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PROFESSIONAL RISK ASSESSMENT METHOD RELATED TO MANAGEMENT SYSTEM REQUIREMENTS

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Abstract: *This paper presents the MEvAR method as an update of occupational risk assessment methods based on new legislative, technological and management system requirements. As a novelty, the approach to certainties, a broader interpretation of the dangers that complement the areas not sufficient covered by the analysis of the professional risks, elements of management involvement, the influence of the external workplace, the correlation with audit and management systems, adapting the specialized technical language. The MEvAR method analyzes, aggregates, and compares risks, considering that a high level of risk can also be reduced by treating the risks through an assumed involvement of the organization's management. The method has attached a working tool based on Microsoft Excel, flexible and adaptable in several directions.*

Key words: *assessment, occupational risk, correlation, requirements, working tool*

1. INTRODUCTION

In the context generated by the modification of the requirements imposed within the OHS (occupational health and safety) management systems SR EN ISO 45001: 2018 and the need to use a methodology to assess occupational risks adapted to present requirements, we propose a framework considering the following considerations (as presented by similar studies of [1-6] and supported by the actual legal framework [12-19]):

- We have identified the need for an evaluation method that is directly related and applied to Community or international standards in the field;
- EC Regulation 1907/2006 REACH on chemicals promotes the development of chemical risk assessment methods (as supported by;
- The method can be applied both to organizations, institutions that have implemented an OHS management system and to companies that are considering this for the future or not;
- The method is provided by at least two occupational risk assessors for a better assessment;
- The work environment is separated from the workplace environment and the environment in its vicinity for a better analysis of external sources and impact.

The method considers different aspects and elements of the OHS knowledge space [6-10]:

- Certainties before risks;
- Risks are aggregated based on sources, hazardous situations and hazards;
- Elements specific to the organization, work teams, workers;
- Direct relationship with the management of the organization, the management of the company and the leaders of the jobs;
- Records and history of impact on workers;
- The risks generated by analysis, action, opportunities, vulnerabilities and capabilities are also assessed;
- The means of production are analyzed by category, particularly those specific to the chemical environment;
- Technical data, operating parameters and up-to-date maintenance are analyzed for the

predictions of the failure of the analyzed equipment;
- The influence on the processes of the Covid-19 Coronavirus pandemic is considered;
- The risks are analyzed and assessed by overlapping, combining and adapting the main elements of SR EN ISO 31010:2019, SR EN ISO 45001:2018 and other elements of different methods of risk assessment (Brainstorming, Delphi, SWIFT, INCDPM - Darabont, Heinrich, FMEA, AMDEC, ARAMIS, ERGOS, LEST) considering the participation in the team of at least two professional risk assessors, analysis and identification of sources, interview, supervision and organization of process meetings, 5 x 5 type risk matrix [1-4, 10, 11];
- The method allows rapid operationalization with the integrated management systems of institutions and companies with easy-to-work elements for managers and/or directors;
- The risk can be assessed in different forms: initial risk, residual risk - proposed, risk weighted by the basic method depending on the purpose and objectives set with the employer;
- We consider the method to be easy to use, accompanied by the working tool generated by the popular Microsoft Excel software application among users;
- The method chosen for reference is the INCDPM Bucharest method, used in the organizations that have the object of activity detergent production, which were the basis of the study of this paper.

2. DETAILED MEvAR ASSESSMENT METHOD (OCCUPATIONAL RISK ASSESSMENT AND ASSESSMENT METHOD)

The method aims at identifying certainties and hazards, assessing the risks associated with them, applying calculation formulas, estimating and assessing the results according to the calculation grids and generating the final reports of the occupational risk assessment.

The mathematical model of the method is based on the calculation of the risk based on the ratio between probability/exposure and severity/impact to which are added the correction factors assumed and specific to each organization.

