Shahrood University of Technology
Iranian Society of Mining Engineering (IRSME)
Journal of Mining and Environment (JME)
journal homepage: www.jme.shahroodut.ac.ir
THOMSON REUTERS

Vol. 11, No. 2, 2020, 363- 373.
DOI: 10.22044/jme.2020.9156.1807

A Safe and Sustainable Development in a Hygiene and Healthy Company Using Decision Matrix Risk Assessment Technique: a case study

R. Kharzi[1*], R. Chaib[1], I. Verzea[2] and A. Akni[1]

1- Department of Transport Engineering and Environment Laboratory, Mentouri University Constantine, Constantine, Algeria
2- Faculty of Textiles - Leather and Industrial Management, The"Gheorghe Asachi" Technical University of Iaşi, Iaşi, Romania

Received 9 December 2019; received in revised form 26 February 2020; accepted 26 February 2020

Keywords

Overall risk rate

Occupational health and safety

Environment

Sustainable development

Evaluation

Prevention

Abstract

This article describes the process of improving risk management practices in a foundry of the ALFET Company (Algeria). The proposed methodology is based on the decision matrix risk assessment technique. This technique allows making a risk assessment for each source of risk (machine, man, environment, and management), which leads to the determination of the overall risk rate during the activity by a new concept. The latter giving a comprehensive vision of occupational health and safety, and compares it with the ALARP principle to determine the acceptability of risk. The main goal of this work is to inculcate a culture on the effects of changing behaviors and attitudes, to disseminate the culture of continuous and sustainable progress within the enterprise, and to ensure that a good atmosphere is maintained in the workplace. It aims to protect and promote the health and safety of workers and the working environment in order to promote a safe and sustainable development company. Our work shows that the working environment is tolerable in terms of health and safety at work. However, to promote a safe and sustainable development in company, an action plan based on the evaluation of the field and feedback through priority actions is recommended for continuous improvement in OSH. Toward the workplace should be continuously monitored to detect risk factors as early as possible before they have negative effects.

1. Introduction

According to an analysis, one of the most affected areas in the City of Tiaret is the Algerian Foundry ALFET [1], and in particular, the working environment in the foundry. From now on, every organism is responsible for the occupational health and safety of its workers in all the aspects related to work [2]. This responsibility includes promoting the wellness and preserving the physical and mental health [3] according to a comprehensive and coherent prevention policy. On the basis of this legislation, and as an illustration of this work, the study of this company will be detailed. It is recommended to identify and upstream all the risk factors having negative impacts on the working climate and the health of workers, and any alteration in the worker's state of health affecting his functional abilities and his work [4, 5]. The consequences of these factors now lead to functional limitations that affect the quality of work life and quality of work and even the company's perceived performance: sustainability and development [6, 7]. As a result, these conditions must be controlled by the employer in order to offer the employees a quality-working environment or even to increase the so-called positive atmosphere conducive to the productivity and competitiveness of the enterprise [8]. Subsequently, the magnitude knowledge of the risk factors present in the organization allows for an overview, a "risk mapping" of the organization, which is crucial for choosing the best direction to take in prevention [9, 10]. In addition, it makes

Corresponding author: kharzi.rabeh@umc.edu.dz (R. Kharzi).

additional arguments about the need for action. The portrait of risk factors provides an opportunity to identify concrete problems, rooted in the specific characteristics of the organization on the spot and in the experience of employees. Taking a portrait involves identifying certain management practices that have a negative impact on the working environment, and the well-being and health of the workers [11]. However, the working environment of foundries is dangerous and characterized by spontaneous exposure to multiple occupational chemical, physical, mechanical hazards, etc. [12, 13]. In addition, the employees working in confined and poorly-ventilated areas have no vocational qualifications. This exposes them to many occupational risks. Therefore, a risk assessment is necessary, objective of the work. The latter consists of identifying the hazards and analyzing the conditions of exposure to these hazards. It emphasizes on the idea of preventing the occurrence of accidents and occupational diseases rather than simply identifying and analyzing accidents and detecting the existing pathologies. It is the initial and essential step in preventing occupational accidents and diseases within the company [14]. The number of work accidents recorded at the ALFET smelter is increasing rapidly and continuously from one year to the next, and even 22 accidents in 2013 to 68 accidents in 2018. What justifies this study, and to carry out an assessment of the occupational risks in the sector of the foundry and in particular to protect and promote the health and safety of workers, protect the environment and promote a safe and sustainable development.

