Mixed Use Trip Generation (MXD) Tool: Development, Validation and Examples

Why is MXD Important to Understand, and Correctly Study and Analyze?

Generation Y consists of 80 million people born between 1979 and 1996.

- 88 percent indicated a preference to live in an urban setting
- One-third are willing to pay more for a walkable community

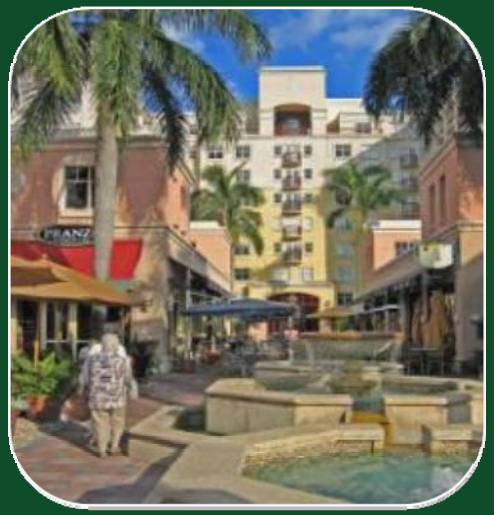
Source: *Growing Wealthier*

Outline

- **What** is MXD?
- **Why** develop a Mixed Use Trip Generation Model (MXD)?
- **How** does MXD perform?
- **When** to use and apply MXD?

Factors Correlated with Reduced Trip Generation

- Development Density
- Jobs / Housing and job-type mix
- Development scale



- Network connectivity, walkability
- Rail stations, bus stops, transit accessible employment
- Surrounding employment
- Household size

What is MXD?

- Statistical relationships between built environment and travel survey data
- Estimates *percent reduction* in vehicle trips entering / leaving site
- Uses ITE (or locally preferred) trip rates
- Replaces current ITE mixed-use method

Why develop a quick response tool for mixed use sites?

Limitations of current ITE Method

- Reductions for mixed use based on a limited number (six) of sites in Florida
- Only land uses available are general (residential, office, retail, and “misc”)
- Does not account for development scale
- Does not account for land use context (surrounding area)
- Can’t analyze AM peak hour

Why develop a quick response tool for mixed use sites? (cont.)

- ITE Trip Generation & Handbook understate traffic benefits of mixed-use developments
- Overstates impacts of mixed-use development / infill / TOD
- MXD Tool = Instant results – incorporates smart growth elements based on extensive research *without* a travel demand model

What is the MXD Model?
Input

- Density (population + jobs per square mile)
- Diversity (jobs / housing, retail / housing)
- Design (intersections per square mile)
- Destinations (jobs within one mile)
- Development Scale (size, total jobs)
- Demographics (household size, auto ownership)
- Distance to Transit (jobs within 30 minutes by transit, bus stop proximity)

An ever-growing, vast body of empirical research

"Data! Data! Data!" he cried impatiently, "I cannot make bricks without clay!"

-- *The Adventures of Sherlock Holmes*, The Adventure of the Copper Beeches

Sir Arthur Conan Doyle, 1892

Mixed Use Trip Generation (MXD) Model

Nationwide Survey of MXD Trips

- 240 MXD's
- 36,000 Trips
- Boston, Atlanta, Houston, Sacramento, Portland, Seattle

16 Nationwide Validation Sites

- 7 Florida sites
  (including those from ITE *Trip Generation Handbook)*
- 6 California sites (3 in Orange County, 3 in Northern Cal)
- 3 sites in Texas and Georgia

