MINISTRY OF EDUCATION AND RESEARCH
National University of Science and Technology
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DOCTORAL THESIS

STUDIU APLICATIV AL INFLUENȚEI RISCURILOR ASUPRA PERSOANELOR FIZICE ȘI AL SISTEMULUI DE EVALUARE A RISCURILOR ÎN DOMENIUL S.S.M. ÎN CADRUL UNITĂȚILOR DE PRODUCȚIE DETERGENȚI

APPLIED STUDY OF THE INFLUENCE OF RISKS ON NATURAL PERSONS AND OF THE HEALTH AND SAFETY RISK ASSESSMENT SYSTEM WITHIN DETERGENT PRODUCTION UNITS

Scientific coordinator,
Prof.univ.PhD.eng. Oana Roxana CHIVU (UNSTPB)

- 2023 -

National University of Science and Technology POLITEHNICA Bucharest Bucharest

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SUMMARY THESIS

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Autor: Eugenia Șt. TUDOSE (BULBOACĂ)

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Content

Foreword

The research and development carried out as a result of a challenge launched 5 years ago on the occasion of professional improvement in the field of safety and health at work by completing the master's courses in the field of Engineering safety and health at work led me to continue and materialize my professional experience and that of my collaborators, the scientific studies all of which represent the motivation and direction of the doctoral studies, completed by this doctoral thesis.

The doctoral program consisted of the preparation, presentation and support of examinations and scientific reports, deepening the study, proposing and developing methods of occupational risk analysis and easy selection of measures to prevent events and protect workers through practical application, realization and publication of scientific works, as well as the elaboration of the present doctoral thesis on the applied study of the influence of risks on natural persons and the health and safety risk assessment system within detergent production units

I express my deep gratitude for the support, recommendations and coordination provided by the project "Performance in research", POCU/993/6/13/153178, to the team and the scientific coordinator of the work, Ms. university professor PhD. eng. Oana-Roxana CHIVU, for the trust, support and recommendations she gave me throughout almost 4 years of doctoral studies. This work was also supported by grant POCU/993/6/13/153178, "Performance in research" co-financed by the European Social Fund within the Human Capital Sectoral Operational Program 2014-2020.

I express my special thanks to the professors of the Faculty and Doctoral School of Industrial Engineering and Robotics from POLITEHNICA University of Bucharest, with whom I prepared, collaborated, analyzed and debated some aspects and took all the exams during the doctoral studies.

I thank all those who helped me in the creation, adaptation and completion of the paper, articles related to the theme, supported and encouraged me for publication.
Last but not least, I would like to express my sincere thanks to my family who understood me, supported me and with whom I collaborated for the realization of this work.

Eugenia Șt TUDOSE (BULBOACĂ)

Introduction

The production and use of chemicals in workplaces around the world presents one of the most important challenges to the implementation of workplace safety programs. Chemicals are essential to life and their benefits are widespread and well known. From pesticides that increase food production and improve its quality, to pharmaceuticals that cure diseases and cleaning products that help establishing hygienic living conditions, chemicals are essential for a healthy life and modern comfort.

Chemicals are also a critical part of many industrial processes that make products important to global living standards. However, controlling workplace exposures to these chemicals, as well as limiting environmental emissions, are tasks that governments, employers and workers continue to struggle to achieve.

Within the units producing detergents, a rigorous analysis of the system of identification, evaluation and assessment of dangers and risks in the field of OSH (occupational safety and health) of equipment, personnel and the entire work and management system is required considering the specific hazards of activities with chemical substances and preparations and production units.

The risk assessment must be presented in an appropriate form and may include the employer's justification that the nature and extent of the risks due to the chemical agents require another detailed risk assessment. The risk assessment will be updated if any produced significant changes due to which the assessment would be exceeded or when the results of health surveillance make this necessary.

In the case of activities involving exposure to several hazardous chemical agents, the risk must be assessed based on the risk presented by all these chemical agents in combination.

The main objective of the paper is the analysis and improvement of the occupational risk assessment system in domestic detergent production units, through theoretical and experimental research adapted and correlated with the updated legislation and the specific OSH RS EN ISO 45001/2018 standard.
The aim of the work was to carry out theoretical and experimental research on the assessment of risks that influence employees and the impact on them within economic units with detergent production.
The objectives of the research are:
- The study, analysis and development of a method adapted to the current legislative and management conditions for the evaluation of the management system in detergent production units;

- Correlation between specific elements in the field of OSH;
- Proposing measures to improve the evaluation system;
- Implementation of the management system adapted to RS ISO 45001/2018 requirements;
- Verification of the efficiency of the management system according to the standard in force;
- Formulation of checklists adapted to the management standard.

In order to achieve the proposed objectives, we did the following:

- Detailing the assessment of occupational risks for the workplace/work station, the technological process, the sensitive group, work equipment, substances and/or dangerous chemical preparations, the layout of workplaces within the organization;
- Study on the advantages of the proposed method adapted to the current requirements in the field;
- Case study and comparative practical application between the INCDPM method and the proposed innovative evaluation method in the field of S.S.M. within detergent production units.

* * *

By completing this thesis, the doctoral student proves her ability to scientifically treat a current research topic, highlights the ability to extract essential ideas from the rich studied bibliography, identifies the most suitable research methods, establishes and follows the research objectives in a logical sequence, draws conclusions based on arguments and offers her own theoretical and practical solutions.

The component parts of the thesis respect the following proportions:

1. The introduction to the issue of the doctoral thesis represents approximately 2% of the paper, containing the motivation for choosing the topic, the topicality, the importance of the topic. Formulating the main objectives of the work, outlining the expected results, indicating the limits of the research carried out/thesis development.
2. The theoretical foundation represents approximately 33% of the work. This part highlights the aspects resulting from previous research in the field of the doctoral thesis topic, including the applicable theoretical models, the methods used, the criteria adopted, the techniques used, etc., presented synthetically and coherently.
3. The development of applied research represents approximately 60% of the work, the thesis demonstrating the ability of the doctoral student to use the results of the research, in a creative, original and innovative way so as to produce a new perspective on the problem addressed. This component of the thesis has materialized in operational research, case studies regarding the assessment of occupational risks specific to jobs/jobs, activities and details of the application using Microsoft Excel. The evaluation methods selected, the research analysis and conclusions, and the spreadsheets used are detailed, linked so that the elements can be viewed in real time and the results can be highlighted according to the initial data.
4. The final conclusions and main contributions represent approximately 5% of the paper. The conclusions are presented in a logical sequence, accompanied by arguments, emphasizing the original aspects, advantages and limits of the solutions offered. The proposals are concrete and achievable and can provide support to both organization managers and OSH specialists in identifying, assessing and evaluating occupational risks.

Chapter 1. Occupational health and safety elements related to the assessment of professional risks in the chemical field

1.1. The main chemical risk factors

The main characteristics of chemical agents very dangerous for the operator are shown in fig 1.1.

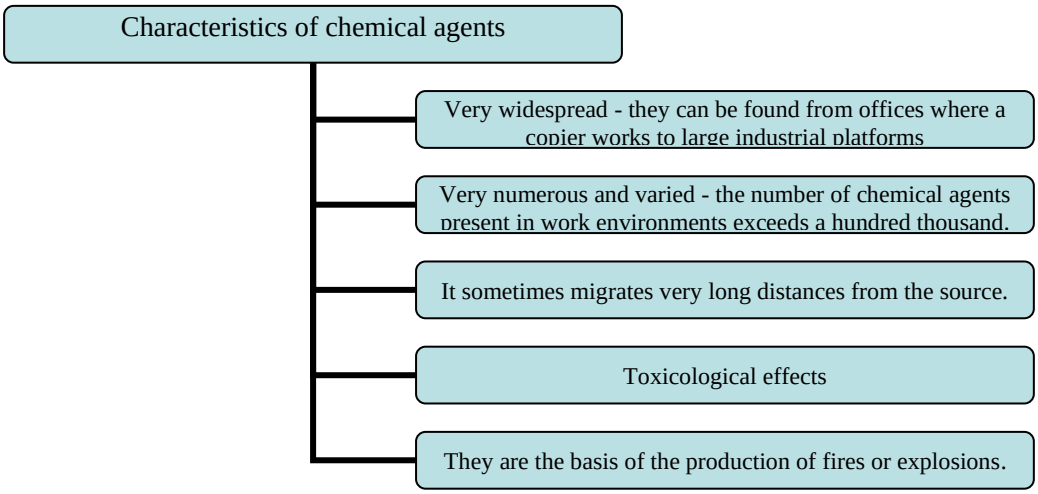

Fig.1.1. Characteristics of chemical agents very dangerous for the operator

According to R.G.D. no. 200 of November 9, 2000, toxic substances and preparations are substances and preparations that through inhalation, ingestion or skin penetration in small quantities can cause death or chronic or acute health conditions [109].

The most serious health consequences occur in the case of inhaling toxic substances, to determine their influence, their cumulative effect and environmental conditions must be taken into account. High temperatures and high humidity increase the risk of poisoning [110]. Depending on their effect on the human body, toxic substances can be classified according to fig. 1.2.

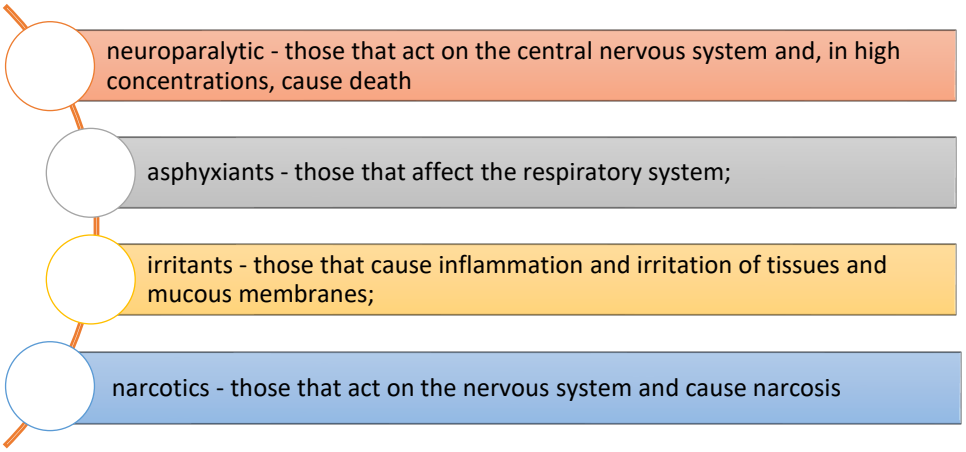

Fig.1.2. Classification of toxic substances

Reproductively toxic substances and preparations are substances and preparations that, through inhalation, ingestion or skin penetration, can produce or increase the frequency of non-hereditary harmful effects in offspring or can damage male or female reproductive functions or capacities [110].

Burns can be caused by the body's contact with gases, vapors and caustic aerosols. The severity of organic injuries determined by chemical burns varies depending on the concentration, nature and time of contact with the caustic substance. Chemical burns can be classified according to position: cutaneous, being the most common and dangerous of the respiratory tract and digestive tube, and ocular.

The most dangerous dusts found in the air at the workplace are the invisible ones with dimensions below 5 μm. These dusts lead to pulmonary transformations, generically called "pneumoconiosis", the severity of which depends on: the aggressiveness of the dusts; their concentration in the inhaled atmosphere; the length of time the powder was inhaled.

1.2. Protection of workers against the risks determined by the presence of chemical agents

RGD-300/2006 published in the Official Gazette of Romania from October 13, 2006, establishes the minimum requirements for the protection of workers against risks for their security and health, which come or may come from the effects of chemical agents present at the workplace [111]. The risk assessment carried out at workplaces where the presence of dangerous chemical agents has been detected depends on the elements presented in fig.1.3.

Fig 1.3. Elements of influence in chemical risk assessment

Occupational exposure limit value [110] is, unless otherwise specified, the limit of the time-weighted average of the concentration of a chemical agent in the air of the area where a worker breathes, for a specified reference period, for 8 hours or for a short term of maximum 15 minutes.

If the risk assessment indicates a risk associated with a dangerous chemical agent at the workplace,[58] its use must be avoided, replacing it with a chemical agent or process that, under the conditions of use, does not represent a risk for the safety and health of workers. If the type of activity does not allow the reduction of the risk by substitution, the risk must be minimized by applying protection and prevention measures, supplemented by health monitoring.

1.3. Chemical risk assessment

The risk factors of injury, trauma and disease represent (attributes, states, processes, phenomena, behaviors) the elements of the work system, which can cause work accidents or occupational diseases.

The prevention of occupational accidents and illnesses involves discovering and excluding or neutralizing the action of risk factors. The proposed prevention measures must fit each component element of the analyzed work system. In the case of the measures taken regarding the operator, such as periodic medical evaluation, psychological testing, training, they aim to remove the own risk factors, determined by the insufficiency of physical skills, the absence of OSH professional knowledge, inappropriate behavior in relation to possible risks.

The risk assessment method developed [110] within the National Research and Development Institute for Labor Protection in Bucharest, which we will hereinafter call the INCDPM method, was approved by the Ministry of Labor and Social Solidarity in 1993 and was tested within a PHARE program carried out in our country. The application of this method is embodied in the drafting of two documents that will accompany each occupation, namely the job evaluation sheet and the preventive measures sheet.

The INCDPM method [112], consists in identifying all the existing risk factors at the workplace evaluated based on predetermined checklists and determining the size of the risk based on the combination of severity and frequency of the maximum possible consequence on the human body. The assessment ends with the calculation of the global risk level of the work system, as well as the partial risk levels corresponding to all the identified risk factors [23].

1.4. The ergonomic approach to the security of work systems

A modern company is an organized system in which work is in constant and necessary interaction, and the functions aimed at making the product are divided into services. Therefore, when analyzing the safety of systems and the etiology and prevention of accidents and occupational diseases, a holistic view of the target system (workplace, workshop, branch, company) is required in which all elements of the system interact and are optimized by mutual adaptation of its component elements.

