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EVA-RISK METHOD OF RISK ASSESSMENT OF INJURY AND PROFESSIONAL ILLNESS

Eduard SMIDU, Oana Roxana CHIVU, Oana SUCIU, Silviu DUMITRESCU

Abstract: *Risk assessment is an activity that identifies existing risks in the workplace and quantifies the size of the risks based on the combination of the severity and the probability of the maximum predictable consequence on the human body. The evaluation systematically examines the risks related to all elements of the work process. Assessing the risk is starting point and at the same time the scientific basis for the stability of priorities in prevention actions. The paper presents* occupational health and safety risk assessment by EVA-RISK method. *This new method can be easily mastered and used because it contains working tools known to users of other assessment methods. The methodology used is in accordance with European standards and Romanian legislation. The method is a result of the need to update the professional risks. The assessment sheet contains: the identified risks, the quantification of the level of risk, the mitigation-elimination system that contains measures for each identified risk, the deadline for carrying out the measures and the persons responsible for carrying out the measures. An important tool in the assessment is the checklist of risks, which also contains ergonomic risks. The new EVA-RISK assessment method has been successfully applied in the field of green technologies, banking, medical field and can be used by as many companies in different branches of the economy to significantly improve their health and safety management system. The assessment is done with the participation and consultation of employees and their representatives, as these are key factors in occupational health and safety management. For a quick use of EVA-RISK, a highly accessible computer program will be developed*

Key words: *risk, occupational risk assessment, ergonomics, preventive measures, OSH management*

1. INTRODUCTION

Risk is one of the ubiquitous elements in the daily work of all active organizations, no matter where they are in the world. Competitive advantage, profitability and overall survival, the success of an organization depends on ability to identify risk, then to evaluate and obtain the best course of action in relation to specific area of operation, operating requirements, and resources at service. It can be said that there are no jobs without danger of injury, regardless of the size of the organization or the nature of the activities carried out [1-6].

Occupational risk, approached as a component of the risk in an enterprise, is characterized by the probability of occurrence and the consequences of a risk of injury. In the last years, the importance of risk management has increased substantially, the problem being approached in an integrated way, based on the principle of organized operation. Such an approach has reduced the frequency of accidents and increased the company's productivity and economic performance [7-9].

The evaluation criteria and methods have developed in step with the general evolution of the concept of work safety, respectively with various theories on the genesis of accidents at work and occupational diseases, from which they have their role [10, 11].

The EVA-RISK evaluation method was developed in the doctoral thesis of PhD student Eduard Smidu, from the University Politehnica of Bucharest, Romania. The main novelty elements in EVA-RISK [1]:

- Contains 2 lists of risk factors, a list of

"classic" risks and a second list of new and emerging risks. All these factors are grouped by the generating element of the work system: the worker, the workload, the means of production, the work environment. The first list (Table 1) contains general risk factors, with specific subcategories covering the most common situations of work systems:

Table 1

Risk factors identification list (selective)

Crt. No.	Risk factors
	Means of production
1.	movement of means of transport - collisions
2.	self-triggers of functional movements of technical equipment
3.	dangerous surfaces and contours - slippery, sharp, stinging
4.	electrocution by direct contact, by indirect contact, step voltage
…	…
	Work environment
36.	high air temperature
37.	natural calamities - earthquake, landslides, lightning
…	…
	Workload
65.	Physical request - dynamic effort, forced work positions, static effort
…	…
	Worker
72.	faulty execution of maneuvers
73.	fall from height
74.	unsynchronized operations
…	…

The second list (Table 2) contains new and emerging risk factors, with their specific subcategories:

Table 2

New and emerging risk factors identification list (selective)

Crt. No.	Risk factors
	Means of production
1.	Nanomaterials - penetration into the human body etc.
2.	new technologies - the functional movement of some equipment used in new technologies
	Work environment
3.	Microorganisms - new viruses, viruses that have undergone mutations, pandemics
4.	climate changes - continuously increasing high temperature, prolonged drought, heavy rainfall in a short time, violent storms
5.	international armed conflict (war) - accidental bombing
	Workload
6.	psychic request - extended work schedule, variable work schedule, unpredictable work schedule, lack of balance between professional and private life, high emotional demands at work
7.	digitization - lack of social interaction, solitary and monotonous work etc.
	Worker
8.	vulnerable persons – persons with disabilities, people with chronic diseases etc.
9.	old people - aging workforce
10.	young people - insufficient level of skills and training, lack of physical and emotional maturity
11.	immigrant workers - difficulties to understanding the Romanian language
12.	gender- harassment, discrimination, underestimation at work (especially of women)

The lists are open so, for particular situation, a new risk could be added if necessary.

