Small Data: Local Trip Generation Data and Developing a Better Model for the City of Austin, Texas

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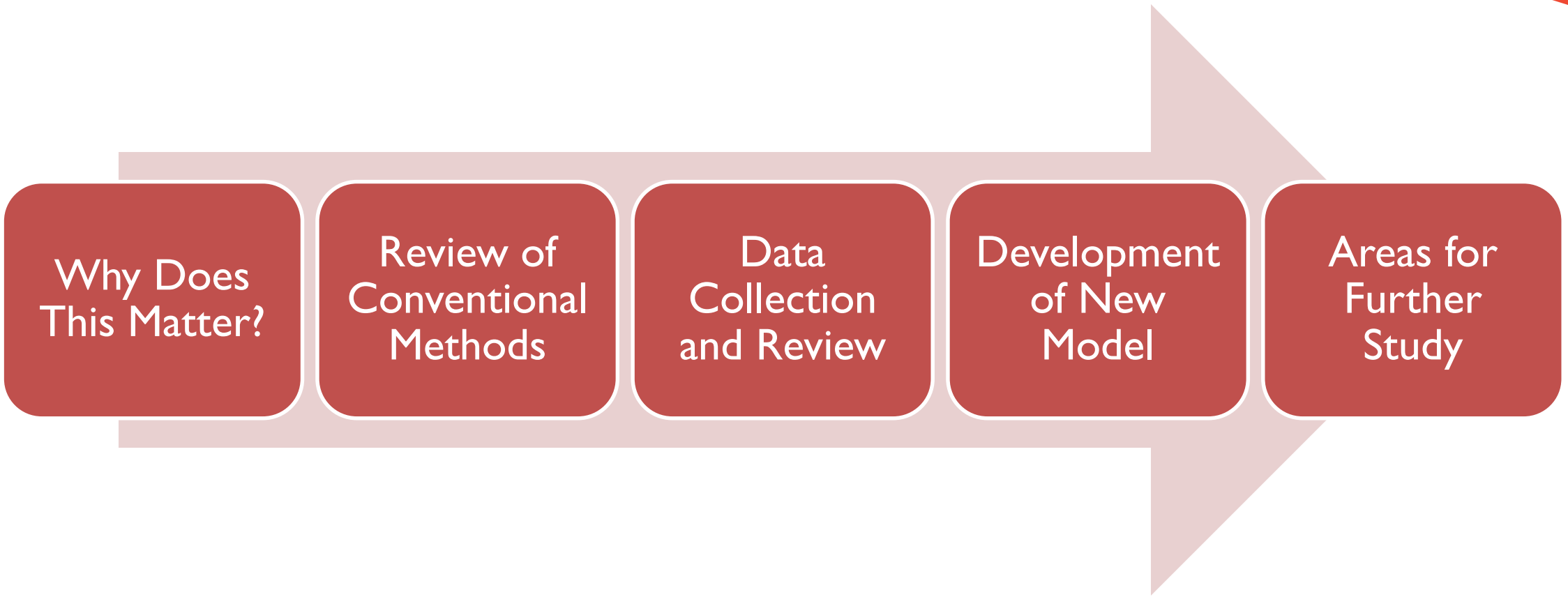
Joint Texas and Western District Annual Meeting

