

Assessment of the efficiency of occupational safety and health cost allocation: Empirical analysis of work disability dynamics



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ABSTRACT

This study examines the efficiency of occupational safety and health costs and their impact on work disability dynamics. Despite increasing investments in occupational safety, the effectiveness of cost allocation remains insufficiently evaluated, particularly from an accounting and analytical perspective. The study is based on statistical data from medical and social expertise in Kazakhstan for 2020–2025 and financial data from six enterprises in the mining, manufacturing, construction, and transport sectors for 2020–2024. It is assumed that different categories of occupational safety and health costs have different effects on work disability outcomes. A quantitative approach was applied using correlation and linear regression analyses to assess the relationship between cost structure and changes in work disability indicators. The results show a predominantly negative relationship between occupational safety and health costs and work disability levels. The strongest correlations were identified for infrastructure investments (up to -0.57), workplace certification (-0.46), and personal protective equipment-related costs (up to -0.47). Regression results indicate that targeted costs show stronger associations ($R^2 = 0.48$) than general costs ($R^2 = 0.21$), which show weak and statistically inconsistent relationships. The findings indicate that the efficiency of occupational safety and health costs depends not only on their total volume but also on their structure and allocation. The study contributes to accounting and auditing by providing an empirical approach for evaluating cost efficiency and supporting evidence-based resource allocation decisions.

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1. Introduction

In recent years, occupational safety has become an essential component of sustainable economic development and organizational performance. Modern enterprises increasingly recognize that investments in occupational safety are not only a regulatory requirement but also a strategic tool for improving productivity, reducing losses, and enhancing human capital (Bayram and Üngan, 2020; Mustard and Yanar, 2023).

Despite the growing volume of costs on occupational safety, the effectiveness of such

investments remains an open question. In many cases, safety-related costs are treated as mandatory expenses rather than as investments requiring evaluation of their efficiency and impact on organizational outcomes. From an accounting perspective, this creates a gap between cost recording and cost analysis, limiting the ability of enterprises to optimize resource allocation (Nagata et al., 2014).

A substantial body of literature has focused on the economic consequences of occupational injuries and diseases. Studies show that workplace incidents lead to high direct and indirect costs, including medical expenses, compensation payments, and productivity losses (Debela et al., 2022; Badun, 2017). At the same time, other research demonstrates that preventive safety investments can reduce accident-related costs and improve overall organizational performance (Nai'em et al., 2020; Lee et al., 2022). However, the effectiveness of occupational safety and health costs depends not

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only on their total amount but also on their structure and allocation. Recent studies suggest that targeted safety measures, such as risk assessment, personal protective equipment, and medical monitoring, tend to have a more direct impact on safety outcomes compared to general costs, such as infrastructure or training (Yang et al., 2021; Steel et al., 2018).

The application of quantitative methods, including regression and statistical analysis, has become increasingly important for evaluating the relationship between safety costs and labor outcomes. Such approaches allow researchers to move beyond descriptive analysis and identify statistically significant relationships between cost structures and performance indicators (Asiedu et al., 2025).

One of the key indicators reflecting the effectiveness of occupational safety systems is the level of work disability. This indicator captures the long-term consequences of occupational risks and provides a measurable outcome for evaluating the efficiency of safety investments. Nevertheless, empirical studies examining the relationship between the structure of occupational safety and health costs and work disability dynamics remain limited, particularly in the context of emerging economies.

In this regard, the present study aims to assess the efficiency of occupational safety and health costs by analyzing their impact on work disability dynamics using regression and correlation analysis. The study contributes to the field of accounting and auditing by providing an empirical approach for evaluating cost efficiency and supporting evidence-based decision-making in resource allocation.

