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PREFACE

It is our great pleasure to present the *Proceedings of the 22nd International May Conference on Strategic Management*, a collection of contributions that reflect the dedication, creativity, and scholarly excellence of our academic and professional community.

We would like to express our sincere gratitude to all authors who have contributed their time, knowledge, and enthusiasm to this conference. This year, we are especially proud to highlight that the proceedings include contributions from authors representing more than 30 countries, underscoring the international character and growing impact of the conference. The diversity of topics and perspectives presented here highlights the importance of collaboration and continuous dialogue in addressing contemporary challenges.

We extend our deepest appreciation to our main sponsor, the Ministry of Science, Technological Development and Innovation, for its invaluable support and commitment to advancing research and innovation. We are also grateful to our gold sponsors, Zijin Mining and Zijin Copper, whose generous contributions have significantly supported the successful organization of this conference. In addition, we would like to thank our exhibition partner, MDPI, for their collaboration and engagement in promoting academic exchange.

We also extend our appreciation to the reviewers and members of the organizing committee, whose dedication and careful work ensured the quality and success of the conference. Their efforts have been essential in maintaining high academic standards and in bringing this publication to fruition.

Finally, we thank all attendees for their engagement and for fostering a stimulating and supportive environment. We hope that these Proceedings will serve as a valuable resource and inspiration for future research, collaboration, and innovation.

Thank you!!

Editors

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OCCUPATIONAL SAFETY CHALLENGES IN SERBIA: A LONGITUDINAL ANALYSIS OF INJURY TRENDS AND FORECASTS (2015–2027)

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Abstract: This study examines the dynamics of occupational safety in the Republic of Serbia over a ten-year period (2015–2024). Utilizing official data from the Ministry of Labour and the Statistical Office of the Republic of Serbia, the research employs descriptive statistics, Pearson correlation, and Holt’s linear trend model to analyze the relationship between employment growth and injury rates. The results indicate a significant deterioration in workplace safety, with the incidence rate nearly doubling from 36.64 in 2015 to 67.03 per 100,000 employees in 2024. A very strong positive correlation ($r = 0.894$) was found between workforce expansion and injury frequency, suggesting that economic growth has outpaced the development of safety protocols. Furthermore, the Holt model forecasts a continued upward trajectory for the 2025–2027 period. These findings highlight a critical "implementation gap" between legislative modernization and practical safety outcomes, emphasizing the urgent need for a more robust enforcement of occupational health and safety (OSH) standards.

Keywords: Occupational safety, workplace injuries, incidence rate, forecasting.

1. INTRODUCTION

Occupational health and safety (OSH) represent a fundamental pillar of social justice, workforce well-being, and long-term economic stability (Quinlan et al., 2001). Globally, workplace accidents and occupational diseases pose a staggering burden on public health systems and national economies, with the International Labour Organization (ILO) estimating that nearly 3 million workers lose their lives annually due to work-related factors (Hamalainen et al., 2009). While developed economies have seen a gradual decline in traditional industrial risks, emerging and transition economies continue to face a complex landscape where rapid labor market expansion often outpaces the development of effective safety infrastructures (Dodoo & Al-Samarraie, 2023).

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In the Republic of Serbia, the last decade has been characterized by intensive economic restructuring, marked by a significant influx of foreign direct investment and a strategic pivot toward manufacturing, construction, and heavy industry. These shifts have led to a steady increase in registered employment (Statistical Office of the Republic of Serbia, 2025); however, this growth has not been without its challenges. While the country has undertaken substantial efforts to modernize its legislative framework—most notably by aligning with European Union (EU) standards and the European Statistics on Accidents at Work (ESAW) methodology (Eurostat, 2013)—the actual impact of these regulatory changes on the daily safety of the Serbian workforce remains an open question (Rađenović et al., 2025).

Despite the critical nature of workplace safety, there is a notable absence of comprehensive longitudinal research that critically evaluates the nexus between Serbia's employment growth and its injury trends over the most recent 2015–2024 period. This research gap is particularly evident in the lack of predictive modeling that could guide future policy interventions. Therefore, this study aims to fill this void by conducting a rigorous statistical analysis of injury incidence rates and fatal outcomes. By utilizing advanced statistical tools, including Pearson correlation and Holt's linear trend model (Hyndman & Athanasopoulos, 2018), the research seeks to determine whether the Serbian labor market expansion is "safety-efficient" or if it is characterized by an escalating risk profile. The findings are intended to provide a data-driven foundation for policymakers, OSH professionals, and labor organizations to mitigate workplace hazards in a rapidly evolving economic environment.

