

Estimating the Impacts of Access Management with Micro-simulation: Lessons Learned

Bill Eisele

Bill Frawley

Casey Toycen, Roelof Engelbrecht, Kristin
Turner, Anna Griffin Martin



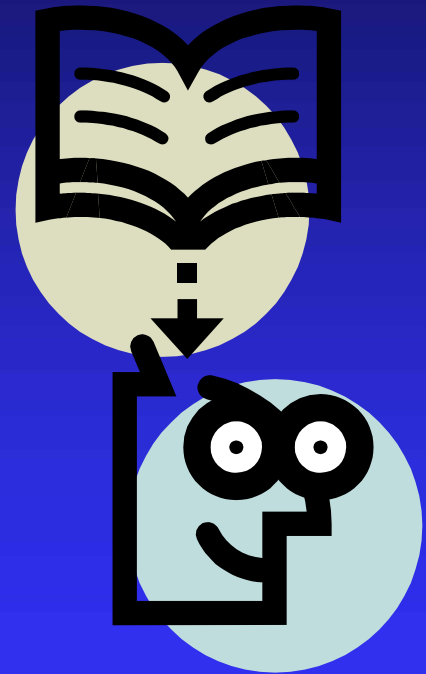
Sponsored by:



6th National Conference on Access Management
8-30-2004

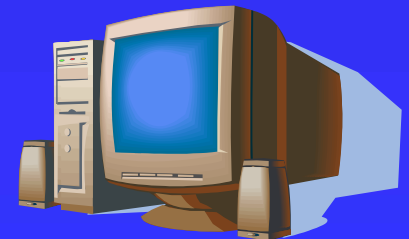
Objectives

- Investigate the impacts of raised median installation and driveway density by traffic volume
 - ◆ 3 case studies
 - ◆ 3 theoretical corridors
- Investigate the use of a surrogate safety measure in micro-simulation
 - ◆ Time-to-collision
- Selecting a micro-simulation tool for access management alternatives analysis
 - ◆ Input and output characteristics
- Concluding thoughts and future work



Methodology

- 3 case studies and 3 theoretical corridors
- Three simulation runs of each traffic volume
 - ◆ Each run provides a random estimate of the measure
 - ◆ Analyzed peak hour
 - ◆ Maintain O-D patterns
- Reduction in conflict points, travel time, speed and delay were analyzed
 - ◆ Travel time and speed of vehicles traversing the corridor
 - ◆ System delay
- Used VISSIM model
- Also ran time-to-collision analysis within VISSIM (1 run)
 - ◆ Proof-of-concept



Three Case Studies (Characteristics)

Location	Corridor Length (miles)	Signals per Mile / Access Points per Mile	Median Opening Spacing (feet)	Number of Lanes Each Direction
Bryan, Texas	0.55	3.0 / 91	690 to 1,320	2
Temple, Texas	0.71	5.6 / 66	350 to 850	2
Tyler, Texas	1.47	4.1 / 46	500 to 1,500	3

- Median opening spacing for selected alternative

Texas Case Study (Results)

Location	Percent Difference in Conflict Points	Estimated Existing ADT	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)
Bryan, Texas	-60				
Temple, Texas	-56				
Tyler, Texas	-60				

- Large reduction in conflict points with raised median installation

Texas Case Study (Results)

Location	Percent Difference in Conflict Points	Estimated Existing ADT	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)
Bryan, Texas	-60	18,200	21,800		
			48,000		
Temple, Texas	-56	13,300	16,000		
Tyler, Texas	-60	24,400	29,300		
			48,000		