According to the ergonomic approach, work accidents and occupational diseases constitute a malfunction of the work system, deviation from its normal state of operation. The causes of these failures should be investigated at the level of individual system components. In general, the occurrence of work accidents and occupational diseases is caused by a combination of different factors.

1.5. The dynamics of occupational injury and illness phenomena

In order for a work accident or an occupational disease to occur, there must be a simultaneous combination of two risk factors, one objective and one subjective, because only then can there be an interaction between the dangerous agent and the worker. In turn, the subjective element specific to the performer includes at least his mere presence in a dangerous area. Knowing the associations of risk factors: presence/action – the impacts that can lead to accidents or occupational diseases is necessary because it provides an opportunity for timely intervention and prevention of the risk factors inherent in the work system or that may appear during operation and the simulation of all possible effects of their presence and actions.

Chapter 2. Occupational risk assessment system – component of OSH policies in detergent production

2.1. General trends

International economic developers of detergents are expanding their areas of influence by taking over, upgrading or building local production units in the country or emerging areas, with most local manufacturers being absorbed by takeover or transformation from manufacturers to distributors.

The increase in the use of washing machines ensures the development of the market and the need for a consumption of liquid or powder detergents necessary for them.

The community market is expected to grow at a significant pace during the next forecast period owing to the increasing sales volume of washing machines and automatic demand for detergents, fabric improvers, bleaches, and stain removers.

In figures no. 2.1. and 2.2. the general trend regarding the use and annual growth rate of the main categories of detergents is presented.

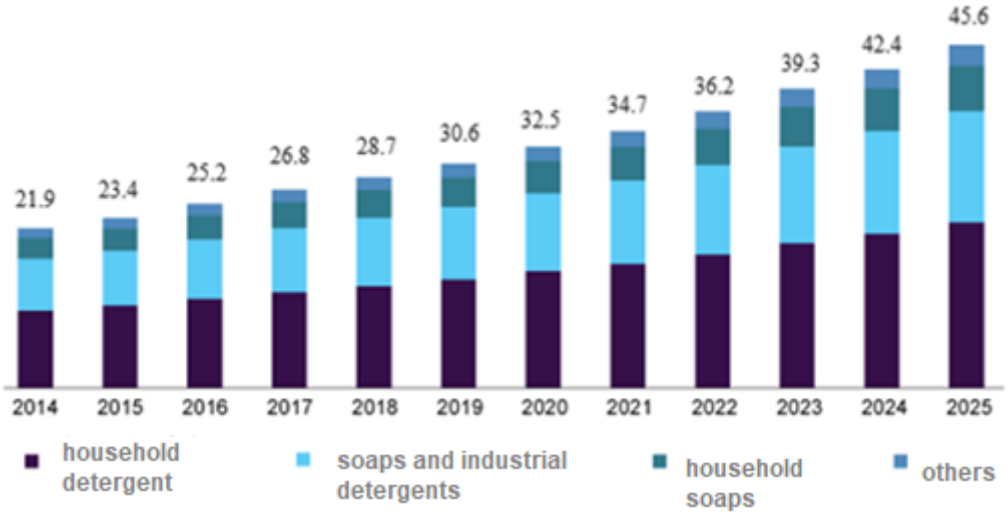

Fig.2.1. Detergent use trend [100].

2.2. OSH policy according to RS EN ISO 45001:2018

The security policy of the organization/unit producing detergents analyzed respects and applies the provisions of the RS EN ISO 45001:2018 standard, being defined as a policy to prevent injury and illness caused by the work of workers and to ensure safe and healthy workplaces.

The objectives regarding occupational health and safety [88] carried out in the organization aim to:

• compliance with the requirements of European and national legislation in the field of occupational health and safety;

• to develop and implement solutions related to health and safety, in accordance with the mandatory and specific regulations of health and safety at work in the operations of the organization, so that the risk of occupational injury and illness of workers is eliminated or minimized;

• identification, assessment, elimination or control of risk factors [110];

• prevention, proposal and initiation of corrective measures, elimination or control of occupational risk factors;
• increasing performance in occupational health and safety, by organizing, tracking and analyzing objectives;
• establishing the technical and organizational measures for work security, corresponding to the positions, places and working conditions, of the risk factors assessed at the workplaces, to ensure the health and safety of workers;
• reduction to elimination of accidents, traumas and breakdowns.

After carrying out a risk assessment for each job and workplace, the technical, organizational, sanitary and other preventive and protective measures necessary to ensure the safety and health of workers are established, and the necessary human and material resources are determined.

2.3. Risk assessment within the organization

The most common methods and techniques for assessing occupational risks and means of preventing work accidents are those provided for in RGD-1218/2006 regarding the establishment of the minimum requirements for safety and health at work to ensure the protection of workers against the risks related to the presence of chemical agents, art. 12. [58]
The I.N.C.D.P.M. method used in most areas of production activity, we have found that it is not suitable for all activities in the chemical environment, and an improvement is needed for the production of detergents. Due to this finding, we propose an updated and adapted method based on the application of the principles from the RS EN ISO 45001:2018 standard, the INCDPM method, the SUVA method, with calculation elements from other methods - e.g., for the analysis the INCDPM method, the definition of jobs the MERA method, for the analysis of the executor's activities the 5-stage method, for the means of work the IOSHA method.

2.4. Assessment of occupational injury and illness risks for the chemical operator workplace

The risk assessment is based on finding all the risk factors in the analyzed system and measures their size using a combination of two parameters: the severity and the frequency of the greatest possible effects on people. In this way, the partial risk level is determined for each risk factor, or the global risk level for the entire analyzed system [6]. The method used for risk assessment is the INCDPM presented below [23].

2.4.1. Work process

The work process whose executor is the chemical operator consists in carrying out the handling, transport and preparation of chemical products, industrial detergents according to the technical specifications of the product.

2.4.2. Means of production

- pallet truck, transport trolley, access ramp, preparation vats, mixer and mixer, electric boilers, product packaging, chemical products, others

2.4.3. Work task

• visual check of the integrity of the warehouse and daily technical check of work equipment;
• information about the activities to be performed on the respective working day and their order of priority;
• preparation of products according to reception-sale needs;

2.4.4. Work environment

The chemical operator works in the production, preparation section - the space is not heated, but there is a special room to ensure the thermal comfort of the workers.

2.5. Interpretation of assessment results for the job: chemical operator [16],[96]

The global risk level determined for the chemical operator job is equal to 3.35, a value that places it in the category of jobs with an acceptable risk level [96].
This result was supported by the "Chemical Operator Assessment Sheet", which showed that 7 out of a total of 28 identified risk factors exceeded the partial risk level.
0 falls into the category of maximum or very high-risk factors, 1 fall into the category of high-risk factors, and the other 6 fall into the category of medium risk factors [96]. The 7 risk factors that fall into the unacceptable range are presented in table 2.5.

Tabel 2.5. Unacceptable risk factors [96]

Unacceptable risk factors identified	Risk level
Hit by motor vehicles when moving between the unit and home, during internal supply and sales maneuvers [16]	5
Falling objects from a height	4
Crushing by loads	4
Electrocution by direct contact with live conductors	4
Electrocution by indirect contact with electrical installations	4
Caustic substances – chemical products classified as dangerous to handle	4
Static and dynamic effort, working in vicious positions and handling masses [16]	4

To reduce or eliminate the seven risk factors (outside the acceptable range), the measures indicated in the "measure sheet" for the workplace are required. Regarding the distribution of risk factors by source, the situation is as follows:

- 46.42%, factors specific to the means of production [16],[96];
- 27.12%, factors specific to the work environment [16],[96];
- 12.17%, factors specific to the workload [16],[96];
- 14.29%, executor's own factors [16],[96].

Fig. 2.5. The share of risk factors identified by the elements of the work system **[16],[96].**

2.6.Conclusions

The chapter describes the assessment of occupational injury and illness risks for the chemical operator workplace [16] within the company, in accordance with the provisions of Law no.319/2006, the Occupational Safety and Health Law, art. 12, lit. a.'[79] and RGD-1425 of October 11, 2006,[62] for the approval of the Methodological Norms for the application of the provisions of the Occupational Safety and Health Law no. 319/2006 art. 15 no. 1.
The evaluation was carried out by applying the I.N.C.D.P.M. method. of occupational health and safety risk assessment, approved by the Ministry of Labor and Social Solidarity [112].
Preventive measures sheets have been completed for the risk factors of the analyzed workplace whose partial risk level is above the accepted limit value 3.
Within the company, the risk assessment was carried out for all jobs using the same method, I.N.C.D.P.M., the global risk levels being calculated and presented in table 2.6.

Tabel 2.6. The calculated risk level for the positions mentioned

No.	The job(workplace)	Risk level
1	office worker	3,23
2	forklift operator	3,32
3	handler	3,30
4	driver	3,46
5	caretaker	3,32
6	commercial agent	3,46
7	packer	3,30
8	chemical operator	3,35
GLOBAL LEVEL OF RISK		**3,34**

The global risk level determined for jobs in society is equal to 3.34, a value that places it in the category of jobs with an acceptable level of risk.
In order to reduce or eliminate the risk factors, measures are proposed according to the method applied and presented in the "Proposed measures sheet", table 2.4., for the evaluated workplace - chemical operator.
The appearance of some changes, even specific ones, in the characteristics of the elements of the work system (executor, work load, means of work and work environment [96]) can lead to the modification of the partial risk levels of the identified risk factors (both in the direction of increase and decrease) as well as the appearance of new risk factors, not named in this paper.
The proposed measures have a recommendation character, their purpose being the provision of an information base for the establishment by the employer of prevention and protection measures [96], within the Prevention and Protection Plan, an obligation that falls to the employer in accordance with the provisions of the Occupational Safety and Health Law no. 319/2006 [79].
Top managers are concerned with providing optimal working conditions for their employees to avoid accidents and occupational diseases.

Chapter 3. Conclusions regarding the current state of risks to natural persons and the risk assessment system in the field of OSH within detergent production units

From the analysis of the current stage of the research-development of occupational risk assessment in the field of OSH within detergent production units, the following important conclusions can be drawn, as follows:

- general risks that can affect natural persons in work processes are interpreted as professional risks and require their identification, appreciation and evaluation, and as a result of the analysis carried out, measures are established to prevent the occurrence of events and to protect employees;
- the legislative requirements are applicable to companies regardless of the field of activity, the management system requirements are optional, being applied only in institutions that wish to implement and certify RS EN ISO 45001:2018;
- the methods frequently used to assess occupational risks are of a general nature, they are insufficiently in-depth for industrial fields with specific risks such as detergent production;
- the calculation tools required for professional evaluations are expensive, require periodic updates established by the manufacturer's policies, have difficult instructions for use and do not present details on the meanings of the results
- there is a need to apply a management system in the field of OSH integrated with that of quality and environment in order to correlate the necessary actions and measures [24];
- a new method of occupational risk assessment applicable to workplaces/jobs is proposed, the method being called MEvAR (Method of Evaluation and Assessment of Risks) and developed by the author;

• the MEvAR method proposes a calculation tool based on the Excel spreadsheet software program produced by Microsoft, with intercorrelated work and calculation pages, in real time, which only requires check list selections and validation. The results are presented in precise forms, easy to follow, implement and monitor;

• the new method proposed by MEvAR allows the real-time observation of the results, the impact of risk selection and the necessary measures, the modification of data or requirements according to potential risks;

• MEvAR OSH risk assessment criteria are defined according to their scope, nature and timing, to ensure that they are proactive rather than reactive and that they are used in a systematic way.

Carrying out professional risk assessments is a professional activity that is regulated by legislative requirements regarding the need to ensure them and the quality of specialists.

However, their application differs from specialist to specialist depending on:

• experience-own professional training (evaluation course, specialization courses, master's, doctorate);

• the environment and nature of the workplace;

• contractual requirements (employee/collaborator company, corporation, service provider).

The work environment is an element of the work system alongside the executor, the work task and the means of production in relation to the work process, but it is not directly related in the regulations in the field of OSH with the external environment, socio-human proximal and distal, relational and informational, financial, political-economic, surrounding environment in general [96].

Professional risk assessment methods do not aggregate risks by category, are only partially adapted to quality, environment, information, security management systems and ensure the treatment of certainties as risks with maximum probability.

Certainties are hazards that can generate serious events with maximum single probability, those with multiple probabilities are risks.

Certainties can be treated by eliminating dangerous situations/sources of production or eliminating the possibility of production, if the human does not interact with the dangerous situation the event will no longer exist.

The risk factors of the work environment are mainly determined by the climate conditions in the work area of the post, activities and workers described in fig.3.1.

Variations in the characteristics of work environment factors are mainly determined by subjective assessments of specialists with estimated values or by technical measurements with calibrated equipment, established system procedures/methodologies that present determined values.

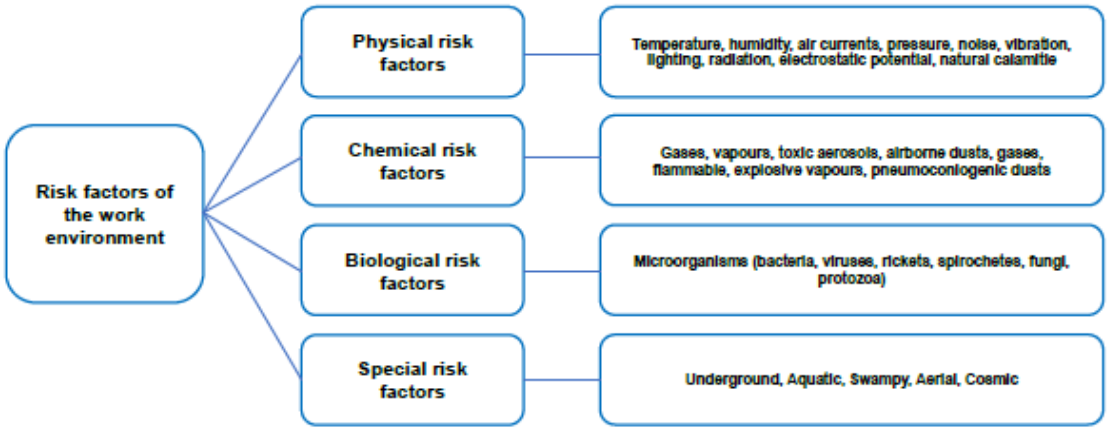

Fig.3.1. Risk factors of the work environment

The influence of the work environment on the workers can be assessed according to the medical conditions found following occupational medicine medical examinations, the number of days of sick leave or in serious cases death.