The stages of occupational risk assessment by the MEvAR method take into account:

a. Ensuring the prerequisites for the evaluation;

b. Identification, analysis and assessment of hazards/dangerous situations;

c. Establishing certainties and risks;

d. Occupational risk assessment;

e. Preparation of the risk assessment report;

f. Preparation of the attached documents of the risk assessment report;

g. Handing over the receipt of the risk assessment documentation.

Details:

a. Ensuring the prerequisites for the assessment involves ensuring the requirements for carrying out the occupational risk assessment in good condition.

The contractual requirements consider:
- Carrying out a contractual collaboration between the team of evaluators and the beneficiary of the evaluation;
- Ensuring the contractual relations with the suppliers, collaborators, legal or natural persons involved in the evaluation;
- Ensuring the contractual relations with the employees of the organization.

Administrative requirements relate to:
- the structure of the organization and the relationship between structures and staff;
- decisions on the organization and functioning of the organization, processes and responsibilities;
- access to jobs, facilities, equipment;
- collaboration and/or cooperation with neighbors, suppliers, beneficiaries, institutions, civil society, other stakeholders.

Legislative compliance information aims to ensure that the organization complies with the requirements of the labor code, social responsibility, employment, work procedures, technologies, occupational safety and health, emergencies, environmental protection, etc. [9, 10, 14-17]. Knowledge of work processes is mandatory before identifying the dangers for structuring the procedure and monitoring the production flow and its interference.

This will be done through documentation; the follow-up of the process and the interview being

performed in the hazard identification stage. Prior to the start of the risk assessment activity, the activities will be planned and the work schedule of the team and staff with whom it will interact will be established.

The information and training of the participating staff will be carried out by the head of the evaluation team or a person designated by the evaluators and will include at least the communication of the names and functions of the participants, the relationship, the tasks of each, the potential risks necessary.

The preparation of documents, equipment, installations by the beneficiary for evaluation will be carried out by the staff of the organization or collaborating suppliers.

Access to workplaces subject to assessment will be followed by access approvals in the presence of the workplace manager after training as a visitor and the provision of the necessary personal protective equipment adapted to the specific risks.

b. The identification, analysis and assessment of hazards/dangerous situations will be performed by collecting data, information and direct observation, documentation, interview, determinations, others, their analysis and assessment, use of checklists and verification and ensuring documented information.

c. The establishment of certainties and risks is ensured by the evaluators by comparison with the checklists specific to the evaluation method, on-the-spot assessment and/ or consultation with other specialists.

d. The occupational risk assessment involves the use of the working tool in the application and includes:

- Entering the data into the application;
- Assessing, determining and estimating the levels of risk calculation elements;
- The calculation of the estimated risk, which is performed by the application;
- The design of the residual risk resulting from the recalculation of the analysis of the treatment of the risks, the verification of the assurance of the measures of prevention and protection and continuous improvement designed to be achieved by entering new data and is carried out by the application.

e. Completion of the risk assessment report involves the application being generated and printed in an acceptable format.

f. The preparation of the attached documents of the risk assessment report is generated by the application and includes in principle the following reports/documents:

- Prevention and protection plan;
- Risk register;
- Assessment sheets for work equipment, hazardous substances or chemicals, work arrangements - ergonomics, sensitive groups
- Certainties (certain dangers), unacceptable risks and acceptable risks;
- Specific forms (risk alert form and risk tracking sheet);
- Graphics and other useful data.

g. Completion of the risk assessment activity consists in handing over the receipt of the risk assessment documentation and its signing by the parties.

Assessment sheets for work equipment, hazardous substances or chemicals, sensitive groups, the job description sheet are entered into the calculation by aggregating the risks and applying a corresponding risk correction factor.

Completion of these involves the application of the specific valuation methods mentioned in the forms and the transformation of the final data into entry elements in the calculation of risks according to the MEvAR method. Following the evaluation, proposals may be made to the organization to improve the organization's objectives, opportunities and performance. The risk handling table contains the general principles applicable to prevention and protection measures for the elimination, avoidance, transfer, treatment, monitoring, risk control measures.

