

**Athens Institute for Education and Research
ATINER**



**ATINER's Conference Paper Series
CBC2024-2755**

**Development and Application of a Methodology
for Analyzing Costs of Ensuring Safe Work in
High-Risk Industries in the Republic of
Kazakhstan: Theoretical and Practical Aspects**

**Inara E. Sarybayeva
PhD student/Senior Researcher
L.N. Gumilyov Eurasian National University
Republic of Kazakhstan**

**Gulnara D. Amanova
Head of the Department «Accounting and Analysis»
L.N. Gumilyov Eurasian National University
Republic of Kazakhstan**

An Introduction to
ATINER's Conference Paper Series

Conference papers are research/policy papers written and presented by academics at one of ATINER's academic events. ATINER's association started to publish this conference paper series in 2012. All published conference papers go through an initial peer review aiming at disseminating and improving the ideas expressed in each work. Authors welcome comments.

Dr. Gregory T. Papanikos
President
Athens Institute for Education and Research

This paper should be cited as follows:

Inara E. Sarybayeva, I.E, Amanova, G.U. (2024). "Development and Application of a Methodology for Analyzing Costs of Ensuring Safe Work in High-Risk Industries in the Republic of Kazakhstan: Theoretical and Practical Aspects". Athens: ATINER's Conference Paper Series, No: CBC2024-2755.

Athens Institute for Education and Research
9 Chalkokondili Street, 10677 Athens, Greece
Tel: + 30 210 3634210 Fax: + 30 210 3634209 Email: info@atiner.gr URL:
www.atiner.gr
URL Conference Papers Series: www.atiner.gr/papers.htm
ISSN: 2241-2891
15/02/2024

Development and Application of a Methodology for Analyzing Costs of Ensuring Safe Work in High-Risk Industries in the Republic of Kazakhstan: Theoretical and Practical Aspects

Inara E. Sarybayeva
Gulnara D. Amanova

This scientific article presents a study focused on the development and application of a methodology for analyzing costs of ensuring safe work in high-risk industries. The article examines the theoretical and practical aspects of this methodology, emphasizing their significance and applicability in various industries with high levels of occupational risk. The presented theoretical foundations and practical recommendations for the application of the methodology for analyzing costs of ensuring safe work will enable organizations in high-risk industries to make informed decisions and optimize their budgets, with the aim of enhancing workplace safety and reducing the likelihood of occupational injuries. This study holds practical significance and can serve as a basis for further research and development in the field of occupational safety in high-risk industries. The objective of this research study is to develop and apply a methodology for analyzing costs of ensuring safe work in high-risk industries with a high incidence of occupational injuries. The methodology employed in this study involves a systematic analysis of key cost factors associated with occupational safety, including equipment procurement and maintenance, training and education programs, and preventive measures to mitigate and respond to workplace injuries. The development of relevant tools and models for evaluating cost-effectiveness and optimizing safety expenditures in these industries is also considered.

Keywords: *occupational safety and health, costs, cost accounting, occupational injuries, occupational risk*

Introduction

At the current stage of the development of occupational health and safety in Kazakhstan, there is an urgent need for improvement in the processes of reporting, monitoring, and analyzing the Occupational Health and Safety Management System (OHSMS), abbreviated as OHSMS. However, the measures taken in the country to update the legislative and regulatory framework have proven to be insufficiently effective. Currently, there is a noticeable increase in the number of fatal workplace injuries and incidents with serious consequences. In light of these circumstances, it is crucial to take additional measures to improve the situation in the field of occupational health and safety and ensure the safety of working conditions.

Safety and occupational health issues at enterprises can be addressed through several possible solutions. One approach is the development and implementation of new equipment and technology, personnel training, updating normative-methodological documents, and promoting occupational health and safety. However, implementing these measures involves certain resource Costs, and now enterprises are responsible for seeking financing for occupational health and safety measures.

In the past, the state bore the main economic burden of occupational health and safety, but currently, the responsibility for this has entirely shifted to enterprises. However, not all enterprises were prepared for such a changed situation, both from a moral and an economic standpoint. Only a few of the enterprise managers realize that expenditures on occupational health and safety should be seen as essential investments to ensure production efficiency.

Regrettably, many enterprises fail to consider the costs of occupational health and safety in their performance analysis and do not evaluate the effectiveness of these expenditures.

