ASSESSING THE IMPACT OF CRISES ON MANAGERS' CHANGE OF MINDSET TOWARDS RISKS AND PREVENTIVE MEASURES IN MANAGEMENT SYSTEMS IN ENTERPRISES: THE CASE STUDY IN SLOVAKIA

[a]MÁRIA HUDÁKOVÁ, [b]KATARÍNA HOLLÁ, [c]JOZEF KUBÁS, [d]VALÉRIA MORICOVÁ

Faculty of Security Engineering, University of Žilina, St. 1. mája 32, 010 26 Žilina, Slovakia, email: [a]maria.hudakova@uniza.sk, [b]katarina.holla@uniza.sk, [c]jozef.kubas@uniza.sk, [d]valeria.moricova@uniza.sk

Abstract: The paper's essence is to assess and evaluate the perceived changes (differences) in the managers' approach to risks in management systems (QMS, OSHMS, EMS) and changes in the investment of funds for the implementation of preventive measures to reduce risks before and after crises (e.g. Covid-19 pandemic, energy crisis) in small, medium and large industrial enterprises in Slovakia. The research carried out consisted of two surveys in 2020 and 2022 using online inquiry. The sample of respondents consisted of a total of 662 industrial enterprises operating in Slovakia. The presented results have an added value as a best practice for owners, top managers and responsible quality managers, OSH managers, and environmental managers of industrial enterprises.
Keywords: Crisis Management; Management Systems; Covid-19 pandemic; Prevention; Mindset Change; In-vestments in Safety.

1 Introduction

Over the last four years, businesses have had to face and are constantly facing various crises in the business environment, whether it was the Covid-19 pandemic, the energy crisis, the war in Ukraine. The consequences of the pandemic, amplified by the Russian aggression in Ukraine, have brought about a rise in energy prices that has caused major problems for Europe. This has affected investors' decisions, reducing the competitiveness of individual countries. According to several authors, e.g. Waiho et al. (2020); Bartik et al. (2020); Carvalho et al. (2023); Coleman, Nautz (2023) the different crises brought with them a number of negative impacts that affected not only the business environment but also the whole society (slowing down the growth of the economy). According to Estiri et al. (2022); Belas et al. (2021), the Covid-19 pandemic contributed to the fact that managers began to feel a greater need to engage in a more comprehensive review of existing approaches to crisis prevention. According to Luburic (2021), the aftermath from the Covid-19 pandemic also highlighted some of the shortcomings in change management that were not addressed in a timely and adequate manner in a more stable environment for better functioning in crisis situations. Small businesses often suffered from a lack of resources, which in many cases was the reason why they were unable to prepare for a crisis. According to Mikusov, Horvath (2023), managers still do not consider crisis preparedness as part of their competitiveness and actual active prevention is still low. According to their findings, it is necessary to initiate their reflection on the necessity of crisis prevention. Dobrowolski (2020) states that the variability of the environment and the constant changes in the company's surroundings place increased demands on management, which must be able to respond quickly and in a timely manner to an adverse situation. If the enterprise is already going through a crisis, it must use the necessary approaches, methods, tools that will help it to get out of the crisis but also to set up prevention and increase resilience so that further crisis situations do not occur. According to the results of the Institute of Risk Management (IRM, 2023), it shows that every year there is a gradually growing international interest in risk management in any governmental, public and commercial spheres. The magnitude of individual negative impacts on businesses also depends on the ability and preparedness of the business to face these negative events (Mazzanti et al. 2020). Gavril et al. (2020) conducted a study in which they highlight the vulnerability of European countries to the impacts of negative environmental threats and recommend the use of innovative strategies to reduce their consequences. As negative events become more frequent and less predictable, the need for greater preparedness is growing, and associated with this is the need for risk assessment in business management systems. Ferreira de Araújo Lima et al. (2020); Tullo, (2020); Ślusarczyk & Grondys (2019) state that enterprises should be more concerned with the risk management process, creating a risk management strategy and linking it to key indicators, so that the impact of external threats can manage to reduce not only strategic but also operational risks. Ciocoiu et al. (2020) stresses the need to pay more attention to the measures proposed to increase risk resilience. Estiri et al. (2022) points out that it is necessary to create a matrix of responsibility for the implementation of risk management in the enterprise.

From the above, it can be concluded that the impact of individual crises in the business environment and their consequences on the management of enterprises has shown that the application of the risk management process is essential and helps to make enterprises more flexible and reliable in meeting their objectives. The authors Katanaeva et al. (2020); Akwei et al. (2018); Levashov et al. (2018), Ramos et al. (2015); Thimm, (2015); Krokhina et al. (2018); Vodolazhskaya et al. (2019), emphasize that it is essential to know the risks of management systems for quality, occupational health and safety (OSH) safety, environment in particular, which are key to thriving and achieving the strategic and operational objectives of the enterprise.

