Agenda

- Need for Analytical Tools
- Overview of Analysis Methods for Planning and Operations
- Key Properties of Dynamic Traffic Assignment Methods
- TRB Study Findings
- Integrated Model Linkages with DTA
- Closing Thoughts

Linking Planning and Operations

SAFETEA-LU Requires Plans to…

.. "Include Operational & Management Strategies to Improve Performance of Existing Transportation facilities, Relieve Vehicular Congestion & Maximize the Safety & Mobility of people & goods." [1]

[1] Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy forUsers (SAFETEA-LU) Section 6001(i), 2005.

Developing SMART Operations Objectives

Operations Objectives Included in an MPO Plan are developed collaborative by planning partners to reflect regional values:

Specific. Sufficient to guide Approaches

Measurable. Quantitative Measurement

Agreed. Consensus among Partners

Realistic. Can be Accomplished

Time-bound. Identified time-frame for Accomplishment

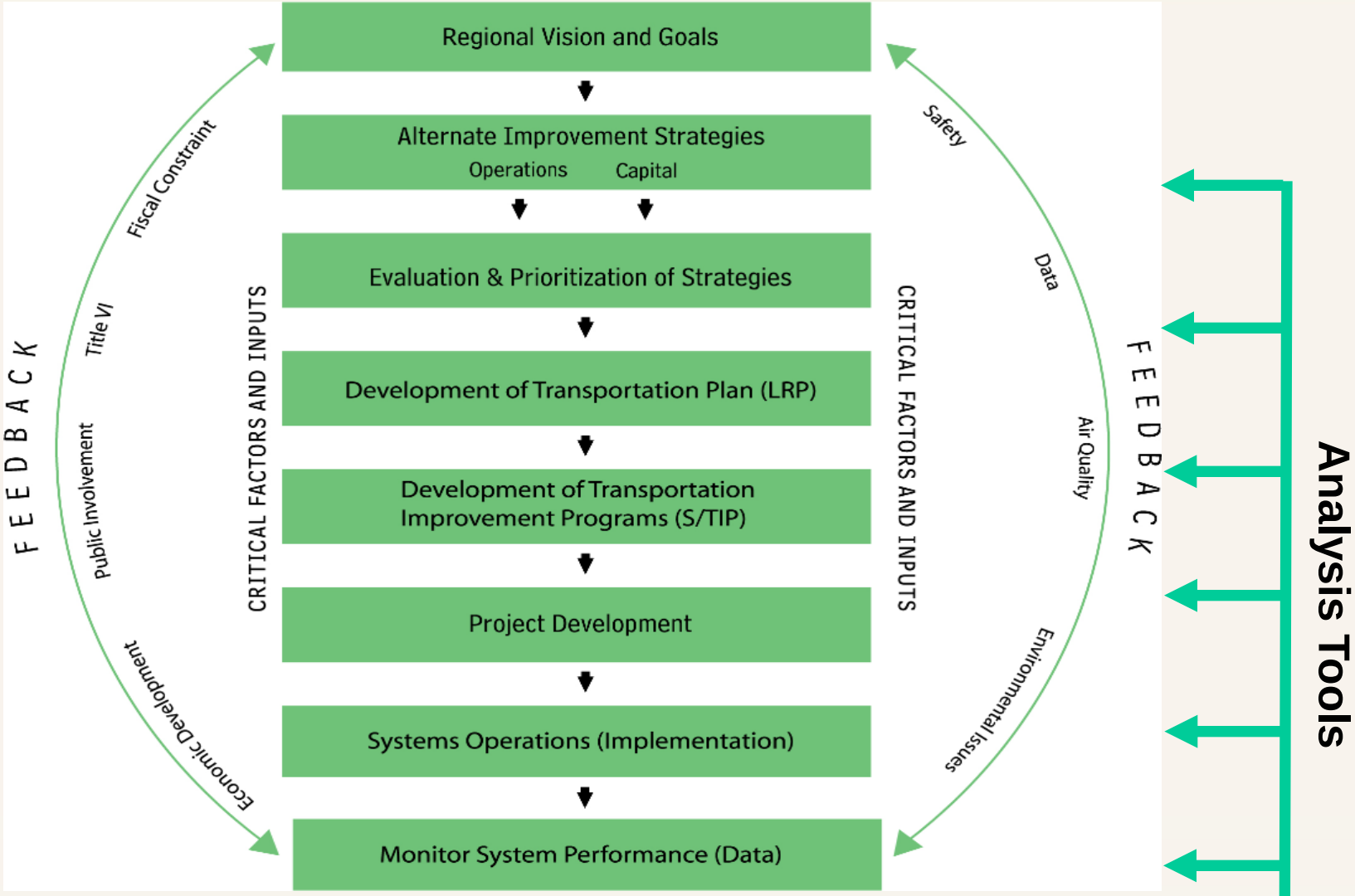
Fact Sheet Title/Page Number	Operations Objective
	System Efficiency
Extent of Congestion	• Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period by X percent by year Y. • Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate). • Reduce the share of major intersections operating at LOS F by X percent by year Y.
Duration of Congestion	• Reduce the daily hours of recurring congestion on major freeways from X to Y by year Z. • Reduce the number of hours per day that the top 20 most congested roadways experience recurring congestion by X percent by year Y.
Intensity of Congestion (Travel Time Index)	• Reduce the regional average travel time index by X percent per year.
Travel Time	• Annual rate of change in regional average commute travel time will not exceed regional rate of population growth through the year Y. • Improve average travel time during peak periods by X percent by year Y.
Delay	• Reduce hours of delay per capita by X percent by year Y. • Reduce hours of delay per driver by X percent by year Y.
Energy Consumption	• Reduce total energy consumption per capita for transportation by X percent by year Y. • Reduce total fuel consumption per capita for transportation by X percent by year Y. • Reduce excess fuel consumed due to congestion by X percent by 2020.

Role of Analysis Tools for Planning and Operations

Analytical Support for Improved decision making

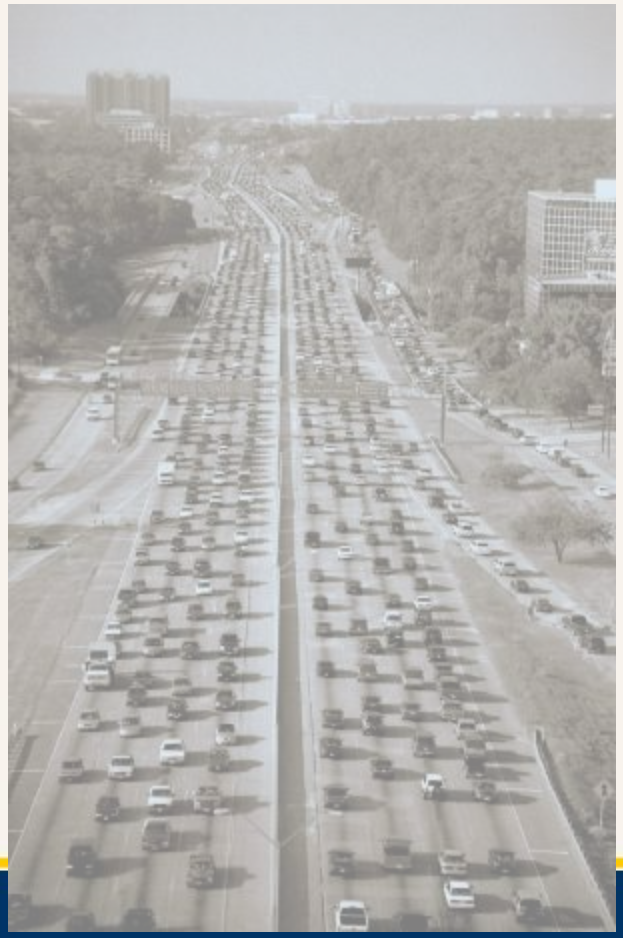
- Set priorities among competing projects
- Consistent approach for comparing alternatives
  - “Balanced” comparison for programming projects
  - Impacts, benefits, and costs of construction & operations strategies considered
- Provides data to support planning needs
- Forecasts future operations resource needs
- Provides benefit information that can be communicated to agency management, politicians, and the traveling public

How Analysis Tools Support the Planning Process



Congestion Management in the U.S.

- Travel demand is on the rise
- Traffic congestion is increasing
- Financial constraints are a reality
- Reduce traffic congestion by bringing supply and demand into alignment
- Active Traffic Management (ATM) is one of the operational strategies to manage congestion



Operational Strategies

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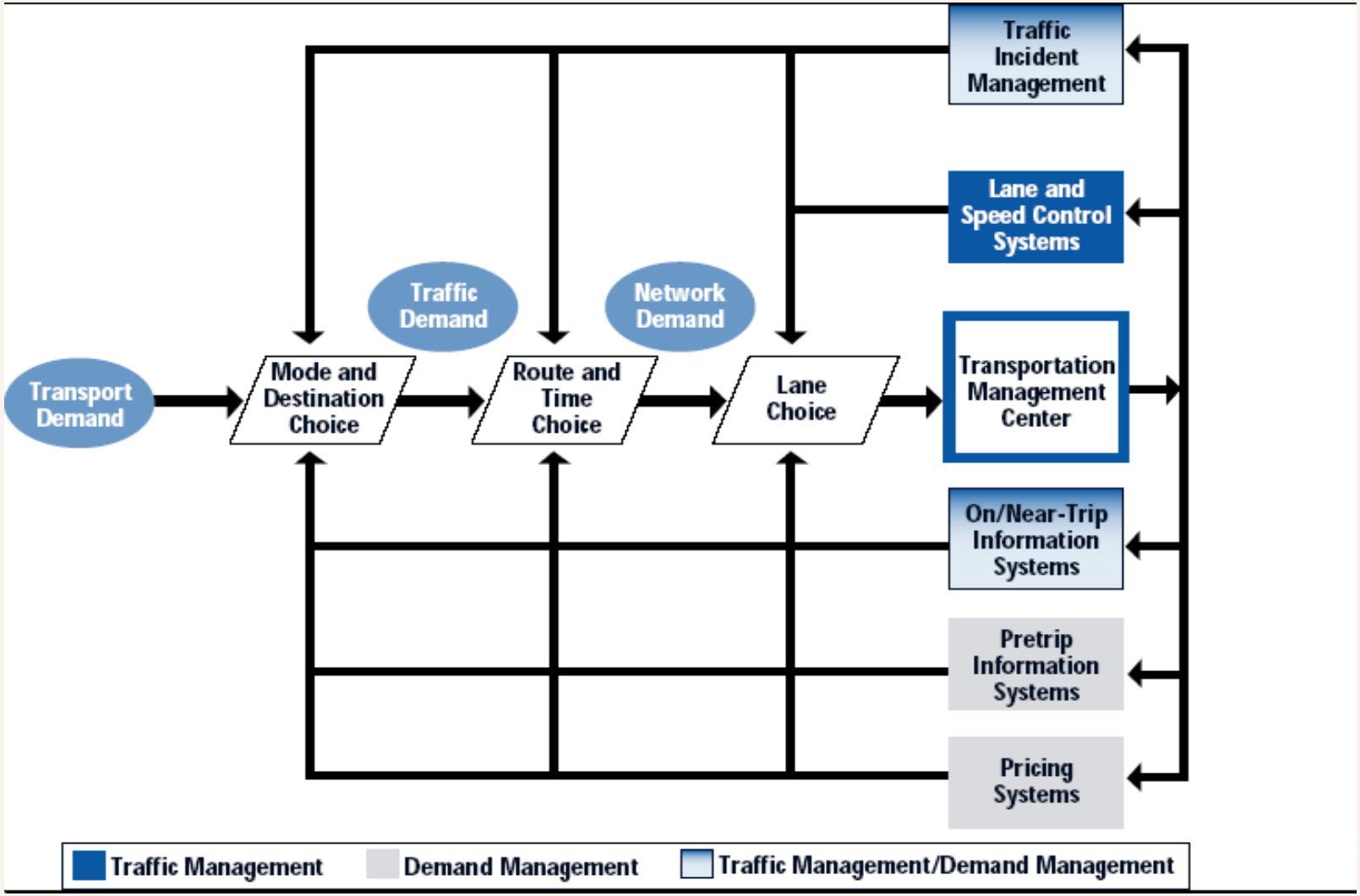
Improving the efficiency of the transport system by:

- Providing real-time, multi-modal information
- Predicting travel times
- Active traffic management
- Traffic management centers
- Parking management
- Improved public transport
- Managing large-scale events and emergencies
- Highway reconstruction mitigation

Sources: ATAC, Schreffler, Hull, AVV

Travel Impacts



Active Traffic Management Strategy	Potential Benefits												
	Increased throughput	Increased capacity	Decrease in primary incidents	Decrease in secondary incidents	Decrease in incident severity	More uniform speeds	Decreased headways	More uniform driver behavior	Increased trip reliability	Delay onset of freeway breakdown	Reduction in traffic noise	Reduction in emissions	Reduction in fuel consumption
Speed harmonization	●		●		●	●	●	●	●	●	●	●	●
Temporary shoulder use	●	●							●	●			
Queue warning			●	●	●	●	●	●	●		●	●	●
Dynamic merge control	●	●	●			●		●	●	●	●	●	●
Construction site management	●	●							●		●	●	●
Dynamic truck restrictions	●	●				●		●	●			●	●
Dynamic rerouting and traveler information	●		●	●				●	●			●	●
Dynamic lane markings	●	●							●				
Automated speed enforcement			●		●	●		●	●			●	●

Key Considerations for Selecting Analysis Tools

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Analysis Context:
Planning, Design, or Operations/Construction

1 Geographic Scope

- Isolated Location
- Segment
- Corridor/ Small Network
- Region

2 Facility Type

- Isolated Intersection
- Roundabout
- Arterial
- Highway
- Freeway
- HOV Lane
- HOV By-pass Lane
- Ramp
- Auxiliary Lane
- Reversible Lane
- Truck Lane
- Bus Lane
- Toll Plaza
- Light Rail

3 Travel Mode

- SOV
- HOV (2, 3, 3+)
- Bus
- Rail
- Truck
- Motorcycle
- Bicycle
- Pedestrian

4 Management Strategy

- Fwy Mgmt
- Arterial Intersections
- Arterial Mgmt
- Incident Mgmt
- Emerg Mgmt
- Work Zone
- Special Event
- APTS
- ATIS
- Electronic Payment
- RRX
- CVO
- AVCSS
- Weather Mgmt
- TDM

5 Traveler Response

- Route Diversion
  - Pre-Trip
  - En-Route
- Mode Shift
- Departure Time Choice
- Destination Change
- Induced/ Foregone Demand

6 Performance Measures

- LOS
- Speed
- Travel Time
- Volume
- Travel Distance
- Ridership
- AVO
- v/c Ratio
- Density
- VMT/PMT
- VHT/PHT
- Delay
- Queue Length
- # Stops
- Crashes/Duration
- TT Reliability
- Emissions/Fuel
- Noise
- Mode Split
- Benefit/Cost

7 Tool/Cost-Effectiveness

- Tool Capital Cost
- Effort (Cost/ Training)
- Ease of Use
- Popular/Well-Trusted
- Hardware Requirements
- Data Require-ments
- Run Time
- Post-Processing
- Documentation
- User Support
- Key Parameters User Definable
- Default Values
- Integration

Integrating Planning and Operations

Categories of Tools

Transportation Planning Needs	Operational Analysis Tools/Methods					
	Sketch Planning Tools	Deterministic Models	Travel Demand Forecasting Models	Simulation	Archived Operations Data	Traffic Signal Optimization Tools
Preliminary Screening Assessments	◆	◆			◆	
Alternatives Analysis		◆	◆	◆		◆
Demand impacts: Mode, Destination choices			◆			
Nonrecurring Congestion and Congestion Dynamics				◆	◆	
Evaluations of Deployed Projects					◆	

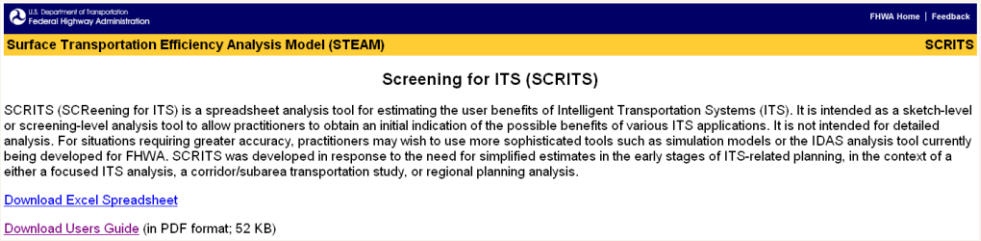
Sketch-Planning Tools

Provide quick order of magnitude estimates with minimal input data in support of preliminary screening assessments

- Typically depend on behavioral assumptions

Examples

- Sketch
  - SCRITS
  - Quickzone
  - Turbo Architecture
  - Cal B/C
  - Simple spreadsheets
- Hybrid
  - IDAS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Surface Transportation Efficiency Analysis Model (STEAM) **SCRITS**

Screening for ITS (SCRITS)

SCRITS (SCReening for ITS) is a spreadsheet analysis tool for estimating the user benefits of Intelligent Transportation Systems (ITS). It is intended as a sketch-level or screening-level analysis tool to allow practitioners to obtain an initial indication of the possible benefits of various ITS applications. It is not intended for detailed analysis. For situations requiring greater accuracy, practitioners may wish to use more sophisticated tools such as simulation models or the IDAS analysis tool currently being developed for FHWA. SCRITS was developed in response to the need for simplified estimates in the early stages of ITS-related planning, in the context of a either a focused ITS analysis, a corridor/subarea transportation study, or regional planning analysis.

Download Excel Spreadsheet

Download Users Guide (in PDF format; 52 KB)

QUICKZONE
A NEW WORK ZONE DELAY ESTIMATION TOOL

IDAS
ITS DEPLOYMENT ANALYSIS SYSTEM

Cal-B/C Demo
Parameters

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Parameters

This page contains all economic values and rate tables.
To update economic values automatically, change "Economic Update Factor."

General Economic Parameters

Year of Current Dollars for Model	2006
Economic Update Factor (Using GDP Deflator)	1.00
Real Discount Rate	5.0%

Highway Operations Parameters

	Value	Units	
Maximum V/C Ratio	1.4	-	1
Percent ADT in Average Peak Hour	7.8%	%	2
Capacity per Lane (general)	2000	veh/hr	
Capacity per HOV Lane	2000	veh/hr	

Travel Time Parameters

Average Hourly Wage			
Transportation and Warehousing	$ 18.74	$/hr	3
Statewide	$ 20.92	$/hr	3
Value of Time			
Automobile	$ 10.46	$/hr	
Truck	$ 27.83	$/hr	
Transit	$ 10.46	$/hr	
Out-of-Vehicle Travel	2	times	
Incident-Related Travel	3	times	

Operating Cost Parameters

Fuel Cost Per Gallon (Excludes Taxes)	$ 2.55	$/gal	4, 5
Non-Fuel Cost Per Mile			
Automobile	$ 0.173	$/mi	6
Truck	$ 0.299	$/mi	7

Accident Cost Paramters

Cost of a Fatality	$ 2,847,668	$/event	8
Cost of an Injury			
Level A (Severe)	$ 157,357	$/event	8
Level B (Moderate)	$ 42,505	$/event	8
Level C (Minor)	$ 22,960	$/event	8
Cost of Highway Accident			
Fatal Accident	$ 3,262,459	$/accident	
Injury Accident	$ 85,716	$/accident	
PDO Accident	$ 7,198	$/accident	9
Average Cost	$ 61,509	$/accident	

Project Types

Highway Capacity Expansion		
General Highway	FALSE	GenHwy
HOV Lane	TRUE	HOV
Passing Lane	FALSE	Passing
Interchange	FALSE	Intersect
Bypass	FALSE	Bypass
Pavement	FALSE	Pavement
Transit Capacity Expansion		
Passenger Rail	FALSE	PassRail
Light-Rail (LRT)	FALSE	LRT
Bus	FALSE	Bus
Operational Improvement		
Auxiliary Lane	FALSE	AuxLane
Freeway Connector	FALSE	FreeConn
HOV Connector	FALSE	HOVConn
HOV Drop Ramp	FALSE	HOVDrop
Off-Ramp Widening	FALSE	OffRamp
On-Ramp Widening	FALSE	OnRamp
Transp Mgmt Systems (TMS)		
Ramp Metering	FALSE	RM
Ramp Metering Signal Coord	FALSE	AM
Incident Management	FALSE	IM
Traveler Information	FALSE	TI
Arterial Signal Management	FALSE	ASM
Transit Vehicle Location (AVL)	FALSE	AVL
Transit Vehicle Signal Priority	FALSE	SigPriority
Bus Rapid Transit (BRT)	FALSE	BRT
TMS Lookup Code	NoAdj	

Operating Cost Tables

FUEL CONSUMPTION RATES
(gal/veh-mi)

Speed	Auto	Truck
5	0.150	0.218
6	0.142	0.215
7	0.135	0.211
8	0.127	0.208
9	0.120	0.205
10	0.112	0.202
11	0.107	0.198
12	0.102	0.194
13	0.097	0.190
14	0.092	0.186
15	0.087	0.182
16	0.083	0.179
17	0.080	0.177
18	0.076	0.174
19	0.073	0.172
20	0.070	0.169
21	0.067	0.168
22	0.065	0.166
23	0.063	0.165
24	0.060	0.163
25	0.058	0.162
26	0.057	0.161
27	0.055	0.160
28	0.053	0.159
29	0.052	0.158
30	0.050	0.157
31	0.049	0.156
32	0.048	0.156
33	0.047	0.155
34	0.046	0.154
35	0.045	0.154
36	0.045	0.153
37	0.044	0.153
38	0.043	0.153
39	0.043	0.152
40	0.042	0.152
41	0.042	0.152
42	0.042	0.152
43	0.041	0.152
44	0.041	0.151
45	0.041	0.151
46	0.041	0.151
47	0.041	0.151
48	0.041	0.151
49	0.041	0.151

Accident Tables

COST OF TRANSIT ACCIDENT EVENTS
($/event)

Event	Pass Train	Light Rail	Bus
Fatality	$2,847,668	$2,847,668	$2,847,668
Injury	$68,922	$68,922	$68,922
Prop Damage	$65,097	$11,296	$11,060

Sources: National Safety Council, Federal Railroad Administration, Journal of Safety Research, and California Public Utilities Commission

RATES FOR TRANSIT ACCIDENT EVENTS
(event/million veh-mi)

Event	Pass Train	Light Rail	Bus
Fatality	0.24	0.23	0.05
Injury	0.94	12.80	12.20
All Accidents	1.09	11.13	14.73

Source: USDOT, average of 1994, 1995, 1996 data

TRANSIT ACCIDENT COSTS
($/million veh-mi)

Value	Pass Train	Light Rail	Bus
Cost	$819,183	$1,662,896	$1,146,145

Source: Combination of above two tables

PASSING LANE ACCIDENT REDUCTION FACTORS
(rate with passing lane/rate without passing lane)

Minimum ADT	Fatality	Injury	PDO
0	25.0%	69.4%	92.6%
5,000	19.2%	80.3%	96.5%
10,000	84.0%	57.7%	97.8%

2) Model Inputs / 3) Results / Travel Time / Vehicle Operating Costs / Accident Costs / Emissions / Final Calculations / PARAMETERS

Sketch Planning Tools: Advantages, Limitations

Advantages

- Low cost
- Fast analysis times
- Limited data requirements
- View of the “big picture”