- The evaluation form has practically two parts: the first, on the left side, presents the actual evaluation (contains the identified risks and the quantification of the risk level, based on the severity-probability pair) and the second, on the right side, contains the prevention measures proposed for each risk, indicating the deadline for carrying out the measures and the persons;
- Responsible for carrying out the measures (mitigation - elimination system); because there are risk factors that cannot be eliminated, named in the literature and residual risk factors, organizational measures are also needed through which workers must be taught to form;

- Strategies to adapt to those factors and problems, strategies that help them. to deal with various dangerous situations that they may encounter during the performance of their duties: (1) the development of an electronic application for the EVA-RISK method fills an existing gap in risk assessment, in general, namely the lack of software or computer application to simplify and speed up the assessment process (regardless of the chosen method); (2) the assessment team will have at least 2 occupational risk assessors.

2. METHOD

Due to the legal requirements, although different, the evaluation methods have the following in common:

- Are based on a probability and severity matrix for the activity carried out at the evaluated workplace [2];
- The evaluation is made on the 4 elements of the work system - the worker, the workload, the means of production, the work environment [9];
- The basic steps are the same: identification of risk factors in the system, risk assessment and proposing prevention measures.

The EVA-RISK method includes the following steps [1]:

- Establishment of the evaluation team, with at least two evaluators;
- Presentation of the evaluated job;
- Identification of occupational risks at the workplace proposed for evaluation;
- Establishing the maximum foreseeable consequence (damage) on the human body;
- Determining the severity class and the probability class of the consequence;
- Establishing the level of risk for each risk;
- Completing the risk assessment sheet and the prevention measures.

The risk assessment sheet (Fig. 1), is the central instrument of the assessment and includes:

- Job identification data: economic entity, department, job etc. and the evaluation team component, with at least two evaluators;
- Characterization of the working time;
- The identified professional risks;
- The maximum foreseeable consequence on the organism and the severity of the consequence;
- The probability class of the consequence;
- The level of risk determined based on the severity and probability;
- Proposed measures – mitigation - elimination systems;
- Deadline for carrying out the measures;
- Responsible for implementing the measures.

Economic unit	**Workplace assessment sheet**				**Work time**	
Department					**Assessment team**	
Workplace	**Lr**					
Risk factors	S	P	l	Mea-sures	Dead-line	Respon-sible
Means of production *(to write all the risks identified with the help of the two risk factors lists)*						
Work environment						
Workload						
Worker						

Fig.1. Risk assessment sheet

The presented framework of EVA-RISK method in Figure 1 is using the following notations: Lr - level of job risk - is a weighted average of the levels of risk factors identified for a job; l - level of risk of the risk factor - is given by the probability and severity; S – severity; P – probability.

The description of the risk assessment methodology using the designed tools is presented in the following (adapted and integrated on analysis and synthesis of the legal framework and modern approaches presented by [7-12]):

- List of occupational hazards - this contains 85 classic risk factors; also, the list contains ergonomic risks, which have been identified in all types of jobs, regardless of the job. If

employees work in a vehicle (car, bus, tram, trolleybus) or a bank, in a store or in an office, it is essential that they can carry out their work safely [2]. It is important to discuss with employees how to improve ergonomics, because applying one-size-fits-all measures may not solve all the problems. We need to talk to everyone to find out what can be done to make the work schedule more enjoyable, safer and more comfortable.

- List of new and emerging risks - contains 12 risk factors like climate change, pandemics, nanomaterials, new technologies [6], digitalization, vulnerable persons, immigrant workers, war;
- The severity of the consequences S (Table 3) is based on medical criteria for clinical diagnosis, function and evaluation of work capacity;

Table 3

Quotation of Severity

Severity Class (S)	Conse-quences	Description
1	Minor	Incapacity for work up to 3 days
2	Medium	Incapacity to work for 3-45 days, requires medical treatment
3	High	Consequences with incapacity for work between 45-90 days
4	Majority	Invalidity class 1, 2 or 3, irreversible consequences, with a decrease in work capacity by 50-100%
5	Fatal	Death

- The probability of the consequences P, (Table 4) is based on the frequency and duration of risk exposure;

