A Case Study of Utilizing Data in DTA Modeling

presented to
MTF

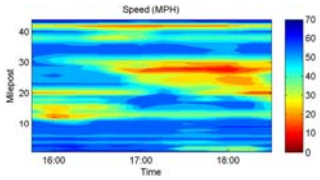
presented by
Mohammed Hadi, Ph.D., PE

June 19, 2013

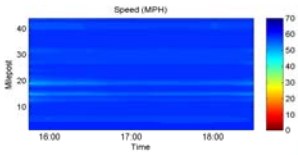
Why DTA

- Traffic dynamics and thus alternative path performance can be better evaluated
- Policy sensitive traveler behavior can be assessed based on experienced travel time for each period
- Trouble spots in network can be identified
- Impacts of events/incidents and advanced strategies (e.g., ML, ICM, ATDM, TSM&O, IM, other ITS)

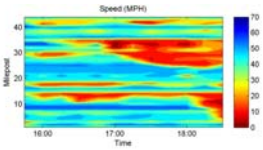
Static Ability to Model Congestion



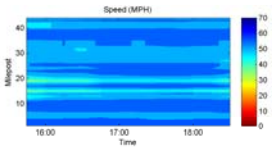
Real-World



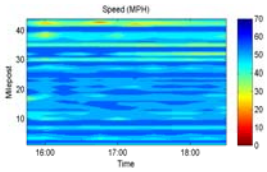
Static Default Capacity



DTA Calibrated

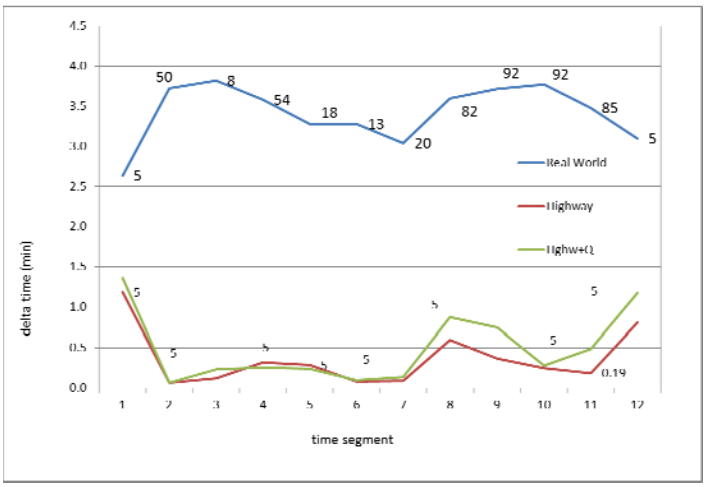


Static Modified Capacity

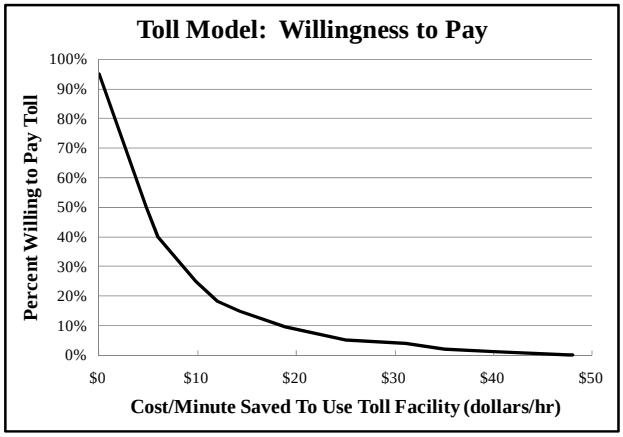


DTA Default

Static vs. real world Delta TT



Willingness to Pay (Source Phase 1 Report)



DTA Modeling Process

- Defining analysis scope
- Data collection and processing
- Network coding
- Supply calibration
- Demand calibration
- Iterate between demand and supply calibration
- Test the assignment results and convergence
- Conduct alternative analysis

Example of Network Refinement

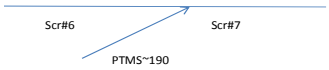
Connections between 2 ramps are deleted, short links are removed, nodes are moved as needed, links updated based on true shape, zone connections updated, number of lanes checked, etc.