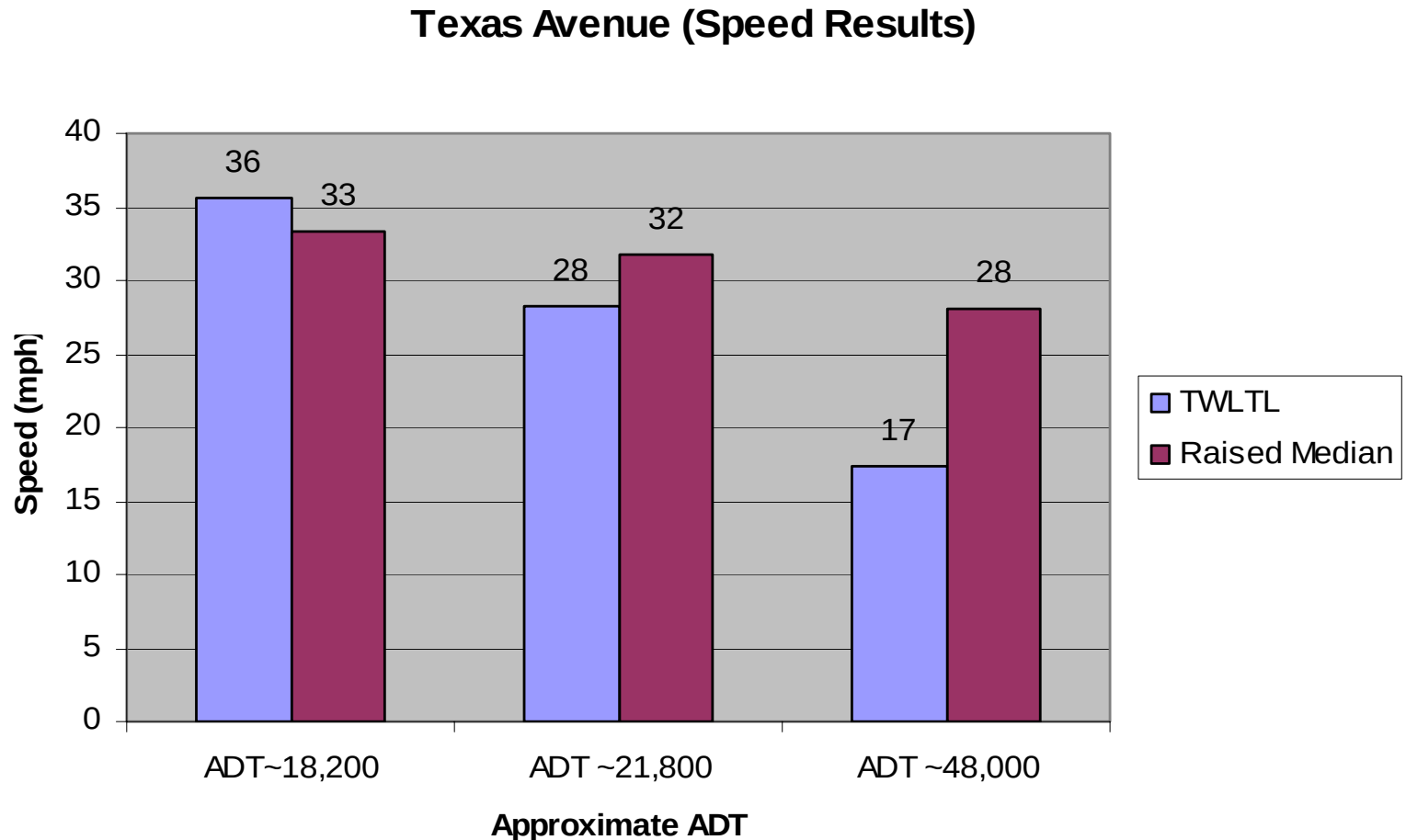
- Lower ADT is “existing +20%”
- Higher volume selected for further analysis

Texas Case Study (Results)

Location	Percent Difference in Conflict Points	Estimated Existing ADT	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)
Bryan, Texas	-60	18,200	21,800	-11	4 (increase)
			48,000	-38	11 (increase)
Temple, Texas	-56	13,300	16,000	3	1 (decrease)
Tyler, Texas	-60	24,400	29,300	2	<1 (decrease)
			48,000	57	4 (decrease)