Table 4

Quotation of Probability

Probabi-lity Class (P)	Event	Description
1	Very rare	The hazard is not observed, very low risk exposure time
2	Rare	The danger could be very difficult to detect during OSH inspections/checks, short exposure time
3	Un-likely	The danger could be noticed during workplace controls and/or OSH inspections, medium exposure time
4	Likely	Easily noticed during workplace controls and/or external OSH inspections/audits, high risk exposure time
5	Very likely	The danger is easy to notice during the controls carried out at the workplace level, very long exposure time

- The risk level l (Table 5) is determined for each identified risk factor, depending on the values of severity and probability - the couple (S, P):

Table 5

Quotation of risk level

Risk level (l)		Values of Severity and Probaility (S, P)
1	Minimum	(1,1)
2	Low	(1,2) (1,3) (2,2) (2,1) (2,2) (3,1)
3	Medium	(1,4) (1,5) (2,3) (2,4) (3,2) (3,3) (4,1) (4,2) (5,1)
4	High	(2,5) (3,4) (3,5) (4,3) (4,4) (5,2) (5,3)
5	Very high	(4,5) (5,4) (5,5)

- Risk assessment sheet and mitigation - elimination system, proposed measures (technical, organizational, hygienic-sanitary, others).

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

$$Lr = \frac{\sum_{i=1}^{n} r_i \bullet l_i}{\sum_{i=1}^{n} r_i} \quad [1]$$

where:

- l_i is the level of risk determined for the risk factor i;
- r_i – weight for the risk factor i;

by definition, $r_i = l_i$;

- n – number of identified risk factors.

All the results of the risk assessment for a certain workplace are centralized in the Risk assessment sheet, as shown in Fig. 1. For each identified risk factor, the values of severity (S), probability (P) and risk level (li) are recorded as well as proposed measures. The mitigation-elimination systems contain the measures proposed for each risk factor, the time of implementation of the measures and the people involved, responsible for taking these measures.

3. RESULT AND DISCUTION

Most case studies were performed on jobs such as driver, mechanic, welder etc. This time we will present the results of the the identification and assessment of a Bank Counter Operator.

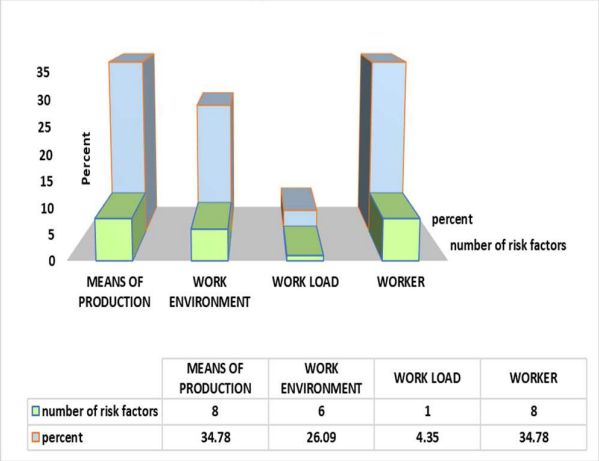
According to the method, 23 risk factors were identified. Among the factors specific to the banking activity, we recall:

- Holding hands or training articles of clothing by the money counting machines, the banding machines, the punching machine
- Biological contamination when working with money
- Biological contamination - contact with various people whose state of health can lead to contamination of the worker (e.g. COVID 19)
- Verbal or physical aggression from some customers
- Special working conditions – the possibility of being the victim of an act of force committed for the purpose of robbery

The following main measures were recommended: training workers regarding the mode of action in case of security events; ensuring the intervention according to the relevant legislation and internal procedures specialized psychological counseling; supervision of workers' health through occupational medicine and prophylactic controls; allowing workers of sanitary materials, giving disinfectant gels to staff who handle cash; non-admission to work of workers who show symptoms of respiratory/viral/dermatological on the palms without the opinion of the occupational medicine doctor; training workers regarding OSH rules; verification if the employees learn the security instructions.

The distribution of risk factors by generating sources is as follows (Fig. 2):

- 34.78%, factors specific to the means of production;
- 26.09%, factors specific to the work environment;
- 4.35%, factors specific to the workload;
- 34.78%, factors specific to the worker.



