Innovative Methodological Instrument for Quantification of Professional Risk Specific to Complex Systems of Work

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Abstract: This paper presents research on estimating and assessing occupational risks to secure specific activities in the presence of hazards of industrial work systems, and is based on a thorough knowledge of interdisciplinary concepts from various fields related to systems security engineering.

Keywords: Methodology, workplace, risk factor, assessment.

1. INTRODUCTION

The innovative methodological instrument presented in this paper, shows a way to quantify the phenomenon of manifestation of specific hazards of work processes which are generating occupational hazards, with an impact, both at the human component, and at the level of others specific elements of work systems, which significantly reduces the subjectivism which appears inherent in the risk assessment due to the human factor [1].

2. METHODOLOGY

The mechanism of production of an accident at work is based on the following logical elements [2]:

- The specific risk generator at the workplace, and the moment at which is happen.
- A specific gainful activity.
- The trigger that turns a risk into an accident or an occupational disease.
- Specific-response due to human exposure to the risk represented by the victim/victims (person/ persons) which has/have suffered an accident at work or an occupational disease.

2.1. Theoretical and Practical Aspects Regarding the Mechanism for the Production of the Phenomenon of Injury

In any workplace there are 4 groups of risk factors that can cause workplace accidents or occupational diseases, respectively [3-5]:

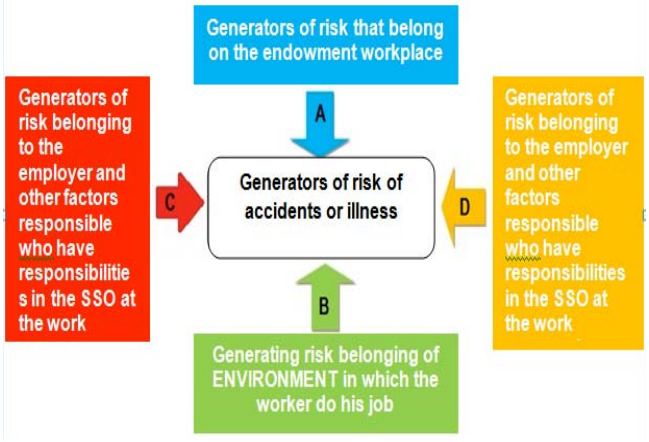

Figure 1: Groups of risk factors that can cause workplace accidents or occupational diseases.

Group A: risks generated of work equipment available and the materials and substances used in this group are:

- A 100 Technical equipment,
- A 200 Tools,
- A 300 Energy sources that put in function the equipments from the workplace or the location form where intervention is done or conjectural location
- A 400 Materials and substances used at work or in connection with the work
- A 500 Other generated risks

These types of risks are caused by the workplace equipment from the based location, but also in other locations in which the worker is occasional or short time.

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Group B: Risks generated at working environment in which the worker is in the work process:

- B 100 Generators related to weather conditions, temperature, light, air pressure, relative humidity
- B 200 Chemical agents
- B 300 Biological agents
- B 400 Animals and dangerous people
- B 500 Meteorological dangerous situations, geological, etc.
- B 600 Dangerous situations from other jobs in the vicinity of the workplace evaluated:

o B601 Noise

o B602 Vibration

o B603 Lucrative activities that are generating risks, jobs carried out in the vicinity of the workplace evaluated or near the workplace where intervention is done at short term or in the vicinity

- B 700 other environmental situations

Group C: Risks arising from employer and other internal and external factors responsible of employer which by law have certain obligations and responsibilities in the OSH area:

- C 100 Risks arising from the employer to the worker framing at the job evaluated

o C101 If it employ workers who are not suitably qualified at the evaluated job

o C102 If it employ workers who do not have proper authorization of their activity that takes place in the workplace evaluated

o C103 If it employ workers who do not have the necessary experience to develop activities in the workplace evaluated