2. LITERATURE REVIEW

The academic discourse on occupational safety frequently examines the "vulnerability hypothesis," which suggests that during periods of rapid economic expansion, new and inexperienced workers are often absorbed into high-risk sectors without adequate training, leading to a spike in injury rates (Quinlan et al., 2001). This phenomenon is often intensified by the "intensification of work" (Dodoo & Al-Samarraie, 2023), where production targets prioritize speed over safety protocols. Studies in transitional economies have consistently found that the pressure to remain competitive in global supply chains can lead to a "race to the bottom" in terms of safety standards, particularly in labor-intensive industries like construction and manufacturing (Hamalainen et al., 2009).

In the European context, research utilizing the ESAW framework indicates that while fatal accidents are generally decreasing across the EU, the disparity between Western and Eastern European safety outcomes remains significant (Eurostat, 2023). This "safety-gap" is often attributed to the legacy of industrial infrastructure and the varying capacities of national labor inspectorates to enforce compliance (Rađenović et al., 2025). Furthermore, the role of firm size is critical; small and medium-sized enterprises (SMEs), which form the backbone of the Serbian economy, often face structural barriers to OSH implementation, including limited financial resources and a lack of dedicated safety expertise (Micheli & Cagno, 2010).

Gender-specific risks have also gained prominence in recent literature. While men traditionally account for the majority of fatal injuries due to their overrepresentation in "dangerous" occupations, recent shifts in the labor market have seen an increase in female participation in manufacturing and service-related risks (Stergiou-Kita et al., 2016; Quinn & Smith, 2018; Berube et al., 2025). This necessitates a more nuanced, gender-disaggregated approach to safety monitoring. Moreover, the macro-economic environment plays a decisive role; research by Jovanović et al. (2005) suggests that injury rates in the Western Balkans are highly sensitive to economic cycles, with post-recession periods showing a marked increase in accidents as industrial activities resume at full capacity.

The emergence of the COVID-19 pandemic introduced an unprecedented variable into OSH data. While lockdowns led to an artificial reduction in total injury numbers due to decreased exposure (Vu et al., 2021), the subsequent "reopening" of economies has been marked by a surge in accidents, potentially due to the loss of safety habits or the prioritization of economic recovery over OSH protocols. To address these complexities, modern researchers are increasingly turning to predictive modelling (Zhou et al., 2026). Techniques such as Holt's linear trend and ARIMA models are now considered essential for moving from reactive to proactive safety management (Hyndman & Athanasopoulos, 2018). These predictive tools allow for the identification of looming risks before they manifest in tragic statistics, providing a critical window for intervention in national OSH strategies.

All these facts and existing challenges were the motivation for conducting this study, which had as its goal a longitudinal analysis of workplace injuries trends, as well as their forecasts.

3. METHODS

The dataset used in this study was compiled from two primary official sources to cover the period from 2015 to 2024. Data concerning the total number of registered employees in the Republic of Serbia were obtained from the dissemination database of the Statistical Office of the Republic of Serbia (data.stat.gov.rs). Information regarding the annual frequency of occupational injuries, categorized by gender and severity (total vs. fatal injuries), was retrieved from the official reports of the Ministry of Labour, Employment, Veteran and Social Affairs of the Republic of Serbia. These secondary data sources provided the basis for a longitudinal analysis of occupational safety trends.

Statistical analysis was performed using the R software environment for statistical computing, version 4.5.3 (R Core Team, 2026). The analysis followed a multi-stage approach, starting with descriptive statistics to determine the mean, standard deviation, median, and range for all variables. To ensure scientific comparability and account for the significant expansion of the workforce shown in the official statistics, injury and fatality data were standardized into rates per 100,000 employees. This standardization followed the European Statistics on Accidents at Work (ESAW) methodology (Eurostat, 2013), which provides a consistent framework for calculating incidence rates to monitor health and safety at work. The relationship between employment growth and injury frequency was quantified using the Pearson correlation coefficient, while the significance of the observed trends was evaluated through linear regression. Additionally, a Holt linear trend model, utilizing the forecast package (Hyndman & Khandakar, 2008), was applied to generate a three-year projection of injury incidence rates for 2025–2027.

