SJSU SAN JOSÉ STATE UNIVERSITY

SJSU Undergraduate Research Grants

Evaluating Adaptive Ramp Metering through Partial Least Squares Path Modeling

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Abstract

We use Partial Least Squares Path Modeling (PLS-PM) to view how the Adaptive Ramp Metering (ARM) system impacts certain freeway metrics when compared to a baseline Coordinated Ramp Metering (CRM) system. We collect data from two comparable freeways: I-80 East (ARM) and I-280 South (CRM). Next, we use path modeling to build a relationship between measures of traffic, safety, efficiency, and travel time reliability. By using the binary variable *arm* to indicate which freeway each observation comes from, we were able to quantify the difference between the two systems.

Research Questions

- Research was based on Mineta Transportation Institute grant
- Three types of CRM systems
  (1) Fixed Ramp Metering
  (2) Local Traffic Responsive Metering
  (3) Adaptive Ramp Metering (ARM)
- Focus of research was ARM system on I-80 East, implemented in April 2017
- Main Question: How does the ARM system impact I-80 East in terms of traffic, safety, efficiency, and travel time reliability?

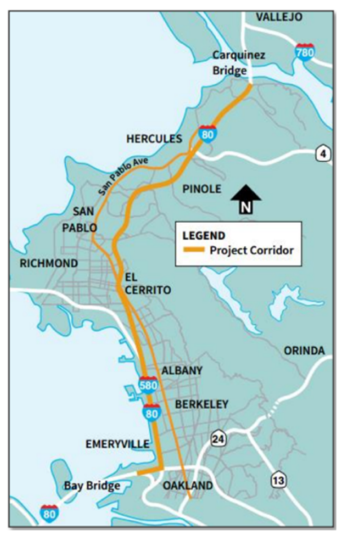

Figure 1: Freeway of interest, I-80 East.

Variable	Description of Variable
Traffic *aadt* *lanes*	**Measures overall traffic on freeway** Annual Average daily traffic per segment Number of lanes per segment (excluding carpool/HOV lanes)
Safety *crashes*	**Measures safety of freeway** Total number of car crashes that occurred per segment
Efficiency *vht* *arm*	**Measures overall efficiency of freeway** Total sum of hours traveled by vehicles per segment Binary variable: 0 if segment is from I-280, 1 if segment is from I-80
Reliability *delay* *length* *arm*	**Measures overall travel time reliability of freeway** Total hours of delay per segment Length of segment (in miles) Binary variable: 0 if segment is from I-280, 1 if segment is from I-80

Table 1: Overview of variables used in path model.

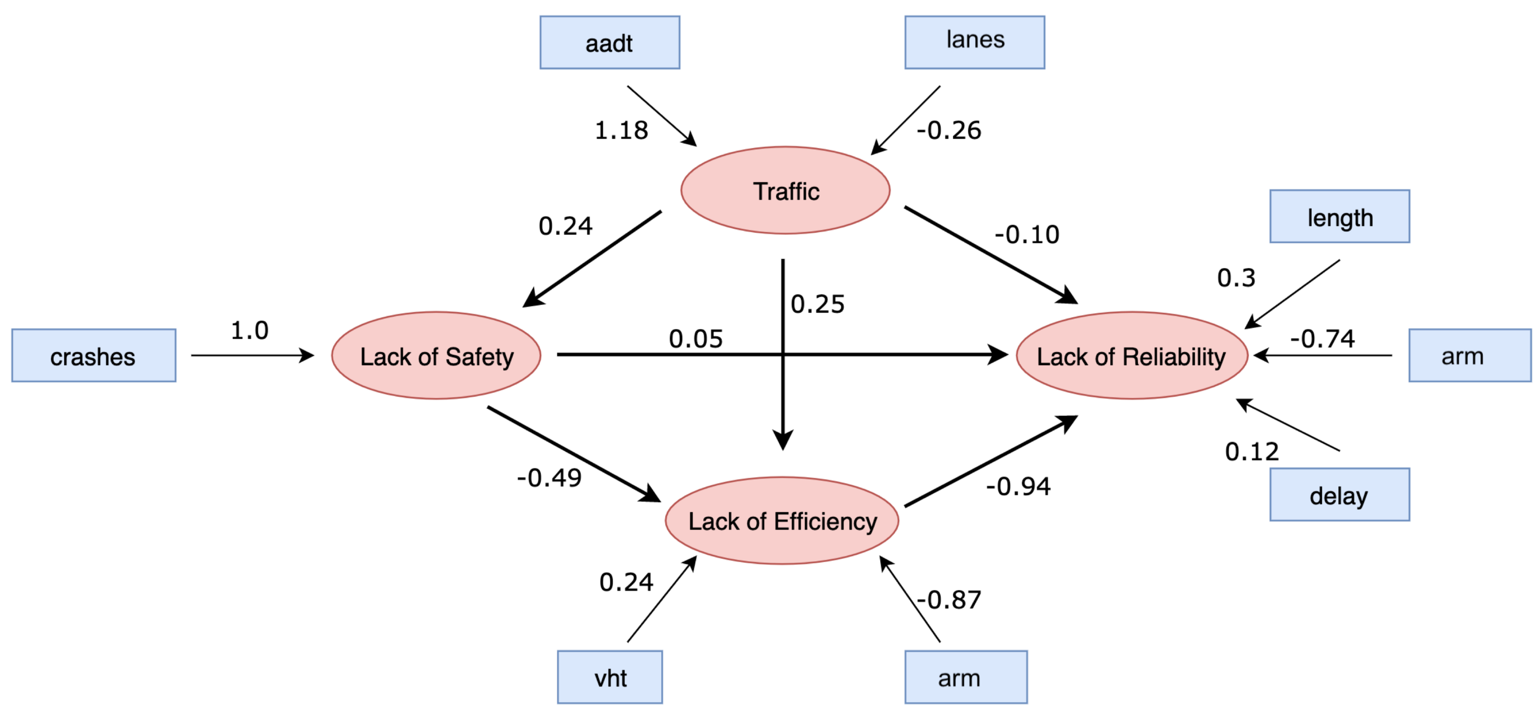

Figure 3: Finalized path diagram with numerical path coefficients.

Project Activities or Findings

- PLS-PM uses multivariate models to quantify latent variables through manifest variables
  Latent variables: variables that cannot be measured directly
  Manifest variables: variables that can be measured directly
- Result: PLS-PM indicates that Adaptive Ramp Metering improves efficiency and travel time reliability of the freeway when compared to baseline Coordinated Ramp Metering.

Figure 2: Example of Coordinated Ramp Metering system.

Citations

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