SUMMARY

CHAPTER I - INTRODUCTION

The first chapter of the thesis presents the general considerations of the thesis, including the motivation, objectives, conclusions and main contributions. The objective is to develop innovative methodological tools for the effective management of the risk of occupational injury and illness in accordance with current requirements.

The text details the motivation of the thesis, which is based on the need to improve methodological mechanisms for preventing and combating occupational risks, as well as the desire to contribute to the configuration of innovative methodological tools in occupational management. The objectives of the thesis include the assessment of occupational morbidity, the development of methodological infrastructure, the development of applicable mathematical models, the analysis and assessment of risks in various fields of activity, and the development of an occupational health and safety management system.

The structure of the thesis consists of an introductory chapter and four content chapters, as well as a final chapter of conclusions and personal contributions. In these chapters, the author addresses various issues such as the analysis of the medical system, the development of research on occupational morbidity, the modernisation of the methodological infrastructure and the development of innovative risk assessment tools.

Significant contributions are also highlighted, including the conduct of an integrated study, socio-statistical evaluation, the development of complex mathematical models, the development of occupational risk management tools, and ways of disseminating the research results are presented along with thanks to those who contributed to the thesis.

CHAPTER II - ANALYSIS OF THE HEALTHCARE SYSTEM AND METHODS FOR ITS INNOVATION

The health system works to maintain the health of the population by using all available resources, including human, technological and pharmacological resources. It is made up of a set of departments organised hierarchically, with the aim of achieving the objectives set and adapting the system to the needs of the population. Relationships between systems and departments are essential for the smooth functioning of the health system.

In Romania, the health system is funded from multiple sources and legislation regulates both organisational and access and delivery aspects of health services. Physiotherapists play an important role in the medical team, contributing to the recovery and improvement of patients' motor functions, in close collaboration with medical specialists.

This section provides a detailed overview of health care services and health system management in Romania, with a focus on the impact of the COVID-19 pandemic. Here is a summary of the main points in the text:

1. **Medical rehabilitation services**:
    - These include actions of physical agents on the human body, such as water, light, heat, electric current, magnets, etc.
    - It also involves the work of physiotherapists, who perform passive movement exercises, massage, assisted drainage or exercise under the guidance of qualified medical staff.
    - Innovation in this field comes from the use of medical devices for prevention and treatment, which facilitate the work of therapists and accelerate healing.
    - Rehabilitation services are recommended both for prophylactic purposes for all age groups and for therapeutic purposes for a variety of conditions.
2. **Impact of the COVID-19 pandemic**:
    - SARS-CoV-2 infection has significantly altered the numbers of people in ill health worldwide.
    - Patients with COVID-19 post-infection status have become a new category that can access medical rehabilitation services, given the systemic impact of the disease.
    - The pandemic has alarmingly increased the number of COVID-19 cases in Romania, which has generated a great demand for medical support and recovery.
    - The depletion of human resources in the healthcare system is a major problem and medical staff are facing an additional burden and increased pressure due to the high caseload.

3. **Socio-statistical assessment of health status in Romania**:
    - Health status is affected by a variety of factors, and competent medical staff are required to restore patients to their original state of health.
    - Statistics show that the 65-74 age group is the most affected, followed by people over 74 and then the 55-64 age group.
4. **Study of health management applicable at national level**:
    - Health management involves integrated activities to achieve the objectives of healthcare institutions, taking into account the needs of patients and the resources available.
    - Strategic and operational management are essential for effective planning and implementation of healthcare services.
    - Managers in the healthcare system need to have both medical and management knowledge to be able to effectively manage healthcare institutions and deliver quality services.

This information highlights the complexity of the healthcare system and the need for an integrated approach to ensure optimal patient care and recovery.

It is obvious that the effective management of a healthcare institution is crucial for its optimal functioning and the achievement of its objectives. Understanding key management needs and applying management functions appropriately are essential elements in this process. Also, innovative ways of working in management, such as the development of an outcome scheme, risk management and quality management, are vital for ensuring the efficiency and quality of the healthcare services provided.

Digitisation and eHealth have become increasingly important in the healthcare system, facilitating access to healthcare services and improving patient communication and monitoring. Telemedicine was a crucial solution during the COVID-19 pandemic, allowing patients to receive medical consultations and treatments remotely.

Population education and the use of digital laboratories are other key aspects of optimising the healthcare system. Population information and continuing education are crucial for disease prevention and management, and the use of digital technologies in education can improve access to learning resources and hands-on training for medical students.

1. **Use of online platforms for education**: In the Bachelor of Kinesiology program, 25% of the 45 students expressed high satisfaction in using online platforms such as Moodle, Praxilab, Labster and LabXchange for practical work. These platforms allowed the application of technical information and testing of skills in a virtual environment before facing the physical lab, thus contributing to the improvement of ICT skills.

2. **Mobile medical apps**: Mobile medical apps provide access to medical databases and support from specialists anywhere in the world. They are used for monitoring vital signs, in-depth studies, monitoring disease progression and accessing home healthcare services.
3. **Digital signature in medical apps**: Digital signature plays an important role in the security and privacy of medical data in mobile apps, and implementing models such as the PP-SS scheme can improve this.
4. **FINTECH in the healthcare sector**: FINTECH technologies enable payments for healthcare services to be made via mobile apps, facilitating access to healthcare.
5. **Artificial intelligence in medicine**: The use of artificial intelligence in medicine is growing, with applications such as diagnosing diseases, optimising treatments and facilitating doctor-patient communication.
6. **Virtual Reality in Medical Rehabilitation**: Virtual reality is used in rehabilitation procedures to improve patient outcomes by providing an interactive and safe environment for cognitive and physical training.

Conclusions

The healthcare system is extensive but digitisation is used throughout the infrastructure, from the medical data centralisation system to intra-operative assisted robotic arms and Artificial Intelligence for initial diagnosis. These innovations bring vital support to the medical team, which is often overwhelmed by the number of cases or the complexity of the diseases and the rate of change of symptoms.

Telemedicine has enjoyed a boom during the Pandemic and the population has become familiar with the innovation, still requesting online advice or informational support from doctors and this field needs promotion and optimisation in order to be adaptable to current needs.

Mobile medical apps have been used concomitantly with Telemedicine and their usefulness has gradually increased in recent years. Physiotherapists have used socilisation sites to support the population with impaired health and a medical rehabilitation-specific app containing exercise videos, tips and an online session section is the future option to facilitate access to a digital source.

Artificial Intelligence is the future trend to optimise the doctor-patient interface for communication and initial diagnosis, optimising the time to determine how to approach and treat diseases.

Medical Recovery specialists have become prominent in the medical market in recent years due to the Covid 19 pandemic which has led to an increase in the number of patients in need of post-Covid recovery, post-trauma after long periods of sedentary lifestyle, exacerbation of rheumatic and joint pathologies. Optimisation of the current system can lead to a better response rate to treatment through the implementation of online physiotherapy sessions and the working methods can be adapted according to the needs of the population, which have been identified through a socio-statistical study.

Employees in the Medical System have to adapt to current needs and trends and staff training methods need to be optimised to be adaptable to the current state of knowledge. The loyalty of medical teams is the motivation for them to get involved in future projects and the study of working methods can bring vital information to achieve the desired result, contributing to the optimization of the system.

In conclusion, digitisation in the healthcare sector brings many benefits, including increased accessibility to healthcare, optimised treatments and efficient communication between patients and doctors. Adapting to current and future technology trends is essential to improve healthcare and patient outcomes.