Businesses strive to offer products and services that not only meet but exceed customer expectations. At the same time, they are under pressure to reduce costs and continuously improve quality in order to remain competitive. In addition to accident prevention, safety of technical equipment and work procedures, OSH must also pay attention to ensuring a healthy working environment with an emphasis on the human factor and occupational health. More recently, also to ensure employees' sense of physical, psychological and social well-being (Hollá 2017). The adoption of new laws, regulations to contribute to environmental protection is creating pressures on businesses to respect the tightening requirements for environmental protection, while at the same time creating measures to mitigate climate change. On the other hand, according to Piatrik et al. (2003), the management systems in place in a company save costs associated with fines for regulatory violations and increase the credit of the organization with its customers, stakeholders and the general public. The above management systems should be in integration with risk management. According to Shandova (2018), risk management should be implemented in an organization so that it can continuously and systematically identify significant risks (including their interrelationships and interactions) across the enterprise. To increase the prevention of enterprise crises and the successful application of risk management, according to several experts, e.g. Katanaeva et al. (2020); Ramos et al. (2015), it is necessary to use the ISO 31000 standard (Risk Management – Principles and Guidance). The standard recommends that companies develop, implement and continuously improve a framework that aims to integrate risk management into enterprise-wide management processes and management systems.

Most of the papers by various authors focus on the assessment of the consequences of crises, the importance of prevention, risk management in the enterprise, the integration of management systems (QMS, OSHMS, EMS), or address risks, problems individually in management systems (QMS, OSHMS, EMS). The originality of the paper lies in the fact that so far no study has been conducted to assess changes in managers' perceptions of risks in management systems (QMS, OSHMS, EMS) and their willingness to invest funds for prevention before and after a crisis period in industrial enterprises. The paper provides an important and significant insight into managers' perceptions towards risks, preventive measures affected by negative threats from the business environment. It contributes to the formation of attitudes, attitudes and knowledge expansion of owners and

responsible managers in order to increase the need for continuous prevention in the enterprise.

The concept of the article is as follows. In the introduction, the authors present the need and importance of the issue addressed. In the literature review, they elaborated the issue of risks in connection with quality management systems, OSH, environment (QMS, OSHMS, EMS) and the view of prevention levels in the enterprise, in order to approach the current state of the problem addressed. In the next part of the paper they set the objective, scientific hypotheses, description of the data obtained, research methodology and methods for their evaluation. In the following section, they presented the results of the empirical research, evaluation and discussion with other related scientific studies. Finally, the authors presented the main contributions of the research, characterized the limitations of the research, and set out the future research activities of the research team.

2 Theoretical background

On the basis of various studies, surveys, scientific articles on the addressed issue, the authors of the article have elaborated a current overview with emphasis on attention to risks, problems in the quality management system, OSH, environment, and prevention in enterprises. The given part pays attention to the importance of risks, possibilities of improvement, and prevention in management systems in enterprises.

A quality management system, according to Gremyr et al. (2021) is seen as a dynamic, long-term, and never-ending process. At its core is the change in the approach of managers and the involvement of all employees at different levels of management in the process. Several authors e.g. Simchenko (2012), Putyatina et al. (2020) discuss the need to constantly look for ways, procedures, approaches to ensure the improvement of quality management systems in enterprises. One of the solutions for quality improvement is the application of risk management. Risks in a quality management system (QMS), e.g., according to Adreev et al. (2021), can be defined as a combination of the probability of damage and the severity of that damage. Where damage is understood as harm to health including damage that may occur due to loss of product quality or availability. According to Akwei et al. (2018), all risks that may have negative consequences in quality management should be assessed and minimized. Product quality is closely related to the quality of the business processes that are implemented in the enterprise system. Therefore, according to Alzamil, (2019), risk management should be applied in product creation, in all enterprise processes of product production, in the entire quality management system in the enterprise. Risks in QMS can also be seen from the perspective of the producer as well as the consumer. From the producer's perspective, according to Grimashevich et al. (2019), these risks can be defined as loss of reputation when supplying non-conforming products, loss of individual customers and entire markets, legal liability for poor quality, degradation of resources, wastage of human labour, and reduction of employee confidence in the capabilities of the enterprise. One of the ways to increase the level of risk management in the field of quality is the application of QMS according to ISO 9001: 2015 Quality Management System – ISO 9001 Requirements. The standard recommends risk-based thinking to integrate risks into the entire enterprise management system, into all processes included in the QMS. It gives attention to creating preventive measures that are part of strategic planning, operational processes and review. Novakova et al. (2017), Andreeva et al. (2019) emphasize the need to implement risk reduction measures in QMS and to evaluate the effectiveness of these measures. According to authors e.g. Samani et al. (2019) and Katanaeva et al. (2020), it is also necessary to develop models of risk management in QMS. Katanaeva et al. (2020) recommends a model that enables management actions to be carried out in a situation of uncertainty and decisions to be made aimed at preventing errors in the management of the organization and ensuring proper quality. Samani et al. (2019) favours the development of a risk-based conceptual model of QMS. Enterprises that seek to implement risk management should incorporate risk management methods and techniques into their processes. Zhang et al. (2022) developed an improved model of quality risk transfer in a new retail service supply chain. Huang et al. (2011) in their study highlights that the application of risk management influences the effectiveness of QMS. They recommend that enterprises should use an effective method to prevent and control verification risk as quality risks flow through the system and affect the overall performance of the enterprise. Pollakova et al. (2016) points out that a thorough process analysis and the use of appropriate risk management tools can minimize existing risks and maximize process efficiency. Along with Zhao et al. (2021) point out that risk management is of prime importance in the quality planning process. Its benefit is the early identification of potential non-conformance risks in systems, processes, products and other quality management risks, which is a good prerequisite for a successful business and a satisfied customer. In terms of prevention, according to several authors, Zhao et al. (2021); Katanaeva et al. (2020); Grimashevich et al. (2019); Samani et al. (2019); Akwei et al. (2018), it is necessary to pay even more attention to risk-based thinking, to look for new opportunities to improve the QMS, to make the customer satisfied and at the same time the business owners, by gaining competitive advantages and adding value to the business.