The proposed MEvAR method was preferred as it provides a more detailed the hazard analysis, risks and measures related to hazardous chemicals/preparations. The introduction of certainties in the analysis ensures a community approach to the legal meaning of not taking any of the legal measures of OHS according to art.349 Criminal Code considering the fact that they can be prevented, quantified and/or prevented informative than practical or applied.

Compared to the known components of the work system: workers, workload, means of

production and work environment, values valued for each and the design of the calculated risk treatment, a new category is introduced in the calculation OTHER RISKS which facilitates the minimization the area of uncertainty of the sources of risk (occupational diseases, financial risks, external) and are integrated as risk factors elements of the OHS management system.

Figure 1 shows the SWOT analysis of the MEvAR method.

The correction factors design, compared to the situation identified by the risk management method, the level that can be ensured and accepted by the organization, factor C - requirements, to which the performance of the management system related to ensuring prevention and protection measures - involvement and the factor Po - weight that represents the importance of the risk especially of its impact in the calculation - the planning.

These factors are not represented in the main methods of occupational risk calculation and we consider that they are representative for the organization because they materialize the planning and involvement of the organization's management in risk management by correlating legislative requirements with those of management system in OHS.

Risk is the ratio between the likelihood of a dangerous event or exposure occurring and the consequences of an event, the trauma or occupational disease. The probability is analyzed according to the associated likelihood of occurrence of an event and the characteristics of the exposure - path, duration and frequency. Severity is treated as a summation of the severity of the trauma/illness on the injured person and the damage caused to the organization and the injured person.

The level of injury can be occupational disease, illness (trauma, injury resulting from temporary incapacity for work, disability) or death. Each risk factor can be assessed according to the specifics of the organization based on documented information from records, interviews, direct viewing or determinations within the limits proposed or chosen by the specialist jointly with the management of the organization.

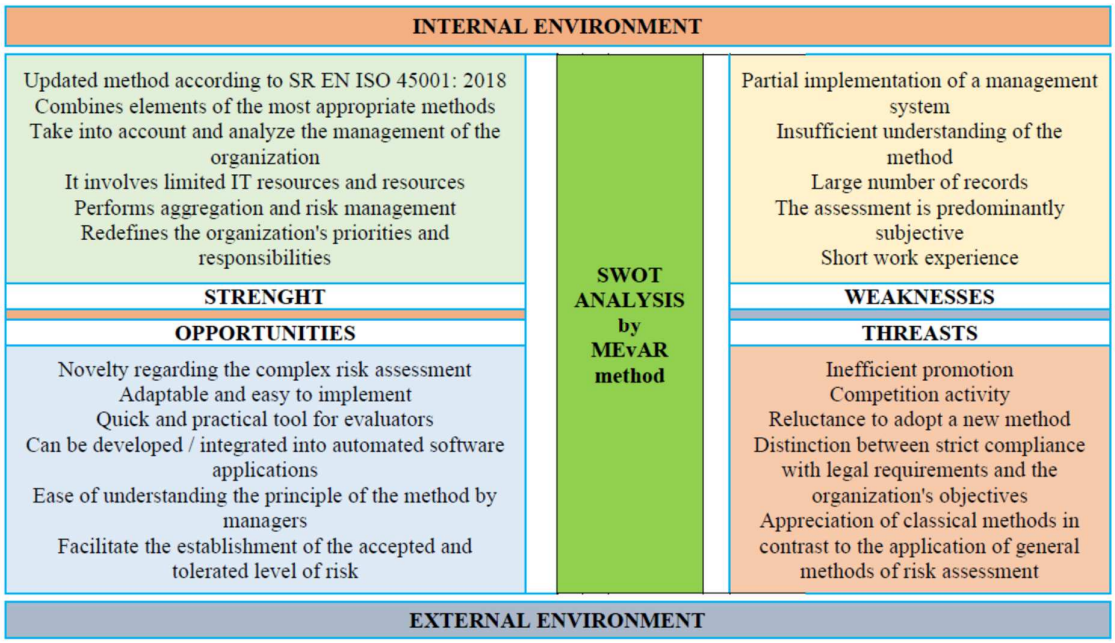

Fig. 1. SWOT analysis by MEvAR method.

