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Data Driven Identification of Candidates for Operational Improvement

tech transfer summary

This project developed an operational improvement candidate list for a Cedar Rapids, Iowa-area case study using available data sets to create a methodology for evaluating roadway operations.

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RESEARCH PROJECT TITLE
Data Driven Identification of Candidates for Operational Improvement

SPONSORS
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The mission of the Center for Transportation Research and Education (CTRE) at Iowa State University is to conduct basic and applied transportation research to help our partners improve safety, facilitate traffic operations, and enhance the management of infrastructure assets.

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Objective

The objective of this project was to explore the development of an operational improvement candidate list (OICL)—analogous to the Iowa Department of Transportation's (DOT's) safety improvement candidate list (SICL)—using currently available data.

Problem Statement

In light of the increasing emphasis on performance-based management driven by federal initiatives, as well as to better allocate scarce resources to locations having the greatest need, it is necessary to identify available and emergent data sets that would allow Iowa transportation agencies to evaluate operations on their roadways, and particularly on non-interstate highways.

Background

In Iowa, the SICL has been used for about 20 years to identify roadway locations that have disproportionate numbers of crashes or crash severity (Hallmark et al. 2002). The creation of that list helps fulfill the Iowa DOT mission to improve highway safety as well as meet a federal requirement to identify locations that have high crash rates.

Until relatively recently, an analogous federal requirement to evaluate the operational characteristics of roadways did not exist. However, in 2012, the passage of the Moving Ahead for Progress in the 21st Century Act (MAP-21) introduced provisions for performance evaluations.

The Federal Highway Administration (FHWA) established a series of performance measures that were first published in a 2014 proposed rule that obliged states to calculate specific performance measures for evaluating travel time reliability (FHWA 2014). At the same time, FHWA programs have increasingly emphasized performance-based management (Day et al. 2020, FHWA 2021).

Meanwhile, the Iowa DOT already has mature practices for monitoring interstate highway mobility (Iowa DOT 2016).

Research Description/Methodology

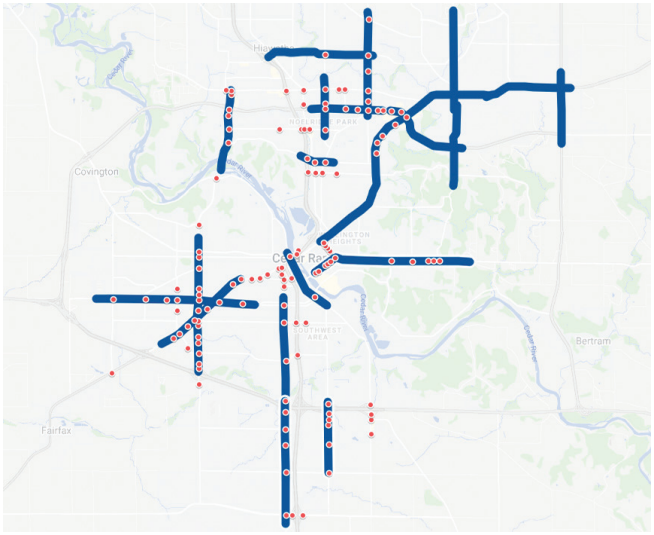
- The research team conducted a review of existing data sets, including those that are legacy, currently available, and emergent, and investigated the potential uses of the data sets that are currently available. The review focused on segment speed data and high-resolution data given their current availability and applicability to OICL development.

- The team used segment speed data from INRIX, i.e., probe vehicle data, to conduct a performance comparison of 250 signalized corridors across Iowa. The researchers compared performance data for 2019 and 2020 and ranked corridors according to a performance index (PI) based on travel time and travel-time reliability.