- C 200 Risks arising from people who have responsibilities related to train workers framing the workplace evaluated

o C201 General introductory training

o C202 Training at workplace

o C203 Periodicals training

o C204 Training to return to workplace

- C 300 Risks arising from people who should ensure proper functioning of equipment work which equips workplace evaluated (Maintenance, repair, service, etc)
- C 400 Risks arising from people who provide personal protective equipment (PPE) for workers from the workplace evaluated

o C401 Acquisition of EIP

o C402 EIP Conformity

o C403 If it purchased EIP provides protection to the assessed risks

o C404 If EIP service is correctly calculated

o C405 If you do replace EIP whenever necessary

- C 500 Risks arising from people who should monitor the health of workers

o C501 Employment medical examination

o C502 Periodic medical examination

o C503 Medical examination at the request of the worker

- C 600 risks arising from the people who should make special checks and do not do them at the workplace evaluated
- C 700 risks arising from people who should ensure the provision of OSH in workplaces that provide or staff training
- C 800 risks arising from those who have to administer first aid in the workplace evaluated
- C 900 risks arising from the leaders at the job from the workplace evaluated

o C901 Of whether or not professionally trained

o C902 If the selection is made on the principle of competence

o C903 If they know to formulate, transmit the work tasks and control how their achievement

o C904 If they know how to properly manage the situations from the workplace evaluated

Group D: risks generated by employee:

- D 100 If he knows hierarchical structure (direct bosses and bosses directly)
- D 200 if he knows the significance of the existing signaling at the workplace, signs and signals
- D 300 if he knows how to use, storage maintenance and replacement of EIP
- D 400 If he knows how to redress the noncompliance that may occur in the workplace
- D 500 if there are working procedures handy of the worker and if he knows them
- D 600 if workers that are framing the workplace evaluated have physical qualities, mental, moral, intellectual, professional proper for the workplace evaluated
- D 700 if workers that are framing the workplace evaluated had misconduct, occupational diseases, workplace accidents or incidents
- D 800 other risks arising from executing the work process

The items listed above are potential risk generating.

3. RESULTS AND DISCUSSION

The overall risk level (Nr) on workplace is calculated as a weighted average on established risk levels and the risk factors identified [6-8].

For the result to reflect reality as accurately as possible, using as a weighting element rank risk factor, which is equal to the risk.

In this way, the factor with the highest level of risk will also rank the highest, eliminating, the possibility that the effect of clearing between the extremes that it involves any statistical average, to mask the presence of the factor with the highest level of risk.

Formula for calculating the overall risk level is next:

$$N_r = \frac{\sum_{z=1}^{n} r_z \cdot R_z}{\sum_{z=1}^{n} r_z} \quad (1)$$

where:

N_r is the overall risk level at workplace;

r_z the rank of the risk factor „z";

R_z the risk level for the risk factors „z";

Starting from the 5 groups of risk factors listed in the first part of this section, we define the domain of definition of each group of risk factors which is the argument risk function R, as follows:

$$R = f(A_{i00}, B_{j0x}, C_{k0y}, D_{w00}) \quad (2)$$

where:

1. A_{i00}=Group A the risks from work equipment at their disposal and the materials and substances used, i=1÷5, of where results the following components of the group: A_{100}, A_{200}, A_{300}, A_{400} and A_{500};
2. B_{j0x}=Group B the risks arising from the work environment in which the worker is in the work process, with j=1÷7 and x=0, of where results the following components of the group: B_{100}, B_{200}, B_{300}, B_{400}, B_{500}, B_{600} and B_{700}. for j=6 and x=1÷3 of where results the following components of the subgroup: B_{601}, B_{602} and B_{603};
3. C_{k0y}=Group C the risks arising from employer and other internal and external factors responsible employer by law have certain obligations and responsibilities OSH, cu k=1÷9 and y=0, from where results the following components of the group: C_{100}, C_{200}, C_{300}, C_{400}, C_{500}, C_{600}, C_{700}, C_{800} and C_{900}. for k=2 and y=1÷4 results the following components of the subgroup: C_{201}, C_{202}, C_{203} and C_{204}; for k=4 and y=1÷5 results the following components of the subgroup: C_{401}, C_{402}, C_{403}, C_{404} and C_{405}; for k=5 and y=1÷3 results the following components of the subgroup: C_{501}, C_{502} and C_{503}; for k=9 and y=1÷4 results the following components of the subgroup: C_{901}, C_{902}, C_{903} and C_{904};
4. D_{w00}=Group D the risks arising from employee, with w=1÷8, where results the following components of the group: D_{100}, D_{200}, D_{300}, D_{400}, D_{500}, D_{600}, D_{700} and D_{800}.

