Sustainability in Environment
ISSN 2470-637X (Print) ISSN 2470-6388 (Online)
Vol. 10, No. 2, 2025
www.scholink.org/ojs/index.php/se

Original Paper

Applying Pareto Analysis to Workplace Fatalities in Vietnam

Do Thi Lan Chi[1*]

[1] Faculty of Occupational Safety and Health, Trade Union University

[*] Email: chidtl@dhcd.edu.vn

Received: February 23, 2025 Accepted: March 12, 2025 Online Published: March 23, 2025

doi:10.22158/se.v10n2p12 URL: http://dx.doi.org/10.22158/se.v10n2p12

Abstract

Ensuring workplace safety remains a significant challenge in Vietnam, where occupational accidents continue to pose serious risks to workers' health and well-being. Despite the implementation of numerous safety regulations and interventions, statistical data indicate that thousands of workplace accidents occur annually, with a considerable proportion leading to fatalities. This study employs the Pareto Principle (80/20 rule) to identify and analyze the primary causes of fatal occupational accidents in Vietnam from 2019 to the first half of 2024. The findings highlight that traffic accidents and falls from height collectively account for over 50% of workplace fatalities, underscoring the need for targeted safety interventions. Additionally, the study identifies key contributing factors such as safety violations, inadequate workplace organization, and insufficient training. By utilizing Pareto analysis, this research provides valuable insights into prioritizing preventive measures, refining safety policies, and strengthening risk management strategies to enhance workplace safety standards in Vietnam.

Keywords

Workplace safety, Occupational accidents, Workplace fatalities, Pareto analysis, Risk management, Occupational health and safety (OHS), Industrial accidents, Workplace risk assessment, Safety policy and intervention, Fatal accident analysis, Vietnam labor safety

1. Introduction

Workplace safety is a critical issue in Vietnam, where occupational accidents continue to pose significant threats to workers' well-being and economic productivity. Despite continuous efforts to enhance safety regulations and enforcement mechanisms, statistics from the Ministry of Labor, Invalids, and Social Affairs (MOLISA) indicate a persistent challenge. From 2019 to the first half of 2024, a total of 41,347 workplace accidents were reported, impacting 42,136 individuals and leading to 4,530 fatalities. This equates to an annual average of approximately 7,845 incidents, demonstrating the ongoing risks in maintaining a safe working environment.

A deeper analysis of workplace fatalities reveals that not all causes contribute equally to the total number of deaths. The Pareto Principle, also known as the 80/20 rule, provides a valuable framework for identifying and prioritizing the most critical factors associated with occupational fatalities. This principle suggests that a small proportion of causes are responsible for the majority of adverse outcomes, thereby allowing for targeted interventions that maximize the effectiveness of safety measures.

Applying Pareto analysis to workplace fatality data highlights that traffic-related accidents constitute the most significant cause, accounting for 1,285 deaths (29%). When combined with falls from height, which resulted in 974 deaths, these two factors alone contribute to 51% of all workplace fatalities. Furthermore, when incidents classified under "other causes" (808 deaths) are included, the cumulative share rises to 70%. Additional analysis of root causes indicates that traffic accidents, external influences, and unidentified causes account for 40% of total fatalities, a figure substantially higher than fatalities resulting from non-compliance with safety regulations (17%) and inadequate work organization and conditions (15%).

Understanding the disproportionate impact of these key causes is essential for developing effective safety strategies. This study applies Pareto analysis to systematically assess the predominant causes of workplace fatalities in Vietnam, aiming to provide insights that can inform evidence-based policy decisions. By prioritizing interventions addressing the leading causes of fatal accidents, this research seeks to contribute to the ongoing efforts of policymakers, employers, and occupational safety professionals in mitigating risks and improving workplace safety standards.

1.1 Research Methodology

This study employs a quantitative research approach, utilizing statistical data on workplace fatalities reported by MOLISA from 2019 to the first half of 2024. The primary data sources include government reports, workplace accident records, and academic studies on occupational safety in Vietnam. The methodology consists of the following key steps:

Data Collection: Statistical reports from MOLISA, national occupational safety databases, and relevant literature were systematically analyzed to ensure accuracy and comprehensiveness.

Pareto Analysis: The 80/20 principle was applied to classify and rank the primary causes of fatal occupational accidents. The analysis identified key risk factors contributing to the highest number of fatalities.

Comparative Analysis: The findings were compared with international occupational safety benchmarks to assess Vietnam's relative performance in workplace safety management.

Policy and Intervention Recommendations: Based on the Pareto analysis, targeted safety strategies were proposed to effectively address the most critical causes of workplace fatalities.

By implementing this structured methodology, the study provides a data-driven foundation for prioritizing safety interventions, enhancing workplace regulations, and improving occupational risk management. This approach ensures that workplace safety improvements are both evidence-based and

impact-oriented.

