



Universitatea Națională
de Știință și Tehnologie
POLITEHNICA BUCUREȘTI

MINISTRY OF EDUCATION
National University of Science and
Technology POLITEHNICA Bucharest
Doctoral School of
Industrial Engineering and Robotics

Costinel BULBOACĂ

DOCTORAL THESIS

**CERCETĂRI TEORETICE ȘI EXPERIMENTALE
PRIVIND ANALIZA INFLUENȚEI FACTORILOR DE
RISC DE MEDIU ASUPRA PERSONALULUI ÎN
CONTEXTUL ACTUAL**

**THEORETICAL AND EXPERIMENTAL RESEARCH
ON THE ANALYSIS OF THE INFLUENCE OF
ENVIRONMENTAL RISK FACTORS ON PERSONNEL
IN THE CURRENT CONTEXT**

Scientific leader:

Univ. prof. PhD. Eng. Oana-Roxana CHIVU



**National University of Science and Technology
POLITEHNICA Bucharest
Doctoral School of
Industrial Engineering and Robotics**

SUMMARY DOCTORAL THESIS

**CERCETĂRI TEORETICE ȘI EXPERIMENTALE PRIVIND
ANALIZA INFLUENȚEI FACTORILOR DE RISC DE MEDIU
ASUPRA PERSONALULUI ÎN CONTEXTUL ACTUAL**

**THEORETICAL AND EXPERIMENTAL RESEARCH ON THE
ANALYSIS OF THE INFLUENCE OF ENVIRONMENTAL
RISK FACTORS ON PERSONNEL IN THE CURRENT
CONTEXT**

**Author:
Costinel BULBOACĂ**

DOCTORAL COMMISSION

Chairman	Prof.univ.dr.ing. Cătălin Gheorghe AMZA	National University of Science and Technology POLITEHNICA Bucharest
Scientific leader	Prof.univ.dr.ing. Oana-Roxana CHIVU	
Academic advisor	Prof.univ.dr.ing. Valentin PETRESCU	"Lucian BLAGA" University Sibiu
Academic advisor	Conf.univ.dr.ing. Claudia BORDA	National University of Science and Technology POLITEHNICA Bucharest
Academic advisor	Prof.univ.dr.ing. Timur-Vasile CHIȘ	University of Petroleum and Gas Ploiesti

Table of contents

Foreword	3	1
Introduction	4	2
Terminology	6	
Part I The current state of the art of performing professional risk assessments.....	10	
<i>Chapter 1. Occupational health and safety elements related to environmental risk factors in occupational risk assessments.....</i>	11	4
1.1. Environmental risk factors highlighted according to the main frequently used occupational risk assessment methods/methodologies.....	11	4
1.2. The work system and the correlation with the requirements of the standards regarding OSH risks	17	5
1.3. Identification of environmental risk factors within the work system	19	7
<i>Chapter 2. Analysis of the influence of environmental risk factors on personnel in the current context</i>	22	7
2.1. Analysis of the influence of environmental risk factors in the current technological context	22	7
2.2. Analysis of environmental risk factors in the field of construction	27	9
2.3. Environmental risk assessment for a construction job	29	9
<i>Chapter 3. Conclusions regarding the current state of how to perform professional risk assessments</i>	54	10
Part II - a. Contributions regarding the analysis of the influence of environmental risk factors on personnel through the MEvAR methodology	55	
<i>Chapter 4. The directions, the main objective and the research-development methodology of the influence of the work environment on the staff through the MEvAR risk assessment methodology</i>	56	11
4.1. Research and development directions	56	11
4.2. The main objective of the research-development activity	56	12
4.3. The methodology used in the thesis	57	12
<i>Chapter 5. Research on the influence of environmental risk factors on personnel through the MEvAR methodology</i>	59	14
5.1. Categories of environmental risks	59	15

5.2. Internal environmental risks	63	16
5.3. External environmental risks	65	16
5.4. Updating the list of environmental risk factors	66	17
5.5. Details on the MEvAR methodology.....	76	18
5.6. Conclusions.....	88	20
<i>Chapter 6. Theoretical and experimental study on the influence of environmental factors through the MEvAR method within an organization</i>	90	21
6.1. MEvAR methodology analysis.....	90	21
6.2. Check list.....	91	23
6.3. Inherent and residual risks generated by environmental factors	111	26
6.4. Comparisons regarding the assessment of occupational risks using the MEvAR methodology	122	28
6.5. Directions for improvement of the MEvAR methodology	150	40
6.6. Conclusions	152	43
<i>Chapter 7. Final conclusions and main contributions to the analysis of the influence of environmental factors on staff</i>	154	44
<i>References</i>	158	48

Foreword

The need to use a synthetic method of identifying, evaluating and assessing professional risks adapted to current challenges that also presents the influence of risk factors on the staff led me to start this applied research and development and to represent my determination and the direction in which I applied my doctoral studies through this doctoral thesis.

The main sources of inspiration were the knowledge acquired during the master's program, the discussions held with the professors and supervisors from the Faculty of Industrial Engineering and Robotics, with experts in the field and last but not least, the professional experience gained from the relationships with our own clients.

By studying, analyzing and verifying data from scientific works and management system requirements or legal requirements, we concretized ideas and synthetic concepts that were presented and supported at conferences in scientific articles published in specialized magazines, which confirmed the need to study the field through interest shown by participants and reviewers.

The doctoral program included the deepening of the study, the stages of preparation and support of scientific reports and exams and was carried out according to planning, all the directions and methodologies recommended by the proposed research-development program being respected.

For the representation and visualization of the study and the results, I used the MEvAR methodology (Management of Evaluation and Assessment of Risks) within the thesis, thus it is possible to identify and follow both the effects of the risk factors on the personnel (injuries), on the organization (damages) and the impact through the accumulation of the effects the production of predictable events.

I would like to express my deep gratitude for the support and guidance provided by the scientific coordinator of the work Ms. university professor Dr. Eng. Oana-Roxana CHIVU and the guidance team during the entire course of the 3 years of doctoral studies.

For the work I was supported within the Human Capital Sectoral Operational Program 2014-2020 by the grant POCU/993/6/13/153178, "Performance in research" which was co-financed by the European Social Fund, the occasion with which I express my thanks for the trust and the support given.

I express a special appreciation to the professors from the Faculty and Doctoral School of Industrial Engineering and Robotics from the National University of Science and Technology POLITEHNICA from Bucharest, with whom I acquired and perfected learning skills at a high level, discovered, collaborated and debated the main aspects of the paper and I supported the hearings, the verifications of the examinations of the doctoral studies.

I thank all the people who helped me in the realization of the paper and scientific articles, supported and supported me in order to complete this laborious work.

I express my sincere thanks to my family, from whom I received the support and encouragement necessary to complete this work.

Costinel BULBOACĂ

Introduction

This paper aims to present a synthetic analysis of the influence of environmental risk factors on personnel according to the current situation at workplaces.

The synthetic analysis is ensured by the specialized analysis regarding the assessment of the occupational risks to which the workers are exposed, other participants in the work processes and any other persons who may be affected by the environmental risk factors.

The environment in the work context is made up of the work environment defined according to the work system, the external environment defined according to the environmental requirements in general and other elements of the external environment that may interfere with the work environment.

In this way, risk analyzes regarding the environment, the work environment, different external environments, international and national security, physical security, economic-financial, social, health, technological or specific internal environments are interfered.

These environments are usually the subject of management risk analysis and are omitted from the analyzes of OH&S specialists.

By integrating the analysis of these risks into the analysis of professional risks, the correlation and clearer definition of environmental risk-generating elements with effects on personnel is ensured.

To simplify the analysis, only the significant elements from the specific analyzes were taken, the details being studied by specialists and presented on request.

Hazards to be analyzed are interpreted by specialists as risk factors.

Their analysis is carried out in accordance with the requirements of risk assessment and identification methods/methodologies by teams of evaluation specialists.

Each evaluation method/methodology presents the predictable risk factors that at a certain moment, depending on the risk exposure and the LIKELIHOOD of occurrence, may generate an event with an impact or severity that may influence the health status of those exposed.

From these in the work I have selected the main elements of the environmental risk factors that can affect the personnel exposed in the workplace in general and in the construction field in particular.

The main objective of the paper is the analysis of the influence of environmental risk factors on the staff and the application of the MEvAR methodology for exemplification, through theoretical and experimental research that is adapted to the current legislation and the standard of OSH management systems - SR EN ISO 45001:2018.

- The objectives of the research are:
 - research on how to identify, analyze and evaluate the influence of environmental risk factors on workers;
 - the correlation of the specific elements in the field of OSH with the requirements of SR EN ISO 45001:2018;
 - measures to improve the system of identification, analysis, evaluation and records;
 - the formulation of lists/forms of checks/controls correlated with the standard regarding the OSH management system regarding environmental risk factors.
- In order to achieve the proposed objectives, we have carried out the following:

-
- - analysis of risk factors for the workplace and/or work station, technological processes, sensitive groups, work equipment, dangerous substances/compounds/chemical preparations, the layout
 - to all workplaces of the organization;
 - studies on updating the MEvAR methodology;
- case study and practical application through the MEvAR methodology;
- establishing conclusions and proposals for improvement.

The purpose of the research is to provide data and reference elements regarding the degree of influence of environmental risk factors by identifying, evaluating and analyzing them, correlating the data with the applied method and visualizing these analyzes through the calculation tool in order to treat the risks in a timely manner.

The relatively low impact of promoting the methodology can be considered as a limitation of the research because it is in the early stage of knowledge and application.

Also, the synthetic presentation can be considered a limitation considering the multitude of development possibilities of the elements of the methodology both horizontally - development, detailing and risk factor analysis aggregation - and vertically - development through the introduction of correction factors and managerial interfaces.

* * *

Through this doctoral thesis, I wanted to prove my ability to deal scientifically with a current research topic, highlighting the ability to synthesize the essential ideas from the rich bibliography studied, identifying the basic elements of the research of the subject, establishing and following in -a pragmatic sequence of research objectives, drawing conclusions based on results and arguments, offering theoretical and practical solutions.

The thesis is structured in 7 chapters and respects the following composition proportions as follows:

1. The introduction represents approximately 1% of the paper, it contains the motivation of the theme, the current state, the importance, the formulation of the aim and the main objective of the paper, the outline of the expected results, the indication of the parameters of the research carried out for the elaboration of the thesis.
2. Chapters 1, 2, 3, concerning the current state, provide the theoretical foundation, representing approximately 31% of the work. In this part I have highlighted the aspects synthesized from previous research on the field of study for the doctorate, it includes some applicable theoretical models, the techniques and methods used, presented synthetically and in a convincing manner.
3. The following chapters 4,5,6 present the development of the applied research and represent approximately 62% of the paper, where my ability to use the research results in an original, creative and innovative way is demonstrated so as to ensure and present the effectiveness of the methodology approached . This part of the thesis was realized with practical research, case studies regarding different forms of occupational risk assessment specific to jobs/jobs, the structure, calculation, activities and other details of the MEvAR methodology, by using the Microsoft Excel application.

The analyzes and conclusions of the research are detailed, and the calculation pages can highlight the results and comparisons of the elements that can be viewed in real time according to the initial data.

4. At the end, in chapter 7, the final conclusions and main contributions represent approximately 6% of the paper, where they are presented in a harmonious sequence, based on argumentation, with the emphasis on their own aspects, the opportunities of the offered solutions. We have made some proposals that are directly applicable, achievable and can provide additional input to managers in organizations, experts and evaluators in the field of OSH regarding the activities of identification,

assessment and evaluation of occupational risks by using the MEvAR methodology in the analysis of the influence of environmental risk factors on the staff.

Chapter 1. Occupational health and safety elements related to environmental risk factors in occupational risk assessments

1.1. Environmental risk factors highlighted according to the main frequently used occupational risk assessment methods/methodologies

In the last 30 years, the construction field in Romania shows an upward trend for housing construction mainly due to local economic growth (see figure 1.1) and as a share of the construction area, the largest increase is observed in the counties of Ilfov, Cluj and the municipality of Bucharest (see figure 1.2).

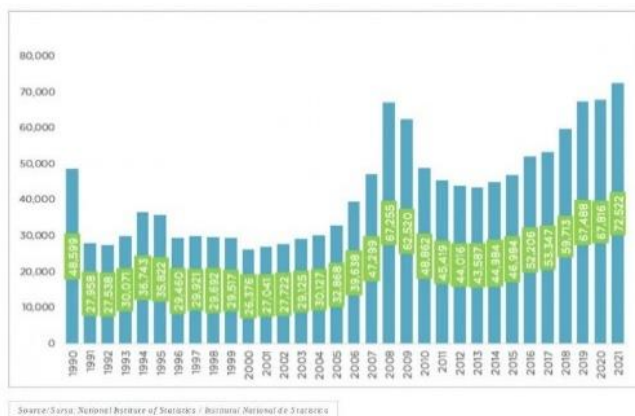


Figure 1.1 Building construction situation [152]

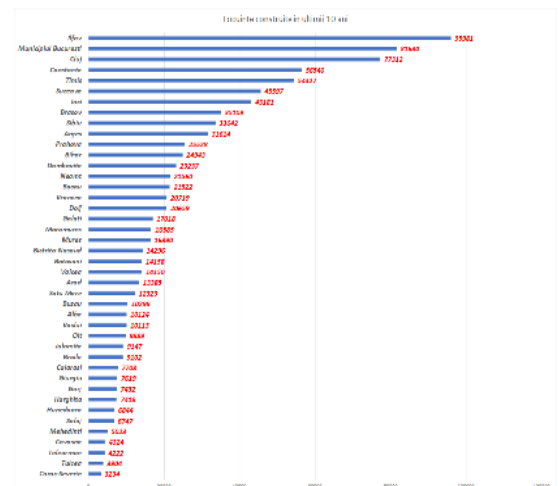


Figure 1.2 Construction situation by county [153]

Against this background of the intensification of construction activities, the number of workplace events also increased in 2018, Romania being number 1 in the European Union (see figure 1.3), the level of fatal accidents being almost double compared to the EU average (see figure 1.4), in 2020, the construction of buildings with a weight of 16.8 of the total number of fatal accidents, being in the first position.

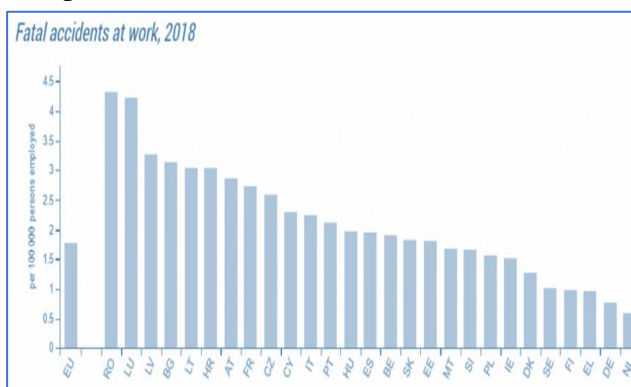


Figure 1.3 EU fatal accidents situation [159]

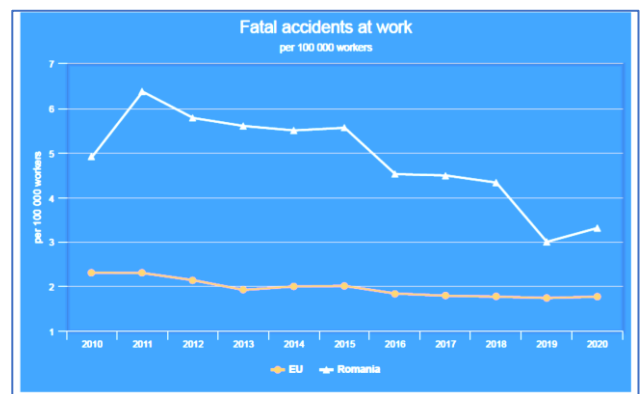


Figure 1.4 EU-Romania fatal accident situation [162]

At the present time, every organization that carries out activities in the field of construction and especially housing ensures its OSH activity through its own or external personnel, based on the

requirements of the specifications or its own, having a high degree of exposure to accident risks as well as financial, controls by the authorities and changes in working conditions due to the environment.

In the classic definition of the environment, it is understood as the totality of the conditions in which beings live.

For the work environment we have as definition the set of conditions in which one or more executors carry out their work task. [116]

In addition, other methods by studying the workplace and especially the work environment in more detail introduce other risk factors/dangerous situations into the calculation, as follows: [120],[135],[136],[138]

- the situation plans and the relations in the workplace organization;
- the number of exposed persons;
- workplace area;
- description of the unit;
- description of activities;
- work equipment;
- hazardous materials and chemical agents;
- data about workers;
- work organization;
- other dangers;
- closed spaces;
- traffic;
- hostile behavior;
- psychological;
- environmental conditions at the workplace;
- ergonomic;
- the notion of acceptable (assumed) and unacceptable risk;
- premises for work;
- setting up workplaces;
- working microclimate;
- unforeseen events;
- organization of activities;
- lack of information;
- co-activity;
- dehydration;
- fatigue;

1.2. The work system and the correlation with the requirements of the standards regarding OSH risks

The specific OSH legislation mentions the conditioning of assessment activities by the work system, so that the identification of risk factors and risk assessment must be ensured for each component of the work system (executor, work load, work means/equipment and the work environment) for jobs and/or work stations. [96]

The main starting points for occupational risk assessments are shown in figure 1.3:

Directive 2006/42/EC of the European Parliament and of the Council /17 May 2006 machine parts updating Directive 89/392/EEC of 14/06/89, Directive 91/368/EEC, Directive 93/44/EEC
ISO 12100:2010 Safety of machinery — General design principles — Risk assessment and risk reduction
ISO Guide 73:2009 Risk management — Vocabulary
ISO TR 14121-2 Safety of machinery - Risk assessment p.2 Practical guidance and examples of methods
Risk assessment guide: 2007 - Labor inspection - Romania
The methods of assessing the risks of occupational injury and illness - course support - professional trainers, faculties

Figure 1.3 Main references on occupational risk assessments

These references were correlated with the professional risk assessment methods, but not with the last published standard, SR EN ISO 45001:2018 OSH management systems, because at the time of the methods' appearance they took precedence over the legal requirements and references or were external and had no correspondence in national legislation. [112]

Within the work system defined by the machine-man relationship, the work environment has different valences of the work climate and less of the relationships between the elements of the work system with each other and/or the surrounding environment.