This ensures a better correlation in communication, identification and analysis of risks, the materialization being found in the establishment of the way of treating the risks and of the measures of prevention and concrete protection. It can be an important tool in defining, identifying and establishing responsibilities for hazards because

uncertainties are correlated with risks and can not only be assessed and situations of certainty are those in which there are no elements of prognosis and reaction but only a posteriori finding and action. The method introduces certain situations that can be the basis for an analysis of the organization's capacity for action and response to identifiable hazards, the legislation being applied only to the risk area. The analysis of certainties considered the anticipation with a single value is certainty, the anticipation with at least 2 values for the probability of occurrence and / or its impact is uncertainty associated with the risk. The risk calculation formula is (see Figure 2):

$$R = ((P \times G)/ C) \times Po \quad (1)$$

Where R is the occupational risk / injury level; P - likelihood of event occurrence; G - event gravity; C - level of insurance requirements prevention and protection measures; Po – weight.

In the case of partial assurance or non-assurance of risk treatment, verification of assurance of prevention and protection measures and continuous improvement designed to be achieved the residual risk level NRR will be considered as that assessed in the initial phase NRA. Verification, assurance, and maintenance of this level of risk is the responsibility of the employer who shall request a reassessment of the risks in the event of a change in the conditions that were previously identified. The level of risk assessed by another method (in this case the INCDPM method) has a comparative role for correlation with the previous experience of the assessors and/or the beneficiaries of the risk assessment [2-6]. Limitations of the method can be considered the following:

- Hazards not identifiable by the date of assessment, identifiable only in exceptional, rare or almost impossible cases or hazards not normally encountered in the socio-political-economic environment of the area;
- The person's intention attacks, aggressions, other forms of behavior that can generate dangers;
- Accidental failures which are not directly affected by the worker or the work environment;
- The subjectivity of the assessment of the limits for estimating the influence of risk factors / dangerous situations by specialists jointly with the organization's management;
- Limited experience of specialists in risk assessment and OHS management systems;
- Knowledge and superficial application of system management requirements by the organization/ risk assessment specialists.

These situations are of an exceptional nature and are strictly dependent on limiting the level of information, training, records and statistics, communication, professionalism of the organization and/or group of evaluators, and there is a need for an external audit and certification of the level of acceptability [6, 20, 21].

IDENTIFIED RISK LEVEL N_{RI} (N_{RI} = P x G)		SEVERITY				
		easy	low	average	serious	very serious
PROBABILITY	very high	accepted	tolerated	tolerated	not accepted	not accepted
	high	accepted	accepted	tolerated	tolerated	not accepted
	average	controlled	accepted	accepted	tolerated	tolerated
	low	controlled	controlled	accepted	accepted	tolerated
	very low	managed	controlled	controlled	accepted	accepted

Fig. 2. Estimated grid Risk level identified.

In the calculation are used the terms of probability and severity identified, estimated risk for the situation at the date of assessment and residual probability and severity, residual risk for the projected situation if they are provided at the assumed level of the proposed measures.

The application is based on the use of Microsoft Excel application with/without security protections. The program works based on the entry, selection, extraction of values, calculation, reports and automatic interpretation or by the evaluator of the reports or values in the spreadsheets.

The elements and variables can be selected for the calculation of the risk identified by the evaluators and depending on the purpose and objectives proposed and approved jointly with the employer, the residual risk level will be chosen in correlation with the measures proposed by the evaluators and provided by the employer, the weight given and the requirements. There are dynamic references between spreadsheet elements that allow you to update and calculate correlated spreadsheets.

3. COMPARISONS

Based on the calculation and the comparative elements regarding the classical methods, the data regarding the professional risk assessment from several detergent companies with Romanian capital, information from other companies carrying out activities with dangerous substances / chemicals and communications from other external service providers were used. prevention and protection with which we collaborate, the main conclusions being revealed in Tables 1, 2, 3.