2. Literature review

In contemporary scientific literature, occupational safety and health (OSH) costs are considered a key element of enterprise economic management and an essential instrument for the prevention of occupational risks. Studies show that OSH costs are associated not only with compliance with regulatory requirements, but also with the prevention of occupational injuries, reduction of economic losses, and improvement of organizational performance. In this context, particular importance is attached to the analysis of the structure of OSH costs and their impact on various indicators of occupational safety and labor performance.

One of the main research directions focuses on examining the impact of OSH policies and workers' awareness on occupational injuries and organizational performance. Thus, Asiedu et al. (2025) investigated the relationship between workers' awareness of OSH policies, the costs of their implementation, and the level of occupational injuries. Based on an OLS regression model, the authors found that workers' awareness is statistically significantly associated with OSH policy, whereas the impact of costs related to policy implementation is statistically insignificant and

negatively associated with the level of occupational injuries. These findings indicate that the effectiveness of OSH costs largely depends on organizational factors and the specific conditions of their application.

The relationship between preventive costs and the consequences of occupational accidents is also examined in the study by Neag et al. (2021). The authors analyzed data from 62 companies and developed a structural equation model to identify the relationship between preventive costs and costs associated with occupational accidents. The results showed that investments in preventive measures have a statistically significant positive effect on reducing accident-related costs. These findings confirm the importance of analyzing the structure of OSH costs for evaluating the effectiveness of preventive measures.

A comprehensive analysis of the relationship between preventive costs, occupational safety and health management system (OHSMS) practices, and safety outcomes is presented in the study by Bayram and Ünğan (2020). The authors found that preventive costs have a positive impact on OHSMS practices and, through them, on employee satisfaction and safety performance indicators. At the same time, employee satisfaction and safety performance act as mediating factors that contribute to the reduction of costs associated with occupational accidents. This study demonstrates that the impact of OSH costs may be manifested through complex organizational mechanisms, including safety management practices and working conditions.

An important area of research is related to assessing the economic efficiency of investments in occupational safety. For instance, Mustard and Yanar (2023) analyzed the financial benefits of employers' OSH costs in Canada. The study results showed that the average return on investment (ROI) in occupational safety exceeds one across all analyzed sectors of the economy, indicating a positive economic effect of such investments. In addition to preventing occupational injuries and diseases, investments in occupational safety contribute to improved employee retention, enhanced workforce morale, and strengthened corporate reputation.

Similar findings are presented in the study by Nai'em et al. (2020), which examines the costs of risk management and the consequences of occupational accidents in a construction project. The authors found that the benefit-cost ratio of occupational safety programs exceeds one, confirming the economic feasibility of investing in preventive measures. These results demonstrate that investments in OSH can generate economic benefits by preventing losses associated with occupational injuries.

A number of studies focus on assessing the economic burden of occupational injuries. For example, Debela et al. (2022) investigated the economic costs of occupational injuries in the sugar industry in Ethiopia and found that indirect costs

account for more than 65% of the total injury-related costs. Key factors influencing total costs include prolonged absence from work, injury severity, and associated health conditions. These findings confirm the substantial economic impact of occupational injuries and highlight the importance of preventive measures.

Similar conclusions are presented in the study by [Bađun \(2017\)](#), which examines the costs associated with occupational injuries and occupational diseases in Croatia. The author demonstrated that employers' costs significantly exceed those borne by the state and include a wide range of expenses related not only to compensation and medical care, but also to compliance with OSH regulations. This underscores the need to consider OSH costs as a comprehensive economic category.

Studies also demonstrate the relationship between occupational injuries and the economic performance of enterprises. For example, [Asfaw et al. \(2013\)](#) identified an inverse relationship between profitability and occupational injury rates in U.S. underground coal mines. The authors found that lower profitability was associated with higher injury incidence rates, suggesting that insufficient investment in safety may contribute to operational disruptions and economic losses.

Issues related to the quantitative assessment of accident prevention costs are addressed in the study by [Lee et al. \(2022\)](#), which developed a model for analyzing accident prevention costs in construction projects in South Korea. The authors showed that the share of accident prevention costs accounts for approximately 1.95% of the total construction cost. This study demonstrates the feasibility of quantitatively analyzing the structure of occupational safety costs.