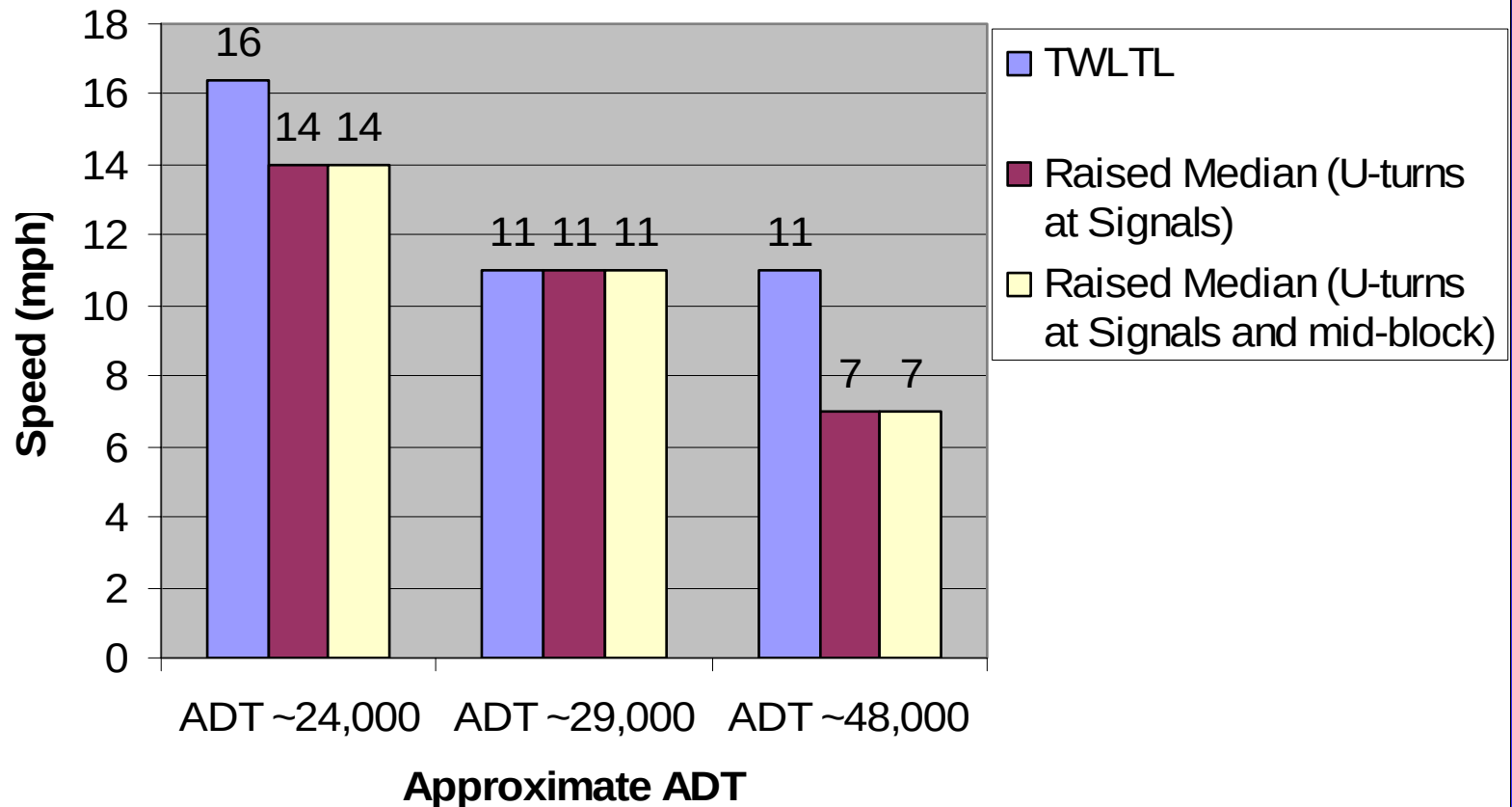
- Case-specific results
- Function of traffic patterns, median opening locations, etc.

Bryan, Texas Speed Results



Tyler, Texas Speed Results

Broadway Avenue (Speed Results)



Theoretical Scenarios (Characteristics)

Theoretical Corridor	Median Treatment	Number of Lanes in Each Direction	Number of Driveways	Driveway Spacing (feet)	Raised Median Opening Spacing (feet)
Scenario 1	TWLTL and Raised	2	18	660	660
Scenario 2	TWLTL	2	42	330	660
	Raised				
Scenario 2	TWLTL	3	42	330	660
	Raised				
Scenario 3	TWLTL	3	84	165	660
	Raised				

- ITE trip generation, driveways across from each other

Future Performance of Theoretical Corridors				
Theoretical Corridor	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)	
Scenario 1	18,000 to 28,000			
Scenario 2 (2 lanes)	18,000			
	23,000			
	28,000			
Scenario 2 (3 lanes)	18,000			
	23,000			
	28,000			
	48,000			
Scenario 3 (3 lanes and higher driveway density)	18,000			
	23,000			
	28,000			
	33,000			
	38,000			
	48,000			

