Innovative Performance Evaluation Matrix for Solving Urban Freeway and Interchange Congestion

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Western ITE Conference
STUDY NEED

- Multimodal microsimulation analysis to compare performance of alternatives
- Develop useful performance measures in overcapacity conditions
STUDY AREA

- I-5
  - Crossroads of Portland freeway systems
  - 150,000 AADT in four-lane cross-section at the pinch point
  - 1,100 feet between each interchange
  - Critical for job and economic generators
STUDY AREA

- Arterial Network
- Broadway & Weidler
- Moda Center Area
- Multimodal facilities
FUTURE ALTERNATIVES

A: No-Build
1 vs. 2 lane SB I-84 flyover

B: Auxiliary Lane
1 vs. 2 lane SB I-84 flyover

C: Single Braid
1 vs. 2 lane SB I-84 flyover

D: Double Braid
1 vs. 2 lane SB I-84 flyover
PERFORMANCE MEASURES FOR CONGESTED CONDITIONS

- Traditional MOEs:
  - LOS, V/C, Average Travel Time, Brainscan Chart, Percent of Unmet Demand, etc.
  - Not particularly useful in heavy congestion

- Proposed MOEs:
  - Travel Time Reliability
  - Lane by Lane Speed
  - Emergency Braking
The less variation from the median, the more reliable the travel time.

Use Vehicle Record data (second-by-second) sorted into northbound and southbound travel routes.

NEW PERFORMANCE MEASURES

Travel Time Reliability

- The less variation from the median, the more reliable the travel time.
- Use Vehicle Record data (second-by-second) sorted into northbound and southbound travel routes.
NEW PERFORMANCE MEASURES
Lane-by-Lane Speed Chart

- Compare speeds between scenarios
NEW PERFORMANCE MEASURES

Emergency Braking Events

- Emergency braking threshold $\geq 14.8 \text{ fps}^2$
  - AASHTO Green Book (2011) emergency braking rate

- Emergency Braking data obtained from Vissim Vehicle Records
Existing ODOT Crashes vs. Existing Calibrated VISSIM Results

Pearson's correlation coefficient:

- $r_{am} = 0.56$
- $r_{md} = 0.95$
- $r_{pm} = 0.73$
**BRAKING DENSITY HEAT MAPS**

- Visualize high risk sections
- High concentration of emergency braking at:
  - Southbound Entry
  - Southbound between I-405 merge and Broadway off-ramp
- Adding two-lane flyover improves the safety.
- North of Broadway: all the “build” scenarios reduce emergency braking events by more than 60%.
- South of Broadway: only braid options reduce emergency braking events.
- Overall significant reductions in emergency braking for all the build options.
## OPERATION AND SAFETY PERFORMANCE MATRIX

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SUMMARY

- Select appropriate performance measures for comparative purposes
- Travel time reliability & emergency braking analysis reveal details of congested facility performance.
- Combination of new and traditional MOEs for congested facility evaluation
Questions?

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