Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Estimating System and Traveler Costs Due to Lane Closures During Construction and Maintenance Operations

Research Objectives

Using the 2016 Highway Capacity Manual methodologies to provide estimates on capacity reduction, delay increases, and fuel usage increases related to various work zone/lane closure conditions. The HCM methodology is based on the VISSIM microsimulation model, and this model will be calibrated to Nebraska conditions. Specifically, the following work zone/lane closure scenarios will be examined:
i. 6 Lane Divided: 3 lanes, 1 lane closed
ii. 6 Lane Divided: 3 lanes, 2 lanes closed
iii. 4 Lane Divided: 2 lanes, 1 lane closed
iv. 2 Lane (undivided): 1 lane closed (flagging or traffic signal operation)
An analysis of each of the scenarios with respect to length of work zone, percent trucks, speed limit, and time the work zone is active will be conducted. Conducting a detailed economic analysis of the costs of delay, increased vehicle operating costs, and accident costs for vehicles traveling through lane closures.

Research Benefits

This research will aid Nebraska DOT employees in improving safety, cost, and completion times of highway construction projects. This will be accomplished by estimating system and traveler costs associated with lane closures and using state of the art economic analyses to quantify these costs. Further, this project will directly address the recommendations made regarding peak hours versus night work detailed in NDOT's 2017 Work Zone Safety and Mobility Process Review Final Report.

Background

Lane closures are used to facilitate activities related to construction and maintenance operations. However, there are economic costs associated with lane closures and these may accrue to both the traveling public as well as to transportation agencies. While it is sometimes necessary to prohibit lane closures during the day to alleviate traffic congestion, there are consequences of this decision related to project delivery timelines, construction costs, and safety within the work zone. The Nebraska Governor's office has identified maximizing the effectiveness of lane closures as a priority for Nebraska Department of Transportation (NDOT).

Conclusion

It was found that the latest and 6th edition of the Highway Capacity Manual (HCM6) has developed a traffic microsimulation methodology for modeling work zones on multilane highways and two-lane highways. It was, therefore, important to calibrate the model under Nebraska conditions. The report presents a calibration methodology for both multilane highways and two-lane highway lane closure cases. The calibration model was tested to determine the sensitivity of the increase in traffic volume, percent of heavy vehicles, work zone lengths, and posted speeds for over 1460 different scenarios. In addition, a state-of-the-science emission modeling software, recommended by the US EPA, was used to model the sensitivity of the vehicle emission performance using the outcome of the calibrated work zone models as a key input. The outcome of the sensitivity analysis is used to develop a lane closure cost simulation model that examines the cost of changes in road user time, emissions, and fuel cost under all of the lane closure scenarios. The economic analysis develops estimates of time, emissions, and fuel use costs to simulate the increase in hourly road user costs associated with a lane closure. A working spreadsheet has been developed to assist NDOT engineers to estimate the cost of lane closures for hundreds of closure scenarios.

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Interested in finding out more?
Final report is available at:
NDOT Research Website

NDOT Recommendations Based of Completed Research

This research resulted in assisting the Department's Traffic Engineering and Construction Division's by estimating system and traveler costs associated with lane closures. Also, this project developed a working spreadsheet to assist NDOT-Traffic engineers estimate the cost of lane closures for hundreds of closure scenarios. Traffic Engineering Division will improve upon the spreadsheet provided methodologies to estimates on capacity reduction, delay increases, and fuel usage increases related to various work zone/lane closure conditions.

- *As provided by Matt Neemann, Lead TAC Member*

Research Readiness Level (RRL) Assessment

RRL 3

Level 3: Development –
Research/Technology developed in an operational environment. This project will have a follow up within 1 year

Technology Transfer

Transportation Research Board (TRB) papers and Publications

- MM Shakiul Haque, Laurence Rilett, and Li Zhao. Impact of Platooning of Connected and Automated Heavy Vehicles on Interstate Freeway Work Zone Operations. The 101st Transportation Research Board Annual Meeting, No. TRBAM-21-01027. Washington D.C., January 2022.
- MM Shakiul Haque, Li Zhao, Laurence Rilett, and Ernest Tufuor. A New Calibration Method of Microsimulation Model for Lane Closure on Two-Lane Highway Work Zone. The 101st Transportation Research Board Annual Meeting, No. TRBAM-22-04100. Washington D.C., January 2022.
- Li Zhao, Laurence Rilett, and Mm Shakiul Haque. A Calibration and Validation Methodology for Simulation Models of Intelligent Work Zones. The 101st Transportation Research Board Annual Meeting, No. TRBAM-22-03066. Washington D.C., January 2022

Journal Papers Submitted for Review and In Progress Journal Papers and Theses

- Published by the Journal of Transportation Research Record **https://doi.org/10.1177/03611981221082591**

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