By adapting and correlating the risk factors in general and those of the work environment in particular with the requirements of the OSH management system, the following can be achieved:

• updating and completing the non-covered and/or niche aspects of the assessment methods used by most specialists;

• adaptation of professional risk assessment methods with the modification of legislative requirements in the field of OSH;

• awareness of dangers and prevention and protection measures from the management of organizations by assuming the evaluation report;

• the possibility of vectorial development of the evaluation system by ensuring the application of general and particular principles of identification, analysis, assessment and evaluation of professional risks;

• the possibility of mitigating hazards by ensuring vigilance and an increased weight of risk treatment, managing and keeping under control those that have the possibility of occurrence or large variations.

A hazardous chemical agent can cause risks of occupational disease or occupational accidents by [106]:

• toxicological properties, for example, highly toxic, poisonous, harmful, corrosive substances, irritants, which cause allergies, substances that cause cancer, infertility or congenital malformations [16]. This category also includes substances that can cause eczema after prolonged contact with the skin. High concentrations of dust can have harmful effects on the respiratory system, even in cases where their chemical composition is not classified as dangerous [58];

• replacing oxygen in the air, for example, nitrogen which is not dangerous in principle, when its concentration exceeds the natural proportion in the air, the proportion of oxygen decreases and the breathed air becomes suffocating [106]. The composition of the air can also be changed in following chemical or biological processes that consume oxygen [101].

Employers must ensure that purchased hazardous chemicals are accompanied by the supplier's, importer's or distributor's safety data sheet. Safety data sheets must contain full information on risks and protective measures [106].

Manufacturers are obliged to draw up safety data sheets and send them to users and to the National Environmental Protection Agency, which is responsible for national enforcement of the law on dangerous substances and their preparations [95].

When choosing hazardous chemicals, not only the chemical risks must be considered, but also any risks of illness or injury that may result from their use. The selection of two chemicals is often simplified by identifying the properties that distinguish them and evaluating them based on those properties.

Employers must avoid the use of hazardous chemicals and replace them with harmless or less hazardous chemicals or technological processes to ensure the health and safety of workers. Changing the product can mean changing the way of working. It is therefore important to assess the risks associated with the combination of chemicals and work methods and also to consider the risks associated with monotonous or repetitive work.

The equipment must be selected and installed taking into account the level of danger, the nature of the materials used or manufactured and the environment in which it will be installed (on equipment operating in explosive environments, it is necessary to install automatic control systems and devices with hydraulic or electrical actuation, in this case the control system must be with explosion-proof encapsulation) [15]. The choice and purchase of work equipment complies with the requirements provided by the applicable safety directives (RGD no. 1146/2006, RGD no. 752/2004) [52] and the equipment without markings as well as how to use them comply with the requirements provided by Directive 89/655/CEE (RGD no. 1146/2006) [95].

The paper focuses on the awareness and control process of companies that produce, store, handle, trade and use dangerous chemical substances, with the objectives presented in fig 3.2.

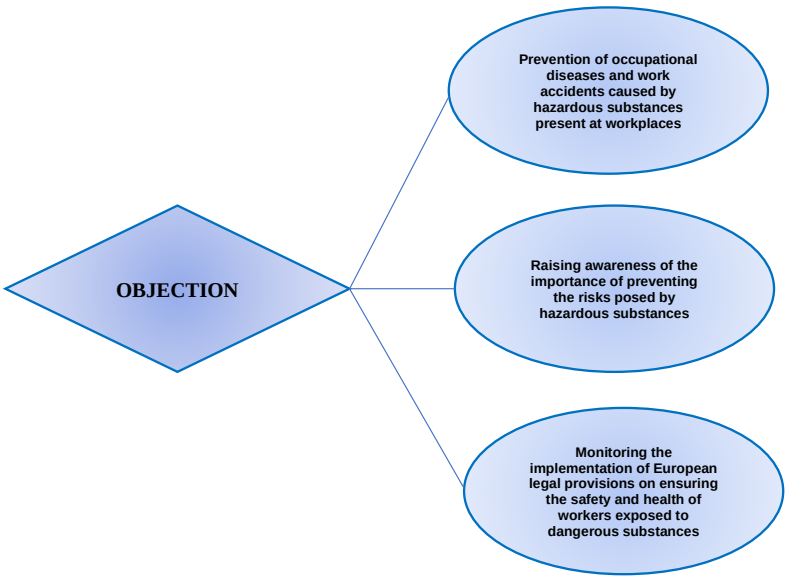

Fig.3.2. Objectives of the current stage

Chemical workers are at risk in many ways. To understand the risks of exposure to chemicals, it is important to know the possible routes of contamination, such as: vapor, spraying, splashing and immersion [97]. Inhalation or dermal absorption of chemicals can occur without workers' awareness. In addition, many workers in the chemical industry are exposed to additional risks beyond chemical exposure when using various tools, processes and applications in the workplace.

The need for the emergence of the MEvAR method provides increased flexibility to risk assessors regarding the choice of relevant risk factors, reference values, how to treat chemical risks, and the impact and exposure of workers in detergent-producing organizations.

Chapter 4. The directions, the main objective and the research-development methodology of a new method for assessing occupational risks in detergent production units

4.1. Research and development directions

Based on the results of the analysis of the current state, the following directions of research and development are taken into account for the identification and assessment of occupational risks in general and in particular, applicable to the field of detergent production:

• analysis of the possibility of applying different professional risk assessment methods to the field of detergent production;

• analysis of the development and application of the MEvAR professional risk assessment method;

• establishing the details of the method (mathematical model, calculation grids, limits and margins of error, legislative and systemic context, forms and other elements);

• realization and development of the calculation tool associated with the MEvAR method;

• supporting and promoting the MEvAR evaluation method.

4.2. The main objective of the research-development activity

The analysis of the data and conclusions resulting from the investigation of the current state, as well as the definition of research and development directions, were the basis for determining

the main objective of the doctoral activity: the analysis, development and support of the MEvAR professional risk assessment method based on the mentioned opportunities.

The main objective of the paper is the analysis and improvement of the occupational risk assessment system in domestic detergent production units, through theoretical and experimental research adapted and correlated with the updated legislation and the specific OSH RS EN ISO 45001/2018 standard.

The aim of the work was to carry out theoretical and experimental research on the assessment of risks that influence employees and the impact on them within economic units with detergent production.

The objectives of the research are:

- The study, analysis and development of a method adapted to the current legislative and management conditions for the evaluation of the management system in detergent production units;
- Correlation between specific elements in the field of OSH;
- Proposing measures to improve the evaluation system;
- Implementation of the management system adapted to RS ISO 45001/2018 requirements;
- Verification of the efficiency of the management system according to the standard in force;
- Formulation of checklists adapted to the management standard.

To achieve the proposed objectives, the following research activities were carried out:

- Detailing the assessment of occupational risks for the workplace, the technological process, the sensitive group, work equipment, dangerous chemicals, the arrangement of workplaces within the organization;
- Study on the advantages of the proposed method adapted to the current requirements in the field;
- Case study and comparative practical application between the INCDPM method and the proposed innovative evaluation method in the field of OSH within detergent production units

4.3. Research and development methodology

The research methodology is intended as a reference for the actions that will be carried out to achieve the central objective of the doctoral thesis, as well as for the future evolution. The main methodological components used are the following:

(1) *The research methodology is intended as a reference for the actions that will be carried out to achieve the central objective of the doctoral thesis, as well as for the future evolution*.

The main methodological components used are the following:

A documentation related to both theoretical and experimental research was carried out, focused on:

– the perception of basic data, of well-established principles, in the field of scientific research regarding the identification of specific risks in detergent production units;

– updated information, with specialized bibliographic reading, regarding the current state of research in the field of work equipment and protective means, used in the chemical field where risks may arise related to the presence of chemical agents as a result of any professional activity in the unit;

– the responsible, ethical and intellectual-scientific commitment of the author of the doctoral thesis, after a critical review of specialized bibliographic literature, both from Romanian and

international literature, in bringing news related to the achievement of safe working conditions regardless of the professional activity performed.

(2*) Specifying the set of research methods.* The research methods used were structured as follows: the quantitative research method - with an explanatory positivist orientation and a qualitative research method - with a phenomenological orientation (using participatory observations, case studies). In the implementation of the general research plan, the established actions were used: the investigation and the case study, the materialization of each method using specific tools, such as exploratory research.

The following aspects were taken into account:

– construction of working hypotheses;

– selection of work techniques for data collection and analysis that will be used to explain the phenomena involved in determining the essential requirements for work safety in detergent production units;

– making a list of the tools indispensable for the research, they being related to the investigation methods;

(3) *Collecting and processing the data from the conducted field research*. The benchmarking strategy used was the investigation, an action that guarantees the collection of information made available by the company regarding the safety and health of workers, such as safety data sheets. For the risk assessment at the workplace where the presence of dangerous chemical agents was found, data were collected on:

- degree, type and duration of exposure;
- the conditions under which the work proceeds in the presence of chemical agents, including their volume;
- professional exposure limit values;
- the effectiveness of the preventive measures that have been or will be taken;
- the conclusions drawn from the health monitoring carried out over time.

An analysis was carried out regarding the identification and assessment of risks for the chemical operator workplace in the unit S.C. DERO PROD S.R.L., using the INCDPM method, in which the identification and reduction of risks was achieved either by proposing technical, organizational and hygienic-sanitary measures.

The research continued with the implementation of the measures proposed to improve the health and safety of workers, finding their ineffectiveness in certain actions carried out at the workplace.

A new risk assessment method adapted to the minimum occupational health and safety requirements was designed to reduce the risks of occupational disease in detergent production units.

(4) *Examination and interpretation of research results*

The results obtained are in line with the elements recognized in the specialized literature, confirm the scientific and practical theories currently applied in the field of OSH, emphasizing the fact that the identification and monitoring of the risks characteristic of the chemical field will continue to remain a current sector both in terms of theoretical and experimental research. The research carried out by the authors brings new elements, multiplying the knowledge regarding the current state of professional risk assessment methods, solving some problems related to the essential principles of the risk assessment method in the chemical field.

(5) *Transmission of conclusions and suggestions*

At the end of the doctoral thesis, the conclusions are presented, in a concise manner, emphasizing the scientific results obtained during the years of study. From these conclusions, the future scientific theories related to the fact that safety and health at work presuppose the existence and operation of a multidisciplinary system of theoretical concepts, legislative acts, measures and technical, socio-economic, organizational, hygiene and occupational medicine will be elaborated. The results of the research contained in this doctoral thesis were partially presented in the framework of scientific events held both in the country and abroad.

The directions of further development are oriented, on the one hand, to the valorization of the research results, and on the other hand, to the identification of professional risks using the MEvAR method, which proposes a calculation tool based on the Excel spreadsheet software program produced by Microsoft, with intercorrelated worksheets and calculations, in real time, which only require check list selections and validation. The results are presented in precise forms, easy to follow, implement and monitor.

The method created and tested - MEvAR, allows the real-time observation of the results, the impact of risk selection and the necessary measures, the modification of data or requirements according to potential risks, both from the chemical field and from other industrial fields.

Chapter 5. Research on the identification and monitoring of risk factors in detergent production units

5.1. The European-Romanian legislation correspondence

It starts from the European Framework Directive 89/391/CE on safety and health at work transposed into Romanian legislation by Law 319/2006 on safety and health at work and reaches the orders of the Minister of Labor and Social Protection. [95], [79].

These requirements are correlated with the requirements in the field of labor relations, social solidarity, emergency situations, environment, personal data protection, physical and computer security, financial, others.

The implementation of the integrated system is an essential requirement considering the specifics of the detergent production field and the methods of elimination, neutralization, reduction, limitation of occupational risks, prevention and protection in the field of OSH.

5.2. The Evaluation of the impact of chemical agents on the health and safety of the population

Health impact assessment represents an association of procedures, methods and documents based on which it can be determined whether a policy, program or project can have determining effects on the health status of the population, as well as the spread of these effects in the exposed population [105].

Health is defined as "a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity. This definition recognizes that health is critically influenced by a number of factors, or determinants. The health of the individual, but also the health of the various communities in which individuals interact, is significantly affected by the following determinants:

- environmental factors;

- access to services;
- stress level;
- age;
- living conditions.

Health in relation to the environment is that component of public health whose purpose is to prevent diseases and promote the health of the population in relation to environmental factors. The field of health in relation to the environment includes all theoretical and practical aspects, from policies to methods and tools related to the identification, evaluation, prevention, reduction and combating of the effects of environmental factors on the health of the population. Thus, the field of health intervention in relation to the environment is a multidisciplinary, complex one, which involves the intersectoral and inter-institutional collaboration of teams of specialists, for the understanding, description, quantification and control of the action of environmental factors on health.

5.2.1. Description of detergent production technology

Detergents are complex compositions, bringing together a series of basic components: surfactants and conditioning agents, together with special components, also called additives, which, although usually added in small amounts (3-10%), have the effect of improving the product's performance.

