Measuring Managed Highways
Emerging Tools for the Emerging Roadway System

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Role of Models

• Provide technical information for planning and design

• Evolving from system construction and expansion

• Evolving to managing system refinements, operations and reconstruction
Evolving From

• In the past:
  – best roadway location
  – required number of lanes
  – long-term needs

• Can the tools currently being used provide useful information for the new types of decisions?
Evolving To

• In the future:
  – lane function
  – marginal benefits
  – operational changes
  – Short term

• What characteristics are needed for the new types of decisions?
Managed Lanes

- Dynamic speed management
- Priced dynamic shoulders
- HOV lanes
- HOT lanes
- Transit treatment
MANAGED LANE FORECASTING 101

• More Complex
  – Competition conditions

• More Data
  – Geometrical consideration/ speed deterioration
  – Time of day profiling

• Eligibility and Pricing Options
  – Operational demand management
  – Revenue generation?
Modeling 101

- Activity generates demand
- Choice modeling of origin-destination patterns and mode
- Time-of-day modeling
- Route assignment
Shortcomings of Static Model

- Demand will still be assigned onto network
- V/C ratios do not reflect queuing and potential bottlenecks
- V/C ratios do not affect upstream links
- Travel demand model cannot “back up” traffic from an overcapacity link
- Traffic flow may not be affected by downstream congestion
Static Assignment: Instantaneous
What is Dynamic Traffic Assignment (DTA)?

- Mesoscopic traffic assignment
- Not Macroscopic (planning)
- Not Microscopic (operations)
What is Dynamic Traffic Assignment (DTA)?

- “Experienced” travel time
- Time-dependent
- Queuing
- “Spillback”/Blockages
- Speed/flow relationship
Traffic Flow Realism

![Graph showing the relationship between speed and v/c ratio, labeled as Travel Demand Model.](image-url)
What is it Good For (Applications)?

- Advanced practice travel demand models
- “High level” operations analysis
- Parallel/multiple corridor conditions
- Pricing/HOT/toll lanes
- System management alternatives
- Work zone planning
## DTA Primer

<table>
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<th></th>
<th>STA</th>
<th>DTA</th>
<th>MICRO</th>
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<tbody>
<tr>
<td><strong>Loading</strong></td>
<td>Analytical</td>
<td>Meso Sim</td>
<td>Micro Sim</td>
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<tr>
<td><strong>Shortest Path</strong></td>
<td>Instantaneous</td>
<td>Time Dependent</td>
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<tr>
<td><strong>Connectivity</strong></td>
<td>Link</td>
<td>Link/Lane</td>
<td>Lane/Turn</td>
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<td><strong>Resolution</strong></td>
<td>Hour</td>
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<td><strong>Solution</strong></td>
<td>UE</td>
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<td><strong>Convergence</strong></td>
<td>Unique</td>
<td>Non-Unique</td>
<td>Non-Unique</td>
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<tr>
<td><strong>Speed</strong></td>
<td>Static Average</td>
<td>Time Varying</td>
<td>Time Varying</td>
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<td><strong>Flow Model</strong></td>
<td>VDF</td>
<td>Speed-Density</td>
<td>Car Following</td>
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<tr>
<td><strong>Arrival Time Profile</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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Tung & Chiu: Integration of DTA in a 4-Step Model Framework
Experienced/Time Dependent Paths

Source: A Primer for Dynamic Traffic Assignment, ADB30 Transportation Network Modeling Committee Transportation Research Board (2010)
What is it Good For (Applications)?

Multi-Resolution Modeling (MRM)

MACRO

- Static/Instantaneous Paths
- Region Wide
- Zonal Trips
- Analytical Equilibrium
- Demand Driven
- Planning/Forecasting

O/D

MICRO

- Static Paths
- Corridor/Intersection
- Individual Vehicles
- Simulation One-Shot
- Supply Driven
- Operational

- Dynamic/Time Varying Paths
- Subarea / Corridor
- Vehicle Platoons

- Simulation Equilibrium
- Supply Driven
- Planning/Operational

Tung & Chiu: Integration of DTA in a 4-Step Model Framework
Multi Resolution Modeling

- **Macro**
  - Regional Travel Demand Model
  - Converter
    - Network
    - OD Data

- **Meso**
  - Preliminary Regional DTA Model
  - Refine DTA Model:
    - Links
    - Lanes
    - Traffic Control
    - Signal Timing
  - Calibration/Validation
  - Final Regional DTA Model

- **Micro**
  - Detailed Operations Analysis
  - Network Alternatives

- **Converter**
  - Create Sub-Area Model
  - Regional Operations Analysis
  - Fine Tune
Multi Resolution Modeling

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- Regional Travel Demand Model
  * Converter
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  * OD Data

Meso
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- Refine DTA Model:
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Field Data
- Link Speeds
- Link Volumes
- Link Density

- Calibration/Validation
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- Detailed Operations Analysis
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Converter
Multi Resolution Modeling

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- **Regional Operations Analysis**
  - Field Data
    * Link Speeds
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Vehicle Simulation Characteristics
Time-dependent/Responsive
Bottleneck
Queuing
Queuing
Queuing
Queuing
Why Isn’t Everybody Using it Now?

- Lack of Awareness
- Data Requirements for Validation
- Diverging Opinions on Theory
- Computer Processing
- Regional Development/Project Application
- Need
Twin Cities Experience

- I-35W and I-394 Corridor ICM Evaluation
- Ahead of market
- Growing pains
- Lesson to be learned: application readiness (regional not project)
System Level Capabilities
Numerous Packages Available

- CALIPER (TransCAD, TransModeler)
- CITILABS (Avenue)
- INRO (DYNAMEQ)
- PTV (VISSIM)
- McTRANS (DYNASMART/DYNUS-T)
- VISTA
- Paramics
- AIMSUN
- Others
A Primer for
Dynamic Traffic Assignment

ADB30 Transportation Network Modelling Committee
Transportation Research Board

2010
Federal Work Zone Safety and Mobility Rule

- Work zone impacts during construction
- Implement transportation management plans (TMPs)
- TMP strategies to manage the work zone impacts of a project.
- The TMP must consist of a TTC plan, and also address TO and PI
Federal Work Zone Safety and Mobility Rule

Quick Zone

- Spreadsheet-based, sketch level
- traffic delays
- average and maximum queue lengths
- facilitates tradeoff
- Evaluates construction schedule options
- Evaluates mitigation strategies

Dynamic Traffic Assignment

- Consistent with project modeling
- work zone-capable
- Queues, delays and diversions
- Analysis of Interim options
Conclusions

- System-level Analysis
- Some Management-level Problems
- Can be integrated with travel demand modeling
- Still resource-intensive
- Regional investment/corridor application
Questions?

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