Management systems from this point of view have a much more interactive and realistic approach, not being limited by strictly legal requirements or personal approaches.

OSH management systems are mainly applied only to organizations that have direct contact with community, structural funds or other organizations that have implemented the integrated management system with a conditional nature of the contractual relationship.

The common part between the environment and the work environment is treated in principle only within the physical limits of the workplace and less of the relations and interferences with the neighborhood or relationship.

At first glance, the connection between the work system and the other related systems is not found.

The main guidelines regarding the relationship between the work environment and the environment are found in studies or research and less in good practices or regulated guidelines.

Also, there are very few professional risk assessment methods that are adapted to the management of the organization and the analysis of risks specific to the performer/worker (policies, objectives, performance indicators, internal and external relations, reputation, psychosocial factors, stress, equal opportunities, aggression, violence, mental health, other)

Occupational risk assessments can be classified according to the environment in which occupational injury and disease risk assessment specialists work as follows:

- specialists from research institutes, faculties, authorities - use professional risk assessment methods established in Romania based on the study of the elements of the labor system structured according to legal requirements (INCDPM Bucharest, Auditing by weights, MERA, Mincă, others) [135], [137], [138]

- specialists from large enterprises, corporations - use the methods specific to the field or the basic organization correlated with audit and management systems (HAZOP, HACCP, Renault, Oira, others)

- specialists providing services in various fields and/or from small and medium-sized enterprises - they use the methods taught in the training courses or the methods that have work tools (predominantly INCDPM Bucharest)

The working tools are adapted to the specifics of the activities, jobs, positions, materials depending on the experience of the evaluators, the technical methods being applicable only in the case of high-level evaluations, the easy methods being preferred because they are fast and provide a satisfactory picture of the level of risk of organizations in relation to the cost of assessment.

These aspects have been and are being studied by every evaluator who wants to compare the known and practiced method with others more related to the field of activity evaluated

1.3. Identification of environmental risk factors within the work system

The ways of identifying environmental risk factors are specific to the professional risk assessment methods, among which we can mention:

- identification through direct viewing, interviews, comparison and verification according to checklists;
- analyses, tests, determinations, technical expertise;
- process mapping; [111], [112]
- risk classification and aggregation;
- identification and analysis of environmental risks that may affect the work environment;
- analysis of documented information;
- forecasting the work environment risk factors that may present variations in the planned period;
- other ways/methods to identify environmental risk factors applicable to the organization.

In the specific analyzes of professional risk assessment methods, the general principles and methods of risk management are not targeted, but only the specific technical ones.

This aspect can generate superficiality in the understanding at the management level of the organizations, the specific technical language used by the evaluators being purely technical without correlation with the procedures and general language.

For this reason, we believe that a more careful focus on the other risks with weight from economic activities can generate a much closer collaboration between specialists and managers within the management systems.

Within the assessment method proposed in this study, the specific elements of financial, security, informational, social, competitive, and other risk assessments were formulated as risk factors.

Chapter 2. Analysis of the influence of environmental risk factors on personnel in the current context

2.1. Analysis of the influence of environmental risk factors in the current technological context

In order to analyze the influence of environmental risk factors in the current technological context, it is necessary to follow the main risks maintained or that have evolved in the last period and to forecast the impact of new technological challenges that may appear in the studied field.

The impact of the COVID-19 pandemic [60], [140], [141]

The COVID-19 pandemic has had an impact of a very large scale and an exceptional proportion, affecting the socio-economic situation and the health of millions of people in the EU (by September 2020, more than 2.2 million EU residents contracted the virus).

The economic crisis of 2020 threatened the job security and career prospects of millions of laid-off or laid-off employees in various industries.

In addition to career and financial impacts, economic downturns can lead to social isolation, emotional distress (eg, uncertainty about one's self), future career options and opportunities, and psychological distress (eg, increased anxiety). [153]

The pandemic has accelerated trends that were already underway, involving the migration of work to online or virtual environments. [142]

Social distancing recommendations have spurred emerging changes in work practices such as working from home, virtual teamwork, virtual leadership and management; the proportion of Europeans working remotely rose sharply to 40% in April 2020. [142]

Almost half of the workers who have worked from home since the pandemic until today had no previous experience working remotely, at home or teleworking.

Surprisingly, working from home was mandatory for most employees in line with social distancing imperatives, which is in contrast to remote workers who were already working voluntarily, making it difficult to generalize previous findings on the impact of working at home. distance.[142]

COVID-19 has accelerated the expansion of synchronous or asynchronous electronic communications, video chats and electronic meetings (eg, Teams video conferencing, Zoom) between geographically dispersed team members, as well as virtual team work.

Homework and virtual teamwork may expose workers to higher levels of psychosocial distress and presenteeism. [149]

The COVID-19 pandemic has fundamentally changed some industries or supply chains, accelerated trends that were already underway in some sectors, and opened opportunities for new industries to emerge.

In this sense, the COVID-19 pandemic provided a "stress test" for OSH in the EU, revealing several structural weaknesses in the regulatory system, with many workers being exposed to SARS-CoV-2 (the cause of COVID-19) and the risks psychosocial issues associated with them [148].

Risk assessment and surveillance

Epidemiological surveillance is based on up-to-date data on the extent of new forms of work and digitalization and the impact on the health and well-being of workers, according to industrial sectors, occupations, occupational categories and risk groups (e.g. the elderly and disabled). [146]

Risk assessment should actively involve the workforce to confirm that actual work activities are being assessed.

Risk assessment for remote workers is particularly difficult (eg entering the worker's home or assessing risks away from the employer's premises).

However, in relation to the use of this data in HR, digital monitoring raises questions about the ethical aspects in the collection and use of this data regarding the involvement of workers and representatives on practical implementation strategies. [115], [146]

Thanks to AI-adapted preventive interventions, real-time advice can be provided to influence worker behavior and prevent potential OSH problems [146].

Digitization can also provide opportunities for more effective OSH training of practitioners and workers to update their skills accordingly, depending on the spread of digital work and virtual environments [146].

The digitization and robotization of the economy has been strengthened by the COVID-19 pandemic, and this has accelerated the spread of new forms of work, work intensification and the fragmentation of the workforce in many occupations and industrial sectors.

Digital technologies and new forms of work present opportunities and challenges for decision-makers, companies and workers.

2.2. Analysis of environmental risk factors in the field of construction

For the analysis of environmental risk factors in the field of construction, it is necessary to follow the phase in which the construction is being carried out, the type of construction and especially the existence of personnel in the work environment or outside.

Depending on the construction execution phase, the dangers/dangerous situations specific to construction activities can be identified where there may be influences of the own work environment, but also external influences that may influence the activities and health of the staff or may be influenced by the activities on the construction site.

For this, in figure 2.3, you can follow the main elements regarding the work environment.

4. WORK ENVIRONMENT	
WORKPLACE ENVIRONMENT/ ENVIRONMENT NEAR THE WORKPLACE HIGH AND SPECIFIC RISK AREAS: WORKPLACE ENVIRONMENT/ THE CLOSE ENVIRONMENT	WORKPLACE ENVIRONMENT/ENVIRONMENT NEAR THE WORKPLACE
	HIGH AND SPECIFIC RISK AREAS:
	AREAS EXPOSED TO NATURAL RISKS:
	hazardous weather phenomena: storms/floods/tornadoes/drought/freeze/forest fires/avalanches
	destructive phenomena: landslides, earthquakes,
	AREAS EXPOSED TO TECHNOLOGICAL RISKS:
	industry, transport, dangerous products, storage: accidents/breakdowns/explosions/fires/water pollution/collapses of constructions/installations/arrangements/failure/damages of public utilities/falls of objects from the atmosphere or space/grounding/sinking of ships/unexploded ammunition
	CBRN/NBC risks: chemical/biological contamination/epidemics/epizootics/irradiation/nuclear contamination
RISK AREAS FOR THE SECURITY OF VISITORS	
AREAS WITH POTENTIAL GENERAL RISKS: fall/slip/hit/road accident/others	

Figura 2.3. Factori de risc de mediu specifici mediului din proximitate

2.3. Environmental risk assessment for a construction job

To exemplify the environmental risk factors, we have selected a risk assessment for a work position/activity in the field of construction - photovoltaic panel installer, which is presented below. [118]

The form and structure of the forms transposed in the following paper are similar to those of other risk assessments, the values may be similar having common assessments but some differ because the jobs/jobs have different elements. [23] ,[118]

INTERPRETATION OF ASSESSMENT RESULTS FOR THE WORKPLACE/POST/ACTIVITY/PROCESS/SENSITIVE GROUP/WORK EQUIPMENT/ SUBSTANCES AND/OR CHEMICALS USED / LAYOUT OF WORKPLACES: Installer of photovoltaic panels [23] ,[118]

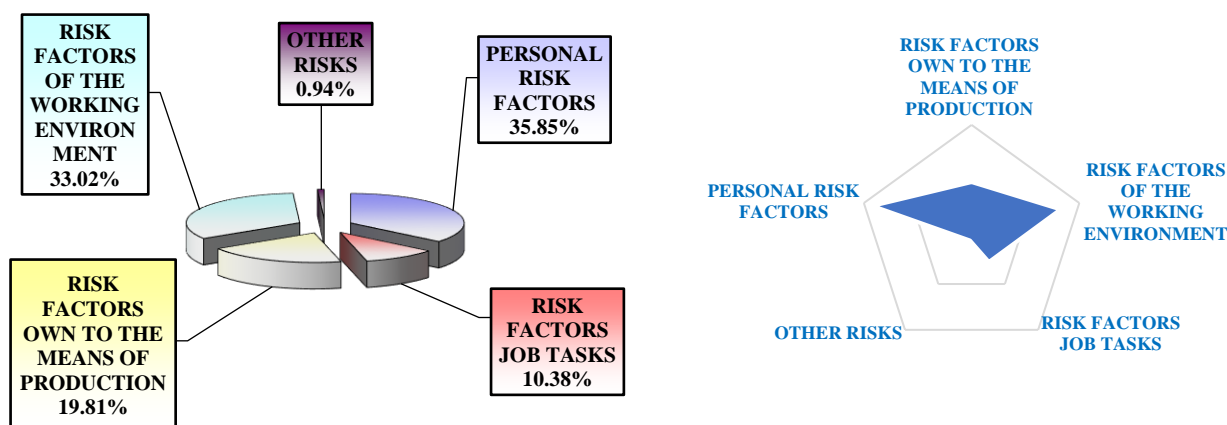
The global risk level calculated for the Photovoltaic Panel Installer job was assessed and determined to be equal to 3.15, which places it in the category of jobs with an acceptable risk level. [23] ,[118]

The risk/danger factors that are in the unacceptable range are: [23] ,[118]

RISK/DANGER FACTORS [23] ,[118]	VALUE/ RISK DETERMINATION
Improper displacement strike [23] ,[118]	4
Carrying out activities in areas of potential imminent, violent, unknown danger [23] ,[118]	4
Accidental starting or stopping of the supply of electricity, gas, oxygen, other energy fluids without having it as a work load (use by personnel who do not have appropriate training and attributions) [23] ,[118]	4

Failure to comply with security procedures [23] ,[118]	4
Failure to use PPE individual equipment and/or collective means of protection [23] ,[118]	4
Aggressions due to conflicts with other people [23] ,[118]	4
Hit by means of motor transport when moving between the unit and home or during specific activities [23] ,[118]	4
Electrocution by direct contact with live conductors [23] ,[118]	4
Electrocution by indirect contact with electrical installations [23] ,[118]	4
Emergency situations - earthquake, fires, explosions, others [23] ,[118]	4
Appearance of potential viruses, bacteria from the soil, buildings, materials, or from the air, staff or visitors [23] ,[118]	4
External risks, lack of visibility, lack of oxygen, drowning [23] ,[118]	4

WEIGHT OF RISK FACTORS/HAZARDS IDENTIFIED/DETERMINED BY THE ELEMENTS OF THE WORK SYSTEM/OTHER RISKS FOR THE WORKPLACE/POST/ ACTIVITY/ PROCESS/SENSITIVE GROUP/ WORK EQUIPMENT/ SUBSTANCES AND/OR CHEMICALS USED / LAYOUT OF WORKPLACES: Solar panel installer [23] ,[118]



Chapter 3. Conclusions regarding the current state of how to perform professional risk assessments

From the analysis of the current state of research and development of the method of carrying out national and international professional risk assessments, the following conclusions can be selected:

- Carrying out professional risk assessments is an activity carried out by professionals that is regulated according to legal requirements, the competence of specialists, documents and application methodologies that are determined by standards and good practice guidelines (see § 1.1).
- Their use varies by expert, considering:
 - the level of professional training (types of specialization courses completed in the field of OSH, bachelor's, master's, doctorate);
 - the specifics of employment (independent/employed/affiliated/collaborator, multinational organization, prevention and protection service provider/consultant in the field of OSH, researcher, inspector);

-
- requirements in collaborations between professional organizations;
 - contractual requirements.

People who have graduated from technical universities, who have completed a basic course of at least 80 hours in the field of OSH, or who have a diploma of occupational/injury risk assessor and professional illness with a minimum duration of 180 hours or a master's degree in the OSH Engineering specialization.

The work environment together with the executors, the work tasks and the means of production in relation to the work process, is a component of the work system, but in the regulations on OSH it is not correlated with the environment in general, social, relational and informational, economic and political.

Most risk assessment and evaluation methods do not group risks into categories, are only partially adapted to quality, environmental, information and security management systems and ensure that certainties such as risks with maximum potential or LIKELIHOOD are addressed.

Certainties are perceived as dangers that can produce serious events with a single maximum LIKELIHOOD, events with multiple probabilities being considered risks.

Approaching certainties can be done by removing dangerous situations, producing sources, production possibilities, if people do not relate to the dangerous situation, then the event will cease to exist.

The way in which the work environment affects workers can be evaluated interdependently with the state of health observed as a result of periodic medical checks by occupational medicine, in correlation with the number of days granted for sick leave or in serious cases, death.

Chapter 4. The directions, the main objective and the research-development methodology of the influence of the work environment on the staff through the MEvAR risk assessment methodology

4.1. Research and development directions

Following the conclusions resulting from the analysis of the current state, I appreciate that the following directions of research and development can be defined for the analysis of the influence of environmental risk factors on personnel:

- analysis of environmental risk factors specific to the work system, the work environment, internal and external;
- analysis of the possibility of updating and using the MEvAR professional risk assessment methodology for the rapid visualization of the influence of changes in environmental factors;
- more in-depth analysis and interpretation of the details of the method (mathematical model, checklists, spreadsheets, standard documents, specific components, alternative forms, ways of integration);
- updating the calculation tool associated with the MEvAR methodology;
- the presentation of the advantages of applying the MEvAR assessment methodology for the current analysis of the influence of the occupational risk factors specific to OSH, environmental and work environment in particular;
- analysis of how to integrate the assessment of professional risks with environmental and external risks.

4.2. The main objective of the research-development activity

The review of the information and the main conclusions obtained from the study of the current situation, as well as the identification of research and development directions, was the basis for establishing the main objectives of the doctoral activity: the identification of current environmental risk factors, data analysis and supporting the application of the methodology of professional risk assessment MEvAR to facilitate the activity of professional risk assessment.

The aim of the paper is to carry out some research, both theoretically and experimentally, regarding the identification, analysis, assessment and evaluation of environmental and work environment risk factors that can influence personnel, within the OSH and/or integrated management system.

The objectives of the research are:

- the study, identification, analysis and evaluation of the influence of environmental and work environment risk factors on the staff;
- updating, adapting and revising the checklists of work environment risk factors, environment in general and newly identified internal and external risks;
- analysis and proposal of measures to improve the MEvAR methodology adapted to the field of construction by using the work tool based on the Microsoft Excel application;
- identifying the forms of presentation of the MEvAR methodology in the managerial system to facilitate the integration of the OSH management system with the environment and quality, information and social responsibility management system;
- comparing, proposing and supporting the advantages of using the MEvAR risk assessment methodology compared to the main assessment methods and methodologies.

The achievement of the proposed objectives was made possible by carrying out the following research activities:

- the identification and analysis of the assessment of professional risks of the work environment for jobs/jobs, technological processes, sensitive groups, work equipment, dangerous chemicals, the arrangement of jobs/jobs within an organization;
- studying the risk factors of the work environment and the environment in general, identifiable from other evaluation methods, the impact of the surrounding environment and the factors of the work environment specific to constructions;
- case study by comparing and analyzing the application of the MEvAR methodology in different work scenarios;
- updating and correlating the elements of the MEvAR methodology with the new perspective regarding work environment factors, environment, internal and external risks as well as their influence on staff.

4.3. The methodology used in the thesis

The methodology used in the thesis on scientific research and development was established as a matrix for the actions necessary to achieve the central objective of the doctoral thesis, as well as the adjacent ones.

The methodological elements used in the thesis are:

- (1) Researching the technical culture in the field and what may be relevant for analyzing the influence of environmental risk factors on personnel.