5.2.2. Identifying potential risk factors in the environment

Among the environmental factors, the soil is of major importance, constituting, on the one hand, a place of accumulation of polluting elements, and on the other hand, a means of dynamic response to the accumulation process. The changes that occur in the soil, as a result of the impact of pollutants, are reflected on the other links of the trophic chain, vegetation - water - animals - man. The soil is the mediating factor that integrates all the consequences of pollution, it also influences the subsoil and groundwater.

The waste resulting from the company's activity is, in the majority, waste from technological processes, from the exploitation and maintenance of machinery, and household waste. In table 5.3. the type of waste/quantity generated in 2020, the source of production and the method of recovery/utilization/disposal of the generated waste are presented centrally.

Table 5.3. Hazardous waste types/source/method of disposal

No.	The type of waste	Production source	The quantity generated tons/year	Recovery/removal mode
1	Absorbents, filter material Preparation/drying, packaging	Absorbents, filter material Preparation/drying, packaging	1.09	Storage in the segregation area, concrete platform equipped with retention/disposal basins
2	Used batteries Supply from electric forklifts	Used batteries Supply from electric forklifts	0.001	
3	Used oil Preparation/drying, packaging, utility maintenance	Used oil Preparation/drying, packaging, utility maintenance	0.02	Marked and labeled storage containers. Pickup by authorized companies for disposal
4	Packaging that contains residues or is contaminated	Packaging that contains residues or is contaminated with	1.6	In closed and labeled containers/bags. Collection

	with dangerous substances Production, maintenance, repair and control activity	dangerous substances Production, maintenance, repair and control activity		by authorized companies for disposal
5	Scrap electrical equipment Office activities	Scrap electrical equipment Office activities	0.05	Containers, storage boxes. Collection by authorized companies for disposal
6	Used solvents and solvent mixtures Office equipment maintenance activities	Used solvents and solvent mixtures Office equipment maintenance activities	0.1	In original packaging or sealed containers. Collection by authorized companies for disposal

5.2.3. Monitoring of environmental factors

According to the data from the assessment of human exposure and health risks, in relation to the location and operation of the industrial objective, the levels of hazardous substances specific to the activity in the atmospheric air in the areas within the area of influence of the objective were determined. The levels of dangerous substances determined in the atmospheric air in residential areas within the area of influence of the objective and at the limit of the industrial premises (points 1-10 located in the residential area in the vicinity; points A, B, C, D located at the limit of the industrial premises) are presented in figures 5.1-5.9.

Under the conditions of the scenarios that were based on the values measured in the atmospheric air, in residential areas in the area of influence of the objective, the theoretically estimated additional risks for reference population groups (adults, children, infants) in the area of influence of the objective, of developing a malignant tumor as a result of respiratory exposure, for 15 and 30 years, respectively, to the benzene concentrations currently measured in the atmospheric air, fell within a range of values included as orders of magnitude between $3x10^{-6}$ and $13x10^{-6}$.

All the hazard indices (HI) calculated for the measurement points established within the area of influence of the objective, for the concentrations of specific contaminants estimated by dispersion models in the atmospheric air as a result of industrial activities, were well below the value of 1, which does not indicate the probability of a potential toxicity of the evaluated pollutant mixture on human health.

5.3. The shortcomings of the INCDPM method

As a result, most risk assessors in Romania were trained as risk assessors using the INCDPM assessment method and they created professional risk assessment documentation using the INCDPM assessment method [96]. Anyone who uses the INCDPM assessment method notices the following shortcomings, as the following types of risks are not sufficiently analyzed:

- furniture products that equip the workplace;

- generated by the materials and substances used at the workplace;

- generated by various sources of risk existing in locations where the employee arrives for interventions;

- generated by various sources of risk, when the employee moves from home to work and vice versa;

- generated by the person who should give the employee from the analyzed workplace, the general introductory training and for various reasons does not do it or does it incompletely;

- generated by the person who should check and maintain the work equipment that the employees use at this job and does not do it, or does it incompletely;

- generated by the person who should control and monitor the health status of employees and does not do it, or does it incompletely.

The INCDPM method. ask the evaluator to specify for each individual risk, which is the probability class. In order to determine the probability class for one or another risk, the evaluator must calculate or estimate the probability of the analyzed risk occurring in the future.

A method for calculating the probability of a risk occurring refers the evaluator to local, regional or national statistics on events that have occurred as a result of a risk of the type being analyzed [96].

In conclusion, a way of calculating the probability class is needed, objective and as simple as possible, if statistics are not useful to us.

From the practice in the field of OSH, after the risk assessment, it emerged that the majority of workers assigned with attributions in the field of OSH who coordinated prevention and protection activities based on the proposed measures sheet made according to the evaluation methodology related to the INCDPM method focused on non-compliant risks and acceptable risks were ignored. As a rule, if these negligible risks are not monitored from time to time by the workers assigned with responsibilities in the field of OSH, so that they remain at a negligible level, it is very likely that some or all of them will increase so much that they become non-compliant risks.

5.4. Comparisons between INCDPM and MEvAR method-specific risk factors

The SR EN ISO 45001:2018 standard mentions that organizations can use various OSH risk assessment methods as part of their global strategy for dealing with various hazards or activities. The method and complexity of the assessment do not depend on the size of the organization, but on the dangers associated with the organization's activities.

The OSH risk assessment process is recommended to take into account day-to-day operations and decisions, external aspects and OSH opportunities [40].

The methodology may include ongoing consultation with affected workers, monitoring and communication of new requirements, ensuring that needs are met and evolving.

The following is observed:

- we have a conditioning of the evaluation by the applicable legal requirements;
- the management system requirements, apart from ensuring the legal requirements, assume the assurance of the OSH management system and other requirements;
- the approach must be based on processes, hazard identification and OSH risk assessment.

Workers' competencies should include the knowledge and skills needed to adequately identify hazards and respond appropriately to OSH risks associated with work and the workplace [19].

In determining the competencies for each role, the organization should take into account factors such as:

- studies, training, qualification and experience, necessary for assuming the role and retraining necessary to maintain these skills;

- work environment;
- preventive and control measures resulting from the risk assessment process(es);
- requirements applicable to the OSH management system;
- legal and other requirements;
- OSH policy;
- the potential consequences of compliance and non-compliance, including the impact on worker health and safety;
- the importance of workers' participation in the OSH management system based on their knowledge and skills;
- tasks and responsibilities associated with the roles;
- individual capabilities, including experience, language skills, education level and diversity;
- the adequate updating of the competences required by the context or by the changes occurring in the activity.

5.5. Conclusions

Following the research carried out in this chapter, the following conclusions can be formulated:

- Correspondences between European normative acts, community directives and laws/government decisions issued in Romania are mentioned.
- Based on the correspondence made, the legislation in the field of OSH applicable in detergent production organizations was selected;
- Health impact assessment represents a combination of procedures, methods and tools on the basis of which it can be established whether a policy, program or project can have potential effects on the health of the population, as well as the distribution of these effects in the targeted population;
- The main phases of the detergent production process are reviewed: unloading/storage of raw materials; supplying facilities with raw materials; preparation; drying / storage of base powder; conditioning (post-dosing) base powder to obtain the finished product; packaging / storage / delivery of finished product;
- Hazardous waste resulting from the company's activity was identified, mostly waste from technological processes and from the operation and maintenance of machinery, and recommendations were made regarding the recovery/utilization/disposal of the generated waste.
- The levels of dangerous substances specific to the activity in the atmospheric air in the areas within the area of influence of the company were analyzed; all the indices determined for the points established within the area of influence, for the concentrations of specific contaminants (VOC) estimated in the atmospheric air as a result of industrial activities, were far below the value of 1, which does not indicate the probability of a potential toxicity of the mixture of pollutants evaluated on human health.
- Through the plan for monitoring the concentration in the atmospheric air of some contaminants specific to the company's activity, in order to prevent potential effects on the health of the population, it is proposed to carry out an annual monitoring, at the section level, by carrying out a set of measurements for powders, detergents and volatile organic compounds;
- The main deficiencies of the most used evaluation method, the INCDPM method, were identified, namely: the risk identification form is incomplete; the global risk level is flawed, it does not offer an alternative way of calculating the analyzed risk level; the absence from the

evaluation documentation of the list of non-conformities, the starting document for the implementation of the measure sheet proposed by the analyzed method; the acceptable risks were ignored, they no longer appear in the list of proposed measures, not being monitored further and not being able to be kept under control.

- A comparative analysis of the risk factors specific to the INCDPM and MEvAR method is carried out, emphasizing the fact that in order to determine the skills of workers, the organization should take into account factors such as: education, training, qualification and experience; work environment; the preventive and control measures resulting from the risk assessment process, the requirements applicable to the OSH management system; the potential consequences of compliance and non-compliance, including the impact on worker health and safety.

The final conclusion of this chapter is that the primary obligation of any appraiser is to eliminate risk at source where possible. Organizations can use various OH&S risk assessment methods as part of their overall strategy for dealing with various hazards or activities. The method and complexity of the assessment do not depend on the size of the organization, but on the hazards associated with the organization's activities, the approach must be based on processes, hazard identification and OH&S risk assessment.

Chapter 6. Contributions regarding the improvement of professional risk assessment methods within detergent production units

In order to carry out the case study and the practical application, I chose as comparison elements regarding the assessment of the risks of injury and professional improvement the INCDPM methods and the proposed MEvAR method applicable to a company producing professional detergents detailed below. The INCDPM method is well known to Romanian specialists and will be analyzed only for comparison without the specific details and elements.

6.1. Description of the MEvAR method (Professional Risk Assessment and Evaluation Method)

The MEVAR method was made based on the assimilation of management system requirements superimposed with the elements of known methods of identification, assessment and evaluation that are applicable in the field of detergent production within organizations.

Thus, it uses checklists and rapid control of the possibility of a dangerous situation occurring, which include most dangerous situations, risk factors, potential dangers and are identifiable within the production processes of professional detergents.

The data from the lists can be easily imported being in a processable electronic format and into other specialist risk assessment programs.

In the context of changing the requirements of OSH management systems through SR EN ISO 45001:2018 and the need to use a method of assessment and evaluation of professional risks adapted to current requirements, we propose a method taking into account the following considerations:

- we identified the need for an evaluation method that has direct and applied correspondence with community or international standards in the field

- the EC 1907/2006 REACH regulation on chemicals promotes the development of methods for assessing the risks of chemical substances
- the method takes into account elements regarding:
  - certainties before risks
  - risks are aggregated based on sources, hazardous situations and hazards
  - elements specific to the organization, work teams, workers
  - the direct relationship with the management of the organization, the management of the company and the managers of the workplaces
  - records and history of impact on workers
  - including the risks generated in the analysis and taking measures, opportunities, vulnerabilities and capabilities are analyzed
  - means of production are analyzed by category, especially those specific to the chemical environment
  - technical data, operating parameters and up-to-date maintenance are analyzed for forecasts of failure of the analyzed equipment
- the work environment is separated into the workplace's own environment and the environment in its vicinity for a better analysis of sources and external impact
- the method allows rapid operationalization with integrated management systems of institutions and companies having easy work elements for managers/directors
- the risk can be assessed in different forms: initial risk, residual risk - proposed, risk weighted with that from the basic method according to the purpose and objectives established with the employer
- we believe that the method is easy to use, being accompanied by the work tool generated by the popular Microsoft Excel software application among users
- the method chosen for reference is the INCDPM method, used in commercial companies whose object of activity is the production of detergents, which were the basis of the study of this work
- the method can be applied both to organizations and institutions that have implemented an OSH management system and to commercial companies that have this aspect in mind for the future or not.

6.2. Stages of occupational risk assessment using the MEvAR method:

a. Ensuring the conditions preliminary to the assessment
b. Identifying, analyzing and assessing hazards/dangerous situations
c. Establishing certainties and risks
d. Risk assessment for personnel, society, environment
e. Realization of the risk assessment report
f. Creating the attached documents of the risk assessment report
g. Delivery and receipt of risk assessment documentation