The context of digitalization across various industries, it is crucial to automate the labor-intensive process of accounting for and analyzing occupational health and safety Costs. This will enable enterprises to more accurately determine costs, analyze their effectiveness, and make informed decisions in the field of occupational health and safety, contributing to improving working conditions and enhancing production efficiency.

Literature Review

In the Literature Review section, we present an overview of contemporary Kazakhstani literature addressing the economics of occupational health and safety. Although materials specifically focused on this topic are relatively scarce within Kazakhstan, internationally, significant strides have been made in the development and implementation of methods for analyzing costs within the realm of health and safety at work. Notably, the research efforts of scholars such as Thompa E., Feng Y., Rohani Z., Zeparkson P., Ibarondo-Davilia M., Lopez-Alonso M., Jung S., Kim K., Akchay K., Yilmaz M., Tutunchian S., Riana-Kasallias M., Nagata T.,

Guido J.M., among others, have contributed extensively to the analysis and evaluation of various cost components associated with occupational health and safety. These components include the examination of accident-related costs, both direct and indirect costs, uninsured risks, costs borne by insurers, and the application of mathematical modeling techniques to assess costs within this domain. In this section, we synthesize the conclusions drawn from the studies conducted by these researchers, providing insights into the current state of knowledge and identifying avenues for future research.

Methodology

The study was meticulously crafted to ensure a rigorous and comprehensive analysis of organizational issues pertaining to occupational health and safety. The study was grounded in the formal-logical approach, which served as a foundational framework for our research. This approach is widely recognized for its versatility and effectiveness in analyzing complex organizational phenomena.

In addition to the formal-logical approach, we integrated specialized methods such as the systemic-structural approach and functional analysis of occupational health and safety tools within the management system. These methodological tools were carefully selected to provide a multifaceted examination of occupational health and safety issues, allowing us to delve deeply into the intricacies of organizational dynamics.

The systemic-structural approach facilitated the exploration of interrelationships and dependencies within the organizational framework, enabling us to identify key factors influencing occupational health and safety outcomes. Meanwhile, the functional analysis of occupational health and safety tools within the management system enabled us to evaluate the efficacy of existing safety protocols and procedures, as well as propose enhancements for ensuring safer working conditions. By combining these methodological approaches, we aimed to achieve a more profound understanding of occupational health and safety issues and to develop actionable insights for fostering a culture of safety within the organization. Through rigorous analysis and systematic evaluation, our methodology sought to contribute valuable knowledge to the field of occupational health and safety management.

Research Results and Discussion

All occupational health and safety Costs can be divided into several major groups: expenditures on specialized job assessments, Costs on medical examinations, costs for purchasing personal protective equipment, and training Costs. Additionally, there are Costs related to measures to improve working conditions and occupational health, costs for compensating work in hazardous and dangerous conditions, and contributions to mandatory social insurance for occupational accidents and occupational diseases.

Investments in occupational health and safety in the form of current Costs can yield significant benefits over time, which can be recouped within a relatively short period.

Budgets are prepared for specific periods and represent a financial plan considering current and prospective goals and objectives of the enterprise. They should be based on the allocation of Costs.

Among a series of works describing the principles of forming Costs for ensuring safe work, we can highlight the study, which provides a detailed description and justification of seven principles: priority, cost-effectiveness, stimulation and motivation, social and public-private partnership in the field of occupational health and safety, minimizing the "human factor," and professional development.

The conducted analysis revealed 4 general principles of forming Costs for ensuring safe work (according to the Budget Code of the Republic of Kazakhstan):

- the principle of justification and recognition of Costs for ensuring safe work. Costs must be justified and incurred within the scope of occupational health and safety activities. The Costs related to ensuring safe work include costs associated with meeting the established safety and occupational health requirements, as well as enhancing workplace safety. Costs related to the absence of workplace safety, including payments for accidents, are also covered;
- the principle of effectiveness and economic efficiency. Costs should be directed towards achieving the results outlined in the occupational health and safety policies and/or programs, as reflected in the Action Plan for reducing occupational risks, while ensuring the highest economic efficiency with minimum costs and limited resources.;
- the principle of responsibility and regulatory compliance. Costs should be determined considering compliance with the norms of legislation and established limits for expenditures by multiplying the normative by quantitative indicators;
- the principle of functionality and target measurability. Costs should have a functional purpose, be capable of separate measurement, and ensure comparability of data.

