

Existing Research found in light literature search:

Literature Search on Data-Driven Framework for Pedestrian Safety Analysis and Project Prioritization

“A new data-driven model for vehicle and pedestrian safety: statistical approach based on spatial decision-making” *International Journal of Injury Control and Safety Promotion*, 2025
<https://pubmed.ncbi.nlm.nih.gov/40742631/>

Minimizing the losses that occur after traffic accidents is a primary duty for all humanity. To do so, it is necessary to examine and analyses the potential risk factors that affect the severity of traffic accidents. In this article, a new spatial decision-making-based statistical solution methodology is proposed to determine the accident risk factors that occur in three different accident types using 5-year (2015–2019) accident data. (I) 22 independent variables and 157 sub-variables were determined for the traffic accident categories where vehicle-vehicle, vehicle-pedestrian and vehicle-other collision types occurred, (ii) the fuzzy simple weight calculation method was preferred to determine the effects of risk factors on accident categories, (iii) spatial analyses of risk factors were provided *via* geographical information system and combined with the obtained effect values, (iv) the current effect of risk factors on accident categories was tested with the multinomial logistic regression model. The multinomial logistic regression model results revealed a strong model fit (McFadden $R_2 = 0.749$) and identified the variables that significantly increase or decrease the probability of each crash type compared to the reference category. For instance, while the geo-intersection had the highest effect for vehicle-vehicle crashes, the pedestrian defect had the highest impact for vehicle-pedestrian crashes. Spatial analysis results also showed that accident severity tends to be higher in the western, southern, and central regions of Türkiye. The proposed methodology offers a comprehensive framework that supports evidence-based policy development for improving traffic safety. The resulting findings serve as a guide for local administrators, policy makers, and traffic safety experts with regard to vehicle and pedestrian safety.

“Road safety assessment and risks prioritization using an integrated SWARA and MARCOS approach under spherical fuzzy environment” *2 Neural Computing and Applications*, 2022
<https://link.springer.com/article/10.1007/s00521-022-07929-4>

There are a lot of elements that make road safety assessment situations unpredictable and hard to understand. This could put people's lives in danger, hurt the mental health of a society, and cause permanent financial and human losses. Due to the ambiguity and uncertainty of the risk assessment process, a multi-criteria decision-making technique for dealing with complex

systems that involves choosing one of many options is an important strategy of assessing road safety. In this study, an integrated stepwise weight assessment ratio analysis (SWARA) with measurement of alternatives and ranking according to compromise solution (MARCOS) approach under a spherical fuzzy (SF) set was considered. Then, the proposed methodology was applied to develop the approach of failure mode and effect analysis (FMEA) for rural roads in Cosenza, southern Italy. Also, the results of modified FMEA by SF-SWARA-MARCOS were compared with the results of conventional FMEA. The risk score results demonstrated that the source of risk (human) plays a significant role in crashes compared to other sources of risk. The two risks, including landslides and floods, had the lowest values among the factors affecting rural road safety in Calabria, respectively. The correlation between scenario outcomes and main ranking orders in weight values was also investigated. This study was done in line with the goals of sustainable development and the goal of sustainable mobility, which was to find risks and lower the number of accidents on the road. As a result, it is thus essential to reconsider laws and measures necessary to reduce human risks on the regional road network of Calabria to improve road safety.

“Integrating Vulnerable Road User Safety Criteria into Transportation Asset Management to Prioritize Budget Allocation at the Network Level” *MDPI*, 2022

<https://www.mdpi.com/2071-1050/14/14/8317>

Safety is a major worldwide concern due to the increasing number of fatalities of vulnerable road users (VRUs). VRUs are pedestrians, bicyclists, and motorcyclists, and their safety is a priority when making infrastructure management decisions. Traditionally, transportation agencies have adopted transportation asset management (TAM) practices based on performance measures to assess the physical condition of transport infrastructure. This paper describes a framework to incorporate VRU’s safety into the TAM decision-making process. The main objective of the VRU-TAM framework is to mitigate pedestrian fatalities by improving the decision-making process at the strategic and operational management level. The VRU-TAM framework is composed of four phases: assessment, prioritization, scenario analysis, and results. It includes a prioritization methodology using a safety-weighted effectiveness ratio (SWER) to consider pedestrian safety factors and costs in the decision-making process. In a broader perspective, pedestrian safety is affected by driver, demographic, pedestrian, infrastructure, and policy related factors. The decision-making criteria reflected in SWER considers the asset importance, location, pedestrian safety risk, costs, and remaining life in the budget allocation process, and adopts the dynamic bubble up (DBU) technique for budget

prioritization at the network level. An example is presented for crosswalks to demonstrate the applicability of the methodology to evaluate different budget-driven scenarios for funding allocation. As a conclusion, it is demonstrated that the outcomes of the budget-driven scenarios following the method that incorporates safety criteria, with tangible metrics, offer a deeper understanding of the effects of budgetary constraints on backlog costs and the remaining life of infrastructure assets.