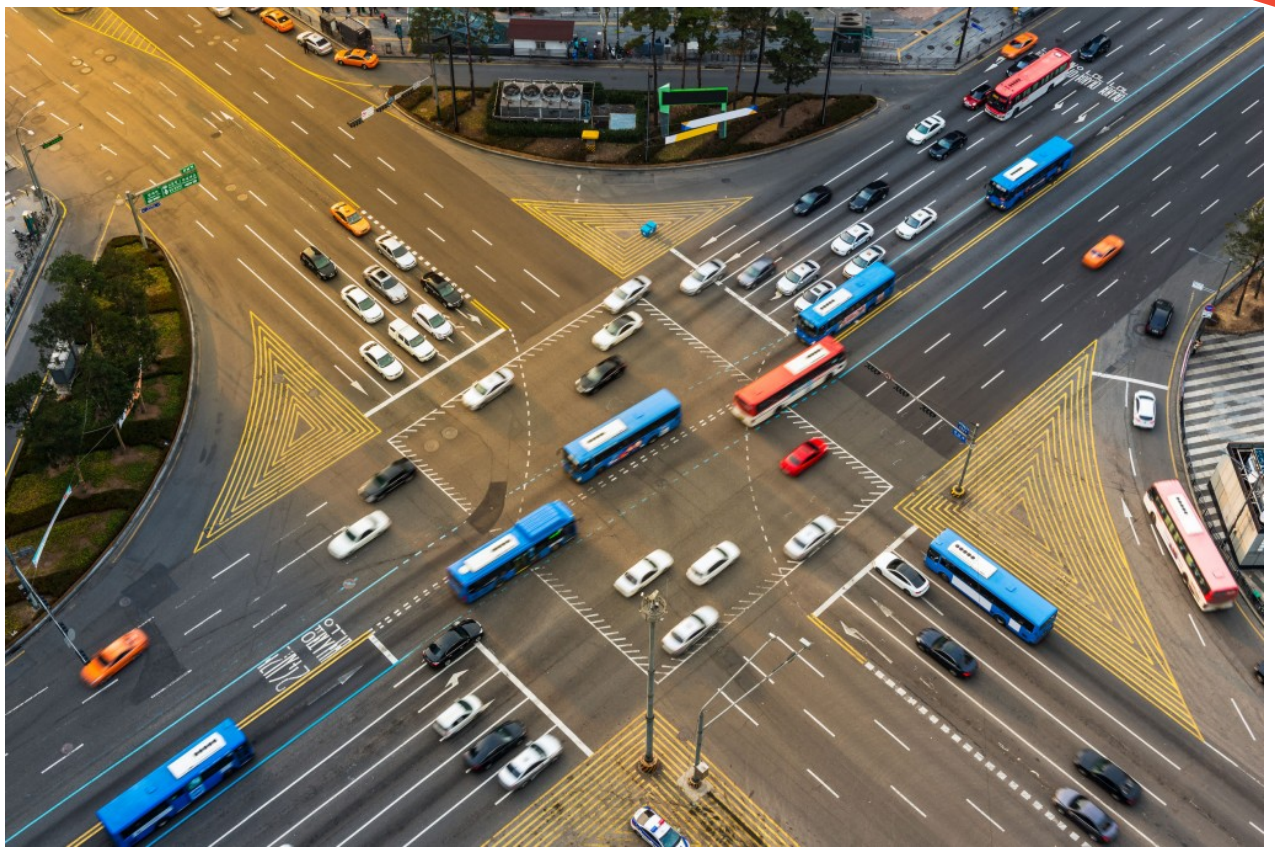
Quick Outline



Why does this matter?

Most common application: TIA

- Assess impacts of development
- Most important variable → trip generation estimates
- *Trip Generation Manual*
- Also affects Multimodal Design, TDM policies



Trip Generation Manual, 9th Edition

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Are ITE rates always applicable?

- Suburban, single-use, freestanding sites
- Collected extending back to the 1960s
- No update for trends in travel behavior
- Appropriate for urban cores and mixed use projects?

Trip generation estimates only reflect **one** variable: the density of the land use selected.

Variables Affecting Trip Generation

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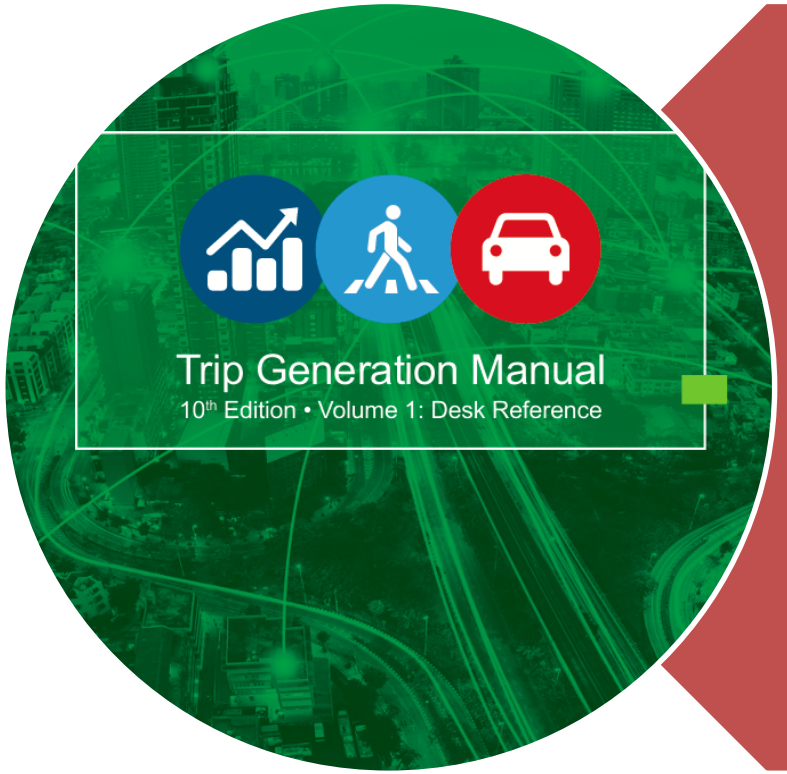
New models can include…