In the field of OSH, enterprises have to comply with the statutory conditions related to OSH as a priority, but at the same time, they implement a management system for more effective compliance with all safety rules and the achievement of enterprise objectives. Occupational health and safety management system (OSHMS), according to Ramos et al. (2015); Podgorski (2010), is a part of the overall management system of an enterprise that has established an OSH concept, manages health and safety risks, in accordance with the requirements of OSH management and through their implementation, achieves effective business results and objectives. Rudakov et al. (2021) state that the main task of all enterprises whether it is small, medium, and large is to improve occupational health and safety conditions with an emphasis on prevention and the use of risk management. According to ISO 45001, risk in an OSH management system is defined as the combination of the probability of a hazardous event or exposure occurring that is work-related and the severity of the injury or damage to health that may be caused by the event or exposure. Roberts, (2017) argues that OSH hazards should be assessed on priority to ensure the protection of employees, i.e. to look for and analyze their causes such as stress, workload, the monotony of work, working conditions, labour and industrial relations, psychosocial factors, equal opportunity (non-discrimination), fair remuneration, appropriate workplace facilities, etc. According to Levashov et al. (2018), the essence of risk management in OSH is to achieve a shift of injuries from post-injury response measures to preventive measures, i.e., management of worker health risks. They justify the possibility of implementing the concept of key risk indicators in the process of OSH management through a model control system and rigorous analysis of occupational risks. According to several authors, e.g. Garcia-Gomez et al. (2020); Beck et al. (2017); Dahler-Larsen et al. (2020), psychosocial risks, which are a concern for employers across Europe, need nowadays much more attention than ever. According to Guadix et al. (2015), psychosocial risk control prevents accidents and absenteeism. Their elaborated study shows the benefits of adopting psychosocial safety management systems to improve the performance of psychosocial risks. Psychosocial prevention activities mediate the relationship between psychosocial safety management and psychosocial performance. Guadix et al. (2015) and Garcia-Gomez et al. (2020); Beck et al. (2017); Dahler-Larsen et al. (2020) point to major benefits of effective psychosocial risk management. Under them, supporting systems of psychosocial prevention activities is likely to effectively improve overall psychosocial performance in European countries. One way to improve the level of OSH risk management is through the application of an occupational health and safety management system (OSHMS) according to ISO 45001:2018 Occupational health and safety management

systems – Requirements with guidance for use. The basic principle of the standard is the identification of all possible risks in workplaces and their effective management to minimise possible damage to the health of employees and the associated consequences. The standard provides a framework to prevent workplace accidents and worker ill health to improve and provide a safe and healthy workplace. According to several authors e.g. Felknor et al. (2021); Klimova et al. (2017), continuous improvement of OSH levels using risk management results in reduced losses, higher productivity, efficiency, and quality of work, which in turn affects the overall performance of the enterprise and especially the safety of employees. A properly implemented OSHMS helps in risk management, which can be used by businesses to improve the safety and health of their workplaces and increase the efficiency and competitiveness of their business. According to Matkovcik (2017), well-applied workplace risk management can protect employees and reduce the risks associated with their work. Bibire et al. (2020) also point out the importance of effective application of risk management as a factor in the prevention of negative OSH incidents.