For high-quality reporting, all tables were generated using the flextable package (Gohel & Skintzos, 2024) and integrated into the manuscript via the officer package (Gohel, 2024). Data visualizations, including trend and forecast plots, were developed using the ggplot2 package (Wickham, 2016). This methodological framework ensured both the statistical rigor and the reproducibility of the findings presented in the study.

4. RESULTS AND DISCUSSION

The following section presents the statistical findings regarding occupational safety in Serbia for the period between 2015 and 2024. The analysis is structured to first provide a comprehensive overview of the raw data concerning employment levels and the frequency of injuries, followed by a detailed descriptive statistical summary. Finally, standardized incidence

and fatality rates are calculated to assess the relative risk within the workforce independently of fluctuations in total employment.

Table 1 provides a baseline overview of the workforce size and the absolute number of occupational injuries, categorized by gender and severity (fatal vs. non-fatal). These data serve as the foundation for the subsequent analytical steps and offer an initial insight into the scale of occupational accidents over the observed decade.

Table 1. Overview of Employment and Occupational Injuries in Serbia by Gender (2015–2024)

Year	Total Number of Employees	Occupational injuries	Non-fatal injuries	Fatal injuries	Occupational injuries by gender	
					Male	Female
2015	1989617	729	724	5	533	174
2016	2009785	771	763	8	531	240
2017	2062588	907	898	9	640	267
2018	2131079	795	788	7	589	206
2019	2173135	1247	1233	14	801	446
2020	2215475	1237	1226	11	790	447
2021	2273591	1301	1289	12	888	413
2022	2310035	1138(1137*)	1127	11	770	367
2023	2360588	1322	1308	14	866	456
2024	2368948	1588	1567	21	1058	530

*The total number of occupational injuries in 2022 was 1,138; however, due to missing gender data for one individual, the combined total for males and females is 1,137.

Following the initial overview of the data, a more detailed statistical treatment was required to understand the central tendencies and the extent of fluctuations within the observed variables. To achieve this, descriptive statistics were calculated for each category of occupational injury. These indicators, including the mean, standard deviation, and range, provide a clearer picture of the stability and distribution of workplace accidents over the ten-year period. The summary of these statistical measures is presented in Table 2.

Table 2. Descriptive Statistics of Occupational Injuries in Serbia (2015–2024)

Variable	Mean	Median	St Dev	Min	Max	Range
Occupational Injuries	1,103.50	1,187.50	287.84	729.00	1,588.00	859.00
Fatal Injuries	11.20	11.00	4.52	5.00	21.00	16.00
Male Injuries	746.60	780.00	171.57	531.00	1,058.00	527.00
Female Injuries	354.60	390.00	123.38	174.00	530.00	356.00

Table 2 shows that both total and fatal occupational injuries in Serbia varied considerably during the 2015–2024 period. Overall, the results indicate a substantial upward trend and significant variability, particularly in the latter half of the decade.

For total occupational injuries, the values show a dramatic increase, ranging from a minimum of 729 cases in 2015 to a maximum of 1,588 in 2024. This represents more than a twofold increase in the absolute number of injuries over ten years. The mean number of total injuries stands at 1,103.50, but the high standard deviation (287.84) highlights a pronounced dispersion of data, indicating that the growth was not uniform but characterized by sharp fluctuations, especially after 2018.

A similar pattern of intensification is observed in fatal injuries. The minimum value was recorded at the beginning of the period (5 cases in 2015), while the maximum reached 21 cases in 2024. Although the mean number of fatalities is 11.20 per year, the standard deviation of 4.52 relative to this mean suggests significant annual volatility. The peak recorded in 2024 represents a critical point in the observed period, nearly doubling the annual average.

Regarding the gender distribution of injuries, the data reveals a substantial disparity, though both groups followed an increasing trend. Male injuries remain predominant, with a mean of 746.60 cases and a peak of 1,058 in 2024. However, female injuries showed even more drastic proportional growth, rising from a minimum of 174 (2015) to a maximum of 530 (2024). The high standard deviation in both categories (171.57 for males and 123.38 for females) further confirms the lack of stability in occupational safety outcomes throughout the decade.

While absolute numbers provide an initial scale of the problem, they do not account for the growth in the total workforce. Therefore, to assess the actual risk independently of employment fluctuations, standardized incidence and fatality rates per 100,000 employees were calculated. These indicators, which offer a more accurate assessment of relative risk, are presented in Table 3.