	MEANS OF PRODUCTION	WORK ENVIRONMENT	WORK LOAD	WORKER
number of risk factors	8	6	1	8
percent	34.78	26.09	4.35	34.78

Fig.2. The weight of risk factors on the work system component

Distribution of risk factors according to the maximum foreseeable consequence is as follows (Fig. 3):

- 52% factors with temporary incapacity for work 3-45 days
- 17% factors with temporary incapacity for work 45-90 days
- 09% factors with invalidity
- 22% factors with death

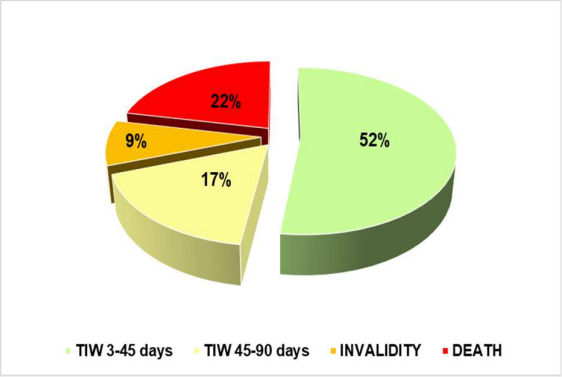


Fig.3. The weight of the risk factors according to the maximum forseeable consequence

The number of identified risk factors - 23 and the level of risk for each (Fig. 4):

- 0 risk factors with risk level 1
- 20 risk factors with risk level 2
- 3 risk factors with risk level 3
- 1 risk factors with risk level 4
- 0 risk factors with risk level 5

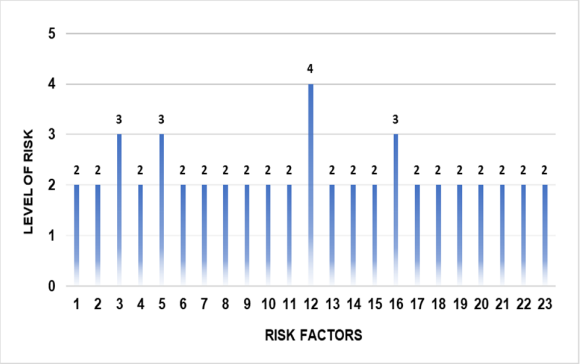


Fig.4. The level of risk for each risk factor

We apply the weighted average formula and obtain the risk level of the workplace: L = 2.47, what is an acceptable level of risk.

In order to eliminate or reduce the identified risk factors, preventive measures were proposed in the assessment sheet. Risks for health or hygiene are those responsible for the potential damage to the psychological well-being and biological balance of the employee, in performing operations or processes that involve exposure to risk factors in the work environment. The study of the causes and the relevant interventions for the prevention and/or protection against these types of risk should be oriented towards finding an appropriate bio-ecological balance between man, the work environment and the means of production. At first glance, public perception does not emphasize the risk factor "Biological contamination when working with money". The same thing should not happen in a bank. People outside the bank handle small amounts of money, at irregular time intervals, and therefore the risk of contamination is greatly reduced. In the case of the bank, the amounts of money are substantially higher and the frequency of handling can go up to almost 100% of the duration of the program in the case of some workers (cashiers, checkers, counter operators). Therefore, in order to prevent contamination, it is necessary to maintain and possibly increase protective measures by ensuring proper hygiene. This involves:

- washing hands and face at small time intervals,
- protecting the epidermis of the hands with a protective cream,
- must be given and used, a disinfectant (for example hydroalcoholic disinfectant gel)
- providing and using FFP2 masks and surgical gloves,
- access to a sanitary first aid kit.

The risk factors that cannot be eliminated, named in the specialized literature and residual risk factors, will be kept under control through organizational measures. Although the general risk level at work is acceptable, the results of the Bank Counter Operator job evaluation show that 30.43% of the total risk factors identified are factors with irreversible consequences (death or invalidity).

We believe that an optimal selection of measures can be achieved by applying two criteria:

1. the level of risk of occupational injury and illness;
2. the expected economic efficiency of the application of the measure.

The selection of measures will be made not only according to the level of risks they will eliminate or reduce, but also according to the cost-benefit ratio. In any field, the preventive activity must be organized and conducted in accordance with scientific management. Investing in job security can be interpreted as an investment in human capital.

The socio-economic impact expected to be obtained by using these elaborate methods:

- Ensuring safe and healthy working conditions;
- Reduction of expenses generated by work accidents and occupational diseases;
- Reducing absenteeism and ensuring the stability of the workforce;
- Awareness of health and safety issues in industrial activity;
- Optimizing the allocation of resources for the prevention of accidents at work and occupational diseases.