The problem of effective budgeting of OSH costs is also examined in the study by [Yang et al. \(2021\)](#). The authors note that the allocation of safety budgets is often carried out without considering the level of occupational risks, which reduces the effectiveness of such costs. In this regard, the use of risk-based approaches in planning OSH costs is proposed. Methodological aspects of assessing the costs of occupational safety measures are discussed in the study by [Nagata et al. \(2014\)](#), where tools were developed to calculate the costs of various OSH activities based on the activity-based costing approach. The authors identified several categories of costs, including personnel costs, operating expenses, outsourcing costs, and capital investments. This approach enables a more accurate analysis of the structure of OSH costs.

The relationship between occupational safety and productivity is examined in the systematic review by [Steel et al. \(2018\)](#), which highlights that changes in labor productivity represent a key indicator of the economic effectiveness of OSH programs. The authors emphasize the need to standardize methods for assessing the impact of occupational safety measures on worker productivity.

Some studies focus on the impact of external factors on occupational safety and workforce productivity. For example, [Marinaccio et al. \(2025\)](#) demonstrated that exposure to extreme temperatures leads to an increase in occupational injuries and a decline in labor productivity among workers engaged in outdoor activities. This underscores the importance of considering working environment factors in the analysis of occupational safety.

Organizational aspects of OSH management are discussed in the studies by [Hidayah et al. \(2022\)](#) and [Kalteh et al. \(2021\)](#). The authors emphasize the importance of effective occupational safety and health management systems, including workplace inspections, the availability of safety infrastructure, and the development of a safety culture within enterprises. These factors have a significant impact on the level of occupational injuries and the effectiveness of preventive measures.

Thus, the review of the scientific literature indicates that most studies focus either on assessing the economic consequences of occupational injuries or on analyzing the effectiveness of specific OSH interventions. At the same time, issues related to the statistical modeling of the impact of the structure of OSH costs on integrated labor-related outcomes, including the level of loss of work ability, remain insufficiently explored.

In this context, a relevant direction of research is the application of statistical methods that allow for identifying quantitative relationships between different categories of OSH costs and changes in the level of loss of work ability among workers. Addressing this issue constitutes the core objective of the present study.

3. Methods

3.1. Data sources

The empirical analysis is based on two data sources. First, statistical data on work disability levels were obtained from the national system of medical and social expertise for the period 2020–2025. Second, financial data on occupational safety and health costs were collected from six enterprises operating in mining, manufacturing, construction, and transport sectors for the period 2020–2025.

The dataset includes information on different categories of occupational safety and health costs and corresponding indicators of work disability. Such integration of administrative and financial data allows for a comprehensive assessment of the relationship between cost structure and labor-related outcomes.

3.2. Variable definition

The dependent variable is the index of change in work disability levels, which reflects the dynamics of occupational health outcomes over time. This

indicator is widely used to evaluate the effectiveness of safety systems and the consequences of occupational risks (Debela et al., 2022).

The independent variables represent different categories of occupational safety and health costs. From an accounting perspective, costs were grouped into two main categories:

- general costs, including training, insurance, and infrastructure-related costs;
- targeted costs, including risk assessment, medical examinations, personal protective equipment (PPE), and other preventive measures.

This classification is consistent with previous studies emphasizing the importance of cost structure in evaluating efficiency (Nagata et al., 2014; Yang et al., 2021).

3.3. Analytical approach

The study applies a quantitative approach based on correlation analysis and linear regression modeling. Correlation analysis was used to identify the direction and strength of relationships between occupational safety and health costs and work disability indicators.

Linear regression analysis was applied to assess the relationship between occupational safety and health costs and changes in work disability levels. The regression models were used to estimate the direction and relative strength of relationships between different categories of costs and work disability indicators.

