STUDIA UBB BIOETHICA, LXII, 1-2, 2017 (p. 75-89)
(RECOMMENDED CITATION)
doi:10.24193/subbbioethica.2017.07

TECHNICAL RISK PROFESSIONAL ASSESSMENT METHOD IMPLEMENTED IN SMALL AND MEDIUM-SIZED ENTEPRISES (SMEs)

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SUMMARY. This paper presents a new technique for identifying hazards and assessing risks of injury specific to professional employment in any type of organization.
This evaluation method comprises three sections, namely:

a) Analysis of the risk of work accidents and professional diseases at workplace / activity performed within the analysed area along according to operational characteristics applicable at the time (date) of performing the analysis;

b) Analysis of the risk of accidents and professional diseases, resulting from the proposed prevention and protection measures applicable;

c) Implementation of measures of prevention and protection and carrying-out an analysis through reassessment of the level of risk of injury and occupational disease;

Keywords: *occupational health and safety, risk level, risk identification, control measures*

REZUMAT. În lucrarea de faţă este prezentată o nouă tehnică de identificare a pericolelor şi evaluare a riscurilor de accidentare profesională specifică locurilor de muncă din oricare tip de organizaţie.
Această metoda de evaluare cuprinde trei secţiuni şi anume:

- analiza nivelului de risc de accidentare şi îmbolnăvire profesională, existent la locul de muncă / activitatea prestată în zona analizată, cu caracteristicile de execuţie existente la momentul (data) analizei;
- analiza nivelului de risc de accidentare şi îmbolnăvire profesională, rezultat în urma propunerii de măsuri de prevenire şi protecţie, aplicabile;
- aplicarea măsurilor de prevenire şi protecţie şi analiza prin reevaluare a nivelului de risc de accidentare şi îmbolnăvire profesională;

Cuvinte cheie: *sănătate şi securitate la locul de muncă, nivel de risc, identificarea riscului, măsuri de control*

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Introduction

Risk identification and assessment of the risk level are both underlying the base of the entire safety and health at work system within an organization. The evaluation team:

- *implements the three sections* of the valuation technique;
- determines the serious risk level;
- establishes safety at work related deficiencies / misconducts;
- proposes preventive and protective measures to be implemented to reduce the level of serious risk to a tolerable level within the organization;

For each job position / activity, the evaluation team analyses and monitors carefully every work process / environment and identifies in each stage the hazards and their related risk factors.

Identifying hazards and assessing risks relating regarding Health and Safety at Work (HSW)

In order to establish the serious risk, the assessment team will:

- explore work process phases performed by the worker within the related work environment;
- identify hazards / related risk factors source;
- determine the possible / potential consequences generated by risk factors.

Number of people exposed to identified hazard

As part of the work examined we shall define precisely the persons involved in work activities (i.e. employees with individual employment contract at the workplace undergoing analysis, occasional staff - i.e. contractors, guests, professional staff, others people potentially exposed) resulting in the total number of people exposed [NT1].

Impact elements on serious risk

After completing the above steps, the assessment team will determine the serious risk related impact elements by assessing the frequency of risk [F1], the probability of a serious risk [P1] and the severity of consequence on people [G1].

We will determine:

- Coefficient of impact in the total number of people exposed, [CN1]:

CN1 = NT1 / (F1 + P1) (1)

- Serious risk level analysed [NRE]:

[NRE] = (F1 x P1 x G1) + CN = (P1 x F1 x G1) + NT1 / (F1 + P1) (2)

By applying the abovementioned algorithm one evaluates the risk level associated with each hazard. For each criterion one applies a scoring system between [ranging 1-5] as shown in Table 1 below with the following specifications:

[1] – is the minimum level of criterion manifestation;

[5] – is the maximum level of criterion manifestation.

Depending on the result / score obtained for the level of risk to be assessed, we shall estimate what kind of risk level that would be generated i.e. a severe or a tolerable risk, by performing the classification of the parameter obtained by the scoring range.