3.1. Dimensioning the Rank Risk Factor Z

The amount of risk related to the ranking factor z, we took into consideration the quantitative ratio that exists at group and subgroup, making the result of

weight a scaled value representing the momentary value of the range of values z according to the rank of the risk factor, namely [9-12]:

5. Group A the risks from work equipment at their disposal and materials and substances used (A_{i00}), we have: $r_{Ai00}=r_z$ where i=1÷5;

6. For Group B the risks arising from the work environment in which the worker is at work (B_{j0x}), we have: $r_{Bj00}=r_z$, where j=1÷5 and j=7 and x=0; for j=6 and x=1÷3 we have $r_{B60x}=0,33*r_z$;

Taking into account the issues mentioned above, equation (1) becomes:

$$N_r=\frac{\sum_{z=1}^{n} r_z \cdot f_z(A_{i00},B_{j0x})}{\sum_{z=1}^{n} r_z} \quad (3)$$

where:

i=1÷5 and j=1÷7, and z is the number of risk factors identified

The general picture for determining rank risk factor, z, for its use in the calculation formula to determine the overall risk is as follows (Table **1**):

In most evaluation methods, risk factors are analyzed only the location of the base of the workstation and for the other temporary locations or incidental damages are separate evaluations.

If you agree that a type of job that is to be evaluated, sets have to be considered as risk factors to each location reaches the work worker assessed in this case will be seen for each location part of the risk factors that may affect worker during as it is in this location and all of them together to compose a set of risk factors for location analysis.

In this way the evaluator is obliged to identify the normal risk factors and several locations than the location of the base and the temporary location.

In this case the relation (3) became:

$$N_r=\frac{\sum_{z=1}^{n} r^*_z \cdot f_z(A_{i00},B_{j0x})}{\sum_{z=1}^{n} r_z} \quad (4)$$

where

$r^*_z=e(\%)/100*r_z$ and e(%) represents temporary exposure to the action of risk factors present in temporary location, expressed as a percentage of normal working time (correction factor risk rank based

Table 1:

Group of risks	The multiplication factor to rank risk factor, associated at risk group		Risk subgroup	Multiplication factor to rank risk factor, associated to subgroup risks	Analytical relationship rankr_z
A_{i00} (risks generated by the work equipment at their disposal and the materials and substances used)	A_{100}	1			$r_{A100}=1,0*r_z$
	A_{200}	1			$r_{A200}=1,0*r_z$
	A_{300}	1			$r_{A300}=1,0*r_z$
	A_{400}	1			$r_{A400}=1,0*r_z$
	A_{500}	1			$r_{A500}=1,0*r_z$
B_{j0x} (risks generated by the working environment in which the worker is in the work process)	B_{100}	1			$r_{B100}=1,0*r_z$
	B_{200}	1			$r_{B200}=1,0*r_z$
	B_{300}	1			$r_{B300}=1,0*r_z$
	B_{400}	1			$r_{B400}=1,0*r_z$
	B_{500}	1			$r_{B500}=1,0*r_z$
	B_{600}		B_{601}	0,33	$r_{B601}=0,33*r_z$
			B_{602}	0,33	$r_{B602}=0,33*r_z$
			B_{603}	0,33	$r_{B603}=0,33*r_z$
	B_{700}	1			$r_{B700}=1,0*r_z$

Table 2:

Group of risks	The multiplication factor to rank risk factor, associated at risk group		Risk subgroup	Multiplication factor to rank risk factor, associated to subgroup risks		Analytical relationship rank $[e(\%)/100]\cdot r^*_z = [e(\%)/100]\cdot 1{,}00\cdot r_z$
	The value of the multiplication factor	e(%)/100		The value of the multiplication factor	e(%)/100	
A_{i00} (risks generated by the work equipment at their disposal and the materials and substances used)	A_{100}	1,00				$r_{A100}=1{,}00\cdot 1{,}00\cdot r_z$
	A_{200}	1,00				$r_{A200}=1{,}00\cdot 1{,}00\cdot r_z$
	A_{300}	1,00				$r_{A300}=1{,}00\cdot 1{,}00\cdot r_z$
	A_{400}	1,00				$r_{A400}=1{,}00\cdot 1{,}00\cdot r_z$
	A_{500}	1,00				$r_{A500}=1{,}00\cdot 1{,}00\cdot r_z$
B_{j0x} (risks generated by the working environment in which the worker is in the work process)	B_{100}	1,00				$r_{B100}=1{,}00\cdot 1{,}00\cdot r_z$
	B_{200}	1,00				$r_{B200}=1{,}00\cdot 1{,}00\cdot r_z$
	B_{300}	1,00				$r_{B300}=1{,}00\cdot 1{,}00\cdot r_z$
	B_{400}	1,00				$r_{B400}=1{,}00\cdot 1{,}00\cdot r_z$
	B_{500}	1,00				$r_{B500}=1{,}00\cdot 1{,}00\cdot r_z$
	B_{600}		B_{601}	0,33	1,00	$r_{B601}=0{,}33\cdot 1{,}00\cdot rz$
			B_{602}	0,33	1,00	$r_{B602}=0{,}33\cdot 1{,}00\cdot rz$
			B_{603}	0,33	1,00	$r_{B603}=0{,}33\cdot 1{,}00\cdot rz$
	B_{700}	1,00				$r_{B700}=1{,}00\cdot 1{,}00\cdot rz$

Table 3:

	1h	2h	3h	4h	5h	6h	7h	8h
e(%)/ 100	0,125	0,25	0,375	0,5	0,625	0,75	0,875	1,0

on temporary or total exposure to the action of risk factors)[1]; i=1÷5 and j=1÷7 where z represents the number of risk factors identified.

Note[1]:

In case of total exposure (ie, throughout the normal working time) we have e(%)/100=100/100=1,00 and $r^*_z=1{,}00\cdot r_z= r_z$.

In the event of total exposure, we obtain the results in Table **2**:

In the case of normal working hours of 8 h, the correction coefficient values to rank risk factor is based on the exposure (e (%)/100) are shown in Table **3** and the values of r^* in Table **4**:

3.2. Calculation of Coefficients Specific Risk Categories C and D

Coefficients for risks in the groups C and D, is calculated depending on how many major nonconformities are unresolved, based on multi-criteria analysis.

For the risks in Group C

Case where all 10 criteria are equally weighted (equally important)α_i=0,1, i=1÷10

For risks from the group D

Table 4:

Group of risks		Multiplication factor to rank risk factor, the risks associated group depending on the hourly exposure		Subgroup of risks	Multiplication factor to the rank risk factor, of risks associated to the subgroup		Rank value based on exposure $r^*_z=e(\%)/100*r_z$
		The value of the multiplication factor e	$e^{xh}(\%)/100$		The value of the multiplication factor	$e^{xh}(\%)/100$	
A_{i00} (risks generated by the work equipment at their disposal and the materials and substances used)	A_{100} A_{200} A_{300} A_{400} A_{500}	1,00	$0,125^{1h}$				0,1250
		1,00	$0,250^{2h}$				0,2500
		1,00	$0,375^{3h}$				0,3750
		1,00	$0,500^{4h}$				0,5000
		1,00	$0,625^{5h}$				0,6250
		1,00	$0,750^{6h}$				0,7500
		1,00	$0,875^{7h}$				0,8750
		1,00	$1,000^{8h}$				1,0000
B_{j0x} (risks generated by the working environment in which the worker is in the work process)	B_{100} B_{200} B_{300} B_{400} B_{500} B_{700}	1,00	$0,125^{1h}$				0,1250
		1,00	$0,250^{2h}$				0,2500
		1,00	$0,375^{3h}$				0,3750
		1,00	$0,500^{4h}$				0,5000
		1,00	$0,625^{5h}$				0,6250
		1,00	$0,750^{6h}$				0,7500
		1,00	$0,875^{7h}$				0,8750
		1,00	$1,000^{8h}$				1,0000
	B_{600}			B_{601} B_{602} B_{603}	0,33	$0,125^{1h}$	0,0413
						$0,250^{2h}$	0,0825
						$0,375^{3h}$	0,1238
						$0,500^{4h}$	0,1650
						$0,625^{5h}$	0,2063
						$0,750^{6h}$	0,2475
						$0,875^{7h}$	0,2888
						$1,000^{h}$	0,3300
C_{k0y} (Risks generated by the employer and other internal and external factors responsible of employer which by law have certain obligations and responsibilities OSH)	C_{100} C_{300} C_{500} C_{600} C_{700} C_{800}	1,00	$0,125^{1h}$				0,1250
		1,00	$0,250^{2h}$				0,2500
		1,00	$0,375^{3h}$				0,3750
		1,00	$0,500^{4h}$				0,5000
		1,00	$0,625^{5h}$				0,6250
		1,00	$0,750^{6h}$				0,7500
		1,00	$0,875^{7h}$				0,8750
		1,00	$1,000^{8h}$				1,0000
	C_{200}			C_{201} C_{202} C_{203} C_{204}	0,25	$0,125^{1h}$	0,0313
						$0,250^{2h}$	0,0625
						$0,375^{3h}$	0,0938
						$0,500^{4h}$	0,1250
						$0,625^{5h}$	0,1563
						$0,750^{6h}$	0,1875
						$0,875^{7h}$	0,2188
						$1,000^{h}$	0,2500