The general form of the regression model can be expressed as:

$$y = \beta_0 + \beta_i x_i + \varepsilon \quad (1)$$

where, y represents the index of change in work disability, x_i denotes different categories of occupational safety and health costs, β_i represents the regression coefficients, and ε is the error term.

Separate models were estimated for general and targeted occupational safety and health costs in order to compare their relative effectiveness. General costs included training, insurance, and infrastructure-related expenditures, while targeted costs included personal protective equipment (PPE), medical examinations, workplace certification, and risk assessment measures.

Given the limited sample size, the analysis should be considered exploratory. Therefore, the findings are interpreted as preliminary evidence of potential relationships between occupational safety and health costs and work disability dynamics rather than as broadly generalizable results.

3.4. Efficiency assessment framework

From an accounting and analytical perspective, the efficiency of occupational safety and health costs is evaluated based on their impact on measurable outcomes, namely changes in work disability levels. This approach aligns with the concept of cost-effectiveness, which emphasizes the relationship between costs and achieved results (Mustard and Yanar, 2023).

The study assumes that higher efficiency is associated with stronger negative relationships between costs and work disability indicators, indicating a reduction in adverse outcomes.

3.5. Study limitations

The analysis is subject to several limitations. First, the dataset includes a limited number of enterprises, which may affect the generalizability of the results. Second, the study focuses on linear relationships and does not account for all external factors potentially influencing work disability dynamics. Third, external factors influencing work disability, such as working conditions and environmental variables, are not explicitly modeled.

Despite these limitations, the applied methodology provides a reliable framework for assessing the efficiency of occupational safety and health costs and can be extended in future research.

4. Results

4.1. Correlation analysis

The correlation analysis reveals a predominantly negative relationship between occupational safety and health costs and work disability levels across all analyzed categories. This indicates that an increase in safety-related costs is generally associated with a reduction in work disability.

The detailed correlation results are presented in Table 1.

Table 1: Correlation between occupational safety and health costs and work disability levels

Costs category	≤ 29%	30–59%	60–89%	≥ 90%
Training	-0.22	-0.11	-0.13	-0.07
Insurance	-0.18	-0.13	-0.38	-0.03
Infrastructure	-0.51	-0.11	-0.57	-0.05
Hygiene materials	-0.15	-0.04	-0.23	-0.08
Risk assessment	-0.07	-0.10	-0.27	-0.11
Workplace certification	-0.08	-0.15	-0.46	-0.03
Medical examinations	-0.11	-0.09	-0.26	-0.12
Maintenance costs	-0.21	-0.12	-0.37	-0.04
PPE	-0.17	-0.14	-0.32	-0.18
PPE service	-0.13	-0.23	-0.47	-0.23

As shown in Table 1, the strongest negative correlations are observed for infrastructure investments (−0.57), PPE-related costs (−0.47), and workplace certification (−0.46), indicating their significant role in reducing work disability levels. These results suggest that technical and preventive measures have a more pronounced effect on reducing work disability levels. The correlation patterns are illustrated in Fig. 1.

4.2. Regression analysis

The regression analysis confirms the results obtained from the correlation analysis and provides a more detailed assessment of the relationships between cost categories and work disability dynamics. As shown in Table 2, general costs demonstrate weak and statistically insignificant effects on work disability dynamics. The results for targeted occupational safety and health costs are presented in Table 3.

As shown in Table 3, targeted occupational safety and health costs demonstrate relatively stronger and statistically more significant associations with work disability indicators compared to general costs. The strongest negative coefficients were identified for workplace certification, PPE-related costs, and

medical examinations, suggesting a closer relationship between targeted preventive measures and reductions in work disability levels.

The estimated model for general costs demonstrates relatively low explanatory power ($R^2 = 0.21$), indicating that these costs alone do not significantly influence safety outcomes.