The mentioned principles are fundamental in the process of forming the budget for occupational health and safety.

The analysis of occupational health and safety Costs requires the consideration of various factors, such as reducing benefits for unsatisfactory working conditions, preventing accidents and occupational diseases, as well as decreasing employee turnover and other indicators.

The majority of financial resources are allocated for the implementation of occupational health and safety measures, while only a small portion of the funds is used for compensation and reimbursement of damages related to working in unfavorable conditions, accidents, occupational diseases, and emergencies.

To assess the potential savings that can be achieved through improving occupational health and safety conditions, it is necessary to conduct an analysis of costs and Costs in this field. Among the key indicators of costs and Costs, the following can be highlighted:

1. Costs for occupational health and safety measures necessary to comply with legislatively established normative requirements.
2. Expenditures for compensations for work in hazardous and dangerous conditions that arise when it is not possible to completely eliminate hazards.
3. Payment of insurance contributions for mandatory social insurance against industrial accidents and occupational diseases.
4. Costs related to accidents, occupational diseases, and emergencies that cannot be fully covered by insurance payments.
5. Fines and payments related to the breach of contractual obligations and other Costs associated with it.

Conducting such an analysis will allow evaluating the degree of economic efficiency and exploring prospects for additional investments in the field of occupational health and safety from the perspective of the enterprise or organization. Therefore, cost management and the assessment of socio-economic effectiveness are key components for successful occupational health management and achieving positive outcomes at the enterprise.

Measurement of Costs related to workplace accidents is a mandatory element in cost management within the Occupational Health and Safety Management System (OHSMS). From a financial perspective, employers are interested in improving the situation in this area by considering economic, variable, direct, and internal Costs.

Economic and non-monetizable Costs. Non-monetizable Costs include the physical suffering of the injured party and the emotional stress experienced by their family. During legal proceedings, attempts are made to give them a monetary evaluation when assessing the degree of harm. However, this can only be an approximate attempt since it is impossible to determine the damage that cannot be compensated with money.

Indeed, economic losses are those that can be specifically measured. These are losses associated with tangible objects or services that have a definite market value or can be roughly assessed by a qualified specialist. Economic losses encompass the financial Costs of the worker and their family, losses incurred by the enterprise, as well as losses for society as a whole.

Direct and indirect Costs. Increasing insurance premiums, Costs for legal settlement, and equipment restoration are typically typical examples of direct Costs at the organizational level. Possible examples of indirect Costs (Costs that do exist but are not calculated for various reasons) may include the following:

- Disruption of the production process immediately after the accident.
- Moral impact on colleagues at work, leading to reduced productivity.
- Involvement of personnel in the accident investigation process.

- Costs for hiring and training new employees.
- Decreased quality and productivity of work due to inexperience of newly hired staff.
- Damage to equipment and materials (if not accounted for within regular accounting procedures).
- Reduced product quality after the accident.
- Decreased productivity of injured workers transferred to lighter duties.
- Costs for maintaining reserve capacity to cover losses associated with accidents.

The ratio of indirect to direct Costs varies from less than 1:1 to more than 20:1, depending on the industry and calculation methodology. Therefore, obtaining information about these Costs can serve as a significant incentive for addressing the situation and making necessary improvements.

Internal and external costs play a significant role in the field of occupational health and safety. The existence of external costs sets a boundary between the incentives that influence decision-making and the interests of society as a whole. These costs are largely compensated for through funds provided by both workers and society as a whole. External costs include various components, such as:

- Medical Costs and loss of worker's wages (both current and future), not covered by compensation payments.
- Time and resources spent by the worker's close ones on their treatment and care.
- Lost working time and participation in daily life due to the consequences of the accident.
- Payments from budgetary and extrabudgetary funds.

The magnitude of external costs indicates that in many cases, reducing occupational risks aligns more with the interests of society as a whole rather than individual enterprises.

Therefore, the implementation of economic management methods in the occupational health and safety system at an enterprise involves selecting socio-economic indicators that reflect the state of occupational health and safety, taking into account the organization's capabilities, specific activities, and the number of employees.

