Risk and Security Management for Accident Prevention

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Abstract

The purpose of this scientific article is to examine in detail risk management and safety, focusing on their importance in accident prevention. It provides the opportunity to anticipate, prevent and limit the negative consequences of unwanted events. By analyzing relevant key concepts, methodologies and practices, it aims to provide a comprehensive understanding of the field and the ways in which risks can be assessed, managed and mitigated in various contexts. Through this study, we do not propose to obtain a deep understanding of how managers in public institutions in Romania understand and apply the concepts and practices of risk management and security in order to prevent accidents. We want to assess managers' awareness and knowledge in this area, as well as their level of involvement and commitment in implementing accident prevention measures to protect the institution's staff and assets.

Key words: management, risks, work system, worker, work environment
J.E.L. classification: M11

1. Introduction

In the modern world, where technology and the complexity of human activities are constantly increasing, risk and safety management play a crucial role in preventing accidents. Whether we are talking about industry, health, transport or other fields, identifying and managing risks are essential elements for ensuring a safe environment and protecting human lives. This article addresses the importance of risk management and safety in accident prevention, looking at the key concepts and methods used in this area. Risk and security management has become a major concern in various fields, having a significant impact on preventing accidents and ensuring a safe environment for individuals and organizations. Accidents can have devastating consequences, affecting health and human life, causing property damage and bringing considerable financial losses. Therefore, it is essential to adopt effective risk management and security strategies and measures to prevent such incidents. In a world characterized by rapid technological advancement, increasing complexity of operations and global interconnection, risks and threats are becoming more diverse and unpredictable.

Whether we are talking about the petrochemical industry, the medical sector, transport or any other field, risk and safety management is a vital approach to preventing accidents and minimizing their effects. Producing major accidents with very serious consequences for employees, the population, material goods and the environment, are the negative effects of natural and technological disasters but also of the existence of risk sources on sites that store or use dangerous substances in the production process, an aspect for which they are to the attention of the specialists from the institutions with responsibilities in this field. Research efforts undertaken by experts at various times

have predominantly concentrated on understanding the effects caused by disasters, identifying their origins, and assessing their impacts. This is done with the aim of formulating specific actions to mitigate and eradicate these effects, as well as to revise the regulations regarding the usage of hazardous substances.

In order to ensure the safety of workers, the general public, and the environment, it is crucial that safety protocols, which are obligatory for businesses that utilize hazardous substances in their production processes, are met. This highlights the need for the development of a unified concept of safety in the chemical industry. This conception must treat in a unified whole the technological problems of the existing installations on the site of the economic operator, the security aspects of the environment and protect it from a physical point of view, from the complementary effects of natural and technological disasters, as well as establish new measures for limiting and removing the consequences of accidents that still occur and the complete restoration of production capacities.

The risks of minor or major accidents with particularly serious consequences resulting in death or injury and pollution of the environment exist in all industrial activities, which occur due to malfunctions in installations and equipment during operation or during the manifestation of natural disasters. The establishment of security systems for facilities and the protection of employees and the public in the affected area hinges upon the potential repercussions of a significant accident. This means that an accurate risk assessment of a major accident can provide a way to ensure enhanced protection for the sites involved, or those that could potentially be impacted.

This article aims to assess managers' awareness and knowledge of risk and security management concepts and practices. It is also desired to investigate the degree of their involvement and commitment in the implementation of accident prevention measures and the protection of the institution's personnel and assets. By obtaining and analyzing the perceptions of managers in public institutions, the article will provide a clear insight into how the risk and security management system is implemented and integrated into work processes.

2. Literature review

Risk management is a systematic and rigorous process of risk identification, analysis, planning, control and communication. Each identified risk passes sequentially through the other functions, continuously and concurrently. Risks are usually tracked in parallel with the identification and analysis of new ones, and the mitigation plans for one risk may produce other risks (Bibire and Ghenadi, 2019).

Risk management takes place within any decision-making process and to be effective, it is necessary to reconsider the current analysis and decision-making processes. An effective risk management process also represents a set of continuous and systematic specific activities for the exchange of relevant information, in an open information environment. Risk management ensures a rigorous environment of active decision-making for (Aven, 2018):
- ✓ continuously assessing what may have undesirable consequences;
- ✓ determination of important risks, to be studied;
- ✓ implementation of strategies for dealing with these risks;
- ✓ ensuring the effectiveness of the implemented strategies.