Table 1. Risk level assessment and classification

SCORE	FREQUENCY [F1]	PROBABILITY P1]	NO. OF PEOPLE EXPOSED (N)	GRAVITY [G1]	SCORING RANGE	
					Serious risk level	Tolerable risk level
5	**Constantly** (permanently) **[5]**	**Continuously** (daily) **[5]**	**RANGING FROM ONE TO 100 PEOPLE**	**Disaster** (fatal accident or disablement) **[5]**	**>3.5 ----- 135**	**1 ----- 3.5**
4	**Frequently** (once a day) **[4]**	**Very likely** (once a week) **[4]**		**High** (unable to work with more then 3 days of medical care) **[4]**		
3	**Occasionally** (once a week) **[3]**	**Probably** (once a month) **[3]**		**Average** (unable to work with less or up to 3 days of medical care) **[3]**		
2	**Rarely** (once a month) **[2]**	**Possible** (once a year) **[2]**		**Small** (one day of medical care with first aid being granted) **[2]**		
1	**Hardly ever** (once a year) **[1]**	**Unlikely** (every 10 years) **[1]**		**Insignificant** Staff member(s) suffered light or mild injuries with first aid being granted but no work interruptions) **[1]**		

The evaluation team analysed the shortcomings / misconducts from the prevention and protection measures already implemented, and such shortcomings / misconducts generating serious risks and propose measures of prevention and protection that once implemented will reduce the risk level from serious to tolerable.

Impact elements of tolerable risk:

Shortcomings / misconducts from prevention and protection measures.
Prevention and protection measures implemented to reduce the level of risk.

Total number of people exposed, [NT2]:

[NT2] ≤ [NT1]

(3) Frequency [F2]

Probability [P2]

Gravity [G2]

Impact coefficient of the total number of people exposed [CN]:

$$CN = NT2 / (F2 + P2) \quad (4)$$

Level of tolerable risk, [NRT]:

$$[NRT] = (F2 \times P2 \times G2) + CN = (F2 \times P2 \times G2) + NT2 / (F2 + P2) \quad (5)$$

Case Study

In order to identify the hazards and carry out the serious risk assessment regarding HSW at the work process / environment level applied by the organization, a case study was conducted on the implementation of technical methods for professional risk assessment in small and medium enterprises (SMEs).

Work process evaluated: cold compressing of metals.

Cold compressing was subject to a stage review by the assessment team and the outcomes were inputted in Table 2 below.

Table 2. Analysis and evaluation of cold compressing

No.	Stages of work process/ work environment	Hazard / Source of risk factors identified	Possible / potential consequences generated by risk factors
1.	Supplying workplace with semi-finished products through a contained handled with forklift	Handling the semi-finished products container with the forklift	Catching, striking, and/or crushing the operator by the container handled by forklift

No.	Stages of work process/ work environment	Hazard / Source of risk factors identified	Possible / potential consequences generated by risk factors
2.	Reading operating instructions in the operator manual by the cold press operator (technological documentation work)	Failing to read operating instructions in the operator's manual by the cold press operator.	Injuries due to an inadequate performance of controls and manoeuvres by an operator not familiarized with the technological process.
3.	Lubricating the operational parts of the matrix (using a brush)	Lubricating grease used for grease.	Splashing the press operator face and/or eyes with lubricating grease. Skin injuries when getting in contact with lubricating grease.
4.	Collecting the semi-finished metal product from the container and placing it into the matrix.	Semi-finished metal part made of sharp edged plate.	Injuries to the upper limbs (arms) of the operator
5.	Cold pressing in matrix	Matrix mobile parts of the matrix	Catching the upper limbs (arms) of the operator into the operational parts of the matrix.
6.	Manual extraction of waste resulted from the stamping carried out by the operator	Waste resulted from stamping the semi-finished products	Injuries to the upper limbs (arms) of the operator
7.	Extraction of metal part from the matrix	Stamped component	Injuries of the upper limbs (arms) of the operator
8.	Storing the stamped components into the container	Manual and periodical handling of stamped components.	Back pain conditions
9.	Electric circuit malfunction of the press and an unauthorised intervention of the operator at the electrical circuit of the press	Electric installation of the powered press	Operator electrocution

No.	Stages of work process/ work environment	Hazard / Source of risk factors identified	Possible / potential consequences generated by risk factors
10.	Mechanical malfunction of the press and an unauthorised intervention of the operator at the mechanical parts of the machine	Press mechanical / hydraulic component	Catching the operator upper limbs (arms) in the moving parts of the machines
11.	High working pace of the press	Noise generated during working when cold pressing materials	Ear disorders
12.	High working pace of the press	Vibrations generated during working when cold pressing materials	Body disorders
13.	Oil leakage from the hydraulic tank or lubricating can	Slippery surfaces due to oil on the floor	Knocks, sprains, fractures caused by operator's falling on the floor
14.	Visibility at workplace	Insufficient lighting around the machine	Eye disorders
15.	Marking the traffic route with delineation (signalling) of the working area/place for the press operator	Domestic means of transportation	Catching, striking, and/or crushing the operator by the domestic means of transportation

In the framework of work process analysed i.e. "*cold pressing of metals*" the assessment team established the stages of work procedures / environment. Fifteen phases of the work process / environment were identified and for each phase the hazard / risk factors related source were identified too For each hazard / risk identified possible / potential consequences generated by risk factors were established.