2. Results and Discussion

2.1 Overview of Occupational Accidents in Vietnam from 2019 to 2024

Accidents and their consequences are among the critical issues that need attention to minimize risks and enhance workplace safety. According to statistics from the Ministry of Labour, Invalids, and Social Affairs, during the period from 2019 to the first half of 2024, a total of 41,347 occupational accidents occurred, affecting 42,136 individuals, including 4,530 fatalities. On average, approximately 7,845 accidents were recorded annually.

The highest number of accidents was reported in 2020, with 8,380 cases, while the lowest was in 2021, with 6,504 cases. The overall trend indicates a gradual decline in the number of accidents from 2021 onwards. Notably, in the first six months of 2024, only 3,201 cases were recorded, suggesting the potential continuation of this downward trend throughout the year.

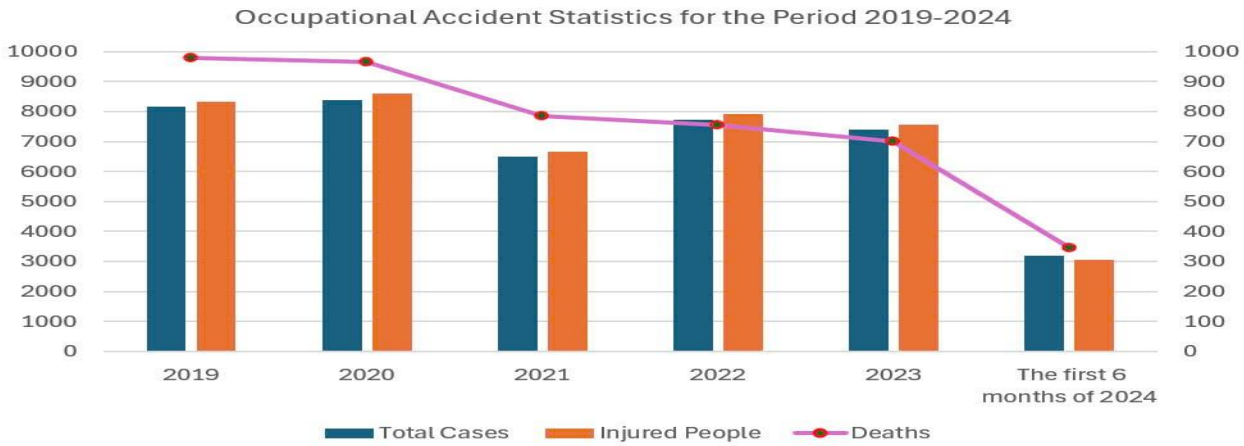

Chart 01: Occupational Accident Statistics for the Period 2019-2024

The total number of affected individuals during this period was 42,136, with an average rate of 1.02 victims per accident. The highest number of affected individuals was recorded in 2020, with 8,610 cases, while the lowest was in 2023, with 7,553 cases. The ratio of victims to the number of accidents remained relatively stable, ranging from 1.01 to 1.03 victims per accident, indicating that the overall impact of occupational accidents has not fluctuated significantly over the years.

Among the total of 4,530 fatalities, the average fatality rate was 0.11 deaths per accident. A clear downward trend in the number of fatalities was observed, decreasing from 979 cases in 2019 to 699 cases in 2023, representing a reduction of 28.6%. In the first six months of 2024, there were 346 fatalities, accounting for approximately 38% of the annual average, suggesting that the decline may continue throughout the year.

The fatality rate relative to the total number of affected individuals is a crucial indicator reflecting the

severity of occupational accidents. This metric not only highlights the risk of fatalities in workplace incidents but also demonstrates the effectiveness of rescue operations, emergency response efforts, and improvements in workplace safety over the years.

Chart 02: Fatality Rate per Total Occupational Accidents

The fatality rate, determined as the percentage of fatalities relative to the total number of occupational accidents, exhibited notable fluctuations during the period from 2019 to the first half of 2024. In particular, a significant decline in this rate was observed during 2022–2023; however, a slight increase was recorded in the first half of 2024.

From 2019 to 2021, the fatality rate ranged between 11.2% and 11.8%, indicating that the severity of occupational accidents had not significantly improved. This could be attributed to unfavorable working conditions, ineffective implementation of safety measures, and suboptimal emergency response and rescue systems. Additionally, the nature of accidents during this period may have been more severe, contributing to a higher fatality rate.

In contrast, during 2022–2023, the fatality rate declined to 9.52% in 2022 and further to 9.26% in 2023, reflecting substantial improvements in workplace safety. This reduction may have resulted from stricter enforcement of safety regulations, enhanced inspection and supervision, increased awareness among workers regarding risk prevention, and improved emergency response and first-aid systems at accident sites. The reduction of severe accidents may have directly contributed to this positive trend.

However, in the first six months of 2024, the fatality rate increased again to 11.28%, signaling a concerning trend. While the total number of affected individuals decreased to 3,065, the number of fatalities remained high at 346, leading to a rise in the fatality rate. Possible causes of this increase include the growing severity of accidents, unfavorable working conditions, or heightened production pressures, which may have led to lapses in compliance with safety regulations.