CHAPTER III - DEVELOPING RESEARCH ON OCCUPATIONAL MORBIDITY ANALYSIS AND RISK ASSESSMENT

Fundamental Principles Used in Occupational Risk Assessment:

- **Risk Assessment Procedure:** Requires the involvement of both employees and employers, and must assess each workstation, work method and area.
- **Team Building:** It is crucial to the assessment and must be made up of competent and endorsed individuals with stability in composition to ensure constant monitoring of workplace safety.
- **Defining Workstations and Assessment Areas:** A company site plan is used to define work areas and identify potential hazards. A hazard matrix is prepared for each area.
- **General Examination:** is carried out by designated members of the assessment team and the results are used to identify specific hazards.
- **Hazard Analysis:** The identified hazards are analysed and solutions for their elimination or reduction are proposed.
- **Risk Assessment:** Quantify the severity of hazards and the likelihood of injury to determine risk categories and required actions.
- **Action Planning and Monitoring:** Technical and organisational measures are proposed and implemented to eliminate hazards and their effects are monitored over time.

These principles provide a comprehensive framework for assessing and managing occupational risks in an organisation.

The paper addresses the issue of occupational safety and risk in the workplace. It highlights that occupational safety is a state in which occupational accidents and diseases are excluded, although it is recognised that there are no completely safe systems of work because of the associated hazards. Occupational risk assessment is described as a complex process that involves estimating the likelihood and severity of the consequences of undesirable events, and identifying and applying preventive and protective measures. It also discusses the inverse relationship between occupational safety and the risk of occupational injury and illness, highlighting the importance of proper risk management in ensuring a safe and healthy working environment. It also explores occupational risk assessment methodologies and emphasises the need for accurate occupational safety diagnosis in the context of effective risk management in the workplace.

Key aspects of occupational safety in the workplace are addressed, focusing on the assessment and management of risks associated with occupational accidents and diseases. The importance of a proactive approach in identifying and managing hazards to ensure a safe and healthy working environment is emphasised. The concept of occupational safety is defined as a complex of factors influencing the safe functioning of the work system, the protection of workers and the promotion of occupational health.

Occupational safety management is presented as a dynamic process, involving knowledge, assessment, control and constant monitoring of occupational risks. Occupational safety diagnosis is essential for identifying and assessing the level of risk associated with different activities within the work system. This process involves identifying risk factors, quantifying their consequences and likelihood of occurrence, and estimating the risk of occupational injury and illness using specific methods.

The paper highlights the need for occupational safety diagnostics in various situations, including in existing work systems to reduce risk, in the case of process retrofits to increase occupational safety, and in the case of new work systems to ensure that occupational safety is guaranteed from the outset.

Responsibility for carrying out the occupational safety diagnosis lies with a working group made up of specialists and managers from the labour system, in accordance with the legislation in force. The diagnosis group must analyse the work system as a whole, identify disturbing factors and set occupational safety objectives.

In addition, a detailed analysis of the level of acceptable occupational risk is presented, in relation to the economic optimum and specified safety criteria. Methods for determining the acceptable occupational risk are presented, including graphical representation of the total cost price structure and determination of the optimal range of the occupational risk level. Theoretical considerations on probability distribution and graphical representation of occupational risk are also discussed, as well as the use of the criticality table for synthetic risk assessment and safety objectives.

The method based on the **Heinrich model** involves the analysis of human error as the main factor in occupational accidents and diseases. This model is built on the premise that major events (fatal, high-risk accidents) are preceded by a series of smaller incidents (minor, low-risk accidents), and preventing these minor incidents can reduce the risk of major events.

The Heinrich model, also called the "accident pyramid", suggests that for every major incident, there are a greater number of minor incidents that have occurred previously, and preventing these minor incidents can significantly reduce the likelihood of major events occurring. Thus, identifying and correcting the causes that lead to minor incidents can reduce the risk of occupational injury and illness.

Heinrich's proposed method, which focuses on the analysis of human errors in work activities, offers an interesting perspective, but has limitations, such as an excessive focus on performer behaviour and a lack of a participatory component. However, it is important to bear in mind that human error is only part of the whole spectrum of risk factors in occupational safety and health.

Methods based on the **reliability theory of work systems** focus on analysing work systems and the interactions between their various components in order to identify and correct any deficiencies that may contribute to the risk of occupational injury and illness. These methods

involve assessing how technical, human and organisational factors interact to identify weaknesses and propose solutions to improve occupational safety and health.

Reliability theory methods bring a mathematical and analytical approach to risk assessment, allowing detailed identification and analysis of failure modes and possible causes. However, these methods may be limited in their consideration of human behaviour and ergonomic factors.

Ergonomics-based methods focus on adapting the work environment to the needs and capabilities of workers to reduce the risk of injury and occupational illness. These methods involve assessing working conditions, including equipment, workspace layout and work tasks, to identify and correct factors that can lead to physical or mental stress and the risk of injury or ill health. It is clear that there are multiple approaches and methods for assessing occupational safety and health, each with specific advantages and disadvantages.

In conclusion, a holistic approach combining elements from all these methods could be the most effective in assessing and improving occupational safety and health. It is important to tailor methods to the specifics of each work environment and to bear in mind that each method can make valuable contributions to an occupational risk management programme.

The contributions of Romanian researchers in occupational risk assessment have been significant and have brought benefits in the field of occupational safety and health. These contributions have involved:

1. **Elaboration of theoretical foundations:** Romanian researchers have contributed to defining and conceptualising the main elements involved in work processes and to establishing the links between them. This facilitated the application of a unified concept on the genesis of occupational accidents and diseases.
2. **Identification and definition of risk factors:** Risk factors associated with the component elements involved in the work process have been identified and defined. This allowed their use in practice for the analysis and evaluation of work systems.
3. **Development of assessment tools:** Researchers have developed lists of risk factors for the development of tools used in occupational safety and health science and practice.
4. **Adaptation of existing methodologies:** Various risk assessment methods have been adapted to the specific conditions in Romania, taking into account European methods and national legislation.
5. **Work safety level assessment method:** This method makes it possible to establish the percentage level of safety corresponding to the system under analysis and to compare the various work systems according to their safety.
6. **Workplace risk level assessment method:** This method is based on the workplace accident model and allows the determination of partial risk levels for each risk factor and the overall workplace risk level.

7. **Critical review of the models and methods used:** The researchers analysed the characteristics and performance of the methods used in occupational risk assessment and highlighted their peculiarities, limitations and restrictions.
8. **Conclusions and practical recommendations:** Conclusions were drawn from the data analysed and practical recommendations were made to improve occupational safety and health, considering high-risk areas such as the mining industry.

Therefore, the contributions of Romanian researchers in occupational risk assessment have been essential for the development and implementation of effective strategies to prevent occupational accidents and diseases in Romania.

Occupational risk assessment and management are crucial issues in occupational safety and health. In order to strike a balance between economic and worker protection objectives, a rigorous analysis of the costs and benefits associated with prevention, protection and insurance measures is required.

The overall costs of occupational safety are made up of two main components: initial costs related to risk assessment and implementation of safety measures (a priori costs) and subsequent costs associated with occupational accidents and illnesses (a posteriori costs). Determining an optimal level of acceptable occupational risk involves striking a balance between these costs and the benefits obtained by reducing risk.