In the framework of work process / environment under review, the evaluation team identified the people involved in the all phases of work and there were assessed the serious risk impact elements specified in Table 3 below.

Table 3

No.	Employees with Employment Contract at the analysed workplace	Occasional staff	Specific staff	Other people	Total no of people exposed [N_{T1}]	Frequency [F1]	Probability [P1]	Coefficient of impact of the total no of people exposed [C_N]	Gravity [G1]	Level of serious risk assessed [NRE]
1.	1	0	1	0	2	3	3	0.33	4	36.33
2.	1	0	2	0	3	4	2	0.50	4	32.50
3.	1	0	0	0	1	5	3	0.13	3	45.13
4.	1	0	0	0	1	5	5	0.10	3	75.10
5.	1	0	0	0	1	5	3	0.13	5	75.13
6.	1	0	0	0	1	5	3	0.13	3	45.13
7.	1	0	0	0	1	5	3	0.13	3	45.13
8.	1	0	0	0	1	4	2	0.17	2	16.17
9.	1	0	1	0	2	3	3	0.33	5	45.33
10.	1	0	1	0	2	2	2	0.50	4	16.50
11.	1	0	0	0	1	5	2	0.14	5	50.14
12.	1	0	0	0	1	5	2	0.14	3	30.14
13.	1	0	0	0	1	3	3	0.17	4	36.17
14.	1	0	3	0	4	2	3	0.80	2	12.80
15.	1	0	3	0	4	4	3	0.57	5	60.57

Example of calculation of serious risk level assessed at Phase I:

Supplying the workplace with semi-finished products in container, handled with forklift involving two operators i.e. press operator and forklift operator.

Hazard frequency [F1] = 3 (once a week);
Probability [P1] = 3 (once a month);
Coefficient of impact of the total no of people exposed [CN]:
$[C_{N1}] = NT / (F1 + P1) = [CN] = 2 /(3+3) = 0.33$
Gravity [G1] = 4 (work incapacity with more than 3 days of medical care)

Level of serious risk assessed [NRE]:

$$[NRE]= (F1 \times P1 \times G1) + C_N = (F1 \times P1 \times G1) + N_{T1}/(F1 + P1) \quad (7)$$

resulting:

$$[NRE] = (3 \times 3 \times 4) + 0.33 / 2 / (3 + 3) = 36.33 \quad (8)$$

In this way all parameters of serious risk level were calculated for all phases of the work process in the case of press operator and the corresponding values were inputted in Table 3. Based on the above data, Chart 1 shows the graphical representation of the serious risk level assessed [NRE]. The graph shows that the moving parts of the matrix followed at close range by the sharp edged blank sheet metal both present a serious risk levels assessed with the highest values (75.13 and 75.10, respectively), while domestic transportation means rank 3rd (60.57).