In order to achieve the proposed theme and objectives, we consulted and analyzed specialized bibliographic sources books, magazines, monographs, volumes and specialized articles, studies and

publications in the field of OSH evaluations by well-known authors, national and international institutions, doctoral theses with applicability to the topic.

We performed an analysis and documentation regarding theoretical and experimental research, focused on:

- the identification and analysis of the main specialized data, principles and directions in the field of scientific research and development for the identification of environmental risk factors and their influence on personnel;
- the common elements of the works and the regulated provisions regarding the risk factors of the work environment and the surrounding environment;
- synthesis and analysis of completing the analysis of environmental risk factors from various environments (work, professional, financial, physical security, environment, administrative, national security, political, etc.).

(2) Research methods.

The research methods applied in the thesis are:

- quantitative research - having a positivist-explanatory direction;
- qualitative research - having a phenomenological direction (observations, critical analysis, case studies).

In order to apply them, we used established actions: case study and investigation, for each action using specific tools and exploratory research as follows:

- building the working hypothesis;
- the choice of techniques for identifying, collecting and analyzing the necessary information to analyze the impact of environmental risk factors on personnel;
- compilation of the list of research requirements, depending on the investigation method;

(3) Interpretation of identified data

The analysis strategy used was survey. In order to identify the risk factors, data were analyzed and collected about:

- environmental risk factors (name, category, source, potential);
- the LIKELIHOOD of influencing the staff and the estimated impact;
- the estimated weight of the risk value;
- necessary treatment, prevention and protection measures;
- medical monitoring reports.

For example, we carried out an analysis of the identification and assessment of risks for the photovoltaic panel installer job in the MONTARE PANOURI S.R.L company, through the adapted and updated INCDPM method, in which the identification and evaluation of environmental risks was carried out, as well as the proposal of technical, organizational and hygienic-sanitary measures.

In order to ensure the elements of comparison, an identification and assessment of the risks for the same workplace was carried out using the MEvAR methodology.

(4) Analysis and evaluation of the results

The elements obtained are in line with the established knowledge from the specialized literature, confirm the elements known from the scientific culture and current practice applicable in the field of OSH.

The research carried out introduces new elements into the analysis of risk factors that ensure the deepening of the research of the influence of risks on personnel because it introduces into the general logic of the analysis of environmental factors the environmental risk factors specific to the work system along with the surrounding environment and adjacent environments.

(5) Valorization of the conclusions

At the end of the doctoral thesis, the conclusions of the conducted research are mentioned in a concise form, emphasizing the scientific contributions made during the 3 years of internship.

I have presented the results of some of the researches contained in this work at conferences and scientific symposia held in the country and abroad, in the form of specialized articles.

The directions of future development are directed, both towards the exploitation of the research results, and towards the updating of the MEvAR methodology for the field of constructions. The results are presented in a clear, precise, easy to understand, integrate and monitor in real time.

The MEvAR methodology provides real-time analysis and visualization of the variation of identified risk factors, assessment and evaluation of initial and residual risks, allowing specialists and beneficiaries to follow the effects of the application of measures to treat the identified risks.

Chapter 5. Research on the influence of environmental risk factors on personnel through the MEvAR methodology

In accordance with the research and development directions, in order to carry out a consistent analysis of environmental risk factors, it is necessary to ensure a broad identification of environmental risk factors specific to different environmental categories (work, environment, financial, physical security, national security, administrative, political, etc.), their integration and analysis in risk analyses, follow-up of data comparison and extraction of summary elements or specialized reports necessary for risk assessment and in particular the assessment of the influence on personnel.

Determining the influence of environmental risk factors is not easy to achieve because neither the doctor nor the patient can realize what the source is, but together the occupational medicine doctor, the medical specialist, the evaluator specialist, the workplace manager and the affected worker based on a complex evaluation but based on analyzes and determinations of damages can ensure a correct identification of the sources of illness, frames or other forms of injury.

Necessary steps to follow to determine the impact of health risks:

- verification of the state of medical fitness before employment and periodically;
- carrying out environmental analyzes and noxious determinations (air and water quality, dust, aerosols, vapors, dangerous gases, radiation, environmental variations, chemical, biological agents, carcinogens, etc.);
- identification, analysis, assessment and evaluation of occupational hazards and risks;
- ensuring risk treatment, prevention and protection measures in the field of OSH;
- monitoring of environmental conditions and the health status of workers and affected persons;
- ensuring internal and external information and communication regarding dangers, dangerous situations and risks, as well as prevention and protection measures;
- ensuring periodic analysis and information meetings and reports regarding the influence of risks on staff.

5.1. Categories of environmental risks

In the classic evaluations we find a structuring of the categories of risk factors based on elements of the work climate (physical, chemical, biological factors and special character of the environment). [8], [23]

Figures 5.1, 5.2 show the main general risks according to LIKELIHOOD and impact [154],[155].

TOP 10 risks according to PROBABILITY	
Extreme weather phenomena	ENVIRONMENTAL risk
Major natural disasters	ENVIRONMENTAL risk
Cyber attacks	TECHNOLOGICAL risk
Data fraud or theft	TECHNOLOGICAL risk
The failure of climate change mitigation measures	ENVIRONMENTAL risk
Large scale involuntary immigration	SOCIAL risk
Man-made natural disasters	ENVIRONMENTAL risk
Terrorist attacks	GEOPOLITICAL risk
Illicit trade	ECONOMIC risk
Asset concentrations in a major economy	ECONOMIC risk

Figure 5.1 Top risks by PROBABILITY/LIKELIHOOD

TOP 10 risks according to IMPACT	
Weapons of mass destruction	GEOPOLITICAL risk
Extreme weather phenomena	ENVIRONMENTAL risk
Major natural disasters	ENVIRONMENTAL risk
The failure of climate change mitigation measures	ENVIRONMENTAL risk
Water crises	SOCIAL risk
Cyber attacks	TECHNOLOGICAL risk
Food crises	SOCIAL risk
Bio-diversity loss and ecosystem collapse	ENVIRONMENTAL risk
Large-scale involuntary migration	SOCIAL risk
Spread of infectious diseases	SOCIAL risk

Figure 5.2 Top risks by impact

The main categories of external or internal risks that can affect the organization are: [156]

- strategic risks (local or global political-economic changes);
- compliance risks (emergence of new legislation on occupational health and safety);
- personnel risks (lack of labor in the market);
- operational risks (breakdown of work equipment);
- financial risks (global or local economic crises);
- environmental risks (climate changes);
- health and safety risks at work (appearance of new, emerging risks);
- other inherent or residual risks with an impact on the organization.

The main risks that organizations face can be defined as actual and potential risks. [156]

Real risks are those that have already occurred, are plausible, can be identified and evaluated based on details and effects. How the risks are dealt with is known and the effects have been assessed and appreciated. Additional residual risk management measures may apply. [156]

Potential risks are risks that have not been identified, have not manifested and may occur under certain conditions. For identification it is necessary to apply projection models and predicted probabilities. The way of treatment implies a model of action when the permits or forms of manifestation of risks appear. [156]

5.2. Internal environmental risks

The internal risks of the work environment can be those risks that are specific to the work environment, generated or not by structure, activity or influence from the neighborhood.

The main internal risks of the work environment can be (see table 5.2):

Table 5.2 Risk factors specific to the internal work environment [18], [23]

RISK FACTORS SPECIFIC TO THE WORKPLACE'S OWN ENVIRONMENT/ENVIRONMENT NEAR THE WORKPLACE	
RISKS SPECIFIC TO THE WORKING ENVIRONMENT	
working in closed spaces	enclosures/spaces/containers/receptacles that can be fully or partially closed
working at height	scaffolding/bodies/scaffolding/pillars/ladders/on a rope/on the hood of machinery/others
work in excavations	excavations/trenches/pits/channels/tunnels/slopes/dumps/other
working outdoors	construction site/agriculture/viticulture/cleaning/handlers/green spaces/forests/animal care/others
working with dangerous voltages	high/medium/low voltages/dangerous voltage poles/transformer areas/electrical switchboards/others
working in the area of action of energies with dangerous potentials	working in the area of action of energies with dangerous potentials
work in flammable, explosive environment	work in flammable, explosive environment
working with open fire	working with open fire
working in isolation	working in isolation
the night thing	the night thing
working in extreme cold/heat conditions	working in extreme cold/heat conditions

5.3. External environmental risks

The external risks of the work environment can be those risks that are not specific to the work environment, are generated or not by the neighborhood or the surrounding environment.

The environment, the climate, the international, national, regional or local environment, the political, social, economic, technological, cultural, ethnic or other environment can have different influences on the work system and implicitly on the work environment.

The newest relevant risk factor is the influence of the Sars CoV-2 pandemic which acted in the surrounding environment and through the random movement of aerosols with the virus reached the work environment or through inhalation of aerosols by workers and transmission from person to person causing illness.

The main external risks of the work environment can be (see table 5.3):

Table 5.3 Risk factors specific to the external work environment [18]

RISK FACTORS SPECIFIC TO THE EXTERNAL WORKPLACE ENVIRONMENT	
Name	Details

the cultural, social, political, legal, financial, technological, economic and natural environment, as well as competition on the market, at an international, national, regional or local level, the dynamics of the environment	social/religious/cultural/political/group affiliation/psychological pressure on management/workers/demotivation/competitive stress/reduced income/lack of prediction/major variations in activity dynamics/risk of job loss/employees/variations/significant environmental changes/ Other
changes related to any of the external aspects	emergence/analysis and provision of measures regarding changes in external aspects/lack/deficiencies/adaptation measures regarding the analysis of changes
overlapping activities	occurrence of overlapping activities/superficial/deficient impact analysis
teleworking/ home work	activities through which workers regularly and voluntarily fulfill their duties specific to the function, occupation or trade they hold, in a place other than the workplace organized by the employer, at least one day a month, using information and communication technology/ activities specific to the position they hold, which workers perform at home and set their own work schedule

5.4. Updating the list of environmental risk factors

The environmental risk factors are automatically correlated with the other elements of the work system, being procedurally interdependent, but it is also necessary to be updated on the structured basis of the OSH management system, because in this way the new elements can be disseminated in the structures of the assessment methods/methodologies occupational risk, specialist language and management perceptions of organizations.

Following the up-to-date analysis regarding the compliance with the new technical, legislative, managerial requirements from the national and international specialist community of professional risk factors, it is found that it is necessary to update and correlate the lists with general and activity-specific risk factors.

This update of the risk factors based on the MEvAR methodology can be found in table 5.4 where, based on the methodology-specific model, the elements with a novelty and update character are represented (they were introduced in the general table for visualization accuracy):

Table 5.4 Risk factors specific to the work system [18] ,[23]

WORK SYSTEM ELEMENTS/ RISKS	RISK FACTORS	
	Category	details
WORK SYSTEM	CERTAINTY/RISKS NOT CONTROLLED BY THE ORGANIZATION	Electrocution by touch/induction lasting more than 1 min
		Bank breaks with a depth greater than 1m
		Falling objects weighing at least 500 gr. from a height greater than 2m
		Slipping on ladders, scaffolding, platforms, ramps
		Hitting/crushing by vehicles/machinery
		Assaults, assaults, violence, other crimes/penalties
		Intention, failure to comply with duties, procedures, work instructions, OSH instructions, dispositions
OTHER RISKS	AUTHORIZATIONS:	authorizations, approvals
		work permits, methods of recognition and/or control

	OCCUPATIONAL ILLNESS:	found/previous/from the record		
	SENSITIVE GROUPS:	pregnant/infirm/lactating/young/disabled women		
	FINANCIAL RISKS:	financial means:	money, cards, bank checks, vouchers	
		damages:	monetary losses, decrease in turnover	
	SPECIFIC RISKS:	chemical pollution		
		risks generated by ensuring prevention and protection measures		
		reputation damage		
		dangerous actions of workers, visitors, neighbors		
	EXTERNAL RISKS:	reduced yield following the occurrence of an event		
		the cultural, social, political, legal, financial, technological, economic and natural environment, as well as competition on the market, at an international, national, regional or local level, the dynamics of the environment		
		the appearance of new competitors, contractors, subcontractors, suppliers, partners and providers, new technologies, new laws and new occupations		
		new knowledge about products and their effect on health and safety		
		key driving factors and trends relevant to the industry or sector, with an impact on the organization		
relations with external stakeholders, as well as their perceptions and values				
changes related to any of the external aspects				
overlapping activities				
OTHER FORECASTING RISKS:	teleworking/ home work			
	falling of atmospheric, cosmic objects			

5.5. Methodology details of MEvAR [17], [18], [20], [23]

The MEvAR methodology essentially includes the following stages to which the specific elements of a professional risk assessment methodology will be added:

- identification of the dangers valued as certainties;
- assessment and evaluation of occupational risks that have not been eliminated;
- data analysis, their introduction into the calculation formulas specific to the methodology's spreadsheets;
- generating through the application the analysis of the results and the final reports of the professional risk assessment
- sending the evaluation report to the beneficiary.

The calculation model of the methodology follows the model of risk calculation which is a variable function between the LIKELIHOOD and severity or the exposure and impact of an event where we have favorably introduced some correction factors in accordance with the specifics and specific structure of the MEvAR.[23]

The calculation application through the Microsoft Excel program uses spreadsheets where the data and values that require calculations are entered, selected, extracted, based on which reports and automatics are generated following the selection and launch of orders by the evaluator specialist.

The results of the spreadsheets constitute the reference elements of the professional risk assessment report and it has as annexes all the spreadsheets specific to the MEvAR methodology.

Input data variables, i.e., risk factors and associated items, can be selected by evaluators in the estimated values spreadsheets.

The following data, forms or reports are entered in the calculation according to the MEvAR methodology:

- checklists of hazards or risk factors;
- the specific calculation of two methods/methodologies (INCDPM and MEvAR);
- reports with acceptable and unacceptable risks;
- calculation grids regarding the assessment according to legal requirements (ergonomics, sensitive groups, others);
- the prevention and protection plan;
- risk register;
- graphics;
- other elements necessary for the calculation and records of the assessment of professional risks according to legal requirements and management systems.

Figures 5.5, 5.6, 5.7, 5.8 show the models of a spreadsheet and graphs from the assessment of occupational risks using the MEvAR methodology.[23]

Between the spreadsheets of the different assessments, only the specific elements are changed from the model.

HAZARDS/ DANGEROUS SITUATIONS/ RISK FACTORS CATEGORY	MEvAR (aggregated risks)	MAXIMUM FORESEEABLE CONSEQUENCE INCDPMB METHOD	DAMAGE LEVEL ND	DAMAGE VALUE	EXPRESSION DAMAGE VALUE	LIKELIHOOD METHOD INCDPMB	LIKELIHOOD METHOD MEvAR P	LIKELIHOOD EXPRESSION MEvAR	SEVERITY/ IMPACT METHOD INCDPMB METHOD	SEVERITY/ IMPACT METHOD MEvAR C	EXPRESSION SEVERITY/ IMPACT MEvAR	IDENTIFIED RISK LEVEL RI	EXPRESSION IDENTIFIED RISK	EXPOSED PERSONS
WORKPLACE ENVIRONMENT/NEARBY ENVIRONMENT	4. WORKING ENVIRONMENT OWN WORKPLACE ENVIRONMENT/ENVIRONMENT NEAR THE WORKPLACE HIGH AND SPECIFIC RISK AREAS: areas exposed to natural risks	death	1,2	10.000-100.000 €	average damage	-	1	very low	-	3	average	2	controlled	any exposed person
	dangerous weather phenomena: storms, floods, tornadoes, drought, frost, forest fires, avalanches	death	1,2	10.000-100.000 €	average damage	-	2	low	-	4	serious	3	tolerated	any exposed person any exposed worker
	destructive phenomena: landslides, earthquakes,	death	1,5	> 1.000.000 €	major damage	-	4	high	-	4	serious	4	not accepted	any exposed person
	areas exposed to technological risks	death	1,2	10.000-100.000 €	average damage	-	3	average	-	4	serious	3,5	not accepted	own exposed worker
	industry, transport, dangerous products, storage: accidents, breakdowns, explosions, fires, water pollution, building collapses, installations, facilities, failure/damage of public utilities, falling objects from the atmosphere or space, grounding/sinking of ships, unexploded	death	1,3	100.000-1.000.000 €	high damage	-	3	average	-	4	serious	3,5	not accepted	any exposed person
	CBRN/NBC risks: chemical, biological contamination, epidemics, epizootics, irradiation, nuclear contamination	death	1,3	100.000-1.000.000 €	high damage	-	3	average	-	4	serious	3,5	not accepted	any exposed person
	risk areas for the security of visitors	death	1,1	1.000 - 10.000 €	low damage	-	3	average	-	4	serious	3,5	not accepted	any exposed person
	general risks: (falling, slipping, hitting, road accident, others)	death	1,2	10.000-100.000 €	average damage	-	3	average	-	3	average	3	tolerated	any exposed person
	DETAILS/LOCATION/SIZE WORKING ENVIRONMENT / LAYOUT OF WORKPLACES: environment: building/outdoor/construction site/mixed/indoors/transportation/underground/other	death	1,1	1.000 - 10.000 €	low damage	-	3	average	-	3	average	3	tolerated	any exposed person
	access areas: in the administration space / at clients, beneficiaries / at institutions / at home / in the field / in means of transport / others	death	1,1	1.000 - 10.000 €	low damage	-	3	average	-	3	average	3	tolerated	any exposed person
height mode: high/max. 4 levels/mezzanine/ground floor/basement/underground/others	death	1,1	1.000 - 10.000 €	low damage	-	3	average	-	2	low	2,5	accepted	any exposed person	
work level: underground/ground floor/floor/ground/doco/scaffold/excavation/aerial/on water/underwater/others	death	1,1	1.000 - 10.000 €	low damage	-	3	average	-	2	low	2,5	accepted	any exposed person	