The implementation of the processes of identification, analysis, planning, control and communication of risks of any nature ensures, at any level, a series of advantages, among which (Aven, 2018):
- ✓ avoiding surprise: continuous assessment of what can end badly can anticipate events and their consequences;
- ✓ increasing the probability that events will occur according to expectations: the results of decisions can be influenced by weighing possible effects and associated probabilities; understanding the risks allows better decisions to be made;
- ✓ changing the focus from treating a crisis to preventing it: risk management can identify and then prevent potential problems when this is easier and cheaper to do, before they turn into real problems and then into crises (the function is much more pronounced preventive);
- ✓ focusing on the main objectives and detecting events that may affect the achievement of these objectives;

✓ early identification of potential problems (proactive approach) as possible support in making resource allocation decisions.

In a broad sense, RISK can be defined as a potential event that, if it occurs, causes loss, damage, destruction, suffering (Bartram et al., 2001). Depending on the field in which the events can occur or their nature, we can speak of a great diversity of risks. The existence of exposure to negative consequences of the population, material assets, heritage values, and the environment can be stated as a feature of the risk. Another criterion used in the identification and ordering of specific risks is the vulnerability of the elements exposed to the risk. This highlights how much man and his goods are exposed to various hazards, indicating the probable level of damage that a certain phenomenon can produce (Bedford and Cooke, 2017).

The negative effect taken into account when defining specific risks is, as a rule, the probable level of loss of human life, number of injured, damage to property and economic activities by a certain phenomenon or group of phenomena, in a certain place and in a certain period of time (Bibire and Ghenadi, 2018). It follows that the risk exists depending on the size of the hazard, the totality of the groups of people and material values at risk and their vulnerability, and can be defined as a mathematical prediction of the loss of human life, injuries, destruction of property and damage to economic activity, during a period of reference and in a given region, for a specific hazard. Risk is defined as the possibility of affecting human life and material assets when a certain type of disaster occurs and represents the possible loss of human life, the number of injured, the damage that can be caused to properties and economic activities by a natural phenomenon or the complementary effects of him, in a certain place and in a certain period. Risk identification aims to anticipate risks and include information about risks in decision-making processes. The data and uncertainties related to one's own interests, specific to a decision-making level, are transformed into distinct risks that are then described and measured (Covello and Merkhofer, 2003).

The risks are described in a unitary format, with two basic components: the condition and the consequence, this format achieving a complete picture of the risk, very important in the subsequent stage of mitigation planning. The condition component refers to what causes concern and starts from what generates fear, uncertainty, doubt in relation to interests and objectives, and the consequence to the immediate and medium or long-term impact of the risk (Mannan, 2015). Correctly understanding the dimensions of the impact is important for determining the time, resources and effort allocated to the risk mitigation action. A risk statement is effective when, both in the description of its condition and in that of the consequences, information is included in terms such as what?, why?, when?, where?, how?, describing the generating factors, the circumstances, the consequences if necessary with the necessary additional details (Bibire and Ghenadi, 2019).

Risk analysis aims to convert data into information for decision making. It represents a process of examining the risks in detail to determine their extent, how to relate one risk to the others, selecting and highlighting the most important risks. This stage involves three basic activities: evaluation, classification, prioritization. Assessing risk attributes – impact, probability, time frame – provides a better understanding of the risk. This means setting values for impact (losses or negative effects), probability of the event occurring, time frame in which mitigation measures must be taken. Risk assessment includes the systematic use of available information to determine the probability of certain events occurring and the magnitude of their possible consequences. Monitoring is the process of obtaining, compiling and reporting status data about risks (Lewis, 2017). The purpose of the stage is to collect accurate, relevant and timely information about the risk and to present it in a clear and easy-to-understand manner. The information from this stage influences the way the control stage is carried out. The mitigation plan and risk attributes are continuously monitored to verify that the plan reduces the impact or probability associated with the risk. Monitoring is a continuous process, even if most information is obtained periodically. Communication allows all participants in the risk management process to understand the risks and mitigation alternatives. It is essential in all stages of risk management. It aims, obligatorily, to inform and prepare the vulnerable elements, respectively the management of public institutions and economic operators, of the elements of the action system to mitigate risk and increase industrial security (Mannan, 2015).