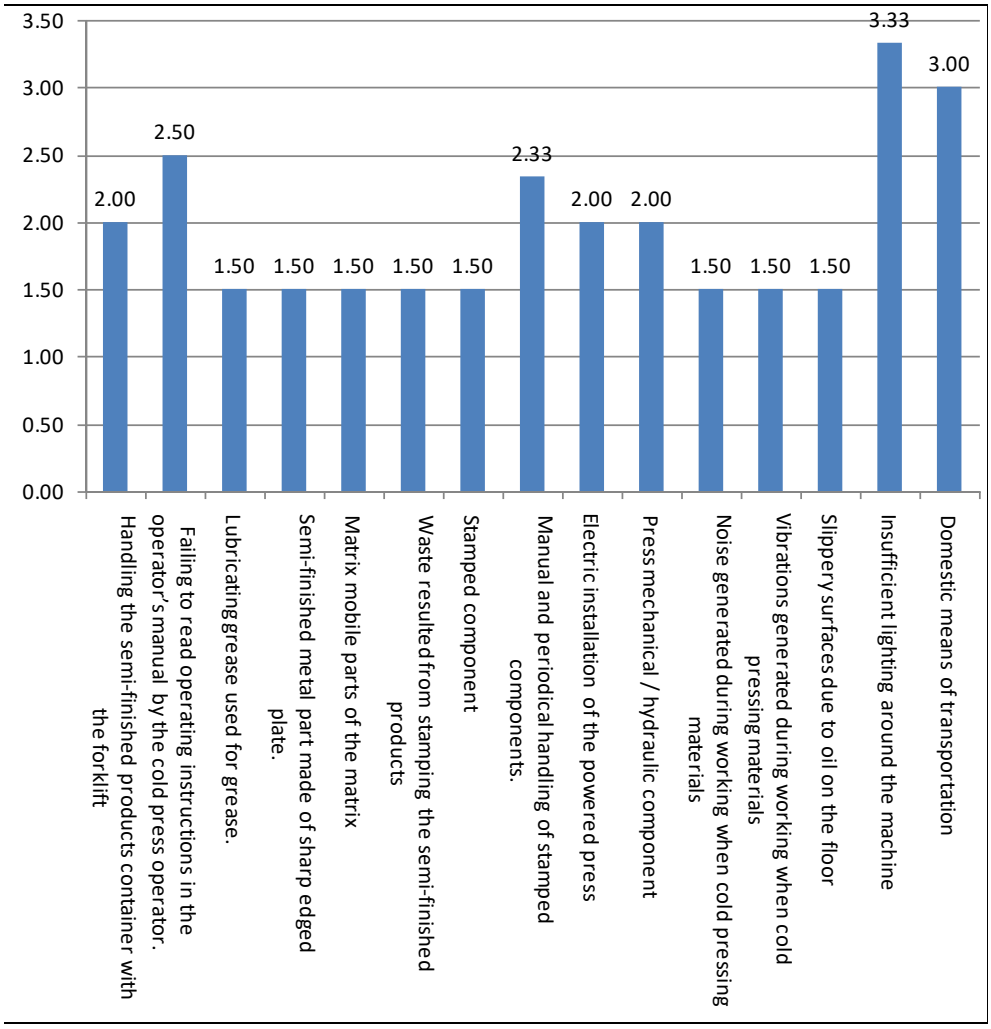

Chart 1. *Graphical representation of the level of serious risk assessed [NRE]*

Measuring the level of tolerable risk within the organization

For each stage of the process work analysed – cold pressing of metals – there were established both the deficiencies / misconducts from the measures of prevention and protection, and the preventive and protective measures implemented to reduce the level of risk to a tolerable level within the organization (see Table 4 below) .

Table 4. Prevention and protection measures

No.	Stages of work process/ work environment	Shortcomings / misconducts from prevention and protection measures	Prevention measures implemented to reduce the serious risk level
1.	Supplying workplace with semi-finished products through a contained handled with forklift	Handling the forklift by untrained and unauthorised staff	Forklift operators will be trained and authorised by ISCIR
2.	Reading operating instructions in the operator manual by the cold press operator (technological documentation)	Lack of knowledge/training from the operator regarding the cold pressing technological process	Before starting his/her work the cold press operator will read and acknowledge the provisions in the work technical documentation
3.	Lubricating the operational parts of the matrix (using a brush)	Failure to use personal protective equipment provided (overalls, gloves, goggles)	Press operator will use compulsory the protective equipment provided.
4.	Collecting the semi-finished metal product from the container and placing it into the matrix.	Failure to use personal protective equipment provided (overalls, gloves)	Press operator will use compulsory the protective equipment provided.
5.	Cold pressing in matrix	Failures in mobile protection shields of the press. Blocking intentionally one of the dual controls of the	Press shall be operated only after securing all mobile protection shields. Operating the machine shall be based on dual