Figure 5.5 Identified risks spreadsheet [23]

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
No	NAME OF MEANS OF PRODUCTION	TYPE/MANUFACTURER	USED ENERGY	DETERMINED PARAMETER	TOLERANCE ACCEPTED	POSSIBLE FAILURE	CORRECTIVE MEASURE	YEAR ENTRY INTO USE	DURATION OF USE	DATE OVERHAUL	AVERAGE REPAIR DATE	CURRENT REPAIR DATE	NO. HISTORICAL EVENTS	HISTORICAL EVENTS DETAILS	RISK FACTOR/HAZARD TO WORKERS	INITIAL ASSESSMENT LEVEL HAZARDS
1	cement mixer	HENNER	electrical installation	viteză rotație	0,5	rotation speed	command mode replacement	2020	5	-	-	-	-	-	hand grip	low
2	drill	BOSCH	electrical installation	viteză rotație	0,5	rotation speed	command mode replacement	2021	2	-	-	-	-	-	hand grip	low
3	circular saw	BOSCH	electrical installation	viteză rotație	0,5	rotation speed	command mode replacement	2021	2	-	-	-	-	-	hand grip	low
4																
5																

Figure 5.7 Equipment evaluation spreadsheet.[23]

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
No	NAME OF MEANS OF PRODUCTION	TYPE/MANUFACTURER	USED ENERGY	DETERMINED PARAMETER	TOLERANCE ACCEPTED	POSSIBLE FAILURE	CORRECTIVE MEASURE	YEAR ENTRY INTO USE	DURATION OF USE	DATE OVERHAUL	AVERAGE REPAIR DATE	CURRENT REPAIR DATE	NO. HISTORICAL EVENTS	HISTORICAL EVENTS DETAILS	RISK FACTOR/HAZARD TO WORKERS	INITIAL ASSESSMENT LEVEL HAZARDS
1	cement mixer	HENNER	electrical installation	viteză rotație	0,5	rotation speed	command mode replacement	2020	5	-	-	-	-	-	hand grip	low
2	drill	BOSCH	electrical installation	viteză rotație	0,5	rotation speed	command mode replacement	2021	2	-	-	-	-	-	hand grip	low
3	circular saw	BOSCH	electrical installation	viteză rotație	0,5	rotation speed	command mode replacement	2021	2	-	-	-	-	-	hand grip	low
4																
5																

Figure 5.8 Assessment spreadsheet for dangerous chemical substances/preparations [23]

5.6. Conclusions

The main conclusions regarding the research carried out in this chapter are:

- a thorough identification of the environmental risk factors specific to the work system and the various environmental categories (work, environment, financial, physical security, national security, administrative, political, etc.) was carried out;
- the integration and analysis of environmental risk factors in the risk analysis was carried out, the risks in the work environment are related and interdependent with the main environmental risks;
- the follow-up of the data comparison and the extraction of the summary elements or specialized reports necessary for the risk assessment and in particular the assessment of the influence on the staff was ensured;
- the main categories of environmental risk, internal and external risks that were the basis of the comparative analysis regarding general and professional risks were presented;
- there was a need to analyze risks that were not previously identified in work systems, such as strategic risks, compliance risks, financial risks, operational risks, personnel risks, environmental risks, including natural disasters, risks regarding political and economic instability, others;

- the main new aspect that was researched and developed in the chapter, consists in the integration of general and especially environmental risks in the analysis of occupational risks specific to safety and health at work;
- elements of the risk to staff generated by the disease generated by the SARS CoV 2 virus and the COVID 19 pandemic were analyzed and presented;
- the risk factors associated with the specific implementation and monitoring activities of the OSH management system according to SR EN ISO 45001:2018 were introduced according to the MEvAR methodology;
- some inconsistencies regarding the terminology and method of substantiation specific to the MEvAR methodology were noticed, such as the modification of the term method in the methodology, of weight in involvement and the introduction of the elements of consequence of the trauma and the value of the damage, inconsistencies that will be the subject of the study in the following chapters;
- the list of risk factors was updated and supplemented with the new risks specific to the MEvAR methodology according to Table 5.4 Risk factors specific to the labor system;
- the MEvAR methodology was briefly presented with which the consistent part of the analysis will be carried out from the research on the influence of environmental risk factors on the staff
- the correlation between the general risks that can affect the organization and the workers, the environmental risks in particular and the newly identified risks through the MEvAR methodology can constitute an important area of research and deepening the analysis of the influence of the environment on the workers by cumulating the analyzes that were carried out separately by category in one integrated form;
- the advantage given by this approach is significant because it ensures the management's understanding of the specific technical elements of risk assessment, especially due to the fact that the methodology ensures the direct involvement of the organization's management in how to treat risks, prevention and protection measures in all the fields not only of safety and health at work;
- the chapter did not present all the parts specific to the structure of the methodology, the spreadsheets or other elements of analysis, but only a few significant comparative tables and graphs necessary for familiarization with the structure and calculation method of the MEvAR methodology;
- the MEvAR methodology was presented in scientific articles published in magazines and at specialized conferences. [17], [18], [19], [20], [21], [22]

Chapter 6. Theoretical and experimental study on the influence of environmental factors through the MEvAR methodology within an organization

6.1. MEvAR methodology analysis

In order to carry out the case study, I have chosen as elements necessary for the analysis the study of the application of the MEvAR professional risk assessment methodology to a job/activity photovoltaic panel assembler in the field of construction by changing the conditions of risk treatment, which will generate the necessary conclusions for establishing the way in which environmental risk factors can influence the health status of workers.

For this, we established the following initial elements of analysis:

- the term personal includes all the people who carry out permanent or temporary activities in the work environment, in its vicinity or proximity, who can be influenced in terms of health by environmental risk factors identified as potential that can generate events in predictable conditions (trauma and/ or diseases). They can be own workers, external workers of other employers, visitors,

other participants in the work process in accordance with the provisions of the law, residents, neighbors, other people potentially affected by risk factors;

- the monitoring of the state of medical fitness of the workers who are the subject of the study was carried out by following the periodical report of the occupational medicine doctor and correlating the conditions found with the previously identified risk factors and no correlations were found between the medical case file and the records and the environmental conditions of the work;

- the performance of noxes determinations and environmental analyzes in the work spaces were checked and found to be within the accepted legal limits;

- the checklist of risk factors from the previous assessment was used and completed according to the update in the previous chapter;

- the professional risk assessment carried out before the workplace was verified and compared using the modified and adapted INCDPM Bucharest method, the results being entered into the calculation and comparison specific to the MEvAR methodology;

- the evaluation of professional risks for the job studied by the MEvAR methodology was carried out by 2 evaluation specialists, according to the requirements of the methodology;

- the way of ensuring prevention and protection measures, of performing controls and monitoring was checked and it was found that it complies with the legal requirements and those of the management of the organization under study;

- the method of informing workers and internal and external communications was checked and it was found that they are ensured;

- the ways of solving the issues found during the monitoring and controls, working meetings were checked and it was found that they are ensured and properly documented;

- in the course of the study, partial changes were made to the correction factors in order to follow the variation of the results;

- risks with LIKELIHOOD values higher than 90% can be considered almost certain or certainties, as well as risks that are not manageable by the organization;

- the research directions and methods were accepted by the management of the organization;

- visits to workplaces and the collection of data necessary for the analysis were carried out.

It was found during the study that the term weight is similar to the elements of the evaluation method by weight where the expression weight refers to the value of importance established by the evaluator of the impact of the risk, and in order not to create confusion it is proposed to change the name of weight in the involvement of the management that represents a better correlation as a correction factor.

Also, the term certainty is associated in the method both for risks with maximum LIKELIHOOD value and for risks with very high values.

A variety of separate establishment of certainties and another of establishment of risks with almost certain value that do not fall under the competence of the organization are proposed.

For the accuracy of the results, we will consider risks with LIKELIHOOD values higher than 90% almost certain or certainties, as well as risks that are not manageable by the organization.

In the analysis of **certainties**, we started from the premise that **certainty** is the anticipation with a single value and the uncertainty associated with the risk is the anticipation with the LIKELIHOOD of occurrence and/or its impact of at least 2 values. [55]

The grid table for calculating the level of injury could be supplemented with the foreseeable consequence so that there is a direct correlation with the other assessment methods.

In order to estimate the calculation of the level of material damage, a convention was used at the disposal of each evaluator who can appreciate at the direct level of the evaluated organization the economic impact of the production of an event - it can be different from one organization to another depending on the endowments, affected technological flow, figures business, others.

The MEvAR methodology is organized in the establishment of risk levels by numerical values for mathematical calculation, but the results are in the form of a grid expression.

The calculation of the risk level is initially established as an identified risk, after the assessment of the level of compliance and involvement of the assessed risk management and finally following the establishment, acceptance and assurance of measures to treat residual risk risks.

The methodology is different from other methods, methodologies precisely through the managerial structure where the evaluation committee establishes the level of risk from a technical point of view and the management of the organization establishes the form of risk treatment so that the two entities participating in the risk assessment and treatment process work jointly for hazard management.

At the end of the chapter, the forms proposed for the changes made to the MEvAR methodology are highlighted.

6.2. Check list

Checklists are useful tools for identifying occupational hazards that may affect the organization, workers or activities.

To achieve them in practice, the analysis of the impact of risk factors and/or foreseeable dangerous situations in the organization is used.

Thus, in the case of the classical methods, the lists with the specific risk factors of the respective methods are used and based on them the risks are identified and assessed according to the calculation procedures, subsequently the changes arising from the evaluation are not verified.

The MEvAR methodology through its own procedures and the attached calculation tool ensures the identification of the categories of hazards/dangerous situations/risk factors in the organization and its external environment, the assessment and evaluation of professional risks adapted to the OSH management system based on the SR EN ISO 45001:2018 standard and for the analysis of the impact of the proposed and ensured prevention and protection measures, it offers the possibility of assessment also after calculating the residual risk. Table 6.1 shows a model list for identification and verification of potential risks in the organization/activity.

Table 6.1 List of identification and verification of potential organization/activity risks using the MEvAR methodology - extracted [23]

DANGER CATEGORY/ DANGEROUS SITUATIONS/ RISK FACTORS		HAZARDS/HAZARDOUS SITUATIONS/RISK FACTORS FOR OCCUPATIONAL ACCIDENTS AND DISEASE MEvAR (aggregate risks)	Certain/almost certain dangers	Probable risks	Potential risks	EXPOSED PERSONS	INSURANCE LEVEL REQUIREMENTS C	INSURANCE LEVEL REQUIREMENTS EXPRESSION	MANAGEMENT INVOLVEMENT PO	EXPRESSION OF MANAGEMENT INVOLVEMENT	DATE OF CHECK	DATE OF LAST REVISION	DETAILS
CERTAINTY		Electrocution by touch/induction lasting more than 1 min	yes	yes	no	any exposed person	0,5	uninsured	1	Minimal involvement	17.11.2021	17.11.2021	
		Bank breaks with a depth greater than 1m	no	no	yes	any exposed person	0,5	uninsured	1	Implica reminimală	17.11.2021	17.11.2021	
		Falling of objects weighing at least 500 gr. from a height greater than 2m	yes	yes	no	any exposed person	0,5	uninsured	1	Minimal involvement	17.11.2021	17.11.2021	
		Slipping on ladders, scaffolding, platforms, ramps	yes	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		Hitting/crushing by vehicles/machinery	yes	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		Assaults, assaults, violence, other crimes/penalties	yes	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		Intention, failure to comply with duties, procedures, work instructions, OSH instructions, dispositions	yes	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
4. WORKING ENVIRONMENT	WORKPLACE ENVIRONMENT/ MEDIUL DIN PROXIMITATE	4. WORKPLACE ENVIRONMENT/ENVIRONMENT NEAR THE WORKPLACE HIGH AND SPECIFIC RISK AREAS: AREAS EXPOSED TO NATURAL RISKS: areas exposed to natural risks	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
	SPECIAL	SPECIAL CHARACTER OF THE ENVIRONMENT: underground/aquatic/subaquatic/swampy/aerial/space/other	no	no	yes	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
	SPECIFIC	SPECIAL CHARACTER OF THE ENVIRONMENT: underground/aquatic/subaquatic/swampy/aerial/space/other...	no	no	yes	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		working at height: scaffolding/gantry/scaffolding/poles/ladders/on a rope/on the hood of machinery/others	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		excavation work: excavations/trenches/pits/channels/tunnels/slopes/dumps/others	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	

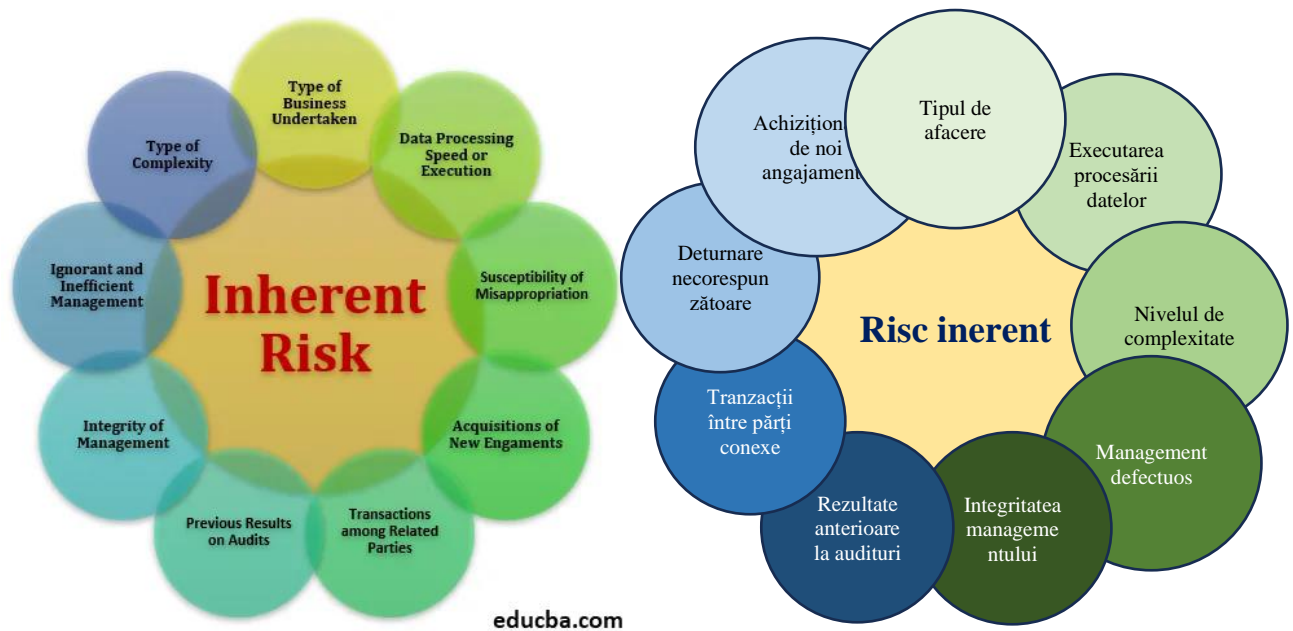
		outdoor work: construction site/agriculture/viticulture/cleaning/manipulators/green spaces/forests/animal care/others	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		working with dangerous voltages: high/medium/low voltages/dangerous voltage poles/transformer areas/electrical switchboards/others	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		working in the area of action of potentially dangerous energies: kinetic/electrical/mechanical/pressure/temperature/gravity/hydraulic/chemical/radiation energies	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		work in flammable, explosive environment: dyers/production, substance handling/cylinders/welders/kitchens/fuel handling/fireworks	no	no	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		open fire work: welders/kitchens/green spaces/fireworks	no	no	yes	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		Isolated working: security/supervision/driver/office/crane/others	no	no	yes	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		night work: guard/surveillance/shifts/control	no	no	yes	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		working in extreme cold/heat conditions: warehouse/construction site/cold installations/kitchens/heating plants/others	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
5. OTHER RISKS	AUTORIZATION	5. OTHER RISKS AUTORIZATION: authorization, approvals	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		EXTERNALS RISKS: overlapping activities	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	
		EXTERNALS RISKS: telework/home work	no	yes	no	any exposed person	0,5	uninsured	1	minimal involvement	17.11.2021	17.11.2021	

6.3. Inherent and residual risks generated by environmental factors

Inherent risk can be defined as an expression of risk at the level of the organization, where the LIKELIHOOD of loss is a derivative function of the type and complexity of the activity performed by the organization without changing the characteristics of the identified environment. [157]

Audit risk includes: [157]

- inherent risk;
- the risk of detection;
- control (see figure 6.1).



educba.com
Figure 6.1. Inherent risks

Inherent risk is inversely proportional to detection risk (risk identification and control) and directly proportional to audit quality). [157]

The formula for calculating the inherent risk can be seen in figure 6.2. [157]

$$\text{Inherent risk} = \frac{\text{risk auditing}}{\text{risk control} \times \text{risk identification}}$$

Figure 6.2 Calculation of inherent risk [157]

These exceptional situations can be considered: [157]

- damage/destruction of equipment, installations, machines that are unlikely to be foreseen;
- the cascading accumulation of sources generating unforeseen events;
- external influence that is not under the organization's control or forecast;
- independent actions/affecting the health status of workers that do not comply with the records, work or security instructions of the organization;
- any other situations in which hazards that generate risk cannot or have not been identified.