Table 1

Comparative data on methods of evaluation of hazardous chemicals / preparations.

The most used method of occupational risk assessment in the organizations under review (INCDPM) [1-3]	**Proposed method MEvAR**
The method is known and applied by most occupational risk assessors	The method is being implemented
The assessment includes the job and / or occupation	Assessment includes workplace / job / activity / process / sensitive group / work equipment / chemical substances and / or preparations used / job arrangement in the organization
The assessment is performed by a single professional risk assessor	At least 2 professional risk assessors participate in the evaluation
The estimated values are the result of the mathematical model of the 6x7 grid method	The estimated values use mathematical models specific to the parameter, different type 5x5, 4x4, 3x3 with associated values that are chosen by the evaluator to achieve the relevance of the risk and the proposed measures
The risk is assessed at the identified level, the proposed measures can reduce it to an accepted value	The risk can be assessed in different forms, the initial one, the proposed one - residual, weighted with the one of the basic methods depending on the established goal and objectives.
The adaptation of the classic method of professional risk assessment with the requirements of the OHS management system depends on the relationship of the evaluator with the management representative of the organization.	The method includes harmonized elements of classical methods of occupational risk assessment, OHS management system requirements and current legislative requirements.
The method is not associated with a calculation tool	A quick calculation tool is used to facilitate the use of the method
No reference is made to how to deal with certainty hazards	Certainty hazards are identified and addressed
No reference is made to the results obtained by applying other methods	The method includes the calculation elements and references regarding the results obtained by the classical method
There are no references regarding the application of OHS management systems	The method integrates the requirements of OHS management systems
The severity is expressed because of the event and refers only to injuries (only other methods include damage)	Severity is expressed as a relationship between consequence and damage, the level of injury being a ratio between trauma and disease and the level of material damage being estimated according to the financial level of the organization.
Probability is taken from statistical data that are not correlated with the diversity of current activities	The probability is analyzed according to the likelihood of occurrence of an event and the characteristics of the exposure - path, duration and frequency
Management involvement is not revealed in the evaluation	Management involvement is included in the evaluation

There are no changes in the calculation in case of exposure of several workers	The number and quality of workers are included in the evaluation
The level of insurance requirements is not assessed	The level of assurance of legal requirements and management of OHS is included in the assessment and ensures a proportionally correct correction of the level of risk
A risk weight is not covered and is calculated	The weight of the importance of the risk is introduced, which is directly proportional to the risk
A calculation of the Insurance Level of system requirements is not covered	New coefficients are introduced for the calculation of the level of assurance of the OHS management system requirements: Level of risk analysis, Level of risk treatment, Level of verification of prevention and protection measures and Level of OHS improvement
Risk management is limited to proposing measures	In the assessment there is a selection of the risk management strategy
The risk following its treatment is not recalculated	The residual risk level is designed for the situation in which the risk is treated
Risks are not reviewed in the assessment	The risks can be reviewed in the assessment by calculating the proposed residual risk
A reassessment of the identified risk following treatment of risks / application of necessary prevention and protection measures is no longer performed.	The level of risk initially identified becomes the identified level of risk Residual risk level is the residual / accepted level of risk that is projected following the treatment of risks / the provision of preventive and protective measures.
There is no distinction between the risk assessment report and the risk register	The risk register is a report generated by the working tool
The assessment is predominantly statistical and subjective	The assessment is predominantly subjective considering that it adapts to each evaluator between the 2 specialists [10]

Table 2

INCDPM method risk details

Total number of INCDPM risks	Number of value risks 7	Number of value risks 6	Number of value risks 5	Number of value risks 4	Number of value risks 3	Number of value risks 2	Number of value risks 1
108	0	0	1	13	83	0	11

Table 3

Details of the MEvAR method risks

Total number of risks	Number of certainties	Number of risks not accepted	Number of risks tolerated	Number of risks accepted	Number of controlled risks	Number of risks managed
167	7	1	7	28	93	38