Challenges

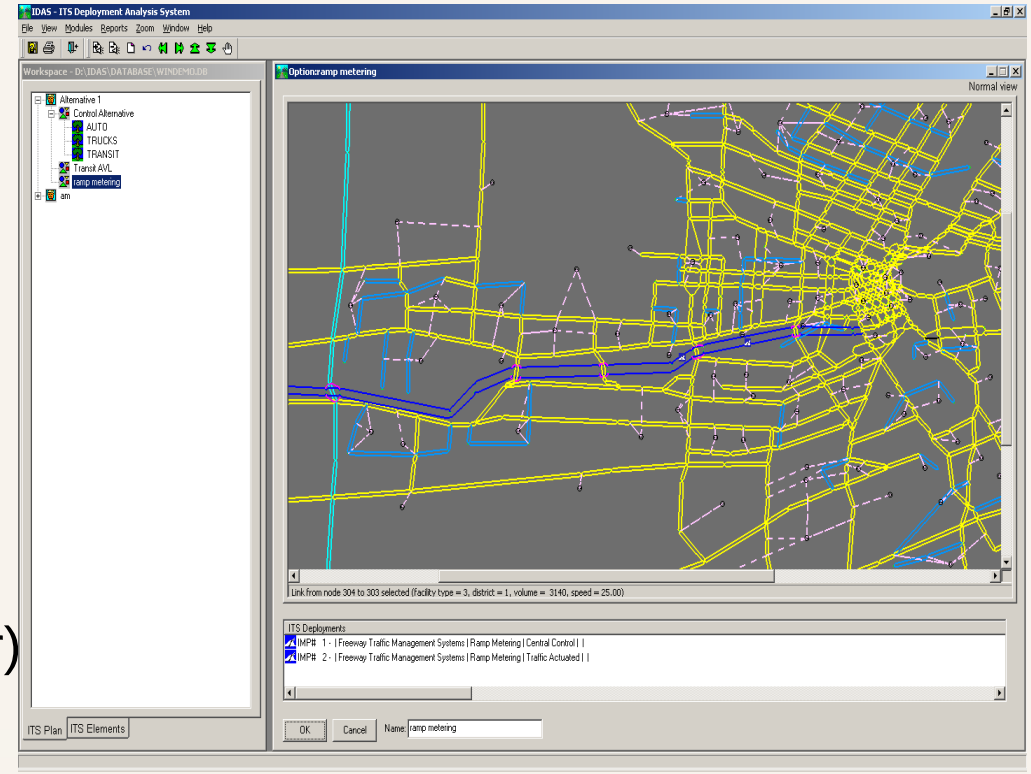
- Limited in scope, robustness, and presentation capabilities
- Results constrained by quality of input data

Travel Demand/Forecasting Models

Estimates the regional traffic impact of changes in travel demand or system capacity

Examples

- Travel Demand Models
  - TRANPLAN
  - EMME/2
  - Cube
  - TransCAD
- Hybrid
  - IDAS (post-processor)



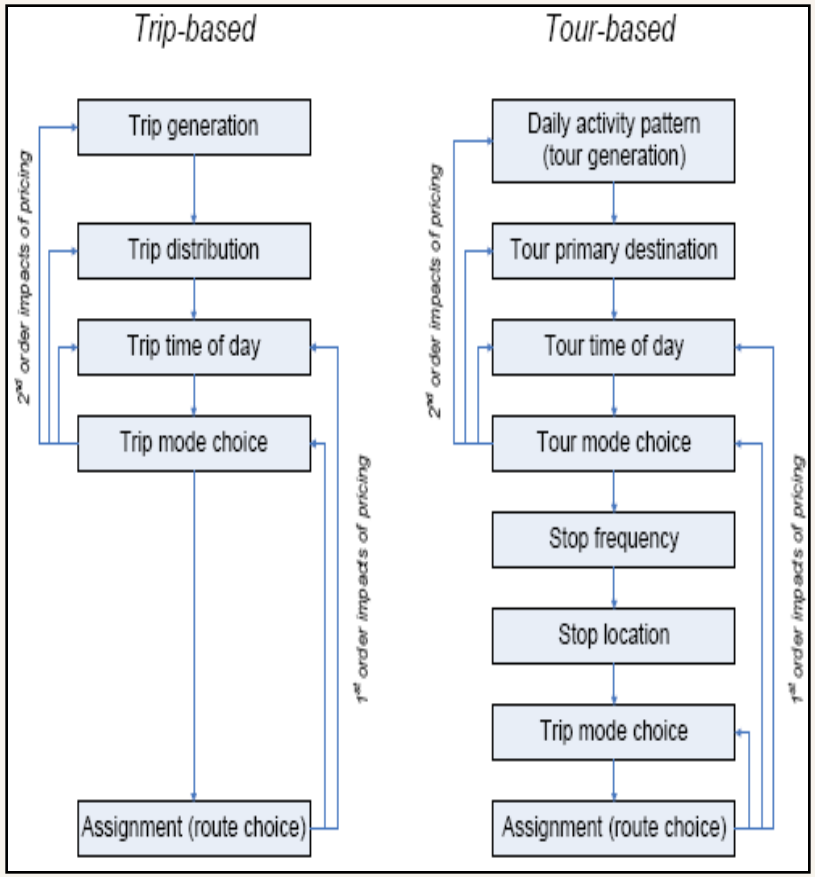
Source: IDAS

Trip vs. Activity [Tour] Based Models

- Trip based models represent the state of the practice in travel modeling

- Activity models developed or under development in many large US cities

- Key advantages of activity based models:
  - Disaggregate treatment of household activities
  - Representation of household interactions
  - Tours in lieu of trips
  - Improved behavioral realism
  - Greater policy sensitivity



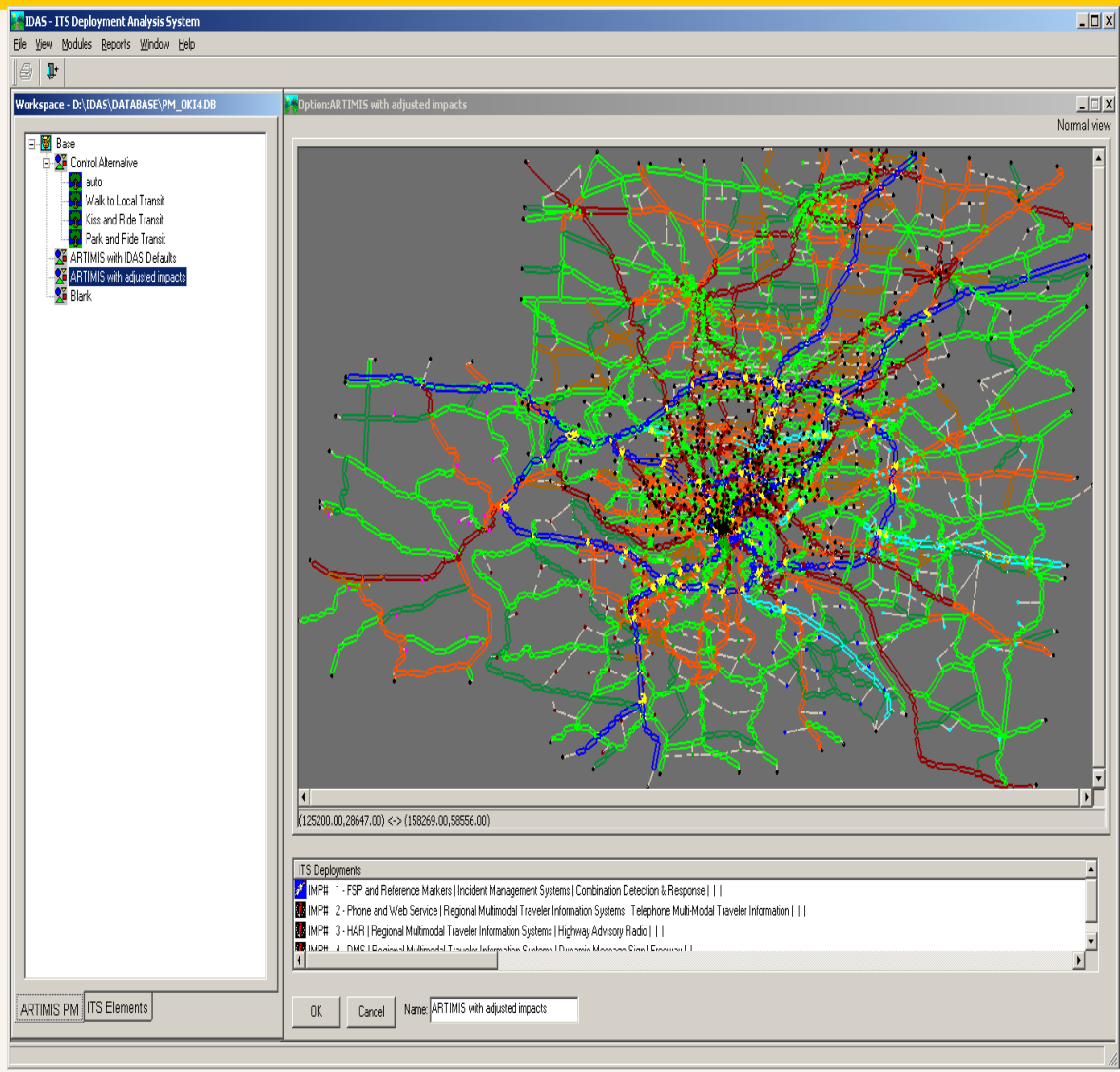
Limitations of Network Models

Regional network models limited in their ability to..

- Reflect oversaturated conditions
- Understand the time-dependent characteristics of congestion
- Represent impacts of bottlenecks on downstream links
- Understand how reliability impacts route choice (and other) decisions

IDAS Demo
Cincinnati Network

- Used to estimate the benefits and costs of ITS/operational deployments
- Hybrid between sketch planning tool and travel demand model
- Originally developed in 2000 for FHWA



IDAS Demo

Sample Performance Summary by Facility Type

IDAS - ITS Deployment Analysis System

File View Modules Window Help

Alternative Comparison Module

Performance Summary

Project: Metro ITS Plan, ITS Option(s): Transit ATS

By: Facility Type	Arterial	Centroid Connector	Expressway	Freeway	Ramp	Transit	Total
Vehicle Miles of Travel							
Control Alternative	655,452	81,514	28,188	63,390	3,018		831,562
ITS Option	653,063	81,306	27,560	63,353	3,018		828,300
Difference (%)	-2,389(-0.4%)	-209(-0.3%)	-628(-2.2%)	-36(-0.1%)	-1(0.0%)		-3,262(-0.4%)
Vehicle Hours of Travel							
Control Alternative	35,978	5,434	726	1,374	224		43,736
ITS Option	35,691	5,420	710	1,371	214		43,406
Difference (%)	-287(-0.8%)	-14(-0.3%)	-17(-2.3%)	-3(-0.2%)	-9(-4.2%)		-330(-0.8%)
Average Speed							
Control Alternative	18.2	15.0	38.8	46.1	13.5		19.0
ITS Option	18.3	15.0	38.8	46.2	14.1		19.1
Difference (%)	0(0.4%)	0(0.0%)	0(0.1%)	0(0.1%)	1(4.3%)		0(0.4%)
Person Hours of Travel							
Control Alternative	46,771	7,065	944	1,786	291		56,857
ITS Option	46,398	7,046	923	1,783	279		56,428
Difference (%)	-373(-0.8%)	-18(-0.3%)	-22(-2.3%)	-3(-0.2%)	-12(-4.2%)		-429(-0.8%)
Number of Trips							
Control Alternative	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
ITS Option	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Difference (%)	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Number of Fatality Accidents							
Control Alternative	4.3260E-03		1.8604E-04	2.5356E-04			4.7656E-03
ITS Option	4.3102E-03		1.8190E-04	2.5341E-04			4.7455E-03
Difference (%)	1.577E-05(-0.4%)		4.142E-06(-2.2%)	1.457E-07(-0.1%)			2.005E-05(-0.4%)
Number of Injury Accidents							
Control Alternative	1.0306E+00		4.4322E-02	4.5914E-02			1.1209E+00
ITS Option	1.0269E+00		4.3336E-02	4.5763E-02			1.1160E+00
Difference (%)	3.756E-03(-0.4%)		9.868E-04(-2.2%)	1.516E-04(-0.3%)			4.894E-03(-0.4%)
Number of PDO Accidents							
Control Alternative	1.4387E+00		6.1869E-02	7.5793E-02			1.5763E+00

Emissions data does not include cold-start amounts

Done

TDM: Advantages, Limitations

Advantages

- Validated models available for most metro areas
- Evaluation of the regional impacts
- Consistent with current planning practices