Occupational safety assessment methods can be classified according to the time at which they are applied, i.e. post-event assessment and pre-event assessment. Quantitative approaches rely on probability calculations and statistical analysis to assess risks and identify necessary corrective measures.

Direct risk assessment methods are preferable, depending on the scope, as they allow human and material efforts to be focused exclusively on the security objective. However, the relative cost of applying these methods needs to be taken into account as it can be significantly higher for analytical approaches.

The interest in applying risk assessment methods can be driven both by legislative considerations and by the needs of private organisations to comply with occupational safety and health standards. The reliability and usefulness of the results obtained are essential to ensure the effectiveness of prevention and protection measures.

Conclusions

Data analysed for 2020 from the National Institute of Public Health draws attention to the field of mining on occupational morbidity. The branch of economic activity dealing with the extraction of upper and lower coal reported 95 cases of occupational diseases and when broken down by occupation, those in the mining industry account for the highest number. Although the reported cases of occupational morbidity due to coal are not representative for analysis, it is important to point out that this risk has chronic effects on the body, not acute ones, so a risk analysis carried out in mining may be suggestive for determining the factors favouring morbidity.

The county most affected by occupational diseases is Hunedoara, and given that mining is the first place for those reported, the mines in the Jiu Valley area can be analysed from the point of view of occupational safety and health to identify specific risks.

In this chapter we have presented the principles and general practice of occupational risk assessment, with an emphasis on how strategies for identifying occupational injury and illness hazards and managing occupational safety should be based on the involvement of all stakeholders: employers, top management, employees and/or their representatives. It also describes how to select external consultancy services for the assessment of occupational risks and the management of these risks, as the dividing line between these approaches (assessment and management of occupational risks) is rather vague in practice.

The starting point in the design and effective implementation of occupational safety management, with the effect of optimising the prevention of occupational accidents and diseases in a system, is the assessment of occupational risks in the system.

Risk assessment involves identifying all risk factors and quantifying their size based on the combination of two parameters: the probability of occurrence of undesirable events and the severity of the maximum foreseeable consequence.

The assessment procedure must allow for the analysis of all occupational injury and illness hazards, regardless of their mode of occurrence (obvious or potential hazards); Elimination, if possible, of all occupational injury and illness hazards identified during the assessment process. The assessment process leads to the exploitation of the possibilities of applying prevention/protection methods, thus entering the field of occupational safety management.

A systematic approach to the process of identifying and assessing occupational risks involves the following steps: Identification of occupational injury and illness hazards and assessment of the risks associated with these hazards in order to establish appropriate measures to ensure occupational safety in accordance with the legislation in force; Assessment of occupational risks with a view to the optimal choice of technical equipment, toxic and/or hazardous substances used, and the appropriate design, planning, layout and organisation of workplaces; Verification of the measures adopted; Establishment of priorities for action; Analysis of the advisability of establishing additional measures, on the basis of the conclusions of the risk assessment; Ensuring that all risk factors for occupational injury and illness, which are relevant to the way in which they occur in the work system, have been taken into account; Ensuring the quality of the prevention and protection measures adopted on the basis of the risk assessment, with regard to improving occupational safety; Monitoring compliance with the measures adopted.

Directive 89/391/EEC establishes the primary responsibility of employers for health and safety at work, obliging them to designate responsible persons or to have recourse to competent outside services or persons to carry out activities to prevent occupational risks and protect against their effects.

The Member States of the European Union have clear provisions, set out in legislative, regulatory and administrative provisions, on the use of external consultancy services specialising in occupational risk assessment, with the possibility of freely taking this decision by using the company's own resources or by recruiting consultancy services only if necessary.

Occupational safety assessment is the action of determining (measuring) the extent to which work systems deviate from the ideal state in which any possibility of occupational injury and illness is excluded.

The assessment of the risk of occupational injury and illness is a way of indirectly assessing occupational safety at work by assigning/determining a value for the indicator "level of risk of occupational injury and illness/occupational safety".

Occupational risk analysis and assessment is necessary as part of a total management process for any activity, as labour issues are inseparable from occupational safety and health policy. Occupational safety diagnosis is a systematic study of all the risks of occupational injury and illness that may influence the "occupational safety status" of the work system under analysis.

The methods, methodologies and models used in practice for the analysis and evaluation of occupational risks, or other parameters specific to occupational safety and health, are the working tools needed to support decisions in occupational risk management.

Occupational safety diagnosis comprises all the multidisciplinary procedures and methods used to quantify the occupational risk specific to a human activity in order to establish all the prevention and protection measures proposed to ensure and maintain an optimum level of occupational safety/the acceptable level of risk of occupational injury and illness.

The analysis and assessment of occupational risk cannot be separated from the subsequent stage, which involves monitoring the work system through audit and inspection actions, in order to successfully apply the iterative nature of the risk study. The conditions and modalities for carrying out risk analysis and risk assessment are discussed as part of a coherent management policy in the field of occupational safety and health, and the data taken into account determine the complex nature of the method with the following characteristics: *uncertainty* - ***because*** chance or hazard are manifestations of objective randomness (objective probability), which influence the estimated value of the risk in terms of the value of the associated probabilities; *imprecision* - *because* subjective randomness intervenes in the estimation of the consequences of the risk manifestation, as well as in the final risk assessment stage.

The risk resulting from the explicit adoption of an objectively established decision by reference to known and accepted natural, social, technological or economic risks shall be considered *acceptable risk (limit risk, acceptable risk)*.

Determining the level of acceptable risk is a compromise between what the responsible body (organisation, body, legal and legislative body, etc.) is willing to assume from an economic point of view if it - a priori - takes into account the occurrence of the risk (and the security measures to be applied) and the costs to be recovered financially - a posteriori - if the risk has been ignored, taking into account the following elements: the cost involved in eliminating human and material damage; the cost generated by the unavailability of the system; the media impact.

By considering the overall costs of occupational safety as consisting of the following elements: the cost of risk studies and safety devices (a priori cost) and the cost associated with the consequences of accidents and occupational diseases (a posteriori cost), a reasonable "economic" value can be determined, taking into account the pre-assessed residual levels of occupational

insecurity and starting from the investment costs as well as those associated with post-accident rehabilitation efforts.

Determining the level of acceptable occupational risk in relation to an economic optimum involves balancing the level of increase in expenditure associated with the risk of occupational injury and illness with the decrease in investment expenditure, so that the cost price is reasonable.

The risk curve has the character of an excess distribution function and, consequently, it can be said that a risk of severity g must have a probability *at most equal* **to** p;

Occupational safety studies and the actions that follow them are aimed at eliminating, reducing or controlling a risk identified and classified as unacceptable, following its assessment and comparison with the pre-established occupational safety objective. The *measures* that enable the transition from unacceptable risk to acceptable risk can be divided into three categories (prevention, protection and assurance measures).

"**Prevention**" is an action to reduce occupational risk by reducing the likelihood of occupational accidents and diseases, P, not affecting the severity parameter G, of the associated consequences. "**Protection**" is an action to reduce occupational risk by reducing the severity G, of the consequences associated with occupational accidents and diseases, not influencing the probability P of occurrence of these undesirable events. "**Insurance**" is the action whereby the financial consequences of the risk of occupational injury and disease are transferred to a third party (the insurer) in whole or in part.