2. Work methodology

The proposed work methodology is based on the DMRA (Decision Matrix Risk Assessment) technique (Figure 1). It is a systematic approach to risk estimation that involves measuring and categorizing risks on the basis of informed judgement, both in terms of probability and consequences and relative importance [15, 16]. This is a quantitative and graphical method that can help the risk managers to prioritize and manage the key risks [17]. This technique allows conducting a risk analysis and assessment for each risk source (machine, human, environment and management), then the overall risk rate during the activity proposed by a new concept is determined (Formula 1).

Consequence classes

Likelihood classes	**C1(1): Insignificant consequences**	**C1(2): Significant consequences**	**C1(3): Serious accident**	**C1(4): Major accident**
F4 (4) Frequent	**R4**	**R8**	**R12**	**R16**
F3 (3) Probable	**R3** No personal harm	**R6** Recoverable injuries	**R9**	**R12**
F2 (2) Improbable	**R2**	**R4**	**R6** Single fatality and several injuries	**R8** Several fatalities and many injured
F1 (1) Very improbable	**R1**	**R2**	**R3**	**R4**

Figure 1. Risk matrix [16].

This research work has been divided into four sources of accidents that are generally the company risks related to either production tools or machines (the operator may be subjected to crushing, shearing, cutting, clutching, training, imprisonment, shock, fall, etc.) [18] either to the operators themselves (human error through failure to comply with safety directives and insufficient training, stress, etc.) or to the working environment (exposure to hazardous agents in the workplace, unsafe work environment, high temperature, dust, etc.) [19] and the management style that has been implemented (improper and non-standard work method, no work execution plan, etc.) [20]. Furthermore, based on the principle, zero risk does not exist [21], and Equation (1) can be proposed in order to determine the level of overall risk during the activity.

$$\text{Overall Risk Rate} = R_{\text{Machine}} \times R_{\text{Human}} \times R_{\text{Management}} \times R_{\text{Environment}} \quad (1)$$

This risk rate represents the rate of overall risk level in any company during its activity. It gives the decision-makers and managers a global vision of occupational health and safety. Moreover, the priority actions are identified to intervene and make the company safer and healthier. Once the risk rate is known, the risk acceptability is

determined by comparing that with the ALARP principle (as low as reasonably practicable) [22].

The method of work proposed in this article is illustrated and clearly clarified in Figure 2.

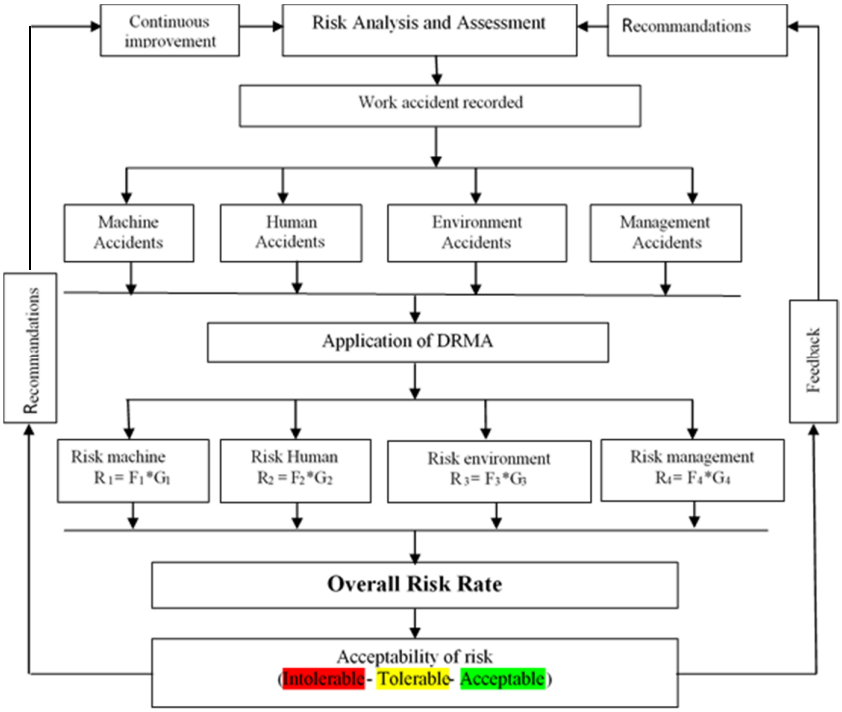
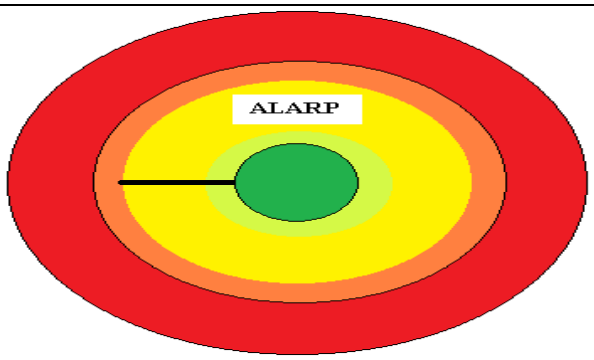