Challenges

- **Limited ability to analyze operational strategies**
- High initial costs

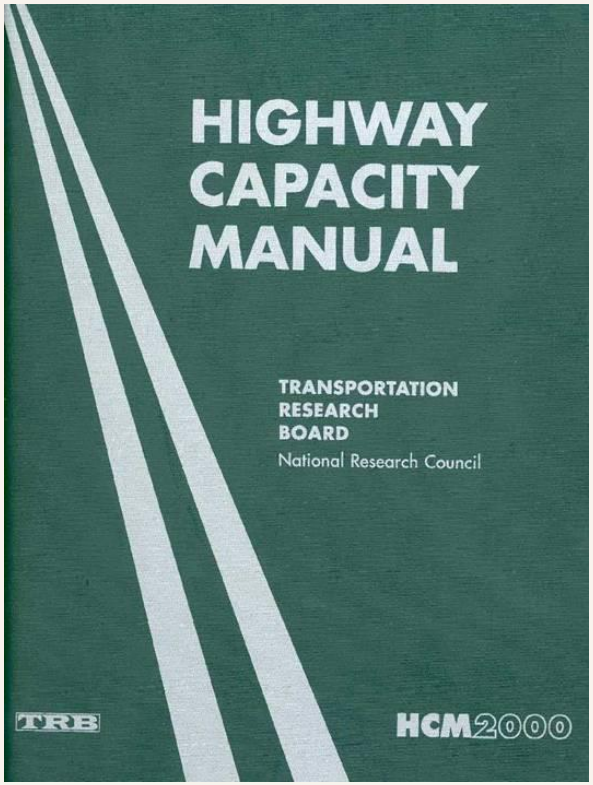
Deterministic Methods

Analyzes the performance for small segments of the transportation system

- Capacity, speed, delay, queuing
- Typically based on the HCM

Examples

- Highway Capacity Software (HCS)
- Traffix



FDOT's Generalized Service Volume Tables

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…provide estimates of maximum service volumes for various types of road facilities

…represent average roadway conditions for an area; not representative of any single roadway

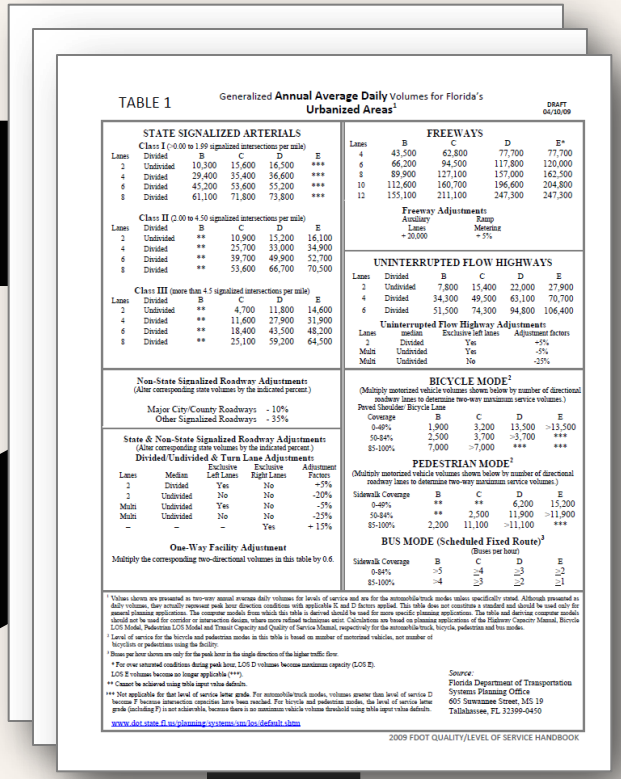


TABLE 1 — Generalized **Annual Average Daily** Volumes for Florida's **Urbanized Areas**[1]

DRAFT 04/10/09

STATE SIGNALIZED ARTERIALS

Class I (>0.00 to 1.99 signalized intersections per mile)

Lanes	Divided	B	C	D	E
2	Undivided	10,500	15,600	16,500	***
4	Divided	29,400	35,400	36,600	***
6	Divided	45,200	53,600	55,200	***
8	Divided	61,100	71,800	73,800	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Divided	B	C	D	E
2	Undivided	**	10,900	15,300	16,100
4	Divided	**	25,700	33,000	34,900
6	Divided	**	39,700	49,900	52,700
8	Divided	**	53,600	66,700	70,500

Class III (more than 4.5 signalized intersections per mile)

Lanes	Divided	B	C	D	E
2	Undivided	**	4,700	11,800	14,600
4	Divided	**	11,600	27,900	31,900
6	Divided	**	18,400	43,500	48,200
8	Divided	**	25,100	59,200	64,500

Non-State Signalized Roadway Adjustments
(Alter corresponding state volumes by the indicated percent.)

Major City/County Roadways - 10%
Other Signalized Roadways - 35%

State & Non-State Signalized Roadway Adjustments
(Alter corresponding state volumes by the indicated percent.)

Divided/Undivided & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	-5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 15%

One-Way Facility Adjustment
Multiply the corresponding two-directional volumes in this table by 0.6.

FREEWAYS

Lanes	B	C	D	E*
4	43,500	62,800	77,700	77,700
6	66,200	94,500	117,800	120,000
8	89,900	127,100	157,000	162,500
10	112,600	160,700	196,600	204,800
12	155,100	211,100	247,300	247,300

Freeway Adjustments

Auxiliary Lanes	Ramp Metering
+ 20,000	+ 5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Divided	B	C	D	E
2	Undivided	7,800	15,400	22,000	27,900
4	Divided	34,300	49,500	63,100	70,700
6	Divided	51,500	74,300	94,800	106,400

Uninterrupted Flow Highway Adjustments

Lanes	median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	-5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

BICYCLE MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Paved Shoulder/ Bicycle Lane Coverage	B	C	D	E
0-49%	1,900	3,200	13,500	>13,500
50-84%	2,500	3,700	>3,700	***
85-100%	7,000	>7,000	***	***

PEDESTRIAN MODE[2]
(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	**	**	6,200	15,200
50-84%	**	2,500	11,900	>11,900
85-100%	2,200	11,100	>11,100	***

BUS MODE (Scheduled Fixed Route)[3]
(Buses per hour)

Sidewalk Coverage	B	C	D	E
0-84%	>5	≥4	≥3	≥2
85-100%	>4	≥3	≥2	≥1

[1] Values shown are presented as two-way annual average daily volumes for levels of service and are for the automobile/truck modes unless specifically stated. Although presented as daily volumes, they actually represent peak hour direction conditions with applicable K and D factors applied. This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and derivative computer models should not be used for corridor or intersection design, where more refined techniques exist. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, Pedestrian LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.

[2] Level of service for the bicycle and pedestrian modes in this table is based on number of motorized vehicles, not number of bicyclists or pedestrians using the facility.

[3] Buses per hour shown are only for the peak hour in the single direction of the higher traffic flow.

* For over saturated conditions during peak hour, LOS D volumes become maximum capacity (LOS E).
LOS E volumes become no longer applicable (***).

** Cannot be achieved using table input value defaults.

*** Not applicable for that level of service letter grade. For automobile/truck modes, volumes greater than level of service D become F because intersection capacities have been reached. For bicycle and pedestrian modes, the level of service letter grade (including F) is not achievable, because there is no maximum vehicle volume threshold using table input value defaults.

www.dot.state.fl.us/planning/systems/sm/los/default.shtm

Source:
Florida Department of Transportation
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450

2009 FDOT QUALITY/LEVEL OF SERVICE HANDBOOK

…allow analysts to quickly and easily compare volumes to estimate LOS

FDOT's Generalized Service Volume Tables

Freeways

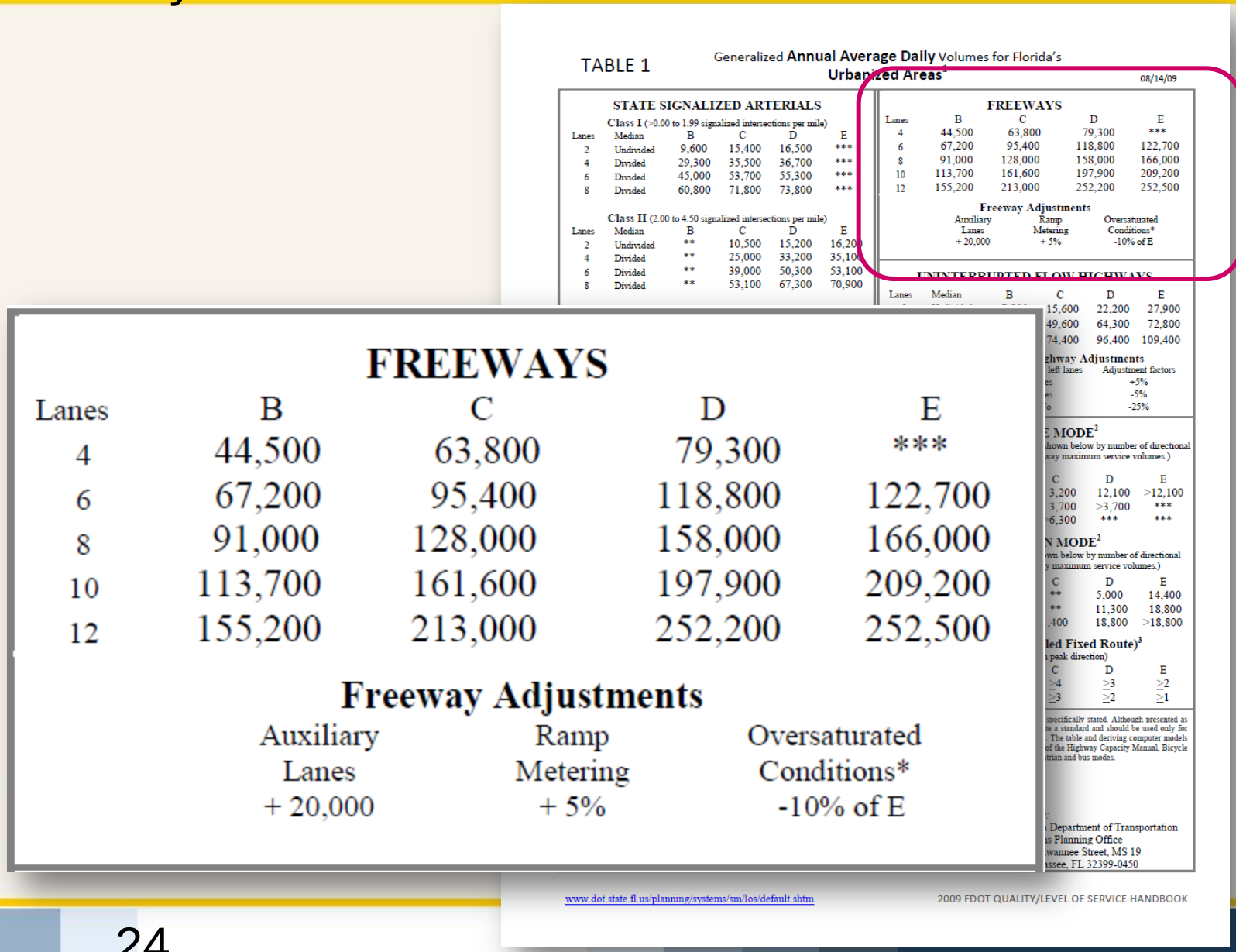


TABLE 1 — Generalized **Annual Average Daily** Volumes for Florida's **Urbanized Areas**[1]

08/14/09

STATE SIGNALIZED ARTERIALS

Class I (>0.00 to 1.99 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	9,600	15,400	16,500	***
4	Divided	29,300	35,500	36,700	***
6	Divided	45,000	53,700	55,300	***
8	Divided	60,800	71,800	73,800	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	**	10,500	15,200	16,200
4	Divided	**	25,000	33,200	35,100
6	Divided	**	39,000	50,300	53,100
8	Divided	**	53,100	67,300	70,900