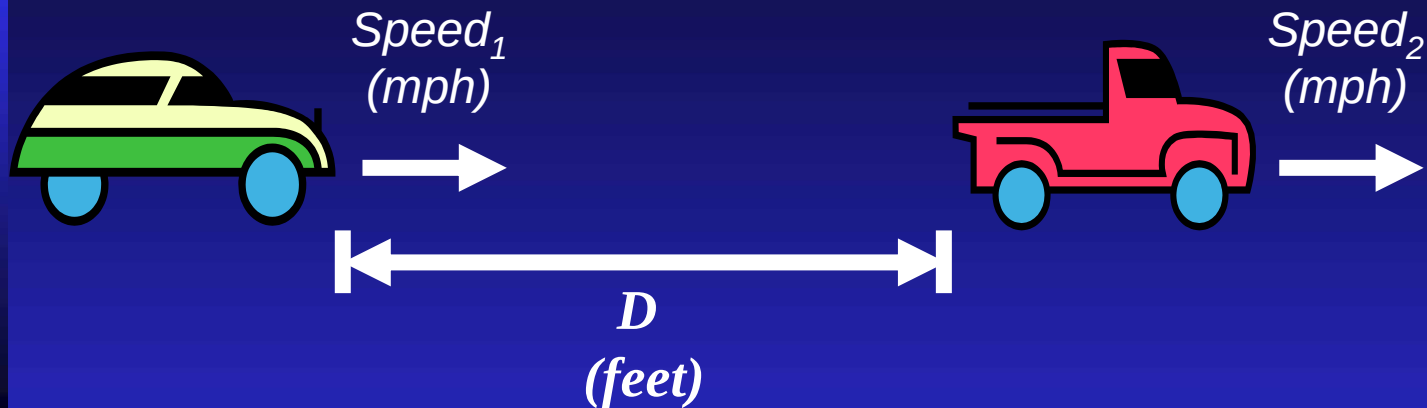
Theoretical Corridor	Estimated Future ADT	Future Percent Difference in Travel Time	Future Actual Difference in Speed (mph)
Scenario 1	18,000 to 28,000	Not Applicable	Not Applicable
Scenario 2 (2 lanes)	18,000	2	0 (same)
	23,000	6	2 (decrease)
	28,000	31	7 (decrease)
Scenario 2 (3 lanes)	18,000	7	2 (decrease)
	23,000	8	3 (decrease)
	28,000	11	3 (decrease)
	48,000	44	9 (decrease)
Scenario 3 (3 lanes and higher driveway density)	18,000	6	2 (decrease)
	23,000	1	1 (decrease)
	28,000	2	0 (same)
	33,000	6	2 (decrease)
	38,000	23	6 (decrease)
	48,000	10	2 (decrease)

Conflict and Safety Analysis

- Crash data suspect, incomplete, or unavailable
- Micro-simulation as a tool
- Distance between vehicles divided by speed difference is time-to-collision (TTC)
- Rear-end only evaluated here (others later)
- TTC threshold of 4 and 10 seconds
- Number of assumptions—real drivers not “perfect”
- Relative safety performance of alternatives
 - ◆ Access, medians, signals....