Environmental management system (EMS), according to Bissacot et al. (2016), can be understood as a planned and coordinated set of all management activities, procedures, documentation aimed at environmental protection. Its main task is the prevention of negative impacts on the environment with the support of activities aimed at preserving or enhancing the quality of the environment (Zelenko et al. 2019). According to several authors e.g. Vodolazhskaya et al. (2019); Breitenstein et al. (2021), the environmental management system should be an integral part of the overall management system aimed at the gradual elimination of negatively impacting activities and products on the human environment. De Oliveira et al. (2019) points out that the objective of environmental compliance management is to ensure corporate compliance with given environmental regulations. Awareness of events that can cause a negative compliance status is a key factor in successful environmental compliance management. Risk management in EMS is understood as a complex system of considerations and analyses that use the results of individual risk management steps together with political, economic, and social formations to generate decisions on corrective actions to reduce a particular environmental risk (Aizaga et al. 2016). According to Algheriani et al. (2019), this is a systematic process that aims to control risks that could endanger the environment. Environmental risks in an enterprise are a direct characteristic of economic activities; therefore, it is necessary to organise a system for managing these risks in the enterprise. Risk can also be defined as a part of activities or products or services that is or can be related to the environment (Aizaga et al. 2016). Risks by their nature may have a direct or indirect or cumulative impact on the enterprise. The relationship between environmental aspects and environmental impacts is that of cause and effect (Weber 2006). Frolenkova et al (2022), Zelenko et al. 2019 defines environmental risk as the relationship between the expected loss (damage to health, loss of life, loss of property in certain specific circumstances) and the uncertainty of the loss under consideration, usually expressed in terms of probability or frequency of occurrence. The ISO 14001:2015 Environmental Management System (Requirements with Guidance for Use) standard is used by enterprises to apply EMS, which is based on the concept of risk-based thinking. The standard defines environmental requirements as needs or expectations that are stated, generally assumed or mandatory. Thimm (2015) proposes a risk management approach based on an information system for corporate environmental compliance management. He emphasizes a risk estimation method that aggregates all identified risks into a risk profile. Several authors point to the increased need to pay attention to environmental risks, e.g. Krokhina et al. (2018) identify the main factors (technological, economic, etc.) that affect the environmental risk of industrial enterprises. They also present a model of a two-level environmental risk management system aimed at complete control of the environmental risk of the enterprise. Yan (2022) highlights the countermeasures of pollution management, describing the relationship between pollution risk perception and pollution management. According to him, it is necessary to let the enterprise take responsibility for pollution management. Vodolazhskaya et al. (2019) paid attention to the identification of the sources of environmental risks of industrial enterprises and the development of new management mechanisms that can prevent the threats of their occurrence. They revealed the weaknesses of controlling the conditions of an industrial enterprise, which determine the adoption of preventive management decisions. De Villiers et al. (2022) and Darus (2016) found that the presence of board committees dedicated to risk management is associated with better environmental performance of the enterprise. The benefits of risk management committees should also extend to non-financial issues such as environmental performance. Kosyakova et al. (2019) also point out the need for the implementation of an environmental risk strategy in an industrial enterprise. They propose a new classification of environmental risk factors, taking into account the nature of the impact of the risk on the industrial enterprise, the degree of occurrence of the risk and the possibilities of its management. They reveal the need to develop a risk management system that minimises and reduces environmental damage and the economic costs caused by it. According to Kas'yanov et al. (2018), risk prevention or risk reduction should take into account not only quantitative, but also qualitative characteristics of risk, which are caused by various factors and mechanisms of environmental risk perception. Identified priorities in the public interest in the state of the environment should be taken into account in the preparation of the necessary environmental measures.

3 AIM, data collection, and statistical methods

The paper aims to assess and evaluate the perceived changes (differences) in the approach of managers to risks in management systems (quality – QMS, OSH – OSHMS, and environment – EMS) and changes in the investment of financial resources for the implementation of preventive measures to reduce risks before and after crises (e.g. Covid-19 pandemic, energy crisis) in small, medium and large industrial enterprises in Slovakia.

Data collection and structure of respondents

The present study consists of empirical research made up of two surveys, i.e. the first in 2020 before the crisis period (No. 1) and the second in 2022 after the crisis period (No. 2), through questionnaires, primarily intended for business executives, quality managers, health and safety managers, environmental managers, process managers, distributed to small, medium and large industrial enterprises in Slovakia.

The first survey was carried out in the 2020s before the outbreak of the aftermath of the Covid-19 pandemic and the energy crisis. An inquiry method with an online electronic questionnaire - Google questionnaire - was used to collect data. The questionnaire was created on the basis of a baseline analysis of the problem addressed as well as subtasks of individual projects solved at Faculty of Security Engineering, University of Zilina (FSE UNIZA).A wide range of owners and managers of small, medium and large industrial enterprises operating in Slovakia participated in the survey. The survey was carried out with the assistance of the National Business Centre (NBC) in Slovakia, which is covered by the Ministry of Economy of the Slovak Republic. The statistical dataset was identified on the basis of data provided by the Statistical Office of the Slovak Republic within the database - Industry Yearbook Slovakia 2020. Taking into account the statistical representative sample size created (Margin of error 4%, Confidence level 95%), despite the small sample size, the survey can be considered representative. A total of 662 enterprises participated in the survey. The sample size consisted of 51.1% small enterprises (11 to 50 employees), 34.8% medium enterprises (50 to 250 employees), 14% large enterprises (over 250 employees). The survey covered industrial enterprises operating in the following sectors: 8.7% energy sector, 4% machinery sector, 5.3% chemical and rubber sector, 9.6% electronic and electrical sector, 21.6% metalworking

sector, 9.6% woodworking sector, 10.7% food sector, 8% textile sector, 12.6% other.

The second survey was conducted in 2022 (No. 2) after the effects of the Covid-19 pandemic and the energy crisis on businesses in Slovakia. Telephone interviewing method (CATI) and inquiry method with the form of the online electronic questionnaire - Google questionnaire were also used for data collection. A wide range of owners and senior managers of small, medium and large industrial enterprises operating in Slovakia participated in the survey. The survey was conducted with the help of Median Ltd., which is one of the leading research agencies with a long tradition in the field of market research, media and public opinion in Slovakia. Based on the data collection, a representative sample size was created (Margin of error 4%, Confidence level 95%), despite the small sample size, the survey can be considered representative. A total of **662** enterprises participated in the survey. The sample size was made up of 56% small enterprises (11 to 50 employees), 32% medium enterprises (50 to 250 employees), 12% large enterprises (over 250 employees). In terms of industry representation: 3% energy industry, 4% machinery industry, 4% chemical and rubber industry, 3% electronic and electrical industry, 44% metalworking industry, 16% woodworking industry, 8% food industry, 8% textile industry, 10% other.