2.2 Fatal Occupational Accidents from 2019 to 2024

During the period from 2019 to the first half of 2024, a total of 4,297 fatal occupational accidents were

recorded, resulting in 4,530 fatalities. This data highlights the alarming severity of workplace accidents, with an average of 859 fatal incidents per year and 906 fatalities per year throughout this period.

Chart 03: Number of Fatal Occupational Accidents and Number of Deaths

In 2019, there were 927 fatal occupational accidents, resulting in 979 deaths. In 2020, these numbers remained nearly unchanged, with 919 accidents and 966 fatalities, indicating that the severity of workplace accidents remained consistently high. However, in 2021, both figures significantly declined to 749 accidents and 786 fatalities, marking respective decreases of 18.5% and 18.6% compared to the previous year. This reduction could be attributed to the disruption of production activities due to the COVID-19 pandemic, which led to a lower risk of workplace accidents. Additionally, this period may have seen businesses implementing stricter occupational safety regulations to adapt to new production conditions.

Following the sharp decline in 2021, the number of fatal occupational accidents continued to decrease in 2022, with 720 recorded cases and 754 fatalities, reflecting a 3.9% and 4.1% reduction, respectively, compared to 2021. This downward trend persisted into 2023, with the number of accidents dropping to 662 and fatalities decreasing to 699, representing declines of 8% and 7.3%, respectively, from 2022. These improvements suggest significant progress in occupational safety management, likely due to stricter safety regulations, increased worker awareness, and greater investments in protective technology and safer work procedures. However, the pace of decline was not as pronounced as in the previous period, indicating that certain challenges remain in fully mitigating workplace accident risks.

In the first half of 2024, the number of fatal occupational accidents dropped sharply to 320 cases, a 51.6% decrease compared to the entire year of 2023. However, the number of fatalities remained high at 346, equivalent to 49.5% of the total recorded in 2023.

Chart 04: Fatality Rate per Fatal Occupational Accidents

Although the overall number of fatal occupational accidents has shown a decreasing trend over the years, the severity of these incidents remains high. This is evident from the fact that the number of fatalities exceeds the number of accidents, averaging 1.05 fatalities per fatal occupational accident. This statistic indicates that many accidents are particularly severe, resulting in significant human losses.

From 2019 to 2021, the fatality rate per fatal occupational accident showed a gradual decline, reflecting some improvements in occupational safety measures. Specifically, in 2019, the fatality rate was 1.05 deaths per fatal accident. By 2020, this figure had slightly decreased to 1.04. This downward trend continued in 2021, reaching the lowest level in this period at 1.02 deaths per fatal accident. This suggests that the severity of individual accidents decreased to some extent, likely due to stricter occupational safety controls. The COVID-19 pandemic, which disrupted many production activities, may have indirectly contributed to reducing workplace accident risks.

However, after a sharp decline in 2021, the fatality rate per fatal occupational accident began to rise again from 2022 onward. In 2022, the number of fatal occupational accidents decreased to 702 cases, but the number of fatalities reached 754, pushing the fatality rate per accident up to 1.07 deaths per case. In 2023, this rate remained high at 1.03 deaths per fatal accident. This indicates that while the number of accidents continued to decline, their severity increased. Possible reasons include a rise in more severe accidents or intensified production pressures after the pandemic, which may have worsened working conditions and increased the risks associated with each accident.

In the first half of 2024, the fatality rate per fatal occupational accident further increased to 1.08 deaths per case - the highest level in the past five years. Several factors may have contributed to this, including

a rise in severe accidents in high-risk industries such as construction and mining, production pressures leading to negligence in safety measures, suboptimal emergency response efforts, a high proportion of inexperienced workers, and increasingly harsh working conditions. This alarming trend underscores the need for stronger safety measures to mitigate accident consequences.

Although the total number of fatal occupational accidents has been decreasing from 2019 to the first half of 2024, their severity has escalated, as reflected in the increasing fatality rate per accident. While a slight decline was recorded between 2019 and 2021, the rate began to rise again in 2022, peaking in the first half of 2024 at 1.08 deaths per accident—the highest in five years. This trend signals an urgent need for enhanced preventive measures, stricter supervision, improved first-aid efficiency, and the integration of advanced technology to minimize fatalities in workplace accidents. Without timely intervention, the incidence of severe occupational accidents is likely to continue increasing in the coming years.