Figure 2. Diagram illustrating the working methodology.

For a more accuracy, a risk zone model is proposed to locate the perception level of overall risk, and even manage to identify the priority actions to be started and where we must act (Figure 3).



Risk Intolerable	**All 4 sources of risk are intolerable (4 red)**	The work must not be started until the identified risks are eliminated immediately. If an activity is in progress, it must be stopped. If the risk is related to the continuation of the work, emergency measures must be taken.
	At least one source among the 4 sources is in an intolerable zone (Red)	
Risk Tolerable (ALARP)	**All 4 sources of risk are tolerable (4 Yellow)**	Actions need to be initiated to reduce the identified risks. This may take time for risk reduction interventions.
	At least one source among the 4 sources is in the tolerable zone (Yellow) (no Red zone)	
Risk Acceptable	**All 4 sources of risk are acceptable (4 Green)**	There is no need to plan control processes to eliminate the identified risks. However, the existing controls must be maintained and these controls must be monitored.

Figure 3. Proposed example of risk areas to determine overall risk.

The idea behind this proposed model is to multiply the 4 sources of risk (each source at a Green-Yellow-Red risk level) to determine the overall risk level.

3. Case study: ALFET foundry

This work was conducted in an ALFET foundry company.

3.1 Presentation of company

The Algerian foundries is a subsidiary of the foundry group of Algeria FONDAL located in the City of Tiaret in the west of Algeria. It was created in 1983. Its production capacity is 830 Tonnes/year of Cast iron and 4000 tonnes/year steels. ALFET's sectors of activity:

- Cement industry sector: manufacture of the manganese steels, impact parts...
- Steel industry sector: manufacture of all-dimensional coating plates, all-dimensional casting mothers…
- Buildings, Quarries, and Mine sector: manufacture of wear blades and various blade doors, jaws, and crushing hammers of different dimensions.
- Agricultural machinery sector: manufacture of pulleys, Coils, Disc Plates, Grid Bars, and Service Spares.
- Mechanical and public works: Manufacturing various parts for public work equipment and miscellaneous parts for hydraulic equipment.

The Algerian foundries of Tiaret use many types of sand, which are used to make molds and cores for molding these metal parts. Mostly siliceous sand (original sand) supplemented by binders according to the intended applications and the type of alloy [23] (Figure 4).

Figure 4. Activities of the foundry workshop.

Figure 4 illustrates the actual working situations at the Algerian foundry, and shows some equipment and operations of their production.

This work was conducted at workshops and workplaces at the ALFET foundry. The first findings were poorly lit rooms and overcrowded ground and traffic areas. There was no storage space in all workshops. No workshop had an adequate ventilation and air conditioning. Bad smells and warm atmospheres were present in all the workshops. This motivated this work, the purpose of which was to carry out an occupational risk analysis and assessment in this foundry in order to put in place a more efficient plan that meets the industrial hygiene and safety expectations.

3.2 Statistics of accidents at work recorded at ALFET:

The data collection and the statistics on accidents at work were realized by means of the National Social Insurance Fund (CNAS) and supplemented by visits to workshops in actual working situations. The activity in these workshops consisted summarily of fusion (put in the oven), molding (making molds according to the customer's model

and casting in the molds), demolding (removing the finished product from the molds), finishing (cutting the weight weights, scraping the roughness, filing, and polishing the finished product).

