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Identification Of Critical Factors In Road Construction Safety: An Analysis Using Spss

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Abstract: Road construction site accidents pose a significant threat to worker safety, resulting in delays, injuries, and fatalities. Despite efforts to improve safety, accidents continue to occur, highlighting the need for a deeper analyzing of the critical factors affecting road construction safety. This study aims to find out the critical factors influencing safety in road construction site at worker's point of view, providing valuable insights for stakeholders to develop targeted interventions. A questionnaire survey was administered to 500 road construction workers in Kerala, focusing on aspects such as Personal Protection Equipment(PPE), signboards, training, and communication. The responses were analyzed using Statistical Package for the Social Sciences (SPSS) software. The findings reveal that PPE availability and usage, signboard presence and effectiveness, training quality and frequency, and communication effectiveness are the most critical factors influencing road construction safety. This study contributes to the existing body of knowledge, informing policy decisions, safety protocols, and regulations to enhance worker safety and reduce accidents in road construction sites. The findings have significant implications for construction companies, policymakers, and regulatory bodies, highlighting the need for a proactive approach to safety management.

Index Terms: Road construction safety, workers perspective, critical factors, SPSS, PPE, signboards, training, communication.

1. INTRODUCTION

Road construction is very important in modern world, representing the physical personification of connectivity, accessibility, and development. In case of new type of highways, roads have contributed a significant role in molding communities, industry, and lifestyles. However, road construction sites are often plagued by accidents, injuries, and fatalities, primarily due to unsafe behaviors by workers and supervisors various studies have investigated the critical factors influencing road construction safety, like the usage of PPE, signboards, communication & training. However, there is a need for a comprehensive review of the existing literature to identify the most critical factors, challenges, and future directions for enhancing road construction safety. This paper aims to provide a critical review of the factors, challenges, and future directions for enhancing road construction safety. A comprehensive literature review was conducted, analyzing existing research on road construction safety, including studies on the use of technology, such as Internet of Things (IoT) and Artificial Intelligence (AI), to improve safety monitoring and management. The following literature reviews provide a summary of the existing research on road construction safety: A. Bener et al. (2003)[1]: Studied strategies to enhance road safety in emerging countries, highlighting the importance of road engineers in improving security. C. Zhu et al. (2022)[51]: Identified and monitored road construction safety factors using Unmanned Aerial Vehicles (UAVs) and Artificial Intelligence (AI).D. Nkurunziza (2020)[3]: Investigated road safety management techniques in Rwanda, highlighting the need for improved safety measures and enforcement of regulations. E. Kurakina et al. (2018)[7]: Analyzed road construction parameters and conditions, identifying factors contributing to road accidents and proposing solutions for improvement. F. Handoko et al. (2020)[9]: Examined the impact of Occupational Health and Safety (OSH) on road construction worker performance, highlighting the importance of proper use of work equipment and safety education. F. J. Gichaga (2017)[10]: Researched influence of road innovations on road safety and linked features in Kenya, highlighting its need for road safety education and improved road design. H. Song et al. (2021)[15]: Conducted an experimental study on real-time warning models for highway engineering construction safety using Internet of Things (IoT) technology. I. K. Yankson et al. (2022)[18]: Investigated hazard perceptions and self-reported non-injury occupational ailments among road construction workers in Ghana, highlighting the need for improved safety measures and training. L. Komackova et al. (2016)[22]: Analyzed factors affecting road safety, highlighting the importance of driver behavior, vehicle construction, and infrastructure quality. L. Shbeeb (2024)[25]: Evaluated safety management at the Amman bus rapid transit project construction site, highlighting the need for improved general site safety and maintenance protocols. The protection to lives, project efficiency and its success can be improved by proper management of these factors using planning, education, regulation adherence, and technology adoption.