Table 3. Annual Occupational Injury and Fatality Rates per 100,000 Employees (2015-2024)

Year	Incidence_Rate	Fatality_Rate
2015	36.64	0.25
2016	38.36	0.40
2017	43.97	0.44
2018	37.31	0.33
2019	57.38	0.64
2020	55.83	0.50
2021	57.22	0.53
2022	49.26	0.48
2023	56.00	0.59
2024	67.03	0.89

The results show a significant and consistent increase in the incidence rate throughout the observed period. The occupational injury incidence rate nearly doubled over the decade, rising from a minimum of 36.64 per 100,000 employees in 2015 to a peak of 67.03 in 2024. This upward trend suggests that the growth in injuries is not merely a consequence of increased employment but indicates a genuine rise in the frequency of accidents relative to the workforce. The most notable surges occurred between 2018 and 2019, where the rate jumped from 37.31 to 57.38, remaining at elevated levels thereafter.

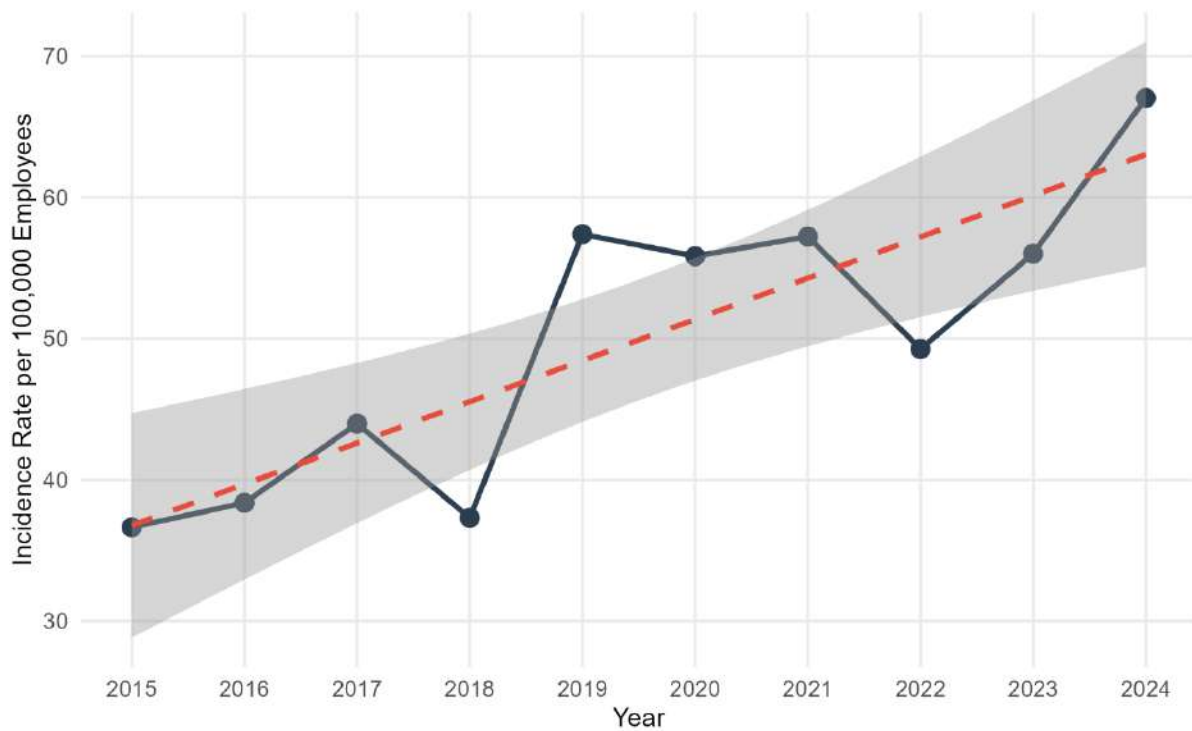
The fatality rate exhibits similar, albeit more volatile, patterns. Starting at a minimum of 0.25 deaths per 100,000 employees in 2015, the rate reached its maximum of 0.89 in 2024. Despite minor fluctuations — such as the slight decline observed in 2020, which can likely be attributed to the COVID-19 pandemic and the subsequent reduction in industrial and on-site work activities — the overall trajectory indicates a concerning and consistent increase in the risk of fatal outcomes. The peak recorded in 2024 is particularly striking, as it is nearly four times higher than the rate observed at the beginning of the period, highlighting a serious deterioration in workplace safety outcomes.