3.3. Application of Decision Matrix (DMRA) Risk Assessment Technique

In the context of the risk matrix, the value of risk is a discrete value corresponding to the consequence categories (Table 1). It is logical that the categories are placed in order along the (ordered) sides of the risk matrix, i.e. the consequence categories should be classified from the least serious to the most serious, and that the probability categories should be classified from the lowest to the highest [24, 25]. The accidents are recorded in the company during the year 2018 are distributed as follow (Table 2):

Table 2. Accidents during the year 2018 classified by gravity.

Source of risk	C1: Insignificant consequences	C2: Significant consequences	C3: Serious accident	C4: Major accident
Risk Machine	9	20	0	0
Risk Human	1	3	0	0
Risk Environment	2	13	0	0
Risk Management	8	12	0	0
Total	**20**	**48**	**0**	**0**

This table shows the accidents at work classified by severity that occurred at the ALFET foundry during 2018. There were 68 accidents distributed as follow: 15 accidents at work for environmental risk including 13 accidents with significant consequences and 20 accidents for risk management including 12 with significant consequences.

3.4. Development of risk matrix:

Before implementing the preventive measures, it is essential to identify the occupational risks incurred by the employees [26, 27]. At present, however, different types of hazards exist, and it is very difficult to establish them as long as the situations are different; the same applies to the prevention or control of the related hazards. However, a general overview of frequently encountered risk situations can be drawn, and then the level of risk can be determined and the priority actions identified. Risks related to Machine (Table 2):

Table 2. Risk Machine matrix.

	Consequence Classes			
Likelihood Classes	4	8	12	16
	3	6	9	12
	2	4	6	8
	1	2	3	4

Risks related to operators (Table 3):

Table 3. Risk Human matrix.

	Consequence classes			
Likelihood classes	4	8	12	16
	3	6	9	12
	2	4	6	8
	1	2	3	4

Risks related to work environment (Table 4):

Table 4. Risk environment matrix.

Likelihood classes	Consequence classes			
	4	8	12	16
	3	6	9	12
	2	4	6	8
	1	2	3	4

Risks related to management (Table 5):

Table 5: Risk management matrix.

Likelihood classes	Consequence classes			
	4	8	12	16
	3	6	9	12
	2	4	6	8
	1	2	3	4

3.5. Results of DMRA

According to the four sources of risk assessed by the Decision Matrix Risk Assessment (DMRA), the following results can be seen with the corresponding analysis. For risks related to machine (Table 6):

Table 6. Likelihood classes and consequence classes of machine risk

Risk Machine	C1: Insignificant consequences	C2: Significant consequences	C3: Serious accident	C4: Major accident
Accidents	**9**	**20**	**0**	**0**
Probability to happen with its consequence	F4: Frequent	F4: Frequent	F1 : Very improbable	F1 : Very improbable
R	**R4**	**R8**	**R3**	**R4**
	Recoverable injuries		Single fatality and several injuries	

According to the statistics, the use of machines led to 29 accidents, classified as 9 non-significant consequences and 20 significant consequences. It was determined that the injuries were recoverable; only one death and several injuries may be presented. Therefore, it appears that the risks associated with machines are classified in the yellow zone (intermediate risks). Actions must therefore be taken to reduce and minimize the risks identified. Where appropriate, the intermediate risk requires actions to be prioritized immediately to reduce this risk to an acceptable level. Risks related to the operators (Table 7):

Table 7. Likelihood classes and consequence classes of human risk.

Risk Human	C1: Insignificant consequences	C2: Significant consequences	C3: Serious accident	C4: Major accident
Accidents	**1**	**3**	**0**	**0**
Probability to happen with its consequence	F1: Very improbable	F2: Improbable	F1 : Very improbable	F1 : Very improbable
R	**R1**	**R4**	**R3**	**R4**
	No personal harm	Single fatality and several injuries		

For the risks related to operators (human), 4 accidents occurred, which were classified as having insignificant consequences and significant consequences. It can be determined that recoverable injuries, one death and several injuries, can be presented. Therefore, it appears that the operator (human) risks are classified in the yellow zone (intermediate risks) and the green zone (acceptable risk). Actions must therefore be taken to reduce the risks identified. Where appropriate, the intermediate risk requires actions to be prioritized to reduce this risk and without neglecting the daily preventive and corrective actions for the acceptable risk. Risks related to work environment (Table 8):

Table 8. Likelihood classes and consequence classes of environment risk.