The basic tool of quantitative analysis is the calculation of probabilities because: it lends itself to mathematical processing; it allows a more rational distribution of responsibilities by limiting misinterpretations; it highlights the weight to be assigned to prevention and protection measures; it facilitates the prioritisation of accident scenarios and the elimination of those that are less likely; it leads for each subsystem to the optimisation of the design effort and to a better assessment of the level of safety achieved and guaranteed; depending on the results obtained, it allows a better assessment of the importance of weak points in the system from a safety point of view and their acceptance in full knowledge of the facts.

The techniques for assessing occupational safety in a work system are absolutely differentiated starting from the time of assessment, which is determined by the events that determine the presence or absence of occupational risks and the associated hazards of occupational injury and illness.From this point of view, there are the following principles of assessment: the principle of post-event assessment (undesirable event associated with occupational accidents and illnesses); the principle of pre-event assessment (undesirable event associated with occupational accidents and illnesses).

Global evaluation methods have a more deductive approach, while analytical evaluation methods ***have a*** more inductive approach. A special case is the method of the occupational accident model, which combines global and analytical typology, with the possibility of generalising some results through the inductive approach, the evaluation results being deductive.

In terms of how to analyse the typology of the results obtained, the qualitative assessment of the level of risk/safety at work as an end result is striking in all the methods discussed. The way of expression, which often uses tables, nomograms or diagrams in which the values have correspondence in lexical nuances, highlights the subjective nature of the assessment. Quantitative

assessment of parameters defining risks at work (physical and chemical measurements, laboratory analyses, physical parameters of the working environment, etc.) contributes to the value of the final result to a greater or lesser extent, depending on the type of method used. The methods of direct assessment of risk/safety at work are preferable depending on the field of application, so that the human and material efforts in the assessment activity are directed solely towards this objective;

The relative cost of applying an assessment method is moderate for global methods, somewhat higher for mixed global-analytical methods and much higher for analytical methods.For analytical methods, the increase in cost is linear in relation to the number of jobs (or technical equipment) to which it is applied and becomes exponential in relation to the complexity of the jobs and the degree of human participation.The cautious attitude to applying a risk analysis and assessment method occurs when a trade-off cannot be made between cost and usefulness of the assessment results.

The application of risk analysis and risk assessment methods is constrained by the interest in *the* issue, the usefulness and reliability of the results of the method as well as the costs of applying the method:

-*legislative:* to impose the application of an assessment method, with the aim of establishing a hierarchy of economic activities (agents), with the purpose of social insurance or social protection measures; to guide the inspection work, with a preventive character, in the field of occupational safety and health;

-*private:* to resolve problems of non-compliance with labour and social protection legislation;

From the point of view of the usefulness of the methods of analysis and evaluation, less laborious methods are preferred, with a lower procedure time, which provide immediate results through technical-organisational measures, with positive feedback in the work system.

The reliability of the results of safety assessment methods is strictly dependent on the time required to apply the procedure*,* which must not exceed the time required to change the state of the work system under consideration.

CHAPTER IV - UPGRADING THE METHODOLOGICAL INFRASTRUCTURE USED IN OCCUPATIONAL RISK ANALYSIS AND ASSESSMENT ISSUES

1. **Determining the probability of risk occurrence using the graph-analytical method:**
    - This model focuses on the relationship between the level of occupational safety (S) and the level of risk (R) associated with occupational accidents and diseases.
    - The occupational safety factor (k) is introduced to quantify the ratio between the level of safety and the level of risk. This coefficient can take several forms, including the ratio of the average level of safety to the average level of risk.
    - The use of the Occupational Safety Coefficient allows the appropriate assessment of the occupational safety and health status in relation to the level of risk.
    - The graph-analytic method is applied to determine the probability of risk occurrence in a work system. It involves plotting the probability densities of the S and R parameters and determining the area of intersection that indicates the existence of occupational safety undershooting.
2. **Establishing the risk-safety characteristic p=f(k,γ) in the analysed work systems:**
    - This model examines the relationship between the probability of risk occurrence (p), the occupational safety coefficient (k) and the pseudo coefficient of variation (γ).
    - If S and R are Gaussian variables, the model provides formulas to calculate the probability of risk occurrence as a function of k and γ.
    - A detailed analysis of the relationships between p, k and γ is presented, including expressing γ as a function of p and k, expressing k as a function of p and γ, and determining the variation of the probability of damage dp as a function of the variations dk and dγ.

The conclusions obtained from the analysis of the partial derivative of the distribution function with respect to the number of samples n are essential for understanding the behaviour of the probability of damage as a function of sample size. By obtaining the partial derivative, it is shown that the probability of impairment is inversely proportional to the number of samples. In other words, the smaller the sample, the higher the probability of damage, and the larger the sample, the lower the probability of damage. This is intuitive because a larger sample size gives a more accurate estimate of the distribution, reducing the associated uncertainty and hence the probability of being affected.

The Mathematical Model for Complex Occupational Risk Analysis (**MRISC**) is used for the assessment and analysis of occupational injury and illness risks. It is a flexible tool, adaptable to different areas and types of analysis, and is based on subjective data provided by assessors.

In the MRISC framework, evaluation criteria are defined by evaluation factors, and an evaluation group assigns values to characteristic variables according to how they affect the overall condition of the work system under analysis. By means of mathematical algorithms, the degree of partial and overall impairment of the system is calculated if the assessment requirements are not met.

To determine the likelihood of damage to the system, compare the values of the degree of damage to predefined levels and calculate the risk based on the degree of damage and likelihood. These calculations are made taking into account the uncertainty and subjectivity of the assessments.

In terms of allocating occupational safety resources, the MRES model (Mathematical Model Specific to Occupational Safety Allocations) uses a numerical algorithm to efficiently allocate resources between the different sub-activities, taking into account the maximum degree of achievement of the occupational safety objective associated with each activity. This model is applied in situations where no concrete data is known about how the activities are carried out and belongs to a domain where uncertainty and imprecision are common.

The METESPRRS method is an unconventional approach to assessing occupational safety in high and specific risk workplaces. This method is based on criteria and assessment factors that allow the analysis and quantification of the potential for serious and imminent hazards associated with activities carried out within the work system.

The main concepts used in METESPRRS include the definition of hazard, the hazard potential specific to an activity or workplace, and the likelihood of harm occurring. The assessment of high and specific risk workplaces is carried out according to the Law 319/2006 on Occupational Safety and Health and its implementing methodological rules, which provide for the identification and highlighting of risk factors. Risk factors are classified into a number of categories, and high and specific risk jobs are characterised by the existence of one or more risk factors. General analysis and evaluation criteria are used to assess these workplaces, covering aspects such as location in the territory, state of infrastructure, technological organisation, technical equipment, hazardous substances, etc.

An important tool within METESPRRS is the **ESPRRSF1** form, which allows the collection of data from authorised assessors to assess the serious and imminent hazard associated with each workplace. This form includes assessment criteria, individual assessment factors, degree of impairment, percentage of staff affected, hazardous conditions, etc.

For the correct application of METESPRRS, authorised assessors must have technical expertise in occupational safety and health, select appropriate assessment criteria and factors, anticipate the possible severity of harm and the likelihood of harm occurring, and consult with the assessment team or workers' representatives to ensure a comprehensive and accurate risk assessment.

