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RISK MITIGATION APPROACH FOR OCCUPATIONAL HEALTH AND SAFETY AND EMERGENCY SITUATIONS MANAGEMENT

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Abstract: *The paper aims to re-design the documented training system in accordance with the employees' evaluations; a case study within Romania's public institutions is proposed. In line with the digital transformation component in institutions, the opportunity for developing a digital risk assessment strategy that reduces medical costs, supports the prevention of working injuries and employees' effectiveness increase, has been identified. Starting with the risk identification, then assessing the potential risks' impact and the probability of occurrence, a digital solution has been developed for employees' training in line with emergency situations and occupational safety and health regulations. Data centralization and tracking presents multiple benefits; the solution has the potential of transfer in other professional contexts.*
Keywords: *risk assessment, data tracking, digital transformation*

1. INTRODUCTION

Occupational safety and health (OSH) management represents an important component of the integrated management system of any organization [1]. Safety culture [2] is an abstract concept, with no direct ways to adjust, but mandatory to set-up for understanding and acting for prevention.

In dealing with occupational accidents, the magnitude of the issue can be estimated in different ways, depending on one's need to estimate how significant the problem was or to estimate the potential evolution in the future. The size of the issue, as well as its types, differ from country to country, from industry to industry and from workplace to workplace [3-5]. In addition, taking into consideration the objectives of the National Recovery and Resilience Plan, mainly the digital transformation component in conjunction with the low degree of digitalization of public institutions in Romania, and the difficult management of physical documents, too, the need to implement a risk assessment strategy with a digital component is obvious. The implementation of a digital strategy would bring with it a number of advantages, such as: reducing the costs related to medical leave, preventing the work accidents [4], preventing the decrease in employees' productivity [5, 6], reducing the consumption of paper needed for printing various documents related to emergency situations (ES) and OSH or reducing the space required for storing and archiving documents and facilitating quick access to them [7, 8]. The pandemic period has boosted digital transformation in all types of organizations, together with a significant shift in the human resources policies in organizations as well as OSH strategies [9].

Risk assessment represents an important concern for every organization. This concept consists of an essential component of the safety and health risk assessor's activity in collaboration with the occupational medicine specialist, because based on the identification of

risks and their assessment, a series of measures can be developed later preventive [10].

Numerous methods for professional risk assessment were proposed and developed. In our case study, Romanian public institutions, the Guidelines developed by the National Research and Development Institute for Labor Protection has been more frequently used, however these are not exhaustive and practically the organization's needs are broadly considered.

2. RISK ASSESSMENT STRATEGY

To develop a risk assessment strategy [11] the organization must detect all the sources that can be classified as risk leading factors, create corrective measures while defining each risk factor severity and find a way to collect and track them in an efficient manner. Identification is achievable using predefined checklists. Then, risk severity and risk frequency are assessed based on risks size criteria and consequently the greatest concentration is defined. Irrespective of method, the OSH risk assessment strategy requires going through the following phases:

a) Determination of the system that will be analyzed;
b) The risk factors detection within the system;
c) The evaluation of the occupational injury risks as well as illness risks;
d) Risk ranking and prevention priority establishment;
e) Proposal for preventive measures for each factor.

Next, a series of tools has been determined as being essential in the process of security assessment process:

The risk factor detection form includes, in a condensed and easy to identify format, the most relevant illnesses and vocational accidents. Information gathered and classified based on the source that generates it within the professional system such as executive, workloads, manufacturing techniques or office habitat.

The consequence sheet represents a list of would-be effects of each risk factor that helps in the process of consequence's severity rating. This instrument contains the classification of the multitude of wounds and damage the human body may encounter. It can also identify the consequences while taking into consideration the body's structural morpho-functionality and the evolution from low seriousness (light wounds or minor effects) to high seriousness generic consequence, i.e. death.