Risk Environment	C1: Insignificant consequences	C2: Significant consequences	C3: Serious accident	C4: Major accident
Accidents	**2**	**13**	**0**	**0**
Probability to happen with its consequence	F1: Very improbable	F4: Frequent	F1 : Very improbable	F1 : Very improbable
R	**R1**	**R8**	**R3**	**R4**
	No personal harm	Single fatality and several injuries		

For environmental hazards, 15 accidents occurred, which were classified as 2 with insignificant consequences and 13 with significant consequences. It can be determined that recoverable injuries, one death and several injuries, can be presented. As a result, it appears that the environmental risks are classified in the yellow zone (intermediate risks) and the green zone (acceptable risk). Thus actions must therefore be taken to reduce the risks identified. Where appropriate, the intermediate risk requires actions to be prioritized to reduce this risk and without neglecting the daily preventive and corrective actions for the acceptable risk. Risks related to management (Table 9):

Table 9. Likelihood classes and consequence classes of management risk.

Risk Management	C1: Insignificant consequences	C2: Significant consequences	C3: Serious accident	C4: Major accident
Accidents	**8**	**12**	**0**	**0**
Probability to happen with its consequence	F4: Frequent	F4: Frequent	F1 : Very improbable	F1 : Very improbable
R	**R4**	**R8**	**R3**	**R4**
	Recoverable injuries		Single fatality and several injuries	

For management risks (company OSH policy), there were 20 accidents, classified as 8 non-significant consequences and 12 significant consequences. It was determined that recoverable injuries, one death and several injuries, could be presented. Therefore, the following actions must be taken to reduce and minimize the identified risks, where appropriate for the intermediate risk requires actions to be prioritized immediately to reduce that risk to an acceptable level. Following this evaluation, it can be noted that the breakdown is as follows (Table 10):

Table 10. Rate of risk from each source.

Source of risk	Accident number	Percentage
Risk Machine	29	43%
Risk Homme	4	6%
Risk Environment	15	22%
Risk Management	20	29%
Total	**68**	**100%**

This table shows us that the highest risk is the 43% machine risk, and then the 29% management risk, the 22% environmental risk, and finally, the lowest is the 6% human risk. The following figure illustrates the percentage of each source of risk present in the ALFET foundry.

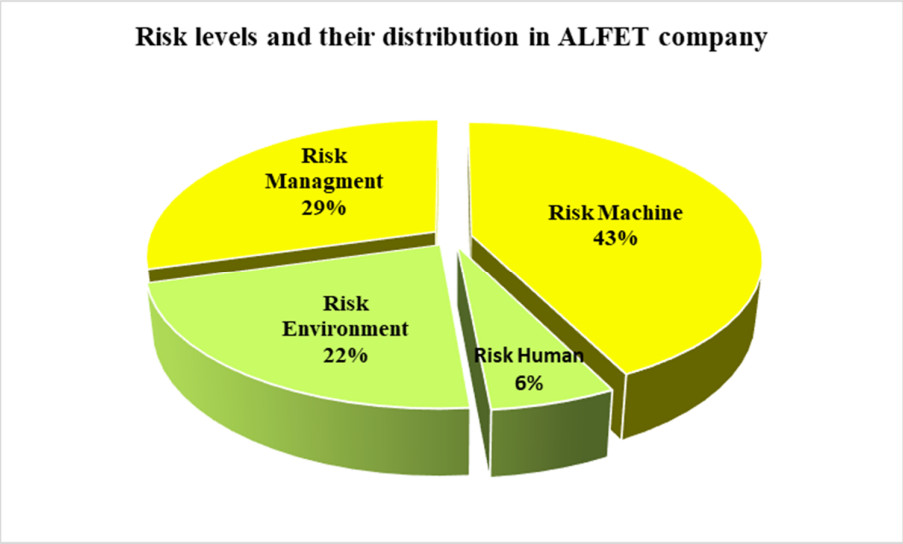


Figure 5. Risk levels and their distribution in ALFET foundry.

3.6. Calculation of overall risk rate

Based on this result, the overall risk rate is determined by the following equation:

$$\text{Overall Risk Rate} = R_{machine} \times R_{Human} \times R_{Environment} \times R_{Management}$$
$$= 0.43 \times 0.06 \times 0.22 \times 0.29$$
$$= 1.3 \times 10^{-3} \text{ mort/an}$$

4. Discussions and recommendations

Generally, to determine the acceptability of the risk, a comparison must be made with the ALARP principle [28], and thus it can be found that **1,3 x 10^{-3}**, and therefore, the risk level is tolerable at the ALFET company. In addition, the four sources of risk are in the green and yellow zones so the overall risk is **Tolerable** (ALARP Region). Thus we arrive through this work to assess the professional environment at the Algerian foundry to establish the necessary preventive measures, ensure the health and safety of the employees and well-being, and the improvement of the working conditions (Figure 3).