2.3 Applying the Pareto Principle to Analyze the Causes of Fatal Occupational Accidents (2019–2024)

2.3.1 Key Factors Causing Fatal Occupational Accidents Based on the Pareto Principle

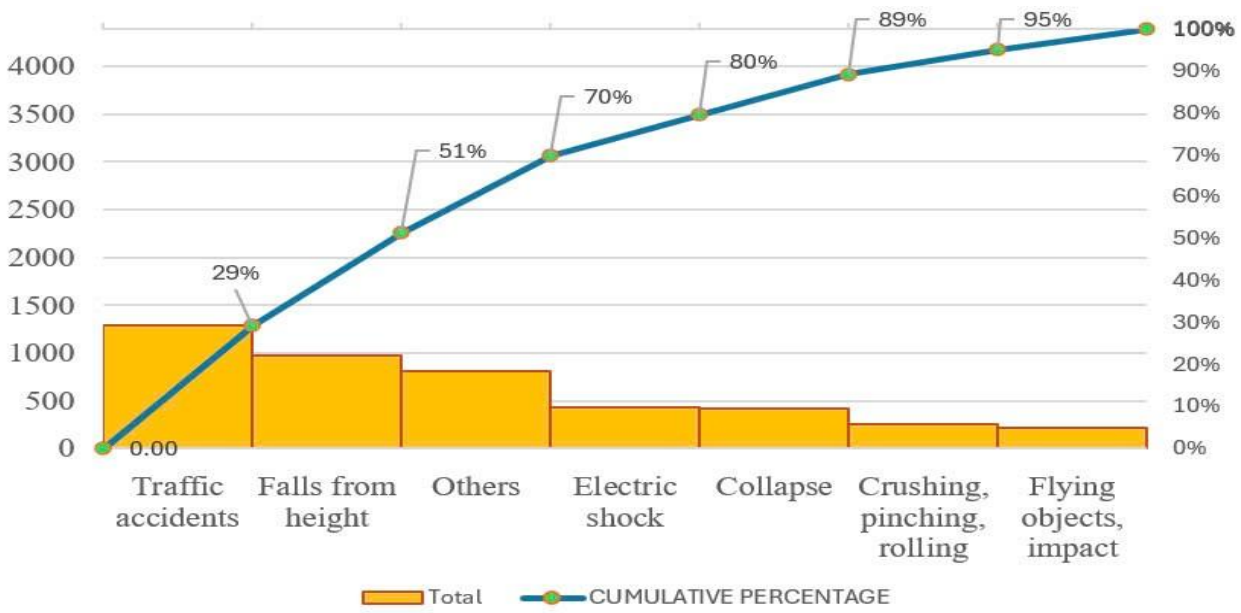

Chart 5: Factors Causing Fatal Occupational Accident

Traffic accidents are the leading cause of fatal occupational accidents, accounting for 1,285 fatalities (approximately 29% of the total). This single factor alone contributes to nearly one-third of all workplace-related deaths. When combined with falls from height (974 cases), these top two causes collectively account for 51% of total fatalities, meaning that more than half of all fatal occupational accidents can be attributed to just these two primary causes. Adding other factors (808 cases) brings the cumulative proportion to 70% of total fatalities, while electrocution (429 cases) further raises the cumulative percentage to 80%, a critical threshold in Pareto analysis, demonstrating that just four

causes explain 80% of all fatalities. Structural collapses (421 cases) push the cumulative proportion to 89%. The remaining two causes - being crushed, trapped, or entangled (257 cases) and being struck by or hit by objects (218 cases) - account for the rest, bringing the total to 4,392 fatalities (100%).

The disproportionately high rate of traffic accidents as a cause of workplace fatalities in Vietnam compared to international benchmarks requires further investigation. While in many developed countries, work-related traffic accidents account for approximately 10-15% of workplace fatalities, in Vietnam, this figure is significantly higher at 29%. Several contributing factors explain this alarming trend.

Firstly, workplace commuting and road conditions play a crucial role. Many workers in Vietnam commute long distances on motorbikes, which inherently pose higher risks than cars or public transportation. The use of motorbikes as the primary mode of transportation among laborers increases vulnerability to severe accidents. Additionally, poorly maintained roads, inadequate traffic signals, and congested urban traffic further exacerbate the risk of accidents.

Secondly, worksite transportation and logistics contribute significantly to workplace fatalities. Many workplace environments, especially in construction and manufacturing, require workers to move between different sites. The lack of proper safety measures for on-site transportation, including improper vehicle maintenance and untrained drivers, leads to a higher risk of fatal accidents. The use of trucks and heavy machinery in industrial zones without adequate traffic management protocols also contributes to workplace traffic-related fatalities.

Moreover, limited enforcement of traffic and workplace safety regulations exacerbates the issue. Although Vietnam has traffic laws in place, enforcement remains inconsistent. Many companies lack strict policies for ensuring worker safety during commutes and on-site transportation. Furthermore, safety gear such as helmets and protective clothing is often not used properly, further increasing the risk of severe injuries in case of accidents.

Fatigue and overworking also play a significant role in traffic-related workplace fatalities. Many workers in Vietnam work long shifts, often exceeding standard working hours, leading to exhaustion and reduced alertness when commuting. Fatigue is a significant risk factor in traffic accidents, as it impairs reaction time and decision-making. Shift work, especially in manufacturing and construction industries, results in workers commuting during unsafe hours, such as late at night or early in the morning.

Cultural and behavioral factors further contribute to the high incidence of traffic-related workplace fatalities. Unsafe driving habits, including speeding, running red lights, and lack of adherence to lane discipline, are common among Vietnamese commuters, including workers traveling to and from job sites. The widespread acceptance of informal transportation methods, such as riding motorbikes without proper licenses or safety training, further increases risks.