No.	Stages of work process/ work environment	Shortcomings / misconducts from prevention and protection measures	Prevention measures implemented to reduce the serious risk level
		machine. Intervention on the part after a machine operation was launched.	control only, using both hands of the operator. No intervention on the part dedicated area shall be carried out after launching the machine operation.
6.	Manual extraction of waste resulted from the stamping carried out by the operator	Waste resulted from stamping the semi-finished products was extracted by hand, without using gloves, tweezers or lifting hooks	When extracting the waste the operator shall wear gloves compulsory and / or tweezers or lifting hooks shall be used.
7.	Extraction of metal part from the matrix	Stamped component shall be extracted from the matrix by hand without using gloves, tweezers or lifting hooks	When extracting the matrix the operator shall wear gloves compulsory and / or tweezers or lifting hooks shall be used.
8.	Storing the stamped components into the container	Storage container shall be placed at a safe distance from the operator	Placing the components storage container will be in the vicinity of operator for a sound and smooth handling and to prevent faulty movements of the operator
9.	Electric circuit malfunction of the press and an unauthorised intervention of the operator at the electrical circuit of the press	Unauthorized intervention from the press operator at the electrical circuit of the machine	Interventions on the electrical wiring of the machine shall be carried out only by certified specialist after getting in contact with the operator
10.	Mechanical malfunction of the press and an unauthorised intervention of the operator at the mechanical components of the machine	Unauthorized intervention from the press operator at the mechanical/hydraulic components of the machine	Interventions on the mechanical/hydraulic components of the machine shall be carried out only by certified mechanic or installer/

No.	Stages of work process/ work environment	Shortcomings / misconducts from prevention and protection measures	Prevention measures implemented to reduce the serious risk level
11.	High working pace of the press	Not measuring the noise level at the level of press operator the working environment	Measuring and assessing the noise level and providing the specific individual protection equipment. Medical checks – audiometry.
12.	High working pace of the press	Not measuring the vibration level at the level of press operator the working environment	Measuring vibration level. Regular medical checks.
13.	Oil leakage from the hydraulic tank or lubricating can	Failure of tanks containing oil or lubricant oil spillage on the floor in the work area	Repairs works to and use of recipients with adequate oil preventing any leakage of oil and lubricating grease
14.	Visibility at workplace	Inappropriate placement of luminaire around the machine	Providing an adequate lighting of the work areas
15.	Marking the traffic route with delineation (signalling) of the working area/place for the press operator	Not safety signalling through strict marking and delineating the traffic areas for the domestic transportation. Non-compliance with the traffic rules applied to domestic transportation.	Marking the domestic traffic route and the dedicated areas of the press operator work place. Compliance with the rules and regulations regarding domestic traffic.

In this way each phase of work was reviewed, identifying both the shortcoming / misconduct from the measure of prevention and protection, and the prevention and protection measure implemented to reduce the level of risk. After the first analysis the risk level was recalculated taking into account the impact elements resulting the level of tolerable risk presented in Table 5 below.

Table 5. Level of tolerable risk

No.	No. of people exposed					Impact elements of tolerable risk				Tolerated risk level l [NRT]
	Employees with Employment Contract at the analysed workplace	Occasional staff	Specific staff	Other people	Total No of people exposed [N_{T2}]	Frequency [F2]	Probability [P2]	Coefficient of impact of the total no of people exposed [C_N]	Gravity [G1]	
1.	1	0	1	0	2	1	1	1.00	1	2.00
2.	1	0	2	0	3	1	1	1.50	1	2.50
3.	1	0	0	0	1	1	1	0.50	1	1.50
4.	1	0	0	0	1	1	1	0.50	1	1.50
5.	1	0	0	0	1	1	1	0.50	1	1.50
6.	1	0	0	0	1	1	1	0.50	1	1.50
7.	1	0	0	0	1	1	1	0.50	1	1.50
8.	1	0	0	0	1	2	1	0.33	1	2.33
9.	1	0	1	0	2	1	1	1.00	1	2.00
10.	1	0	1	0	2	1	1	1.00	1	2.00
11.	1	0	0	0	1	1	1	0.50	1	1.50
12.	1	0	0	0	1	1	1	0.50	1	1.50
13.	1	0	0	0	1	1	1	0.50	1	1.50
14.	1	0	3	0	4	1	2	1.33	1	3.33
15.	1	0	3	0	4	1	1	2.00	1	3.00

Calculation of level of tolerable risk:

$$[NRT]= (F2 \times P2 \times G2) + N_{T2} / (F2+P2) \quad (9)$$

$$[[NRT] = (1 \times 1 \times 1) + 2 /(1+1)=1+1=2 \quad (10)$$

According to the graphical representation of the level of tolerable risk [NRT] presented in Chart 2 above, one can notice that the insufficient lighting in the area of the machine (by inappropriate placing of the luminaire) generates the highest risk level (3.33), followed by the domestic transport (3.00) and failure to read instructions in the operator's manual (2.50).