(Table 4). Continued.

Group of risks		Multiplication factor to rank risk factor, the risks associated group depending on the hourly exposure		Subgroup of risks	Multiplication factor to the rank risk factor, of risks associated to the subgroup		Rank value based on exposure $r^*_z=e(\%)/100*r_z$
		The value of the multiplication factor e	$e^{xh}(\%)/100$		The value of the multiplication factor	$e^{xh}(\%)/100$	
	C_{400}			C_{401} C_{402} C_{403} C_{404} C_{405}	0,20	$0,125^{1h}$	0,0250
						$0,250^{2h}$	0,0500
						$0,375^{3h}$	0,0750
						$0,500^{4h}$	0,1000
						$0,625^{5h}$	0,1250
						$0,750^{6h}$	0,1500
						$0,875^{7h}$	0,1750
						$1,000^{h}$	0,2000
	C_{900}			C_{901} C_{902} C_{903} C_{904}	0,25	$0,125^{1h}$	0,0313
						$0,250^{2h}$	0,0625
						$0,375^{3h}$	0,0938
						$0,500^{4h}$	0,1250
						$0,625^{5h}$	0,1563
						$0,750^{6h}$	0,1875
						$0,875^{7h}$	0,2188
						$1,000^{h}$	0,2500
D_{w00} (risks generated by employee)	D_{100} D_{200} D_{300} D_{400} D_{500} D_{600} D_{700} D_{800}	1,00	$0,125^{1h}$				0,1250
		1,00	$0,250^{2h}$				0,2500
		1,00	$0,375^{3h}$				0,3750
		1,00	$0,500^{4h}$				0,5000
		1,00	$0,625^{5h}$				0,6250
		1,00	$0,750^{6h}$				0,7500
		1,00	$0,875^{7h}$				0,8750
		1,00	$1,000^{8h}$				1,0000

Case where all 10 criteria are equally weighted (equally important) $\alpha_i=0,1$, $i=1\div10$

$G_{affecting}$	0,0	0,25	0,4	0,55	0,70	0,85	1,00
N_R	1	2	3	4	5	6	7

4. CONCLUSION

The main aim of occupational risk assessment is to prevent and combat the causes that can cause accidents and / or occupational diseases.

For estimation and risk assessment was developed innovative methodological tool for quantifying the risk parameters for the diagnosis and prognosis "accidentogen" plausible phenomenon that can manifest in the work system.The results of the risk assessment provides data and information relevant to security status and health specific to the activity, to improve and more dynamic process underlying the policy of preventing and combating the causes that can cause accidents and / or occupational diseases.

Following this method, the same type of job evaluated at the same time for the same working point, two evaluators, independently of one another, eventually obtain substantially the same results. This aspect shows that the method is more accurate than many of the methods used worldwide for highly complex risk assessment where the binomial human machine is seen in a structural connections and dependent on the environment in which the binomial is.

However the method is very flexible, allowing them to adapt to any system of work and any organizational structure, where People -machine binomial is to be analyzed.