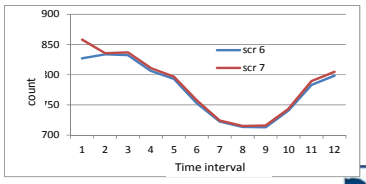
Data Collection

- Subarea network and associated initial O-D matrices from demand model
- Network geometry and signal control
- Count data (PTMS, TTMS, ITS, previous studies)
- Travel time (ITS data, INRIX data, previous studies)
- Any other estimates of O-D matrices (previous studies, AirSage, etc.)
- Willingness to pay surveys/VOT/VOR
- Pricing (Toll) curves
- Truck percentages from PTMS and TTMS
- Associate with network

Data Processing

- Compare ITS detector, PTMS, and manual counts
- Eliminate redundant detectors
- Upstream-downstream data consistency checking
- Filter weekends, special events, incident days
- Cluster days into patterns
- Signal timing/geometry checking

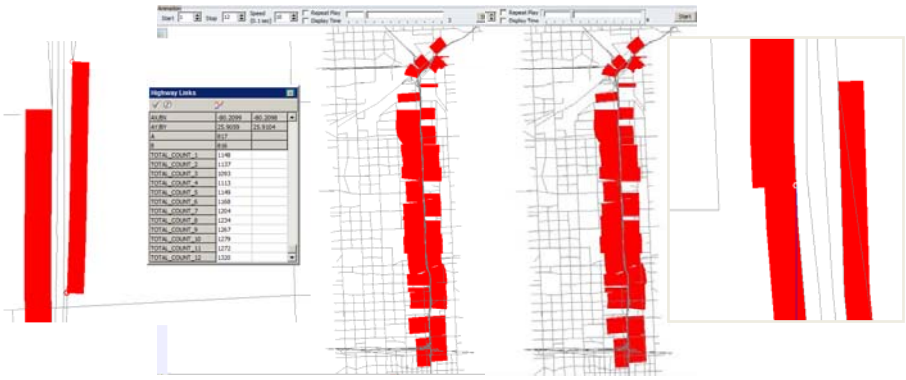




I-95 Detector Stations

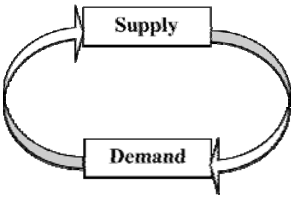
Detector Station	No. of Stations	
	Available	Selected
ITS	**109**	**87**
• General- Purpose Lane	78	56
• Express Lane	31	31
PTMS	**150**	**150**
• Mainline	10	10
• Ramps	99	99
• Arterial	41	41
TTMS	**1**	**1**

Data Consistency Checking

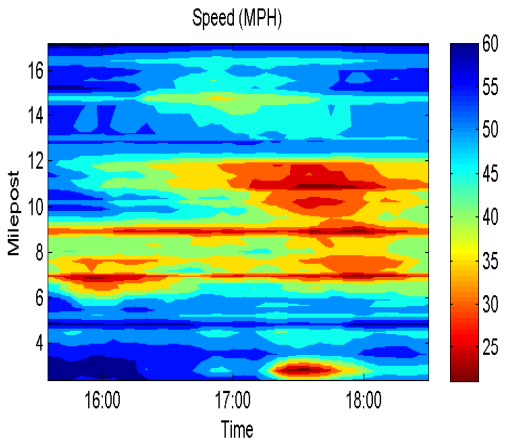


Calibration Process

- Process for calibrating DTA-based models
  - Sequential, iterative, or simultaneous supply and demand calibration
- Iterative calibration is utilized in our effort