Time-to-collision Illustration

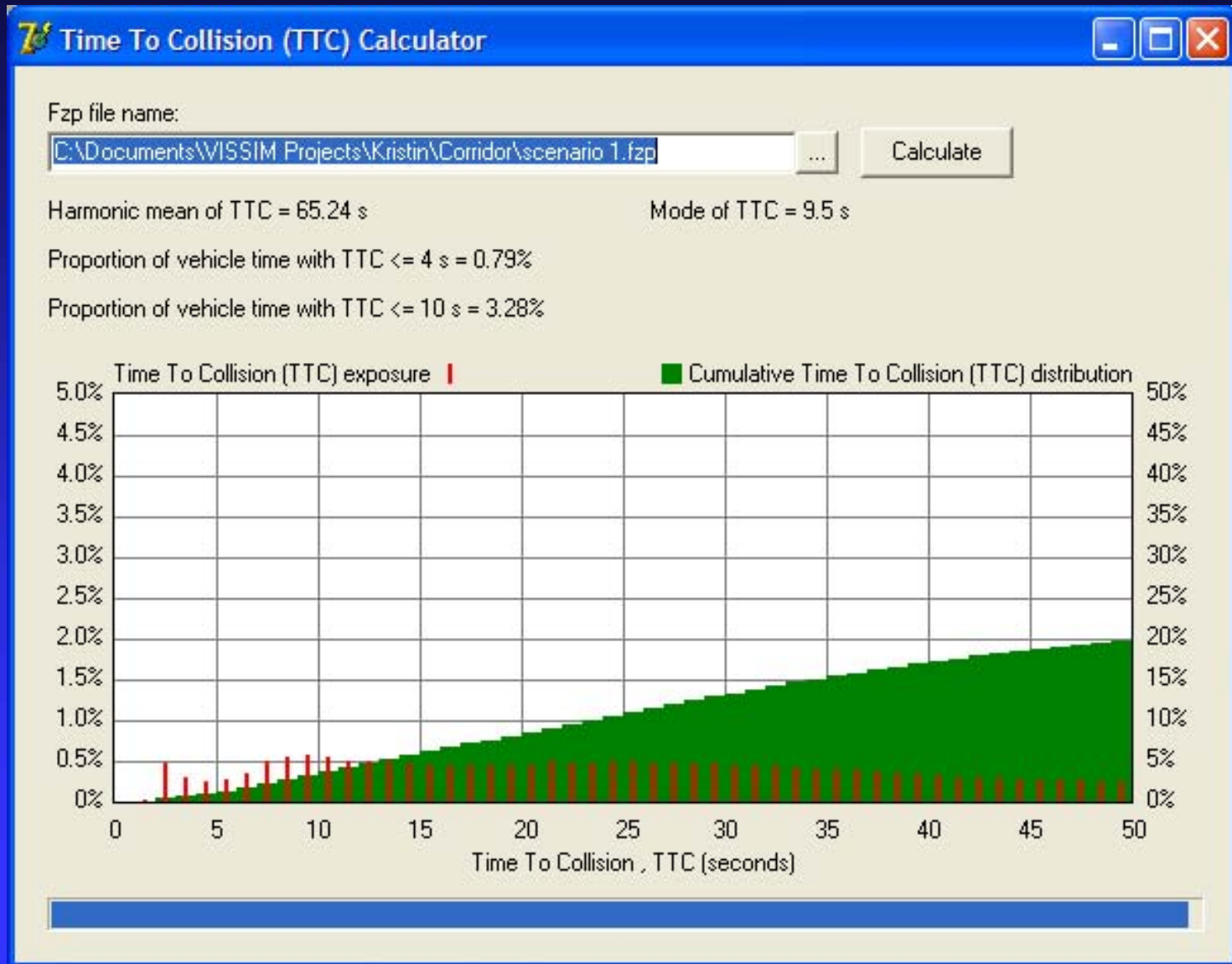


$$\text{Time-to-collision (seconds)} = \frac{D \times 3,600}{(Speed_1 - Speed_2) \times 5,280}$$

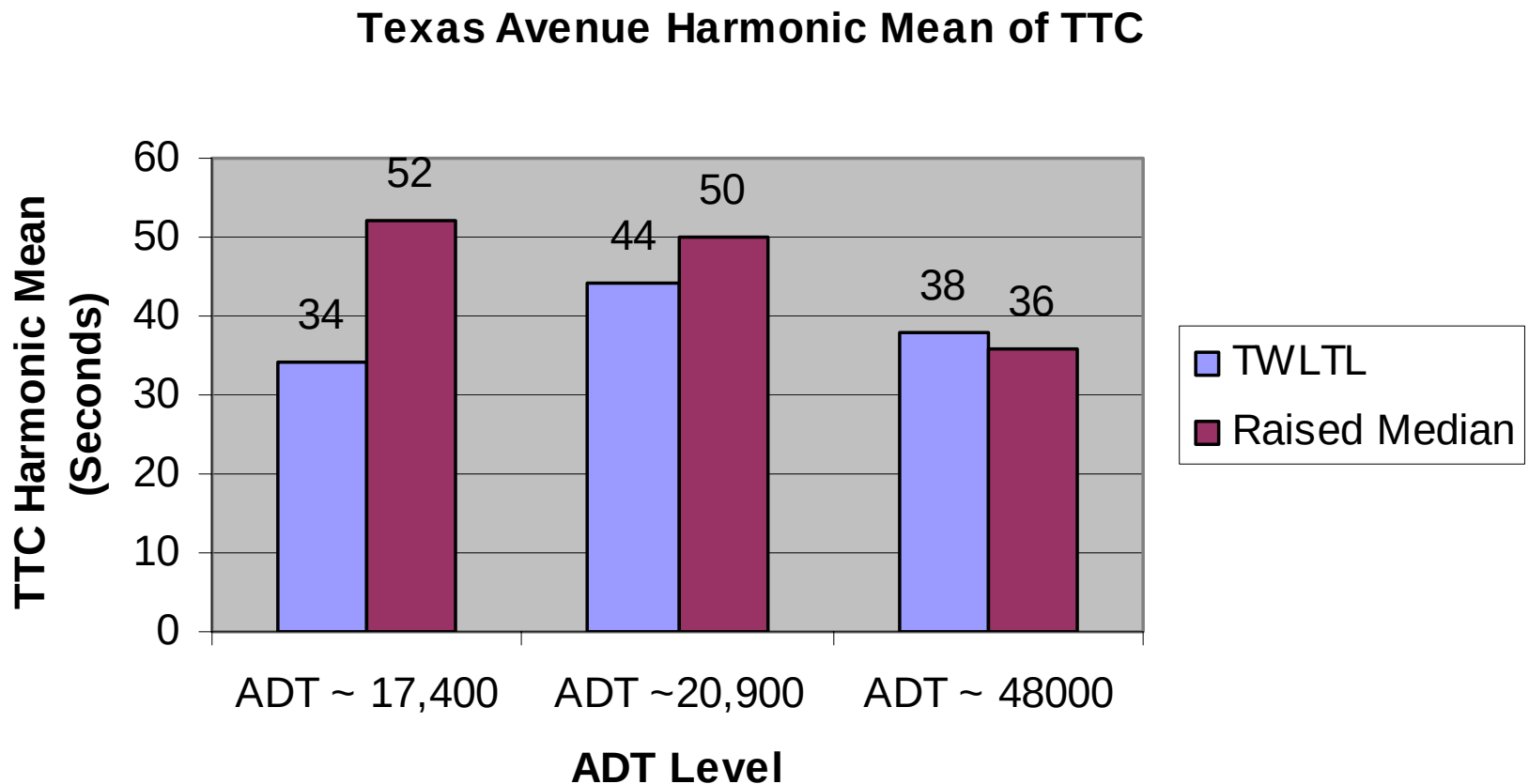
Example:

$$\text{Time-to-collision (seconds)} = \frac{100 \text{ feet} \times 3,600 \text{ seconds/hour}}{(30 \text{ mph} - 15 \text{ mph}) \times 5,280 \text{ feet/mile}} = 4.5 \text{ seconds}$$

Conflict and Safety Analysis

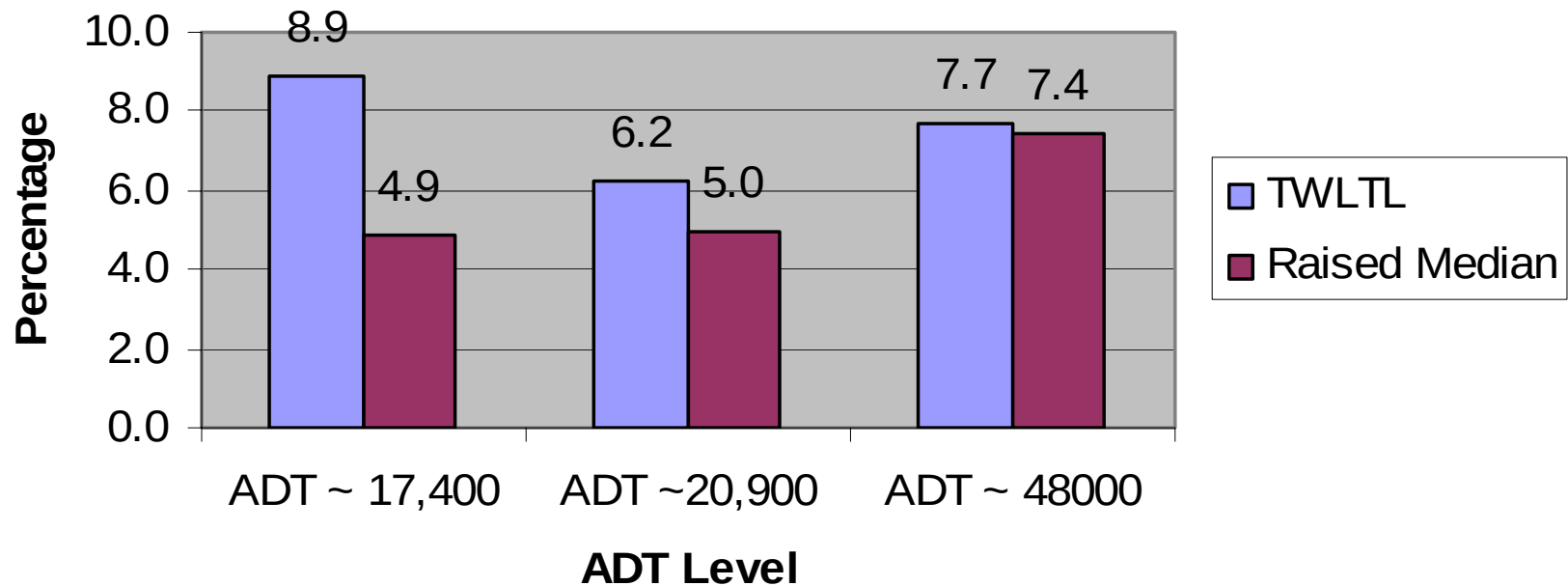


TWLT generally lower harmonic mean
(as expected for increased conflict
points).....