To sum up, the management of risk and security plays an essential role in averting accidents and safeguarding human lives and physical property. Through the effective identification, evaluation, and control of risks, we can guarantee a secure environment and reduce the negative effects of unforeseen

incidents. The execution of a solid risk and security management system calls for a methodical strategy, the participation of all concerned parties, and an ongoing process of surveillance and enhancement. By applying appropriate strategies and adapting to changes in the business environment, organizations can achieve significant results in preventing accidents and creating a safe and secure environment.

3. Research methodology

This scientific article aims to examine the viewpoints of managers from diverse public institutions in Romania about the risk and safety management system, particularly in relation to accident prevention and its effect on the functioning of the work system.

The operational framework is composed of four primary elements: the executor, or the employee, the means of production, the working environment, and the workload. These components are interrelated and directly affect the effectiveness and outcomes of tasks performed within the working system.

The executor, or the employee, represents one of the key elements of the work system. This is the person responsible for carrying out activities and performing specific tasks within the system. The qualifications, competencies, experience, and motivation of the employee significantly influence the quality and effectiveness of the tasks executed.

The term 'means of production' pertains to the resources, equipment, tools, and technologies utilized in the work system. These are essential for executing work tasks and attaining the set objectives. The quality and appropriateness of the means of production can have an impact on productivity, safety, and the comfort level of the employee.

The work environment represents the physical, social and organizational context in which work activities take place. It includes factors such as working conditions, organizational climate, labor relations and organizational culture. A healthy and safe work environment is essential for employee well-being and performance.

Workload refers to the specific objectives, requirements, and responsibilities associated with a particular job or position. This includes the activities and actions that the employee must perform to achieve the desired results. Clarity, consistency and balance of work tasks are important to ensure efficiency and employee satisfaction.

In alignment with the aim of the scientific research, the subsequent objectives were established:

1. To analyze the complete work system;
2. To scrutinize the elements that make up the work system;
3. To identify the connections between the components of the work system.

In the course of scientific investigation, drawing upon scholarly articles, theories in the field, and personal observations, the following hypotheses were formed that serve as the foundation for the research:

Hypothesis 1: There is a strong correlation between the executor (employee) and workload;

Hypothesis 2: There is a highly significant positive relationship between work environment and workload.

These hypotheses constitute the basic premises of scientific research and will be tested and analyzed in later stages of the study. The results obtained from the research will contribute to a deeper understanding of the relationship between risk and security management and accident prevention in public institutions in Romania and will provide a solid basis for the development of recommendations and strategies in this field.

Data collection was carried out between January 2023 and March 2023 by means of a questionnaire. A total of 512 valid questionnaires were obtained in this process. For the processing and analysis of the collected data, the software specialized in statistical research, S.P.S.S., was used. (Statistical Package for the Social Sciences). This program facilitated the calculation of the Spearman rho correlation coefficient, an indicator used to evaluate the relationship between the studied variables.

Using the S.P.S.S. software offers significant advantages in data analysis due to its ability to process and interpret the collected information efficiently and accurately. It allows complex statistical analyses, such as the calculation of the Spearman rho correlation coefficient, which measures the relationship between two ordered variables.

The Spearman rho correlation coefficient is used to assess the relationship between two variables that are not normally distributed and can be ordered. This coefficient provides a measure of the degree of correlation and its direction between the studied variables. The analysis of this coefficient allows the identification of relationships and associations between variables and can reveal relevant aspects regarding the managers' perception of the risk and security management system for the prevention of accidents in public institutions in Romania. By using S.P.S.S., the data collected through the questionnaires were processed and analyzed in a rigorous and objective way, thus providing valid and interpretable results. The statistical analysis of the obtained data allows the identification of trends, relationships and significant differences, providing relevant information for understanding the managers' perception of the risk management and safety system for accident prevention.

The results of the data analysis collected and processed through S.P.S.S. they can provide valuable information and relevant conclusions regarding managers' perception and provide a solid basis for developing recommendations and strategies for improving the risk and security management system in public institutions in Romania.

4. Findings

To verify and validate the hypotheses formulated in the research, we used a recognized and widely used statistical analysis tool, namely the Spearman rho correlation coefficient (Table no. 1). This value, often referred to as the rank correlation coefficient, is apt for assessing the relationship between ordered variables or their respective rankings.