Questionnaire and variables

In both the first and second surveys, the survey was addressed to owners, managing directors, senior managers and responsible managers for QMS, OSHMS, and EMS of industrial enterprises. All groups of respondents were represented according to demographic characteristics compared to the relative size of enterprises in the business environment at the national level. The questionnaire was developed on the basis of a baseline analysis of the issues addressed as well as sub-tasks of single-question projects addressed at FSE UNIZA. The questionnaire consisted of three parts i.e. the first part described the demographic data of the respondent, the second part focused on the research questions related to the issue under study and the third part focused on additional research questions.

Statistical hypothesis and statistical methods

Given the issues, it was necessary to establish null hypotheses (H0). Null hypotheses are crucial in statistical analyses because they provide a formal framework for testing claims objectively and accurately. They serve as a starting point for comparisons, assuming that there is no effect or difference between the groups or variables under study. This structured approach allows for systematic data collection and analysis, which is essential for reliable scientific conclusions. Null hypotheses help to minimize Type I and Type II errors, thereby allowing for controlling the level of significance and guiding statistical decision making. They are the basis for inference and generalization, support scientific testing of theories and hypotheses, and provide a framework for interpreting and communicating results. In this way, they contribute to accuracy, objectivity and research. Rejection of the null hypothesis indicates that the observed difference or relationship is statistically significant. This means that such a result is unlikely to be due to chance. Statistical significance was assessed using p-value; if the p-value is less than the set significance level of α=0.05, we reject the null hypothesis and accept the H1 hypothesis. We then examined the strength of the dependence using Cramer's V. Cramer's V is a statistical indicator used to measure the strength of association between two nominal (categorical) variables, providing a standardized measure of dependence that ranges from 0 (no dependence) to 1 (complete dependence). Its calculation includes the value of the chi-squared statistic, the total number of observations, and the smaller of the number of rows or columns in the contingency table. When examining dependence, we begin by obtaining data for two nominal variables, arranging them in a contingency table, and conducting a chi-square test for statistical significance. If the result is significant, we calculate Cramer's V, which allows us to determine the strength of the relationship. Cramer's V values close to 0 indicate a weak dependence, while values close to 1 indicate a strong dependence. This indicator thus provides a clearer picture of the relationships in the data, thus contributing to a better understanding of statistical dependence.

The null hypotheses focused on the priority of risks and the size of the enterprise that takes them. These hypotheses were examined separately for the survey conducted in 2020 and for the survey conducted in 2022 to observe if there were any changes in priorities.

1. H0: There is no dependency between the size of the companies from the 2020 survey and the priority of risks in the quality management system.
2. H0: There is no dependency between the size of enterprises from the survey in 2020 and the priority of risks in the HSE management system.
3. H0: There is no dependence between the size of enterprises from the survey in 2020 and the priority of risks in the environmental management system.
4. H0: There is no dependence between the size of enterprises from the survey in 2022 and the priority of risks in the quality management system.
5. H0: There is no dependence between the size of enterprises from the survey in 2022 and the priority of risks in the OSH management system.
6. H0: There is no dependence between the size of enterprises from the survey in 2022 and the priority of risks in the environmental management system.

We also focused on some of the indicators from the survey where we examined the minimum, maximum, median, mode, mean, direction, variance, and selection variance. We compared these results between the 2020 survey and the survey conducted in 2022.

4 Empirical results

The processed results were divided into the following sections:

1. Assessment of changes in perceptions, managers' attitudes towards risks in management systems in industrial enterprises in Slovakia

In Survey 1 (2020), when focusing on the priority of risks in QMS, option 1 was the most frequently indicated option for all sizes of enterprises, which meant the highest priority. However, in the next survey 2 (2022), across all enterprise sizes, the most commonly assigned option was numbered 3 which meant lowest priority – there has been a change.

When focusing on the priority of risks in the OSHMS in Survey 1 (2020), the options assigned were fairly even across all sizes of businesses. However, in Survey 2 (2022) the following year, 2022, for the same risk category, the largest proportion of options identified across all business sizes were numbered 1 as the highest priority – there has been a change.

When focusing on the priority of risks in the EMS, in Survey 1 (2020), for all sizes, the most frequently assigned option was numbered 2. In the next Survey 2 (2022), for small businesses, the most frequently assigned option was numbered 3. When focusing on medium and large enterprises, there was a significant decrease in the number of responses marked with option 1 and a significant increase in the number of responses marked with option 3.

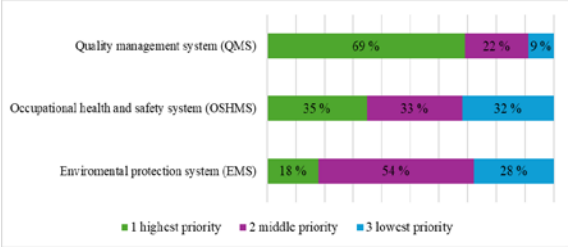

Figure 1. Percentage of perceived risks in QMS, OSHMS, EMS by owners and managers of enterprises in Slovakia in **2020**

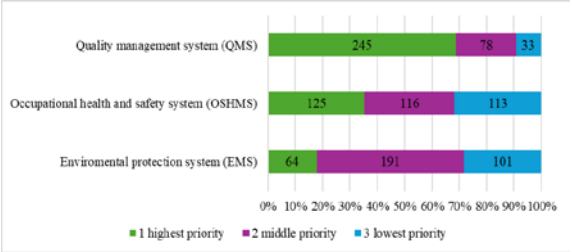

Figure 2 Percentage of perceived risks in QMS, OSHMS, EMS by owners and managers of enterprises in Slovakia in 2022