Finally, we end this work with the following practical recommendations:

1) For **risk machine**, the health and safety managers must:

- Strictly apply the general principles of prevention;
- Report machinery hazards; all machinery must carry warnings, signs, and warning devices essential for the safety of workers (crash sign, high voltage electrical hazard, etc.);
- Minimize noise and vibration from machinery (80 dB(A) vibration exposure alert threshold for 8 hours of work);
- Take into account the state of technology evolution (managers must be up to date with the technology market of their industrial domain, the latest products, new methods, scientific articles, etc.).

2) For **risk human**, health and safety managers must:

- Enforce the use of personal protective equipment by operators; health and safety managers must be rigorous, stop the operator; and give him warnings);
- Motivate, sensitize, and give appropriate instructions to the workers to ensure their safety and protect their health (increase in wages and a no-accidents bonus);
- Conduct periodic operator training; for example, every 6 months, the health and safety manager must explain to their workers the dangers that exist and raise awareness of how to protect them;
- Medical surveillance: a medical sheet for each operator contains\ last name, first name, age, state of health, nature of workplace, hazards to be exposed.

3) For **risk environment**, health and safety managers must:

- Have an adequate ventilation of workplaces to avoid any alteration of the workers' health;

- Respect hygiene rules; a good floor holding by suction or by a wet process (water jet or water vapor system) is essential to avoid the accumulation of spills and dust under or around machinery.
- Have good lighting in workshops to eliminate the health and minimize accidents. Finally, good lighting is a factor of both physical and moral comforts (the average illumination to be maintained must not be less than 200 lux).
- Identify, remove/substitute the most toxic products.

4) For **risk management**, the health and safety managers must:

- Have a recommendation for the strict application of 5S to improve the working environment Rid (throw that is useless), Stow (each item in its place, Clean (secures the place and makes the work environment within), Maintain order, be rigorous);
- Renovate the equipment and change the used and very old tools and machines (purchase of new materials for handling, collective and individual protection);
- Enforce the existing occupational health and safety regulations, and the Plant Manager must take the necessary steps to:
  - Establishment an appropriate organization and means;
  - Establish work execution plans to eliminate the disorder of the works;

Finally, the employer is required to determine the preventive measures to be implemented (human, organizational, technical) by giving priority to the collective over the individual, while engaging in a process of continuous improvement based on the field work and the feedback, the assessment of risks and the opinions of the employees of actual knowledge acquired in the field.

5. Conclusions

The analysis shows that the Algerian foundry in Tiaret is in a tolerable position from the viewpoint of health and safety at work. Therefore, an action plan is required for continuous improvement in OSH to promote a safe and sustainable development in the workplace. One of the goals of occupational health is to protect and promote the health of workers, to protect the environment, and to promote a safe and sustainable development. Thus the role of occupational hygiene is precisely to prevent and control the risks associated with the occupational activities. As a result, the workplace should be continuously monitored to detect, remove or control hazardous agents and factors before they have negative effects. This work enables the decision-makers to classify the work-related hazards according to their severity and likelihood of occurrence, even manage to draw up an action plan based on the priority actions to be undertaken and thus engage in a process of continuous improvement based on the field work and the feedback. This approach can be generalized for other sectors.

References

[1]. Kharzi, R., Chaib, R. and Akni, A. (2017). Comment priorisez les actions à entreprendre en santé et sécurité au travail, 4eme conférence internationale sur la maintenance et la sécurité industrielle CIMSI2017, Université 20 aout 1955, Skikda 20-21 novembre. 60-65.

[2]. UE Framework directive-89/391/EEC

[3]. ISO 450001 (2018).

[3]. Glen, P.K., Jane, E.Y., Lucie, M. and Ollie, J. (2008) Physical work capacity in older adults: Implications for the aging worker. American journal of industrial medicine. 51 (8): 610–625.