In the software application is used the classic Excel calculation formulas: = Spreadsheet cell for translated reference, = IF (cell 1 = value1; "expression1"; IF (cell 2 = value2; "expression2"; "ERROR")) for the expression of the associated value for damage, probability, severity, other calculation, = ((cell 1 + cell 2) / 2) for the average risk calculation identified, = ((cell 1 + cell 2) / 2) / (cell 3 * cell 4) for average residual risk calculation, = ROUNDUP ((cell 1 + cell 2) / 2; 0) for calculating the average risk, = AVERAGE (cell 1: cell 10) for calculating the average partial risk, = 'Selected spreadsheet'! Cell 1 for retrieving data from another spreadsheet, selection of multiple cell values, conditional formatting to highlight certain values.

4. CONCLUSIONS

Following the comparative assessment of the occupational risks for a job / activity - chemical operator worker by the two methods, the classic INCDPM and the proposed MEvAR, the following aspects can be distinguished:

- The management system requirements are applied in an integrated manner in the evaluation;
- There is the possibility to reduce the risk by designing the residual risk according to the correction factors accepted by the management of the organization;
- The application can generate quick and effective reports on the details and elements of the assessment (acceptable, unacceptable risk statements, proposed prevention and protection plan, assessment sheets by categories required by law, evidence and follow-up sheets required by the administration, correlation with OHS or integrated management systems;
- It is possible to adapt to each evaluation specialist, the application is flexible and allows the modification of the input data, the adaptation of the reports and the introduction of any data necessary for the evaluation, specific elements of the evaluation methods dedicated to some fields of activity;
- The two results can be compared and conclusions can be drawn regarding the most appropriate result in direct correlation with OHS policies and opportunities the values of the determined risk level are: 2.93 for INCDPM and respectively 2.34 for MEvAR;

There are comparative graphs by evaluation stages presented in Figure 3 as a summary with certainties and risks.

There have been observed that:

- The MEvAR method achieves by designing the residual risks the assumption by the employer of the dangers, the risks identified, assessed and evaluated including the prevention and protection measures according to the proposed way of complying with the requirements and the weight given in the treatment of the risks;
- The method presents the elements of occupational risk assessment and can ensure that any beneficiary of the risk assessment report understands and how to treat them in a known manner that is a reference to the results obtained;