The Lead Authorised Assessor has several responsibilities in the process of completing the Occupational Safety and Health Risk Assessment Form (ESPRRSF1). These responsibilities include:

1. **Selection of influence criteria and assessment factors**: The authorised assessor selects the influence criteria he considers important for the risk assessment. He also specifies within each criterion only those individual assessment factors relevant to the technical expertise of the objective.
2. **Establishing the weighting of criteria and assigning importance coefficients**: The authorised assessor assigns importance coefficients to each criterion in order to establish a scale of the weight of the criteria in the total assessment.
3. **Lexical definition of assessment factors**: The authorised assessor shall define the individual assessment factors of each criterion lexically to express the meaning of the manifestation or non-manifestation of the dangerous condition and the damage caused by the existence of a serious and imminent danger.
4. **Intuitive assessment of the situation**: Through individual perception of the situation under analysis and evaluation, the evaluator assesses the degree of affectation and the percentage of personnel affected.
5. **Determination of the potential for serious hazard**: If the type of damage is anticipated as a result of the occurrence of the serious and imminent hazard, the assessor obtains the appraised variable to express how the individual appraisal factor influences the potential for serious hazard.
6. **Data collection and completion of the ESPRRSF1 form**: The values assessed and entered on the ESPRRSF1 form constitute the data collected. The importance coefficients and weights assigned to the criteria are pre-determined by the authorised assessor and entered on the ESPRRSF2 calculation form.
7. **Centralisation of results and input into the calculation program**: The results are centralised by the authorised evaluator for input into the calculation program on the ESPRRSF2 calculation form, where the calculation principles derived from the mathematical method are applied.
8. **Obtaining the workplace characterisation sheet**: After entering the data on the ESPRRSF1 and ESPRRSF2 forms and performing the calculations manually or using the computer evaluation program, a workplace characterisation sheet is obtained for the high- and specific-risk workplace, which contains information such as the identification data of the economic operator, the list of workplaces with serious and imminent danger, the "potential for serious and imminent danger" rating and the list of evaluation criteria for which there were maximum values.

The working algorithm of the METESPRRS method is designed for the analysis and assessment of the potential for serious and imminent workplace hazards. It consists of the following steps:

1. Establishing and delimiting the objective: Identifying and collecting general information about the economic operator and the main activities carried out.
2. Divide the objective into subdivisions: Division of the objective into distinct compact parts that are presented as areas, sections, workshops, etc., that lend themselves to analysis.
3. Establishing the content of the risk analysis and evaluation sheet (Form ESPRRSF1): Selection of a set of evaluation criteria established and assessed according to the size and complexity of the activities carried out, and completion of the ESPRRSF1 form for each subdivision analysed.
4. Establishing trained evaluators: Selection of trained persons who will participate in the evaluation group and who know the specifics of the activities. Each member of the group completes an ESPRRSF1 form.
5. Viewing objects and identifying hazards: Field travel and viewing of objects under assessment to identify and select serious and imminent hazards, assess the degree of damage and identify personnel exposed to the action of the hazard.
6. Collection of data and information on work environment parameters: Collection of data and information on measurements of work environment parameters and entry of these values into the appropriate assessment criteria by completing the ESPRRSF1 form.
7. Centralisation of data and information on the ESPRRSF2 form: Collect data and information from the evaluation group, complete and centralise it on the ESPRRSF2 form, and study the answers to eliminate gross errors. Data processing using specialised software: Processing data obtained from the field using specialised software.
8. Highlighting criteria with unfavourable influence and establishing a strategy to mitigate negative effects: Identify evaluation criteria with unfavourable influence on occupational safety and health and establish a strategy to mitigate or eliminate these negative effects.

The proposed mathematical model for analysing and assessing the potential for serious and imminent danger is described by a series of definitions and mathematical formulae. This model uses importance coefficients, exponential functions and matrix operations to assess the degree of hazard impairment and probability of occurrence, and to determine the associated risk. The results are then associated with appropriate lexical nuances to assess the potential for serious and imminent hazard in a detailed and structured way.

METESPRRS mathematical model algorithm:

1. **Receipt and completion of ESPRRSF1 forms:** Working group members receive the evaluation forms and complete them based on their knowledge and experience.

2. **Assigning variables to criteria:** Group members assign variables to how the criteria in the forms, which contain the individual evaluation factors, are met.

3. **Entering forms in the calculation procedure:** Completed forms are entered into the mathematical calculation procedure of the model, either manually or using a computer program.
4. **Selection of criteria with a higher degree of impairment:** Based on the result of the mathematical calculation, criteria with higher degrees of impairment are selected, targeting the corrective action programme to those jobs.

Model for assessing the professional risk associated with human error when performing a RISCOM action:

- **Definitions applied in RISCOM:** Action judgement criteria and human error risk assessment criteria are used. These criteria are used to assess the effectiveness of actions and to determine the degree of impact of human error on occupational risk.
- **Formalising the risk associated with a human action:** A goal-mean relationship is used to quantify human reasoning about mitigating the risk of a wrong action. This formalisation involves assessing the values of goal, means and ground in relation to the acceptable risk of consequences.
- **Determination of probability of harm:** Determine the probability of occurrence of the maximum foreseeable consequences using statistical parameters and occupational safety coefficients.

Procedural algorithm of the RISCOM model:

1. **Choosing the human action and defining the terms of the relationship:** choose the human action to be evaluated and define the terms of the goal-means relationship according to the human factors involved.
2. **Establishment and selection of assessment criteria:** Assessment criteria are selected to evaluate the effectiveness of human action and the risk associated with human error.
3. **Establishing the weight of the relationship terms:** The weight of each term in the relationship is established to ensure consistency and relevance of the assessment.
4. **Entering variables and assigning values:** Variables are entered and each variable is assigned a value according to the selected judgement criteria.
5. **Establishing the coefficients of importance:** The importance coefficients are established for each assessment criterion in order to weight them in the total assessment.
6. **Calculation of total impairment:** Calculate the total impairment associated with human error in performing an action using the importance coefficients and values assigned to the variables.
7. **Determination of the overall degree of damage:** choose a formula and calculate the overall degree of damage associated with human error according to the selected relationship.

8. **Comparison and assessment of the result:** The result is compared with the rating scale defined to assess the risk associated with human error and the effectiveness of corrective actions.

The MERG method (Method for Evaluating the Occupational Risk Associated with Wrongdoing):

- This method involves the use of working tools such as check-list forms, inspired by other French methods such as LEST and RENUR, adapted to specific problems.
- At least one evaluator trained in the evaluation method is required to apply this method and to familiarise with the issue and the concrete way of applying it.
- Reducing occupational risk through ergonomic analysis is achieved by adapting the procedures used to assess ergonomic working conditions in order to optimise the performer's work.
- The quality of the results is determined by the nature of the data and information obtained from the ergonomic assessment procedure and how they are quantified using a specific mathematical model (MRISC).
- The MERG method is also useful in workplaces with serious and imminent hazards, where the likelihood of unwanted events is increased by the occurrence of human error.

METRES method (Numerical Method for the Allocation of Occupational Safety Resources):

- This method focuses on the a priori allocation of occupational safety levels to ensure that activities are subsequently carried out without unwanted events.
- The allocation process is iterative and is applied to all levels of the work system in a differentiated way, depending on the stage of research-design or development and the degree of knowledge of the system's particularities.
- The allocation of occupational safety levels is achieved by defining weighting and criticality coefficients for each component of the work system in order to achieve an optimal level of occupational safety.
- The METRES method is based on the functional assessment of the components of the work system and the determination of the probability of occurrence of undesirable events in each possible scenario.

Both methods are essential for managing occupational risks and ensuring a safe and healthy working environment for employees. By applying them, organisations can effectively identify and manage the risks associated with workplace activities.