Table 2: Regression results: General occupational safety and health expenditure categories

Variable	Coefficient (β)	Std. error	p-value
Training costs	−0.08	0.05	0.12
Insurance costs	−0.04	0.06	0.38
Sanitary infrastructure investments	−0.06	0.04	0.18
Maintenance of working environment	−0.05	0.05	0.29
Hygiene materials	−0.07	0.04	0.15
Constant	1.12	0.10	< 0.01

Table 3: Regression results: Targeted occupational safety and health costs

Variable	Coefficient (β)	Std. error	p-value
PPE costs	−0.32	0.08	< 0.01
Medical examination costs	−0.27	0.07	< 0.01
Workplace certification	−0.35	0.09	< 0.01
Risk assessment costs	−0.18	0.06	0.02
PPE service costs	−0.10	0.05	0.07
Constant	1.05	0.09	< 0.01

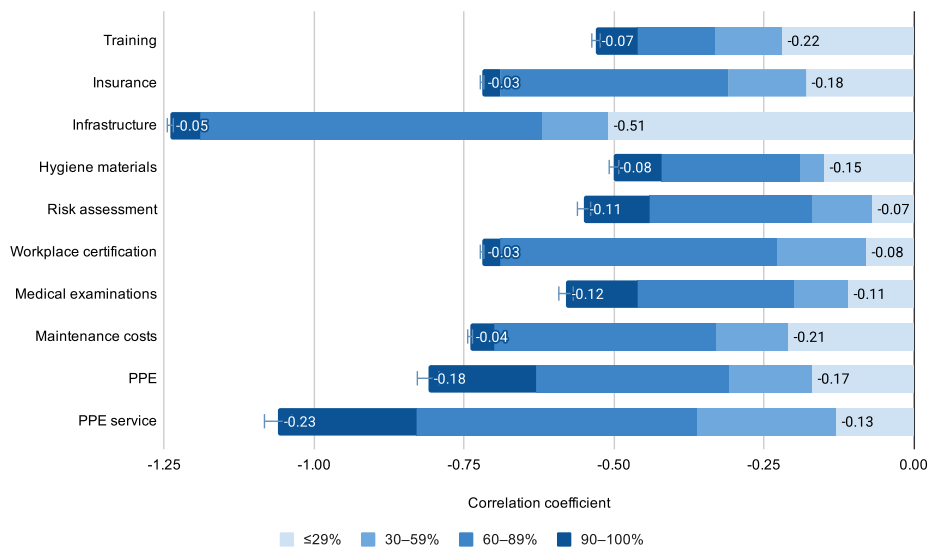


Fig. 1: Correlation coefficients between occupational safety expenditure categories and changes in work disability levels across disability groups (exploratory analysis)

The estimated model for general costs demonstrates relatively low explanatory power ($R^2 = 0.21$), indicating that these costs alone do not significantly influence safety outcomes. In contrast, the model for targeted costs shows significantly higher explanatory power ($R^2 = 0.48$), confirming their stronger role in reducing work disability levels.

As illustrated in Fig. 2, targeted costs provide significantly higher explanatory power ($R^2 = 0.48$) compared to general costs ($R^2 = 0.21$). Among the analyzed variables, costs on risk assessment, medical examinations, and PPE show the strongest negative coefficients, indicating their higher effectiveness in improving occupational safety outcomes.

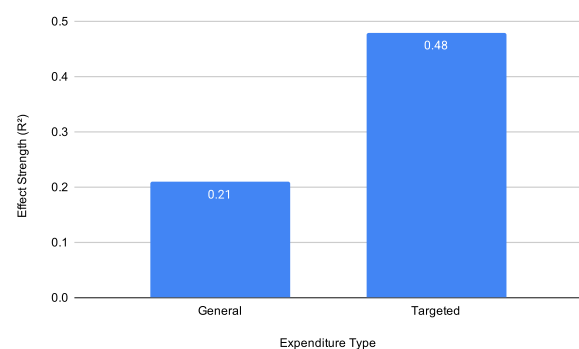


Fig. 2: Comparison of explanatory power of general and targeted occupational safety and health costs

4.3. Comparative patterns across disability groups

The analysis indicates that the strength of relationships between OSH costs and work disability varies across disability groups. Relatively stronger negative associations were observed in the 60–89% disability group, while weaker relationships were identified in the $\leq 29\%$ and $\geq 90\%$ groups.

