

STANDARDISED SAFETY ASSESSMENT FRAMEWORK FOR ROAD USERS IN SRI LANKAN ROAD WORK ZONES

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The critical road user safety deficiencies prevalent within road work zones across Sri Lanka are addressed in this research, as the ongoing construction and maintenance of transportation infrastructure are associated with significantly heightened risk exposure for motorists, pedestrians, and workers. A comprehensive nationwide analysis identified that the primary contributor to these elevated hazards is a widespread non-compliance with national guidelines for traffic control in road work areas. The core safety challenges manifest as inadequate traffic control measures, insufficient illumination, a complete absence or glaring inadequacy of warning signage, inconsistent enforcement of established safety protocols, and adverse geographic or environmental conditions that are not properly mitigated.

A fundamental methodological gap was identified: inconsistencies in risk assessments conducted by consulting engineers. These variations arise from subjective judgment, uneven expertise, and the lack of a standardised quantitative framework, which hinders accurate classification of risk levels and delays effective mitigation. To address this, the study introduces a novel online risk assessment platform powered by machine learning (ML), designed to deliver automated, objective, and consistent evaluations of road work zone safety. The methodology applied a mixed-method strategy across 40 representative work zones selected for functional relevance, regional diversity, and accessibility, spanning urban, rural, and highway settings. Field surveys captured physical conditions, traffic characteristics, and compliance data, complemented by expert engineering insights. Risks were quantified along three dimensions—severity, exposure, and likelihood—using a weighted Likert-scale applied to 40 observed factors. These were clustered via K-means analysis to empirically define thresholds for low, medium, and high-risk categories, forming a validated baseline for ML model training. Supervised ML algorithms were developed and optimised using this dataset, with cluster-derived labels serving as ground truth. Their primary task was the classification of work zones into predefined risk levels. Validation involved comparison against independent expert evaluations, ensuring alignment between algorithmic outputs and engineering judgment.

Results showed a concerning prevalence of medium- and high-risk zones, reflecting systemic non-compliance with standards for signage, lighting, and protective barriers. Among the tested models, Random Forest achieved the best balance of accuracy and interpretability, supported by feature importance analysis, and was selected as the optimal algorithm for deployment. The final platform provides scalable and objective assessments by calculating a composite Risk Index that integrates model predictions with an audited work zone database. Risk is categorised into three levels: low, medium, and high. This tool serves as a decision-support system for engineers, policymakers, and contractors, enabling targeted, data-driven safety interventions. Key recommendations are to institutionalise the platform for audits, establish a standardised national checklist, and adopt a hybrid audit model combining quantitative and qualitative assessments. Future research should integrate driver behaviour data and AI-based image recognition to enhance comprehensive road safety management in Sri Lanka.

Keywords: Machine Learning, Urban & rural road, Road safety, Safety index

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BACKGROUND

High accident risk in Sri Lankan road

Non-compliance with traffic control guidelines in Work Zone.

Unmitigated adverse geographic and environmental conditions.

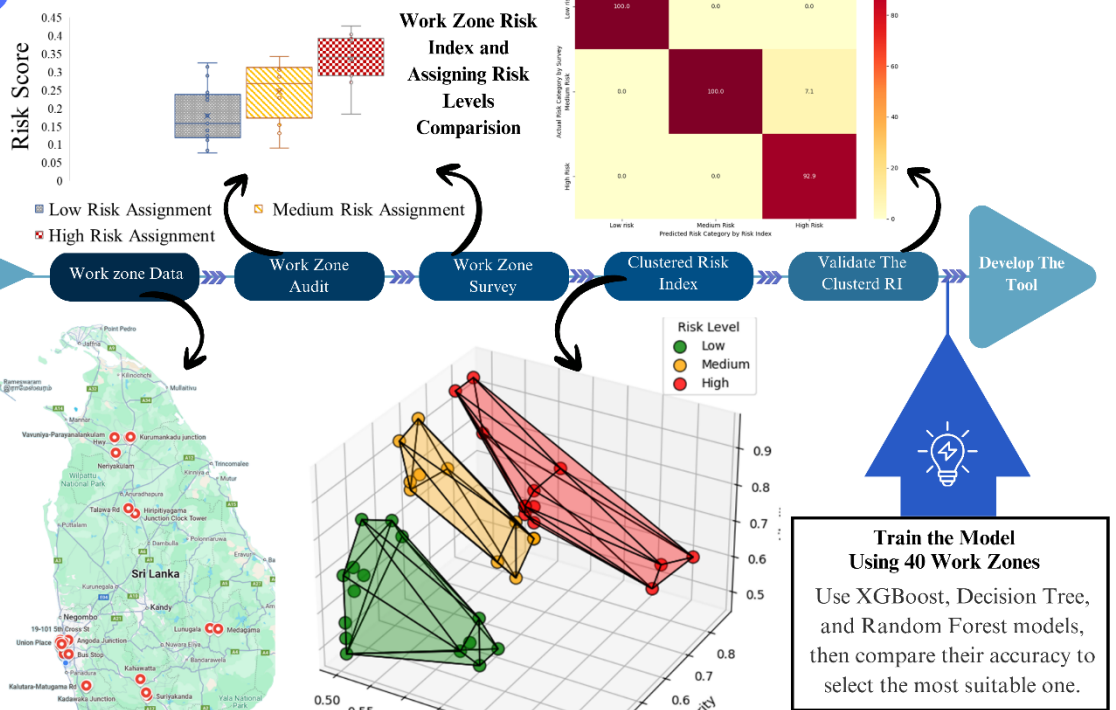


Risk Assessment Framework

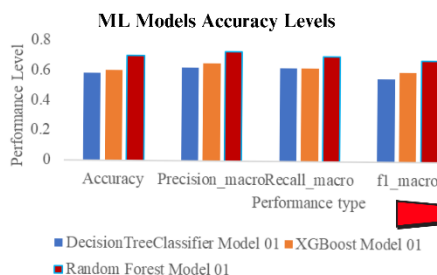


- To evaluate the adequacy and real-world application
- To develop and validate a predictive, data-driven model
- To create a practical risk quantification tool

METHODOLOGY



RESULTS & RECOMMENDATION



Work Site Risk Assessment

Form

Audit (Annual Average Daily Traffic)

Absence Barricade Boards

Absence Road Humps with Road Markings

Absence Runble Strips

Absence Traffic Cones

Absence Warning Lighting Devices

Model Predictions

Random Forest Classifier 1

Prediction: Medium Risk

The site is not safe to operate in its current state but can be improved with safety modifications for short-term operation.

Statistical score: 0.2562111801242236

Recommended to develop image recognition.