Table 1. Exploring the relationship between firm size and risk priority in QMS, OSHMS, EMS

Year 2021						
	Allocated weight	Small enterprises (%)	Medium-sized enterprises (%)	Large enterprises (%)	chi-square statistic	p-value *
Risk Priority – QMS	1	70.9	67.7	64	5.8	0.2146
	2	22	23.4	18		
	3	7.1	8.9	18		
Risk Priority – OSHMS	1	34.1	36.3	36	1.61	0.807
	2	31.3	35.5	30		
	3	34.6	28.2	34		
Risk Priority – EMS	1	19.2	13.7	24	3.02	0.5545
	2	53.3	55.6	50		
	3	27.5	30.6	26		
Year 2022						
	Allocated weight	Small enterprises (%)	Medium-sized enterprises (%)	Large enterprises (%)	chi-square statistic	p-value *
Risk Priority – QMS	1	22.9	23.2	32.4	2.38	0.6662
	2	32.4	30.3	21.6		
	3	44.7	46.5	45.9		
Risk Priority – OSHMS	1	63.5	67.7	64.9	8.08	0.0887
	2	31.2	18.2	27		
	3	5.3	12.1	8.1		
Risk Priority – EMS	1	13.5	7.1	2.7	9.8	0.0439
	2	36.5	51.5	51.4		
	3	50	41.4	45.9		

* test $p < 0.05$

Table 1 shows an examination of the relationship between firm size and risk priority. In testing this relationship, we use statistical methods that allow us to determine whether there is a significant relationship between the two variables. If the resulting p-value is less than 0.05, we reject the null hypothesis (H0), which states that there is no relationship between firm size and risk priority. Thus, we accept the alternative hypothesis (H1), which suggests that there is a statistically significant relationship between the variables under study. At the significance level of $\alpha = 0.05$, we reject only one null hypothesis for the survey years 2020 and 2022. The rejected null hypothesis was number 6 H0: There is no dependence between the size of the enterprises from the 2022 survey and the risk priority in EMS. Therefore, we accept the hypothesis H1: There is a dependence between the size of the enterprises from the survey in 2022 and the priority of risks in EMS. Consequently, the strength of the dependence was therefore investigated in this case using Cramer's V. Cramer's V is a statistical indicator that is used to measure the strength of association between two nominal variables such as the size of enterprises and the priority of risks in the environmental management system. Its calculation involves the value of the chi-squared statistic from a contingency table that shows the distribution of data between these variables, and the result in this case was V = 0.1265. This means that there is a very weak relationship between the size of the companies from the 2022 survey and the priority of risks in EMS.

Focusing on the strength of priority, with number 1 being the highest priority and number 3 the lowest, there were interesting year-on-year changes that were found for all businesses regardless of size. Enterprises changed their preferences between risk priorities, but even so, only the last null hypothesis was rejected across risk size and risk priority.

2. Assessment of changes in the approach of business managers to the implemented preventive measures in enterprises in Slovakia

We have classified firm size as a nominal variable in the analysis as this category of firm represents qualitative data without numerical meaning. However, we focused on the average amount of money spent on preventive measures and the expected amount of money planned to be spent on preventive measures in the future, which are cardinal variables. Firm size is a nominal variable, average finance and planned expenditure on preventive measures are quantitative in nature and therefore we analyzed them as cardinal data.

We focused on some important statistical indicators from the survey, which included minimum, maximum, median, mode, mean, standard deviation, and sampling variance. These indicators play a key role in analyzing the distribution and variability in the survey data between 2020 and 2022. The minimum and maximum denote the smallest and largest values in the dataset, while the median represents the middle value that divides the data in half. The modus represents the value with the highest frequency in the dataset, while the mean is the arithmetic average of all values. Standard deviation measures the dispersion of the data from the mean, which provides information about its diversity, while sampling variance can provide additional insight into the variability of the data. Comparing these indicators between 2020 and 2022 helps us to identify changes in the distribution and nature of the data over time, which is key to understanding the dynamics and evolution of the variables of interest in the context of the phenomenon under study. Such analyses provide businesses with important information on which they can form strategies and decision-making processes based on empirical data.

Table 2. Percentage of annual turnover **spent** on the implementation of preventive measures

	Year 2020			Year 2022		
	Small enterprises	Medium-sized enterprises	Large enterprises	Small enterprises	Medium-sized enterprises	Large enterprises
Minimum	0	0	0	0	0	0
Maximum	10	15	5	35	30	30
Median	0.15	0.15	0.32	3	4	2
Modus	0	0	0	2	2	1
Average	0.54	0.6	0.78	4,82	6,74	5.03
Directional deviation	1.24	1.72	1.15	5.53	6.74	6.39
Selection variance	1.56	2.99	1.35	30.81	45.85	41.92

A comparison of the statistical characteristics between 2020 and 2022 for small, medium and large enterprises reveals significant changes in their distribution and variability. In 2020, we observe values for all categories of enterprises at lower levels. Conversely, in 2022 these values increase significantly. Focusing on the average in 2020, small, medium and large enterprises spent 0.54%, 0.6 and 78% of their annual turnover respectively on implementing preventive measures. However, in the next survey, these figures averaged 4.82%, 6.74% and 5.03% of annual turnover for small, medium-sized and large enterprises respectively on the implementation of preventive measures.