Table no 1. Values recorded by the Spearman rho correlation coefficient

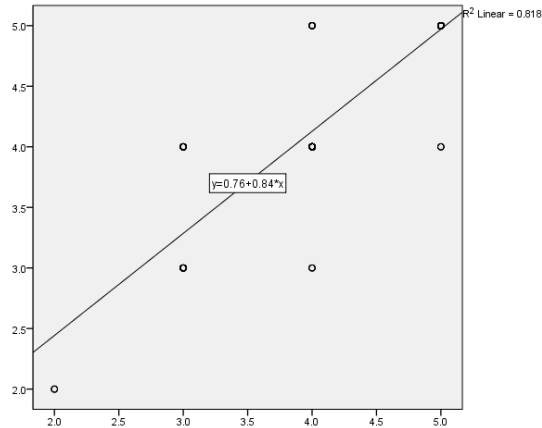| Correlations					
Spearman's rho		**Executor (employee)**	**The means of production**	**Work environment**	**Workload**
Executor (employee)	the correlation coefficient	1.000	.718**	.737**	.923**
	Sig. (2-tailed)		.000	.000	.000
	N	512	512	512	512
The means of production	the correlation coefficient	.921**	1.000	.700**	.784**
	Sig. (2-tailed)	.000		.000	.000
	N	512	512	512	512
Work environment	the correlation coefficient	.837**	.800**	1.000	.947**
	Sig. (2-tailed)	.000	.000		.000
	N	512	512	512	512
Workload	the correlation coefficient	.823**	.784**	.895**	1.000
	Sig. (2-tailed)	.000	.000	.000	
	N	512	512	512	512
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: processing data obtained through SPSS program

After analyzing the Spearman rho correlation coefficient, the following correlations can be identified between the various components that make up the work system:

1. There is a significant positive correlation between the Executor (employee) and the Means of Production (rho=0.72, df=512, p<0.001). Looking at the scatter diagram (Figure no.1), it can be seen that the points are distributed in a relatively narrow range, which indicates a strong correlation (R^2=0.81). It can also be seen in the plot that the spread of points forms an almost straight line, suggesting a linear relationship rather than a curvilinear one.
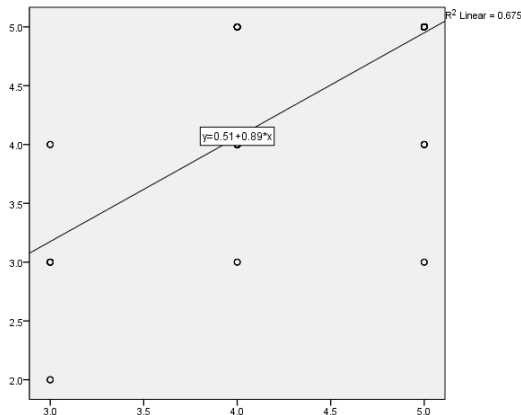
Figure no. 1. Scatter diagram – correlation between Executor (employee) and Means of production

Source: processing data obtained through SPSS program

2. From Table 1, it can be seen that there is a significant positive correlation between the Executor (employee) and the Work Environment (rho=0.74, df=512, p<0.001). Analyzing the scatter diagram (Figure no. 2), we can see that the points are distributed in a relatively narrow range, which indicates a strong correlation (R^2=0.67). It can also be seen in the plot that the spread of points forms an almost straight line, suggesting a linear relationship rather than a curvilinear one.
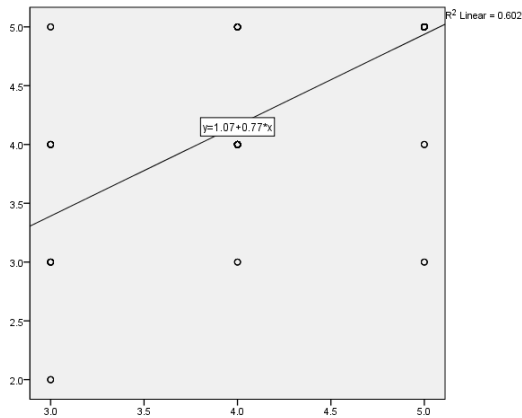
Figure no. 2. Scatter diagram – correlation between Performer (employee) and Work environment