Given the significant contribution of traffic accidents to workplace fatalities, urgent interventions are needed to address this issue. Recommendations include implementing mandatory workplace

transportation safety programs, ensuring that employers provide safe transport for workers when necessary. Strengthening enforcement of existing traffic regulations, particularly in high-risk industries such as construction and logistics, is crucial. Additionally, promoting alternative and safer modes of transportation for workers, such as company-provided shuttle buses, should be encouraged. Increasing awareness through safety training programs on commuting risks and defensive driving techniques can further reduce the likelihood of accidents. Finally, encouraging businesses to implement fatigue management policies to prevent overworked employees from driving under unsafe conditions is essential.

By addressing these underlying factors, Vietnam can significantly reduce the number of workplace-related traffic fatalities and align its safety statistics more closely with international benchmarks.

Based on the statistical data presented, it is evident that not all causes of fatal occupational accidents have an equal impact. The Pareto Principle, also known as the 80/20 rule, is clearly reflected in this dataset, indicating that a small number of causes are responsible for the majority of fatalities.

Specifically, the Pareto analysis reveals the following insights:

- Traffic accidents are the leading cause, accounting for 1,285 fatalities (approximately 29% of the total). This single factor alone contributes to nearly one-third of all workplace-related deaths.
- When combined with falls from height (974 cases), these top two causes collectively account for 51% of total fatalities. This means that more than half of all fatal occupational accidents can be attributed to just these two primary causes.
- Adding other factors (808 cases) brings the cumulative proportion to 70% of total fatalities.
- Electrocution (429 cases) further raises the cumulative percentage to 80%, a critical threshold in Pareto analysis, demonstrating that just four causes explain 80% of all fatalities.
- Structural collapses (421 cases) push the cumulative proportion to 89%.
- The remaining two causes - being crushed, trapped, or entangled (257 cases) and being struck by or hit by objects (218 cases) - account for the rest, bringing the total to 4,392 fatalities (100%).

This Pareto analysis provides valuable insights into prioritizing intervention strategies to reduce fatal occupational accidents. Rather than implementing preventive measures across all causes equally, policymakers and occupational safety managers should focus resources on addressing the four leading causes: traffic accidents, falls from height, other factors, and electrocution. By doing so, maximum impact can be achieved with limited resources, significantly reducing workplace fatalities.

In particular, prioritizing the top two causes - traffic accidents and falls from height - has the potential to reduce workplace fatalities by up to 51%, representing a highly effective investment. In resource-constrained environments, applying the Pareto Principle in this way will optimize intervention outcomes.

Implications for Occupational Safety Training and Risk Management. The findings suggest the need to design targeted occupational safety training programs, with a strong emphasis on preventing traffic

accidents and falls from height. Additionally, enhancing supervision and improving safety procedures in high-risk areas prone to electrocution and structural collapses should be prioritized.

In summary, this Pareto analysis not only provides a comprehensive overview of fatal occupational accidents but also serves as a practical tool for prioritizing interventions, ultimately contributing to more effective workplace safety measures and reducing fatality rates.

Pareto Chart Analysis: Unequal Distribution and High Concentration of Fatal Occupational Accidents.

The Pareto analysis of fatal occupational accident causes reveals a highly concentrated distribution pattern, demonstrating the 80/20 principle in action. The dataset, comprising 4,392 fatalities, clearly shows that a small number of causes are responsible for most deaths.

Traffic accidents emerge as the leading cause, with 1,285 fatalities (29%) - a strikingly high proportion compared to international studies, where this cause typically accounts for 10 –15% of workplace fatalities. This discrepancy highlights local factors such as transportation culture, infrastructure conditions, and compliance with workplace safety regulations. In terms of relative impact, traffic accidents occur 1.32 times more frequently than the second leading cause, falls from height (974 cases, 22.2%). Notably, these two causes alone account for 51% of all fatalities, a clear indicator of the high concentration of risk factors. When including other factors (808 cases, 18.4%) and electrocution (429 cases, 9.8%), these four causes collectively explain 80% of total fatalities, perfectly aligning with Pareto's critical threshold. The Gini concentration coefficient, calculated from this chart, is relatively high, reinforcing the unequal distribution of accident causes and confirming the strategic importance of prioritizing interventions based on the Pareto Principle.

Grouping causes into broader categories provides additional insights: Physical hazard-related causes (falls from height, structural collapses, being struck by objects) account for 36.7% of total fatalities. Vehicle/machinery-related causes (traffic accidents, crushing, entanglement) represent 35.1%. In high-altitude construction environments, the combination of falls from height (22.2%) and structural collapses (9.6%) accounts for 31.8% of total fatalities - comparable in magnitude to traffic accidents but distributed across two causes. Meanwhile, industrial environments, characterized by electrocution (9.8%), crushing/entanglement (5.9%), and being struck by objects (5%), collectively account for only 20.7% of fatalities - lower than the proportion of traffic accidents alone.

The classic 80/20 Pareto ratio is evident in this dataset: four out of seven causes (57%) account for 80% of fatalities, closely mirroring Pareto's standard principle. This finding strongly supports the need for a targeted intervention strategy.