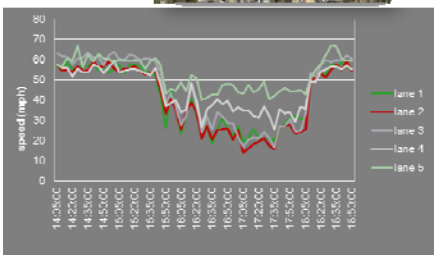


Bottleneck Identification

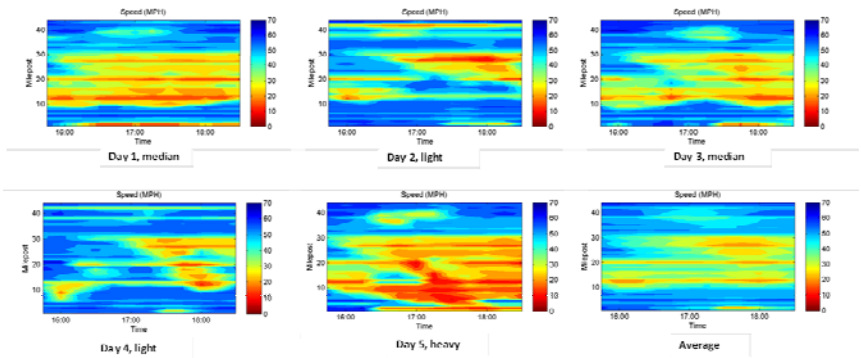


Stations 600561, 600711, and 600921 were recognized as potential bottlenecks

Bottleneck Cause Identification



Day-to-Day Variation



Free Flow Speed (I-95 in Miami)

- HCM 2000: $FFS = BFFS - f_{LW} - f_{LC} - f_N - f_{ID}$
  - (Results in FFS of 59.1 mph for 11 ft lane width and ramp density of 1.2)
- HCM 2010: $FFS = 75.4 - f_{LW} - f_{LC} - 3.22TRD^{0.84}$
  - (Results in FFS of 66.9 mph for 11 ft lane width and ramp density of 1.2)

ID	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Type	B	OFR	B	ONR	ONR	R	OFR	B	ONR	R	OFR	B	W	B	ONR	R	OFR	B	OFR	B	W	B	W	B	ONR	R	OFR	OFR	B
#lane	5	4	4	4	4	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4	5	4	5	4	5	5	5	3	3
FFS	60	61	61	61	63	63	63	58	62	62	62	60	60	58	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59

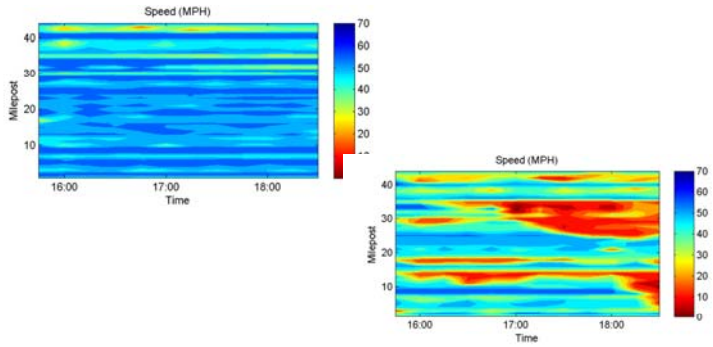
* Posted speed for I95 is 55mph over all analyzed segments.

Capacity Estimation

- HCM and SERPM coding overestimates capacity and free flow speed based on real-world results (I-95 in Miami)
- When calculating queue discharge rate, time intervals that contain spillback from downstream bottlenecks was removed
- Queue discharge is lower than pre-breakdown flow (7-8% in this case)
- The effect of modeling capacity drop due to breakdown being investigated
- Capacity coded in SERPM is 2,142 vphpl
- Capacity estimated based on data about 1,850 vphpl before breakdown and 1,750 vphpl after breakdown