Source: processing data obtained through SPSS program

3. There is a very high significant positive correlation between Executor (employee) and Workload (rho=0.92, df=512, p<0.001). Analyzing the scatter plot (Figure no.3), we can see that the points are distributed in a relatively narrow range, which indicates a strong correlation between the two variables. We could say that Hypothesis 1 was fully validated.
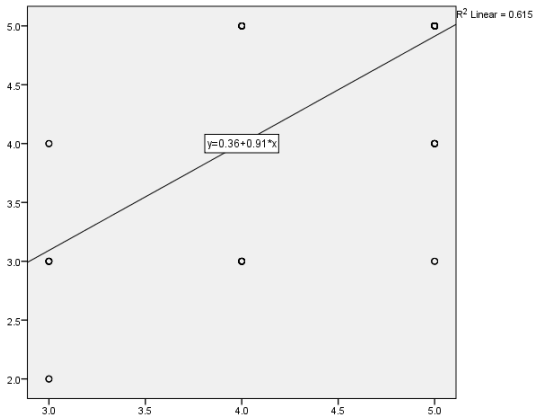
Figure no. 3. Scatter diagram – between Executor (employee) and Workload

Source: processing data obtained through SPSS program

4. After analyzing the Means of Production and the Work Environment, a significant positive correlation results (rho=0.70, df=512, p<0.001). Examining the scatter diagram (Figure no.4), we notice that the points are distributed in a relatively narrow range, suggesting a strong correlation between the two variables (R^2=0.61). Also, the shape of the scatterplot shows an almost straight line, indicating a linear rather than curvilinear relationship.

Figure no.4. Scatter diagram – the correlation between the means of production and the work environment

Source: processing data obtained through SPSS program

5. Between the means of production and the workload there is a significant positive relationship (rho=0.70, df=310, p<0.001). The scatterplot reveals that the spread of points is relatively limited, indicating a moderate to strong correlation (R^2=0.54) - Figure no. 5 The slope of the scatterplot of the results is relatively a straight line, indicating a linear relationship rather than a curvilinear one.

Figure no. 5. Scatter diagram – correlation between Production Means and Workload
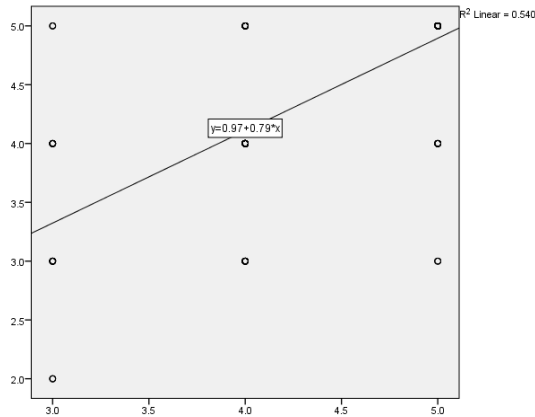
Source: processing data obtained through SPSS program

6. There is a very high significant positive relationship (rho=0.95, df=512, p<0.001) and between the Work Environment and Workload (Table no. 1). The scatterplot (Figure no. 6) reveals that the spread of points is relatively limited, which indicates a moderate to strong correlation (R^2=0.74). The slope of the scatter of the results is relatively a straight line, indicating a linear relationship rather than a curvilinear one - Thus Hypothesis 2 was validated.

Figure no. 6. Scatter diagram – correlation between Work Environment and Workload
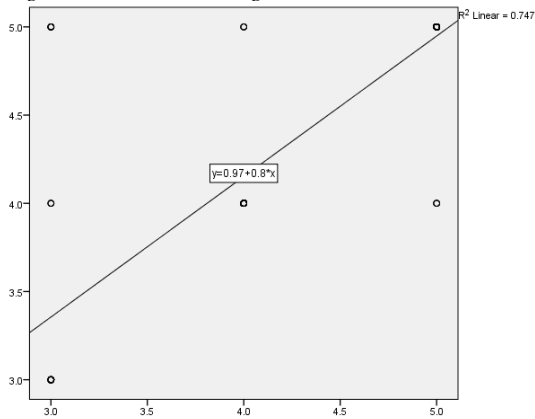
Source: processing data obtained through SPSS program

We can say that the components of the work system - the performer, the means of production, the work environment and the work load - are interdependent and mutually influence the performance and results within a work system. Understanding and properly managing these components is critical to ensuring a safe, healthy and productive work environment where employees can achieve their goals and gain satisfaction in their work.