- Mix of uses within the development
- Connectivity and walkability
- Adjacent land uses
- Availability of non-auto modes
- Size of development
- Demographic profile of the surrounding area
- Transportation Demand Management (TDM)

Trip Generation Manual, 10th Edition



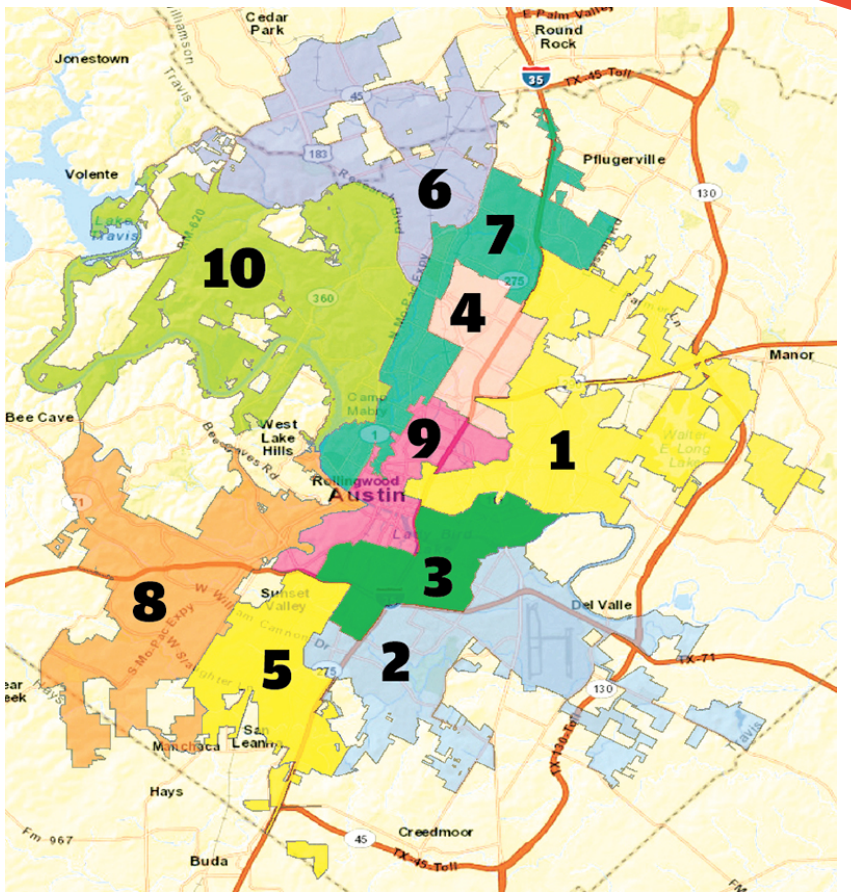
Released in late 2017

- All data after 1980
- Sorted data by geographic settings (Center City Core, Dense Multi-Use Urban, etc.)
- Data can also be sorted by the year it was collected
- Updated land use categories

Data Collection

35 sites from transportation studies and impact analyses.