To further investigate the relationship between labor market expansion and occupational safety, a Pearson correlation analysis was conducted. The test aimed to determine the extent to which the increase in the total number of employees is associated with the rising trend of occupational injuries. The results of this analysis are summarized in the correlation matrix presented in Table 4.

Table 4. Pearson Correlation Matrix of Employment and Injury Variables

Variable	Total Employees	Occupational Injuries	Fatal Injuries	Male	Female
Total_Employees	1.000	0.894	0.804	0.906	0.855
Occupational_Injuries	0.894	1.000	0.940	0.991	0.980
Fatal_Injuries	0.804	0.940	1.000	0.939	0.915
Male	0.906	0.991	0.939	1.000	0.946
Female	0.855	0.980	0.915	0.946	1.000

The analysis confirms an exceptionally strong positive relationship between the size of the workforce and the incidence of workplace accidents. Specifically, the correlation between Total Employees and Occupational Injuries is remarkably high ($r = 0.894$), indicating that employment expansion is almost inextricably linked to a rise in reported injuries. Furthermore, a very strong correlation is observed between employment levels and Fatal Injuries ($r = 0.804$), as well as between employment and injuries among Male ($r = 0.906$) and Female ($r = 0.855$) workers. These results, all statistically significant ($p < 0.001$), suggest that the intensification of economic activity and labor market growth in Serbia has not been accompanied by a proportional strengthening of occupational safety and health (OSH) frameworks.

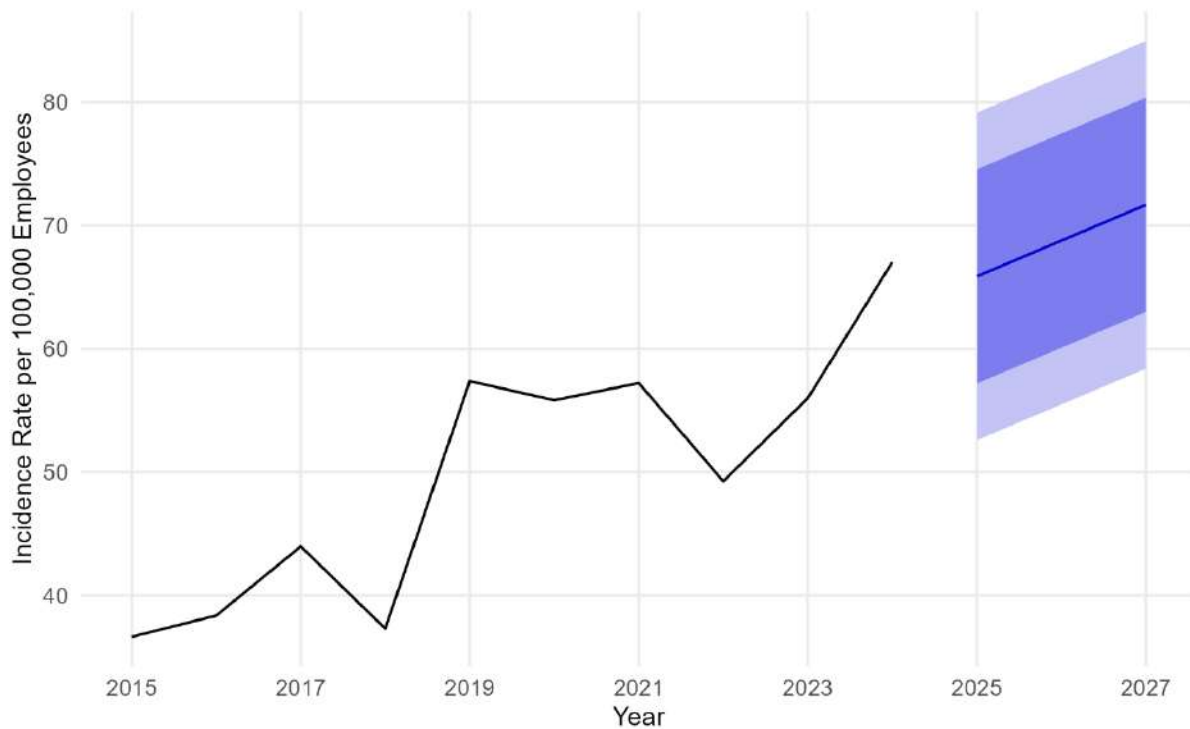


Note: The dashed line represents the linear regression trend; the shaded area indicates the 95% confidence interval.

