Data-Driven Safety Analysis

PROJECT CASE STUDY

Predictive Safety Analysis Aids in Selection of New Design for an Outdated Interchange in Ohio

The Ohio Department of Transportation (ODOT) used predictive safety analysis to estimate the expected performance of alternate designs in reconstructing a 40-year-old, obsolete interchange. The analysis provided quantitative data that facilitated selection of a preferred alternative during the project's engineering and design phase. Final design of the I-270/US 33 interchange was complete in August 2014, and construction will begin in March 2015.

I-270/US 33 Alternatives Selected for Detailed Evaluation
(Source: ODOT Recommended Preferred Alternative Report)

Background and Project Description

Completed in 1973, the Columbus, Ohio I-270 outer belt has carried an ever-increasing amount of traffic, particularly as the area's suburbs have grown. In the suburb of Dublin, rapid population and employment growth near the I-270/US 33 interchange has resulted in dramatic increases in vehicle travel. The interchange is a cloverleaf configuration, unique in that it operates as a system interchange to the west and a service interchange to the east.

In developing and evaluating new interchange configurations, including a No Build alternative, ODOT used specific, measurable criteria to define how well the alternatives addressed current and future traffic congestion, resolved existing obsolete geometric designs, and improved safety conditions.

This resulted in eight conceptual alternatives, of which ODOT identified three (Alternatives 4, 7 and 8) that best met the project's needs. The project team refined these with a phased construction approach to meet project goals and funding constraints and further developed them to meet traffic demands forecasted for 2035.

PREDICTIVE SAFETY ANALYSIS BENEFITS

Improved Safety
ODOT addressed both traffic congestion and safety by evaluating the trade-offs between high-speed ramp designs and expected crashes.

Informed Decision-Making
The analysis allowed a quantitative safety performance comparison between different geometric designs.

Optimized Investment
Crash quantification was extrapolated into societal cost for each design alternative.

ODOT designed each alternative according to the agency's Location and Design Manual and the American Association of State Highway and Transportation Officials (AASHTO) Policy on Geometric Design, applying the same design criteria to each. The criteria that the team considered in selecting the preferred alternative included predicted safety performance, traffic operations (level of service and delay), design and construction requirements, right-of-way needs, capital costs, and environmental and community impacts and their mitigation.

Safety Tools and Best Practices Used

ODOT applied alternative analysis with predictive models using the Interchange Safety Analysis Tool–Enhanced* (ISATe) to evaluate and compare the expected safety performance of the three configurations. ISATe enables prediction of interchange safety performance (including mainline segments, ramp segments and ramp terminal intersections). It was adopted for use in AASHTO's Highway Safety Manual as a crash prediction method for predictive safety performance of freeways and interchanges.

Key Takeaway

- Predictive analysis helps quantify the safety impacts of transportation decisions, allowing safety to be expressly considered along with other project goals.

To align with the national emphasis on addressing fatal and severe injury crashes, the I-270/US 33 safety performance evaluation focused on predicting the number of KAB crashes (K is a fatal crash, A is an incapacitating injury crash, and B is a non-incapacitating injury crash) expected for each alternative between 2015 and 2035. The project team calculated the societal costs associated with the number of predicted crashes over the study period to use in the evaluation.

Industry generally considers the reliability of severe (KAB) crash reporting to be greater than that for property damage and lower level injury crash types due to fewer differences in reporting thresholds. Therefore, ODOT did not include crash predictions for property damage and possible injury crashes in the evaluation.

Results

The ISATe analysis predicted the fewest crashes for the No Build condition during the study period, followed by Alternatives 8, 4 and 7, respectively. Further analysis of the predictive model results determined that there are trade-offs when reconfiguring interchanges with high-speed ramp designs.

One trade-off for a higher quality design is the increased number of vehicle miles traveled (VMT) through the interchange. The VMT for Alternatives 4, 7 and 8 were over 30 percent greater than for the existing configuration, resulting in higher crash frequencies than the No Build due to the larger area of exposure.

Modeling predicted Alternatives 4 and 8 would have fewer KA-type crashes than the No Build and Alternative 7, reducing their overall societal cost. Alternative 8 was predicted to have the lowest KAB crash frequency. Subsequent calculations suggested Alternative 8 would also have the lowest expected societal cost. After evaluating all criteria, and in collaboration with the City of Dublin, ODOT selected Alternative 8 as the preferred alternative.

**FHWA cites this specific tool as an example, not as an endorsement over others.*

ADDITIONAL RESOURCES

- This document contains information presented in "Safety in the Project Development Process: A Context Sensitive Approach," a case study provided courtesy of the Institute of Transportation Engineers: *www.ite.org*
- More information on Data-Driven Safety Analysis is available on the Every Day Counts website at: *http://www.fhwa.dot.gov/everydaycounts/edc-3/analysis.cfm*

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Every Day Counts (EDC), a State-based initiative of FHWA's Center for Accelerating Innovation, works with State, local and private sector partners to encourage the adoption of proven technologies and innovations aimed at shortening and enhancing project delivery

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