As an illustrative example, the linear trends for medical examination expenditure ratios across disability groups can be expressed as follows:

$$y_{\leq 29} = -0.12x + 1.85 \quad (2)$$

$$y_{30-59} = -0.24x + 1.65 \quad (3)$$

$$y_{60-89} = -0.42x + 1.55 \quad (4)$$

$$y_{\geq 90} = -0.34x + 2.03 \quad (5)$$

where, y represents the expenditure ratio and x represents the year-over-year change in work disability.

As an illustrative example, Eqs. 2–5 present the estimated linear specifications for medical examination costs across different work disability

groups. As shown in Fig. 3, the strength of linear associations varies across work disability groups, with relatively stronger negative relationships observed in the 60–89% disability group.

4.4. Comparative analysis of cost categories

A comparative analysis of general and targeted occupational safety and health costs reveals notable differences in the strength and consistency of their associations with work disability dynamics.

General costs, including training, insurance, and maintenance expenditures, demonstrate relatively weak and less consistent relationships with work disability indicators. The regression results suggest that these costs mainly perform a supportive organizational role and may not directly lead to immediate improvements in occupational safety outcomes. In contrast, targeted costs related to personal protective equipment (PPE), medical examinations, workplace certification, and risk assessment demonstrate stronger and more stable negative associations with work disability indicators. These findings suggest that targeted preventive measures may have a more direct relationship with reductions in occupational risks.

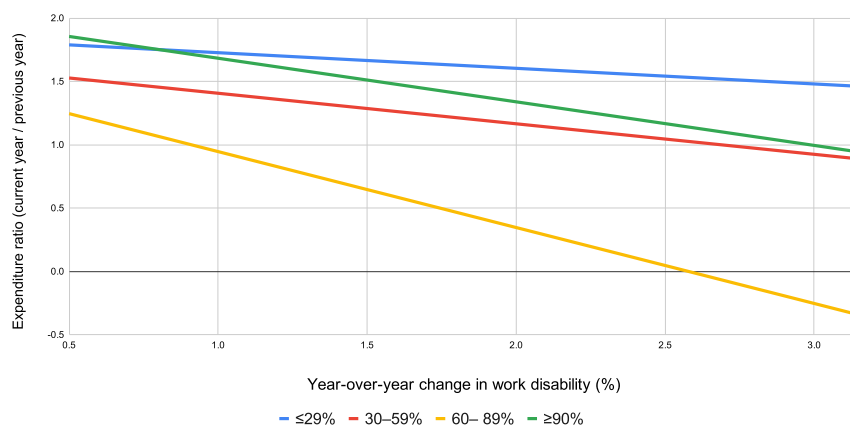


Fig. 3: Illustrative linear association between medical examination expenditure ratios and changes in work disability levels across disability groups

The results indicate that the effectiveness of occupational safety expenditures depends not only on the total amount of spending but also on the internal structure and allocation of resources. From an accounting and analytical perspective, reallocating resources toward targeted preventive measures may contribute to improved occupational safety outcomes.

4.5. Summary of findings

The results of the study provide empirical evidence of a negative relationship between occupational safety and health costs and work disability levels, indicating that increased investment in occupational safety may contribute to improved safety outcomes. However, the strength and consistency of these relationships vary across

different categories of expenditures and work disability groups.

