

MEVA - a new method of occupational health and safety risk assessment

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Abstract. The paper describes a new method of occupational health and safety risk assessment. This method, called MEVA, unlike the old ones, focuses more on reduce or eliminate subjective issues in determining the probability of manifestation of risk factors and is based on a deductive reasoning, with the help of which is studied the chain between two or more events. The novelty of the method consists in combining risk assessment techniques with evaluation of compliance with legal and other requirements, aiming to provide a more objective results of the risk assessment. In the MEVA method, the risk matrix is defined by 5 classes of severity and 5 probability classes, resulting in 5 levels of risk. After quantifying the risk factors, prevention measures are proposed for all the identified risk factors and each partial risk level is recalculated as a result of the proposed measures. The five levels of risk were grouped into three categories: acceptable, tolerable and unacceptable. The MEVA method is a simple method and it can be used for assessing various workplaces, with different characteristics of complexity, activity domain or occupational health and safety recordings.

1 Introduction

In general, the methods of analysis and evaluation address the risk as an unwanted event or failure that occurs during operation of plant and machinery. They consider factors that can induce dysfunction problems or human error, affecting the following characteristics of work systems: reliability, the ability to be repaired, usability, system performance in terms of production and energy consumption, not to cause damage to man, or to the environment, installations or the product [1-2].

The use of risk assessment methods should normally be complemented by the study of the consequences and effects in terms of damage that undesirable events can cause on workers, which requires that all risk factors be identified, their variability and their impact on the risk assessed.

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The problem is, however, that there is no universal method or predefined solutions for risk analysis. Each approach has its specificity. Moreover, the methods are not clearly delimited. There are variants and combinations. It is often advisable to start with a rough analysis and, after getting an idea of the most important risks, continue with a more in deep method. In order to minimise this issues, an IT instrument should be used for applying the method. Moreover, this instrument could be integrated or connected with other software instruments used in production processes [3]. Very important issues regarding risk assessment are generated by the human factor, which sometimes has unpredictable behaviour, apparently not related to experience level or training level. For addressing properly this subject, individual analysis are required as well as wide analysis performed at macro level [4-7].

In the logic of continuous improvement, the risk management system is subject to constant review and updating. In this context, the MEVA risk assessment method have been developed.

2 Method description

2.1 General considerations

The principle of the method is to identify all the risk factors in the system that can be the ultimate cause of injury and/or professional illness by means of predefined control lists and quantifying the risk based on the combination of gravity and probability of risk factor manifestation.

The MEVA method is based on a deductive reasoning that studies the chain between two or more events and has the advantage of being able to be applied, even if detailed system information is not available at the start of the assessment process. Moreover, it is suitable both for the analysis of the complex systems security (e.g. workshops, factories, installations etc.) as well as for the analysis of less complex systems, such as offices.

2.2 Method applying

The main steps in applying the method are the followings (Fig.1):

- Forming the assessment team;
- Description of the analysed system (workplace, installation);
- Identifying the risk factors of the system;
- Quantification of identified risk factors;
- Calculating the Global Risk Level;
- Establishing preventive measures;
- Recalculating the risk level;
- Editing the Assessment Report.

The above mentioned steps of the method are fulfilled using the following work instruments:

- Risk factors identification list;
- Questionnaires for assessing the Compliance Factor (FC);
- Matrix for quotation of severity (G) and probability (P) of the potential consequences;
- Risk assessment matrix;
- Matrix for quotation of risk level and safety level;
- Workplace assessment card.

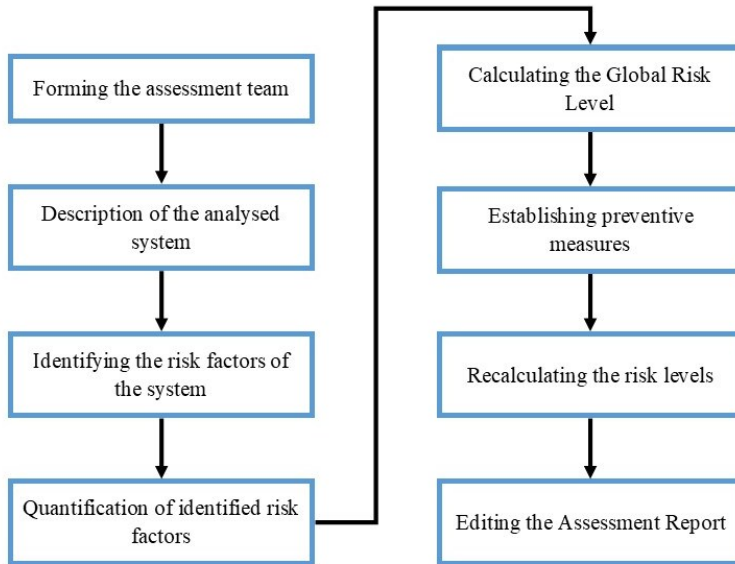


Fig. 1. MEVA method steps flowchart

Table 1. Risk factors identification list (selective)

Crt. No.	Risk factors
1.	Same level slips, trips and falls
1.1.	Fall by tripping on uneven surface
1.2.	Fall by tripping on the objects
1.3.	Fall on slippery surface
...	...
2.	Fall from height
2.1.	Fall in unguarded holes in floors
2.2.	Fall from ladders, scaffoldings
2.3.	Fall in excavations
...	...
11.	Electric shock
11.1.	Electrocution by direct contact
11.2.	Electrocution by indirect contact
...	...
29.	Wrong actions and omissions (workers)
29.1.	Deficient operation execution
29.2.	Unsynchronized operations
29.3.	Omissions
...	...