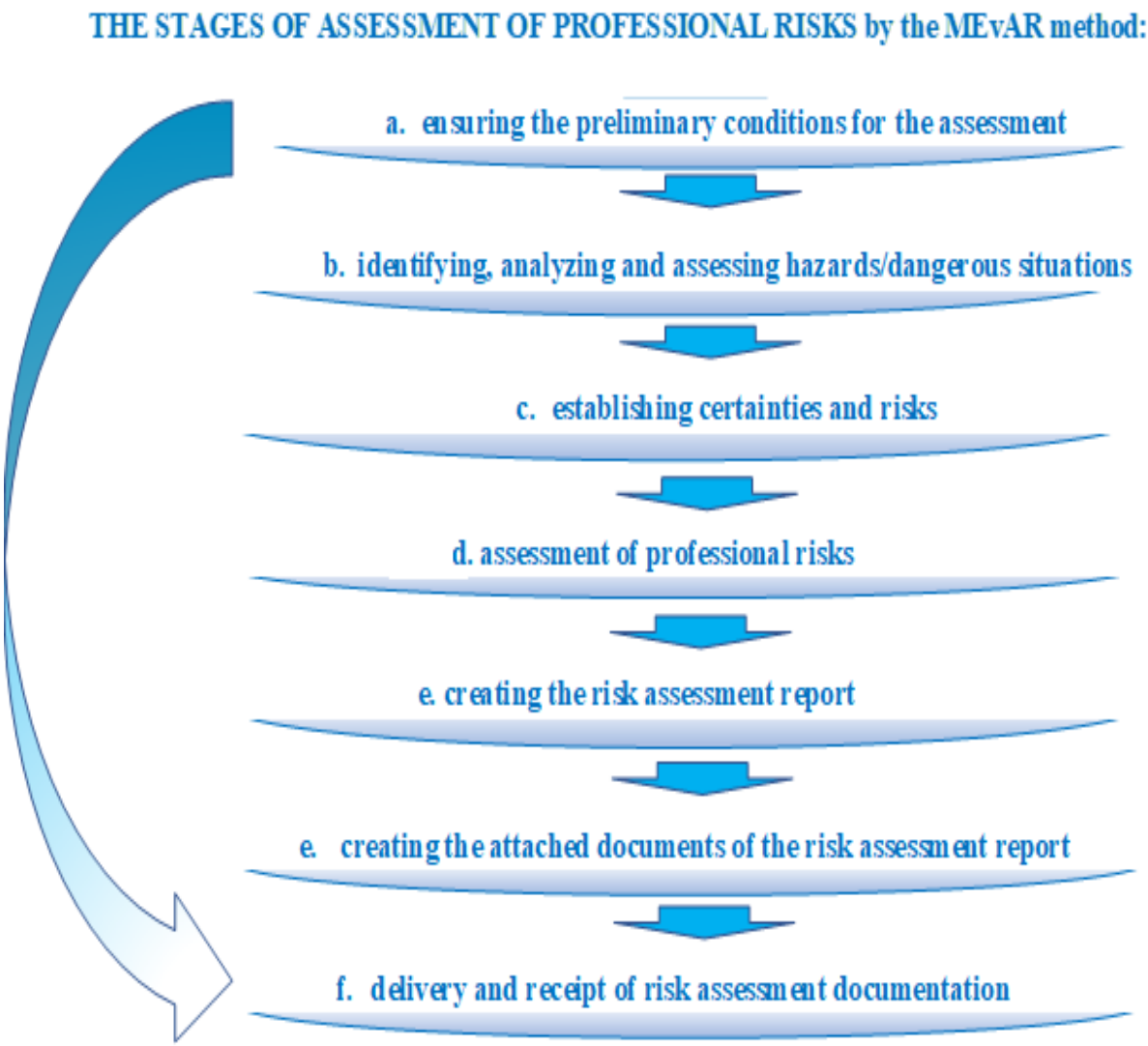

Fig. 6.1. The stages of occupational risk assessment using the MEvAR method

The assessment sheets for work equipment, dangerous chemical substances or preparations, sensitive groups, the sheet on the arrangement of workplaces are entered into the calculation by aggregating the risks and applying a corresponding risk correction factor.

Completing them requires the application of the specific evaluation methods mentioned in the forms and the transformation of the final data into necessary elements in the risk calculation according to the MEvAR method. Following the evaluation, proposals can be made to the organization regarding the improvement of the organization's objectives, opportunities and performance. In table no. 6.2 is the SWOT analysis regarding the MEvAR method.

Table 6.2 – MEvAR method SWOT analysis

INTERNAL ENVIRONMENT		
Updated method according to RS-EN-ISO-45001:2018 **It combines elements from the most adapted methods** **Keep track of and analyze the organization's management** **It assumes low computing resources and funds** **Perform risk aggregation and treatment** **It redefines the organization's priorities and responsibilities**	**SWOT ANALYSIS - MEvAR**	**Partial implementation of a management system** **Insufficient understanding of the method** **Large number of records** **The assessment is predominantly subjective** **Little work experience**
STRENGHT		**WEAKNESSES**
OPPORTUNITIES		**THREATS**
News on complex risk assessment **Adaptable and easy to implement** **Quick and practical tool for evaluators** **Can be developed/integrated into automated software applications** **Ease of understanding of the principle of the method by managers** **Facilitating the establishment of the level of accepted and tolerateded risk**		**Ineffective promotion** **Competition Activity** **Reluctance to adopt a new method** **Distinction between strict compliance with legal requirements and the organization's objectives** **Appreciation of classical methods in contrast with the application of general risk assessment methods**
EXTERNAL ENVIRONMENT		

6.3. The calculation model

The method considers the identification of certainties and dangers, the assessment of the risks associated with them, the application of the calculation formulas, the estimation and assessment of the results according to the calculation grids and the generation of the final reports of the professional risk assessment.

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

Compared to the known components of the work system: executor, work load, means of production and the work environment, valued values for each and the design of how to treat the calculated risks, a new category, that of OTHER RISKS, is introduced into the calculation, which facilitates the minimization of the area of uncertainty of the risk sources (occupational diseases, financial risks, external). These are integrated as risk factors elements of the OSH management system.

The correction factors project, in relation to the situation identified by the way of treating the risks, the level that can be ensured and accepted by the organization, the factor C – requirements, to which the performance of the management system relating to the provision of prevention and protection measures is related – the involvement and the factor Po – weight which represents the importance of the risk, especially its impact in the calculation – planning.

These factors are not represented in the main methods of calculating professional risks and we consider that they are representative for the organization because they materialize the planning and involvement of the organization's management in the treatment of risks by making the correlation of legislative requirements with those of the management system in the field of OSH.

Through this modality, the connection between the management system requirements and the legislative requirements and the organization's insurance possibilities is directly achieved (see figure 6.3).

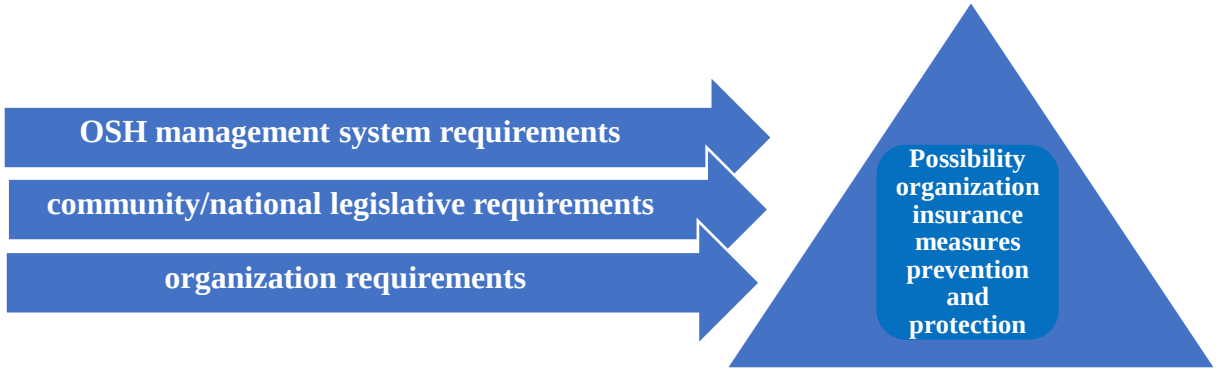

Fig. 6.3. The link between the organization's requirements and capabilities

Each risk factor can be assessed according to the specifics of the organization based on documented information from records, interviews, direct visualization or determinations within the limits proposed or chosen by the specialist together with the organization's management.
This fact ensures a better correlation in communication, identification and analysis of risks, the materialization being found in the establishment of the way of treating the risks and concrete prevention and protection measures. It can be an important tool in defining, identifying and establishing responsibilities regarding hazards because uncertainties are correlated with risks and cannot only be assessed and situations of certainty are those in which there are no elements of forecasting and reaction but only subsequent observation and action. Situations of certainty are introduced in the method that can be the basis of an analysis of the organization's capacity for action and response to identifiable dangers, the legislation being applied only to the risk area.
In the analysis of certainties, anticipation with a single value was considered certainty, anticipation with at least 2 values for the probability of occurrence and/or its impact is called uncertainty associated with the risk.

Limitations of the method can be considered the following:

- unidentifiable dangers until the evaluation date, identifiable only in exceptional, rare or almost impossible cases

- the person's intention
- attacks, aggressions, other forms of behavior that can generate dangers
- accidental breakdowns that are not directly influenced by the worker or the work environment
- the subjectivity of the estimation limits of the influence of risk factors/dangerous situations by specialists
- limited experience in risk assessment and OSH management systems
- knowledge and superficial application of system management requirements by the organization/risk assessment specialists

These situations have an exceptional character and are strictly dependent on the limitation of the level of information, training, records and statistics, communication, professional of the organization and/or the group of evaluators, there being the need for an external audit and certification regarding the level of acceptability.

In the calculation, the terms of identified probability and severity, assessed risk for the situation on the evaluation date and probability and residual severity, residual risk for the projected situation are used if they are ensured at the assumed level of the proposed measures.

Tabelul 6.2. Probability grid

P - PROBABILITY				
Probability level	Expunerea			Value of P
	route(s) of exposure (respiratory tract, skin, limbs, body, eyes, ears, other)	exposure time	exposure frequency	
very high	either one	minimum 6 hour/day	f≥1 event/month or f≥3 events/ quarter	1,5
high	either one	minimum 3 hour/day	f≥1 event/ 1 year or f≥3 events/ 5 years	1,3
average	either one	minimum 1 hour/day	f≥1 event/ 5 years or f≥3 events/ 10 years	1,2
low	either one	minimum 4 hours/week	f≥1 event/ 10 years or f≥3 events/ 15 years	1,1
very low	either one	minimum 4 hours/month	f≥1 event/ 15 years or f≥3 events/ 20 years	1

Table 6.3. Damage level calculation grid

N_V – DAMAGE LEVEL			
Type of trauma/ilness	TRAUMA	ILNESS	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)	1,22
great trauma	hemorrhages, open wounds, fractures, burns, wounds, organ damage, crushing	intoxications, infections, hearing loss, glaucoma, cataracts, arthritis, tendinitis, syndrome, intoxications	1,14

medium trauma	**bleeding, bruises, excoriations, dislocations, post-traumatic stress, strong blows, limbs, organs**	**conjunctivitis, otitis, boils, posttraumatic stress**	**1,09**
low trauma	**contusions, hematoma, bruises, reduced panic attack**	**allergies, irritations, mycoses, sensitivities**	**1,05**
easy trauma	**light contusions, loss of consciousness reduced time**	**colds, coughs**	**1**

Table 6.4. Material damage level calculation grid

N_D – LEVEL OF MATERIAL DAMAGE		
Level damage	**Estimate**	**Value N_D**
major damage	**estimated damage value >1,000,000 € (major level destruction of equipment, installations, structures, finished products, raw materials, acts, documents, blocking processes, recovery, major repairs, mediation, legal processes)**	**1,22**
great damage	**estimated damage value - €100,000-999,999 (large-scale destruction of equipment, installations, structures, finished products, raw materials, acts, documents, blocking processes, recovery, major repairs, mediation, legal processes)**	**1,14**
medium damage	**estimated damage value - €10,000-99,999 (damage to equipment, installations, structures, furniture, finished products, raw materials, acts, documents, damage to processes, fines, taxes, average repairs, mediation, consultancy)**	**1,09**
low damage	**estimated damage value - 1,000-9,999 € (affecting equipment, installations, structures, furniture, minor repairs, research costs)**	**1,05**
minor damage	**estimated damage value < €1,000 (affecting equipment, installations, structures, furniture, minor repairs, research costs)**	**1**

Table 6.5. Gravity estimation grid

S - SEVERITY			
Severity level N_G	**Predictable consequence**	**Financial value gravity**	**Value N_G**
very serious	**Death/Disability degree I-II**	**> 1.000.000 €**	**1,5**
serious	**Disability degree III-V**	**100.000-1.000.000 €**	**1,3**
average	**TIW (temporary incapacity for work) 46-180 days**	**10.000-99.999 €**	**1,2**
low	**TIW (temporary incapacity for work) 3-45 days**	**1.000 - 9.999 €**	**1,1**
easy	**TIW (temporary incapacity for work) < 3 days**	**< 1.000 €**	**1**

Table 6.6. Gravity calculation grid

SEVERITY LEVEL $N_G = (N_V \times N_D)/2$			LEVEL OF MATERIAL DAMAGE N_D				
			minor damage	low damage	medium damage	great damage	major damage
			1	1,05	1,09	1,14	1,22
DAMAGE LEVEL N_V	major trauma	1,22	1,2	1,3	1,3	1,4	1,5
	great trauma	1,14	1,4	1,2	1,2	1,3	1,4
	average trauma	1,09	1,1	1,1	1,2	1,2	1,3
	low trauma	1,05	1,1	1,1	1,1	1,2	1,3
	easy trauma	1	1,0	1,1	1,1	1,1	1,2

Table no. 6.7 – Grid for estimating the level of identified risk

IDENTIFIED RISK LEVEL N_{RI} ($N_{RI} = P \times G$)		SEVERITY				
		easy	low	average	serious	very serious
LIKELIHOOD	very high	accepted	tolerated	tolerated	unnacepted	unnacepted
	high	accepted	accepted	tolerated	tolerated	unnacepted
	average	controlled	accepted	accepted	tolerated	tolerated
	low	controlled	controlled	accepted	accepted	tolerated
	very low	managed	controlled	controlled	accepted	accepted

Table 6.9 – Grid for calculating insurance level requirements

C – INSURANCE LEVEL REQUIREMENTS			
Level insurance requirements	C_L – insurance level legal requirements	C_S – OSH management system requirements level	Value C
conformable	conformable	conformable	100 %
	conformable	corresponding	80 %
	corresponding	conformable	80 %
corresponding	corresponding	corresponding	60 %
	corresponding	satisfactory	50 %
	satisfactory	corresponding	50 %
satisfactory	satisfactory	satisfactory	40 %
	satisfactory	minimum	30 %

	minimum	satisfactory	30 %
minimum	minimum	minimum	20 %
	minimum	uninsured	10 %
	uninsured	minimum	10 %
	uninsured	uninsured	1 %

Table 6.10 – Grid for calculating insurance level legal requirements

C_L – INSURANCE LEVEL LEGAL REQUIREMENTS		
Insurance level legal requirements	Estimate	Value C_L
conformable	insured and certified following a third-party audit / domain authority control	50 %
corresponding	insured and certified following a third-party audit / domain authority control	30 %
satisfactory	ensured at the level of the minimum requirements in the field	20 %
minimum	ensured partially compliant with the minimum requirements in the field	10 %
uninsured	uninsured	0,5 %