It is obvious that the allocation procedures presented above are characterised by objectivity and subjectivity depending on the level of knowledge of the components of the work system and their behaviour over time. Although the risk equipartition allocation technique does not take into account the occupational risks due to the interactions of the system with the reference environment and the criticality values of its components, preliminary risk analyses recommend the use of procedures based on priority weighting of risks or weighting by the number of structural relationships, which better characterise the work system.

In addition, a risk assessment is required for specific containment construction operations, such as those relating to rapid closure systems in underground transport infrastructure. This assessment should consider the hazards associated with the various types of mining damage that may occur underground and identify measures to reduce/control them.

The purpose of this assessment is to ensure compliance with applicable occupational health and safety legislation, to understand the risks specific to containment construction operations and to establish prevention and protection measures to reduce and control the risks of intervention in the event of mining damage. The main operations in the construction of the containment structures with the rapid closure system include the preparation, transport and installation of the rapid closure system, as well as the entry of the rescuers into the damaged area for the investigation and the execution of the final containment structures.

These measures and operations contribute to increasing the degree of security of the intervention activities carried out by the special intervention-rescue teams and to the appropriate sizing and rational allocation of financial and human resources for securing mining works requiring containment constructions with rapid closure systems.

The innovative methodological tool for occupational safety assessment in the field of underground infrastructure construction is designed to assess the degree of compliance with legal regulations on occupational safety and health and aims to identify weaknesses in specific activities, processes or work systems that do not comply with the necessary preventive measures.

The method has several objectives, including identifying non-conformities, determining deviation from legal requirements, assessing the level of occupational safety and health and establishing the measures necessary to achieve 100% compliance. The principle of the method is to identify the essential requirements applicable in a reference system and to assess the degree of compliance of the subject of the audit with this system.

Method tools include a referencing system, general and specific checklists for conformity assessment, non-compliance identification and analysis sheets, weighting grids for overall assessment, overall compliance assessment sheets and non-compliance summary sheets. The article also details the breakdown of requirement categories and the scoring of the maximum possible consequences of non-compliance.

The method is applicable to both internal and external auditors and can be used at various stages of occupational safety and health management, including management decisions, in the operation of the management system or in situations of major changes in technology or equipment. It is a comprehensive and detailed tool for assessing and improving occupational safety in the field of underground transport infrastructure construction.

The formula for calculating the ***overall degree of compliance*** (GC) is:

$$GC = \frac{\sum_{j=1}^{14} I_j \times P_j}{\sum_{j=1}^{14} P_j}$$

In this formula, the sum is done for the 14 categories of requirements, from *j=1* to *j=14*.

This formula represents a weighted calculation of the degree of compliance, taking into account the importance of each category of requirements in achieving occupational safety and health. The Global Occupational Safety and Health Compliance Scorecard is a crucial tool in the occupational safety and health audit process in the field of underground transport infrastructure construction. This document contains essential information on the degree of compliance of work activities and systems with legal regulations on occupational safety and health.

To calculate the overall degree of compliance, weighting coefficients assigned to each requirement and category of requirements are used, taking into account their importance in ensuring occupational safety and health. This assessment is made on the basis of the average compliance indices for each requirement and category of requirements. The results of these calculations are recorded in the evaluation sheet, allowing a detailed assessment of the level of compliance.

In addition, the assessment sheet shall also contain an overall assessment of the level of occupational safety and health for the activity or system being audited. This assessment is made on the basis of a conventionally established grid, which assigns an occupational safety and health grade according to the degree of compliance achieved. Finally, the assessment form also includes a summary of the non-conformities found and the measures required to remedy them. This process is essential for the continuous improvement of occupational safety and health in underground transport infrastructure construction.

An occupational safety and health audit was carried out at an economic operator active in the field of hydrotechnical construction. Here is a summary of the main issues and conclusions:

1. **Risk Assessment Methodology:**
    - A Gumbel likelihood function methodology was used to determine occupational safety and health safety risk.
    - The Kolmogorov-Smirnov statistical test was used to ensure the accuracy of risk predictor estimates and to determine the confidence interval of the forecast results.
2. **Probability Law Adjustment:**
    - Probability laws of the representative/maximum value samples were fitted to Gumbel's theoretical probability law.
    - Statistical parameters (mean and standard deviation) were calculated for the adjusted synthetic samples.
3. **Uncertainty Assessment:**
    - The Kolmogorov-Smirnov statistical goodness-of-fit test was used to assess the uncertainty of the results obtained by adjusting the samples to Gumbel's law.
    - The assessment of fit was performed by analyzing the K parameter (Kolmogorov-Smirnov discriminant).

4. **Audit Results:**
    - Both positive aspects and shortcomings at the level of the economic operator were highlighted.
    - The implementation and maintenance of an occupational health and safety management system were strengths.
    - Deficiencies included workers' poor knowledge of appropriate workplace behaviour and inadequate organisation of mobile equipment recording and checking.
5. **Results of the Audit Mission:**
    - According to the overall assessment, the economic operator in the field of hydrotechnical construction recorded a very good occupational safety and health situation, with a compliance rate of 91.94%.
    - Both positive aspects (91.94% compliance) and negative aspects (identification of 12 non-conformities) were highlighted.
6. **Conclusions and Recommendations:**
    - Twelve non-conformities were formulated and a recommendation was proposed for each.
    - Notable shortcomings include the absence of clear duties of workers responsible for occupational safety and health and insufficient training of workers in issues specific to working at height.
7. **Audit Report:**
    - The audit was led by Drs. Cristina TATARCAN, Chief Auditor.
    - Two specific activities were assessed: working at height and the use of electrically powered equipment.
8. **Appraisals and Proposed Measures:**
    - Criteria were used to assess risk and to judge the quality of the Gumbel's law sample fit.
    - Various estimates have been presented, including the determination of the value of the insecure state exceedance and the assessment of the probability of exceeding certain values associated with insecure states.

Conclusions

The conclusions relating to section 4.1 are as follows:

1. The MRES numerical resource allocation model has diverse applications in planning and strategy, being useful in situations where the activities to which resources are allocated cannot be precisely characterised by value factors or measurable parameters, and the degree of activity achievement is judged subjectively.
2. The use of computer programs facilitates the operation of the model, but becomes more difficult when working with large matrices or introducing preference restrictions when assessing the degree of achievement of activities.
3. The mathematical models presented in this section use specific tools to quantify subjective and objective uncertainty, offering the possibility of adapting them to different situations to prevent and combat occupational accidents and diseases.

The conclusions relating to section 4.2 are:

1. The METESPRRS method is useful for assessing the potential for serious and imminent danger at workplaces and can be applied with one or more assessors, targeting either a single work system or several work systems.
2. This method can also be adapted to specific situations where the parameters of the work environment are difficult to measure and the assessment is subjective.
3. The use of a MRISC mathematical model facilitates the subjective quantification of the valuation parameters, providing classification indices for the economic agents analysed.

The conclusions relating to section 4.3 are:

1. Risk assessment in underground containment construction operations involves identifying hazards and assessing the level of risk, both technological and occupational, in order to establish mitigation and control measures.
2. Risk mitigation is achieved through the application of classical prevention and liquidation measures, as well as rapid closure systems, to ensure an acceptable level of security.
3. The risk assessment provides the necessary data for sizing the measures to prevent and liquidate mining damage and for allocating the necessary material and human resources.