Different methods	Value	Reference
HCM (2% truck, f_p=0.98)	2230	HCM 2010 exhibit (10-5)
HCM (2% truck, f_p =0.85)	1935	HCM 2010 exhibit (10-5)
HCM (5% truck, f_p =0.98)	2200	HCM 2010 exhibit (10-5)
HCM (5% truck, f_p =0.85)	1905	HCM 2010 exhibit (10-5)

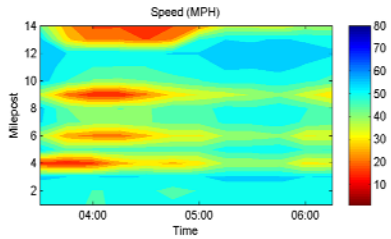
Effect of Capacity Estimates



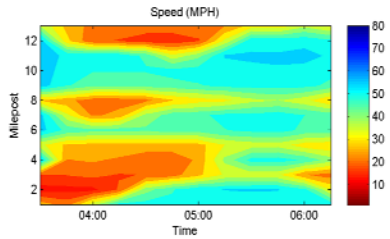
Queuing Density

- Queuing density in Avenue is not the same as jam density used in other models
- Values recommended in Avenue produces unacceptable results (lower speeds and shorter queues)
- The default value is 295 veh/mile/lane. The value calculated based on real-world volume and speed is 100-120 veh/mile/lane

Effect of Queuing Density Estimate



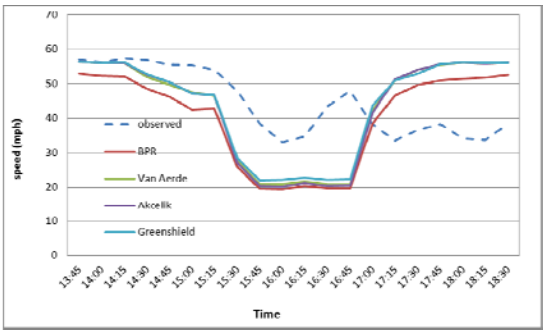
Default



Modified

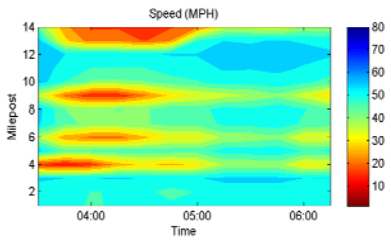
Traffic Flow Model

In Cube Avenue, TFM mostly affected traffic in queue free conditions – Not the case in other tools

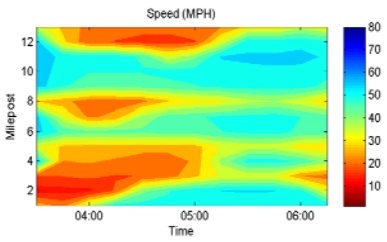


Supply Calibration MOP

- Utilize measures of proximity of observed vs. simulated screen line volumes and link speeds
- Visualize using Speed temporal-spatial contours



Average over days

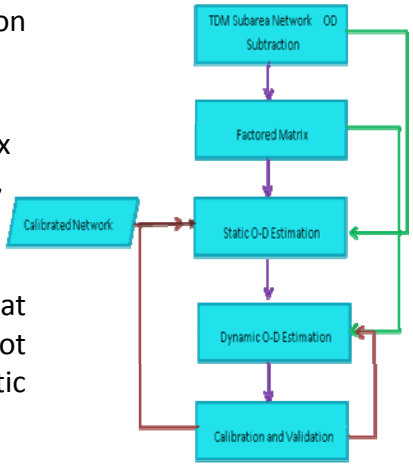


Median day

22

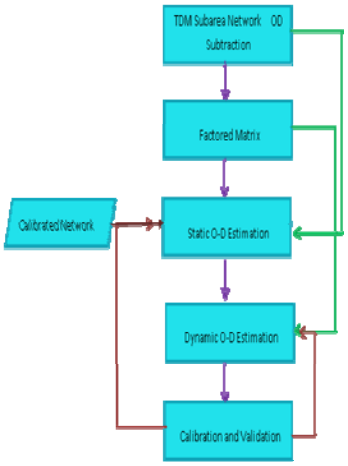
DTA Demand Calibration

- Test different O-D estimation sequence and parameters
- Estimated O-D should also be consistent with the seed O-D matrix values (generation/attraction rates, trip length distributions, split proportions)
- Our experience to date shows that dynamic Cube Analyst does not produce better results than static Cube Analyst with queue addition