Table 6.11 – OSH management system requirements level calculation grid

C_S – OSH MANAGEMENT SYSTEM REQUIREMENTS LEVEL			
Insurance level OSHM requirements	Estimate	Estimated value C_s	Value C_s
conformable	insured and certified following a third-party audit / domain authority control	C_S=1,26-1,5	1,5
corresponding	insured conforming to own legislation and procedures	C_S=1,1-1,25	1,25
minimum	ensured at the level of the minimum requirements in the field	C_S=0,6-1,0	1
uninsured	uninsured	C_S=0,5	0,5

Table 6.12 – Risk analysis level calculation grid

N_A – RISK ANALYSIS LEVEL		
Risk analysis level	**Estimate**	**Value N_A**
conformable	**insured and certified following a third-party audit / domain authority control**	**0,375 %**
corresponding	**insured conforming to own legislation and procedures**	**0,3125 %**
minimum	**ensured at the level of the minimum requirements in the field**	**0,25 %**
uninsured	**uninsured**	**0,125 %**

Table 6.13 – Risk treatment level calculation grid

N_T – RISK TREATMENT LEVEL		
Risk treatment level	**Estimate**	**ValueNT**
conformable	**insured and certified following a third-party audit / domain authority control**	**0,375 %**
corresponding	**insured conforming to own legislation and procedures**	**0,3125 %**
minimum	**ensured at the level of the minimum requirements in the field**	**0,25 %**
uninsured	**uninsured**	**0,125 %**

Table 6.14 – Grid for calculating the level of prevention and protection measures

N_V – VERIFICATION LEVEL PREVENTION AND PROTECTION MEASURES		
Level check prevention and protection measures	**Estimate**	**Value N_V**
conformable	**insured and certified following a third-party audit / domain authority control**	**0,375 %**
corresponding	**insured conforming to own legislation and procedures**	**0,3125 %**
minimum	**ensured at the level of the minimum requirements in the field**	**0,25 %**
uninsured	**uninsured**	**0,125 %**

Table 6.15 – OSH improvement level calculation grid

Nî – OSH IMPROVEMENT LEVEL		
OHS improvement level	**Estimate**	**Value Nî**
conformable	**insured and certified following a third-party audit / domain authority control**	**0,375 %**
corresponding	**insured conforming to own legislation and procedures**	**0,3125 %**
minimum	**ensured at the level of the minimum requirements in the field**	**0,25 %**
uninsured	**uninsured**	**0,125 %**

Table 6.16 – Weight assessment grid

PO – VALUE ESTIMATED INVOLVMENT		
Involvement level	**Estimate**	**Value P**
important involvement	**the level of risk is of major importance to the organization/ appropriate treatment of the risk can be ensured**	**1,5**
normal involvement	**the level of risk is of appropriate importance to the organization/ the treatment of the risk can be ensured**	**1,25**
minimum involvement	**the level of risk is of minor importance for the organization/ the appropriate treatment of the risk cannot be ensured**	**1**

The calculation and the comparative elements regarding the classical methods were based on the data regarding the assessment of professional risks from several companies producing detergents with Romanian capital, information from other companies that carry out activities with dangerous chemical substances/products and other communications to other external service providers prevention and protection with which we collaborate, the main conclusions being revealed in table no. 6.17.

Table. 6.17 Differences in assessment methods for hazardous chemicals

Comparisons between the occupational risk assessment methods used in the observed organizations and the proposed MEvAR method on hazardous chemical substances/preparations	
The occupational risk assessment method used more often in the analyzed organizations (INCDPM)	**The MEvAR proposed method**
The method is known and applied by most professional risk assessment specialists	The method is being implemented
The assessment covers the job and/or job	The evaluation includes the workplace/post/activity/process/sensitive group/work equipment/substances and/or

	chemical preparations used/organization of workplaces
The assessment is carried out by a single specialist professional risk assessor	At least 2 occupational risk assessment specialists participate in the evaluation
The estimated values are the result of the mathematical model specific to the 6x7 grid method	The estimated values use parameter-specific mathematical models, different type 5x5, 4x4, 3x3 with associated values that are chosen by the evaluator in order to realize the relevance of the risk and the proposed measures
The risk is assessed at the identified level, the proposed measures can reduce it to an accepted value	The risk can be assessed in different forms: the initial one, the proposed one - residual, weighted with the one from the basic method depending on the purpose and objectives established
The adaptation of the classic method of assessing occupational risks with the requirements of the OSH management system depends on the relationship of the assessor with the representative of the organization's management	The method includes harmonized elements of classic occupational risk assessment methods, OSH management system requirements and current legislative requirements
The method does not have an associated calculation tool	A quick calculation tool is used to facilitate the use of the method
No references are made to how to deal with certainties	Certainty hazards are identified and addressed
No references are provided regarding the results obtained by applying other methods	The method includes calculation elements and references regarding the results obtained by the classical method
There are no references to the application of OSH management systems	The method integrates the requirements of OSH management systems
Severity is expressed by the consequence of the occurrence of the event and refers only to injuries (only other methods also include damages)	Severity is expressed as a ratio between consequence and damage, the level of injury being a ratio between trauma and illness and the level of material damage being estimated according to the financial level of the organization
The probability is taken from statistical data that is not correlated with the diversity of current activities	Probability is analyzed according to the likelihood of an event occurring and the characteristics of the exposure – route of access, duration and frequency
Management involvement is not revealed in the assessment	Management involvement is included in the assessment
There are no changes in the calculation in case of exposure of several workers	The number and quality of workers are included in the assessment
The level of assurance of requirements is not assessed	The level of assurance of legal and OSH management requirements is included in the assessment and ensures an inversely proportional correction of the risk level
A risk weight is not targeted, being dissipated in the calculation	The risk importance weight is entered which is directly proportional to the risk
A calculation of the System Requirements Assurance Level is not intended	New coefficients are introduced for the calculation of the Level of assurance of OSH management system requirements: Level of risk analysis, Level of risk treatment, Level of

	verification of prevention and protection measures and Level of OSH improvement
Treating the risk boils down to proposing some measures	In the evaluation there is a selection of the risk treatment strategy
The risk is not recalculated after its treatment	The level of residual risk is designed for the situation in which the risk is treated
Risks are not reviewed in the assessment	Risks can be reviewed as part of the assessment
A reassessment of the risk identified following the treatment of the risks/application of the necessary prevention and protection measures is no longer carried out	The level of risk initially found becomes the Level of identified risk The residual risk level is the residual/accepted risk level that is projected after treating the risks/ensuring prevention and protection measures
There is no distinction between the risk assessment report and the risk register	The risk register is a report generated by the work tool
The assessment is predominantly statistical and subjective	The assessment is predominantly subjective

The program works based on input, selection, extraction of values, calculation, reports and automatic or evaluator interpretation of reports or values from spreadsheets.
Spreadsheet tables can be printed, signed and kept as written occupational risk assessment reports or kept electronically.
The elements and variables can be selected for the calculation of the risk identified by the evaluators and depending on the purpose and objectives proposed and jointly approved with the employer, the residual risk level will be chosen in correlation with the measures proposed by the evaluators and ensured by the employer based on the recalculation of the risk , weightage and insurance requirements.
Dynamic references exist between spreadsheet elements that allow related spreadsheets to be updated and calculated.

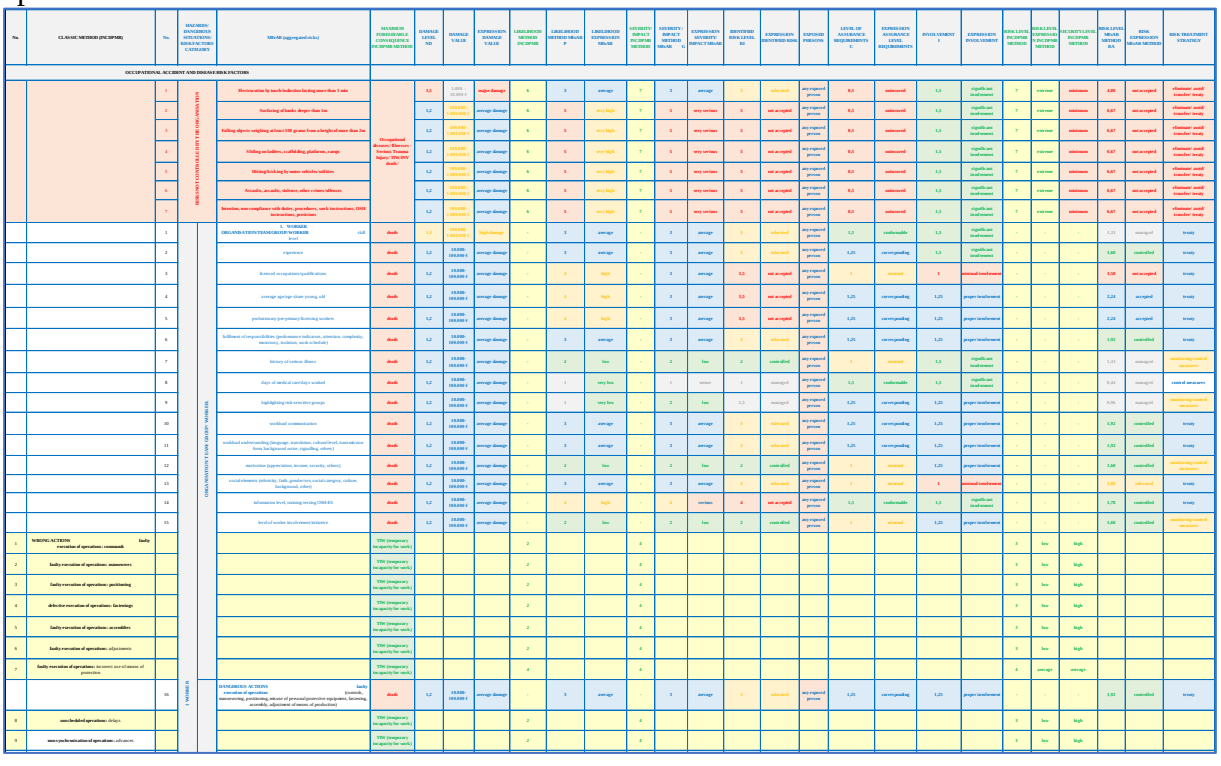

Fig. 6.4. Identified risks spreadsheet

SOCIETY .....S.R.L.

PREVENTION AND PROTECTION PLAN

No.	Job/workplace	Certainties/ Assessed risks	Technical measures	Organizational measures	Hygienic-sanitary measures	Other measures	Actions in order to achieve the measure	Deadline	The person responsible for carrying out the measure	Obs./ risk treatment strategy
C1	chemical operator	Electrocution by touch/induction lasting more than 1 min	ensuring appropriate technical conditions	training and periodic checking	social distancing, epidemiological triage, provision of disinfectant dispensers, provision of protective masks,	cooperation, collaboration authorities, institutions, economic operators, populations, visitors, customers	information, communication, training	15.12.2021 permanent	workplace manager	additional avoidance/treatment
C2		Surfacing of banks deeper than 1m	personal protection check	training and periodic checking	first aid training	intervention-evacuation means insurance	information, communication, training	15.12.2021 permanent	workplace manager	additional avoidance/treatment
C3		Falling objects weighing at least 500 grams from a height of more than 2m	insurance of protected traffic routes	training and periodic checking	emergency medical kit insurance	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	additional avoidance/treatment
C4		Sliding on ladders, scaffolding, platforms, ramps	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	additional avoidance/treatment
C5		Hitting/kicking by motor vehicles/utilities	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	additional avoidance/treatment
C6		Assaults, assaults, violence, other crimes/offences	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	additional avoidance/treatment
C7		Intention, non-compliance with duties, procedures, work instructions, OSH instructions, provisions	selection and verification of PPE/collective protections	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	additional avoidance/treatment
E1		1. WORKER ORGANISATION/TEAM/GROUP/WORKER skill level	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E2		experience	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E3		licensed occupations/qualifications	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E4		average age/age share young, old	periodic technical checks	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E5		probationary/pre-primary/licensing workers	periodic technical checks	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E6		fulfilment of responsibilities (performance indicators, attention, complexity, monotony, isolation, work schedule)	periodic technical checks	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E7		history of serious illness	periodic technical checks	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	control measures
E8		days of medical care/days worked	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	control measures
E9		highlighting risk-sensitive groups	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	monitoring
E10		workload communication	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E11		workload understanding (language, translation, cultural level, transmission form, background noise, signalling, others)	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E12		motivation (appreciation, income, security, others)	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	monitoring
E13		social elements (ethnicity, faith, gender/sex, social category, culture, background, other)	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	maintenance
E14		information level, training-testing OSH-ES	technical assurance for training	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	menținere
E15	chemical operator	level of worker involvement/initiative	personal protection check	training and periodic checking	periodic occupational medicine check	financial assurance of activities	information, communication, training	15.12.2021 permanent	workplace manager	monitorizare
E16		DANGEROUS ACTIONS faulty execution of operations (controls, manoeuvring, positioning, misuse of personal protective equipment, fastening, assembly, adjustment of means of production)	verificări tehnice periodice	instruire și verificare periodică	verificare periodică medicina muncii	verificări tehnice periodice	informare, comunicare, instruire	15.12.2021 permanent	workplace manager	menținere

Fig. 6.7. Prevention and protection plan spreadsheet

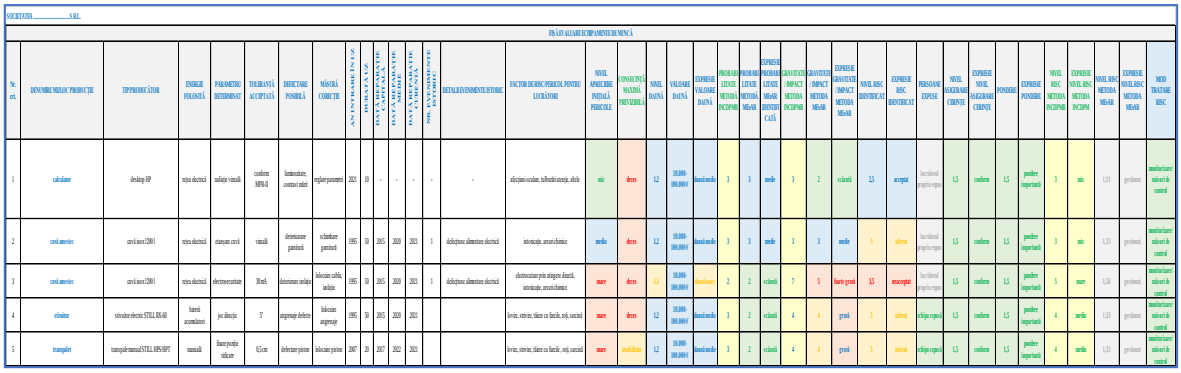

Fig. 6.10. Equipment evaluation spreadsheet

Fig. 6.11. Assessment spreadsheet for dangerous chemical substances/preparations

In Figure no. 6.14 graphically exemplifies the level of risks on elements of the work system before and after their treatment.