The potential consequences of risk factors occurrence on the operators' body are organized in *the severity and probability rating scale*, a grid for grouping into classes the risks' consequences occurrence.

The risk evaluation grid existing in the analyzed system considers the frequency gravity couple of occurrences.

The scale of occupational safety/risk levels is a tool used to assess the predicted risk level, based on the risk assessment grid, respectively the security level.

The job evaluation sheet represents the summary of all the identification and evaluation operations of the risks of professional harm, illness or injury. This form includes:

- Data regarding the workplace (units, workshops);
- Identifying the evaluator's information: name, surname and position;
- Working structure's general elements;
- Assign a name for each risk factor discovered;
- Describing the risk factor's way of occurrence: specifications, explanation and practical attributes;
- Risk factors' actions maximum planned for consequences;
- The class of gravity and predicted possibility;
- The amount of risk.

The list of proposed measures is the form that summarizes the mandatory preventive actions needed to be applied. These actions resulted after evaluating the workplace's security.

The process is iterative; usually once per year, as part of the OSH management system implementation and maintenance, the risk assessment is proceeded. In case of events occurrence, risk assessment is mandatory to be revised.

A case study has been implemented in one structure from a public institution of the central administration, which oversees the management

of emergency situations and employees' professional safety. A period of one year was considered to analyze and track tasks of training, evaluating, recording, assigning and storing documents.

Several types of employee training are required: general introductory training, on-the-job training, periodic training, additional training or collective training, the purpose of which is to inform the trained person about the activities that the organization carries out as well as preventive measures and existing protections at the level of the organization. To carry out one of these types of training, the organization should delegate a person responsible for the training.

The activity consists in preparing various OSH and ES documents, operating digital registers, employees training, correct placement of fire extinguishers, the preparation of the evacuation plan and internal checks within the health and safety at work field, fire extinguishing and prevention, environmental protection and emergency situations [12, 13]. The severity table contains the risk factors [14] as well as their specific impact and probability. For the current strategy a total of ten risk factors were considered [15]. It is also known that working with large amounts of documents within a low optimized workspace brings with it the possibility to sustain injuries over the body [16-18].

3. RISK FACTORS SEVERITY

As a first step of the risk identification process, the history of accidents and their occurrence patterns was studied over a period of one year. The results indicated that the most types of accidents were related to office work activities [19, 20], so based on the information collected, a total of 10 risk factors were established.

Each risk has its own impact and probability measured on a scale from 1 to 10. The final score of each individual risk is determined by multiplying the impact rating with its' corresponding probability rating.

As seen in Table 1 the color code shows the severity of each risk factor, as the risk assessment matrix further explains.

To fully minimize the risk factors, impact and probability a series of corrective measures will be developed for each risk factor.

Table 1

Risk factors severity table.

No.	Risk factor	Impact	Probability	Final score
1	Free fall of incorrectly positioned materials	5	3	15
2	Electromagnetic radiation emitted by telecommunication operators - antennas	6	4	24
3	Natural calamities (earthquake, frost, storm, blizzard, lightning, heat wave)	7	1	7
4	Equipment operation in insecure before electrical circumstances and not properly securing the electrical grounding	7	2	14
5	Incorrect use of tools, measurement devices while carrying out inspections at the electrical installations, braces or sharp objects	4	4	16
6	Using unverified measuring devices and relying on indications unauthorized in the norms	6	3	18
7	Interventions on electrical equipment (change of lighting fixtures) without disconnecting from the power supply	7	3	7
8	Voltage coupling before verifying the intervention's completion or before receiving a notification regarding the operation's completion	6	3	18
9	Performing unauthorized operations (on his own behalf) without the required qualification	5	4	20

10	Walking or standing within the vicinity of electrical installations, out of working hours	5	3	15

4. CORRECTIVE MEASURES

The purpose of the corrective measures is to help minimize each risk factor's impact and probability, in the end supporting the employee to carry out the activity in a safety manner. The identification, analysis and assessment of the risks presented above were carried out using the risk assessment matrix. It was designed in accordance with the ISO 31010 standard [21] and aims to ensure both consistency and transparency in the risk assessment process.