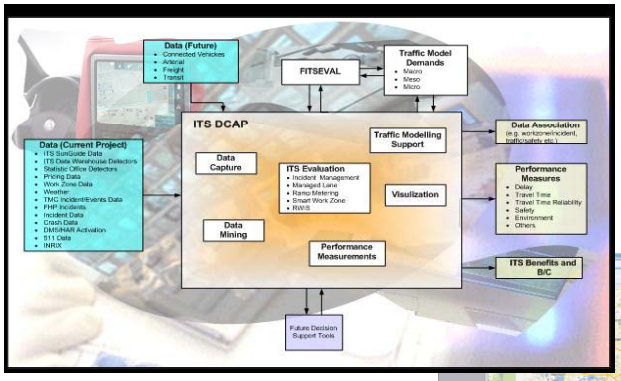


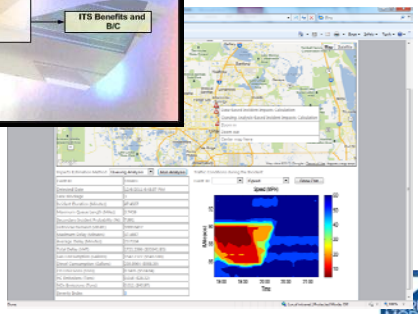
DTA Demand Calibration

- Identified potential improvements to Analysts
- Trip matrix segmentation and VOT variation/randomization based on SHRP 2 and NCHRP research