The analyzed work system directly influences the performance and efficiency of the organization. By optimizing the components of the work system, such as the appropriate assignment of tasks, the efficient use of the means of production, and the creation of a healthy work environment, productivity and the quality of the work performed can be improved. A well-structured and supported work system promotes employee satisfaction. This can be achieved by ensuring a safe and stimulating work environment, by clarity and consistency of work tasks, and by recognizing and involving employees in making decisions relevant to their activities.

A crucial aspect of the work system is ensuring the health and safety of employees. The implementation of appropriate protection and accident prevention measures, as well as the creation of a healthy and ergonomic work environment, contribute to reducing risks and protecting employees

from harm and injury. An effective work system provides opportunities for developing and increasing the skills and capabilities of employees. By ensuring access to appropriate training and coaching, through constant feedback and guidance, the personal and professional development of employees can be supported, contributing to increasing their performance and commitment. Proper evaluation and control of risks associated with the work system are critical for preventing accidents and safeguarding employees. With the implementation of a risk and security management system, possible risks can be identified and analyzed, and preventive measures can be instituted to lessen the exposure of employees to hazards and accidents.

5. Conclusions

After examining the elements of the work system - the performer, the means of production, the work environment, and the workload - several key insights can be deduced. The components of the work system are intertwined and they mutually impact the performance and the outcomes achieved. A well-trained performer, adequate means of production, a healthy work environment and a clear and balanced workload contribute to employee efficiency and satisfaction.

a) The importance of resources and equipment: means of production are essential elements in the work system. Proper use of modern and well-maintained resources and equipment can improve employee performance and productivity, helping to accomplish tasks in an efficient and quality manner.

b) The influence of the work environment on employees: The work environment is a crucial factor in employee well-being and satisfaction. A secure, healthy, and stimulating work environment can bolster employee engagement, productivity, and satisfaction. Conversely, an unsuitable work environment characterized by poor conditions or a negative organizational culture can adversely impact employee performance and well-being.

c) The need for a well-defined workload: a clear, appropriate and balanced workload is essential for an efficient performance of activities. Ambiguous or overloaded work tasks can lead to stress and dissatisfaction, affecting employee performance and motivation.

d) The importance of the integrated approach: to ensure an efficient and productive work system, an integrated approach of all components is necessary. By taking into account all aspects - the performer, the means of production, the work environment and the workload - an optimal work environment can be created that promotes employee performance, satisfaction and safety.

Understanding and properly managing the components of the work system is essential to ensure efficient and safe work. Promoting a healthy work environment, appropriate equipment, clarity of tasks and respect for the needs and skills of employees are key factors for the success and well-being of the organization. By integrating and optimizing these components, organizations can achieve better results in terms of performance, work quality and employee satisfaction.

To maximize the efficiency of the work system, it is important to pay attention to both the individual components and the interactions and mutual influences between them. Managers and leaders of organizations must consider the needs and capabilities of employees in assigning tasks and provide the necessary resources and support to successfully carry out the planned activities.

Also, identifying and assessing the risks associated with each component of the work system is essential to prevent accidents and ensure the safety of employees. Risk and security management systems must be integrated into all aspects of the work system so that potential risks can be identified and managed proactively.

Finally, work system optimization is not a static process, but requires a continuous improvement and adaptation approach. Organizations must be open to employee feedback and be willing to implement changes based on needs and requirements. By maintaining a proactive and growth-oriented attitude, organizations can create a work environment that promotes employee performance, satisfaction and safety, thereby contributing to their long-term success and sustainability.

In the future, it is necessary to carry out studies and research in order to identify and develop new risk assessment methods in Romania, especially in the case of locations where there is a possibility of a major accident involving dangerous substances. As there is still no single methodology accepted by risk assessors in these situations, it is important to continue research efforts to address this issue.

In further development, a multidisciplinary and collaborative approach to developing a standardized risk assessment methodology at such sites may be considered. It requires the involvement of experts from various fields, such as chemical engineering, risk management, security and environmental protection, to develop a comprehensive and effective approach.

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