Chart 3 presents a comparative graphical representation of serious risk levels assessed and the tolerable risk factors for the 15 risk factors identified in our case study.

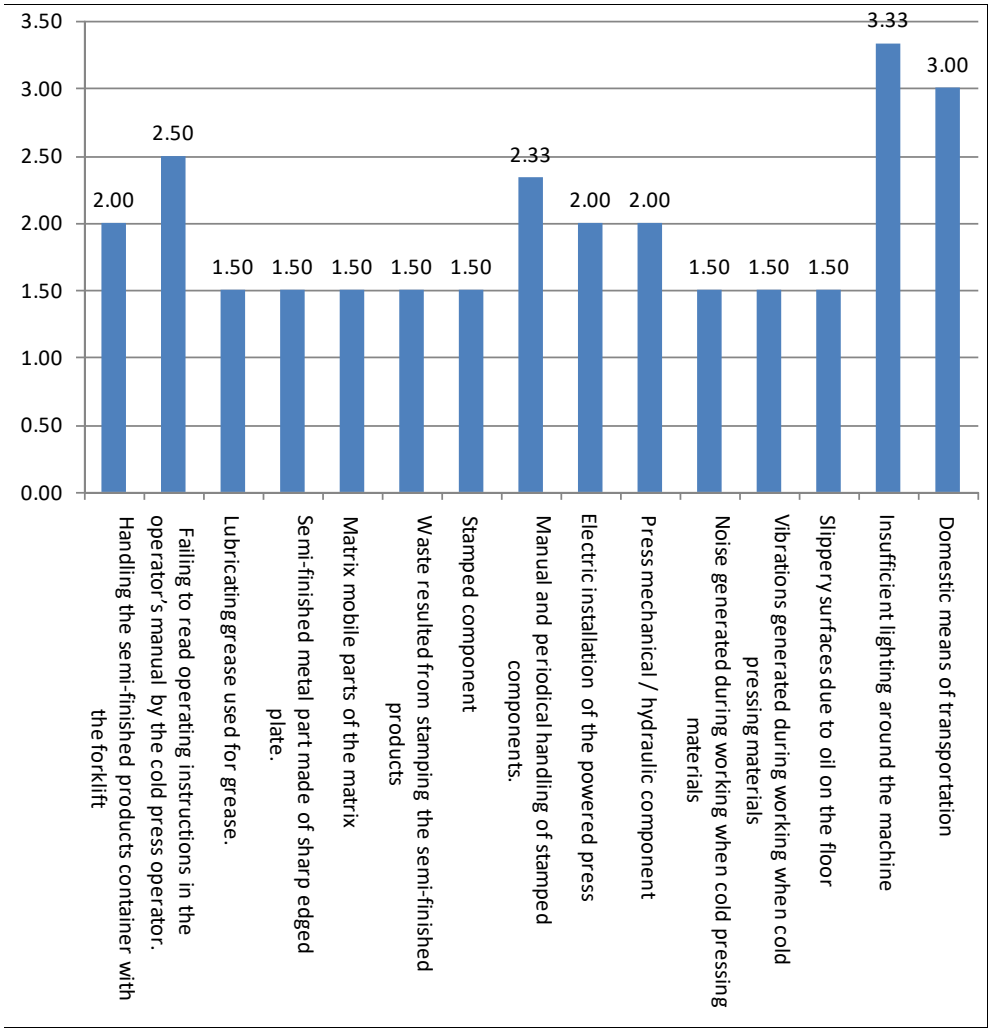

Chart 2. *Graphical representation of the level of tolerable risk, [NRT]*

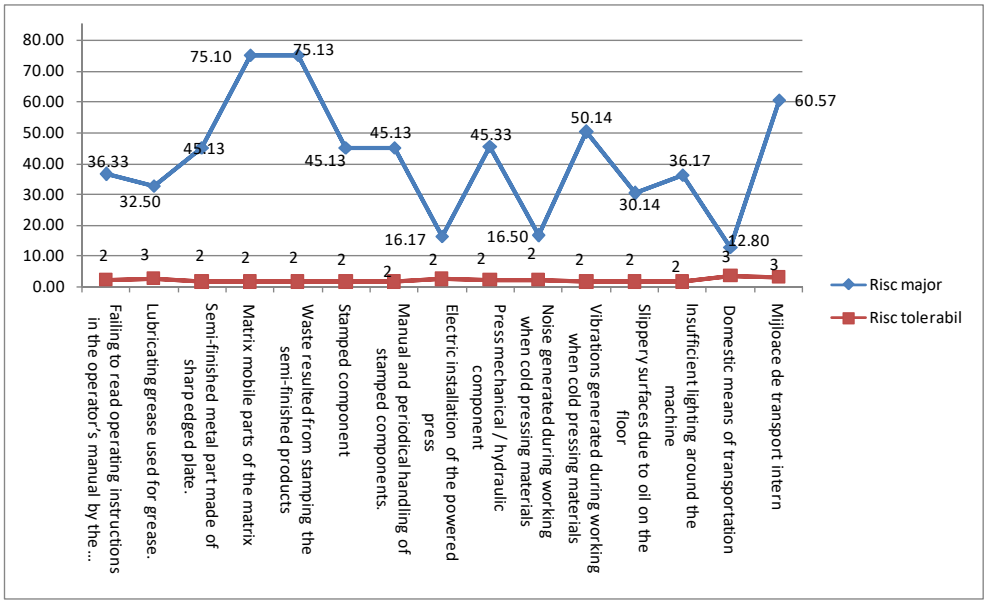

Chart 3. *Graphical representation of serious and tolerable risk levels*

Conclusions

In the case of the workplace analysed i.e. press operator there were identified 15 hazards encompassing related risks and whose risk levels exceed the tolerable level of 3.5. This requires the implementation of prevention and protection measures to minimize the risks to levels tolerable by the organization. The measures implemented lead to ensure the health and safety at work by downsizing the serious level of risk to a tolerable level for the workplace analysed. Risks identified by the technical evaluation method presented in this paper must undergo a close and periodic monitoring and updating to ensure that the measures taken are still enforced.

REFERENCES

Romanian Government (2006), Government Ordinance no. 1425/2006 for the approval of Methodological Rules for the implementation of the provisions of Operational Security and Health Law no. 319/2006, Romanian Official Gazette, Part I, no. 882/30.10.2006.

Law no. 319 / 2006, Operational Security and Health Law
Pece, Şt., Dăscălescu, A. (1998), Evaluation method of risks for accidents and occupational disease at the workplaces, M.M.P.S. - I.C.S.P.M., Bucharest, Romania
Pece, Şt. (2010), Evaluation of risk in the work system, Rubin Publishing House, Galaţi, Romania.