The analysis demonstrates that targeted costs – particularly those related to personal protective equipment (PPE), risk assessment, medical examinations, and workplace certification – show relatively stronger and more stable negative associations with work disability indicators. These findings suggest that targeted preventive measures may have a more direct relationship with reductions in occupational risks.

In contrast, general costs demonstrate weaker and less consistent relationships with work disability indicators, suggesting that their impact is more indirect and dependent on organizational and contextual factors.

The study also indicates that the strength of associations between occupational safety

expenditures and work disability indicators varies across disability groups, with relatively stronger relationships observed in the intermediate disability range (60–89%). Overall, the findings suggest that the effectiveness of occupational safety investments depends not only on the total volume of expenditures but also on the structure and allocation of resources. The results support the importance of targeted and evidence-based approaches to occupational safety cost management.

5. Discussion

The data obtained during the study serve as an empirical foundation for assessing the economic efficiency of occupational safety and health measures and their role in minimizing the risk of work disability associated with occupational factors. The analysis made it possible to identify significant trends that can contribute both to the development of new approaches and to informed managerial decision-making in the field of occupational safety and health.

5.1. Structural heterogeneity of occupational safety and health costs

Based on the obtained results, it can be concluded that occupational safety and health expenditures have a multidirectional impact. Different categories of expenditures affect indicators of occupational work disability in fundamentally different ways.

General expenditures, including costs related to training, insurance, and technical maintenance, mainly perform supportive and organizational functions. Their effects are neither immediate nor direct, but rather manifest as delayed outcomes. This is evidenced by the low regression coefficients and weak correlation values. Since the relationship between general expenditures and work disability indicators is less pronounced, the influence of such costs on the dynamics of work disability remains limited. In contrast, task-specific expenditures demonstrate significantly stronger relationships. Costs associated with the provision of personal protective equipment, occupational risk assessment, medical examinations, and workplace certification are characterized by higher correlation values and regression coefficients, indicating more substantial statistical relationships.

The obtained results demonstrate that, when assessing the effectiveness of occupational safety and health expenditures, it is necessary to take into account their internal structure.

5.2. Differences across work disability groups

The study revealed significant variability in the economic feasibility of investments in occupational safety and health, correlating with the levels of occupational morbidity and injury rates. A weak correlation between expenditures and achieved

outcomes was observed in cases of low levels of work disability (up to 29%). The analysis demonstrated less pronounced relationships between expenditures and work disability indicators within this group. This finding suggests that under relatively stable conditions, additional investments may not produce immediate or quantitatively measurable positive effects.

The most pronounced effects were identified within the range of 60% to 89%. Within this interval, the relationships demonstrated stronger associations between expenditures and work disability indicators, reflecting a higher sensitivity of disability indicators to fluctuations in expenditures. The results indicate that the strongest relationships between expenditures and work disability indicators are observed under conditions of controllable occupational risks. For the group with high levels of work disability (90–100%), relatively weaker relationships were identified between occupational safety and health expenditures and changes in work disability indicators. The obtained results highlight the importance of considering differences between work disability groups when planning occupational safety and health measures.

5.3. Comparative effectiveness of general and targeted costs

The comparative analysis of the data indicates that targeted expenditures, such as investments in personal protective equipment and medical examinations, consistently demonstrate a more pronounced impact compared to general expenditures, regardless of the analytical method applied. This divergence is reflected in several significant parameters of the developed models.

It was established that targeted expenditures are associated with higher regression coefficients and significant correlation values, indicating a stronger statistical relationship with the dynamics of work disability. Moreover, the corresponding relationships are characterized by more pronounced interdependencies, suggesting that changes in targeted expenditures contribute to more substantial improvements in safety indicators. It should be noted that this characteristic is reflected in the stability of their effect regardless of the degree of work disability. Unlike general expenditures, whose effectiveness may vary under certain circumstances, specific expenditures demonstrate more stable statistical relationships, particularly in cases of moderate levels of occupational work disability.

