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THE METHOD OF RISK ASSESSMENT AT WORKPLACE AND WORKING ENVIRONMENT IN AN EXAMPLE OF A METAL MECHANICAL PROCESSING SECTION OF A FACTORY

Bozo NIKOLIC, Biljana GEMOVIC

Higher Education School of Professional Studies, Novi Sad, SERBIA

ABSTRACT

The aim of this work is to show, with due respect to the existing methodologies, the implementation of an original method of risk assessment at workplace and working environment. The example represented here is based on implementation of this method in a section of a factory where mechanical processing of metal is performed. The risk assessment procedure is conducted through implementation of our own method. It is ensured that the project is conducted thoroughly, from the defining of technological process – system, to implementation of measures for control of ("emergency") risk.

The method is of quantitative character with possibility to determine and compare all risks, at every workplace and including all participants who take part in working environment on every basis.

1. INTRODUCTION

Risk assessment is based on systematic record keeping and tracking of all factors, vulnerability and hazards in a working process. Therefore, it is crucial to recognize organization of work, working process, means of work, material and raw material used in working process, means and equipment for personal protection and other relevant elements. A precondition to this has to be the recognition of existent facts. This is a basic and starting point and it is also required by the Code of Practice (1), made in compliance with Directives of the European Union. Apparently, the true answer and primary task of any method is: to determine risk arising at any workplace and regarding any worker, to determine all risks and to allocate the risks to individuals, working space and working environment.

Risk assessment methodology has to be clear and unambiguous in order to enable a complete analysis of risk assessment to be conducted. A methodological way of risk analysis, according to the method of High School from Novi Sad is the following:

Defining of system – defining assessment levels (company, facilities, floors, premises, work-rooms, workplace, work activity etc.) – identifying hazards and vulnerability – evaluation of risk – measures for elimination, prevention and reduction of risk – re-evaluation of risk – conclusion on risk – measures for maintenance of risk control.

2. THE STUDY

2.1 Input data. Technological setting

In our example, an engine hall and working process of metal processing are used as a model. In this section of a factory, steel material is processed through grinding, perforating, milling, welding etc. It is a standard section of a factory with typical and recognizable hazards.

There are N workplaces in this factory section where it is likely that hazards and vulnerability for workers at those workplaces may occur. The workers in the engine hall are exposed to shared hazards and vulnerability arising from workplaces in the environment all the time during their working hours. The workers whose workplace is not the engine hall, but who are frequently present there during their working hours (such as section managers, maintenance workers, controllers and alike) are also exposed to the same hazards. Also, all those who every now and then enter the hall are exposed to the same hazards (directors,

trainees etc.). Naturally, risks relating to each of these categories of employees are different because of their different frequency of exposure to hazards and vulnerability.

2.2 About the method

The method of the School is formed to meet the following requirements:

- to include all workplaces by making a selection of them out of technological process together with important hazards and vulnerability and to determine risks for each of them
- to determine risks at all levels (the engine hall);

By meeting the given requirements it is ensured that risks for each of the workers are determined, i.e. for all those who are present in the company (the engine hall)

- the method for all risk parameters is based on numerical, quantitative values, independent of a level at which the risk is determined, thus enabling presentation of all risks together and their uniform observation
- the measures for elimination, reduction and prevention of risks are clearly defined, as well as the measures for maintenance of risk control level. The represented system of risk management makes way to implementation of quality systems in health and safety at workplace.

Characteristics of the method:

a) Risk calculation of a workplace based on a table determination of all risk parameters; likelihood of accidents, damage size, frequency and number of people exposed to hazards and vulnerability

$$R_i = V*F*S_i*N$$

R_i, S_i – risks and damage size for different categories of employees, depending on the frequency of their exposure to hazards and vulnerability.

b) risk assessment of working environment based on determining likelihood of accident occurrence which is based on values of safety conditions in the working environment and accordingly developed mathematical equation

$$R_i = f(x)*F*S_i*N$$

where

$$f(x) = 16.46\ x^{2.7}$$

$$x = n/N,$$

n – is the number of negative values of safety conditions

N – is the total number of evaluated values of safety conditions

The evaluated values of safety conditions have to be in compliance with legislation and technical regulations.

2.3 Output data

There are several key points in the risk assessment procedure, of which every represents an interest evaluated from various points of view. One of them is a table of remaining risk for all workplaces, working environment and for each of the workers. The significance of this table is to the advantage of an employer and, naturally, to the advantage of an employee. According to the results of this work, the table has to determine the following risks for each of the workplaces:

- the risk of a workplace
- the risk of the engine hall
- the "somebody else's" risk

The "somebody else's risk" relates to the activities of some other workplace, which a worker sometimes has to perform. The example is a job of a driver, a work which we sometimes have to do. The risk is considerably lower compared to a driver's risk, since the frequency of exposure to hazards and vulnerability is also lower, but positively this risk exists.

Only a risk assessment conducted in such a way can provide answers regarding size and types of risks which a worker is exposed to during the working hours.