FREEWAYS

Lanes	B	C	D	E
4	44,500	63,800	79,300	***
6	67,200	95,400	118,800	122,700
8	91,000	128,000	158,000	166,000
10	113,700	161,600	197,900	209,200
12	155,200	213,000	252,200	252,500

Freeway Adjustments

Auxiliary Lanes	Ramp Metering	Oversaturated Conditions*
+ 20,000	+ 5%	-10% of E

www.dot.state.fl.us/planning/systems/sm/los/default.shtm

2009 FDOT QUALITY/LEVEL OF SERVICE HANDBOOK

Deterministic Methods: Strengths, Limitations

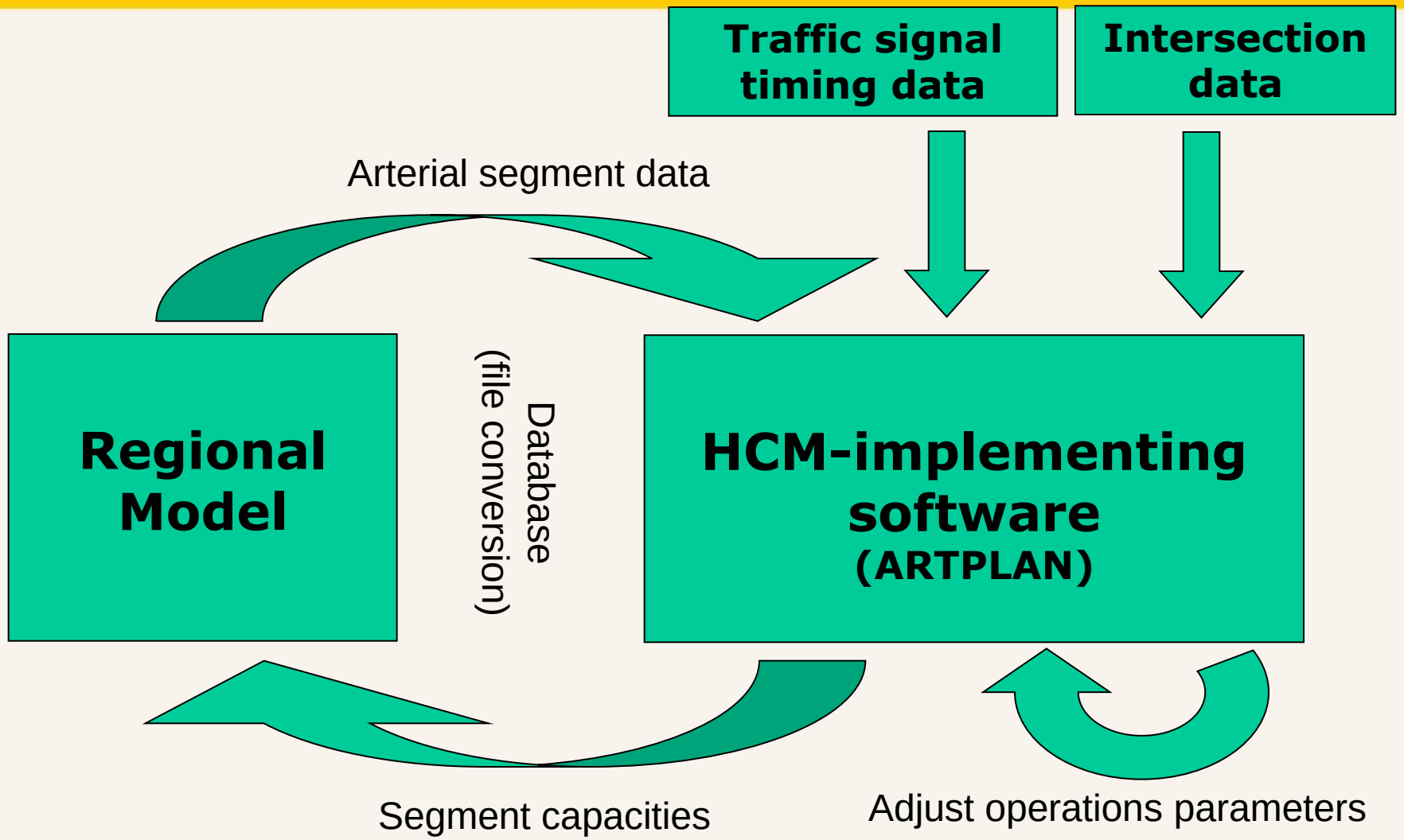
Advantages

- Quickly predict impacts for an isolated area
- Widely accepted

Challenges

- Limited ability to analyze broader network impacts
- Limited performance measures

Travel Demand Model: Adoption of HCM relationships



Traffic Signal Optimization Tools

Analyze delay and identify optimum signal phasing and timing plans for isolated intersections or small signal systems

Examples

- PASSER
- TRANSYT-7F
- Synchro

Traffic Signal Optimization: Strengths, Limitations

Advantages

- Effective tool for testing plans prior to field implementation
- Proven operational benefits

Challenges

- Limited ability to analyze broader network impacts
- Calibration process can be difficult/time consuming

Current Methods and Tools
Archived Operations Data

Sources

- Surveillance equipment on freeways
- Probe vehicles
- Cell phone tracking
- Toll tags
- Third-party providers

Data types

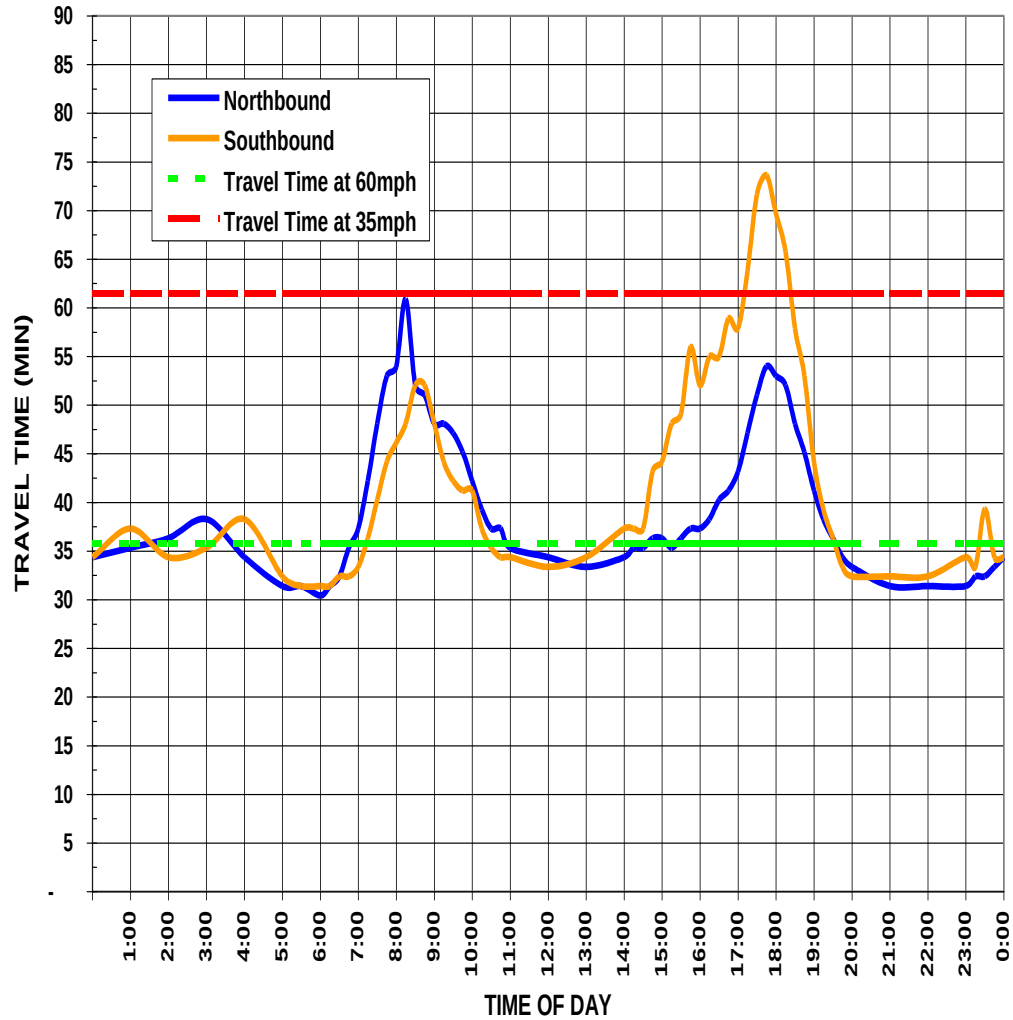
- Travel times
- Volumes
- Lane occupancies

Archived Data Source in California: Travel Time

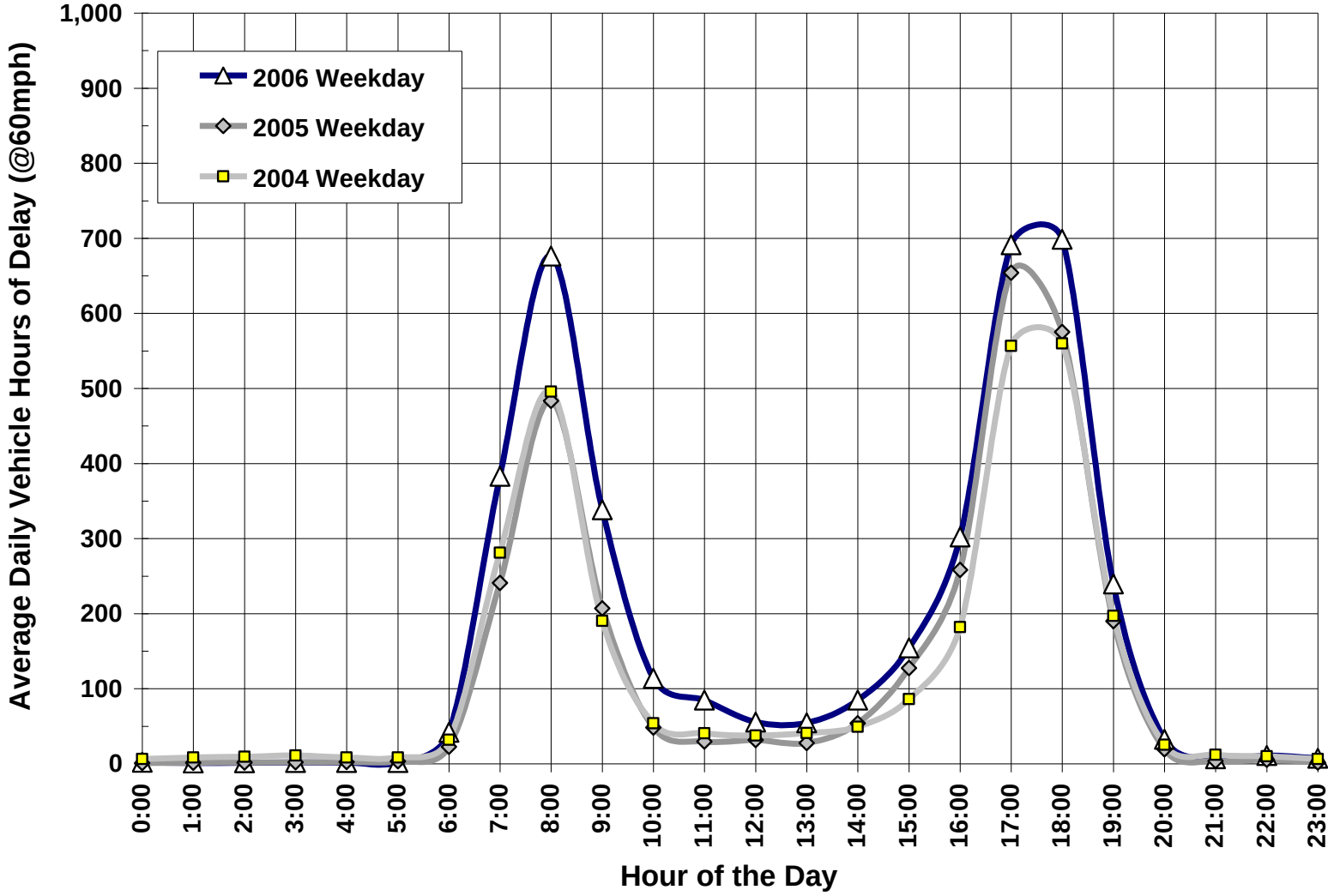
Quantitatively understand traffic conditions and bottlenecks