The conclusions relating to section 4.4 are:

1. The occupational safety and health audit method for underground structures allows to assess compliance with legal regulations, identify non-compliances and establish the necessary measures to ensure a safe and healthy working environment.
2. The principle of the method is to identify the applicable essential requirements and to assess the degree of compliance of the subject of the audit with them, by assessing on a percentage basis the extent to which the selected requirements are met.
3. The use of a benchmarking system and appropriate tools facilitates objective assessment of compliance and identification of problems in the implementation of prevention measures.

CHAPTER V - DEVELOPMENT OF THE INNOVATION FRAMEWORK FOR THE INTEGRATED OCCUPATIONAL RISK MANAGEMENT SYSTEM

Approaching occupational health and safety management from the perspective of the overall management of the organisation is essential to ensure that these issues become an integral part of the social and ethical role of the organisation. The implementation of an occupational safety and health management (OSHM) system is crucial for organising and focusing efforts to control and manage occupational risks and improve work performance.

Implementing an MSSM brings many benefits, including creating a work environment with lower risks of injury and ill health, achieving more effective control of risk factors, increasing the transparency and effectiveness of occupational health and safety management, achieving better performance from workers and improving the organisation's image in the eyes of suppliers, beneficiaries, authorities and society as a whole.

An MSSM must be integrated into the overall management of the organisation and be compatible with other related systems, such as quality management or environmental management. The objectives of a modern MSSM include designing principles applicable to all activities of the organisation, organising co-operation and communication between management and workers, planning objectives and monitoring performance criteria to ensure control of risks in the working environment.

The review of the occupational safety and health management system focuses on the implementation of an MSSM in accordance with specific standards such as SR OHSAS 18001:2008 and SR OHSAS 18002:2009. This analysis involves hazard identification, risk assessment, setting objectives, establishing responsibilities and authorities, staff training and awareness, communication and consultation, system documentation, performance measurement and monitoring, compliance assessment, incident investigation and continuous system improvement.

Implementing an integrated MSSM system brings many benefits to the organisation, including achieving occupational safety and health, controlling hazards and risks, limiting incidents and accidents at work, organising workplace activities efficiently, increasing staff motivation and improving the organisation's image.

The main justification for implementing an MSSM is highlighted in its multiple benefits, including the creation of a cohesive framework for managing occupational health and safety activities and improving organisational performance in this area.

Initial analysis is highlighted as a key stage in the MSSM implementation process, involving multiple levels of analysis covering the whole organisation, specific work processes and individual workplaces. This analysis serves as the basis for the further development of occupational health and safety policies and practices.

Planning and implementation are presented as crucial stages where organisations need to set clear policies and objectives for occupational health and safety and develop appropriate strategies to achieve them. The need for a proactive approach to identifying and managing workplace hazards and risks is emphasised.

The crucial role of human resources is emphasised, highlighting the importance of staff competence, training and awareness within the MSSM. Communication and consultation with employees is essential to ensure effective implementation and an occupational health and safety-oriented organisational culture.

Documentation issues, document control and operational procedures are detailed as an integral part of the MSSM, necessary to ensure compliance and to effectively manage information and processes.

Implementing an OHSAS-compliant occupational health and safety management system (OHSMS) requires a series of steps and procedures to ensure effectiveness and compliance. Here is a summary of these:

1. **Verification and corrective action:**
    - The organisation should verify the effect of the MSSM and measure its effectiveness before completion.
    - Corrective and preventive action should be taken, if necessary, to improve the system.
2. **Performance measurement and monitoring:**
    - Performance monitoring involves collecting information related to the results of parameters relevant to OHSAS requirements and the use of equipment and work techniques.
3. **Conformity assessment:**
    - The organisation must periodically assess compliance with legal requirements and implement appropriate assessment procedures.
4. **Investigation of incidents, non-conformities, corrective and preventive actions:**
    - A procedure is needed for reporting, investigating and analysing incidents to prevent recurrence and to identify opportunities for improvement.
5. **Document control:**
    - MSSM records must be adequately protected and kept under control according to documented procedures.
6. **Internal audit:**
    - Internal audit is essential for the evaluation and continuous improvement of the MSSM and must be carried out by qualified and independent personnel.

7. **Management analysis:**
    - Top management should periodically review the operation of the MSSM to ensure its adequacy and effectiveness and to identify needs for change and improvement.
8. **Practical implementation steps:**
    - Implementing MSSM requires a systematic approach and the involvement of all staff, and its development must be based on local analysis, risk assessments and the definition of appropriate objectives and policies.

The development of occupational safety and health (OSH) management system documents is an essential process for the effective implementation of OSH standards and requirements. Here is a detailed overview of the main documents developed:

Checklist of SSM system requirements:

This document provides a detailed description of the requirements of SR OHSAS 18001:2008 and facilitates verification of compliance within the organisation.

The SSM Management Manual:

The manual is the main document of the scheme and provides an overview of how the requirements of the standard and relevant legislation in the field of SSM are implemented. It also includes a management policy statement on SSM and describes the structure and operation of the system.

SSM management system procedures:

These procedures detail how the requirements contained in the system manual are met. They set out responsibilities, information flows and data recording arrangements to ensure compliance and efficiency of the system. Examples of procedures include hazard identification, risk assessment, legal compliance assessment, staff competence and training, communication, employee participation and consultation, performance monitoring and measurement, incident investigation, non-compliance management and corrective and preventive action, document and record control, internal audit and management review.

The MSSM.EXE 01 software application is an essential working tool for developing and managing occupational safety and health (OSH) management system documents. Here is a detailed overview of the functionalities and use of this application:

1. **Program interface:**
    - The program is accessed via a PC and has a user-friendly interface. Launching is done by pressing the "Start program" button and the application displays a main window divided into four distinct areas.
2. **Facilities offered by the application:**

- **Applicable standards" area:** the user can consult in detail the applicable standards for the MSSM domain, translated in PDF format.
- **Area "MC-SSM":** Allows access to the layout of the SSM manual, with instructions for completing each point in the structure.
- **Area "PS-SSM":** Provides access to the list of 13 system procedures, with the possibility to complete their layouts according to the instructions.
- **Verification of requirements" area:** provides the possibility to verify/self-check the fulfilment of the requirements of the SR OHSAS 18001:2008 referential.

3. **Information security:**
   - Access to the application and system documents is by authentication with a unique identified password, thus ensuring the protection of data and information contained in the program.
   - Data protection is ensured by appropriate read and write permissions for consultation documents and system document layouts.
4. **Usefulness of the app:**
   - MSSM.EXE 01 allows the operational and procedural development of system documents in the field of MSSM, adapting to the particularities of the organisation and the requirements of the legislation in force.
   - By updating information and upgrading the application, users can benefit from the latest changes and improvements to the SSM system.
   - The use of this application can help to address occupational safety and health issues in a planned and documented way, define areas of responsibility, raise awareness of the issues in the field of SHH and improve SHH management.

Conclusions

A literature review was conducted to provide a basis for an organisational approach to SSM. The main stages of the implementation of the occupational health and safety management system according to the SR OHSAS standards were established and highlighted.