2. CONDUCTION OF QUESTIONNAIRE SURVEY

The development of infrastructure, particularly road construction, causes remarkable threats to employees and the people. To reduce these threats, a questionnaire regarding road construction safety is essential. This tool ensures comprehensive safety measures, identifies safety risks, informs decisionmaking, enhances safety training and awareness, improves communication and supervision, customizes safety solutions, fosters a culture

of safety, and ensures compliance with regulations. By gathering data from this questionnaire, companies can develop significant safety measures, reducing accidents and contributing to project success and sustainability.

Worker's Questionnaire

Worker's safety relation questionnaires are crucial for determining risks, enhancing interactions, updating policy development, and ensuring cooperation. They cover aspects like PPE, training, safety practices, work environment, incident reporting, and worker engagement. For improving safety in road construction projects this questionnaire plays a vital role. By gathering and analyzing safety data, it identifies risks, ensures regulatory compliance, and fosters a culture of continuous improvement, ultimately contributing to healthier working conditions and a better social setting. This questionnaire survey was done fully in offline mode and the data was collected by going directly to the workers. Respondents will rate their answers on a five-point Likert scale: Strongly Agree, Agree, Neutral, Disagree, Strongly, Disagree. This scale allows researchers to capture the degree of agreement or disagreement, making it easier to interpret workers' perceptions and identify trends across different aspects of site safety.