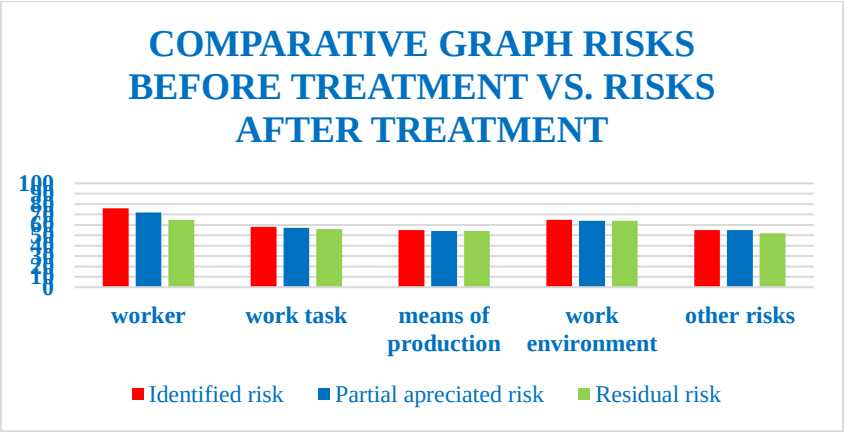

Fig. 6.14. Graphic comparing risks before and after treatment

The influences of the environmental risk factors that influenced the organizations in the last analyzed period are illustrated in Figures no. 6.16, 6.17

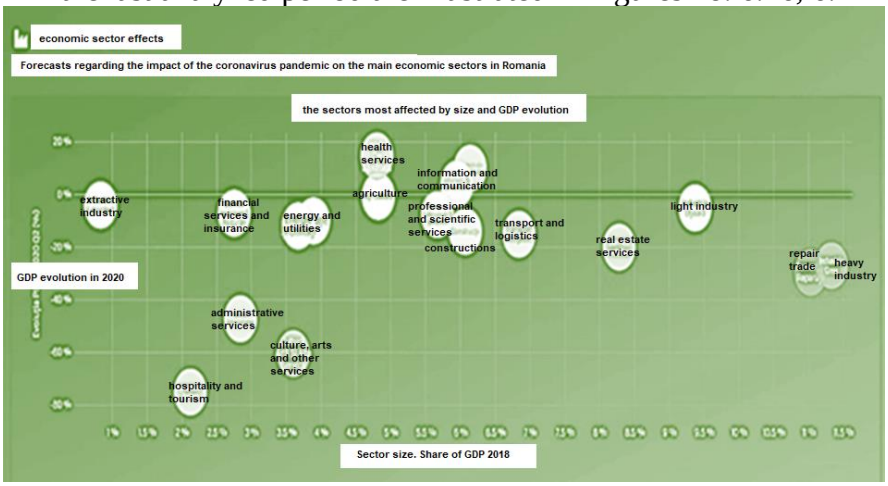

Fig. 6.16. Sectoral effects of the COVID pandemic in Romania [106].

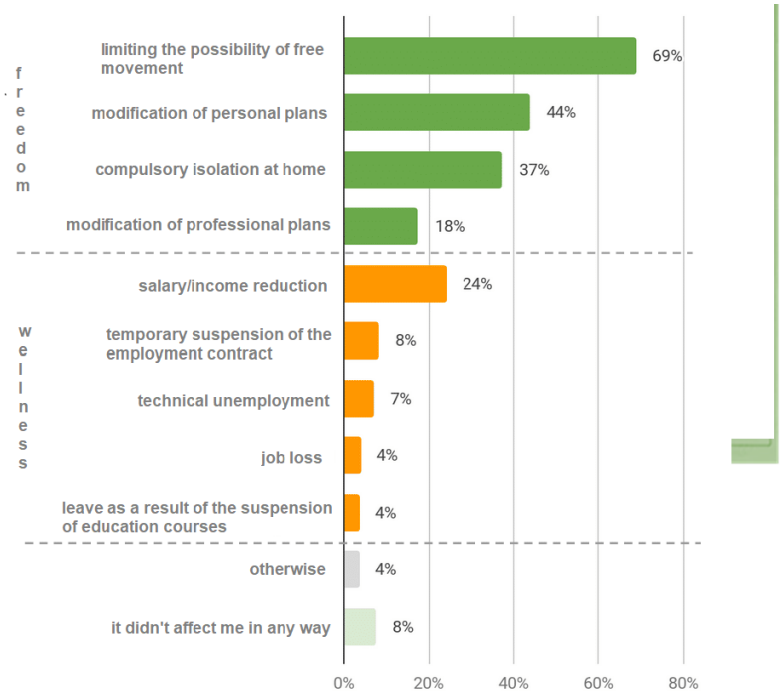

Fig. 6.17. The impact of the Coronavirus epidemic on the lives of Romanians [106].

Figures 6.18, 6.19 highlight the main measures ensured at national level and by activity sector during the COVID-19 coronavirus pandemic [106].

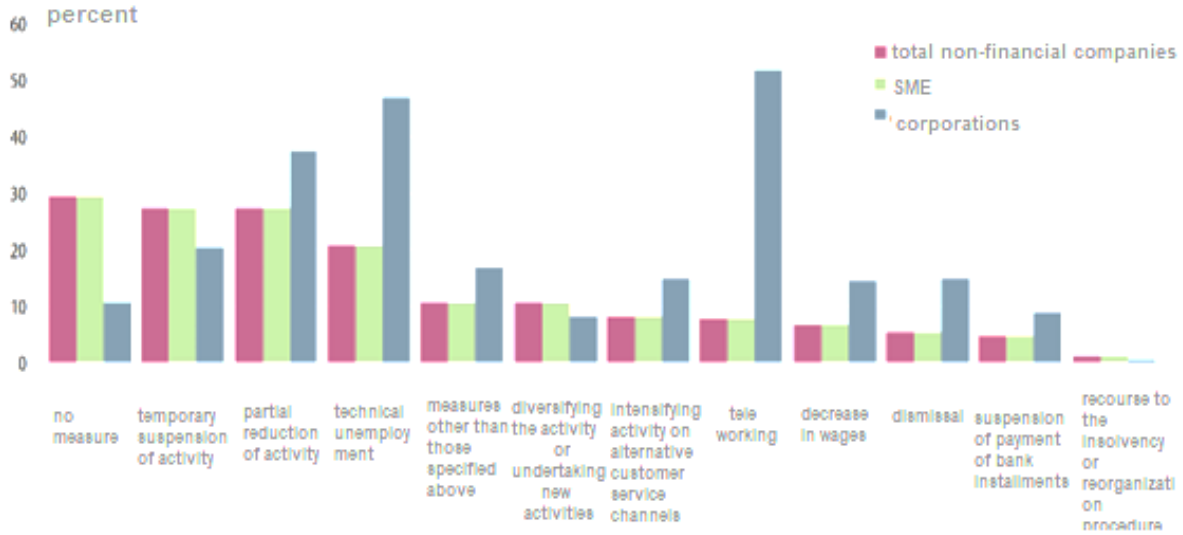

Fig. 6.18. The main measures ensured at national level during the COVID-19 pandemic [131]

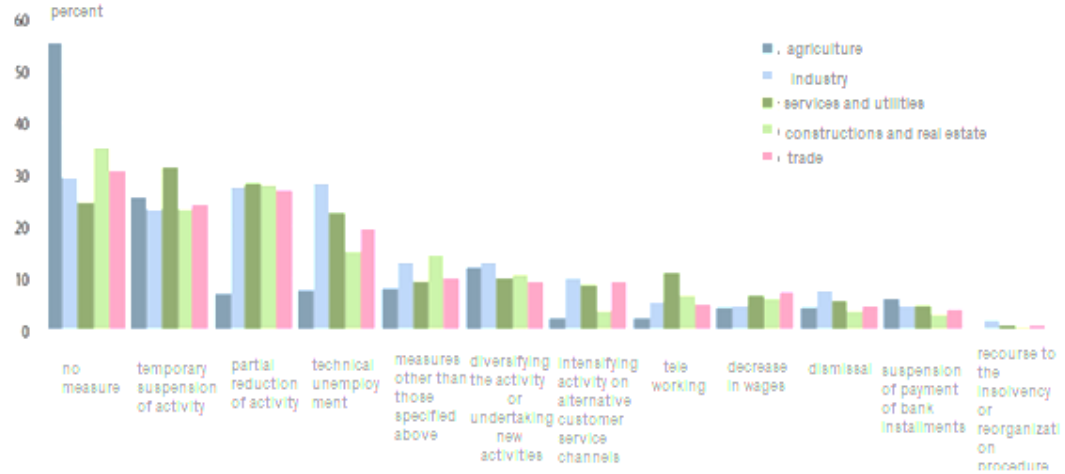

Fig. 6.19. The main measures ensured at national level during the COVID-19 pandemic by activity sector [131]

6.4. Evaluation of occupational risks in the field of OSH – the MEvAR method

The tabular calculation is based on the use of the Microsoft Excel application with/without security protections and the use of specific calculation sheets and formulas. The program works on the basis of input, selection, extraction of values, calculation, reports and automatic or evaluator interpretation of reports or values from spreadsheets.

The file can be protected by passwords on opening, using and viewing spreadsheets, opening the file or protecting access to the file by specialized programs.

The application in the work does not have the protections activated in order to effectively visualize all the elements of analysis, calculation and work for the ease of applying the method in the activity of identifying, evaluating and assessing professional risks in the field of detergent production or others. [132]

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

- management system requirements are applied in an integrated manner within the assessment
- you can compare the two results and draw conclusions regarding the most appropriate result in direct correlation with OSH policies and opportunities see figures 6.21-6.22

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

Fig. 6.21. Risk details of the INCDPM method

Number certainties	Number of unnacepted risks	Number of tolerated risks	Number of accepted risks	Number of controlled risks	Number of managed risks	Number of total risks
7	1	7	28	93	38	167

Fig. 6.22. MEvAR method risk details

- the MEvAR method achieves, through the design of residual risks, the assumption by the employer of the dangers, risks identified, assessed and evaluated, including prevention and protection measures according to the proposed way of complying with the requirements and the weight given in the treatment of the risks
- there are comparative graphs for evaluation stages that can quickly present the situation of the risk level, see figure 6.23.

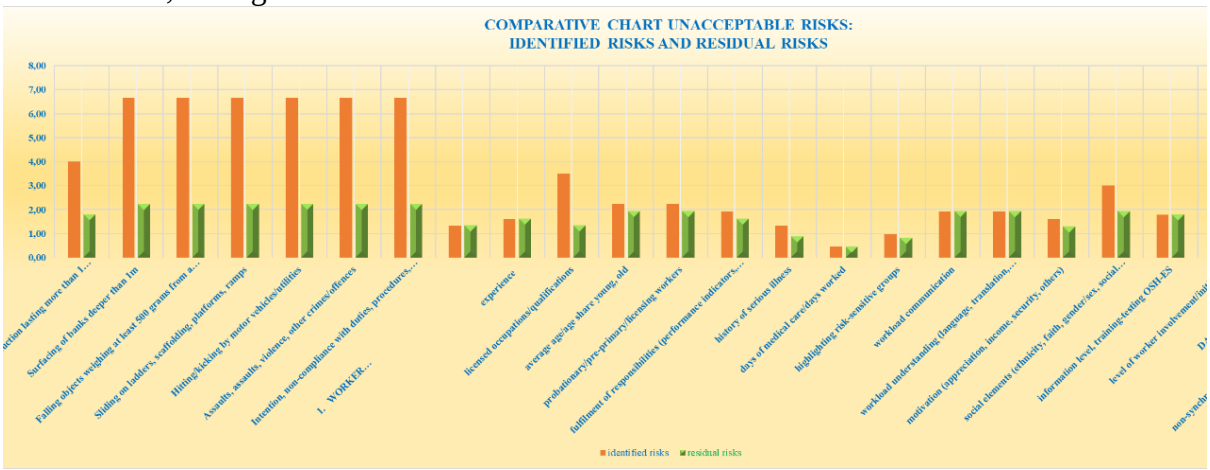

Fig. 6.23. Chart comparing unacceptable risks

It is found that the proposed method ensures, through the methodology and the calculation tool, an increased efficiency both in the evaluation and appreciation of professional risks based on the most current legislative and management system requirements, as well as the rapid generation of reports, forms and measures regarding the treatment of dangers and risks, the prevention and protection in the field of OSH at a high, structured and effective level within the monitored organization as well as in others.