Table 6.2 exemplifies the residual risks specific to the MEvAR methodology [23]

Table 6.2 Assessment of risks after treatment – residual risks according to the MEvAR methodology [23]

ASSESSMENT, EVALUATION AND TREATMENT OF DANGERS/RISKS OF ACCIDENTS AND OCCUPATIONAL DISEASE using the MEvAR methodology FOR THE WORKPLACE/POST/ACTIVITY/PROCESS/SENSITIVE GROUP/WORK EQUIPMENT/USED CHEMICALS AND/OR CHEMICALS/ORGANIZATION OF WORKPLACES AFTER TREATMENT OF THE RISKS (RESIDUAL RISK)																											
OBJECTIVE/ ACTIVITY	ID	MEvAR (aggregate risks)		MAXIMUM FORESEEABLE CONSEQUENCE - CO	DAMAGE LEVEL - ND	DAMAGE VALUE	EXPRESSION VALUE DAMAGE	MEvAR LIKELIHOOD IDENTIFIED - PI	LIKELIHOOD EXPRESSION MEvAR IDENTIFIED	RESIDUAL MEvAR LIKELIHOOD - PR	LIKELIHOOD EXPRESSION RESIDUAL MEvAR	SEVERITY/ IMPACT MEvAR IDENTIFIED - GI	EXPRESSION SEVERITY/ IMPACT MEvAR IDENTIFIED	GRAVITY/ IMPACT MEvAR RESIDUAL - GR	EXPRESSION GRAVITY/ IMPACT RESIDUAL MEvAR	EXPOSED PERSONS	INSURANCE LEVEL REQUIREMENTS - C	INSURANCE LEVEL REQUIREMENTS EXPRESSION	MANAGEMENT INVOLVEMENT - IM	EXPRESSION MANAGEMENT INVOLVEMENT	ASSESSED RISK LEVEL MEvAR - RA	RISK EXPRESSION	RESIDUAL MEvAR RISK LEVEL - RR	RESIDUAL MEvAR RISK LEVEL EXPRESSION	IDENTIFIED RISK TREATMENT STRATEGY	RESIDUAL RISK TREATMENT STRATEGY	DATE OF LAST REVISION
		DANGER CATEGORY/ DANGEROUS SITUATIONS/ RISK FACTORS	DANGERS/ DANGEROUS SITUATIONS/ OCCUPATIONAL ACCIDENT AND DISEASE RISK FACTORS																								
MM 1	4. WORKING ENVIRONMENT	WORKPLACE ENVIRONMENT/MEDIUL DIN PROXIMITATE	4. WORKPLACE ENVIRONMENT/ENVIRONMENT NEAR THE WORKPLACE HIGH AND SPECIFIC RISK AREAS: AREAS EXPOSED TO NATURAL RISKS: areas exposed to natural risks	death	1,2	10.000-100.000 €	average damage	1	very low	1	very low	3	average	3	average	any exposed person	1,25	appropriate	1,25	appropriate involvement	1,28	managed	1,28	managed	monitoring/ măsură de control	monitoring	17.11.2021
MM 64			EXTERNAL RISKS: overlapping activities	death	1,1	1.000 - 10.000 €	low damage	2	low	3	average	3	average	3	average	any exposed person	1,25	appropriate	1,25	appropriate involvement	1,6	controlled	1,92	controlled	monitoring/ control measures	monitoring	17.11.2021
MM 65			EXTERNAL RISKS: telework/home work	death	1,1	1.000 - 10.000 €	low damage	2	low	3	average	3	average	3	average	any exposed person	1,25	appropriate	1,25	appropriate involvement	1,6	controlled	1,92	controlled	monitoring/ control measures	monitoring	17.11.2021

6.4. Comparisons regarding the assessment of occupational risks using the MEvAR methodology

The work environment in the construction sector includes variable elements to most of the specific risk factors determined by climatic conditions, organization, internal or external influences, other sources.

Before studying the work environment, it is necessary to establish whether the structure of the work system in the current definition is comprehensive or whether an update or addition is needed in order to ensure an analysis adapted to the current conditions.

Likewise, in the definition of risks, we do not find the certainties that have the maximum LIKELIHOOD of realization and from practice it is found that these certainties can be activated in situations that do not depend exclusively on employers.

The obligation to comply with prevention and protection measures in the field of OSH rests with workers according to art. 22 of Law 319/2006 Each worker must carry out his activity, in accordance with his training and training, as well as with the instructions received from the employer, so as not to expose both himself and others to the risk of occupational injury or illness persons who may be affected by his actions or omissions during the work process. [96] their violation being penalized by violating the Criminal Code art. 350 non-compliance by any person with the obligations and measures established regarding safety and health at work, if this creates an imminent danger of an occupational accident or occupational disease, contravention or disciplinary according to internal regulations. [64]

These aspects can significantly affect the work of organizations and especially professional risk assessors because the reasonable limit is not clearly defined.

For this purpose, we can present some risks with an appreciated character by convention of certainties which, upon an interpretation based on elements of LIKELIHOOD, insurance possibilities and skills, can establish reasonable limits of accepted, tolerated or assumed risks (see figure 6.3).

WORK SYSTEM ELEMENTS	CATEGORY HAZARDS/HAZARDOUS SITUATIONS/ RISK	FACTORS HAZARDS/HAZARDOUS SITUATIONS/RISK FACTORS FOR OCCUPATIONAL INJURY AND ILLNESS	CAUSES OF RISK
WHOLE WORK SYSTEM	CERTAINTIES	electrocution by touch/induction lasting more than 1 min	occurrence/existence of dangerous voltage in the area of action of the worker who does not distinguish/avoid the hazard in time or touch/touch/penetration/induction of the hazard
		bank overtopping deeper than 1m	occurrence/existence of excavation more than 1 m deep, lack of protection/supports and access of the worker to the area not recognizing/avoiding the danger in time
		falling objects weighing at least 500 grams from a height of more than 2m	the appearance/existence of objects weighing at least 500 g at a height of more than 2 m in the area of action/travel of the worker who does not distinguish/avoid the danger in time or in the absence of protection and improper use of PPE
		slipping on ladders, scaffolding, platforms, ramps	occurrence/existence of environmental/health factors/elements that may cause slipping, falling on ladders, scaffolding, platforms, ramps in the area of action of the worker who does not recognize/avoid the danger in time or in the absence of protection and improper use of PPE
		being hit/struck by vehicles/tools	the appearance/existence of vehicles/tools in the worker's area of action which do not recognize/avoid the danger in good time, or in the absence of safeguards/signs/warnings/maintaining normal conditions of movement/safety zone boundaries
		assaults, attacks, violence, other offences/contraventions	the occurrence/existence of dangerous situations such as assaults, attacks, violence, other crimes/contraventions in the area of action of the worker who does not recognize/avoid the danger in time
		intent, non-compliance with duties, procedures, work instructions, SSM instructions, provisions	occurrence/existence of situations where the worker intentionally or unintentionally fails to comply with the worker's duties, procedures, work instructions, SSM instructions, provisions
	unauthorized/unconscious/ access to dangerous areas	occurrence/existence of situations of intentional or unintentional non-compliance by the worker with duties, procedures, work instructions, SSM instructions, provisions in hazardous areas	

Figure 6.3 MEvAR methodology certainty analysis [23]

Risks in the work environment are related and interdependent with the main environmental risks defined according to environmental and OSH legislation through the MEvAR methodology (see table 6.3).

A classification of the categories of occupational risk factors is presented in table 6.5 from which we can consider a new category that exceeds the assessment of the risks of the work system, namely other risks that complement the general and specific situation of the assessed workplace.

Table 6.5 Categories of occupational risk factors INCDPM method and MEvAR methodology [18]

WORK SYSTEM/ RISKS [23]	RISK FACTORS CATEGORIES	
	The INCDPM method [23]	MEvAR Methodology [18], [70]
worker [23]	-	organization/ team/ group/ worker
	wrong actions	dangerous actions
	omissions	omissions
work task [23]	-	daily operations and decisions
	-	OSH opportunities
	inappropriate content of the work load in relation to the security requirements	applications
	the task is under/oversized in relation to the capacity of the performer	
means of production [23]	-	means of work
	-	objects of work
	-	hazardous material
	-	technical data
	mechanical risk factors	mechanical risk factors
	thermal risk factors	thermal risk factors
	electrical risk factors	electrical risk factors
	chemical risk factors	chemical risk factors
biological risk factors	biological risk factors	
Work environment [23]	-	the workplace's own environment/ the environment in the vicinity
	-	workplace details
	physical risk factors	physical risk factors
	chemical risk factors	chemical risk factors
	biological risk factors	biological risk factors
	special character of the environment	special risk factors
Other risks [23]	-	sensitive
	-	finance
	-	specific
	-	outer
	-	other

The main new external risks of the working environment updated according to the MEvAR methodology are highlighted in bold and italics in table 6.6:

Table 6.6 Risk factors specific to the external work environment MEvAR methodology [18], [23]

RISK FACTORS SPECIFIC TO THE EXTERNAL WORKPLACE ENVIRONMENT [23]	
overlapping activities	occurrence of overlapping activities/superficial/deficient impact analysis
<i>emerging risks/TIC/digitalization</i>	<i>analyzing the emerging risks of the possible effects of new technologies, new ways of working and changes in society on the safety and health of workers, analyzing the rapid evolution of digital technologies, including artificial intelligence and robotics, and their potential impact on safety and health at work</i>
<i>teleworking/homework [128]</i>	<i>activities through which workers regularly and voluntarily fulfill their duties specific to the function, occupation or trade they hold, in a place other than the workplace organized by the employer, at least one day a month, using information and communication technology/ activities specific to the position they hold, which workers perform at home and set their own work schedule [128]</i>

Following the analysis of the influences of other environmental elements not classified in the main assessment methods known in Romania, we propose the adaptation, completion or comparison of the following elements specific to the work environment that can affect the health and safety of workers, those highlighted by thickening and tilting being new or updated elements (see table 6.7):

Table 6.7 Risk factors specific to the work environment MEvAR methodology [18], [23]

WORK SYSTEM ELEMENTS	HAZARDS CATEGORY/ DANGEROUS SITUATIONS/ RISK FACTORS	HAZARDS/DANGEROUS SITUATIONS/ OCCUPATIONAL ACCIDENT AND DISEASE RISK FACTORS	CAUSES THAT FAVOR THE EMERGENCE OF RISK
WORKING ENVIRONMENT	WORKPLACE ENVIRONMENT/NEARBY ENVIRONMENT	HIGH AND SPECIFIC RISK AREAS:	
		<i>own areas exposed to natural risks</i>	the appearance/existence of work areas exposed to natural risks (working in open air spaces, snow removal, construction site, exterior landscaping, others)
		<i>risk areas for visitors' security</i>	the periodic/predicted/random occurrence/existence of some risks in the visitors' action area
		<i>general risks of injury: (falling, slipping, hitting, road accident, others)</i>	the periodic/predicted/random occurrence/existence of other general risks not specific to the work environment
	WORKPLACE DETAILS	DETAILS/LOCATION/SIZE WORKING ENVIRONMENT / LAYOUT OF WORKPLACES:	
<i>environment: building/outdoor/ construction site/mixed/indoors/transportation/underground/others</i>		the influence of the type of environment on the work environment	

		<i>access areas: in the administration space / at clients, beneficiaries / at institutions / at home / in the field / in means of transport / others</i>	the influence of access areas on the work environment
		<i>height regime: high/ max. 4 levels/semi-floor/ground floor/basement/underground/others</i>	the influence of the height regime on the work environment
		<i>working level: underground/ground floor/floor/ground/nacelle/scaffold/excavation/aerial/on water/underwater/others</i>	the influence of the work level on the work environment
		<i>personal access inside: normal/double/revolving/automatic/others:</i>	the influence of indoor access on the work environment
		<i>circulation routes: corridor/hallway/elevator/concrete stairs/metal stairs/escalators/alleys/parking lot/others:</i>	the influence of traffic routes on the work environment
		<i>access restrictions: no access control/access control/card identification/human identification/barrier/turnstiles/others</i>	the influence of access restrictions on the work environment
OTHER RISKS OF OCCUPATIONAL DISEASE:	SPECIFIC RISK FACTORS	<i>specific construction risks</i>	the influence of specific risks in the field of construction
		<i>risks generated by the provision/application of prevention and protection measures</i>	the influence of the risks associated with the insurance/application of prevention and protection measures
		<i>emerging risks/TIC/digitalization</i>	the influence of using digitization and TIC
		<i>telework/home work</i>	the influence of the lack of control of the organization

Table 6.8 shows the relationships regarding the influence of the MEvAR correction factors in changing the effects of risk treatment for the job/activity of photovoltaic panel installer in a construction company.

Table 6.8 Risk relationship – MEvAR correction factors

RELATIONSHIP RISK -FACTORS CORRECTION		MANAGEMENT INVOLVEMENT		
		1,0	1,25	1,5
INSURANCE REQUIREMENTS	0,5	6,61 unacceptable	5,29 unacceptable	4,41 unacceptable
	1	3,31 unacceptable	2,65 tolerated	2,20 accepted
	1,5	2,20 accepted	1,76 controlled	1,47 managed

In the following tables, we have presented extracts from the risk assessment reports that constitute the support for the above grid in the sense that it is found that for a risk already assessed

by using the variation of the estimated values of the correction factors, ensuring the legal and management system requirements and management involvement in risk management.

Thus, it can be seen that for not ensuring the legal requirements, regardless of the involvement of the management, the risk values will not be accepted.

In the case of minimal involvement of the management only in the case of ensuring the legal requirements and additionally those of the management system, an accepted level of risk can be found.

In the case of ensuring the legal and management system requirements at the level required by the legislation if there is management involvement the risks can be tolerated or acceptable.

The most favorable situation is in the case of ensuring both requirements at the maximum level.

In the framework of the activity regarding the assessment/evaluation/determination of the risks of injury and/or illness/dangers for places/jobs/activities/processes/sensitive groups/work equipment/substances and/or chemical preparations used/arrangement of positions/places of work: fitter I used the following initial data (table 6.9): [23]

Table 6.9 Initial details of professional risk assessment MEvAR methodology

Nr. crt.	Category	Details	Obs.
A	WORK SYSTEM		
1	the work process	<p>activity carried out / process:</p> <ul style="list-style-type: none"> - assembly activities, handling, transport, loading-unloading, stacking, site elements, components and materials, directing transport vehicles - use of equipment, installations, systems, materials from the construction site - use of substances and/or chemical preparations in specific activities - movements inside and outside the construction site, use of technical means of movement - other work-related activities <p>inputs: qualified personnel, installer of photovoltaic panels according to framing functions, tasks, orders, elements, equipment, electricity, water, natural air</p> <p>outputs: handling services, transport, loading-unloading, performing work tasks, electricity consumption, spare parts, heat emissions, polluted air, biological agents, powders, waste, others</p>	
2	worker	<ul style="list-style-type: none"> - the employment conditions of the worker are ensured - the state of health is checked by the occupational medicine doctor periodically - the level of knowledge is periodically checked - there is previous training, he knows the work procedures - the workers have different employment qualifications, but they only carry out photovoltaic panel assembly activities - was previously informed about how to travel to/from work at home - it was processed and verified regarding the Internal Regulation, the organization and operation regulation, management provisions and internal procedures - was processed and trained on how to prevent and protect against infection with viruses, bacteria such as SARS CoV-2 (observing and 	

		ensuring distance, mask use, disinfection, epidemiological triage, self-quarantine, communication, others)	
3	work task	<ul style="list-style-type: none"> - carries out activities during the program between 08⁰⁰ - 16³⁰ or according to the decisions - visual check of the integrity of the office, the warehouse, the warehouse, the workplace, the state of fixation, inventory, operation of installations, equipment - information on the activities to be carried out on the respective working day and on their prioritization, meetings - assembly activities, handling, transport, loading-unloading, stacking, site elements, components and materials, directing transport vehicles - activities according to the job description 	
		<ul style="list-style-type: none"> - special activities regarding the health of the population and compliance with measures at the workplace (prevention and protection against infection with viruses, bacteria like SARS CoV-2) - other activities not specified above that can be carried out in the company/site 	
4	means of production	<p>according to the list of means/equipment provided:</p> <p>means of work/work equipment:</p> <ul style="list-style-type: none"> - work tools: poles, beams, support system elements, photovoltaic panels, ladder, drill, circular saw, tools, others - means of transport and means of communication: shared/own/service means of transport - productive buildings: warehouse, office, buildings, workplaces, company/site, - containers and warehouses for storing products: cupboards, shelves, drawers, boxes, containers, stacks - energetic fluids: electricity, water, fuels, compressed air, hydraulic fluids <p>objects of work:</p> <ul style="list-style-type: none"> - raw materials, materials, semi-finished products, etc.: photovoltaic panel elements, ballast, sand, anchorage, cement, concrete, screws, nuts, clamps, parts, components, others - financial means: money, bank cards, vouchers <p>related means of work:</p> <ul style="list-style-type: none"> - coffee machine, filter, water dispenser, electric oven/microwave, drinks machine, TV, cutlery, crockery, different containers, others - thermometer, disinfectant dispenser, respiratory mask, gloves according to recommendations - barracks 	
B	WORK ORGANIZATION		
5	work environment	according to the checklist	
6	work organization	at the headquarters/work point	
7	type of work	mixed	
8	overlapping activities	site entry-exit, movement of circulation paths, connections, connections, joint work	
9	site organization	in charge of the general contractor	
C	STATISTICS/RECORDS		
10	previous events	no evidence was presented	
11	work-related medical conditions	no evidence was presented	