3. Assessment of changes in the approach of business managers to planned preventive measures in enterprises in Slovakia

We applied the same procedure in this section, where we examined year-on-year differences, focusing on the amount of

annual turnover they plan to spend in the future on the implementation of preventive measures.

Table 3. Percentage of annual turnover planned to be spent in the future on the implementation of preventive measures

	Year 2020			Year 2022		
	Small enterprises	Medium-sized enterprises	Large enterprises	Small enterprises	Medium-sized enterprises	Large enterprises
Minimum	0	0	0	0	0	0
Maximum	20	23	5	25	35	30
Median	0.75	0.85	0.80	3	5	3
Modus	0	0	0	0	2	1
Average	1.15	1.33	1.24	4.89	7.19	5.95
Directional deviation	2.16	2.51	1.35	5.29	7.13	7.14
Selection variance	4.67	6.33	1.86	28.12	51.30	52.33

The results in Table 3 show that a comparison of the percentage of annual turnover planned to be spent on implementing preventive measures between 2020 and 2022 shows significant changes in the strategies of companies, which vary according to their size. In 2020, on average, small enterprises allocated 1.15% of their annual turnover to preventive measures, medium-sized enterprises 1.33% and large enterprises 1.24%. In contrast, by 2022 these percentages have increased significantly: small businesses plan to spend on average 4.89%, medium-sized businesses 7.19% and large businesses 5.95% of their annual turnover on preventive measures.

5 Discussion and evaluation of the results

Within the framework of the conducted research it was found that managers whether in small, medium, large industrial enterprises before the occurrence of crises placed a higher priority on the risks in the quality management system, then on the risks in the environmental management system and then on the OSHMS. Their attitudes and risk perceptions have changed due to the impact of crises (Covid-19 pandemic, energy crisis). The aftermath of the crises influenced their attitude towards risks and they started to give more priority to the risks of the OSH management system, whether it was all types of risks. Risks in the quality management system were perceived as the second priority by the small enterprise, followed by risks in the environmental management system. The medium and large enterprise gave second priority to risks in the environmental management system, followed by risks in the quality management system.

The above results can be confirmed by authors who address QMS risks either before or after the crisis period, e.g., Grimashevich et al. (2019); Katanaeva et al. (2020), who emphasize the importance and relevance of continuously identifying risks in QMS even with the acceptance of ISO 9001 focused on risk-oriented thinking. Zhang et al. (2022) emphasise the need for establishing a regular QMS risk inventory and the use of different models and approaches to streamline it in an industrial enterprise. From the perspective of the OSHMS, it is not only important to comply with legal obligations but also to implement the OSHMS, ensuring the monitoring and control of the assessed risks of individual processes. It is declared by Bibire et al. (2020); Ramos et al. (2015) that, risk management should be part of OSHMS and emphasis should be placed on its development, integration and implementation of OSH policy and risk management. Felknor et al. (2021); Levashov et al. (2018); Klimova et al. (2017) emphasize that the continuous improvement of OSH with the integration of risk management results in the reduction of losses, occupational hazards, accidents, incidents, crashes, higher productivity, efficiency and quality of work, which affects the overall performance of the enterprise and especially the safety of employees. Also from the point of view of environmental protection, it is important not only to fulfil legal obligations but also to introduce QMS. Environmental protection increasingly requires attention, the importance of finding solutions and managing risks in the near future. The authors Yan (2022); Vodolazhskaya et al (2019); De Villiers et al (2022); Darus (2016) state that the environmental risk assessment of an industrial enterprise is very important, also the creation of committees in the board of directors with an orientation towards EMS risk management. They are inclined to the view that there is a need for companies to take responsibility for managing environmental pollution and as evidenced by the forthcoming revision of ISO 9001 with a climate change orientation.

Other findings in the research conducted were that managers whether in small, medium, large industrial enterprises before the occurrence of crises actually invested some financial resources on preventive measures that would reduce the probability and consequences of the assessed risks. Before the crisis period, a small enterprise was willing to invest 0.54%, a medium enterprise 0.6%, a large enterprise 0.78% of annual turnover. The consequences of the crises affected their attitude to risks and there was a radical change in the increase in the amount of funds invested, with a total increase of up to 764%. Small enterprises were willing to invest 4.82%, medium enterprises 6.74%, large enterprises 5.03% of annual turnover.

As part of the research, the findings included not only the actual status of the funds invested in preventive measures, but also the amount of funds planned for the coming years. Managers whether in small, medium, large industrial enterprises before the crises occurred had plans to invest funds for preventive measures that would reduce the probability and consequences of the assessed risks. Before the crisis period, a small enterprise was willing to increase the amount of investment in preventive measures to 1.15%, a medium enterprise 1.33%, a large enterprise 1.24% of annual turnover. The aftermath of the crises affected their attitude and there was also a radical change in terms of the amount of investment of funds for the future, with an overall increase of 384.68%. Small enterprise was willing to invest 4.89%, medium enterprise 7.19%, large enterprise 5.95% of annual turnover. Comparing the change in the perception of managers before the crisis period in terms of actual reported and planned funds for preventive measures there was an increase of 93.75%, after the crisis it was only an increase of 8.68%.

