPR – risk indicator,

A – probability of the event,

B – frequency of risk occurrence,

C – type of damage,

D – scope of damage [1].

Table 8.2 Values of parameters and classification of the risk indicator for the WPR method

Parameter (A)	Parameter (B)	Parameter (C)	Parameter (D)	Risk indicator WPR	Risk category
15	5	15	12	WPR>1000	Unacceptable
10	4	8	8	500<WPR≤1000	Extreme
8	2,5	4	4	100<WPR≤500	Very high
5	1,5	2	2	50<WPR≤100	High
2	1	1	1	10<WPR≤50	Significant
1	0,2	0,5	-	5<WPR≤10	Small
0	0,1	0,1	-	1<WPR≤5	Very small
-	-	-	-	0<WPR≤1	Acceptable

Source: own analysis based on [1]

8.2.3   The Extended Five Steps Method (by J. Szlązak)

That method was proposed by prof. Jan Szlązak and described in the scientific dissertation [9]. It consists of three component functions. The basic function f_1 is the equation of the standard five steps method. Additionally, the climatic conditions of the work environment (function f_2), as well as the health of the employed person (function f_3) have been taken into consideration. Due to the degree of complexity of the parameters in this method, they have been presented in Table 8.3.

Table 8.3 Values of parameters for the Extended Five Steps Method

Parameter (P)	Parameter (S)	Parameter (F)	Parameter (L)	Function f_2	Parameter (W)	Parameter (SP)	Parameter (Z)
15	15	6	12	2,0	3,0	3,0	x
10	10	4	4	1,5	2,5	2,5	1,5
8	6	2,5	2	1,0	1,5	2,0	1,0
5	4	1,5	1	-	1,0	1,5	-
2	2	1,0	-	-	-	1,0	-
1,5	0,5	0,5	-	-	-	-	-
1,0	0,1	-	-	-	-	-	-
0,033	-	-	-	-	-	-	-

x – prohibition of employment
Source: own analysis based on [8, 9].

The equation of the risk indicator is as follows:

$$R_2 = f_1(P \cdot S \cdot F \cdot L) \cdot f_2 \cdot f_3(W \cdot SP \cdot Z) \tag{8.3}$$

where:

F – exposure,

f_1 – basic function of the Five Steps method,

f_2 – function of the climatic impact,

f_3 – function of the employee health impact,

L – number of exposed persons,

P – probability of event occurrence,

R_2 – risk indicator,

S – size of damage,

SP – seniority parameter,

W - employee age parameter,

Z – health status parameter [9].

The interpretation of the calculated risk indicator is conducted in four levels of intensity:

➢ $0<R\leq5$ negligible risk,

➢ $5<R\leq50$ low (but important) risk,

➢ $50<R\leq500$ high risk,

➢ $R>500$ unacceptable risk [8].

8.3 POSSIBLE DIRECTIONS OF CHANGES

Each of the methods described above has its strengths and weaknesses. The Risk Score method is relatively easy to use and might be applied by persons who do not have much experience in conducting assessments of occupational risk. Descriptions of individual parameters are comprehensible, while existing technical documentation and observations of the assessing team might be used to conduct the assessment [7]. The WPR indicator method is more complex, categorization of risk has an expanded gradation, which enables more accurate adjustment of preventive activities. The extended five steps method is far more accurate and, consequently, requires a large contribution of the assessing team. It is necessary to conduct detailed analyses of climatic conditions and designation of substitutive climate, as well as the assessing team's thorough analysis of the employee's documentation. So far, the applied methods of assessment of occupational risk do not take full advantage of available data. Thus, it is necessary to create a new indicative method that will acknowledge additional components. The innovative approach should be based on proven methods while, at the same time, it should supplement calculations with new indicators designated on the basis of statistical data. Such data is collected and stored and the level of detail allows creation of parameters that include experience gained in the particular industry within the scope of negative impact of individual hazards on the employees. The fact of expanding work places and facilitating places of employment with high-technology, indicated in the introduction, allows extension of the employee scope of obligations, which leads to the necessity of updating the occupational risk assessment and application of more detailed methods. New

methods should be designed in such a way that there would be no necessity of simultaneous application of several methods to make sure that the risk assessment has been performed correctly. Creation of synergistic methods would significantly simplify the tasks of assessing teams. The direction described above is not the only possible option due to the fact that nowadays, the solution of difficulties in performance of occupational risk assessment might be solved with computer software aided by the so-called artificial intelligence. The application of relevant software has a major impact on the time required for calculations related to the analysis of documentation and search for modern actions that would reduce the risk. The computer systems used nowadays are helpful, but the whole work must be done by the assessing team, of course, individually for each employee [4]. Modernization of software may result in a solution that, in the case of employees working at similar positions at a particular place of employment, the software would, by way of suggestion, fill in the occupational risk assessment sheet, leaving, of course, the possibility to have it verified and approved by members of the assessing teams.

8.4   CONCLUSION

All the methods described above are used in full at places of employment in order to conduct assessment of occupational risk. This article constitutes an important presentation, especially for persons who look for proper methods to be used in the places of employment they manage. Employees who start their job in assessing teams, due to the simplicity of performing the assessment, very often apply the Risk Score method. The WPR indicator method will prove itself useful in the case of enterprises with a moderate potential of existing hazards. The extended five steps method will find application in places of employment with specific working environment, such as foundries, mines, or plants in the ceramics sector. The use of that method requires an experienced assessing team and a detailed analysis of the potential of individual occupational hazards. The proposed directions of changes at work indicate the necessity for conducting research in one of the most significant areas, i.e. the management of occupational risk assessment. The development of existing methods has been chosen as the field of knowledge of the authoress's detailed research.

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Abstract: *The article presents the been reviewed most frequently used methods of risk assessment. They have been analyzed coefficients used in various methods of paying attention to the rules for their designation. Also important was the way we defined risk index and the rules of its interpretation in the various methods.*

Key words: *occupational risk assessment, Risk Score method, WPR indicator method, extended five steps method, management of occupational risk*

PRZEGLĄD STOSOWANYCH METOD OCENY RYZYKA ZAWODOWEGO

Streszczenie: *W artykule przedstawiono przeglądowo najczęściej stosowane metody oceny ryzyka zawodowego. Analizie poddane zostały współczynniki stosowane w poszczególnych metodach ze zwróceniem uwagi na zasady ich wyznaczania. Istotnym był także sposób w jaki określa się wskaźnik ryzyka oraz zasady jego interpretacji w poszczególnych metodach.*

Słowa kluczowe: *ocena ryzyka zawodowego, metoda Risk Score, metoda wskaźnika WPR, poszerzona metoda pięciu kroków, zarządzanie ryzykiem*