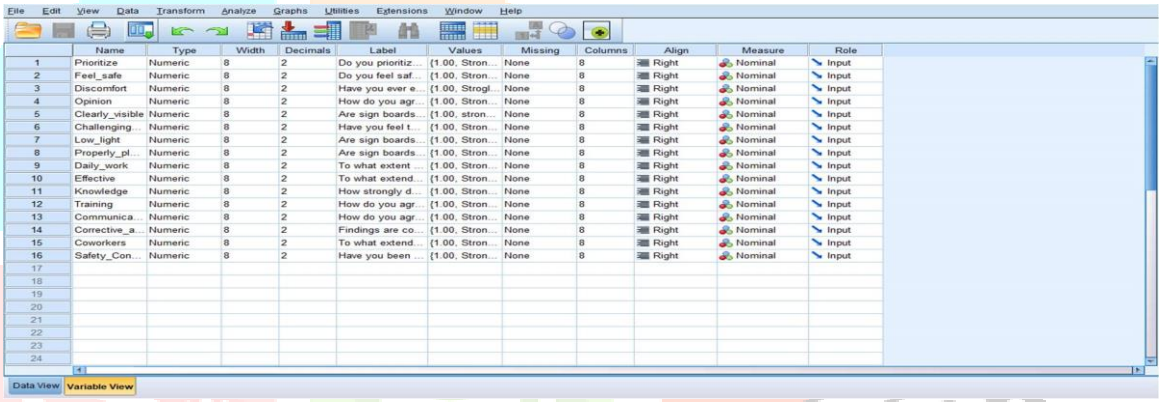


Fig 1 Variable view in SPSS

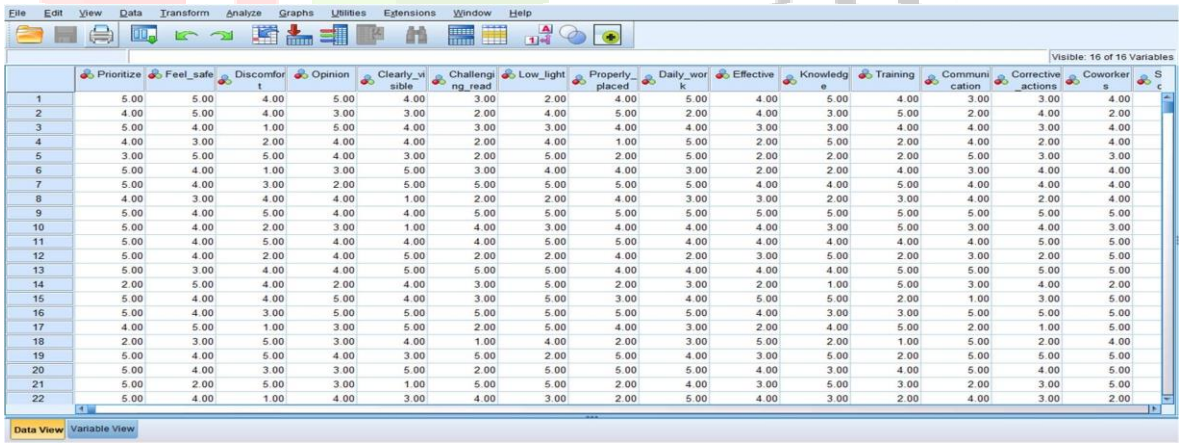
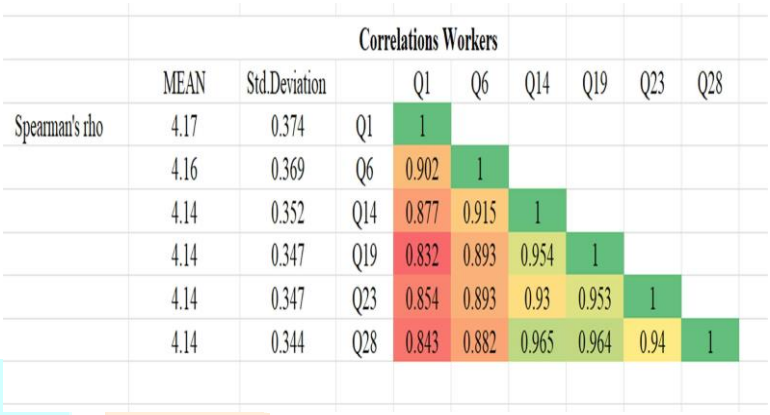


Fig 2 Likert scale data in SPSS

3. SPSS

Spearman Correlation Analysis

Through Spearman correlation analysis conducted on 30 questionnaire responses six key factors influencing were detected. The six safety factors went through more analysis, resulting three factors that's mainly affect safety in road construction from the workers point of view.



Correlations Workers

	MEAN	Std.Deviation		Q1	Q6	Q14	Q19	Q23	Q28
Spearman's rho	4.17	0.374	Q1	1					
	4.16	0.369	Q6	0.902	1				
	4.14	0.352	Q14	0.877	0.915	1			
	4.14	0.347	Q19	0.832	0.893	0.954	1		
	4.14	0.347	Q23	0.854	0.893	0.93	0.953	1	
	4.14	0.344	Q28	0.843	0.882	0.965	0.964	0.94	1

Fig.3 workers spearman correlation analysis.

Table.1 six factors influencing safety in road construction site from perspective of workers

Q1	All the essential PPE are not supplied in road construction site?
Q6	Signage and sign boards used in road construction site is efficiently transferring safety information?
Q14	Proper assessment is carried out for equipment, scaffolding, and work areas?
Q19	New employees are provided with thorough orientation and guidance before starting work on road construction sites?
Q23	Orientation given makes you empowered in recognizing risky behaviors that results in accidents or injuries?
Q28	Rewards or appreciation programs in place for encouraging safe behaviors and demotivating risky ones?

Analysis of Spearman correlation revealed a significant provision of necessary PPE in road construction zones positively correlates with safety of laborers. This suggests that verifying PPE availability offer improved safety from the workers' point of view. Furthermore, the study highlighted for enhancing safety in road construction by providing adequate PPE for workers.