Data sources:

- Freeway Performance Monitoring System (PeMS)
- MTC 511 system
- Caltrans Highway Congestion Monitoring Program (HICOMP)
- Caltrans Traffic Accident Surveillance and Analysis System (TASAS)
- Historical probe vehicle runs and traffic counts



Mobility: Delay



Simulation Methods

Macroscopic

- Simulation of flow, speed, and density made on a segment-by-segment basis
- Examples: FREQ, PASSER, Transyt-7F, VISTA

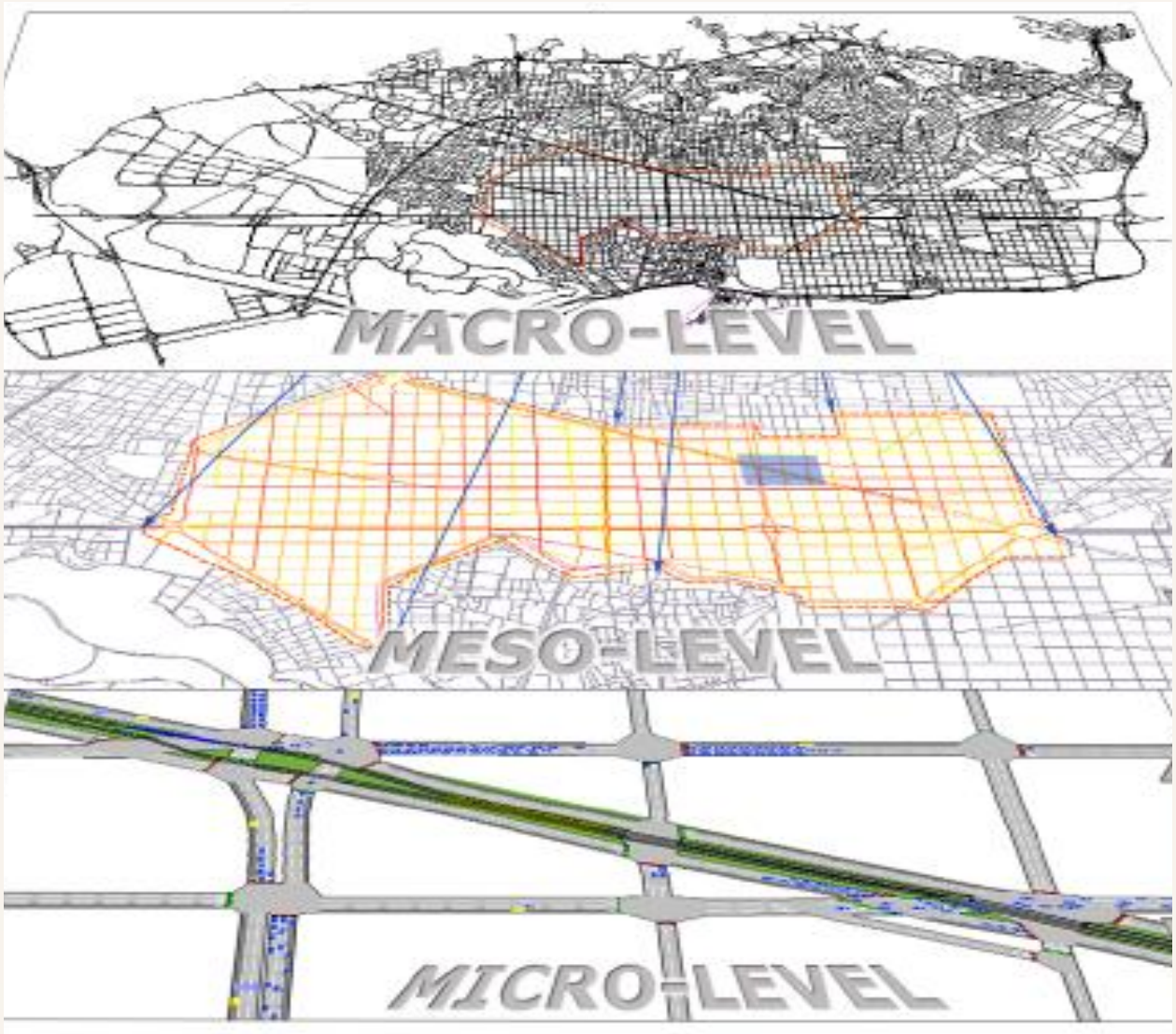
Mesoscopic

- Hybrid model where dynamic estimation of individual vehicles based on average segment speeds
- Examples: DYNASMART-P/DynusT, DynaMIT-P, TransModeler, TRANSIMS

Microscopic

- Simulates detailed movement of individual vehicles throughout the network
- Examples: CORSIM, Paramics, VISSIM, AIMSUN, TransModeler

Spatial Resolution



Aggregate

Detailed

Simulation Methods: Strengths, Limitations

Advantages

- Network-based
- Detailed results, particularly microsimulation
- Dynamic analysis of incidents and real-time diversion patterns
- Visual presentation opportunities
- Reuse for future analyses

Challenges

- Demanding data and computing requirements, particularly microsimulation
- Calibration may be time consuming for larger, more complex, or congested networks

TRB Study: Cost Effectiveness of Simulation

…"Despite all of these advantages, very few of the study participants believed their micro simulation studies were cost-effective. They almost always agreed that the tool answered the study questions and influenced the design decisions, and they plan to do similar studies in the future because they see no viable analysis alternative. But from the perspective of cost-effectiveness, they found the time and cost of developing and applying microscopic simulation models to be excessive."

NCHRP 8-36 Task 90 Draft Final Report: Best Practices in the Use of Microsimulation Models

Dynamic Traffic Assignment

DTA is emerging as a practical tool for numerous planning and operational applications

- Addresses both the short- and long-term impact of operation plans and strategies at the investment and regional/systems level
- Capable of reflecting true capacity constraints on upstream and downstream system performance over time
  - Better equipped (than) macroscopic models to evaluate the effectiveness of operations alternatives
- Can interface with signal optimization, macro, and microscopic models
  - Ideal analysis scale for corridor studies

TRB Study: Resolution

Decision Criteria	*Criteria Value Options*	*Macroscopic Simulation*	*Mesoscopic Simulation*	*Microscopic Simulation*
Scope	Regional	Yes	**Maybe**	Rarely
	Corridor	Yes	**Yes**	Maybe
	Subarea	Maybe	**Yes**	Yes
Network Size	Large (> 10K Links, > 3K Nodes, > 1,000 Zones)	Yes	**Maybe**	Rarely
	Medium	Yes	**Yes**	Maybe
	Small (< 1K Links, < 400 Nodes, < 100 Zones)	Yes	**Yes**	Yes
Time Periods	24 Hours	Yes	**Maybe**	Rarely
	6 Hours	Yes	**Yes**	Maybe
	Peak Period	Yes	**Yes**	Yes
	Peak Hour	Maybe	**Yes**	Yes
Demand	Large (> 1 M vehicles)	Yes	**Maybe**	Rarely
	Intermediate	Yes	**Yes**	Maybe
	Small (< 200k vehicles)	Yes	**Yes**	Yes

TRB Study: Analysis Capabilities

Decision Criteria	*Criteria Value Options*	*Macroscopic Simulation*	*Mesoscopic Simulation*	*Microscopic Simulation*
Performance Measures				
Required Accuracy	< 15 Minutes	**Rarely**	**Yes**	**Yes**
	15 Minutes – 1 Hour	**Maybe**	**Yes**	**Maybe**
	> 1 Hour	**Yes**	**Maybe**	**Rarely**
Analysis Dimension	Vehicle/Person-Based	**Rarely**	**Yes**	**Yes**
	Link-Based	**Yes**	**Yes**	**Yes**
	Path-Based	**Rarely**	**Yes**	**Yes**
	Network-Based	**Yes**	**Yes**	**Yes**

NCHRP 8-36 Task 90 Draft Final Report: Best Practices in the Use of Microsimulation Models

TRB Study: Resources

Decision Criteria	*Criteria Value Options*	*Macroscopic Simulation*	*Mesoscopic Simulation*	*Microscopic Simulation*
Staffing	> 2	**Yes**	**Yes**	**Yes**
	< 2	**Yes**	**Yes**	**Maybe**
Funding	> $1M	**Yes**	**Yes**	**Yes**
	$250K-$1M	**Yes**	**Yes**	**Yes**
	<$250K	**Yes**	**Yes**	**Maybe**
Time Deadlines	> 12 Months	**Yes**	**Yes**	**Yes**
	4-12 Months	**Yes**	**Yes**	**Maybe**
	< 4 Months	**Yes**	**Maybe**	**Rarely**

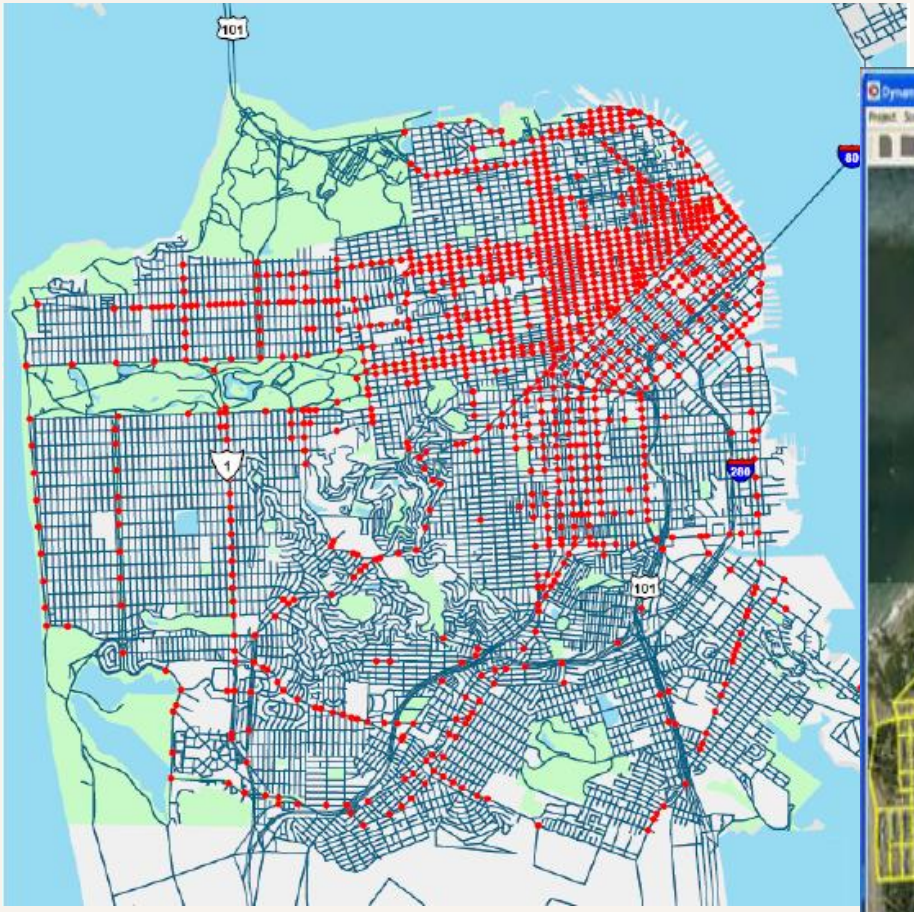
NCHRP 8-36 Task 90 Draft Final Report: Best Practices in the Use of Microsimulation Models