Using the risk assessment matrix, the organization has an extensive, documented and prioritized analysis for each particular risk. Within the matrix, the possibility of it happening is divided into five categories, as shown in Table 4. In addition, inside the matrix, the impact of risks is divided into three categories, as shown in Table 5.

Finally, the risk levels of tolerance are defined by the risk amount that an entity is ready to tolerate or the percentage that's prepared to make itself vulnerable within situations where taking a risk can mean an opportunity or a threat.

Table 2

Corrective measures.

Number	Measure	Impact	Probability	Final score
1	Check the storage process	3	2	6
2	Periodic measurement of the electromagnetic radiation level	3	2	6
3	Checking the knowledge of the staff regarding the actions that should be carried out in case of calamity	4	1	4
4	Total and periodic checking of electrical equipment if they meet all Electrical Safety conditions	4	1	4
5	Periodic verification of the knowledge of the staff, in relation to the usage of tools, measurement devices while carrying out inspections at the electrical installations, braces or sharp objects	2	2	4
6	The adoption of an automated process for notifying the administrative department about the approach of the technical verification interval	3	2	6
7	Appointment of qualified personnel for de-energizing electrical equipment; Verification of the validity of the qualification of the designated personnel	3	1	3
8	Designation of qualified personnel for connection to voltage; Verification of the validity of the qualification of the appointed personnel	3	1	3
9	Implementing a system for verification and validation of the needed qualifications	4	2	8
10	Daily checks with video cameras regarding compliance with the indications given by the markings	3	2	6

Table 3

Risk assessment matrix.

Probability \ Impact	Minor	Major	Catas-trophic
Rare	1 … 2	3 … 4	5
Low	2 … 4	6 … 8	10
Medium	3 … 6	9 … 12	15
High	4 … 8	12 … 16	20
Very high	15 … 20	15 … 20	25

Table 4

Risk probability levels.

Probability		Description
1	Rare	The chances of occurrence are very low over three – five years; nearly no chances of happening
2	Low	The chances of occurrence are low over three – five years; few chances to happen
3	Medium	The chances of occurrence over one - three years are medium; few times to happen in the last three years

Probability		Description
4	High	The chances of occurrence over less than one year are high; few times to happen in the last three years; few times (max. 3) in the last year
5	Very high	The chances of occurrence over less than one year are very high; more times to happened (more than 4) in the last year

Table 5

Risk impact levels.

Impact level	Description
Minor	Low impact on objective/activities achievement Very low financial impact
Major	Major impact on objective/activities achievement Major financial impact
Catastrophic	Significant impact on objective/activities achievement Significant financial impact

Table 6

Risk tolerance table.

Tolerance level		Description
1 – 2	Tolerable	No control measures needed
3 – 4	High tolerance	Control measures at medium level and on long term (3-5 years)
5 -12	Low tolerance	Control measures on short-term, less than one year action plan
15 - 25	Intolerable	Emergency action plan and immediate control measures

5. DATA CENTRALIZATION AND TRACKING

The data collected following the training of each employee will be centralized and tracked using an application [22]. Numerous organizations tend to outsource software development services but considering the existence of an IT department within the (public) organization, the application will the developed [23] in house. This decision will help save the cost of design and development of such a solution [15]. More than that, an internal approach is expected to be better perceived by the employees as the internal culture may be more effectively considered. The internal developer may be more acknowledged with the organization particularities, limitations, and constraints, so the communication to implement the solution should be improved.