[4]. Pilar, B., Carla, B., Carla, F., Sónia, A. and Álvaro, R. (2018). Healthcare Workers: Occupational Health Promotion and Patient Safety. Journal of Medical Systems. 42 (159).

[5]. Tania,C., Sanjib, K.D., Vasundhara, P. and Suman, M. (2018). Occupational stress, musculoskeletal disorders and other factors affecting the quality of life in Indian construction workers. International Journal of Construction Management. 18 (2): 144-150

[6]. Chaib, R., Verzea, I., Cozminca, I. and Benidir, M. (2015). Preserving and Improving the Safety and Health at Work: Case of Hamma Bouziane Cement Plant (Algeria). Safety Science. 76: 145–150.

[7]. Dul, J. and Neumann, W.P. (2009). Ergonomics contributions to company strategies. Applied Ergonomics. 40 (4): 745–752.

[8]. Jaskiewicz, W. and Tulenko, K. (2012). Increasing community health worker productivity and effectiveness: a review of the influence of the work environment. Human Resources for Health. 10(38).

[9]. Mourad, S.A., Chaib, C., Irina, C, and Verzea, I. (2017). Map risks in the company: highlight at the top priority risks. World Journal of Engineering. 14 (6): 550-555.

[10]. Aib, A., Chaib, R., Verzea, I. and Cozminca, I. (2015). Mapping Of Occupational Hazards At Palma Industrial Park, Constantine, Algeria. Sustainable Development; WIT Transactions on the Built Environment. 168: 1075-1086.

[11]. Chaib, R., Verzea, I., Taleb, M. and Benidir, M. (2014). Promoting in Companies a Successful Culture of

Health and Safety. International Journal of Safety and Security Engineering. 4 (1): 64-76.

[12]. Dia, S.A., Mohamed, A.S., Gueye, M., Ndoye, E.O., Gaye Fall, M.C., Soumah, M.N. and Ndiaye, M. (2017). Occupational risk assessment in the sector of small-scale aluminum smelter in Dakar. Archives des Maladies Professionnelles et de l'Environnement Elsevier.78 (5). 454-459

[13]. Tiago, S.P., Elizabeth de Souza, N., Carlos, S.S. and Marco, A.B. (2012). Occupational exposure profile of Pb, Mn, and Cd in nonferrous Brazilian sanitary alloy foundries. Toxicology and Industrial Health. 30 (8). 701-713.

[14]. Marhavilas, P.K., Koulouriotis, D. and Gemeni, V. (2011). Risk analysis and assessment methodologies in the work sites: On a review, classification and comparative study of the scientific literature of the period 2000–2009.Journal of Loss Prevention in the Process Industries. 24 (5): 477-523.

[15]. Marhavilas, P.K. and Koulouriotis, D.E. (2008). A risk-estimation methodological framework using quantitative assessment techniques and real accidents' data: Application in an aluminum extrusion industry. Journal of Loss Prevention in the Process Industries 21: 596–603.

[16]. Gul, M. and Guneri, A.F. (2016). A fuzzy multi criteria risk assessment based on decision matrix technique: A case study for aluminum industry. Journal of Loss Prevention in the Process Industries. 40: 89-100.

[17]. Domínguez, C.R., Martínez, I.V., Piñón Peña, P.M. and Ochoa, A.R. (2019). Analysis and evaluation of risks in underground mining using the decision matrix risk-assessment (DMRA) technique, in Guanajuato, Mexico. Journal of Sustainable Mining. 18: 52-59.

[18]. Hasse, N., Birgitta, W., Ulrika, W., Katarina, W. and Ragnar, W. (2015). Safety culture and reasons for risk-taking at a large steel-manufacturing company: Investigating the worker perspective. Safety Science. 73: 126-135.

[19]. Fu Gui Xie, X., Qingsong, J. and Tong Wenqing, G.Y. (2020). Accidents analysis and prevention of coal and gas outburst: Understanding human errors in accidents. Process Safety and Environmental Protection. 134: 1-23.

[20]. Kambiz, M., Jun, R., Charles, R. and Jin, W. (2011). Application of a generic bow-tie based risk analysis framework on risk management of sea ports and offshore terminals. Journal of Hazardous Materials. 192 (2): 465-475.

[21]. Hartford, D.N.D. (2009). Legal framework considerations in the development of risk acceptance criteria. Structural Safety, 31 (2): 118-123.