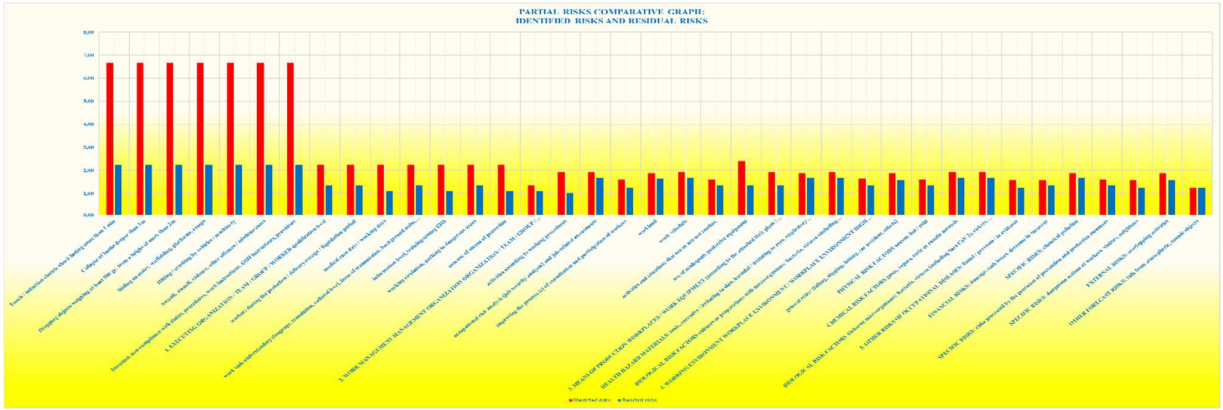

Fig. 3. Partial risk comparison chart

- The usefulness of the new method is immediately found in the fact that in addition to a professional evaluation report and the proposed measures for prevention and protection, data and elements are obtained that can be entered automatically through the application for generating performance indicators, updating objectives and OHS policy and the most important aspect is that the assessment of a major risk can be reduced to a medium-accepted or reduced-monitored risk, managed by designing the residual risk by the assessment team together with the organization's manager depending on how the risk is treated. and the share given to occupational risks;
- For example, a major risk of injury by designing corrective measures adapted to the capacity of the organization, by giving more importance to compliance with legal requirements or management system, giving a greater share of that risk is assessed and

assessed at a managed risk is a very low risk because all possible predictable measures are taken by the organization, the effects are limited and reduced, there is permanent supervision and monitoring of the risk, staff is trained and verified, maintenance of the equipment involved is ensured, preventive control measures are taken and continuous improvement, documented information is performed, interpreted and updated and, where appropriate, third party auditing may be provided);

- The proposed MEvAR method provides increased flexibility for risk assessors in choosing relevant risk factors, benchmarks, working methods, treatment, impact and exposure on workers, equipment, substances, effective calculation for assessment and evaluation;
- The low cost of the application allows the use and development of the method among specialists and the optimization of the beneficiaries' expenses;
- The method allows participation in its development by updating the checklists of risk factors, spreadsheets, reports and forms generated and especially the ease of adapting to new future regulatory requirements that will be based on management systems;

We note that the proposed method ensures through the methodology and the calculation tool an increased efficiency both the assessment and assessment of occupational risks based on the most current legislative and management system requirements and the rapid generation of reports, forms and measures on hazard and risk treatment, prevention and OHS protection at a high, structured and effective level within the monitored organization as well as others. The importance of OHS assessment is placed in the general context of wellbeing assurance together with working environment quality assurance [20-25]. In addition, there have been considered for future research the context of different university-industry collaborations due to the mutual advantages for education and research activities [26].

5. REFERENCES

[1] Moraru, R.I., *Securitate şi sănătate în muncă. Tratat universitar*, Ed. Focus, Petroşani, Romania, ISBN 978-973-677-272-6, 2013.

[2] Darabont, A., Pece, St., Dascalescu, A., 2001, Managementul securitatii si sanatatii in munca, Ed. Agir, Bucharest, Romania, ISBN 973-8130-54-9 973-8130-55-7, 2002.

[3] Moraru, R.I., Băbuţ, G.B., *Evaluarea şi managementul participativ al riscurilor: ghid practic*. Ed. Focus, Petrosani, Romania, ISBN 978-973-677-206-1, 2010.

[4] Chivu, O.R., *Research and contributions on occupational health and safety in the field of industrial engineering*, Assoc. UPB 2020

[5] Chivu, O.R, *Occupational medicine in industry*, Politehnica Press, Bucharest, Romania, 2020.

[6] Dragoi, G., Draghici, A., Rosu, S.M., Radovici, A., Cotet, C.E., *Professional risk assessment using virtual enterprise network support for knowledge bases development*. In International conference on enterprise information systems, 168-177). Springer, Berlin, Heidelberg, ISBN 978-3-642-16418-7, 2010.

[7] Anghelache, C., *Environmental risk management - economic and social priority*, Artifex University, Bucharest, 2011.

[8] *Metodologie de management al riscurilor*, https://sgg.gov.ro/1/wp-content/uploads/2018/07/Metodologia-de-management-al-riscurilor-2018.pdf.

[9] *Ghid pentru realizarea procedurilor de sistem şi operaţionale*, https://www.scjs.ro/prezentare/proceduri_op/Ghid-proceduri%20SGG.pdf

[10] *IEC 31010:2019, Risk management - Risk assessment techniques*, https://www.iso.org/standard/72140.html

[11] *ISO 45001:2018. Occupational health and safety management systems - Requirements with guidance for use,* https://www.iso.org/standard/63787.html.