Every 1% of resources invested in preventing traffic accidents could yield 1.32 times greater impact than investments in preventing falls from height. Investing in the top two causes alone could be 1.76 times more effective than spreading resources across the remaining five causes.

Falls from height (22.2%) in Vietnam closely aligns with international statistics, where this cause typically accounts for 20–25% of workplace fatalities, confirming the universal nature of high-altitude work risks. Traffic accident fatalities (29%), however, are abnormally high compared to the

international average of 10–15%, emphasizing the urgent need for specialized interventions tailored to local conditions. Electrocution (9.8%) and structural collapses (9.6%) exceed the 7% global benchmark, suggesting that Vietnam's occupational safety standards for these hazards require significant improvement.

This Pareto-based analysis is not just a statistical tool but also a foundation for designing evidence-based occupational safety strategies. It clearly illustrates that not all causes have equal impact, and limited resources should be allocated to high-priority areas with the greatest potential to reduce fatalities.

In an environment where resources are constrained, applying the Pareto Principle is not just a smart choice - it is essential for effectively protecting workers and minimizing preventable workplace deaths.

2.3.2 Key Causes of Fatal Occupational Accidents Based on the Pareto Principle

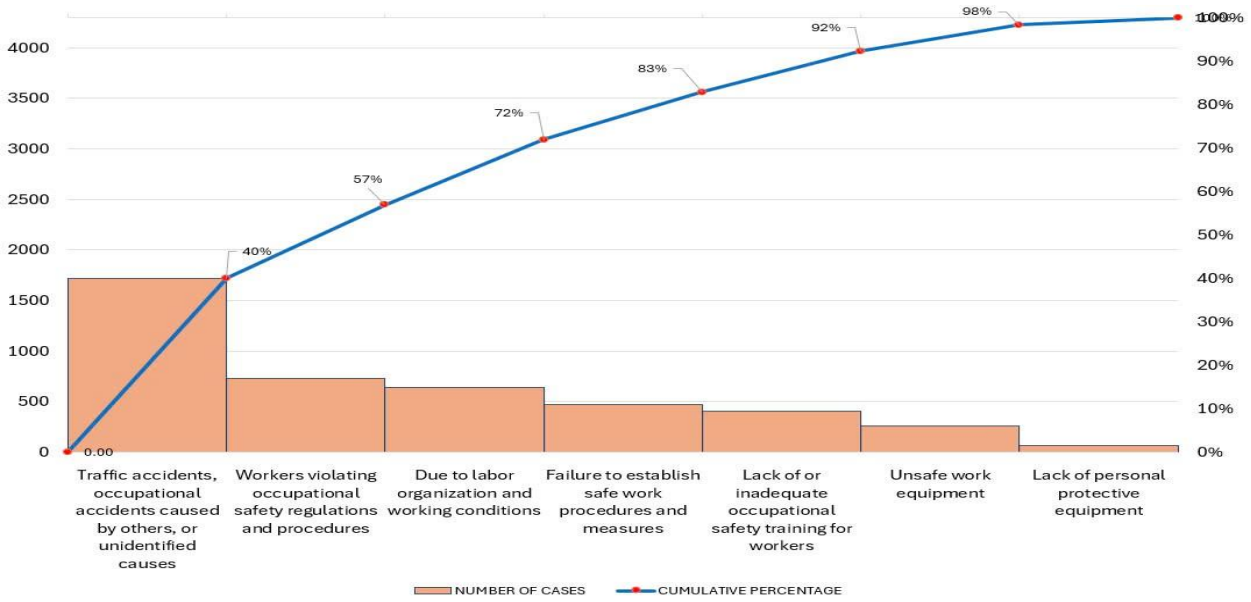

Chart 6. Pareto Chart Identifying the Main Causes of Fatal Occupational Accidents

The analysis of the causes of fatal occupational accidents using the Pareto Principle highlights the unequal distribution of accident factors, where a small number of causes contribute to the majority of fatalities, aligning with the 80/20 principle. Statistical data indicate that traffic accidents, accidents caused by external factors or unidentified causes dominate the statistics with 1,722 cases, accounting for 40% of total fatalities - 2.35 times higher than the second leading cause, violations of occupational safety procedures (727 cases, 17%), and 2.68 times higher than the third-ranked cause, poor labor organization and working conditions (642 cases, 15%). When combining these three causes, they account for 72% of total fatalities, while the fourth cause - lack of safety procedures and measures - raises the cumulative rate to 83%, indicating that these four leading causes have a dominant impact and should be prioritized for intervention.

When comparing these findings to international data, it becomes evident that the fatality rate from traffic accidents and unidentified causes in Vietnam is significantly higher than the global average. In many developed countries, work-related accidents typically account for around 25% of labor-related fatalities, whereas occupational diseases, cancers, and respiratory illnesses contribute a larger share. This difference reflects the unique infrastructure challenges and safety management issues in Vietnam, along with limitations in risk management within the labor environment.