The risk factors identification list contains the main categories of work accidents and illness risk factors grouped by the generating element of the work system: worker, equipment, work task and environment. The list contains a number of 29 general risk factors, each with several specific subcategories covering the most common situations of work systems (Table 1). Also, the list is open so, for particular situation, a new risk could be added if necessary.

The MEVA risk assessment method, unlike the old one, focuses more on eliminating subjective factors in determining the probability of manifestation of risk factors. Thus, checklists were developed for each risk factor, which establishes a compliance factor for

each risk factor. As an alternative, the results of previously fulfilled evaluation of compliance with legal and other requirements could be used, e.g. using the method for assessing the safety level at work [8]. Following the identification of the risk factors and the audit of the workplace (having OH&S legislation and other organization's requirements as criteria) the check-lists applicable to the work place/activity are established. Using the checklists, the Compliance Factor (FC) is determined as the percent of observing the audit criteria. Corresponding to the value of FC, the Frequency of exposure (F) are established, the possible values being 1 (low), 2 (medium) or 3 (high). Also, the Exposure Time Coefficient (T) is established considering the estimated or calculated period of worker exposure to the risk, in relation with total shift time. The possible values for T are from 1 (very short) to 5 (whole shift time or almost) – Table 2.

Table 2. Exposure Time Coefficient (T)

T	Percent of whole shift time
1	0 – 20%
2	21 – 40%
3	41 – 60%
4	61 – 80%
5	81 – 100%

The probability (P) for a certain risk depends on frequency of exposure (F) and Exposure Time Coefficient (T), as shown in Table 3. The severity (G) for a certain risk is quoted in 5 classes, as shown in Table 4.

The risk level is determined for each identified risk factor, depending on the values of probability (P) and severity (G), using the Matrix for quotation of risk level and safety level, as shown in Table 5.

Table 3. Quotation of Probability (P)

Probability (P)		Values of Frequency of Exposure and Exposure Time Coefficient(F,T)
1	Very Rare	(1,1) (1,2) (2,1)
2	Rare	(1,3) (1,4) (2,2) (3,1)
3	Less frequently	(1,5) (2,3) (3,2)
4	Frequently	(2,4) (2,5) (3,3)
5	Very frequently	(3,4) (3,5)

Table 4. Quotation of Severity (G)

Severity (G)		Description
1	Minor consequences	Reversible consequences, up to 3 days of work incapacity, no medical treatment needed
2	Medium consequences	Reversible consequences, 3-45 days of work incapacity, medical treatment needed
3	High consequences	Reversible consequences, 45-90 days of work incapacity, medical treatment needed
4	Serious consequences	Irreversible consequences, invalidity class 1 to 3 (diminishing work capacity by 50-100%)
5	Very serious consequences	Fatality

Table 5. Matrix for quotation of risk level and safety level

Risk level		Values of severity and probability (G,P)	Safety level	
1	MINIMUM	(1,1) (1,2) (1,3) (2,1) (3,1)	5	MAXIMUM
2	LOW	(1,4) (1,5) (2,2) (2,3) (3,2) (4,1) (5,1)	4	HIGH
3	MEDIUM	(2,4) (2,5) (3,3) (4,2) (5,2)	3	MEDIUM
4	HIGH	(3,4) (3,5) (4,3) (4,4) (5,3)	2	LOW
5	MAXIMUM	(4,5) (5,4) (5,5)	1	MINIMUM

The Global Risk Level (*Nrg*) is calculated as a weighted mean of risk level values determined for all identified risk factors, using the following formula:

$$Nrg = \frac{\sum_{i=1}^n r_i \cdot R_i}{\sum_{i=1}^n r_i} \tag{1}$$

where:

- R_i is the risk level determined for the risk factor i ;
- r_i – weight for the risk factor i ; by definition, $r_i = R_i$;
- n – number of identified risk factors.

Finally, all the results of the risk assessment for a certain workplace is centralised in the Workplace assessment card, as shown in Fig.2. For each identified risk factor, the values of severity (G), probability (P) and risk level (R_i) are recorded as well as proposed measures. Also, estimated values of severity (G^*), probability (P^*) and risk level (R_i^*) as effect of proposed measures are recorded.

Organization:	WORKPLACE ASSESSMENT				Assessment team:		
Department:	CADR No.						
Workplace:	Nrg=		Nrg*=				
Risk factors	G	P	R _i	Proposed measures	G*	P*	R _i *
Means of production							
F1.							
F2.							
...							
Work environment							
...							
...							
...							
Work task							
...							
...							
...							
Worker							
...							
...							
Fn.							

Fig. 2. Workplace assessment card

3 Conclusion

The risk assessment of injury and professional illness represents an important point of occupational health and safety management. It, also, represents the starting point for preparing all the preventive and protective actions required by the legislation, such as

elaboration of Preventive and Protective Plan or specific safety instructions. Thus, it is very important to ensure the objectivity of the risk assessment process, and for reach this goal a proper assessment method is needed.

The MEVA risk assessment method, presented in the paper, focuses more on reduce or eliminate subjective issues in determining the probability of manifestation of risk factors and is based on a deductive reasoning, with the help of which is studied the chain between two or more events. The novelty of the method consists in combining risk assessment techniques with evaluation of compliance with legal and other requirements, aiming to provide a more objective results of the risk assessment.

The method is suitable for a large diversity of workplaces, regardless their activity domain or complexity, even if detailed system information is not available at the start of the assessment process. The risk factors are assessed more accurately comparative with other previous similar methods, by considering the probability of occurrence of a certain risk as a function of exposure frequency and exposure time. Moreover, the method is not limitative in the assessment process, allowing workplace specific risk factors to be defined and considered.

Thus, the MEVA risk assessment method is a strong and reliable instrument for occupational health and safety specialists in any organisation.

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