Occupational safety and health in Kazakhstan is one of the key priority areas aimed at ensuring the safety and well-being of workers in the workplace. Statistical data related to occupational health and safety plays a crucial role in understanding the current situation and developing effective strategies to improve conditions in enterprises and organizations. Let's examine real figures and recognize the socio-economic significance of statistical observations on the state of occupational health and safety in Kazakhstan.

Industrial accidents and occupational diseases result in economic losses for society and enterprises. Monitoring these Costs helps to assess the impact of occupational hazards on the country's economy. In 2022, the total expenditures of

enterprises aimed at improving workplace safety and occupational health amounted to 271,892,843.2 thousand tenge (Table 1). This includes loss of working time, medical Costs, and insurance payments. The magnitude of these economic losses underscores the importance of reducing workplace injuries and enhancing occupational safety.

Table 1. *Costs of Enterprises aimed at Measures to Improve Workplace Safety and Labor Protection for 2018-2022*

№	Name of the costs	2018	2019	2020	2021	2022
1	Costs of insurance against accidents at work, the amount of the insurance premium, thousand tenge	25 002709,0	31 809212,0	31 965 503,0	34 787 584,0	59 562 081,0
2	Mandatory occupational pension contributions, thousand tenge	476 492,0	507 742,0	526 111,0	542397,0	592 250,0
3	Compensation costs for work in harmful and other unfavorable working conditions, thousand tenge	125 266153,0	138 752 316,0	96 864 387,4	109898640,1	207631773,3
4	Material consequences of accidents, thousand tenge	1 532 656,2	1 730 202,4	1 971 764,0	2 636722,8	4106738,9
	Total	152 278 010,2	172 799472,4	131327765,4	147 865343,9	271892843,2

Source: [4], [5], [6]

Analysis of the data on occupational health and safety expenses in Kazakhstan from 2018 to 2022 reveals key trends and changes in the financial commitments of enterprises towards providing safe working conditions for their employees. The expenses on accident insurance continuously increased throughout the observation period. Particularly significant growth was observed from 2020 to 2021 when the insurance premium amount increased by 70%, indicating a potential rise in insurance rates and an increase in the number of accidents.

The expenses on mandatory professional pension contributions also increased each year, but more moderately compared to insurance. This indicator demonstrates a stable growth and may indicate increased attention to the pension security of workers.

The expenses on compensations show different dynamics in different years. Particularly significant decrease in expenses was observed from 2019 to 2020, after which they sharply increased in 2021 by more than two times. This is related to the revision of compensation rules and changes in labor legislation.

Expenses on material consequences are also increasing, but at a less rapid pace compared to other occupational health and safety expenses. In 2022, a more significant increase in expenses was recorded compared to previous years.

Thus, the total expenditures on occupational health and safety in Kazakhstan continue to increase, indicating heightened attention to the safety and social protection of workers. It is important to note that certain categories of expenses (such as insurance and compensations) exhibit high variability in different years, requiring further analysis and justification of the reasons for such fluctuations. Continuous improvement of the occupational health and safety system and social support for workers is a key factor in ensuring sustainable and safe development of production in Kazakhstan. Attention to these expenditures allows for optimizing

budgetary expenses and focusing efforts on providing a high level of safety and well-being in the workplace.

Conclusions, Proposals, Recommendations

The authors propose a Methodology for Analyzing Occupational Health and Safety Costs, which allows evaluating the effectiveness of resources invested in ensuring safe working conditions at the enterprise. This methodology will utilize the following formulas:

1. Calculation of total occupational health and safety costs (OHSC) for a specific period of time:

$$OHSC = C_{iai} + C_{mpc} + C_{comp} + C_{mat} \quad (1)$$

where:

C_{iai} - Costs of industrial accidents insurance,

C_{mpc} - Mandatory professional pension contributions,

C_{comp} - Compensation for working in hazardous and other adverse working conditions,

C_{mat} - Material consequences of accidents.

2. Calculation of average costs for occupational safety and health per year (COHSY):

$$COHSY = \frac{OHSC}{n} \quad (2)$$

where:

n - The number of years in the analyzed period (for example, 5 years).