Another key observation is the high proportion of fatalities resulting from safety violations (17%), highlighting the critical role of worker behavior in determining occupational safety levels. This finding underscores the need to enhance safety training quality, enforce compliance with safety regulations, and improve worker awareness and accountability. Additionally, causes related to labor organization and working conditions (15%) emphasize the importance of improving the work environment, including task organization, workplace conditions, and infrastructure.

Examining other causes such as lack of safety training (9%), unsafe equipment (6%), and absence of personal protective equipment (2%), it is evident that infrastructure and equipment-related issues, though important, are not the primary causes of fatalities. This differs from trends in industrialized nations, where machine-related hazards, faulty equipment, and exposure to toxic chemicals often account for a higher proportion of workplace fatalities.

From a risk management perspective, this Pareto analysis suggests a strategic roadmap for optimizing the effectiveness of preventive measures. The priority should be to first address traffic accidents and external causes, followed by improving worker compliance with safety procedures, then enhancing labor organization and working conditions, and finally refining workplace safety management systems, including establishing safety procedures and expanding structured training programs.

Overall, this analysis reinforces the value of the Pareto Principle in guiding intervention strategies while also highlighting significant differences between Vietnam and developed countries in the structure of occupational fatality causes. These findings suggest that intervention strategies should be tailored to local conditions to effectively reduce workplace fatality risks.

The two Pareto charts can be analyzed together to provide a comprehensive overview of the root causes and direct factors leading to fatal occupational accidents. The first chart reflects the underlying causes of workplace accidents, while the second chart analyzes the direct causes of fatalities. Integrating these two perspectives helps identify targeted solutions to reduce both accident occurrences and the severity of consequences.

Key findings from the combined analysis include: Traffic accidents rank highest in both charts (40% of total accidents and 29% of total fatalities), indicating the urgent need for traffic safety measures, especially for workers commuting or operating in outdoor environments. Safety violations (57% cumulative) are closely linked to factors such as falls from height (51% cumulative in the fatality chart) and electrocution (80% cumulative), emphasizing the importance of proper safety training and compliance monitoring. Poor working conditions and inadequate labor organization (72%) contribute

to severe incidents such as structural collapses (89% in the fatality chart), crushing incidents (95%), and being struck by objects (100%), requiring improvements in workplace organization and risk management. Lack of safety procedures (83%) and insufficient training (92%) significantly contribute to fatal accidents, explaining why falls from height, electrocution, and structural collapses remain common causes of workplace fatalities. Unsafe equipment (98%) is directly linked to crushing incidents (95%) and being struck by objects (100%), highlighting the need for enhanced equipment inspections and maintenance. Absence of personal protective equipment (100%) can exacerbate injury severity in accidents, reinforcing the importance of mandatory safety gear enforcement.

3. Solutions for Reducing Occupational Accidents in Vietnam

By utilizing a data-driven approach based on Pareto analysis, policymakers, industry leaders, and occupational safety professionals can optimize resource allocation and implement high-impact safety measures. Future research should explore sector-specific accident trends, assess the long-term effectiveness of implemented interventions, and identify innovative solutions to enhance workplace safety standards.

Ultimately, achieving sustainable improvements in occupational safety requires a continuous commitment to risk prevention, regulatory enhancements, and the promotion of a strong safety culture within organizations. Addressing these challenges effectively will contribute to reducing workplace fatalities and creating a safer working environment for all employees in Vietnam.

3.1 Enhancing Traffic Safety Control for Workers

Traffic accidents are the leading cause of fatal occupational accidents, accounting for 40% of total cases. The causes may include commuting between work sites, accidents involving construction vehicles, or risks associated with public transportation. A key solution to mitigate these risks is to enhance traffic safety training for workers, emphasizing the dangers of driving in construction environments and high-risk areas.

Enterprises should implement speed control measures within work areas, improve internal traffic infrastructure, especially in construction and industrial zones, and promote safer transportation methods, such as specialized vehicles equipped with protective cabins and warning signals.

3.2 Strengthening Safety Procedures and Compliance Monitoring

Violations of occupational safety regulations account for 57% of total accidents. The primary causes include lack of knowledge about safety procedures, negligence, or insufficient managerial supervision. To address this issue, stricter safety protocols must be enforced, ensuring that workers fully understand safety regulations before starting their tasks.

In addition to theoretical training, businesses should implement practical drills and simulated scenarios to help workers recognize potential hazards. Monitoring measures such as installing surveillance cameras, using safety sensors, and assigning dedicated safety supervisors can help ensure strict adherence to safety procedures.

3.3 Improving Working Conditions and Work Organization

Poor labor organization and unsafe working conditions contribute to 72% of occupational accident causes. High-risk environments, such as construction sites and factories, expose workers to falling from heights, electrocution, and structural collapses, necessitating thorough risk assessments before work begins.

Solutions include improving worksite design, installing guardrails and safety nets to prevent falls, and clearly marking emergency exits in hazardous areas. Additional measures such as warning signs, zoning of dangerous areas, and ensuring proper working conditions that align with workers' health standards should also be prioritized.

3.4 Enhancing the Quality of Occupational Safety Training

Lack of or inadequate occupational safety training is a cumulative cause in 92% of workplace accidents. Workers who are not properly trained may fail to recognize potential hazards and respond inadequately in dangerous situations.