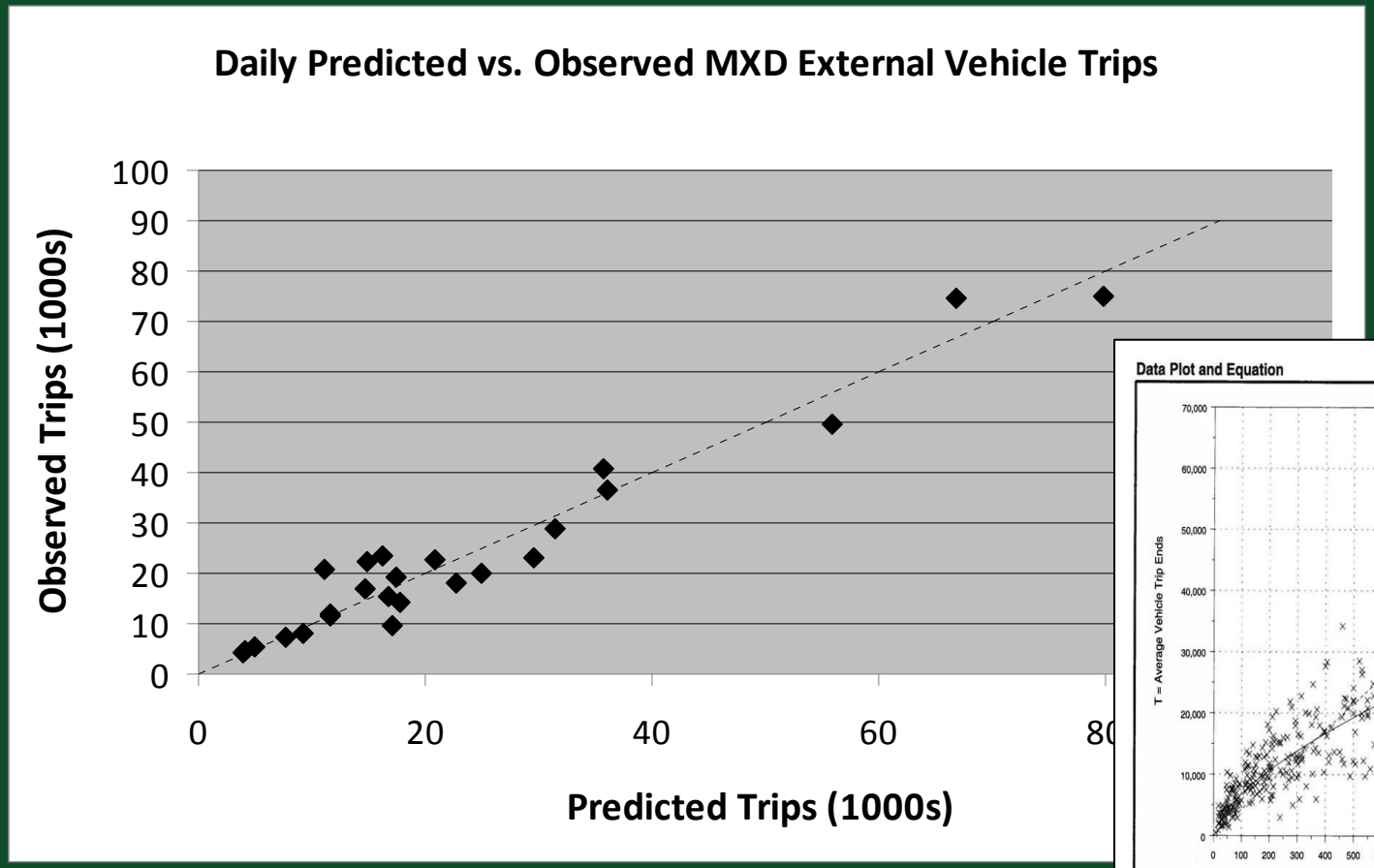
MXD Output

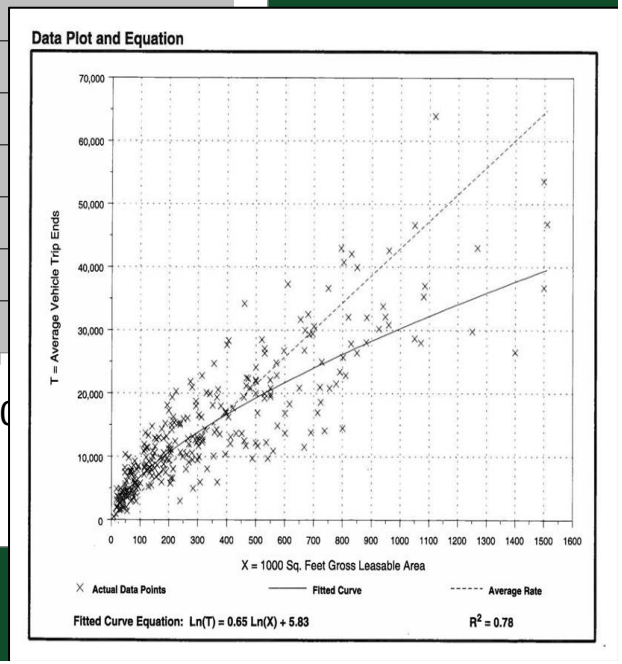
	Total
ITE Trip Generation (“Raw” Vehicle Trips)	9,000
Internally Captured Trips	1,300
External Trips by Walk or Bike Mode	450
External Trips by Transit	525
“Net” External Vehicle Trips	6,725

How does MXD Perform?
Validation Sites – 25 Total

- Combination of ITE Handbook Florida sites, Fehr & Peers studies, NCHRP 8-51, SANDAG Smart Growth Trip Gen Study
- Site and surrounding area land use collected from articles, travel models