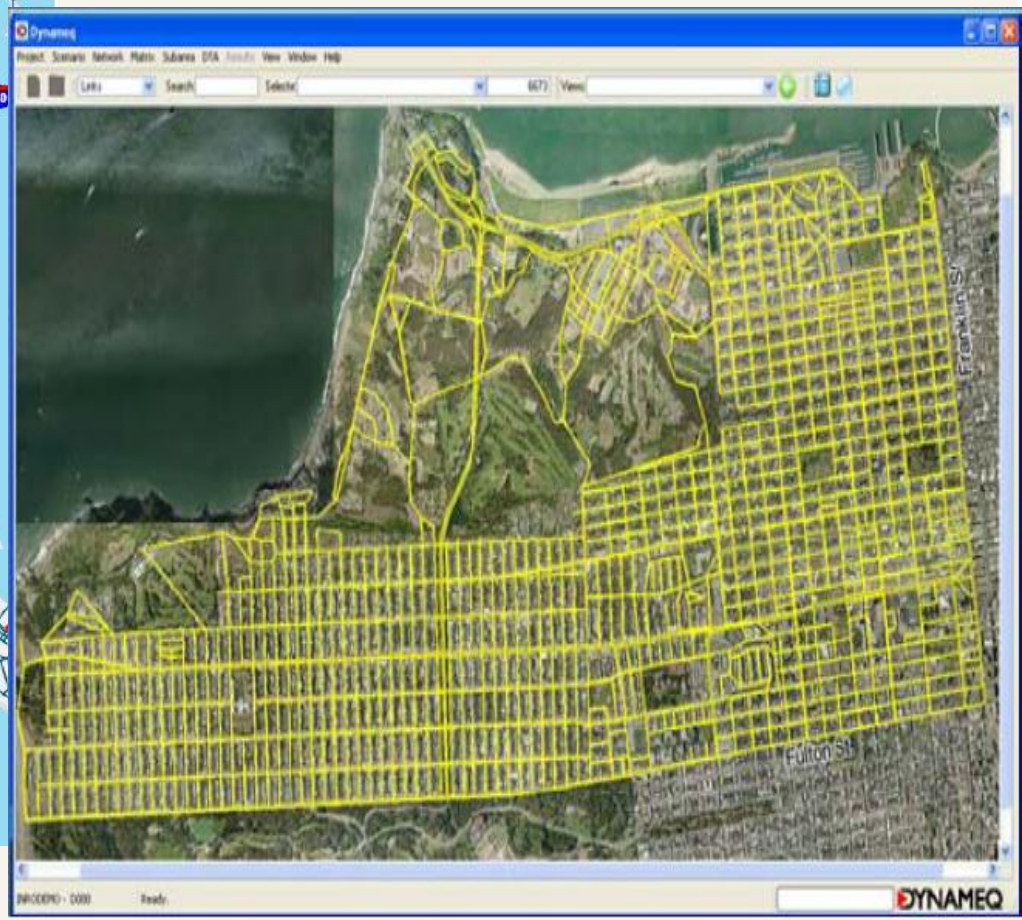
TRB Study: Model Capabilities

Decision Criteria	*Criteria Value Options*	*Macroscopic Simulation*	*Mesoscopic Simulation*	*Microscopic Simulation*
Animation		**No**	**Yes**	**Yes**
Weaving/Merging		**No**	**No**	**Yes**
Queuing/Shock Waves		**No**	**Somewhat**	**Yes**
Link-Based Flow Model		**Yes**	**Yes**	**Yes**
Lane-Based Flow Model		**No**	**No**	**Yes**
Signals		**No**	**Somewhat**	**Yes**
Sign Control		**No**	**Somewhat**	**Yes**

NCHRP 8-36 Task 90 Draft Final Report: Best Practices in the Use of Microsimulation Models

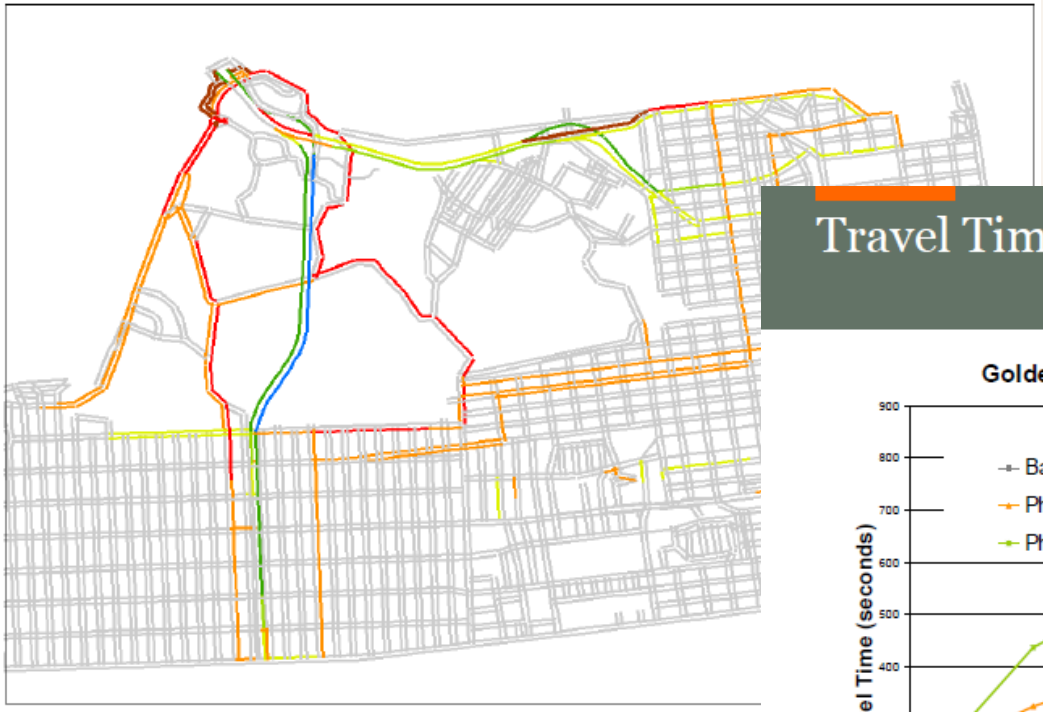
San Francisco DTA Model



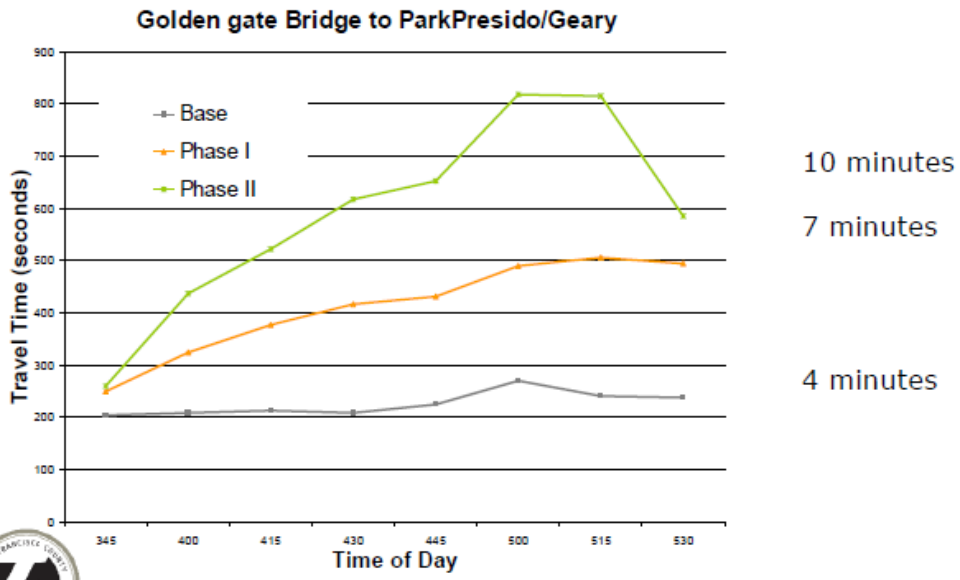


Dynamic Performance Measures

DTA Predicted Volume Differences and Diversions

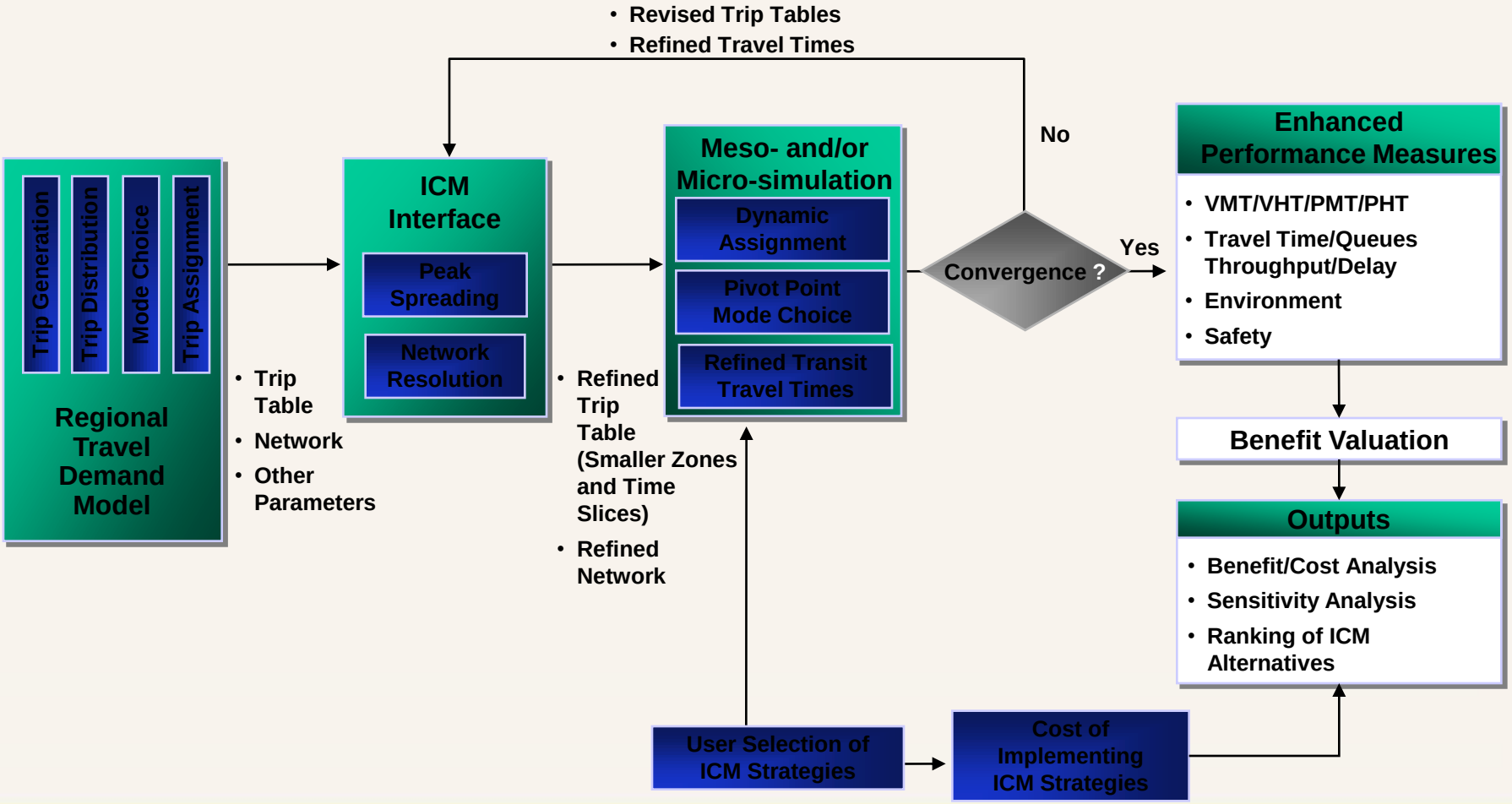


Travel Time Changes



DTA Methods and Integrated Corridor Management

Analysis, Modeling, and Simulation (AMS) Methodology



The Case for Integrated Models

"The peer exchange participants .. viewed the ultimate goal as a suite of integrated modeling tools that support regulatory requirements and studies representing a broad spectrum of spatial and temporal fidelity…(and)… should include macroscopic, mesoscopic, and microscopic components that share common data and work together to support the analytical needs within the region."