12	equipment technical records	according to the technical books of the equipment	
13	authorizations/approvals	it is not the case for the installer	
14	authority's controls	two previous checks by local authorities with remedial measures: use of PPE, verification of compliance with extreme temperature measures	
D	DOCUMENTS REQUIRED FOR EVALUATION		
15	employment documents	- individual employment contract - job description with OSH annex - OSH, ES training sheet completed up to date	
16	working documents	- work procedure for installing photovoltaic panels - own OSH instructions for installer of photovoltaic panels - PPE grant list - minutes handing over - receiving location/front work/site organization	
17	employed questionnaire	28 questionnaires were completed	
18	workplace leader questionnaire	2 questionnaires were completed	
E	INTERVIEW/DISCUSSIONS		
19	interview/discussions	direct interviews/discussions with workers at the workplace were ensured	

Table 6.10 Evaluation of occupational risks/accidents and occupational diseases for the place/job: installer of photovoltaic panels (minimum insurance of requirements and significant management involvement) according to the MEvAR methodology [23]

DANGER CATEGORY/ DANGEROUS SITUATIONS/ RISK FACTORS	HAZARDS/HAZARDOUS SITUATIONS/RISK FACTORS FOR OCCUPATIONAL ACCIDENTS AND DISEASE MEvAR (aggregate risks)[23]	Certain/almost certain dangers	Probable risks	Potential risks	EXPOSED PERSONS INITIAL	IDENTIFIED RISK LEVEL	IDENTIFIED RISK EXPRESSION	INSURANCE LEVEL	INSURANCE LEVEL REQUIREMENTS EXPRESSION	MANAGEMENT INVOLVEMENT	EXPRESSION OF MANAGEMENT INVOLVEMENT	ASSESSED RISK LEVEL MEvAR methodology RA	RISK EXPRESSION MEvAR methodology	RISK TREATMENT STRATEGY
CERTAINTY [23]	Electrocution by touch/induction lasting more than 1 min	yes	yes	no	any exposed person	5	unacceptable	0,5	uninsured	1,5	important involvement	6,67	unacceptable	elimination/avoidance/transfer/treatment
	Bank breaks with a depth greater than 1m	no	no	yes	any exposed person	5	unacceptable	0,5	uninsured	1,5	important involvement	6,67	unacceptable	elimination/avoidance/transfer/treatment
	Falling of objects weighing at least 500 gr. from a height greater than 2m	yes	yes	no	any exposed person	5	unacceptable	0,5	uninsured	1,5	important involvement	6,67	unacceptable	elimination/avoidance/transfer/treatment
	Alunecare pe scări, schele, platforme, rampe	yes	yes	no	any exposed person	5	unacceptable	0,5	uninsured	1,5	important involvement	6,67	unacceptable	elimination/avoidance/transfer/treatment
	Hitting/crushing by vehicles/machinery	yes	yes	no	any exposed person	5	unacceptable	0,5	uninsured	1,5	important involvement	6,67	unacceptable	elimination/avoidance/transfer/treatment
	Agresiuni, atacuri, violențe, alte infracțiuni/contravenții	yes	yes	no	any exposed person	5	unacceptable	0,5	uninsured	1,5	important involvement	6,67	unacceptable	elimination/avoidance/transfer/treatment

		Intention, failure to comply with duties, procedures, work instructions, OSH instructions, dispositions	yes	yes	no	any exposed person	5	unacceptable	0,5	uninsured	1,5	important involvement	6,67	unacceptable	elimination/avoidance/transfer/treatment
4. WORKING ENVIRONMENT [23]	WORKPLACE ENVIRONMENT/MEDIUL DIN PROXIMITATE [23]	4. WORK ENVIRONMENT [23] WORKPLACE ENVIRONMENT/ THE ENVIRONMENT NEAR THE WORKPLACE HIGH AND SPECIFIC RISK AREAS: areas exposed to natural risks	no	yes	no	any exposed person	4	unacceptable	0,5	uninsured	1,5	important involvement	5,33	unacceptable	elimination/avoidance/transfer/treatment
		dangerous weather phenomena: storms, floods, tornadoes, drought, frost, forest fires, avalanches	no	yes	no	any exposed person	4	unacceptable	0,5	uninsured	1,5	important involvement	5,33	unacceptable	elimination/avoidance/transfer/treatment
		destructive phenomena: landslides, earthquakes,	no	no	yes	any exposed person	4	unacceptable	0,5	uninsured	1,5	important involvement	5,33	unacceptable	elimination/avoidance/transfer/treatment
		general risks: (falling, slipping, hitting, road accident, others)	no	yes	no	any exposed person	4	unacceptable	0,5	uninsured	1,5	important involvement	5,33	unacceptable	elimination/avoidance/transfer/treatment
	WORKPLACE DETAILS [23]	DETAILS/LOCATION/SIZE WORKING ENVIRONMENT/ WORKPLACE LAYOUT: Environment: Building/Outdoor/Site/Mixed/Indoor/Transportation/ Underground/Other	no	yes	no	any exposed person	4	unacceptable	0,5	uninsured	1,5	important involvement	5,33	unacceptable	elimination/avoidance/transfer/treatment
PHYSICAL RISK FACTORS [23]	PHYSICAL RISK FACTORS season: hot/cold	no	yes	no	any exposed person	3	tolerated	0,5	uninsured	1,5	important involvement	4,00	unacceptable	elimination/avoidance/transfer/treatment	

		air temperature: high / low	no	yes	no	any exposed person	3,5	unacceptable	0,5	uninsured	1,5	important involvement	4,67	unacceptable	elimination/avoidance/transfer/treatment
		temperature of objects/materials/work equipment: high/low	no	yes	no	any exposed person	3,5	unacceptable	0,5	uninsured	1,5	important involvement	4,67	unacceptable	elimination/avoidance/transfer/treatment
		precipitation: rain/snow	no	yes	no	any exposed person	4	unacceptable	0,5	uninsured	1,5	important involvement	5,33	unacceptable	elimination/avoidance/transfer/treatment
		noise	no	yes	no	any exposed person	3	tolerated	0,5	uninsured	1,5	important involvement	4,00	unacceptable	elimination/avoidance/transfer/treatment
	SPECIAL[23]	SPECIAL CHARACTER OF THE ENVIRONMENT: underground/aquatic/subaquatic/swampy/aerial/space/other	no	no	yes	any exposed person	3	tolerated	0,5	uninsured	1,5	important involvement	4,00	unacceptable	elimination/avoidance/transfer/treatment
	SPECIFIC[23]	working at height: scaffolding/gantry/scaffolding/poles/ladders/in rope/on the hood of machinery/others	no	no	yes	any exposed person	3	tolerated	0,5	uninsured	1,5	important involvement	4,00	unacceptable	elimination/avoidance/transfer/treatment
		outdoor work: construction site/agriculture/viticulture/cleaning/manipulators/green spaces/forests/animal care/others	no	yes	no	any exposed person	3,5	unacceptable	0,5	uninsured	1,5	important involvement	4,67	unacceptable	elimination/avoidance/transfer/treatment

5. ALTE RISCURI [23]	AUTORIZĂRI [23]	5. OTHER RISKS [23] AUTHORISATION: authorization, approval	no	yes	no	any exposed person	4,5	unaccepta ble	0,5	uninsured	1,5	importan t involveme nt	6,00	unacceptab le	elimination/ avoidance/ transfer/ treatment
		work permits, methods of recognition and/or control	no	yes	no	any exposed person	4,5	unaccepta ble	0,5	uninsured	1,5	importan t involveme nt	6,00	unacceptab le	elimination/ avoidance/ transfer/ treatment
		EXTERNAL RISKS: overlapping activities	no	yes	no	any exposed person	4	unaccepta ble	0,5	uninsured	1,5	importan t involveme nt	5,33	unacceptab le	elimination/ avoidance/ transfer/ treatment
Medium risk level												4,41	unacceptable		

The format of the table corresponds to and respects the model according to the MEvAR methodology, the data and elements selected by the evaluator may be different depending on the risks identified and the values chosen by the evaluator. The data may be identical or similar given some similarities identified in the workplaces/jobs. These details will be mentioned in the evaluation report.

Through the calculation tool associated with the method, it is possible to view in real time, similar to the spreadsheet above, which constitutes an assessment report of the risks identified for a job/activity, any modification of the correction factors according to the needs of the organization.

Later, depending on the selections of the correction factors, the residual risk will be calculated, which will be presented in the final report assumed by the beneficiary of the risk assessment together with the other necessary forms generated by the application.

It can be seen that by changing the planning of the effects of the management intervention through the two forms, the effects on the staff are also highlighted by applying the human-risk-measure relationship, so that by ensuring the prevention and protection measures, the direct effects on the human are limited.

The work environment in the OSH regulations is not represented together with the external environment, or the surrounding environment.

The evaluation methods and methodologies for professional risks do not have in their structure the application of risk aggregation, they are not correlated with the systems for integrated management, in the field of quality, environment, information, security, and they do not include the analysis of certainties.

The method of dealing with certainties can be ensured by eliminating dangerous situations from the design or identification and eliminating the possibility of production, if we separate the human interaction with the danger

The assessments of the specialists regarding the environmental factors in the work system are determined subjectively or objectively through measurements with a pronounced technical character and are not correlated with determinations of the surrounding environment.

The main statistical elements of the way to determine the effects of environmental factors on personnel are represented by the effects of exposure through the level of documented medical conditions, the number of days with medical leave granted to them or the number of serious events produced.

The adaptation of professional evaluations to the elements proposed by the MEvAR methodology within construction activities can ensure an analysis adapted both to the requirements of integrated management systems and the optimization of expenses by treating the risks initially assessed considering the reduction of the level of residual risks based on indicators and reports generated in the application associated with the method.

The realization of communications on a systemic basis significantly helps the internal and external processes of the organization primarily at the management level which can ensure the elements of control and continuous improvement.

In the construction sector, the activities start from the project development phase and in the construction phase if there are the necessary elements for risk analysis, the proposed prevention and protection measures superimposed with an adequate level of monitoring and control, both legislative and system requirements are ensured of OSH or integrated management.

Organizations carrying out construction activities, whether beneficiaries or contractors, can compare the elements of the methods applied by the specialists with whom they have contracted the evaluation or service provision in the field of OSH with those of the MEvAR methodology and can apply the significant optimized parts in their own processes or collaborations with third parties .

Table 6.11 shows the main conditions/injuries/diseases registered in the period 2018-2022 by presenting the medical leave forms for the study group conveniently chosen to highlight the potential effects of the work environment.

The lot was chosen from the collaborating construction companies that responded to the request to provide statistical data for the study.

It can be seen that most of the conditions are ocular without having a direct relationship with the activity or the environment but the appearance of optical corrections for workers due to physiological changes.

It was not possible to associate a causal link between the conditions and the work environment, system or processes, the work accident resulting in 21 days of medical leave for recovery having the main cause exclusively on the worker through the non-use of personal protective equipment.

Table 6.11 Evidence of conditions registered in the period 2018-2022 for the study group

the number of registered conditions / calendar year the condition/trauma/illness	Period				
	2018	2019	2020	2021	2022
death	0	0	0	0	0
invalidity	0	0	0	0	0
chronic diseases	1	0	0	0	0
acute diseases	1	0	5	2	3
intoxications	0	1	0	0	0
eye diseases	23	19	3	7	11
irritation	5	2	0	0	0
contusion	7	17	3	13	24
colds	3	2	0	0	1
flu like COVID	0	0	14	3	0
work accident	0	0	0	1	0

6.5. Directions for improving the MEvAR methodology

In order to effectively track the influence of environmental risk factors on the staff by applying the MEvAR methodology, an addition was made regarding the references of injuries with foreseeable consequences, being necessary in the process of correlating the reference data regarding the influence of risks on health and the current legal provisions, thus the foreseeable consequence column has been introduced (see figure 6.4).

The modification is useful for comparison with other methods regarding the relationship between consequence and harm.

The foreseeable consequence is established by the occupational medicine doctor who can establish, based on the diagnosis, the level of impairment at the time of the examination, the subsequent changes in the state of health due to the evolution of the disease, the trauma being factors that do not belong to the internal management of the organization or third parties.

Thus, if the victim does not comply with his treatment, the anamnesis did not result in aggravating factors or other elements that cannot be foreseen at the time of the analysis, the assessment will be redone later, the methodology being applied a priori. A posteriori will only be revised based on the new data.

For this, it is considered necessary to introduce a new spreadsheet of the work tool specific to the MEvAR methodology that will generate a report after the occurrence of an event/disease, a spreadsheet that will include an additional column for the calculation of the severity value and the recalculation will be made according to of the new data.

N_V – DAMAGE LEVEL				
Type of trauma/disease	TRAUMA	ILLNESS	Predictable consequence	Value N_V
major trauma	death, circulatory shock, respiratory failure, major fractures, amputation, rupture, perforation of limbs, organs, ligaments	death, cancer, erasure, blindness, rheumatism, CMR effects (cancer, mutagen, reproduction)	Death/Disability degree I-II	1,22
great trauma	hemorrhages, open wounds, fractures, burns, wounds, organ damage, crushing	intoxications, infections, hearing loss, glaucoma, cataracts, arthritis, tendinitis, syndrome, intoxications	Invalidity degree III-V	1,14
average trauma	bleeding, bruises, excoriations, dislocations, post-traumatic stress, strong blows, limbs, organs	conjunctivitis, otitis, boils, posttraumatic stress	TIW (temporary incapacity for work) 46-180 days	1,09
low trauma	contusions, hematoma, bruises, reduced panic attack	allergies, irritations, mycoses, sensitivities	ITM (temporary incapacity for work) 3-45 days	1,05
mild trauma	light contusions, loss of consciousness reduced time	colds, coughs	ITM (temporary incapacity for work) < 3 days	1

Figure 6.4 Corrected damage level calculation grid [18],[23]

The renaming or correction of the name, better said, of the weight in the original version of the method and the involvement of management in the proposed version ensures the avoidance of the appearance of comparison or confusion with the specific elements of the weight method (see figure 6.5.).

The importance defined by management is strictly related to its involvement in the process of risk treatment, establishment of prevention and protection measures, and the grid shows the three variants of importance and minor involvement, which implies an improper treatment of the risk with unwanted potential implications, the usual variant of ensuring the treatment of risks in a minimal and optimal manner in which an appropriate importance and involvement of the management in the treatment of risks and obtaining the desired results is ensured.

I_M –INVOLVEMENT MANAGEMENT VALUE		
Level of management involvement	Estimation	Value I_M
important involvement	the level of risk represents for the organization a major importance and involvement of the management/appropriate risk treatment can be ensured	1,5
normal involvement	the level of risk presents an importance to the organization and appropriate management involvement/ the treatment of the risk can be ensured	1,25
minimum involvement	the level of risk is of minor importance and management involvement for the organization/ the appropriate treatment of the risk cannot be ensured	1

Figure 6.5 Corrected management involvement estimation grid [18], [23]

It can be analyzed to change the calculation formula by introducing fuzzy logic models to simplify the analysis and prognostication of the probabilities and the assessment of the initial risk.

Another direction to improve the method is the introduction into the spreadsheets of the work equipment used in the processes or activities at the workplaces. Table 6.12 shows a model for drawing up and completing this list.

Based on this model, a calculation of the risk generated by the use of each piece of equipment can be associated, which can later be aggregated according to the method.

Table 6.12 The list of work equipment provided/used within the processes/activities [23]

No.	Name/type/brand of work equipment from the workplace	Existent		Conformity			Location	Obs.
		yes	no	yes	no	in progress		
1.	computer	x		x			office	
2.	printer	x		x			office	
3.	monitor	x		x			office	
4.	paper shredder	x		x			office	
5.	projector	x		x			office	
6.	online communication station	x		x			office	
7.	lighting installations	x		x			office	
8.	other electrical installations	x		x			office	
9.	heating installation	x		x			office	
10.	ventilation/air conditioning installation	x		x			office	
11.	wooden/PVC doors	x		x			office	
12.	metal/PVC/wooden windows	x		x			office	
13.	concrete/stone/wood/plastic/other flooring	x		x			office	
14.	marble/tile/linoleum/carpet/	x		x			office	
15.	carpeting/others	x		x			office	
16.	office elements (office, chair, others)	x		x			office	
17.	cupboard materials metal/wood/PAL	x		x			office	
18.	waste bin	x		x			warehouse	
19.	boxes, packaging	x		x			office	
20.	office utensils (knife, scissors, hole punch, stapler, others)	x		x			office	
21.	indoor/outdoor stairs	x		x			office	
22.	related means of work (coffee machine, filter, water dispenser, electric oven/microwave, automatic water dispenser, TV, cutlery, crockery, different containers, others)	x		x			office	
23.	epidemiological triage equipment, thermometer, disinfectant dispenser, respiratory mask, gloves, separators, screens, traffic restriction aisle, biological waste bin, prevention and protection against unknown/emerging infectious pathogens (SARS CoV-2 type, others)	x		x			office	

The checklist will be supplemented with emerging risks, ICT use and the influence of digitization, telework and/or home work because during the pandemic these forms of work were identified at European level and introduced by legislation (see table 6.13).

The evaluation area is affected because these forms of work generate impediments in the assessment of risks considering that they are not or are partially under the control of the organization and the identification of risk factors depends on the contractual provisions and the changes that may occur are directly dependent on the workers and not on the organization.

Table 6.13 Completing the list identifying risk factors [23]

Category	Hazard/risk type	Details
OTHER RISKS: [23]	EXTERNAL RISKS: [23]	emerging risks/TIC/digitalization
		telework/home work

The inclusion in the evaluation of the number of previously registered events/diseases constitutes a consistent supplement regarding the records and statistics necessary for the evaluation and follow-up of the influence of risk factors on the staff (see table 6.14).

