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

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITE Trip Generation (“Raw” Vehicle Trips)</td>
<td>9,000</td>
</tr>
<tr>
<td>Internally Captured Trips</td>
<td>1,300</td>
</tr>
<tr>
<td>External Trips by Walk or Bike Mode</td>
<td>450</td>
</tr>
<tr>
<td>External Trips by Transit</td>
<td>525</td>
</tr>
<tr>
<td>“Net” External Vehicle Trips</td>
<td>6,725</td>
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</tbody>
</table>
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?

Daily Predicted vs. Observed MXD External Vehicle Trips

Data Plot and Equation

- Actual Data Points
- Fitted Curve
- Average Line

Fitted Curve Equation: Ln(T) = 0.03 Ln(A) + 5.83

\[ R^2 = 0.78 \]
# How does MXD Perform?

## Validation Statistics – 25 Sites

<table>
<thead>
<tr>
<th></th>
<th>ITE / San Diego</th>
<th>MXD Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw Rates</td>
<td>Current Methods</td>
</tr>
<tr>
<td>Average Model Error</td>
<td>28%</td>
<td>16%</td>
</tr>
<tr>
<td>Average Absolute Model Error</td>
<td>33%</td>
<td>23%</td>
</tr>
<tr>
<td>%RMSE</td>
<td>42%</td>
<td>31%</td>
</tr>
<tr>
<td>R Squared</td>
<td>0.72</td>
<td>0.85</td>
</tr>
</tbody>
</table>
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*
For more information:

Brian Welch
Principal
Fehr & Peers
Santa Monica Office
(310) 458-9916 ext. 3126
b.welch@fehrandpeers.com
www.fehrandpeers.com
www.coolconnections.org