Moraru, R., Băbuţ, G. – Risk analyze, Universitas Publishing, Petrosani, 2000;
Babut, G., Moraru, R., Health &Safety, Universitas Publishing, Petrosani, 1999;
Darabont, Al., Pece, St, Health & Safety, Didactic and Pedagogic Publishing House, Bucharest, 1996;
Darabont, Al., Pece, St., Dascalescu, A, Occupational health and safety management (Vol. I and II), AGIR Publishing House, Bucharest, 2001
Darabont, Al., Darabont, D., Constantin, G., Darabont, D., Security quality assessment of machinery, AGIR Publishing House, Bucharest, 2001
Moraru, R., Babut, G., Risk analysis, Universitas Publishing, Petrosani, 2000;
Moraru, R., Babut, G., Matei, I., Risk Assessment Guide professional, Focus Publishing, Petrosani, 2002.
Pece, St, Risk assessment method in the micro (job), Risk and Safety at Work I.C.S.P.M. Bucuresti, nr. 3-4 / 1994.
Pece, St., Risk assessment system, man-machine Publisher Atlas Press, Bucharest, 2003
Pece, St., Dascalescu, A, Security and health at work - explanatory dictionary, GENICOD Publishing, Bucharest, 2001
Moraru, R., Băbuţ, G. **–** Participatory risk assessment and management professional, Focus Publishing, Petrosani, 2010, ISBN: 978-973-677-206-1
****http://www.ohs.ro/files/formulare/metoda%20evaluare%20incdpm.doc*
****, http://www.qreferat.com/referate/administratie/METODA-INCDPM-DE-EVALUARE-A-RI411.php*
****, http://www.ohs.ro/files/formulare/metoda%20evaluare%20incdpm.doc*
****, http://www.automation.ro/Invata_Automatica/pdf/Eval_risc.pdf*
****http://www.apssmt.ro/download/analiza-critica-si-modalitati-de-imbunatatire-a-metodei-i-n-c-d-p-m-bucuresti.pdf*