- ITE / SANDAG trip generation calculated, MXD model applied
- Results compared to empirical traffic counts at all site entrances

How does the MXD Model Perform?





Single-Family Detached Housing
(210)

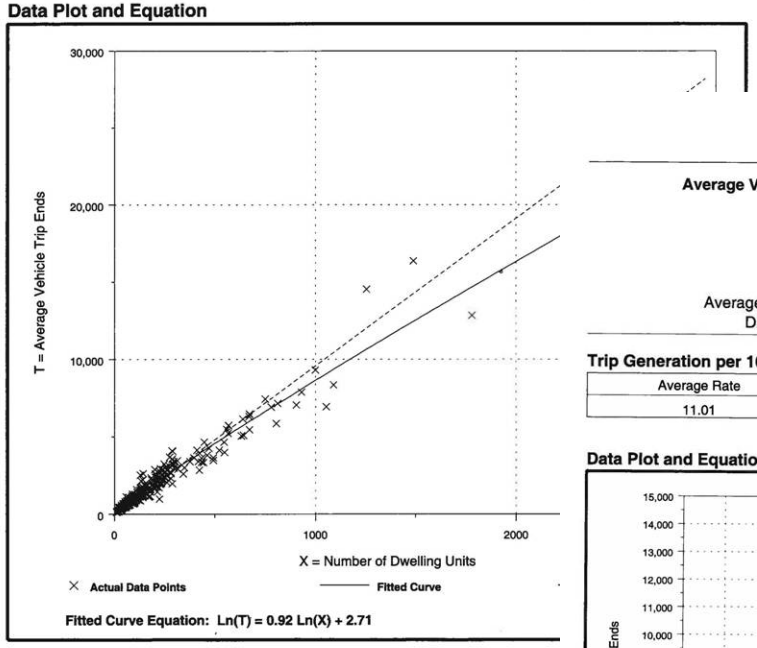
Average Vehicle Trip Ends vs: Dwelling Units
On a: Weekday

Number of Studies: 350
Avg. Number of Dwelling Units: 197
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.57	4.31 - 21.85	3.69

Data Plot and Equation



General Office Building
(710)