“Achieving Vision Zero: Data-Driven Investment Strategy to Eliminate Pedestrian Fatalities on a Citywide Level” TRR 2519, 2019 <https://journals.sagepub.com/doi/abs/10.3141/2519-16>

San Francisco, California, completed a robust, data-driven process to define and prioritize pedestrian safety improvement projects. The goal of this process was to identify the lowest cost and most effective strategy to meet a citywide goal to eliminate traffic fatalities. A team of planners, engineers, and epidemiologists examined longitudinal pedestrian collision data to identify the major factors that corresponded with pedestrian– vehicle crashes in San Francisco and focused on locations with the highest frequency and severity of pedestrian injuries.

Collision profiles were developed to classify the most frequent types of vehicle–pedestrian collisions at each intersection. Corresponding pedestrian safety countermeasures, selected for their relatively high effectiveness and low cost, were matched with applicable collision profiles.

A scenario planning process was used to formulate a final investment strategy: a prioritized pedestrian safety project list that targeted the specific needs at priority locations. The data-driven capital planning process helped to secure funding commitments to implement pedestrian safety projects at 195 intersections over the course of 5 years, which moved San Francisco closer to its policy objective to eliminate pedestrian fatalities. All cities face a challenge in the employment of rigorous analysis to select and prioritize improvement projects with limited funding. This study created a new, streamlined approach to capital-constrained project development and prioritization that is applicable to all types of safety improvements across any jurisdiction. 4

“Coordinating Road Safety Reviews with Bicycle and Pedestrian Project Prioritization: Final Report on Development and Implementation of a Guide for North Carolina Agencies” NCDOT, 2018 <https://rosap.ntl.bts.gov/view/dot/62357>

Concerted, well-coordinated, and performance-driven efforts are needed by state and local agencies to achieve North Carolina’s strategic safety goals since pedestrians and bicyclists continue to experience a high injury and fatality rate in traffic crashes. This report summarizes the development of the North Carolina Pedestrian and Bicycle Road Safety Assessment Guide, for use by North Carolina agencies to improve the safety project development process. The

Guide aims to foster an inter-agency collaborative and data driven approach to identify pedestrian and bicycle safety problems, diagnose problems through road safety assessments (RSAs), identify potential countermeasures, and document the results in RSA reports. The RSA report can be used as a detailed plan for longer-range safety project development and to identify more immediate safety improvements such as signal timing changes, re-channelization, or enhanced enforcement. There are challenges for local and regional agencies and NCDOT to implement this approach primarily resulting from limited resources and staffing levels across all of these agencies, but through incorporation of these activities into regular work processes, it may be feasible to streamline and sustain such activities to enhance safety in NC communities.

“Uncertainty-based prioritization of road safety projects: An application of data envelopment analysis” *Transport Policy*, 2016

<https://www.sciencedirect.com/science/article/abs/pii/S0967070X16303985>

The use of ranking methods in safety retrofit projects, in order to reduce uncertainty to an acceptable level, is a crucial problem. This paper presents a multidimensional method for prioritizing safety retrofit projects, in which uncertainty is taken into account in benefits estimation (accident reduction) and costs. Data Envelopment Analysis (DEA) with uncertainty assessment is described to help decision makers select the most cost-effective projects. It is different from other ranking methods in that this approach adds standard errors of crash modification factor and crash costs in selecting process as well as the average values. Furthermore, this model is applied to a sample of intersections that are required to improve safety. Results have revealed that the proposed model is a suitable tool in selecting efficient projects when tolerances in accident reductions and project cost are incorporated.

Comparative study between the proposed model and incremental benefit

5 cost analysis and integer programming methods has also indicated that some changes in the list of selected projects considering the uncertainty impacts of data were observed. This analysis allows such safety projects to be identified. This also provides more complete information for safety analysts to allocate a limit budget to more efficient safety projects.

“Data-Driven Freeway Performance Evaluation Framework for Project Prioritization and Decision Making” *Mountain-Plains Consortium*, 2017 <https://rosap.ntl.bts.gov/view/dot/31882>

This report describes methods that potentially can be incorporated into the performance monitoring and planning processes for freeway performance evaluation and decision making. Reliability analysis was conducted on the selected I-15 corridor by employing congestion

frequency as the performance measure. Hot spots during peak hours were identified through sensitivity analysis. A data-driven algorithm combining spatiotemporal analysis and shockwave theory was developed to determine secondary incidents. Incident-induced delay was further quantified through spatiotemporal pattern recognition. The average delay induced by incidents aligns well with the incidents' severity and impact. Several hot spots suffered from higher delays and were explored in further detail. A statistical mechanism was developed to determine adverse weather impact on travel. Using the weather records in 2013 and mapping with the PeMS traffic database, volume and delay were estimated under normal conditions and compared with adverse weather conditions. The analysis of different roadway conditions reveals that the general parabolic pattern of speed and volume disappear under severe adverse weather condition. The mechanism was able to identify the causes for reduced volume under a variety of scenarios through empirical data, either due to roadway capacity reduction or travel demand reduction.