3. Calculation of the Occupational Safety and Health Expenditure Growth Index (OSH EGI) for a specific period of time:

$$OSH\ EGI = \frac{OHSC_{Final} + OHSC_{Initial}}{OHSC_{Initial}} * 100\% \quad (3)$$

where:

$OHSC_{Initial}$ - Occupational Safety and Health Expenditure at the beginning of the period,

$OHSC_{Final}$ - Occupational Safety and Health Expenditure at the end of the period.

4. Calculation of the Average Occupational Safety and Health Expenditure Growth Index (AOSH EGI) for a specific period of time:

$$AOSH\ EGI = \frac{C_{30T_{конец}} + C_{30T_{конец}}}{C_{30T_{начало}}} * 100\% \quad (4)$$

where:

$AOHSC_{Initial}$ - Average Occupational Safety and Health Expenditure at the beginning of the period,

$AOHSC_{Final}$ - Average Occupational Safety and Health Expenditure at the end of the period.

5. Calculation of the Occupational Safety and Health Expenditure Efficiency Coefficient (OSHEEC):

$$OSHEEC = \frac{OSHE}{COHSY} * 100\% \quad (5)$$

where:

OSHE - The indicator of occupational safety and health efficiency is determined based on statistics of accidents and occupational injuries.

6. Calculation of the Return on Investment in Occupational Safety and Health coefficient (ROI-OSH):

$$\text{ROI} - \text{OSH} = \frac{\text{Savings}}{\text{COHSY}} * 100\%$$

where:

Savings - the amount of savings obtained through the improvement of working conditions and the reduction of accidents.

The authors note that this Methodology includes expenses that can be obtained from open data of national statistics. The Methodology may include: costs for individual and collective protective equipment, training expenses, certification of production facilities for working conditions and assessment of professional risks, periodic medical examinations, and so on.

The proposed Methodology for analyzing occupational safety and health (OSH) expenses provides companies and organizations with the opportunity to conduct a comprehensive analysis of their investments in the field of occupational safety and health. Calculating the total OSH expenses and average expenses per year allows assessing the expenditure volume over a certain period of time and identifying expense trends. The growth indices of OSH expenses enable the evaluation of changes in expenses in percentage terms, helping to identify the reasons for increases or decreases in costs.

The coefficients of efficiency and return on investments allow the assessment of how effective the resources invested in occupational safety and health were, and how they contributed to cost savings and increased safety in the workplace. Analyzing data based on these coefficients and the efficiency indicator enables companies to make informed decisions on optimizing budgetary expenditures and further enhancing the occupational safety and health system.

The article presents a methodology for analyzing occupational safety and health (OSH) expenses in high-risk industries, which represents a comprehensive approach to assessing the effectiveness of investments in occupational safety and health. The methodology includes an examination of key expenses, such as workplace accident insurance, mandatory professional pension contributions, compensation for hazardous work, and material consequences of accidents.

The proposed analysis method allows for the identification of key factors influencing the effectiveness of occupational safety and health expenses and determining an overall efficiency indicator that consolidates all the metrics into a single numerical value. This enables the comparison of results over different time periods and facilitates informed decision-making regarding the optimization of occupational safety and health expenditures.

A high overall efficiency indicator for occupational safety and health expenses indicates a diligent effort to ensure employee safety and reduce the risk of accidents. However, a low indicator may suggest the need to review the occupational safety and health strategy and further improve the management system.

Indeed, based on the proposed methodology, companies can conduct a systematic analysis of occupational safety and health expenses, identify problematic areas, and take targeted measures to improve working conditions and ensure employee safety. This contributes to enhancing production efficiency, reducing the risk of accidents, and improving the company's image in the eyes of employees and the public. By prioritizing the safety and well-being of their workforce, companies can create a positive and responsible image, which can lead to increased productivity and overall success.

Indeed, the developed methodology for analyzing occupational safety and health expenses is a valuable tool for evaluating the effectiveness of the occupational safety and health system in organizations. It contributes to achieving a high level of safety and health for employees, which, in turn, positively impacts overall productivity and the success of the company. By using this methodology, companies can make informed decisions, allocate resources more efficiently, and implement targeted measures to improve workplace safety. This proactive approach to ensuring the well-being of employees not only enhances their working conditions but also fosters a positive work environment and promotes the company's overall success. Ultimately, prioritizing the safety and health of the workforce is a critical aspect of responsible and sustainable business management.