- Within last two years
- Located within City of Austin limits
- All ten City Council districts
- Ten different land use categories



Comparison to ITE Trip Generation

ITE Edition	Statistic	AM Peak Hour	PM Peak Hour
9th Edition	ITE Generated Estimates vs. Actual Vehicle Trip Generation Totals	152%	150%
	Average Overestimation Per Site	47%	54%
	Sites with Higher Actual Vehicle Trip Generation Than Estimate	4 / 31	1 / 31

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	Sites with Actual Trip Generation Less Than 80% of ITE Generated Estimate	22 / 31	24 / 31
	Sites with Actual Trip Generation Less Than 60% of ITE Generated Estimate	14 / 31	12 / 31

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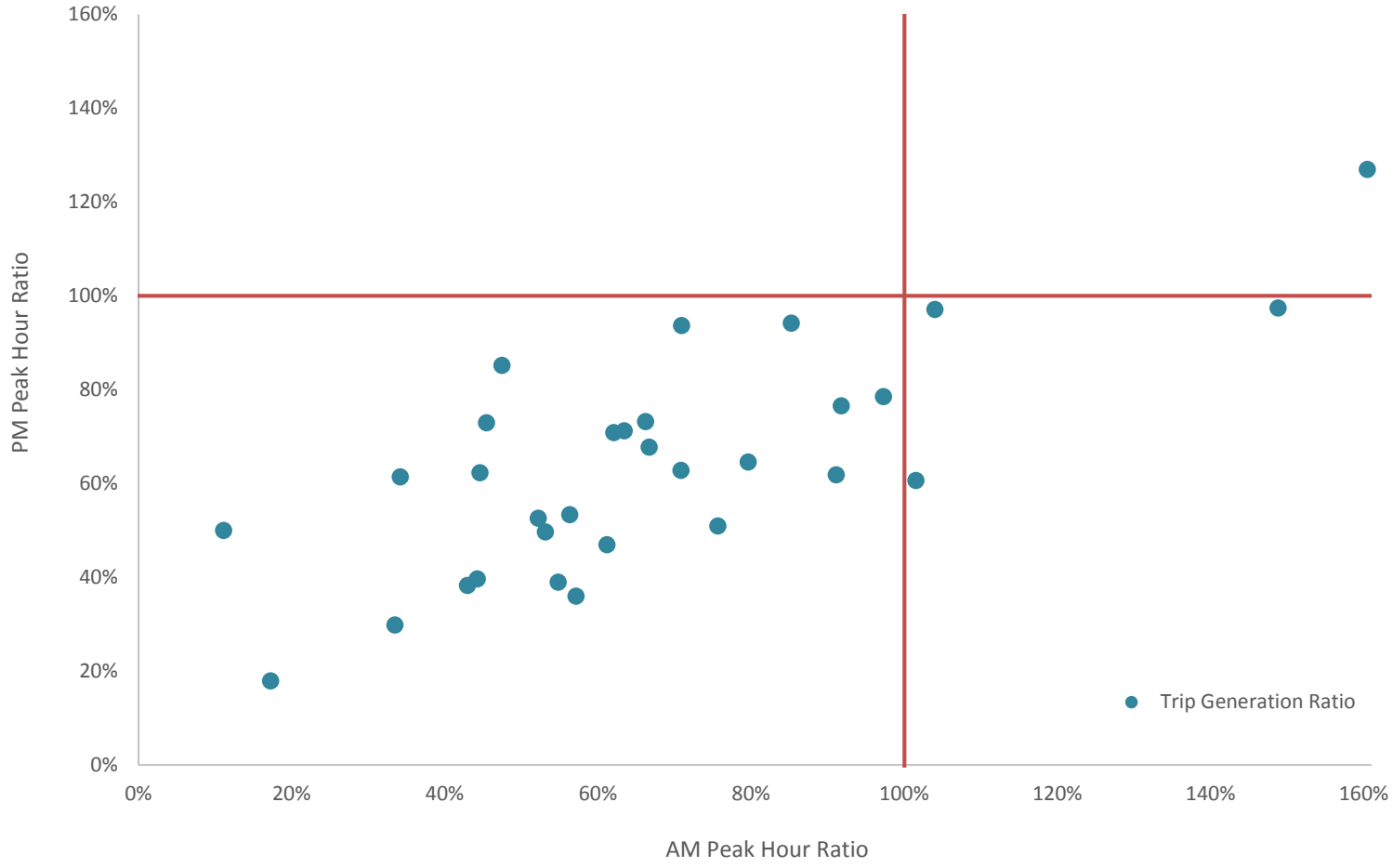
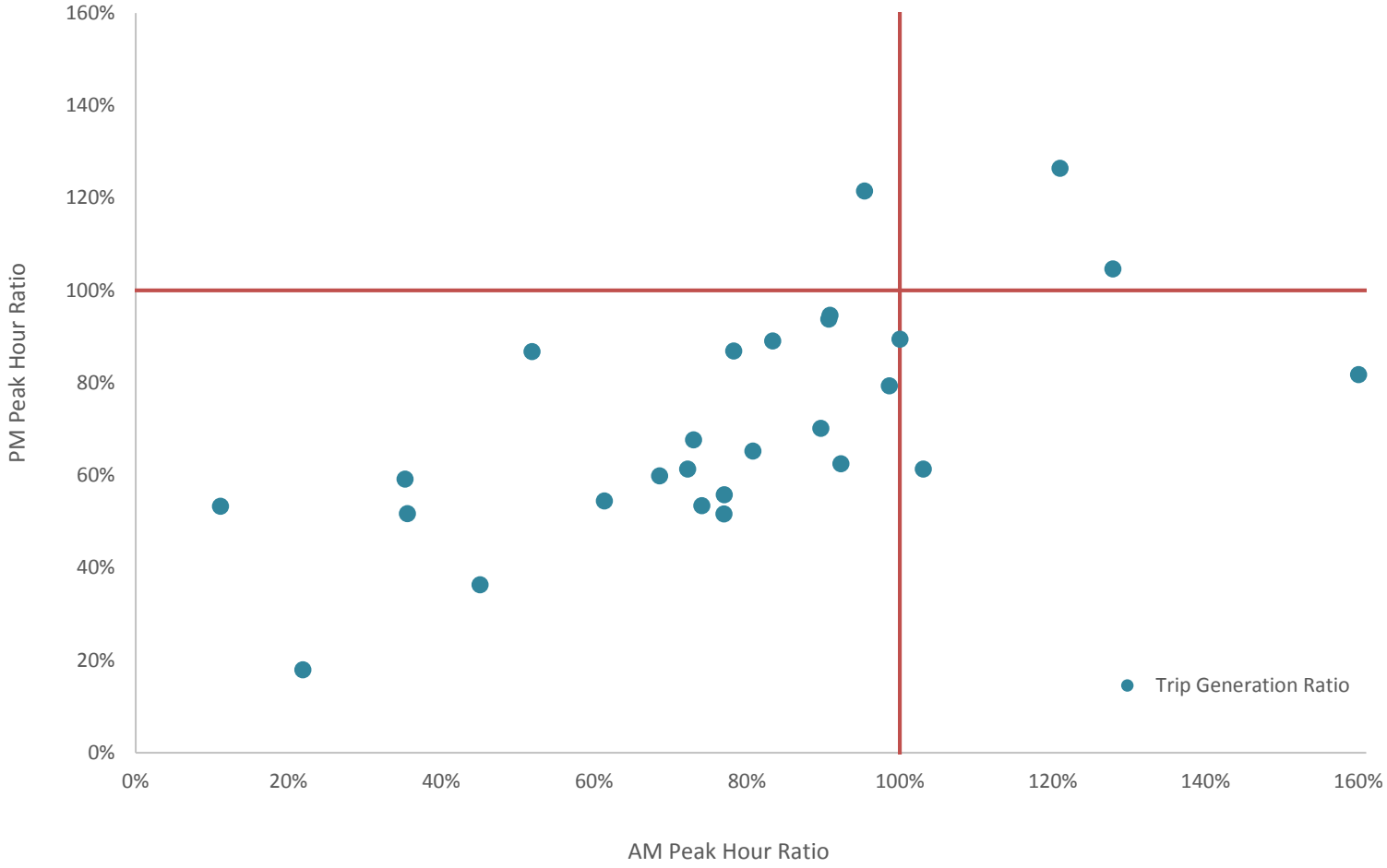
	Sites with Actual Trip Generation Less Than 80% of ITE Generated Estimate	14 / 31	17 / 31
	Sites with Actual Trip Generation Less Than 60% of ITE Generated Estimate	6 / 31	10 / 31