“Changing the Future? Development and Application of Pedestrian Safety Performance Functions to Prioritize Locations in Seattle, Washington” TRR 2659, 2017

<https://journals.sagepub.com/doi/abs/10.3141/2659-23>

This study aimed to use robust analysis methods to identify and screen locations at risk for pedestrian crashes and injuries to help Seattle, Washington, a Vision Zero city, broaden treatment priorities beyond only high-crash locations. For this objective, data from the entire network were used to develop safety performance functions (SPFs) for two pedestrian crash types: total pedestrian crashes at intersections (a high frequency type) and a subset of intersection crashes involving through motorists striking crossing pedestrians (a high severity type). Many variables from roadway, built environment, census, 6 and activity measures were tested. A similar but not identical set of variables, including measures of activity and intersection size and complexity, significantly contributed to crash prediction in both models. Pedestrian volume exhibited a curved relationship to crashes and demonstrated a tendency for expected crashes to begin to decline above a threshold value; however, the causes of this relationship were unknown. The SPFs were used in several ranking methods, including SPF-predicted crashes, empirical Bayes estimated crashes, and potential for safety improvement, to aid in prioritization of locations that might have been candidates for safety improvement but that had not necessarily experienced a high frequency of crashes. On the basis of this example, this approach is feasible for jurisdictions that wish to be more

proactive in addressing potential crashes and injuries. Jurisdictions must, however, begin routinely collecting the data needed to implement the method efficiently.

“Prioritizing highway safety improvement projects: A multi-criteria model and case study with Safety Analyst” *Safety Science*, 2012

<https://www.sciencedirect.com/science/article/pii/S0925753511003080>

This paper presents a multi-criteria model for prioritizing highway safety improvement projects, in which a set of criteria related to the project’s technical, economic, and social impacts are properly weighted in consideration. The proposed model features an Analytical Hierarchy Process (AHP) framework to tackle the multi-criteria decision-making problem. Different from the conventional AHP, this paper adds a fuzzy scale level between the criteria level and the alternative level, which offers the advantage of preventing the vagueness and uncertainty on judgments of the decision-maker(s). Such a unique modeling feature is further embedded with a non-linear optimization formulation to maximize the consistency in pair-wise comparison and weight estimation for each criterion. Case study results reveal that the proposed model is efficient not only for selecting the most suitable project for a specific site, but also for determining the priorities for implementing those suitable projects among multiple sites given the budget constraint. Comparative study between the proposed model and the existing ranking methods has also indicated its capability to capture the comprehensive impacts of all contributory factors which have been neglected by most existing single multi-criteria approaches during the safety project selection process. The clarity of model inputs, ease of synthesizing the final score of each candidate project, and the interpretation of results with respect to different selection criteria offer its best potential to be used as an effective tool for highway safety managers to assess and refine the safety improvement investments.

7 “Addressing Pedestrian Safety: A Content Analysis of Pedestrian Master Plans in North Carolina” *Traffic Injury Prevention*, 2010

<https://www.tandfonline.com/doi/abs/10.1080/15389580903434199>

Objective: To systematically examine the content of pedestrian master plans in North Carolina in order to assess whether and how these plans were designed to improve pedestrian safety.

Methods: All current pedestrian master plans in North Carolina through 2008 were gathered and examined using content analysis. A safety quality index was developed to assess the thoroughness with which a plan addressed safety issues in four categories: (1) goal statement, (2) analysis of current conditions, (3) policy proposals, and (4) program proposals. Plans were

also compared according to the implementation guidelines included and on the recent pedestrian accident history of the municipalities in which they were developed.

Results: Forty-six plans were developed in North Carolina through 2008, either at the municipal or regional level. Almost all pedestrian master plans in North Carolina described improving safety as one of their goals. The majority attempted to do so by improving the built environment through engineering projects, including building new sidewalks, trails, or greenways and by upgrading existing facilities. Regional plans tended to propose fewer policies and programs, as well as less specific proposals, than did municipal plans. Although most plans contained multiple proposals to address pedestrian safety, few plans identified a group accountable for implementation, a timeline of implementation actions, or the resources necessary to make implementation possible. Municipalities with a recent history of pedestrian injuries were more likely to develop plans than those with fewer pedestrian injuries. Plans developed by municipalities with a recent history of pedestrian fatalities tended to more thoroughly address safety.

Conclusion: Safety was a major component of nearly every pedestrian master plan in North Carolina. Most plans contained multiple proposals to address pedestrian safety. These findings lay the foundation for future research evaluating both the implementation and the impact of these planning documents on the safety of pedestrians.