This digital solution will be responsible for the electronic management of training at the workplace of each employee, compliance with the methodology of using the equipment during professional activity, but also the storage of information regarding OSH and the respective ES. The application is currently tested and in the implementation stage at the organization level as part of risk assessment strategies. Therefore, in the first stage of the application's development, the design was shaped to fulfill the organization's demands and requirements. In the second stage, the application was built, with its' components, the database, the component responsible for the functionality and the client interface. The third step is the application testing and validation stage, where the application functionalities and the behavior of the client interface are tested.

To use the application, the employee will receive a web address (link) to access. The link will redirect the employee to the application where the new OSH or ES sheet can be created. The form will be saved by the employee after completing all the fields provided in the electronic form. After the sheet's creation, it will become visible, then the person responsible with the periodic training approval will grant admitted working qualification, and the employee will be notified by e-mail.

The application with all its functionalities is presented as follows. As seen in Fig. 1, the OSH sheets created for the first three employees are displayed. It will be used by an employee responsible for the OSH and ES sheets. If a previously created sheet must be edited, the user clicks the green "Edit" button, as seen in the Fig. 1, and after modification the blue "Save" button will be clicked. To create a new sheet, the user clicks on "Create a new OSH sheet" button (Fig. 1). Fig. 2 shows the creation procedure of an OSH sheet by completing the required fields.

After filling all the fields, the user clicks on the blue “Save” button (Fig. 2).

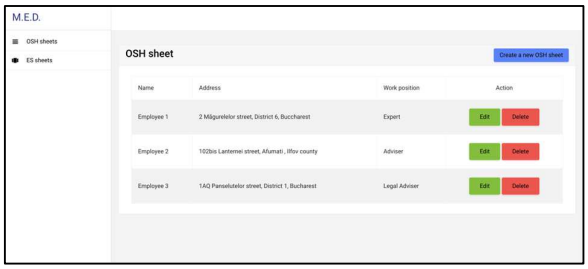

Fig. 1. OSH sheets.

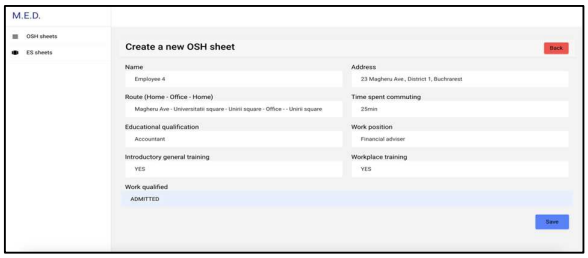

Fig. 2. OSH creation sheet.

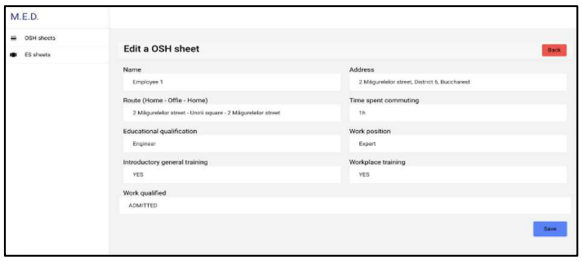

Fig. 3. OSH edit sheet.

To validate it, the application had to meet all the needs and requirements of the case-study organization therefore in the design phase, the application’s architecture was built with this in mind. After the application validation, the testing process follows. This was made by checking that all the components work together, as well as separately, checking the application’s performance under light, moderate and heavy workloads, checking that the authentication and authorization tools work properly and only the authorized users are provided access to the information, and collecting feedback from the users regarding the application’s interface ease of use.

Regarding the limitations and the constraints of the study, the following observations are made. Firstly, there were challenges regarding the implementation of such a solution, especially the digital component. In organizations where the employees’ digital skills are limited, as in the concerned case study of a Romanian public institution, the solution was met with reluctance at multiple levels of execution and management. So naturally, specialization courses for the employees were required to support overcoming the new digital challenges and boost their daily productivity, too. Secondly, the IT infrastructure highlights other series of constraints.