Table 1: Risk table

	WORKPLACE		QUANTITATIVE ASSESSSMENT OF REMAINING RISK							QUALITATIVE RISK ASSESSMENT
			Primary risk					Secondary risk		
	Occupation (job)	Code number	Company, facility	facility part, plant	Plant, working room	workplace	source	value	Source (activity, workplace, ...)	
1.	Counselor	112	0	0,3	0,05		Company Headquarters			
2.	Technical secretary		0	0,5	0,32		Company Headquarters			
3.	Operational engineering						Company Headquarters			
4.	Qualified worker						Company Headquarters			
5.	Coordinator						Centre for ambrosia suppression			
6.	Section manager		2,7	0,52	0,36		Plantation			
7.	Assistant		2,7	0,52	0,36		Plantation			
8.	Non-qualified worker						Plantation			
9.	Driver					37,5	Form 4/23 Company Headquarters			

3. ANALISES, DISCUSION, INTERPRETATIONS

3.1 The example for mechanical processing on a lathe:

IDENTIFICATION OF HAZARDS AND VULNERABILITY

1 No.	2 Code of hazards and vulneradility	3 The descriptive analysis of hazards and vulnerability including data regarding easier and more precise determination of likelihood, frequency and damage size
1	05	When grinding fragile material with low speed of cutting or with particular geometry of cutting tools, there occur torn parings whose temperature might go even up to 800^{0}C, and which are likely to hit a worker in the eye thus causing a severe injury. As a worker does this type of work during a whole working day, it is possible that a worker sustains eye injuries often and it is more than likely that injuries occur every day

QUANTITATIVE RISK ASSESSMENT

4 Likelihood lavel	5 Frequency	6 Damage size	7 No. of peple – coeff.	8 Risk	9 Risk lavel
5	4	2	1	40	Low but present

THE MEASURES FOR REDUCTION, PREVENTION AND ELIMINATION OF RISK

10 Safetyain	11 Organizacioal	12 Constructive	13 Safety	14 Personal safety means	15 Other
Protection of eyes				Protective spectacles	

ADDITIONAL RISK ASSESSMENT

16 Likelihood lavel	17 Frequency	18 Damage size	19 No. of peple – coeff.	20 Risk	21 Risk lavel
0,033	4	2	1	0,264	Negligible

RISK MANAGEMENT

22 Who implements	23 Time frame for implementation measures	24 Procedure within quality systems	25 Conslusion	26 Measures for control of the remaining risk
Safety officer	Immediately	IQ2.f...	Rislk is low and tolerated	Drawing up and strict implementation of code of personal means of protection

3.2 The example of working environment risk assessment

According to the Code of general measures for buildings whose purpose is to be used for working or subsidiary premises and Code of keeping records, values that characterize the safety conditions of the engine hall can be determined. Those values are:

- Clear height of the work-room
- Clear area of the work-room per worker
- Clear volume of the work-room per worker
- floor of the work-room
- inner surface of ceiling and walls
- opening of windows of the work-room
- door of the work-room
- lighting of the work-room
- corridors, availability of staircase
- passages and access
- protective fence
- handy warehouse
- rotating and mobile parts
- free movement of parts
- indoor transport
- exposure to being blocked (shut), covered by something and alike
- hazardous surfaces
- work at height and depth
- cramped, limited
- hazardous space
- wet and slippery surfaces
- physical instability of the work-room
- inappropriate and not adapted working methods
- contact of elements at voltage
- indirect contact
- thermal effect of electrical source
- thunderbolt
- electrostatic charge
- work in low/ high pressure atmosphere
- radiation
- work in the open air
- use of hazardous material
- work with animals
- water surfaces

In comparison with the procedure for the workplace, we determined hazards and vulnerability in this way (columns 1, 2 and 3); other columns are identical to risk assessment of a workplace

4. CONCLUSION

In compliance with the set aims of the work, the conclusions have completely met and justified the expectations. Basically, the conclusions are:

- the established methodology and formed method of risk assessment make risk analysis simple
- the method implemented in engine hall for metal processing gives completely precise answers to all arising risks
- two risk levels are distinctive: the level of engine hall and the level of workplace, evaluation within these two levels gives all information;
- quantitative nature of the method enables comparison of all obtained values;
- the method presented in this work can be completely applied to any engine hall that is basically used for mechanical processing;
- the same method, but with a change to values evaluating safety conditions, can be used for any working environment, which can differ.

REFERENCES

[1] Bozic, V., Kosic, S., Nikolic, B. (2006). Regulation for risk assessment procedure in the work place and in the workspace – comments, VTS Novi Sad.
[2] Harms-Ringdahl, L., (2001) Safety Analysis: Principles and Practice in Occupational Safety, CRC Press
[3] Laban, M., Krnjetin, S., Nikolic, B. (2007). Risk management and risk assessment in the enterprise, *Symposium about occupational safety and health*, Novi Sad, pp. 44-57.
[4] Macdonald, D., (2004). Practical Machinery Safety, Integra Software Services Pvt. Ltd, Pondicherry, Inidia
[5] Nikolic, B., (2007). Enactment about risk assessment, *Symposium about occupational safety and health*, Novi Sad, pp. 32-43.
[6] Nikolic, B., Laban, M.: Occupational health and safety risk assessment method, 17th International Symposium ECOLOGY 2008, Sunny Beach Resort, Bulgaria
[7] Risk Management: Implementation principles and Inventories for Risk Management/Risk Assessment methods and tools, Conducted by the Technical Department of ENISA Section Risk Management, June 2006
[8] Ruzic-Dimitrijevic, Lj., Nikolic, B., (2008). Designing and building an information system for a higher education institution, InSITE 2008, Bulgaria.
[9] Ruzic-Dimitrijevic, Lj., Nikolic, B., (2008). A way forward – correction of the risk assessment method for workplace and work environment and its wider application, Kopaonik, 2009, Serbia