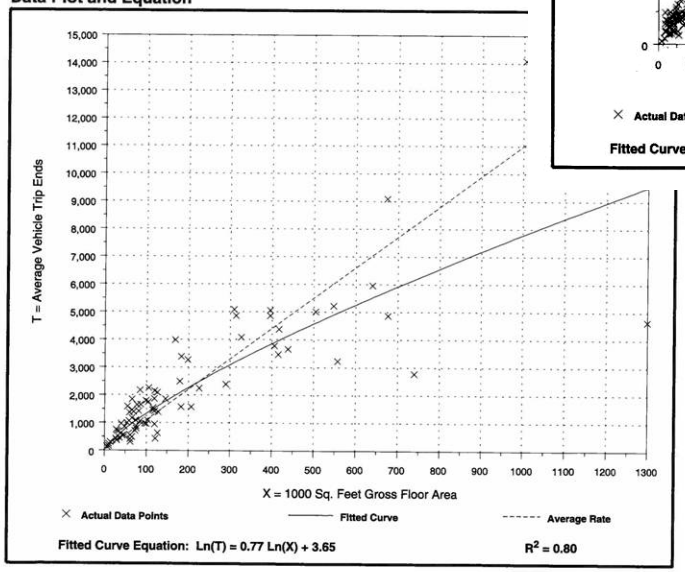
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Flo
On a: Weekday

Number of Studies: 78
Average 1000 Sq. Feet GFA: 199
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Sta
11.01	3.58 - 28.80	

Data Plot and Equation



Shopping Center
(820)

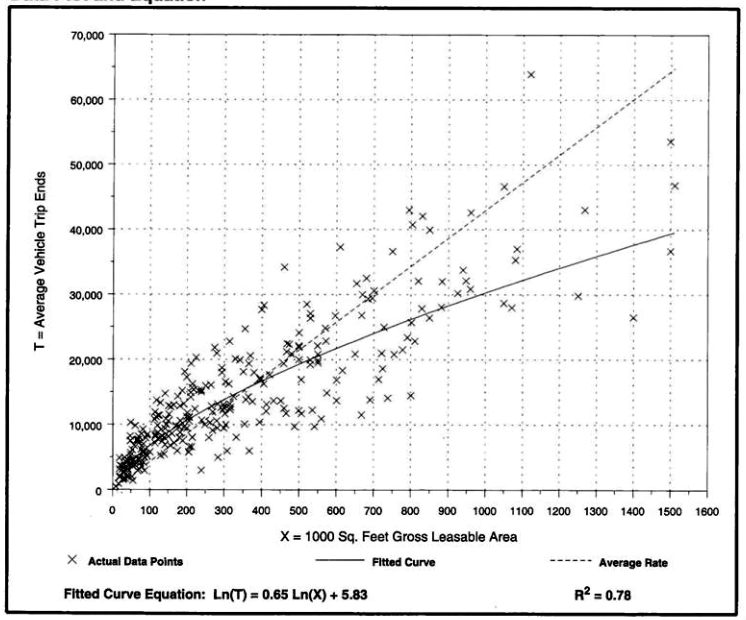
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area
On a: Weekday

Number of Studies: 302
Average 1000 Sq. Feet GLA: 328
Directional Distribution: 50% entering, 50% exiting

Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
42.94	12.50 - 270.89	21.38

Data Plot and Equation



How does MXD Perform?
Validation Statistics – 25 Sites

	ITE / San Diego		MXD Model
	Raw Rates	Current Methods	
Average Model Error	28%	16%	2%
Average Absolute Model Error	33%	23%	17%
%RMSE	42%	31%	20%
R Squared	0.72	0.85	0.94

Recent MXD Application Example – SANDAG Smart Growth Trip Generation Study

- Six Sites chosen based on
  - mix of land uses
  - feasibility of count data collection
- National MXD Equations matched up well with empirical San Diego data
- Model estimates to counted sites comparisons show MXD model is valid

Example MXD Trip Generation

- Mizner Park, Boca Raton, FL
- Redwood Shores, Redwood City, CA
- Hazard Center, San Diego, CA