NCHRP 8-36 Task 90 Draft Final Report: Best Practices in the Use of Microsimulation Models

Integrated Models in Atlanta

Georgia Department of Transportation (GDOT)

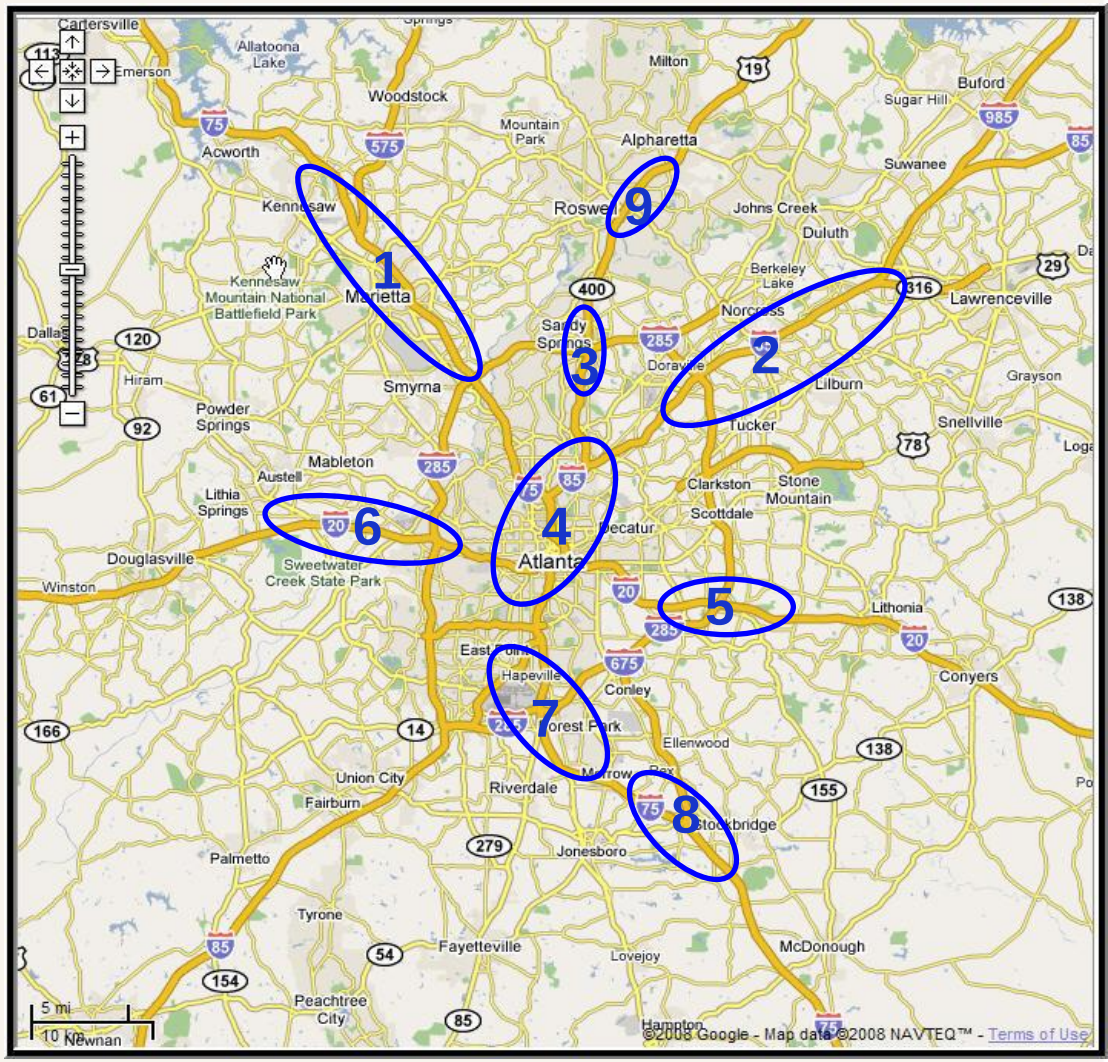
- In cooperation with Atlanta Regional planning partners

Radial Freeway Strategic Improvement Plan

- Interstate System Plan (outside Atlanta region)
- I-285 Study
- Downtown Connector Study

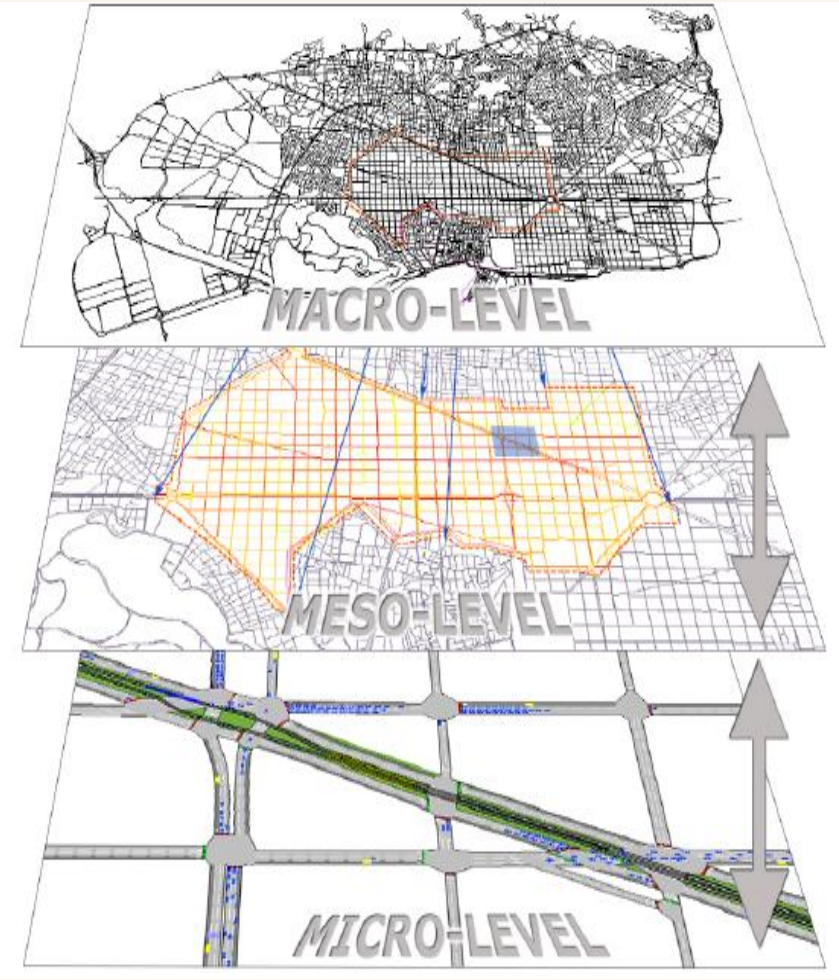
Objective

- Identify and analyze impacts of operational strategies
- Use innovative modeling tools to overcome limitations of traditional forecasting methods



Integrated Model Platform

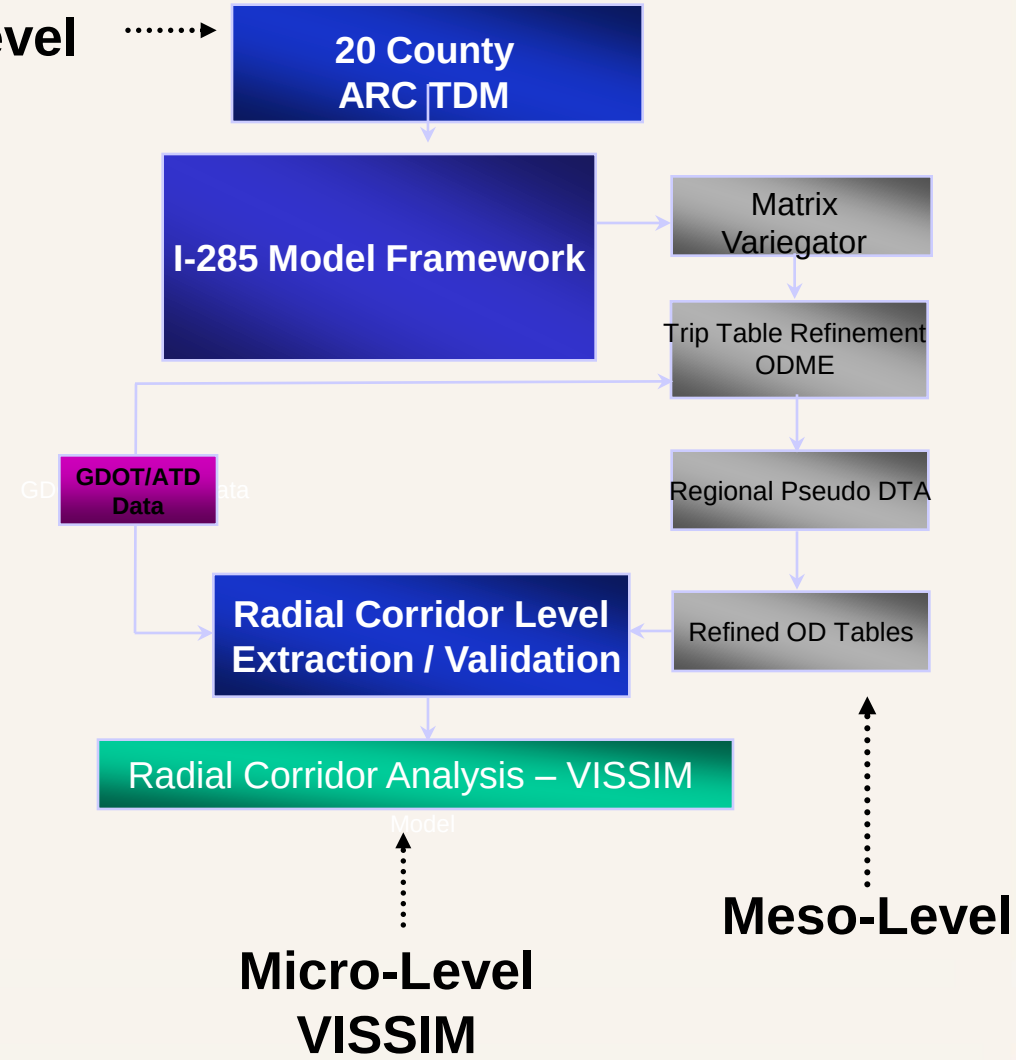
- Macro-Level
  - ARC 20 County TDM
- Meso-Level
  - 20 County dTA model
- Micro-Level
  - Corridor VISSIM models



Improved Forecasting Using DTA Methods

- Traffic forecasting models and microsimulation models do not integrate well
  - Demand models have <u>flexible</u> capacity constraint
  - Microsimulation models have <u>fixed</u> capacity constraint

Source: Improving the Application of Existing Methods to Advance Transportation Operations: Two Case Studies of Microsimulation Applications (Dowling et al, 2009)



Lessons Learned

Demand models may overestimate benefits of bottleneck relief projects

- “Downstream” effects not captured

Practical limitations on OD adjustment

- Labor intensive
- Ad hoc nature of OD adjustments

Simulation model could not cover full extent of congestion

- State agency wanted more analysis
- Local agency could not afford it

Partially Integrated Model

- Refine demand model using DTA methods
  - Create subarea DTA model
  - Estimate subarea OD against counts
  - Apply adjustments to future OD as well
- Export subarea DTA outputs to simulation model
- Feedback congested speeds to subarea DTA model
- Apply peak hour spreading in subarea DTA model
- Re-run microsimulation model

Benefits of Model Integration: Macro, Meso, Micro

Chained Models, No Integration

- Doing all refinement work in simulation model is expensive
- Resulting in simulation model covering too small an area

Partial Integration

- Doing significant refinement of demand model [using DTA methods] reduced effort needed on simulation
- Improved equilibration between supply and demand
- Simulation model able to cover larger area

Closing Thoughts

- Limitations of traditional Network-Based Models amplified when evaluating operations alternatives
  - Trip assignment is a ‘weak link’ of network models
    - Poor representation of speeds and congestions
- Meso methods (including DTA) provide a suitable level of fidelity for the effective evaluation of operations-based alternatives
  - Ideal temporal and geographic detail for corridor level analysis
  - Also applicable for regional analysis in large-scale networks
  - Retain some important properties of microsimulation methods
  - Can improve existing 4-step models and help enhance the effectiveness of microsimulation models
- Not “just” another tool, but a valuable addition to existing regional models