Table 6.14 Evidence of conditions registered in 2023

Evidence of the number of registered conditions / period / calendar year				
Nr. crt.	the condition/trauma/illness			2023
1	work accident	death	-	0
2		invalidity	grade I, II, III, IV	0
3		temporary incapacity for work	break	0
4			contusion	1
5			chronic diseases	1
6			acute diseases	0
7			intoxications	1
8			eye diseases	1
9			irritation	1
10			colds	0
11			flu like COVID	0
12			other diseases	0
13		potential conditions if preventive measures are not provided	hospitalization	0
14	optical corrections		5	

6.5. Conclusions

Following the realization of the theoretical and experimental study on the influence of environmental factors through the MEvAR methodology within an organization, the following conclusions resulted:

- I chose a job/activity photovoltaic panel installer in the field of construction for which I applied two forms of professional risk assessment;
- the monitoring of the medical fitness status of the workers was carried out;
- the performance of noxes determinations and environmental analyzes in the work spaces were verified;
- the checklist of risk factors from the previous assessment was used and completed according to the update in the previous chapter;
- the professional risk assessment carried out before the workplace was verified and compared using the modified and adapted INCDPM Bucharest method, the results being entered into the calculation and comparison specific to the MEvAR methodology;
- the evaluation of professional risks for the job studied by the MEvAR methodology was carried out by 2 evaluation specialists, according to the requirements of the method;
- the way of ensuring prevention and protection measures, of performing controls and monitoring was checked and it was found that it complies with the legal requirements and those of the management of the organization under study;
- in the course of the study, partial changes were made to the correction factors in order to follow the variation of the results;
- visits to workplaces and the collection of data necessary for the analysis were carried out;
- a variety of separate establishment of certainties and another of the establishment of risks with an almost certain value that do not fall within the competence of the organization are proposed;

- new dangers were identified and entered into the checklists for risk assessment according to Table 6.1 Organization/activity potential risk identification and verification list;
- the inherent and residual risks as well as their implications in organizations were analyzed;
- the remaining risks within the studied organization were analyzed;
- the influence of the MEvAR correction factors in modifying the effects of risk treatment for the job/activity of photovoltaic panel fitter in a construction company was analyzed;
- the risks were analyzed and the initial details and the spreadsheet regarding the evaluation by the MEvAR methodology for the selected workplace were presented;
- it was found that the organizations carrying out construction activities can compare the elements of the methods applied by the specialists with whom they have contracted the assessment services or the provision of services in the field of OSH with those of the MEvAR methodology and can apply the significant optimized parts in their own processes or collaborations with third parties;
- comparisons were highlighted regarding the results of the conditions found;
- at the end of the chapter, the forms proposed for the changes made to the MEvAR methodology are highlighted.

The final conclusion is that through the study applied to the selected workplace, the records and the evaluation results, it is found that the methodology is applicable and constitutes a consistent support for risk assessment specialists and managers in the construction field.

Chapter 7. Conclusions and contributions regarding the analysis of the influence of environmental factors on personnel

From the analysis of the current state of the influence of the risk factors on the staff, the conclusions that were stated in chapter 3 resulted.

The directions of research and development presented in subchapter 4.1 have taken into account the data and findings resulting from the analysis of the current state in the field and can constitute future research and development guidelines. (see § 4.1)

By supporting the main objective of the research carried out during the internship, the investigation and optimization of the way of evaluating professional risks by applying the MEvAR methodology and the adjacent objectives, sufficient arguments were presented to support the working hypothesis and the development of research in this direction. (see § 4.2).

The conclusions regarding the activities carried out to achieve the proposed objective are closely related to the methodological part (see § 4.3) and can be defined as follows:

- To achieve the theme and the established objectives, specialized bibliographic sources were considered and examined: books, magazines, monographs, specialized volumes and articles, studies and publications in the field of OSH evaluations by well-known authors, national institutions and international;
- Established actions were used to implement the research plan: case study and investigation, and content inquiry was used for the analysis strategy;

- For example, a research study was carried out for the evaluation of occupational risks/accidents and occupational diseases for the place/job: installer of photovoltaic panels in the company. MOUNTING PANELS S.R.L. ;

- The results obtained are in accordance with the established notions from specialized publications, they support the elements known from scientific and practical research in the field of work safety.

Reference elements have been provided regarding the study of risk factors specific to different environmental, work, economic, security, information, political, domestic and international environments, others.

Data on correlated environmental risk factors were also collected and structured according to the reference elements studied.

The quantitative research was organized by selecting bibliographic sources from the online environment (due to the ease of access), from the university environment (library), from private sources (clients or collaborators) with the help of which the search direction for the elements necessary for the study and comparisons was structured.

Qualitative research consists of selecting the common and current parts of the conducted study, comparing them with the requirements of each type of evaluation specific to the environment studied.

It is very important to correlate the methods, the results of the assessments specific to the respective fields in order to ensure effective communication between specialists and the final data to be correlated and integrated into the management analyzes of the institutions and organizations.

The data collected from the field represents the basis of the applied study and can be used as references because the methodology and form of data collection through questionnaire and comparative analysis were followed.

The results, conclusions and suggestions are presented in a concise manner, in the chapters of the thesis being exemplified according to the requirements of the thesis.

The correctness of the examination and interpretation of the data is supported by the fact that the MEvAR methodology requires the participation of at least two specialist evaluators in carrying out an assessment of occupational risks and at least two assessment methods. Thus the minimum comparison requirement is achieved.

It can be seen that the main objective of the paper was achieved through the comparative study of the use of several hypotheses regarding the application of the MEvAR specific professional risk assessment methodology, and combined with the use of the calculation tool based on the Microsoft Excel application, the documented information was created to support the analysis .

The extensive study of the bibliography applied to the field facilitated obtaining some elements that can constitute references for the proposed analysis.

Achieving the main objective was possible by applying the adopted methodological research plan, which included:

- the use of a MEvAR adapted methodology that provides the necessary elements to study the influence of environmental risk factors on personnel;

- the use of several working hypotheses to ensure the comparative study - the comparisons were made according to the different involvement of management in the way of treating risks, the analysis of the effects of the work environment on the health of workers at the level of an organization, the correlation of injuries and damages with the effects on workers and the organization;

- development of measures to improve the MEvAR assessment methodology based on the results of the study - the checklists of risk factors were completed with new elements, the situations of interpretation of some terms were fixed, the existing forms were completed and new ones were added;

- the study of the opportunity to change the method of calculating risks and the level of security.

At the end of the doctoral thesis, the main conclusions and scientific results obtained as a result of the research activity during the 3 years of doctoral study are presented in an analytical manner.

The technical-economic advantages presented are those specific to the MEvAR evaluation methodology, namely:

- the reduced cost and time of the professional risk assessment activity for the beneficiaries;

- the possibility of ensuring the transfer of indicators and analysis elements between dedicated software applications;

- the overlap of the elements of the integrated management system and/or the OSH management system, the requirements for compliance with the legislation as well as the national administrative-territorial management system requirements with the professional risk assessment methods;

- identifying and monitoring the occurrence of intolerable effects on staff.

The current reality confirms that the influence of environmental risk factors on personnel can be noticed quickly or over a long period of time, and the activities of occupational risk assessors and those of doctors specializing in occupational medicine or from public health departments, are not unregulated regarding collaboration and cooperation, thus generating a situation that requires increased attention.

The main contributions of the work are registered alongside the articles and works of the collaborators in the direction of presenting a methodology adapted to everyday reality, flexible and comprehensive in the analysis of the risks regarding the influence on the person who can be affected by the environment, the work processes and the environment.

The main personal contributions for the study topic - the influence of environmental risk factors on the staff are:

- identification of environmental and work environment risk factors, internal and external, with significant influence on staff health and their correlation in a single analysis;

- updating and completing the specific elements of the MEvAR professional risk assessment methodology by harmonizing, consolidating, updating, completing and modifying the spreadsheets, checklists, reports and specific or newly introduced forms, according to the needs of the beneficiaries regarding the work environment and the environment in general ;

- identifying the forms of presentation of the MEvAR methodology in the managerial system to facilitate the integration of the OSH management system with the environment and quality, information and social responsibility management system;

- the introduction as a study topic of the application of LIKELIHOOD calculation and the interpretation of risk assessment results through fuzzy logic in order to quickly and efficiently determine them;
- the presentation of the results of the analysis of injuries as effects of the risks on the health of the staff correlated with the economic effects within the companies.

Theoretical contributions are revealed through the documentary study of data selection that can be used as references in the analysis of environmental and work environment risk factors.

The MEvAR methodology used presents and ensures, through its structure, methodological forms and the calculation tool, a superior yield and efficiency adapted to the identification and assessment of professional risks, prevention and protection in the field of OSH as well as cooperation in the field of management systems applied in the organization.

The experimental contributions are made by introducing some calculation hypotheses regarding the involvement of the management according to the visualization of the effects of the way of treating the risks.

- It can be concluded that **the influence of environmental risk factors** on the staff, with an important weight according to research, applying the MEvAR methodology, resides in:
 - the study of people who may be affected by risk factors;
 - the study of injuries, traumas and diseases that may appear as a result of certain events;
 - the study of material damages suffered by organizations as a result of certain events and the effects on personnel;
 - the study of the influence of the internal and external environment of the organization on the health of the staff;
 - the study of the correlation of the analysis of the surrounding environment and the environment in the work system in a unitary system;
 - correlation of the medical records regarding the staff with the forecasts resulting from the risk assessment;
 - establishing cooperation and collaboration measures between the evaluation committee, organization managers, occupational medicine doctor, specialist doctors and doctors from the public health departments, other authorities with attributions in the field regarding the record and correlation of the effects on the health status of the staff;
 - the influence of biological agents external to the work environment on the work system and especially on the staff under conditions specific to the organization;
 - the study of certainties/risks with a very high level and methods of elimination and/or limitation;
 - the study of the influence of inadequate insurance, non-insurance and/or non-compliance with the necessary prevention and protection measures according to legislation, management systems, best practices, internal or external policies, other requirements on the organization and implicitly on the staff.

The doctoral thesis, through its structure, issues, form of approach, planning and debate of aspects and results, directly enriches the MEvAR professional risk assessment methodology used in the study and can be used by assessment specialists, managers and beneficiaries.

The scientific value of this doctoral thesis corresponds to the scientific requirements through the theoretical and experimental contributions made to the well-defined examination of the influence of risk factors on personnel and the methods/methodologies used in the assessment of occupational risks.

The practical importance of the doctoral thesis consists in completing with important technical and scientific aspects the structure and specific elements of the MEvAR professional risk assessment methodology and confirming the value of the methodology regarding its use in different fields of activity.

The present doctoral thesis, through the issues addressed, through the special theoretical and applied character, improves and confirms the opportunity regarding the use of the analysis methodology, the evaluation and appreciation of professional risks in the field of occupational safety and health MEvAR being useful to all evaluators, managers and/or interested parties .

References

- ALBULESCU A. G. - Legislative and Methodological Bases of Safety and Health at Work, course support, UT Gh Asachi, 2003
- ALLI B. O. -Fundamental principles of occupational health and safety ILO Geneva 2008 p. 8
- ANGHEL R., Anghel-Tudor G., Nicola-Gheorghiu D., Patrasc-Balan I.-D., Vasonan A. -Sănătatea și securitatea în muncă. Abordare multidisciplinara , 2019
- ANGHELACHE C.- Managementul riscului de mediu – prioritate economică și socială, 2011.
- AVEN T., Ylonen M.- Safety regulations: Implications of the new risk perspectives.Reliab. Eng. Syst. Safety, 149, 164–171, 2016.
- BABIȘ C., Iacobescu G., Chivu O. R., Dobrotă D. - Elemente Legislative în Domeniul Securității și Sănătății în MuncăSinteze și teste grilă, Ed.POLITEHNICA PRESS, ISBN 978-606-515-535-0, București 2013.
- BĂBUȚ G.B, Moraru R.I.- Evaluarea riscurilor: transpunerea cerințelor Directivei 89/391/CEE în legislațiile statelor membre ale Uniunii Europene, Ed Universitas, Petroșani,2009.
- BABUȚ, G. – Evaluarea Riscurilor de Accidentare și îmbolnăvirea profesională, 2004.
- BADEA D.O., Darabont D.C., Bucerzan D., Trifu A., Smîdu E., Bulboacă E., Haralambie V. -Occupational safety issues related to computer equipment installation, maintenance and use, 2022, MATEC Web of Conferences 354, 00001 (2022) – lucrare susținută la 10th International Symposium on Occupational Health and Safety, SESAM 2021.
- BASUC M., BALTA M. și alții - Reglementări și bune practici în domeniul SSM, 2004
- BĂBUȚ G.B., Moraru R.I.-Critical analysis and ways to improve the I.N.C.D.P.M. Bucharest for the assessment of the risks of accidents and occupational diseases,Quality Access to Success, vol. 14, no. 137, pp. 55-66, 2013
- BĂBUȚ BUJOR G., MORARU R.I. - Evaluarea riscurilor profesionale: cerințe pentru eficientizarea procesului, 2021.
- BĂBUȚ Bujor G., MORARU R.I. - Evaluarea riscurilor profesionale: cerințe pentru eficientizarea procesului - suport de curs Universitatea Petroșani 2019
- BEJINARIU C., Darabont D.C., Baci E.R., Georgescu I. S., Bernevig-Sava M.A., Baci C. -Considerations on Applying the Method for Assessing the Level of Safety at Work, Sustainability, 09-01263-v3-1, MDPI, 2017.
- BEJINARIU C., Darabont D.C., Burduhos Nergis D. P., Cazac M., Chiriac Moruzzi C. - Considerations Regarding the Application of the Occupational Injury and Illness Risk Assessment Method at Workplaces/Workstations, in Relation to the ISO 45001 Standard, MDPI, Sustainability 2023.
- BOGÁTHY Z., POPESCU C. - Manual de Psihologia Muncii și Organizațională

- BULBOACĂ C.**, Gheorghe M., Chivu O.R., Bulboacă (Tudose) E., Nitoi D., Enache C. - New MEvAR risks evaluation methodology in construction, SIM Timișoara 2023- în curs de indexare
- BULBOACĂ C.**, Bulboacă (Tudose) E., Chivu O R., Marinescu M., Borda C., Nițoi D., Luchian C. - Considerations of the working environment within the method for assessing occupational risks – MEvAR in construction - Fiabilitate si Durabilitate - Fiability & Durability No 1/ 2023 Editura “Academica Brâncuși” , Târgu Jiu, ISSN 1844 – 640X
- BULBOACĂ C.**, Bulboacă (Tudose) E., Chivu O R., Marinescu M., Borda C., Nițoi D., Luchian C. - Considerations of the working environment within the method for assessing occupational risks – MEvAR in construction - MDPI may 2023 DOI: 10.20944/preprints202304.0865.v2 – neindexată
- BULBOACĂ (TUDOSE) E., Bulboacă C., Darabont D.C., Feier A.I., Chivu O.R** - Professional risk assessment method related to management system requirements –Timișoara 2023/1/4, Jurnal ACTA TECHNICA NAPOCENSIS-Series: APPLIED MATHEMATICS, MECHANICS, and ENGINEERING, Volume 65, Issue 3S, Page 921-930, Special Issue, SI, Published NOV 2022, Indexed 2023-04-06, Accession Number WOS:000953026700046, ISSN 1221-5872
- BULBOACĂ (TUDOSE) E., Chivu O.R., Bulboacă C., Crângureanu A., Borda C., Nitoi D., Gheorghe M., Villi P., Enache I.C., Feier A.I** - Contributions regarding the influence of risks on natural persons and of the risk assessment system in the field of health and safety at work in the framework of detergent –, 2023/5/1, Jurnal Fiability & Durability/Fiabilitate si Durabilitate, Nr. 1
- BULBOACĂ (TUDOSE) E., Bulboacă C., Chivu O.R., Țăpârdea A.I., Haralambie V.T** - Aspects concerning the identification and assessment of professional risks in the production of detergents , 2020/7/1, Jurnal Fiability & Durability/Fiabilitate si Durabilitate, Numărul 2
- BULBOACĂ (TUDOSE) E.** - Studiu aplicativ al influenței riscurilor asupra persoanelor fizice și al sistemului de evaluare a riscurilor în domeniul SSM în cadrul unităților de producție detergenți - Teză doctorat UNST Politehnica București 2023
- CHIVU O. R.** - Cercetări și contribuții privind sănătatea și securitatea în muncă în domeniul ingineriei industriale- UPB (UNSTPB) 2020.
- CHIVU O. R.** - Medicina muncii în industrie - . UPB (UNSTPB) 2020.
- COSTACHE F.** - Sanatatea si securitatea muncii, 2022
- CRIȘAN E., Afrăsinei-Zevoianu C., Crișan Mitra C., Stegorean R.** - Managementul riscurilor organizaționale – Editura RISOPRINT Cluj Napoca 2018 - p.112
- DARABONT A., Darabont D., Constantin G.** - Evaluarea calității de securitate a echipamentelor tehnice AGIR 2001
- DARABONT A., Nisipeanu S., Darabont, D.** - Auditul Securității și sănătății in muncă, 2002.
- DARABONT D.C., Trifu A.,Badea D. O, Bucerzan D., Tudose Bulboacă E., V. Haralambie, Smîdu E.** - Occupational safety issues related to computer equipment installation, maintenance and use - 10th Edition of the International Symposium on Occupational Health and Safety – SESAM 2021.
- DARABONT D.** - Manual SSM – Ghid de evaluare conformitate cu cerințele legale-2010.
- DARABONT D., PECE Ș., DĂSCĂLESCU A.**- Managementul securității și sănătății în muncă vol. 2, 2001echipamentelor tehnice, Editura AGIR, București, 2001.
- DIOȘAN I.**– Artificial intelligence – intelligent systems – rule-based systems in uncertain environments, Babes Bolyai University, student course 2018
- DUFOUR C., Draghici A., Ivascu L., Sarfraz M.** - Occupational health and safety division of responsibility: A conceptual model for the implementation of the OHSAS 18001: 2007 standard, Human Systems Management, 39(4), 549-563, 2020.
- GEORGE P.G., Renjith V.R.** - Evolution of Safety and Security Risk Assessment Methodologies towards the Use of Bayesia, Networks in Process Industries. Process Saf. Environ. Prot. 149, 758–775, 2021.
- GKIKAS C.N. G., Agaliotis G., Sfakianakis K. et al.** - Occupational Heat Stress, Multi-Country Observations and Interventions. Int. J. Environ. Res. Public Health 18, 6303,2021.
- GOGELSCU C., Solomon G., Tudose E., Bulboacă C., Ispasoiu A.** - Occupational health aspects for height work in temporary and mobile sites Journal of Research and Innovation for Sustainable Society 2023 DOI: 10.33727/jriss.2021.2.12:110-119, Part of ISSN: 2668-0416
- GOGELSCU C., Solomon G., Tudose E., Bulboacă C., Chivu O..** - Improving occupational health at work for height work in temporary and mobile sites Journal of Research and Innovation for Sustainable Society 2023 DOI: 10.33727/jriss.2021.2.2:17-26 Part of ISSN: 2668-0416