Figure 1. Trend of Occupational Injury Incidence Rates in Serbia (2015-2024)

The visual representation of the incidence rate trend (Figure 1) confirms a steady and significant deterioration in occupational safety over the ten-year period. Linear regression analysis reveals that the upward trend is statistically highly significant ($F(1, 8) = 20.4$, $p = 0.0019$), with time explaining 71.8% of the variance in the increased injury rates ($R^2 = 0.718$). These findings, coupled with the previously established correlation, provide robust evidence

that workplace safety risk in Serbia has fundamentally increased, independently of the overall growth in employment.



Note: The blue line represents the forecast trend; the shaded areas indicate 80% and 95% confidence intervals.

Figure 2. Forecast of Occupational Injury Incidence Rates for 2025–2027

To provide an outlook on future workplace safety conditions, a Holt linear trend model was applied for a three-year projection period (2025–2027). The model predicts a sustained upward trajectory, with the incidence rate expected to rise from 65.88 in 2025 to 68.78 in 2026, reaching 71.68 per 100,000 employees by 2027. This continued growth, extending beyond the current observation period, indicates that without significant policy changes, the risk of occupational injuries in Serbia is likely to intensify. Furthermore, the 95% confidence interval suggests that in a least-favorable scenario, the rate could escalate to 84.97 by 2027, highlighting the urgent need for more robust occupational safety and health (OSH) strategies.

The findings of this study reveal a distressing paradox in Serbia's labor market: while the economy has successfully expanded its workforce, it has failed to maintain, let alone improve, the safety of its workers. The strong correlation ($r = 0.894$) between employment growth and injury rates suggests that the current expansion is 'safety-inefficient.' This indicates that new jobs are likely being created in high-risk sectors (such as construction or manufacturing) or that the pace of hiring has outstripped the capacity of occupational health and safety (OSH) training and inspection services. Despite the adoption of the Strategy for Occupational Safety and Health in the Republic of Serbia for 2018–2022 (Ministry of Labour, Employment, Veteran and Social Affairs, 2018), our findings suggest that the strategic goals of reducing workplace injuries were not fully realized in practice.

While the legal framework was further modernized with the enactment of the new Law on Occupational Safety and Health in 2023 (National Assembly of the Republic of Serbia, 2023), the statistical data for 2024 shows a record peak in both total and fatal injuries. This

discrepancy between the formal adoption of high-level strategies and the deteriorating safety outcomes on the ground indicates a significant 'implementation gap.'

Furthermore, the steady rise in the fatality rate, which reached its peak in 2024 (0.89 per 100,000), points toward a potential erosion of safety standards. While this figure is below the European Union average of approximately 1.63 fatal accidents per 100,000 employees recorded in recent years (Eurostat, 2023), the rapid fourfold increase within the Serbian context suggests a critical deterioration in safety outcomes. The slight decrease in injuries during 2020 confirms that the risk is directly tied to the intensity of physical labor, as the COVID-19 lockdowns temporarily lowered the figures. However, the rapid rebound suggests that no structural improvements in OSH were implemented during that period. Finally, the Holt model projection serves as a critical warning. If the current trajectory remains unaddressed, the incidence of injuries will continue to escalate, reaching 71.68 per 100,000 employees by 2027. These results emphasize that occupational safety must be integrated into national economic growth strategies, rather than being treated as a secondary regulatory requirement.

5. CONCLUSION

This research provides a comprehensive longitudinal analysis of occupational safety in Serbia over a pivotal decade (2015–2024). The statistical evidence conclusively demonstrates that the expansion of the Serbian labor market has been accompanied by a significant and disproportionate increase in workplace injuries. The exceptionally strong correlation ($r = 0.894$) between employment growth and injury rates, along with the doubling of the incidence rate per 100,000 employees, indicates that economic growth has outpaced the development of effective safety infrastructures.

Furthermore, the study highlights a critical "implementation gap" between the adoption of national strategies and laws and the actual safety outcomes on the ground. Despite legislative modernization, fatal injuries reached their peak at the end of the observed period, suggesting that formal regulatory changes have yet to produce a safer working environment. The Holt model projection for 2025–2027 serves as an urgent warning that without immediate and targeted interventions, the risk to the Serbian workforce will continue to escalate.

In conclusion, it is imperative for Serbian policymakers to move beyond formal compliance and focus on the practical enforcement of safety standards. Strengthening labor inspections, enhancing mandatory OSH training, and prioritizing safety in high-growth industrial sectors are essential steps to ensure that economic progress does not come at an unacceptable cost to human life and health.

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