Acknowledgement

The research paper has been prepared within the R&D project «Improving the system for accounting and analyzing occupational health and safety costs in industries with a high risk of occupational accidents» (RRN AP19680581), operated by the RSE on REM «Republican Research Institute for Occupational Safety and Health of the Ministry of Labour and Social Security of the population of the RK».

References

- Tompa, E., Mofidi, A., van den Heuvel, S. et al. Economic burden of work injuries and diseases: a framework and application in five European Union countries. *BMC Public Health* 21, 49 (2021). URL:<https://doi.org/10.1186/s12889-020-10050-7>.
- Feng, Y., Zhang, S., & Wu, P. (2015). Factors influencing workplace accident costs of building projects. *Safety Science*, 72, 97–104. URL:<https://doi.org/10.1016/j.ssci.2014.08.008>.
- Rohani, J. M., Johari, M. F., Hamid, W. H. W., Atan, H., Adeyemi, A. J., & Udin, A. (2015). Occupational Accident Direct Cost Model Validation Using Confirmatory Factor Analysis. *Procedia Manufacturing*, 2, 286–290. URL:<https://doi.org/10.1016/j.promfg.2015.07.050>.
- Rohani, J. M., Johari, M. F., Wan Hamid, W. H., & Atan, H. (2015). Development of direct to indirect cost ratio of occupational accident for manufacturing industry. *Jurnal Teknologi*, 77(1), 127–132. URL:<https://doi.org/10.11113/jt.v77.4095>.

- Thepaksorn, P., Pongpanich, S. (2014). Occupational injuries and illnesses and associated costs in Thailand. *Safety and Health at Work*, 5(2), 66–72. URL:<https://doi.org/10.1016/j.shaw.2014.04.001>.
- Ibarrondo-Dávila, M. P., López-Alonso, M., Rubio-Gámez, M. C. (2015). Managerial accounting for safety management. *The case of a Spanish construction company*. *Safety Science*, 79, 116–125. URL:<https://doi.org/10.1016/j.ssci.2015.05.014>.
- López-Alonso, M., Ibarrondo-Dávila, M. P., Rubio, M. C. (2016). Safety cost management in construction companies: *A proposal classification*. *Work*, 54(3), 617–630. URL:<https://doi.org/10.3233/WOR-162319>.
- Jung, C., Baek, J. B. (2017). A study on the importance of uninsured (indirect) cost item of workplace accidents. *Korean Chemical Engineering Research*, 55(4), 497–502. URL:<https://doi.org/10.9713/kcer.2017.55.4.497>.
- Kim, K. W. (2020). Costs of injuries and ill health in the workplace in South Korea. *International Journal of Occupational Safety and Ergonomics*, 26(4), 772–779. URL:<https://doi.org/10.1080/10803548.2018.1509825>.
- Akçay, C., Aslan, S., Sayin, B., & Manisali, E. (2018). Estimating OHS costs of building construction projects based on mathematical methods. *Safety Science*, 109, 361–367. URL:<https://doi.org/10.1016/j.ssci.2018.06.021>.
- Yilmaz, M., Yildiz, S., 2021. The Importance of Occupational Health and Safety (OHS) and OHS Budgeting in terms of Social Sustainability in Construction Sector. *J. Build. Mater. Sci. 2*. URL: <https://doi.org/10.30564/jbms.v2i1.2591>
- Nagata T, Mori K, Aratake Y, Ide H, Ishida H, Nobori J, Kojima R, Odagami K, Kato A, Tsutsumi A, Matsuda S. Development of cost estimation tools for total occupational safety and health activities and occupational health services: cost estimation from a corporate perspective. *J Occup Health*. 2014;56(3):215-24. doi: 10.1539/joh.13-0277-fs. Epub 2014 Apr 17. PMID: 24739371.
- Guido J.L. Micheli, Enrico Cagno, Alessandra Neri, Emanuele Cieri, Non-safety costs: A novel methodology for an ex-ante evaluation, *Safety Science*, Volume 133, 2021, URL:<https://doi.org/10.1016/j.ssci.2020.105025>
<https://www.nationalbank.kz/ru/news/svodnyy-otchet-o-strahovyh-premiyah-str-sektor/rubrics/694>
<https://www.enpf.kz/ru/indicators/pa/current.php>
<https://stat.gov.kz/ru/industries/labor-and-income/stat-wags/>.