Criteria C_i	**Description of criterion**				**Weighting value criterion C_i, α_i**	**The degree of fulfillment of the criteria C_i, $G_i=\exp[(-\alpha_i)(1-x_{med})]$**
C_1	Is approved, evaluation plan	The compliance of the indicators		The variable of assessment, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	Is approved	x	-	1,0		
	It has evaluation performed by competent person	x	-			
	It has conformity assessment with reality field	x	-			
	It has prevention and protection plan	x	-			
C_2	It has hazardous substances, e.g. ISCIR	Compliance indicators		Variable appreciationx_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	It has hazardous substances	x	-	1,0		
	It is a record of their	x	-			
	Hazardous substances with controlled regime (traceability)	x	-			
	Have average ex	x	-			
	Are zoning	x	-			
	Are established measures for environments Ex existing	x	-			
C_3	It has responsible OSH	Compliance indicators		Variable appreciationx_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	He called the person (created structure)	x	-	1,0		
	It has course	x	-			
	It has called the leaders of job	x	-			
	Leaders made training course	x	-			
C_4	It has documentation OSH	Compliance of indicators		Variable of appreciationx_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	It has documents for employment training (iig + ilm + ip)	x	-	1,0		
	It has its own instructions	x	-			
	It has themed	x	-			
	It has individual sheets	x	-			
	It has check tests	x	-			

C_5	Equipment for work	Compliance of indicators		Variable of appreciation$_{xmed}$	0,1	1,0
		Yes	No			
--- Evaluation indicators	They have accordance CS	x	-	1,0		
	They have chart verification	x	-			
	There is a person qualified to make intervention / service	x	-			
	There are acts which showing that equipment have been checked and are in their period of validity	x	-			
	There was damage to the equipment or incidents	x	-			
C_6	It has signal and display	Compliance of indicators		Variable of appreciationxmed	0,1	1,0
		Yes	No			
Evaluation indicators	Signal is calculated after calculation base	x	-	1,0		
	It is a signaling *scheme* at the work point	x	-			
	Signal is displayed	x	-			
	Signaling is consistent with the existing risks	x	-			
C_7	The protective equipment is alright	Compliance of indicators		Variable of appreciationxmed	0,1	1,0
		Yes	No			
Evaluation indicators	EIP are certified	x	-	1,0		
	EIP are period of validity / service	x	-			
	EIP are functional..	x	-			
	EIP is calculated according to the risks	x	-			
	EIP is distributed to all employees and is a record of their	x	-			
C_8	Occupy the post	Compliance of indicators		Variable of appreciation xmed	0,1	1,0
		Yes	No			
Evaluation indicators	It is a procedure of occupation the job	x	-	1,0		
	Are employed on contract basis	x	-			
	Positions are occupied by competent staff / supporting documents	x	-			
	Job description	x	-			

C_9	Training of employees	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Da	Nu			
Evaluation indicators	the training IG is made	x	-	1,0		
	The testing is made	x	-			
	Is made the ILM instruction	x	-			
	It gives practical test	x	-			
	Training is recorded in sheets	x	-			
C_{10}	Health monitoring and first aid	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Da	Nu			
Evaluation indicators	It is contract with the occupational medicine physician	x	-	1,0		
	There are sheets of skills for all staff and are valid	x	-			
	First aid kit is calculated and distributed correctly	x	-			
	It is competent personal for first aid	x	-			
	Personal hygiene measures are established and collective and are displayed	x	-			
$Gg_{lobal}=\Sigma\alpha_i G_i$		1,00				
$G_{affecting}=1-G_{global}$		0,00				

Criteria D_i	**Name of the criteria**				**Weighting value of the criteria D_i, α_i**	**The degree of fulfill of the criterion D_i, $G_i=\exp[(-\alpha_i)(1-x_{med})]$**
D_1	Heads directly	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	Know who are the hierarchical superiors	x	-	1,0		
	Know where and how to contact	x	-			
D_2	Accidents	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	There were work accidents	x	-	1,0		
	Were occupational diseases	x	-			
D_3	Training	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			