- The researchers further explored high-resolution data from traffic signal controllers in two studies as follows:

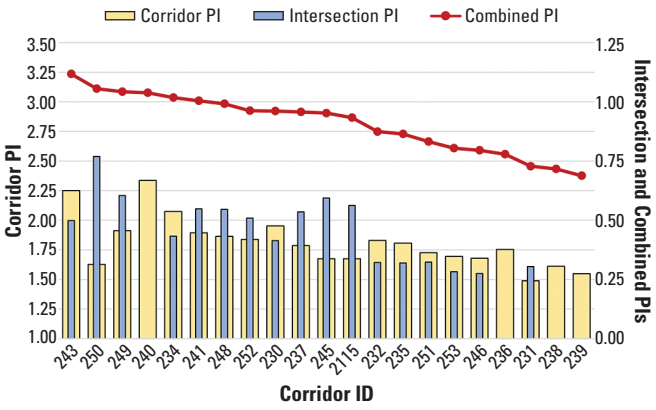
  – The researchers used data from 150 intersections in the Cedar Rapids, Iowa, area to rank intersections according to a few different performance measures that investigate the quality of capacity (or "green time") allocation at those intersections.
  – The researchers compared corridor segment speed data with measurements of percent on green (POG) from high-resolution data at a few intersections in the Dubuque, Iowa, area to determine whether the outcomes of the two data sets correlate.

- Ultimately, the researchers combined the corridor-level and intersection-level metrics to yield a composite metric that allowed for the creation of an OICL. The researchers applied this to the Cedar Rapids area as a case study, given both corridor and intersection data were available for that area.



Base map image © 2021 Google Maps

Corridors selected for ranking and signalized intersections with high-resolution data in the Cedar Rapids, Iowa area



Comparison of corridor, intersection, and combined performance index values

Project Accomplishments and Key Findings

- The study demonstrated the feasibility of using a combination of segment speed data and high-resolution data to establish an OICL.

- A preliminary analysis was undertaken to develop an OICL for corridors in the Cedar Rapids area.

- A ranking of 250 signalized corridors across the state was carried out using probe vehicle segment speed data.

- A ranking of 150 signalized intersections in Cedar Rapids was carried out using high-resolution controller event data.

- The first study directly comparing signal performance measures from high-resolution data (specifically the POG and volume-to-capacity [v/c] ratio) with segment speed data was carried out, finding that the two data sets exhibit correlation when models are adjusted by day-of-week and time-of-day variables.

Implementation Readiness and Benefits

This project used available data sets to create an OICL for the Cedar Rapids region, which could be duplicated in other areas where such required corridor and intersection data sets are available.

Two challenges remain in the scaling of such a methodology for statewide use. One is in the relatively small coverage of high-resolution data collection infrastructure at signalized intersections. The other is in the analysis of non-signalized intersections lacking such data. However, new data sets have recently become available that may have the potential to greatly improve scalability by enabling analysis of movement-based performance measures for intersections of all types.

Recommendations for Future Research

A future study could extend the methodology to incorporate the emerging data sets, provided that the data sets yield enough data to support the methodology and expand the OICL to include the entire inventory of all 2,300 signalized intersections in the state.

Another area in which the present methodology could be expanded would be to include non-signalized intersections. This also would likely be assisted through the introduction of another emerging data set, which is known as movement-based probe vehicle data.

References

Day, C. M., P. O'Brien, A. Stevanovic, D. Hale, and N. Matout. 2020. *A Methodology and Case Study: Evaluating the Benefits and Costs of Implementing Automated Traffic Signal Performance*. FHWA-HOP-20-003. Federal Highway Administration, Office of Operations, Washington, DC.

FHWA. 2014. National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program. *Federal Register*, Vol. 79, No. 47, pp. 13846–13871.

———. 2021. Transportation Performance Management (TPM) Toolbox. https://www.tpmtools.org/.

Hallmark, S. L., R. Basavaraju, and M. Pawlovich. 2002. *Evaluation of the Iowa DOT's Safety Improvement Candidate List Process*. Center for Transportation Research and Education, Institute for Transportation, Iowa State University, Ames, Iowa. https://intrans.iastate.edu/app/uploads/2018/03/SafetyCandidate.pdf.

Iowa DOT. 2016. *2016 Interstate Congestion Report*. Iowa Department of Transportation and Insitute for Transportation Center for Transportation Research and Education at Iowa State University, Ames, Iowa. https://iastate.box.com/shared/static/gue2p1mc5axzad1r2uh5sb7kfh1chsse.pdf.