ITE 9th Edition Comparison



ITE 10th Edition Comparison



Other Available Models

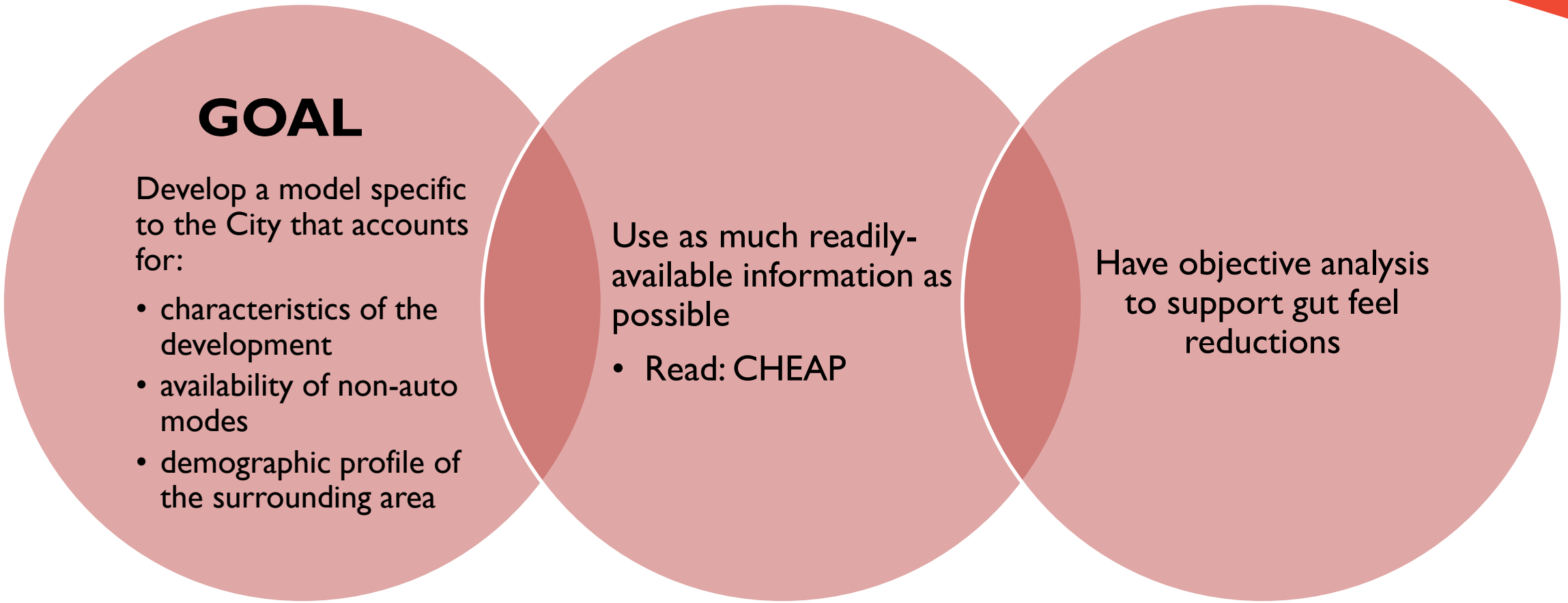
EPA MXD Model

- Built from 239 sites, validated at 27 sites
- Includes many of the variables mentioned earlier

NCHRP Report 684

- Examines interactions between specific uses

Model Development



Variables Considered

- Land use categories and intensities
- Zip code and City Council district
- Most-frequent transit service within ¼-mile radius of project
- Intersection density within ¼-mile radius
- Provision of parking and fees associated
- Walk Score, Bike Score, and Transit Score from walkscore.com
- MobilityScore from TransitScreen
- Size of project in acres

By Zip Code:

- Household size
- Average family size
- Percentage of households without vehicles
- Average vehicle ownership per household
- Drive alone commute percentage

Census Data

Potential Variable	National Rate			
Household Size	2.58			
Average Family Size	3.14			
Households without Vehicles	9.0%			
Vehicles per Household	1.79			
Drive Alone Commute Percentage	76.4%			

Census Data

Potential Variable	National Rate	City of Austin		
Household Size	2.58	2.37		
Average Family Size	3.14	3.16		
Households without Vehicles	9.0%	6.4%		
Vehicles per Household	1.79	1.66		
Drive Alone Commute Percentage	76.4%	73.7%		