- GOGELSCU C., Bulboacă (Tudose) E, **Bulboacă C.**, Chivu O.R.- Analysis of occupational safety measures at work under working conditions at height in temporary and mobile sites -, 2021/7/1, Journal of Research & Innovation for Sustainable Society (JRISS), Numărul 2
- HARALAMBIE V, Tudose Bulboacă E, Chivu O. R., Trifu A., Badea D. O. - The working environment involves us all - National scientific conference with international participation CONFERENG 2020 Tg Jiu, Romania Assessment Tool Selection in Work Environments. Environ. Eng. Manag. J 13, 1371–1376, 2014.
- LUNGHI, Cardillo - Hazard assessment of substances produced from the accidental heating of chemical compounds, Journal of hazardous materials, Journal of hazardous materials , 2004
- JENSEN R.C., Bird R.L., Nichols B.W.- Risk Assessment Matrices for Workplace Hazards: Design for Usability. Int. J. Environ. Res. Public Health 19, 2763, 2022
- JOHANSEN I.L., Rausand M.- Ambiguity in risk assessment. Safety Sci., 80, 243–251, 2015. Hazards: Design for Usability. Int. J. Environ. Res. Public Health 19, 2763, 2022.
- JOJA A. și colab. - [Dicționar Enciclopedic Român](#), București: Editura Politică, 1962-1966
- JORGENSEN K.- Prevention of “simple accidents at work” with major consequences, Safety Sci. 81, 46–58, 2016.
- KIM A., Oh J., Kwon K., Lee K. - Consider the Consequences: A Risk Assessment Approach for Industrial Control Systems. Secur. Commun. Netw, 3455647, 2022.
- KIM Y., Park J., Park M.- Creating a Culture of Prevention in Occupational Safety and Health Practice, Safety Health Work 7, 89–96, 2016.
- LA ROCCA B., Sarazin P. - MiXie, an Online Tool for Better Health Assessment of Workers Exposed to Multiple Chemicals, International Journal of Environmental Research and Public Health, 2022.
- LUNGHI, C. - Hazard assessment of substances produced from the accidental heating of chemical compounds, Journal of hazardous materials, Journal of hazardous materials , 2004.
- MAHDINIA M., Jafarina E. , Soltanzadeh A. - Development of a New Technique for Safety Risk Assessment in Construction Projects Based on Fuzzy Analytic Hierarchy Process ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part A: Civil Engineering Volume 7, Issue 3 2021
- MINCĂ, G. – Analiza Riscurilor Profesionale, curs postuniversitar, București 2004
- MORARU R. I., Babut G. B., Cioca L. I. - An Inventory of Environmental Risks Induced by Tailing Dams and Systematic Mitigation Measures. In 12th International Multidisciplinary Scientific Geoconference, SGEM 2012, Vol. V; Stef92 Technology Ltd.: Sofia, Bulgaria, pp. 43–49, 2012.
- MORARU R.I., Babut G.B., Cioca L.I.- Rationale and Criteria Development for Risk Assessment Tool Selection in Work Environments. Environ Eng. Manag. J.13, 1371–1376, 2014.
- MORARU R. I. - Cercetări și rezultate în domeniul securității industriale și ocupaționale - - Teza de abilitare - Universitatea Petroșani 2015
- NOVAC L. E., Brezeanu P. - Metode moderne de identificare a riscurilor în managementul riscului - Academia de Studii Economice București, suport curs Reliab. Eng. Syst. Safety, 149, 164–171, 2016.
- PECE Ș.- Evaluarea riscurilor în sistemul om-mașină, editura Atlas Press, București, ISBN 973-86192-6-2, 2003.
- RULE K., L. Cadwallader, M. King, Y. Takase, Y. Oshima, K. Nishimura, and A. Sukegawa -Safety Culture And Best Practices At Japan's Fusion Research Facilities PPPL-5012 Princeton Plasma Physics Laboratory april 2014 - P 4
- RUSU-ZAGAR, G., Nisipeanu, S., Iorga, I., Gheorghe, I.I. și Ionescu, C. Implementarea Managementului Securității și Sănătății în Muncă într-o Economie Bazată pe Cunoaștere, INCDPM, (2011)
- STĂNESCU DUMITRU R.- Agenti nocivi în mediul profesional, 2008
- VANCEA F., Apostol M.Ș.- "Changes in mental health during the COVID-19 crisis in Romania: A repeated cross-section study based on the measurement of subjective perceptions and experiences", 2021
- VASILESCU G.D.- Metode neconvenționale de analiză și evaluarea riscului profesional, 2008.
- WANG, J.; Yang, J.B.; Sen, P. Safety analysis and synthesis using fuzzy sets and evidential reasoning. Reliab. Eng. Syst. Safe. 1995
- ZENG J, An M, Smith NJ - Application of a fuzzy based decision-making methodology to construction project risk assessment - International journal of project management, 2007
- Codul penal al României 2009
- Codul muncii actualizat 2023 - Legea 53 din 2003 actualizata prin Legea 283 din 17 octombrie 2022
- HGR 300/2006 privind cerințele minime de securitate și sănătate pentru șantierele temporare sau mobile
- HGR 493/2006 privind cerințele minime de securitate și sănătate referitoare la expunerea lucrătorilor la riscurile generate de zgomot, cu modificările și completările ulterioare

HGR 511/1994 privind adoptarea unor masuri pentru prevenirea și combaterea poluării mediului de către societățile comerciale din a caror activitate rezulta unele deseuri poluante – modif de Rectificarea 511/1994
HGR nr. 557/2007 privind completarea măsurilor destinate să promoveze îmbunătățirea securității și sănătății la locul de muncă pentru salariații încadrați în baza unui contract individual de muncă pe durată determinată și pentru salariații temporari încadrați la agenți de muncă temporară
HGR 557/2016 privind managementul tipurilor de risc/2016 anexa nr.1
HGR nr. 600/2007 privind protecția tinerilor la locul de muncă.
HGR nr. 971/2006 privind cerințele minime pentru semnalizarea de securitate și/sau de sănătate la locul de muncă
HGR nr. 1028/2006 privind cerințele minime de SSM referitoare la utilizarea echipamentelor cu ecran de vizualizare
HGR nr. 1048/2006 privind cerințele minime de securitate și sănătate pentru utilizarea de către lucrători a echipamentelor individuale de protecție la locul de muncă
HGR nr. 1051/2006 privind cerințele minime de securitate și sănătate pentru manipularea manuală a maselor care prezintă riscuri pentru lucrători, în special de afecțiuni dorsolombare.
HGR nr. 1091/2006 privind cerințele minime de securitate și sănătate pentru locul de muncă.
HGR nr. 1092/2006 privind protecția lucrătorilor împotriva riscurilor legate de expunerea lor la agenți biologici în muncă.
HGR nr. 1093/2006 privind stabilirea cerințelor minime de securitate și sănătate pentru protecția lucrătorilor împotriva riscurilor legate de expunerea la agenți cancerigeni sau mutageni la locul de muncă, cu modificările și completările ulterioare.
HGR nr. 1146/2006 privind cerințele minime de securitate și sănătate pentru utilizarea în muncă de către lucrători a echipamentelor de muncă.
HGR nr. 1218/2006 privind stabilirea cerințelor minime de SSM pentru asigurarea protecției lucrătorilor împotriva riscurilor legate de prezența agenților chimici, cu modificările și completările ulterioare
HGR NR.1425/2006 privind normele metodologice de aplicare a prevederilor Legii securitatii si sanatatii in munca nr. 319/2006
HGR nr. 1876/2005 privind cerințele minime de securitate și sănătate referitoare la expunerea lucrătorilor la riscurile generate de vibrații, cu modificările și completările ulterioare
Legea 19/2000 - Legea privind sistemul public de pensii si alte drepturi de asigurari sociale
Legea 22/2002 privind aprobarea Ordonantei de urgenta a Guvernului 41/2000 pentru modificarea si completarea Legii 19/2000 privind sistemul public de pensii si alte drepturi de asigurari sociale
Legea 31/1991 privind stabilirea duratei timpului de munca sub 8 ore/zi pentru salariatii care lucreaza in conditii deosebite, vatamatoare, grele sau periculoase
Legea 100 din 1998 - Legea privind asistenta de sanatate publica
Legea 108 din 1999 pentru infiintarea si organizarea Inspectiei Muncii, republicata in Monitorul Oficial al Romaniei 740 din 2002
Legea 130/1999 privind unele masuri de protectie pentru persoanele incadrate in munca
Legea 145/1997 - Legea asigurarilor sociale de sanatate, abrogata si inlocuita prin Ordonanta de urgenta a Guvernului 150 din 31/10/2002
Legea 155/2000 pentru aprobarea Ordonantei de urgenta a Guvernului 16/2000 privind ratificarea unor conventii adoptate de Organizatia Internationala a Muncii
Legea 202/2002 privind egalitatea de sanse intre femei si barbati
Legea. 219/2019 din 15 noiembrie 2019 pentru modificarea și completarea art. 16 din Ordonanța de urgență a Guvernului nr. 195/2005 privind protecția mediului
Legea 220/2019 privind modificarea și completarea unor acte normative din domeniul protecției mediului
Legea 240/2004 privind raspunderea producatorilor pentru pagubele generate de produsele cu defecte
Legea 245/2004 privind securitatea generala a produselor
Legea 319/2006 a securității și sănătății în muncă, cu modificările și completările ulterioare .
Legea 338/2002 privind aprobarea Ordonantei de urgenta a Guvernului 49/2001 pentru modificarea si completarea Legii 19/2000 privind sistemul public de pensii si al drepturi de asigurari sociale
Legea 346 din 2002 - Legea privind asigurarea pentru accidente de munca si boli profesionale republicata in Monitorul Oficial al Romaniei, Partea I nr. 722 din 12 noiembrie 2009
Legea 349/2007 privind reorganizarea cadrului instituțional în domeniul managementului substanțelor chimice, modificată.

Legea 598/2003 privind aprobarea Ordonanței de Urgență a Guvernului 107/2003 pentru modificarea și completarea Legii 346/2002 privind asigurarea pentru accidente de muncă și boli profesionale
Legea 608/2001 privind evaluarea conformității produselor.
Ordinul MS nr. 1297/2011 privind constituirea Comisiei pentru securitate și sănătate în muncă privind agenții chimici periculoși.
OUGR-96/2003 privind protecția maternității la locurile de muncă, cu modificările și completările ulterioare pandemiei de COVID-19.
OUGR- 99/2000 privind măsurile ce pot fi aplicate în perioadele cu temperaturi extreme pentru protecția persoanelor încadrate în muncă
ORDIN Nr. 784/91/2021 din 7 mai 2021 pentru aprobarea Procedurii de interzicere a utilizării sau punerii în funcțiune a unui amplasament, unei instalații ori zone de depozitare sau a oricărei părți din acestea .
Ordinul nr. 3309 din 28.12.2022 pentru modificarea Procedurii pentru aplicarea vizei anuale a autorizației de mediu și autorizației integrate de mediu, aprobată prin Ordinul nr. 1150 din 2020
ISO / IEC TS 17022: 2012, Evaluarea conformității - Cerințe și recomandări pentru conținutul unui raport de audit terță parte asupra sistemelor de management.
SR EN ISO 9001: 2015, Sisteme de management al calității - Fundamente și vocabular.
SR EN ISO 14001:2015 Sisteme de management de mediu.Cerințe cu ghid de utilizare.
SR EN ISO 19011:2011 Linii directoare pentru auditarea sistemelor de Management.
SR EN ISO 31001: 2018, Managementul riscurilor
S.R. EN ISO 45001:2018-Sisteme de management al sănătății și securității în muncă.Cerințe și îndrumări pentru utilizare.
Ghid de evaluare a riscului proiect PHARE RO/04/IB/SO/01 Inspekția Muncii 2007 p 43
The 13th Occupational Safety & Health Program Ministry of Health, Labour and Welfare February, 2018 - P 17
New forms of work in the digital era: Implications for psychosocial risks and musculoskeletal disorders EU OSHA <https://osha.europa.eu/ro/publications/digitalisation-work-psychosocial-risk-factors-and-work-related-musculoskeletal-disorders/view>
*** Rubinian, Ghid complet pentru Fisa de post,actualizat în 2022.
*** Metodologie management al riscurilor – Program operațional capacitate administrativă Guvernul României- 2014
*** Raport evaluare de risc de accidentare și îmbolnăvire profesională S.C. MONTARE PANOURI SRL București 2020
***Agenția europeană de mediu <https://www.eea.europa.eu/ro/themes/human/intro>
***Evaluarea riscurilor profesionale – metoda MEVA Laboratorul Evaluarea Riscurilor și Managementul SSM Ing. Eduard Smîdu INCDPM Alexandru Darabont
https://govnet.ro/uploads/files/15_GOVNET%20HSE%20FORUM%20EVALUARE%20RISC%20METODA%20MEVA.pdf
*** Agenția europeană de mediu <https://www.eea.europa.eu/ro/themes/human/intro>
*** Emerging risks, <https://osha.europa.eu/en/emerging-risks>
*** [Evaluarea riscurilor, https://www.snlp.ro/wp-content/uploads/2012/10/ Evaluarea riscurilor.pdf,](https://www.snlp.ro/wp-content/uploads/2012/10/Evaluarea_riscurilor.pdf)
***<https://www.protectiamunciibrasov.ro/>
***<https://www.fisapostului.eu>
***<https://www.ilegis.ro>
***<https://www.protectiamuncii.ro/>
***<https://www.inspectiamuncii.ro>
***<http://ssm-competitivitate.inpm.ro/>
***<https://www.legisplus.ro/>
***<https://legislatiamuncii.manager.ro/>
*** <https://dexonline.ro/definitie/mediu> DEX '98 (1998)
*** https://www.rubinian.com/dictionar_detalii.php?id=4469
*** https://ro.wikipedia.org/wiki/Securitatea_muncii
***metoda MERA
***metoda MEVA
***metoda Mincă
***metoda SUVA
*** Oshima, 2021)

- *** McKinsey Global Institute, 2020
- *** Eurofound, 2020c, OIM, 2021
- *** ILO, 2021
- *** ETUI și ETUC, 2020
- *** US-OSHA, 2020
- *** Giorgi et al., 2020; Kramer și Kramer, 2020; Nimrod, 2020
- *** EU-OSHA, 2021e, f
- *** JRC, 2020
- *** Kniffin et al., 2021
- *** SteidelMüller și colab., 2020; Kniffin și colab., 2021
- *** Bérastégui, 2021
- *** Roquelaure, 2016; EU-OSHA, 2020e; 2021d
- *** Madsen et al., 2018; EU-OSHA, 2020c
- *** PE732.573v02-00, 2020
- *** <https://www.lasig.ro/Top-10-Riscuri-Globale-2018-Riscurile-de-mediu-domina-topul-preocuparilor-specialistilor-articol-3,100-57847.htm>
- *** <https://www.lasig.ro/pictures/xprimm/riscuri-19ian2018.jpg>
- *** <https://felder-gruppe.ro/calitate/gestionarea-riscurilor-cu-ce-categorii-de-riscuri-ne-confruntam/>
- *** <https://ro.education-wiki.com/7201624-inherent-risk>
- *** <https://muhaz.org/microsoft-word-manual-managementul-riscului-doc.html?page=3>
- *** <https://www.wall-street.ro/articol/Real-Estate/284340/in-2021-au-fost-construite-cele-mai-multe-locuinte-in-ultimii-30-de-ani-2022-sta-sunt-semnul-incertitudinii.html> 19.07.2023/17.00
- *** <https://www.rfi.fr/en/france/20221031-france-among-most-dangerous-places-to-work-in-eu-figures-show> 19.07.2023/17.05
- *** <https://www.rfi.fr/en/france/20221031-france-among-most-dangerous-places-to-work-in-eu-figures-show> 02.03.2023/17.05
- *** https://ec.europa.eu/eurostat/databrowser/view/HSW_MI01/bookmark/line?lang=en&bookmarkId=9edf396d-7316-4e72-93c7-a84acac4d9fb 17.11.2022/17.20
- *** <https://www.indeed.com/career-advice/finding-a-job/types-of-work-environments>
- *** <https://insse.ro/cms/en/content/territorial-statistics>
- *** https://www.ccohs.ca/oshanswers/hsprograms/occ_hygiene/occ_exposure_limits.html