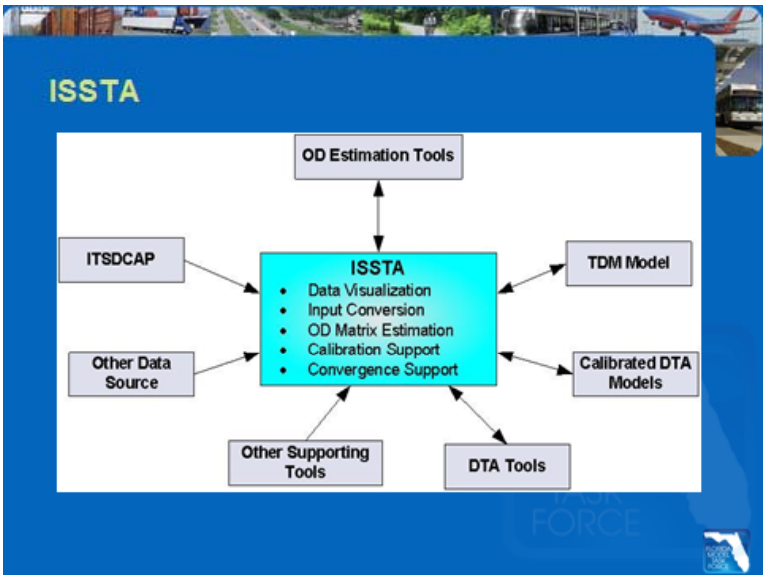
Data and Analysis Support Tools





25

Data and Analysis Support Tools

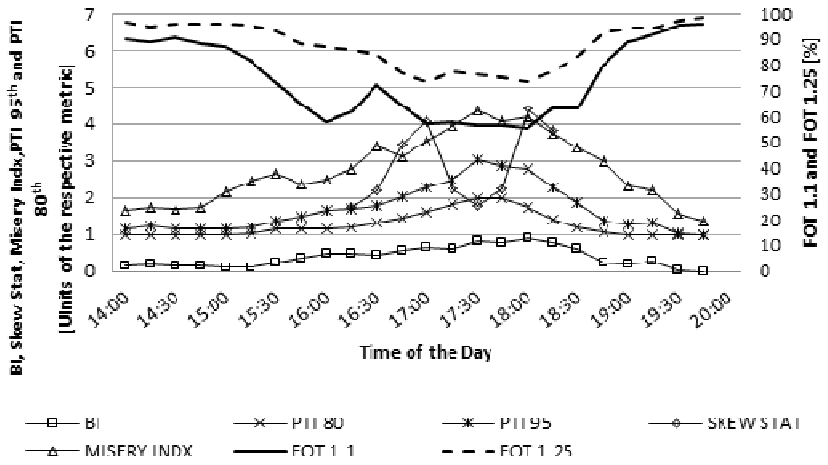


26

Support Tools

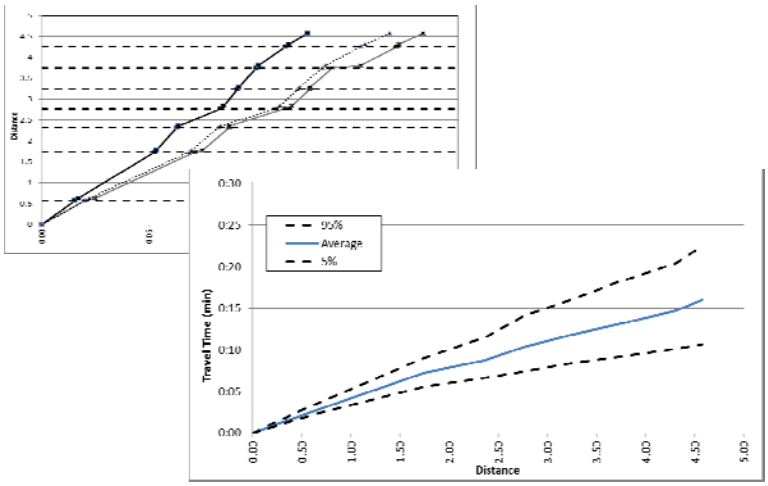
- SunGuide data (TSS, TVT data, incident, DMS, etc.)
- Central data warehouse
- Weather data
- Managed lane dynamic congestion pricing rates
- Work zones data
- Statistics office data
- Crash data/CAR System
- 511 data
- INRIX data
- Bus AVL
- AVI data

Reliability of GP vs. ML



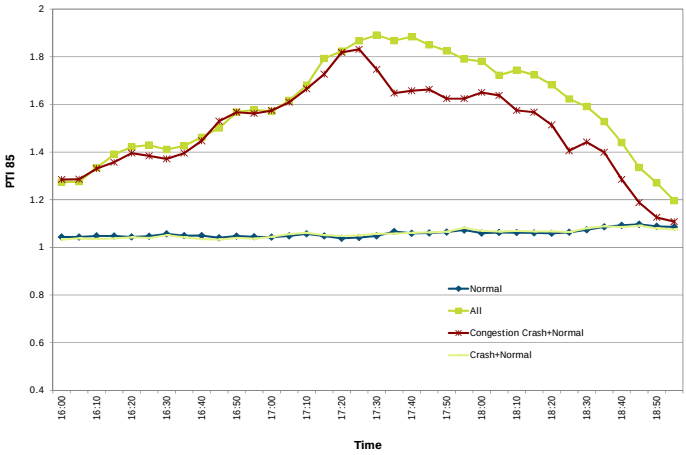
28

Bus Travel Time



29

Effect of Incidents on Reliability



30

L38C Project Tested Products


- L05 guidance to support the use of SHRP 2 products in various business processes of the FDOT
- L02 for assessing reliability performance based on system monitoring
  - Based on point detector and INRIX data
- L08 HCM methodologies for freeways and arterials to assess improvement alternatives
- L07 spreadsheet to assess highway design features to reduce non-recurrent congestion and thus improve reliability