Evaluation indicators	It has sheet	x	-	1,0		
	It has signature on the form everywhere (at IIG, ilm, ip ,)	x	-			
	It has employment test	x	-	1,0		
	It has annual test	x	-			
D_4	Equipments from endowment	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	Respect work instructions	x	-	1,0		
	Know the specific procedures of the workplace	x	-			
	Equipment are maintained	x	-			
	Temperature, humidity, air flow, noise, etc	x	-			
D_5	Echipament de protectie	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	Wear the protective equipment	x	-	1,0		
	He knows what risks are at workplace	x	-			
	The equipment is in good condition	x	-			
D_6	Hazardous substances, ex environments etc	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	Have dangerous substance	x	-	1,0		
	Know the procedure for working with them (how to keep working with these substances)	x	-			
	Apply the procedure	x	-			
	Other cases are treated similarly	x	-			
D_7	OSH signaling	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	Know the significance of the signaling, at workplace	x	-	1,0		
	know where to displays OSH signal at the workplace	x	-			
D_8	PSI	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	equipped with means of PSI	x	-	1,0		
	knows how to use them	x	-			

D_9	First aid	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	knows where health bag is	x	-	1,0		
	knows who is appointed to give first aid	x	-			
	He knows who has to announce if an accident occurs or if it was injured	x	-			
D_{10}	Surveillance of the health condition	Compliance of indicators		Variable of appreciation, x_{med}	0,1	1,0
		Yes	No			
Evaluation indicators	Has medical conditions	x	-	1,0		
	Behavior workplace showing symptoms of abnormality (stressed, bored, restless, sweating profusely)	x	-			
	Know individual and collective hygienic measures	x	-			
	It is cleanliness the workplace	x	-			
	Equipment on it is clean	x	-			
$Gg_{lobal}=\Sigma\alpha_i G_i$		1,00				
$G_{affecting}=1-G_{global}$		0,00				

For the types of jobs which do not have the method groups and specific risk subgroups, the method allows in principle structural development adapted to the new areas, provided that these newly defined groups and subgroups, must be specific and as detailed as possible.

For the risks identified and then evaluated in these new areas, are applicable weighting criteria that exist in method or may be established specific criteria for weighting which when introduced into the method, eliminate as far as possible the error in the assessment caused by the subjective factor specific to each evaluator that is applying this method.

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REFERENCES

[1] Dragos Vasilescu Non-conventional methods for analysis and evaluation of occupational risks, INSEMEX Publishing House. Petroşani ISBN 978-973-88590-0-5, 2008.

[2] Dragos Vasilescu Probabilistic calculation methods used to diagnose and prognose industrial risk, INSEMEX Publishing House 2008. Petroşani ISBN 978-973-88753-2-6, 2008.

[3] Desroches A. Concepts et methodes probabilistes de base de la securite. Lavoisier-TEC&DOC 1995 Paris.

[4] Murè, Demichela, Piccinini. Assessment of the risk of occupational accidents using a "fuzzy" approach, Cognition, Technology and Work 2006; 8: 103-112. http://dx.doi.org/10.1007/s10111-005-0025-5

[5] Marhavilas, Koulouriotis. 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 2008; 21: 596-603. http://dx.doi.org/10.1016/j.jlp.2008.04.009

[6] Papadopoulos, Georgiadou, Papazoglou. Occupational and public health and safety in a changing work environment. An integrated approach for risk assessment and prevention Safety science 2010, 48, 943-949. http://dx.doi.org/10.1016/j.ssci.2009.11.002

[7] Conte, Rubio, Garcia. Occupational accidents model based on risk-injury affinity groups. Safety science 2011; 49: 306-314. http://dx.doi.org/10.1016/j.ssci.2010.09.005

[8] Martini, Fantini, D'ovidio. Risk assessment of aggression toward emergency health care workers. Occupational medicine (Oxford) 2012; 62: 223-225.

[9] Lee, Kim, Park. Construction Risk Assessment Using Site Influence Factors. Journal of computing in civil engineering 2012; 26: 319-330. http://dx.doi.org/10.1061/(ASCE)CP.1943-5487.0000146

[10] Von Misses R. The Mathematical Theory of Prob and Statistics. Academic Press New York 1964.

[11] Reichenbach H. Wahrscheinlickheitslehre. Leiden 1935.

[12] Kolmogorov A. The Foundations of the Calculus of Probability. New York 1950.

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