The identified patterns indicate that targeted interventions directly influence key occupational risk factors, which, in turn, are associated with reductions in work disability indicators.

In contrast, general expenditures primarily affect the institutional and operational sustainability of occupational safety and health management systems. Their impact is less significant and more dependent on contextual factors, leading to the conclusion that

they play a supportive rather than dominant role in improving safety performance.

5.4. Implications for accounting and analytical frameworks

From an accounting perspective, the obtained results indicate the necessity of improving approaches to the analysis and accounting of expenditures. Instead of the traditional approach focused primarily on the absolute amount of expenditures, it is proposed to shift toward a system oriented to the assessment of their effectiveness and impact on operational performance. Contemporary accounting practices often concentrate on aggregate expenditure indicators while overlooking their efficiency and influence on the company's final outcomes.

The study revealed that the economic effectiveness of investments in occupational safety and health is determined primarily by their internal structure rather than solely by the volume of expenditures. It was established that different categories of expenditures are associated with work disability indicators in different ways, while the nature of these relationships depends on the direction of investments and the level of occupational risks.

In addition, the results of the study emphasize the importance of applying analytical methods for evaluating expenditure effectiveness within accounting systems and occupational safety and health management frameworks. This makes it possible to take into account differences in the effectiveness of individual expenditure categories and to make more informed decisions regarding resource allocation.

The obtained findings highlight the relevance of developing analytical tools capable of integrating information on financial investments with performance metrics. Such an approach would ensure a more accurate assessment of the economic feasibility of expenditures and would provide a foundation for evidence-based managerial decision-making in the field of occupational safety and health.

5.5. Managerial and policy implications

The results of this study have significant implications for managerial decision-making and policy development.

First, it was established that a simple increase in overall expenditures is not, in itself, a sufficient condition for improving occupational safety performance. Consequently, resource allocation should be reoriented toward targeted measures that demonstrate higher levels of effectiveness.

Second, safety measures should be adapted to the specific nature of occupational risks. Investments that prove effective under conditions of moderate occupational hazards may be less effective in cases characterized by either very low or extremely high levels of work disability.

Third, the obtained results demonstrate the importance of ensuring adequate financing of core safety measures. Insufficient investment in these areas may reduce the effectiveness of preventive interventions.

In conclusion, the presented findings indicate that occupational safety and health management should be based on evidence-based decision-making principles. This underscores the critical role of empirical analysis in the process of resource allocation.

6. Conclusion

This study provides an empirical assessment of the efficiency of occupational safety and health costs based on the analysis of work disability dynamics. The results indicate the existence of a consistent negative relationship between costs and work disability levels, indicating that increased investment contributes to improved occupational safety outcomes.

At the same time, the findings demonstrate that the effectiveness of costs is not uniform.

The analysis reveals substantial differences between general and targeted costs, with the latter showing significantly stronger and more consistent associations. In particular, costs related to personal protective equipment, risk assessment, medical examinations, and workplace certification play a key role in reducing work disability levels.

The study also demonstrates that the strength of associations between occupational safety expenditures and work disability indicators varies across disability groups, with relatively stronger relationships observed in the intermediate disability range.

These findings suggest that the efficiency of occupational safety investments depends primarily on the structure and allocation of costs rather than their total volume. Therefore, increasing costs alone is insufficient without strategic prioritization of targeted measures.

From a practical perspective, the results support the development of more effective occupational safety policies based on differentiated and evidence-based resource allocation. From an analytical perspective, the study highlights the importance of integrating evidence-based analytical approaches into the evaluation of occupational safety and health costs.

Overall, this research contributes to the advancement of methodological approaches for assessing occupational safety efficiency and provides a basis for improving decision-making in the management of occupational risks.

List of abbreviations

OLS	Ordinary least squares
OHSMS	Occupational health and safety management system
OSH	Occupational safety and health

PPE Personal protective equipment
R² Coefficient of determination
ROI Return on investment

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Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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