[12] Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

[13] Law no. 319/2006 on safety and health at work.

[14] Law no. 360/2003 on the regime of dangerous chemical substances and preparations.

[15] Law no. 254/2011 for the amendment of art. 26 of Law no. 360/2003 on the regime of dangerous chemical substances and preparations.

[16] Government decision no. 1425/2006 Methodological norm for the application of Law 319/2006.

[17] Government decision no. 1218/2006 on establishing minimum occupational safety and health requirements to ensure the protection of workers from the risks related to the presence of chemical agents.

[18] Government decision no. 557/2016 regarding the management of risk types.

[19] Order no. M.108 / 2013 for the approval of the Methodological Norms regarding the granting of the exemptions provided in art.2, paragraph 3 of the completion of art. 4 para. (1) of Regulation (EC) no. Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration,

Evaluation, Authorization and Restriction of Chemicals (REACH), establishing the European Chemicals Agency, amending Directive 1999/45 / EC and repealing Regulation (EEC) No. Council Regulation (EC) No 793/93 and Regulation (EC) No 1.488 / 94 of the Commission and of Council Directive 76/769 / EEC and Commission Directives 91/155 / EEC, 93/67 / EEC, 93/105 / EC and 2000/21 / EC.

[20] Feier, A., Banciu, F., *Ergonomic aspects of real and virtual welding tools*, Acta Tehnica Napocensis/Series Applied mathematics, mechanics and Engineering, 64(1), S1, 2021.

[21] Albulescu, C. T., Draghici, A., Fistiş, G. M., Trusculescu, A., *Does ISO 9001 quality certification influence labor productivity in EU-27?* Procedia of Social and Behavioral Sciences, 221, 278-286, 2016.

[22] Gogan, L. M., Duran, D. C., Draghici, A., *Structural capital-A proposed measurement model*. Procedia economics and finance, 23, 1139-1146, 2015.

[23] Baesu, V., Albulescu, C.T., Farkas, Z.B., Draghici, A., *Determinants of the high-tech sector innovation performance in the European Union: a review*. Procedia Technology, 19, 371-378, 2015.

[24] Gogan, L.M., Rennung, F., Fistis, G., Draghici, A., *A proposed tool for managing intellectual capital in small and medium size enterprises*, Procedia Technology, 16, 728-736, 2014.

[25] Dimitrescu, A., Babis, C., Alecusan, A. M., Chivu, O. R., Feier, A., *Analysis of Quality Problems in Production System Using the PDCA Instrument*, Fiability & Durability / Fiabilitate si Durabilitate, 1, pp. 286-292, 2018.

[26] Draghici, A., Baban, C. F., Ivascu, L. V., Sarca, I. (2015). *Key success factors for university–industry collaboration in open innovation*, Proceedings of the ICERI2015, ISBN: 978-84-608-2657-6, 7357-7365, IATED, 2015.

Metodă de evaluare a riscurilor profesionale corelată cu cerințele sistemelor de management

Acest articol prezintă metoda MEvAR ca o actualizare a metodelor de evaluare a riscurilor profesionale bazate pe noile cerințe legislative, tehnologice și ale sistemului de management. Elementele de noutate sunt abordarea certitudinilor, o interpretare mai amplă a pericolelor care completează domeniile insuficient acoperite de analiza riscurilor profesionale, elementele de implicare a managementului, influența locului de muncă extern, corelarea cu sistemele de audit și management, adaptarea limbajului tehnic de specialitate. Metoda MEvAR analizează, asigură agregarea și compară riscurile, considerând că un nivel ridicat de risc poate fi redus și prin tratarea riscurilor printr-o implicare asumată a conducerii organizației; pentru operaționalizarea folosirii metodei a fost dezvoltat un mijloc de lucru bazat pe Microsoft Excel, flexibil și adaptabil în diferite contexte de aplicare.

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