[22]. Georgi, P., Bruce, K.l. and Bruce, H. (2016). RISK ASSESSMENT: A Practical Guide to Assessing Operational Risks, John Wiley & Sons, Inc., Hoboken, New Jersey, 481p.

[23]. Aissat, S. and Kacimi, A. (2011).Caractérisation physico-chimique des sables usés de la fonderie de Tiaret (Algérie), en vue de leur valorisation. Afrique SCIENCE. 07 (3): 97 – 107.

[24]. Duijm, N. J. (2015). Recommendations on the Use and Design of Risk Matrices.Safety Science. 76: 21–31.

[25]. Nikkhah, M., Ghasvareh, M.A. and Farzaneh Bahalgardi, N. (2019). Risk management in urban tunnels using methods of game theory and multi-criteria decision-making. Journal of Mining and Environment (JME). 10(3): 597-611.

[26]. Chaib, R. (2016). Pour un développement durable en santé et sécurité au travail dans les entreprises.Editions Universitaire Européennes, Deutschland, p 184.

[27]. Morejon, O., Wadeson, A., White, M., Zhang, W. and Kaber D. (2019). Ergonomic Risk Assessment of Gas Delivery Operations and Stretching Program Design. In: Goossens R. (eds) Advances in Social and Occupational Ergonomics. AHFE 2018. Advances in Intelligent Systems and Computing, 792. Springer, Cham.

[28]. Knoflacher, H. and Pfaffenbichler, P.C. (2004) A COMPARATIVE RISK ANALYSIS FOR SELECTED AUSTRIAN TUNNELS, International Conference „Tunnel Safety and Ventilation, Graz.

توسعه ایمن و پایدار در یک شرکت بهداشت و سلامت با استفاده از روش ماتریس تصمیم گیری ارزیابی خطر: یک مطالعه موردی

رابه خرزی[1*]، راشد شایب[1]، یون ورزا[2] و احسن آکنی[1]

1- گروه مهندسی حمل و نقل و آزمایشگاه محیط زیست، دانشگاه منتوری کنستانتین، کنستانتین، الجزایر
2- دانشکده منسوجات - چرم و مدیریت صنعتی ، دانشگاه فنی یورگه آساچی، یاشی، رومانی

ارسال2019/12/09 ، پذیرش 2020/02/26

* نویسنده مسئول مکاتبات: kharzi.rabeh@umc.edu.dz

چکیده:

این پژوهش بهبود شیوه‌های فرآیند مدیریت ریسک را در کارخانه ذوب آهن شرکت ALEFT در الجزایر شرح می‌دهد. روش پیشنهادی مبتنی بر تکنیک ماتریس تصمیم گیری ارزیابی ریسک است. این روش امکان ارزیابی ریسک را برای هر منبع خطر (ماشین، انسان، محیط زیست و مدیریت) فراهم می‌آورد، که منجر به تعیین نرخ کلی خطر در طول انجام فعالیت با یک مفهوم جدید می‌شود. همچنین این پژوهش، دیدی جامع در مورد بهداشت و ایمنی شغلی ارائه می‌دهد، و آن را با اصل ALARP برای تعیین میزان قابل قبول ریسک مقایسه می‌کند. هدف اصلی این کار تلقین یک فرهنگ مناسب بر روی اثرات تغییر رفتارها و نگرش‌ها به‌منظور گسترش فرهنگ پیشرفت مداوم و پایدار در شرکت و اطمینان از حفظ جو مناسب در محیط کار است. این هدف برای حمایت و ارتقاء سلامت و ایمنی کارگران و محیط کار به منظور ارتقاء توسعه‌ی پایدار و ایمنی شرکت است. کار ما نشان می‌دهد که محیط کار از نظر بهداشتی و ایمنی در محل کار مناسب است. با این وجود به منظور ارتقاء توسعه پایدار و ایمنی شرکت، یک برنامه عملی بر اساس ارزیابی زمینه و بازخورد آن از طریق اقدامات اولویت‌دار برای بهبود مستمر در OSH توصیه می‌شود. به این منظور محیط کار باید بطور مدام برای یافتن عوامل خطر در سریع‌ترین زمان ممکن قبل از اثرگذاری منفی آنها مورد بررسی قرار گیرد.

کلمات کلیدی: میزان خطر کلی، بهداشت و ایمنی شغلی، محیط زیست، توسعه پایدار، ارزیابی، پیشگیری.