Census Data

Potential Variable	National Rate	City of Austin	Average Study Site	
Household Size	2.58	2.37	2.45	
Average Family Size	3.14	3.16	3.15	
Households without Vehicles	9.0%	6.4%	6.6%	
Vehicles per Household	1.79	1.66	1.68	
Drive Alone Commute Percentage	76.4%	73.7%	72.9%	

Census Data

Potential Variable	National Rate	City of Austin	Average Study Site	Rate Range
Household Size	2.58	2.37	2.45	1.44 – 3.67
Average Family Size	3.14	3.16	3.15	2.23 – 4.05
Households without Vehicles	9.0%	6.4%	6.6%	0.4% - 14.9%
Vehicles per Household	1.79	1.66	1.68	1.26 – 2.19
Drive Alone Commute Percentage	76.4%	73.7%	72.9%	60.9% – 81.8%

Variables Considered

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By Zip Code:

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Variables Selected

Land use categories and intensities

~~Zip code and City Council district~~

~~Most-frequent transit service within ¼-mile radius of project~~

~~Intersection density within ¼-mile radius~~

~~Provision of parking and fees associated~~

Walk Score, ~~Bike Score, and Transit Score~~ **from walkscore.com**

~~MobilityScore from TransitScreen~~

~~Size of project in acres~~

By Zip Code:

- **Household size**
- ~~Average family size~~
- ~~Percentage of households without vehicles~~
- **Average vehicle ownership per household**
- ~~Drive alone commute percentage~~

Model Calibration

Calibration / Validation Statistics of Using ITE (10th Edition) and BRD Trip Generation Model					
	Validation Statistic	AM Peak Hour		PM Peak Hour	
		ITE Method	BRD Model	ITE Method	BRD Model
Calibration	Average Model Error %	14%		24%	
	Average Absolute Model Error %	34%		33%	
	Root Mean Square Error %	49%		57%	
	R-Squared	0.89		0.80	

Model Calibration

Calibration / Validation Statistics of Using ITE (10th Edition) and BRD Trip Generation Model					
	Validation Statistic	AM Peak Hour		PM Peak Hour	
		ITE Method	BRD Model	ITE Method	BRD Model
Calibration	Average Model Error %	14%	13%	24%	9%
	Average Absolute Model Error %	34%	16%	33%	7%
	Root Mean Square Error %	49%	21%	57%	13%
	R-Squared	0.89	0.97	0.80	0.95

Model Validation

Calibration / Validation Statistics of Using ITE (10th Edition) and BRD Trip Generation Model					
	Validation Statistic	AM Peak Hour		PM Peak Hour	
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	Average Absolute Model Error %	34%	16%	33%	7%
	Root Mean Square Error %	49%	21%	57%	13%
	R-Squared	0.89	0.97	0.80	0.95
Validation	Average Model Error %	21%		29%	
	Average Absolute Model Error %	32%		39%	
	Root Mean Square Error %	59%		61%	
	R-Squared	0.86		0.74	

Model Validation

Calibration / Validation Statistics of Using ITE (10th Edition) and BRD Trip Generation Model					
	Validation Statistic	AM Peak Hour		PM Peak Hour	
		ITE Method	BRD Model	ITE Method	BRD Model
Calibration	Average Model Error %	14%	13%	24%	9%
	Average Absolute Model Error %	34%	16%	33%	7%
	Root Mean Square Error %	49%	21%	57%	13%
	R-Squared	0.89	0.97	0.80	0.95
Validation	Average Model Error %	21%	12%	29%	14%
	Average Absolute Model Error %	32%	15%	39%	11%
	Root Mean Square Error %	59%	24%	61%	14%
	R-Squared	0.86	0.94	0.74	0.94

Potential Issues

- Is 31 sites enough for calibration? Five enough for validation?
- Counts for each site occurred on one day only
- Included land uses represent small subset of ITE's *Trip Generation*
- Locations with fewer access points chosen
- Used simplified versions of many variables

Follow-up Possibilities

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Calibrating/validating for person-trip data

Develop mode split estimates

Use additional data to develop VMT estimates

Implications for Impact Fee Programs/Long-Term Planning?

Transportation Demand Management

Impact on ability to design multimodally

Conclusion

- ITE's 10th Edition is better, but national data do not reflect City
- Model lowers average error from 17-31 percent to 5-9 percent
- Total cost for the data was just under $10,000
- Fewer than 100 hours of staff time
- Easy to replicate