EVA-RISK application has the following advantages:

- Can be installed on any computer, laptop, phone;

- Quick assessment;
- The necessary modifications or completions are easy to make and do not require major changes in application; it has been considered that the field of OSH is a dynamic one, technology is evolving, some dangers disappear, new ones appear instead.
- The addressability of the computer application is very high and it joins the risk assessors professionally all those interested in workplace safety.

4. CONCLUSIONS AND PERSPECTIVES

The EVA-RISK assessment method is adaptable, accessible and in accordance with Law No. 319/2006 and GD No. 1425/2006 represents easy to use tool for the occupational health and safety managers, to assess workplaces in the Romanian economy.

The new and emerging risks, the mitigation-elimination system, the electronic application of the EVA- RISK method will update the field of occupational risk assessment and will contribute to awareness of the risks to which workers are exposed, so that safe work becomes a habit for them. In addition, considering the current challenges (climate change, threat of a new world war, pandemic etc.), the aim will be to increase the capacity of workers to deal with dangerous and emergency situations.

Future studies and investigations should be dedicated to other workplaces and working systems risk assessment and by integration in the EVA-RISK approach of new methods and tools (as described and applied in the studies of [10, 11]). This could be done by extended our collaborations with other ergonomists and OSH specialists at the international level [12].

In addition, based on the preliminary researches done in different working systems, managers have underlined the importance of EVA-RISK assessment methods for the design and applications (monitor and control) of the OSH strategies and for measure the prevention measures effectiveness and efficiency. Thus, it is important to underline that the general perception about the assessment approach is positive, in comparison with other existing and applied methods in companies.

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Evaluarea riscurilor și sistemul de reducere – eliminare in domeniul sănătății și securității în muncă

Evaluarea riscurilor este o activitate prin care sunt identificate riscurile existente la locul de muncă și sunt cuantificate mărimea lor pe baza combinației dintre severitatea și probabilitatea consecinței maxime previzibile asupra organismului uman. Demersul de evaluare examinează sistematic riscurile legate de toate elementele procesului de muncă; riscului este „punctul de plecare” și, în același timp, baza științifică pentru stabilitatea priorităților în acțiunile de prevenție. Lucrarea prezintă evaluarea riscurilor pentru sănătatea și securitatea în muncă prin metoda EVA-RISK. Această nouă metodă poate fi utilizată cu ușurință deoarece conține metode și mijloace de evaluare cunoscute utilizatorilor/evaluatorilor. Metodologia utilizată este în conformitate cu standardele europene și cu legislația română în vigoare. Metoda a fost concepută în urma identificării necesității de actualizare a demersului de evaluare a riscurilor profesionale. Fișa de evaluare conține: riscurile identificate, cuantificarea nivelului de risc, sistemul de atenuare-eliminare care conține măsuri pentru fiecare risc identificat, termenul de realizare a măsurilor și persoanele responsabile cu realizarea măsurilor. De asemenea, un instrument important în evaluare este lista de verificare a riscurilor, care conține și riscuri ergonomice. Noua metodă de evaluare EVA-RISK a fost aplicată cu succes în domeniul tehnologiilor verzi, în domeniul bancar, medical și poate fi folosită de companii din diferite ramuri economice pentru a-și îmbunătăți semnificativ sistemul de management al sănătății și securității. Procesul de evaluare se poate realiza cu participarea și consultarea angajaților și a reprezentanților acestora, având în vedere rolul cheie deținut de aceștia în managementul sănătății și securității în muncă. Pentru o utilizare rapidă a metodei EVA-RISK se preconizează dezvoltarea unui program informatic.

Eduard SMIDU, PhD Student, Politehnica University of Bucharest, Faculty of Industrial Engineering and Robotics, edismidu@gmail.com, +40 0726772336, 313 Splaiul Independentei, RO-060042 Bucharest, Romania.
Oana Roxana CHIVU, PhD., Professor, Politehnica University of Bucharest, Faculty of Industrial Engineering and Robotics, virlan_oana@yahoo.co.uk, +40722219498, 313 Splaiul Independenței, Sector 6, RO-060042 Bucharest, Romania.
Oana SUCIU, Doctor, Associate Professor, Victor Babeş University of Medicine and Pharmacy, oana_suciu96@yahoo.com, 2 Piata Eftimie Murgu, RO-300041 Timisoara, Romania.
Silviu DUMITRESCU, Doctor, Titu Maiorescu Faculty of Medicine, silviudumius@yahoo.com , 67A Gheorghe Petrascu Street, RO-031593 Bucharest, Romania.