Multinomial Logistics Regression Analysis

A multinomial logistics regression analysis is carried in the three factors after the spearman correlation analysis carried out in SPSS, they significantly influence safety in road construction site from the worker's perspectives. Descriptive statistics as Model Fitting Information, Goodness of Fit, Pseudo Rsquare

4. RESULT

The SPSS is cornerstone software in social science research, offering robust statistical analysis, data management, and visualization capabilities. With a simple interface and efficient procedure, SPSS simplifies the analytical process, making it accessible to researchers of varying expertise levels. Its versatility, scalability, and comprehensive suite of tools have made it an indispensable asset for researchers and practitioners worldwide. Chi-square statistics is used to assess the model fitness. This study utilizes a statistical method to analyze the goodness of fit of a model, in the case of evaluating model fitness, it is also used to identify the similarity between observed data and the expected data under the model in investigation. Table.2 shows the model fitting information evaluating the Chi- Square statistics.

Table.2 model fitting information

Model Fitting Information				
Model Fitting Criteria -2 Log Model Likelihood		Likelihood Ratio Tests		
		Chi-Square	df	Sig.
Intercept Only	122.807	46.692	24	0.004
Final	76.116			

For statistical models, especially in case of generalized linear models (GLMs) Pearson and deviance statistics are used for goodness of fit. Table.3 below shows the goodness of fit for statistical models revealing the Pearson and Deviation statistics.

Table.3 goodness of fit

Goodness-of-Fit			
Chi-Square		Df	Sig.
Pearson	14.230	16	0.582
Deviance	16.610	16	0.411

Fitness of data is indicated by Pearson (14.230) and deviance (16.610). In which the p-value is related to these statistics shows if observed values markedly changes from the expected values under the model. Here these tests have p-values higher than 0.05 which indicates these tests are not statistically significant, so this recommends there is no major difference between the observed values and model anticipations. The deficiency of notable variation results in a decision that this model clearly shows connection between the variables, giving more strength in its accuracy and consistency.

Pseudo R-Square

Table.4 pseudo r-square

Pseudo R-Square	
Cox and Snell	0.125
Nagelkerke	0.133
McFadden	0.048

Pseudo R-Square values in linear regression are used in the case of logistic regression and other type of GLMs. They give a estimate of how well the model defines the variation in the dependent variable. The Pseudo R-Square are Cox and Snell (0.125), Nagelkerke's (0.133) and McFadden (0.048).

- Cox and Snell (0.125): Model shows 12.5% of the difference in the dependent variable.
- Nagelkerke's (0.133): Recommends that the model explains 13.3% of the variance, which is a small change from Cox and Snell's measure.
- McFadden (0.048): Indicates that the model explains 4.8% of the variance in the dependent variable.

Here we can see the values are seem less, but they can still represent major impacts in condition of logistic regression, where pseudo R-Square values are generally lesser than those in linear regression.

5. DISCUSSIONS

Stakeholders can improve road construction safety by finding critical factors in the projects. By following safety protocol, educational initiatives, and evaluation of economic factors effectively provide to a safer working condition throughout the project. This integrated strategy leads to reduce the chances of risks and damages, increase the total project output, also develop a safety culture that gives profits to every investors in road construction work. In summary, the study represents an integrated strategy to safety management. It is targeting on compliance, education, and economic factors is important for reducing hazards and improving safety outcomes in construction of roads. Using these policies, investors can confirm the protection of the workers and productive project delivery.

6. CONCLUSION

This study undertook a comprehensive survey of approximately 500 workers to identify critical factors affecting road construction safety. The findings revealed distinct concerns from each group, highlighting risks associated to the influence of sign boards and connectivity systems on road construction sites. Meanwhile, workers stressed the need for adequate PPE in road construction zones, highlighting the imperative of ensuring the safety and well-being of those working on-site. Furthermore, the study's results showed that most participants believed that the presence of work zones on the road might increase the probability of crash occurrence, with the transition area identified as the area with the highest risk probability of causing a crash in the work zone. By

analyzing these diverse perspectives, the study provides valuable insights into the complex factors influencing road construction safety, emphasizing the importance of continuous monitoring, adaptation to feedback, and ongoing training in developing a culture of safety in road construction projects. Ultimately, the study's findings underscore the need for a multi-faceted approach to road construction safety, one that takes into account the diverse perspectives and concerns of workers.

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