How to use and apply MXD

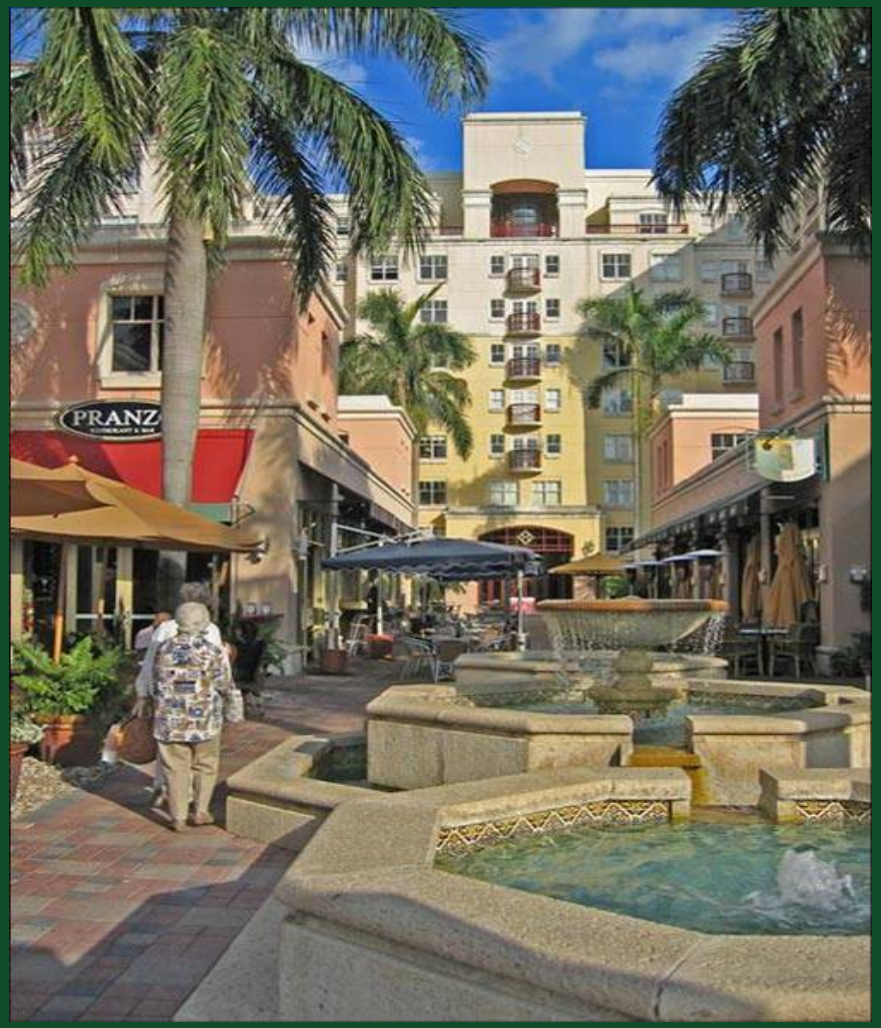
- Under review by ITE
- Verify with local data
- Use professional judgment
- Conservative on TOD
- Development size range: 5-2000 acres (most were 100-500 acres)

Utilization and Approval Status

- **Los Angeles County**: Approved
- **Sacramento County**: Approved
- **SANDAG**: Approved for inclusion in *Traffic Generators Manual*
- **ASCE**: Approved for Publication
- **Caltrans**: "Improved Analysis Tools for Smart-Growth Plans and Projects in California" Study Underway for Consideration a Statewide tool
- **CEQA**: MXD has been utilized in certified EIRs
- **ITE**: Currently under review
- **EPA**: Beta testing

Current Status of MXD Model

- Spreadsheet tool
  - Built-in Trip Generation Calculations
  - Built-in VMT Calculator
- Used by Fehr & Peers
  - TIAs
  - Specific plans
  - EIRs
- SCAG status
  - Proposal submitted to create customized tool for the SCAG region



Do | Measure | Learn

- **Do** additional applications of the tool
- **Measure** projects in the field when occupied
- **Learn** and share findings

Source: *Growing Wealthier*

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