The system documents for a generic economic operator have been established, i.e.: the checklist for the fulfilment of the requirements of the management system in the field of occupational safety and health and the quality system documents in the field of occupational safety and health (the occupational safety and health management manual and 13 system procedures). The 13 system procedures are as follows: Hazard identification, risk assessment and establishment of controls (PS-SSM-01); Assessment of compliance with legal and other requirements (PS-SSM-02); Competence, training and awareness (PS-SSM-03); Communication (PS-SSM-04); Participation and consultation (PS-SSM-05); Document control (PS-SSM-06); Emergency Preparedness and Response (PS-SSM-07); OHSAS Performance Monitoring and Measurement (PS-SSM-08); Incident Investigation (PS-SSM-09); Non-conformities, Corrective and Preventive

Actions (PS-SSM-10); Control of Records (PS-SSM-11); Internal Audit (PS-SSM-12); Management Review (PS-SSM-13).

The MSSM.EXE 01 program is a working tool used for the operational and procedural development of MSSM system documents by entering data and information on: applicable legal regulations in the field of MSS, MSS objectives, purpose, scope of use, responsibilities for the development and management of the MSSM manual, implementation, maintenance and improvement of the MSSM system, modes of action, information flows, data recording modes, in order to ensure compliance with the requirements of the model and efficient functioning of the MSSM system.

Therefore, **MSSM.EXE 01** is a viable solution for efficiently solving occupational safety and health problems, providing users with an efficient and easy-to-use tool for implementing and managing the OSH management system.

CHAPTER VI - FINAL CONCLUSIONS AND PERSONAL CONTRIBUTIONS

The conclusions in section 6.1 are the summaries and observations made from the analyses and research on occupational safety and health, as well as innovations in the medical system and methodologies used for occupational risk assessment.

The main points of these conclusions include:

1. Employers' responsibility for the safety and health of their employees, in accordance with European standards and relevant legislation.
2. The need for accurate knowledge and assessment of occupational risks in the workplace.
3. The negative impact of occupational accidents and diseases on employees and companies.
4. The importance of the health system in maintaining the health of the population and the need to use available resources for prevention, treatment and research.
5. Specific risks in the mining industry and the need to identify and control them to ensure worker safety.
6. Using telemedicine and other technologies to improve access to treatment and medical advice.
7. Use of modern methodologies and technology to assess and manage occupational risks and improve the working system.

By implementing these management systems, organisations complement their existing organisational structure and promote systematic compliance with European occupational safety and health legislation by integrating this area into the overall management of the organisation.

The rationale for developing and implementing an occupational safety and health management system in organisations is based on a number of considerations, including: creating a unified framework for the management of occupational health and safety activities, improving occupational health and safety performance, protecting workers by reducing the risk of injury and ill health, complying with legal regulations and other applicable requirements, increasing worker awareness and improving the image of the organisation.

In this chapter, a literature review has been conducted to inform the approach to occupational safety and health management at the organisational level. The main stages of the implementation of the occupational safety and health management system according to SR OHSAS standards have been established and highlighted.

Standard system documents were set up for a generic economic operator, including the checklist for meeting the requirements of the occupational safety and health management system, the SHM management manual and 13 system procedures. Also presented was the MSSM.EXE 01 program, a working tool used for the operational and procedural development of MSSM system documents. These documents include essential information on applicable legal regulations,

occupational safety and health objectives, responsibilities, modes of action and information flows. In the annex, the results of the implementation of the MSSM system at the level of a National Research and Development Institute are presented.

Personal contributions

Theoretical contributions

The theoretical contributions, documented in the work, which are of major technical-scientific importance are:

- To carry out an integrated analysis through which the national and international legislative framework has been identified, allowing the foundation of legal, administrative and governmental instruments for the development of the Romanian health care system;

- Analysis of the impact of the pandemic on the Health Care System of Medical Recovery in order to improve the efficiency of the activity of the Medical Recovery Services, both for prophylactic and therapeutic purposes, addressed to people with altered health status, as well as to those whose health status has not changed;

- Evaluation of health management based on an integrated analysis of the medical institutions in the field, from the perspective of investigating the innovative working methods applied within them, in order to ensure an increased efficiency of functionality in terms of proper management of specialized medical services;

- Conducting a socio-statistical study on a target group of people with impaired health, in order to establish the correspondence between the age group analysed and the predisposition to impaired health, with the aim of basing effective dedicated prevention, recovery and treatment programmes;

- Study the possibilities of optimizing the Health System by implementing modern solutions for the use of information technology (IT) regarding: digitization of the medical industry, use of eHealth system, integration of ICT in medical practice, use of telemedicine facilitating access to remote medical services, creation and development of digital laboratories, as well as ensuring the necessary conditions for the use of artificial intelligence in the medical field;

- A synthesis study was carried out to highlight the trends in occupational morbidity based on the evolution of cases reported in the various industries and due to the Covid 19 pandemic;

- Analysis of the current status of the methodology for identifying chemical risk factors, highlighting the methods for optimising the assessment of the state of danger, in order to ensure that the activity is carried out in predictable occupational safety conditions, in accordance with the applicable legislation in the field;

- Conceptualising occupational risk and safety concepts in complex work systems;

- Critical study of models and methods used for the analysis and evaluation of work systems from an occupational safety and health point of view;

- Development of mathematical models applicable to occupational risk analysis and assessment problems: The graph-analytical method for determining the probability of damage to work systems, which makes it possible to determine, by calculation, the probability of occurrence of occupational risk and the confidence interval associated with this parameter, and is the basis for the construction of risk-safety characteristics whereby the probability of damage is made explicit in terms of the occupational safety coefficient and the pseudo-coefficient of variation which quantifies the uncertainty with which this occupational safety coefficient is assigned to the evaluated work system; The mathematical model of complex analysis of occupational risks for the MRISC assessment; The mathematical model specific to occupational safety allocations MRES;

- Development of non-conventional methodological infrastructure for analysis and assessment of risks of occupational injury and illness: METESPRRS method for assessing occupational safety in high-risk and specific workplaces; RISCOM model for assessing occupational risk associated with human error in carrying out an action; METERG method for assessing occupational risk associated with faulty actions; METRES numerical method for allocating occupational safety resources;

- Development of an innovative methodological tool to assess the occupational safety level specific to underground transport infrastructure construction activities;

- Development of the innovation framework in the field of integrated occupational risk management system through the development of occupational safety and health management system documents.

Contributions in the field of applied IT

The contribution in the field of applied IT is represented by:

Development of a software application MSSM.EXE 01 on the integrated occupational safety and health management system.

Experimental and applied contributions

The contributions with experimental and applied value, documented in the thesis, which have a significant technical-scientific value are:

- Practical application on the assessment of the level of occupational risk expressed by the potential for serious danger in terms of compliance with occupational safety and health measures when applying the framework method of mining with a submined coal bed;

- Analysis and risk assessment of specific operations of containment constructions (rapid closure systems) in underground transport infrastructure;

- Practical application on the assessment of the safety level of an economic operator working in the field of underground transport infrastructure construction.

Future research directions

Considering the contributions expressed in the thesis and the specific issues addressed in the thesis, the following future research directions can be exemplified:

- Design and implementation of dedicated, safe and innovative Medical Systems with embedded artificial intelligence;

- To realize an AI-based robotic technology to provide treatment innovation for Medical Recovery using digital therapist with remote Physiotherapist assistance;

- Specialised medical applications based on innovative artificial intelligence and virtual reality models useful for medical recovery;

- Digitisation of the occupational risk assessment on the estimation and assessment of risk indicators, as well as the documents for reporting the results of the assessment (assessment sheet-EF, proposed measures sheet-MF, prevention and protection plan-PPP);

- Innovative expert system for occupational risk and occupational health management in healthcare institutions.