Carrying out professional risk assessments is a professional activity that is regulated by legislative requirements regarding the need to ensure them and the quality of specialists, but the forms and methods of work are specified in standards and best practices.
However, their application differs from specialist to specialist depending on:
- personal professional training (evaluation course, specialization courses, master's, doctorate);
- situation at work (company employee/collaborator, corporation, OSH service provider, researcher, inspector);
- requirements in collaborations within professional organizations;
- contractual requirements.

Occupational injury and disease risk assessor specialists according to the legal requirements in the field can be persons with higher technical education, with higher training in the field of OSH of at least 80 hours basic course, postgraduate course of occupational risk assessor of at least 180 hours or master in OH&S field for 2 years.
The work environment is an element of the work system alongside the executor, the work task and the means of production in relation to the work process, but it is not directly related in the regulations in the field of OSH with the external environment, socio-human proximal and distal, relational and informational, financial, political-economic, environmental in general.
Professional risk assessment methods do not aggregate risks by category, are only partially adapted to quality, environment, information, security management systems and ensure the treatment of certainties as risks with maximum probability.
Certainties are hazards that can generate serious events with maximum single probability, those with multiple probabilities are risks.
Certainties can be treated by eliminating dangerous situations/sources of production or eliminating the possibility of production, if the human does not interact with the dangerous situation the event will no longer exist.
The risk factors of the work environment are mainly determined by the climate conditions in the work area of the post, activities and workers and refer to:
• physical risk factors: temperature, humidity, air currents, pressure, noise, vibrations, lighting, radiation, electrostatic potential, natural calamities
• chemical risk factors: gases, vapors, toxic aerosols, caustics, dusts suspended in the air, gases, flammable vapors, explosives, pneumoconiogenic dusts
• biological risk factors: microorganisms (bacteria, viruses, rickets, spirochetes, fungi, protozoa
• special risk factors: underground, aquatic, marshy, aerial, cosmic
Variations in the characteristics of the work environment factors are mainly determined by subjective assessments of specialists in estimated short assessment periods or by technical measurements with calibrated equipment, established system procedures/methodologies that present determined values.
The way in which it affects the work environment and especially the workers can be appreciated according to the medical conditions found following occupational medicine medical examinations, the number of days of sick leave or, in serious cases, death.
Following the analysis of how to evaluate the influence of occupational risk factors specific to the work environment, it can be concluded that it is necessary to update and adapt an occupational risk assessment method to the current requirements in the field of OSH and especially to the system requirements OSH management.
By adapting and correlating the risk factors in general and those of the work environment in particular with the requirements of the OSH management system, it is possible to achieve:
• updating and completing the non-covered and/or niche aspects of the assessment methods used by most specialists

• adaptation of professional risk assessment methods with other general or specific risk assessment methods
• adaptation to territorial administrative management systems
• awareness of dangers and prevention and protection measures from the management of organizations by assuming the evaluation report
• the possibility of vectorial development of the evaluation system by ensuring the application of the general and particular principles of identification, analysis, appreciation, evaluation and conclusion of the specialists
• the possibility of mitigating hazards by ensuring an increased attention and weight of risk treatment, managing and keeping under control those that have large variations or possibilities of occurrence
• improving resilience in the field of OSH, ES, EM in case of events.

6.5. Conclusions

Following the comparative assessment of occupational risks for a chemical operator worker using the two methods, the classic INCDPM and the proposed MEvAR, the following aspects can be distinguished:
- management system requirements are applied in an integrated manner within the assessment
- you can compare the two results and draw conclusions regarding the most appropriate result in direct correlation with OSH policies and opportunities
- there is the possibility to reduce the risk by designing the residual risk according to the correction factors accepted by the management of the organization
- the application can generate quick and efficient reports on the details and elements of the assessment (acceptable and unacceptable risk situations, prevention and protection plan proposal, assessment sheets for the categories provided by the legislation, record sheets and risk tracking requested in the administration , correlation with OSH or integrated management systems
- the MEvAR method achieves, by designing the residual risks, the assumption by the employer of the dangers, risks identified, assessed and evaluated, including prevention and protection measures according to the proposed way of complying with the requirements and the weight given in the treatment of the risks
- there are comparative graphs for evaluation stages that can quickly present the situation of the risk level
- the INCDPM method presents the elements regarding the assessment of professional risks and can ensure the understanding by any beneficiary of the risk assessment report and how to treat them in a known manner, which constitutes a reference to the results obtained by the proposed MEvAR method
- the usefulness of the new method is immediately found in the fact that, in addition to a professional evaluation report and the proposed measures for prevention and protection, data and elements are obtained that can be entered automatically through the application for the generation of performance indicators, the updating of the objectives and the OSH policy and the most important aspect is that it is possible to reduce the assessment of a major risk to a medium-accepted or low-monitored risk, managed by designing the residual risk by the assessment team together with the manager of the organization according to the way of treating the risks, compliance with the requirements and the weight given to professional risks (e.g. a major risk of injury by designing corrective measures adapted to the organization's capacity, by giving increased importance to the way of complying with legal or management system requirements, giving an increased weight to that risk ends up being evaluated and assessed at a managed risk, i.e. a very low risk because all possible predictable measures are taken by the organization, the effects are limited and reduced, there is permanent risk supervision and monitoring, the staff is trained and checked, the maintenance of the equipment involved is

ensured, are preventive measures for control and continuous improvement are taken, documented information is created, interpreted and updated and, if necessary, third-party auditing can be ensured

- the proposed MEvAR method provides increased flexibility to risk assessors regarding the choice of relevant risk factors, reference values, way of working, way of treatment, impact and exposure on workers, equipment, substances, actual calculation for assessment and evaluation.

It is observed that the proposed method ensures, through the methodology and the calculation tool, an increased efficiency both in the evaluation and appreciation of professional risks based on the most current legislative and management system requirements, as well as the rapid generation of reports, forms and measures regarding the treatment of dangers and risks, the prevention and protection in the field of OSH at a high, structured and effective level within the monitored organization as well as in others.

Chapter 7. Final conclusions and main contributions to the influence of risks on natural persons and the risk assessment system in the field of OSH within detergent production units

From the analysis of the current state of risks on natural persons and the risk assessment system in the field of OSH within the detergent production units, the conclusions that are presented in chapter 3 were drawn.

Considering the data and conclusions drawn from the analysis of the current state, the research-development directions as presented in subchapter 4.1 were considered promising.

In relation to the current state and directions of research and development regarding the methods of assessing occupational risks in detergent production units, the main objective of the research and development activity within the doctorate was determined to be the analysis and improvement of the occupational risk assessment system in units with production of domestic detergents, through theoretical and experimental research adapted and correlated with the updated legislation and the specific standard RS EN ISO 45001/2018. (v. and § 4.2).

The relevant conclusions regarding the doctoral research and development activity to achieve its main objective, in relation to the methodological reference elements (see § 4.3), are as follows:

The main objective of the paper regarding the improvement of the occupational risk assessment system in the units with detergent production, through theoretical and experimental research corroborated with the updated legislation and the RS EN ISO 45001/2018 standard, was achieved through the comparative research of several assessment methods of professional risks and the creation of a new method called MEvAR that facilitates the creation of the professional risk assessment and treatment report and other related documents through the Microsoft Excel spreadsheet application.

In relation to the current stage and directions of research and development, it was determined that the main objective of the research and development activity was based on the study of professional risk assessments and accidents in companies producing detergents with Romanian capital and less for those with mixed capital or external, because the method of analyzing the influence of risks on natural persons and risk assessment systems in the field of OSH with regional and national specificity was followed.

To achieve the main objective, the following were proposed/implemented:

- the research of an adapted method for the evaluation of the management system in detergent production units - we proposed the MEvAR method that ensures this aspect
- the correlation between the specific elements in the field of OSH - several specific elements mentioned in the main professional assessment methods used in the field were analyzed and compared

- measures to improve the evaluation system – the risk calculation formula was completed with elements that are directly correlated with management actions and the external environment
- applicability of the management system adapted to the requirements of RS EN ISO 45001/2018 - the correlation was made with the management system in the field of OSH according to RS EN ISO 450001:2018

verification of the efficiency of the management system conformed to the new standard – reports are generated by the application on how to achieve the objectives and performance indicators of OSH

formulation of checklists adapted to the new management standard - are generated directly as inputs in the application of the MEvAR method.

The technical-economic advantages of the presented method are: the significantly reduced cost of the professional risk assessment borne by the employers, the minimized time allocated by the expert assessors to the risk analysis, the possibility of ensuring the compatibility of the data transfer between dedicated software applications and, last but not least, the correlation of the analysis elements of assessment methods, integrated management systems or OSH, with legislative compliance and the requirements of national administrative-territorial management systems.

The method constitutes a starting point in the implementation of the OSH management system within the national-European legislative requirements and the known methods, applied by professional risk assessment experts. It can be adapted and developed by each specialized user based on the directions established by the MEvAR method, emphasizing the implication of the management of organizations in the field of OSH and the influence of the external environment insufficiently treated in the current methods.

Another aspect that can be considered as a weak point of the method is the complexity of chemically specific activities that require in-depth specialized knowledge both in the chemical field and in the field of OSH. The influence on the staff that can be ascertained immediately or in the long term and the overlapping of the activities of the occupational risk assessors with that of the doctors from the public health departments represent another aspect that needs to be improved.

Personal contributions

The main personal contributions for detergent production units are highlighted by:

- Detailing the assessment of the worker's professional risks for the workplace, work station, activity, technological process, sensitive group, work equipment, dangerous substances and/or preparations, setting up workplaces through spreadsheets with checklists, reports and forms synchronized in the application.
- Applied research regarding the comparison of the significant elements, the overlap and the integration in the method of the relevant aspects mostly accepted by the experts, of the main methods of occupational risk assessment used at the local and national level
- Case study and practical software application – was provided by the application associated with the MEvAR method based on synchronized Microsoft Excel spreadsheets.

The theoretical contributions are revealed through the documentary study of research in the field of detergent production units, the case presented in the paper being that of S.C. DERO PROD SRL.

It can be seen that the proposed method ensures, through the methodology and the calculation tool, an increased efficiency both in the evaluation and appreciation of professional risks based on the legislative requirements and the requirements of the management system, as well as the rapid generation of reports, forms of measures regarding the treatment of hazards and risks , prevention and protection in the field of OSH at a high, structured and effective level within the monitored organization as well as in others.

In the field of experimental contributions, the PhD student created and implemented the software application for assessing risks specific to detergent production units. There are comparative elements between the two calculation methods: the INCDPM method and the MEvAR method to validate the results.

The INCDPM method aims to comply with the national legislation, and the MEvAR method also aims to comply with the legislation, the implementation of the requirements of the management system in the field of OSH and the requirements of the national administrative-territorial management.

We can conclude that the risk factors with important weight in the risk assessment applying the MEvAR method are:

- The COVID-19 pandemic caused by the Sars CoV-2 coronavirus with the following aspects:
- organizing work through telework, remote work and working in shifts/variable schedule;
- the lack/reduction of current control and checks regarding ensuring ergonomics at the workplace in case of organizing work by telework and/or remote work;
- changing the layout of the workplace to prevent illness;
- insufficient updating of risk assessments and prevention and protection measures due to the lack of communication by the authorities, the change of regulations, the unpredictable evolution of the pandemic;
- the weakening of workers' immunity by going through illness;
- stress due to the use of respiratory or general protective equipment;
- damage to the epidermis as a result of the frequent use of disinfectants;
- psychosomatic disorders due to isolation and restriction of daily activities;
- increased costs for ensuring prevention and protection measures;

Modification/adaptation of work processes within organizations for the organization of work in a combined regime with telework and remote work with the following aspects:

- reduction of administrative and logistic costs;
- flexible work schedule for workers;
- yield optimization;
- territorial dispersion adapted to the needs of workers;
- increasing the possibility of real monitoring of activities;
- increasing worker satisfaction;
- possible increase in the number of musculoskeletal disorders, mental disorders, events produced as a result of the lack of supervision and assurance of activities and the workplace

The efficiency of production processes through the use of nanotechnologies, automation and especially through the use of 3D printing with the following aspects:

- product design and manufacturing diversification;
- product quality increase;
- reduced energy consumption;
- minimal exposure of workers to hazards generated by the equipment;
- noxe level reduction;
- increase in regional temperature with implications regarding air currents (storms, tornadoes, hurricanes);
- changing climatic characteristics, desertification, seasons, sudden winter-summer transition;
- the application of environmental policies regarding the reduction of the carbon footprint;
- the energy crisis;
- modification and/or change of energy production sources;
- changing the share of polluting energy resources.

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The present doctoral thesis, through the problem, approach and results, directly develops the adaptation of the professional risk assessment methods used by specialists with the legal requirements and those of the management system in the field of OSH.
The scientific importance of this PhD thesis is supported by the contributions made to the structured analysis of the influence of risks on workers and the methods of occupational risk assessment used in the compared domestic detergent production units.
The practical importance of this doctoral thesis lies in the fact that, in addition to the completed studies, it provides a work tool that represents a system - useful support for evaluation specialists, OSH specialists, employers but also professional trainers, faculties with specific or related fields, teaching staff , students, organizations, and any other interested parties

The issue of methods for assessing the occupational risks of injury and illness calls for a research activity - continuous and analytical development, which involves deepening in the following directions:
- updating the analysis regarding the record of recent events in the chemical and specific field of detergent production;
- the continuation of the correlation of the elements of the method regarding compliance with the community and national legislation with those of the management systems;
- completing and developing initial hazard and risk factor checklists;
- optimized correlation of checklists with risk analysis spreadsheets;
- optimization of the software application underlying the MEvAR method;
- completing the spreadsheets with new forms adapted to the needs of the reports;
- securing the application.

This doctoral thesis meets the requirements of the proposed objectives, has a theoretical and applied character, is an opportunity for the modernization of the methods of analysis, evaluation and assessment of occupational risks in the field of OSH, being useful to the interested parties.

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