Enterprises should implement comprehensive safety training programs that go beyond theory and incorporate hands-on practice. Training sessions should include real-life scenarios and simulations to improve workers' reflexes in handling workplace hazards. Periodic assessments and competency tests should be conducted to ensure that all employees master essential safety skills.

3.5 Controlling Equipment and Personal Protective Gear

Unsafe equipment (98%) and the lack of personal protective equipment (100%) are two critical factors that increase the severity of workplace accidents. Enterprises must establish regular equipment inspection and maintenance protocols to detect and repair faults in a timely manner, ensuring that all machinery operates in a safe condition.

Additionally, providing and enforcing the use of personal protective equipment (PPE) is essential. Workers should be properly equipped with helmets, safety harnesses, cut-resistant gloves, protective eyewear, and respirators, depending on their job requirements. Strict monitoring and disciplinary actions should be applied to ensure compliance with PPE usage rules.

The comprehensive implementation of these solutions will not only reduce the number of occupational accidents but also minimize the severity of incidents, thereby improving workplace conditions and effectively protecting workers' lives.

4. Conclusion

The application of the Pareto Principle in analyzing fatal occupational accidents in Vietnam has provided valuable insights into the disproportionate impact of specific accident causes. The findings indicate that traffic accidents (29%) and falls from height (22%) collectively account for more than half of workplace fatalities, emphasizing the need for targeted interventions in these high-risk areas. Additionally, safety violations, poor labor organization, and inadequate training contribute significantly to workplace risks, further necessitating improvements in safety regulations and compliance

enforcement.

This study makes a significant contribution to workplace safety management by offering a systematic, data-driven approach that enables policymakers and industry leaders to prioritize interventions effectively. By applying Pareto analysis, decision-makers can allocate resources more efficiently and develop targeted safety measures that address the most critical risk factors, ultimately leading to a substantial reduction in workplace fatalities.

The research also underscores the importance of strengthening traffic safety measures, enforcing strict adherence to safety protocols, enhancing workplace organization, and improving occupational training programs. Furthermore, integrating advanced risk management systems and adopting technological innovations in workplace safety can significantly mitigate occupational hazards and prevent fatal accidents.

Future research should explore sector-specific accident trends, evaluate the long-term effectiveness of implemented interventions, and propose innovative solutions to further improve workplace safety standards. Additionally, collaboration between regulatory bodies, businesses, and safety professionals is essential to fostering a culture of safety awareness and continuous improvement in occupational health and safety practices.

Ultimately, achieving sustainable improvements in occupational safety requires a persistent commitment to risk prevention, regulatory enhancements, and the development of a proactive safety culture within organizations. Addressing these challenges effectively will contribute to reducing workplace fatalities and creating a safer working environment for all employees in Vietnam.

References

Górny, A. (2015). Application of the Pareto Principle to Accident Analysis to Improve Working Environment. *Proceedings of the 19th Triennial Congress of the International Ergonomics Association (IEA)*. Melbourne, 9-14 August 2015.

Heinrich, H.W., Petersen, D., & Roos, N. (1980). *Industrial Accident Prevention: A Safety Management Approach* (5th ed.). McGraw-Hill.

Institute of Occupational Safety and Health Sciences. (2021). *Analysis Report on Causes of Fatal Occupational Accidents in Vietnam (2015-2020)*.

International Labour Organization (ILO). (2020). *Report on Occupational Safety and Health in Vietnam*.

International Labour Organization (ILO). (2022). *World Statistics on Occupational Accidents and Diseases*. Geneva: ILO Publications.

Juran, J. M., & Godfrey, A. B. (1999). *Juran's Quality Handbook* (5th ed.). McGraw-Hill.

Karwowski, W., & Marras, W. S. (Eds.). (2003). *Occupational Ergonomics: Principles of Work Design*. CRC Press. https://doi.org/10.1201/9780203010457

Khanzode, V. V., Maiti, J., & Ray, P. K. (2012). Occupational Injury and Accident Research: A

Comprehensive Review. *Safety Science*, *50*(5), 1355-1367. https://doi.org/10.1016/j.ssci.2011.12.015

Koch, R. (2011). *The 80/20 Principle: The Secret to Achieving More with Less*. Crown Business.

Mureșan, P. I., Miloșan, I., Senchetru, D., Reit, A. N., Pisu, T., Machedon, G., & Oancea, G. (2019). *Study of Health and Safety in the Manufacturing Industry Using Pareto Analysis*. MATEC Web of Conferences, 299, 05008. https://doi.org/10.1051/matecconf/201929905008

Reason, J. (2016). *Managing the Risks of Organizational Accidents*. Routledge. https://doi.org/10.4324/9781315543543

Vietnam Ministry of Labour, Invalids and Social Affairs (MOLISA). (2019-2024). *Notifications on the Situation of Occupational Accidents*.

Vietnam Ministry of Labour, Invalids and Social Affairs (MOLISA). (2023). *Vietnam Occupational Accident Statistics Yearbook*.