Public institutions still rely on outdated IT infrastructure that aren’t compatible with modern technologies, but to overcome this shortcoming the decision to install the solution on a dedicated machine was made, outside of the organization’s network following future integration within the network after the IT infrastructure has been updated to the latest technologies.

Within the current administrative process, where most of the documents are used in physical form, an option would be to develop an application that uses technologies capable of recognizing and interpreting handwritten text. It’s safe to say that the level and rate of digitalization is variable per country, but there are many countries where the degree of digitalization is similar, so the proposed risk assessment system is suitable in public organizations that face similar challenges and limitations as the case-study one.

In the economic practice, two tendencies are found: developing the applications internally or outsourcing these kinds of services. For public organizations, this appears as a third constraint, as budgetary limitations or planning may be encountered. It is well known how long the administrative procedures for purchasing allocations and bureaucratic approaches for approval may take.

Lastly, but maybe a major one, the legal framework which still requires the OSH and ES forms in physical form. If the management systems certification may be proceeded including digital solutions as more effective and efficient one, the OSH and ES regulations followed by regulatory bodies require paper-form and employee handwritten signatures.

5. CONCLUSIONS

Facing challenges with the employees reluctance and limited skillset regarding the digital transformation, barriers imposed by the outdated IT infrastructure, the current workflow within the public organizations where most of the documents are required in physical form, especially the OSH and ES sheets, the current trends where majority of organizations outsource the OSH and ES services, and the legal framework's constraints, were challenging the special approach of this case-study.

By developing the risk assessment system, the organization has identified, analyzed and assessed the ES and OSH risks. These were identified and registered in risk registry, as having a very high aggregate risk level, with risks no. 1, 2, 5, 6, 8, 9 and 10 being placed at the "intolerable" tolerance level. Therefore, the organization had to develop the strategy to mitigate the risks, with the emphasis on reducing them as much as possible by adopting urgent corrective measures and with increased efficiency. After applying the corrective measures and re-performing the risk assessment mentioned above, a decrease in the residual risk level and an increase in the tolerance level were observed, too.

Risks factors with no. 3, 4 and 7 resulted, following the identification, analysis and evaluation, with a significant added risk level and will also be included in the risk management strategy. By implementing the corrective actions for each risk, the organization has managed to lower its global risk level.

Next, the organization started to document and track the data using the application so that it can keep track of training for all employees in terms of OSH and ES.

Future developments will be focused to corelate the data of employees' assessment (degree of motivation, medical leave, productivity, injuries etc.) with ES and OSH effective approaches and the concerned resources management. The first tangible step refers to reducing paper consumption for printing various documents and reducing the space required for storing and archiving documents and facilitating quick access to them, too. Possible constraints are linked to the OSH regulations in terms of documents digital signature. The perspective is intended to connect employee health issues following the regular medical monitoring and medical absence, but the results of employee evaluations (productivity, motivation, key performance indicators, absence, career progression, professional attitude and loyalty for the organization), too, and choose the most cost-effective path between internally developing these services or outsourcing them.

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Demersuri de reducere a riscurilor in managementul sănătății și securității muncii și a situațiilor de urgență

Scopul acestei cercetări este de a proiecta un sistem de instruire documentată în conformitate cu evaluările angajaților. Lucrarea propune un studiu de caz realizat într-o instituție publică din România. În acord cu componenta de transformare digitală în organizații, a fost identificată oportunitatea dezvoltării unei strategii digitale de evaluare a riscurilor, care să reducă costurile medicale, să contribuie la prevenirea accidentelor de muncă și creșterea eficienței angajaților. Începând cu identificarea riscurilor, apoi evaluarea impactului și probabilității de apariție a riscurilor potențiale, a fost dezvoltată o soluție digitală pentru instruirea angajaților în domeniul sănătății și securității muncii și gestionarea situațiilor de urgență. Centralizarea și urmărirea datelor prezintă multiple beneficii. Soluția propusă poate fi transferată în alte contexte profesionale.

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