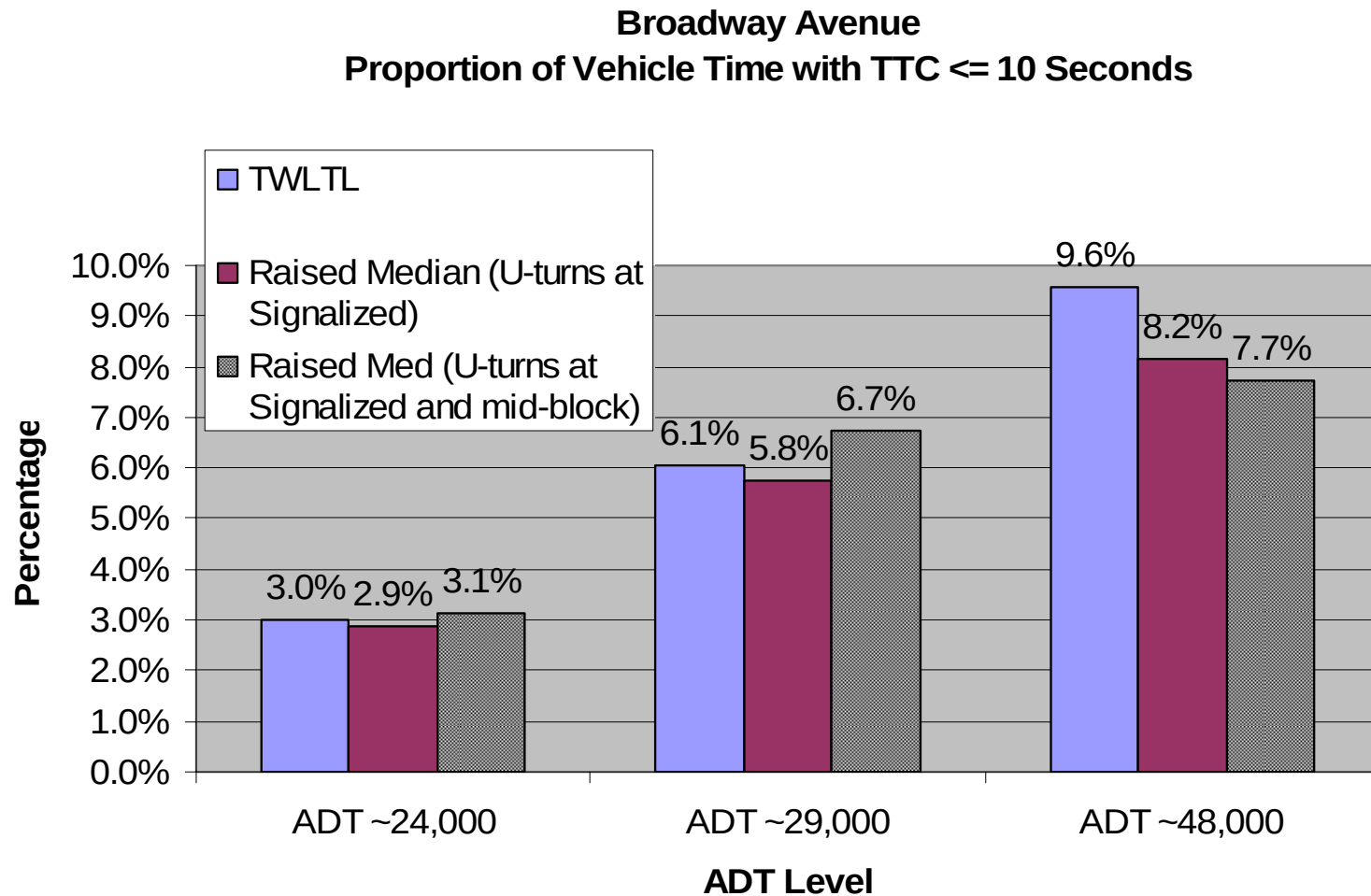


...which equates to higher proportion of vehicle time at ≤ 10 seconds for the TWLTL alternative.