In the current business management, the importance of prevention with emphasis on risk management in QMS, OSHMS, EMS is constantly increasing and its activities significantly determine the success of the enterprise. This is declared by several authors e.g. Katanaeva et al. (2020); Akwei et al. (2018); Levashov et al. (2018), Ramos et al. (2015); Thimm, (2015); Krokhina et al. (2018); Vodolazhskaya et al. (2019), that proper application provides enterprises with a comprehensive and holistic view of the critical factors affecting product quality, as well as worker and consumer safety, environmental protection, and contributes to the streamlining of key internal enterprise processes. According to the authors Montoya-Quintero et al. (2022), Rebelo et al. (2016), Kafel (2016), risk management should be an integral part of the management of an enterprise enabling better coordination and collaboration between different departments and levels of the organization. Especially in the planning function, which is related to the trend towards prevention-oriented, early identification of risks and translates risk potential into possible scenarios of development. A good event analysis can help pave the way for proper risk management in the areas of quality improvement, safety with emphasis on environmental protection in the enterprise. Risk management becomes a prerequisite for increasing the success of the implemented business activities of the organization in terms of safety and sustainable development. The basis should be the correct approach of owners, top managers to risks, the creation of a risk culture and the established responsibility of managers for risk management in the management systems QMS, OSHMS, EMS and emphasis on the need to invest funds for the application of preventive measures.

6 Conclusion

The article highlights the fact that quality, OSH, environmental protection are nowadays, with the growing global business trends, considered as the most important management systems in connection with risk management in the enterprise. Every enterprise is affected by negative threats of the business environment, which is evidenced by changes in the perception of risks and attitudes towards preventive measures by managers also in industrial enterprises in Slovakia. The main findings presented in the paper can be summarized as follows: there are differences in the attitudes and risk perceptions of managers of QMS, OSHMS, EMS systems before and after the period of crises. Managers whether in small, medium, large industrial enterprises before the emergence of the crisis put more priority on risks in QMS. The aftermath of the crises influenced their attitude towards risks and they started to give more priority to OSHMS risks. Also, the aftermath of the crises has affected their attitude towards risks and there has been a radical change in the amount of money invested to implement preventive measures. There has been a change in attitude, albeit to a lesser extent in the increase of planned funds for the implementation of preventive measures in the future. On the basis of the processed results, it can be stated that some enterprises in Slovakia have learnt from the consequences of the crises. The question is to what extent they will continue to invest funds in preventive measures. Some enterprises in Slovakia still do not pay the necessary attention to risks, they only deal with the consequences caused by crises, despite knowing how highly the importance of crisis preparedness is rated.

The presented results have enormous added value as a “best practice” for owners, managing directors, senior managers and responsible managers of QMS, OSHMS, EMS industrial enterprises. The benefit to businesses is that if risk management is incorporated into the QMS, OSHMS, EMS of an enterprise, the likelihood of achieving the organisation's objectives will increase, compliance of individual outputs will be achieved, customers will be more confident that they will receive the expected product, the number of workplace accidents will be reduced, and employees will feel that they are working in a safe and healthy workplace improving the reputation of the enterprise. Properly applied, QMS, OSHMS, EMS in conjunction with risk management helps to achieve specified product quality, workplace safety and enhanced environmental protection. This contributes to increasing the efficiency of production and business processes, improving the bottom line and achieving sustainable business development. The results can form a treasure for the creation of national and supranational rules, guidelines, documents dealing with the prevention of corporate crises, risk management in QMS, OSHMS, EMS. The results can also serve for educational institutions oriented to the improvement of managerial qualification.

The processed results represent limiting characteristics, i.e. the set objective, hypotheses processed survey results are oriented only on QMS, OSHMS, EMS in industrial enterprises in Slovakia. The scientific article does not analyze other management systems such as information security system, socially responsible business system. The survey was oriented only on industrial enterprises, it did not assess service enterprises. As it was a challenging assessment of the development of managers' perception of attitudes towards risks and preventive measures in 2020 and 2022-23, the results are processed only at the national level, i.e. within Slovakia.

The results are also baseline data for the implementation of further surveys, i.e. the continuation of the development of attitudes and risk perception of business managers in Slovakia as well as in the Visegrad Four (V4) countries or in other European countries. Further direction of the authors' research lies in linking the normative requirements of management systems and the obligations arising from laws, especially for OSH and the environment, with an emphasis on the Compliance Management System. The authors are also interested in contributing to the development of the concept of risk culture for more effective risk enforcement in the company as well as to the comparison of the results obtained in Slovakia in comparison with the V4 countries.

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Appendix A: Questionnaire - Integrated risk management

Question - Your company ranks according to the number of employees among:

- Small enterprises (from 11 to 50 employees)
- Medium-sized enterprises (50 to 250 employees)
- Large enterprises (over 250 employees)

Question - In which industry does your business operate?

- Energy sector
- Engineering sector
- Chemical and rubber industry
- Electronic and electrical engineering sector
- Metalworking industry
- Woodworking industry
- Food processing industry
- Other

Question - Which risks in the above management systems do you give the highest priority to reduce? (please rank 1-3, where 1 is the highest priority, 3 is the lowest priority)

- Quality management system
- Occupational health and safety system
- Environmental protection system

Question - What % of funds from annual turnover do you invest on average for the implementation of preventive measures in your company (current situation)?

Question - What % of the financial budget do you plan to invest for the implementation of preventive measures in your enterprise (plan)?

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