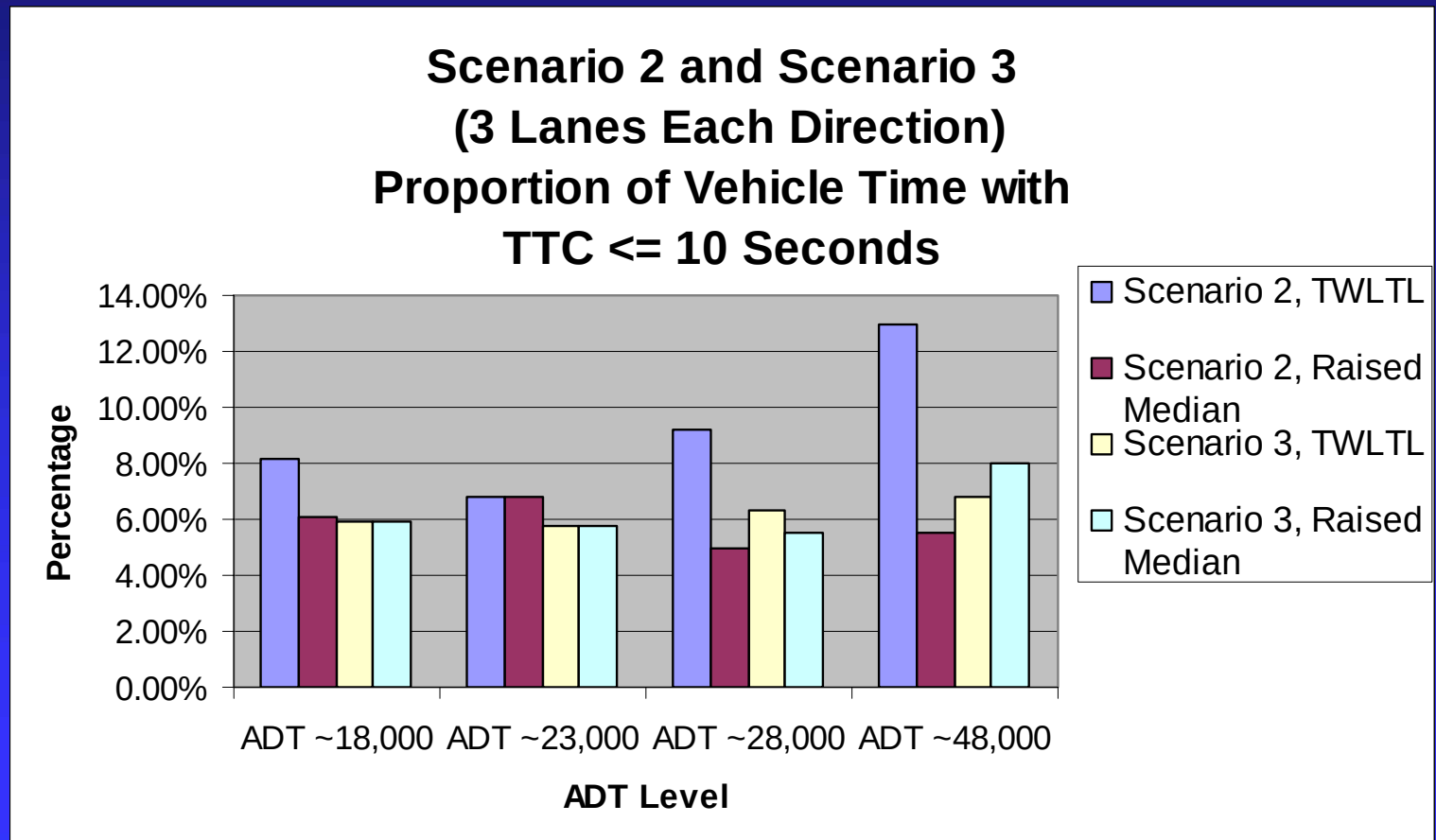
**Texas Avenue Proportion of Vehicle Time with
TTC ≤ 10 Seconds**



Similar result on Tyler corridor...



...and on the theoretical corridors.



Selecting a Micro-simulation Tool

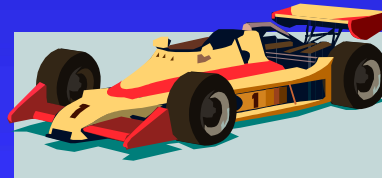
■ Input characteristics

- ◆ Complex situations, individual drivers
- ◆ Geometric inputs
 - ◆ Scale, auxiliary lanes, turning radii, lane width
- ◆ Operational inputs
 - ◆ Gap acceptance, speeds, accelerations
 - ◆ Signal optimization
- ◆ Calibration (evaluate default values)
- ◆ O-D, and other underlying theory

Selecting a Micro-simulation Tool

■ Output characteristics

- ◆ Analysis at the individual vehicle level
- ◆ Spatial
 - ◆ By location—intersections, median openings
- ◆ Temporal
 - ◆ Over time—platooning, queuing
- ◆ Animation features
 - ◆ Visual consistency
 - ◆ 3-dimensions



Concluding Thoughts

- Results from raised median installation are case-specific
- Caution should be used when generalizing AM impacts across corridors
- Function of traffic volumes, driveway density, weaving (o-d patterns), median opening location and density, decel lane length, signal coordination, speed distribution, driver behavior, etc.
- Micro-simulation allows detailed corridor analysis



Concluding Thoughts

- Relatively small increases in travel time are likely offset by the well-documented increase in safety
 - ◆ NCHRP 395, NCHRP 420
 - ◆ Bill Frawley's talk tomorrow
- TTC appears to be a promising method for assessing safety in the micro-simulation environment
 - ◆ Indexed ranking of alternatives
- Must coordinate access management analysis needs with micro-simulation tool

Future Work

- More runs that vary median opening number, median opening spacing and location, driveway density, traffic volume, decel lane length, etc. to populate larger matrix
- Expansion of TTC to angle crashes
- Additional TTC runs

Contact Information

Bill Eisele, Ph.D., P.E.

979/845-8550

bill-eisele@tamu.edu

Bill Frawley, AICP

817/462-0533

w-frawley@tamu.edu

Can't get enough of this?!?....

See poster at the break!

Full paper on CD (or contact me)!