

# WATS MODEL

Michigan TTC March 2, 2010

R. Buck

Señor Transportation Planner

WATS

# Model Development Background

- ◎ RFP Sent out September 15 2006
  - Coordination with MDOT
    - Not to exceed
    - Built in flexibility for steering committee
    - Great emphasis put on documentation
    - Focus on deliverables

# Scope of RFP

- Scope included a head-to-toe refurbishing of the 1998 model
  - Network, TAZ, Trip Gen, Distribution, Mode Choice, Cali/Vali, Interface, Complete Documentation

On a Wing and a Prayer

# Consultant Selection

# Selection Process

- ③ 3 firms interviewed
  - 2 had very similar scores
    - Technical vs. Rapport
- ③ Not subject to Brooks Act
  - Cost consideration but not deciding factor
- ③ Designed to allow a decision to be made by Steering Committee – maximum flexibility

*“Let’s say, if I may, that we decide we want, for example, an F-150. My concern is, and this is totally your call, if they end up building an S-10, sure that’s a good truck, but will it meet our needs?”*

-High Ranking MDOT Official

# Contract Management Issues

- ⦿ Extreme delays in getting consultant clearance for ES202 data
  - Funding put at risk
- ⦿ Head-butting over documentation
- ⦿ Release of TransCAD 5.0
- ⦿ Are we ever going to finish?
- ⦿ Distance was not an issue (Colorado)
  - Possibly even a positive

Narrowing the gap between modeling and reality

# MODEL UPGRADES

# Geographic Updates

- ⦿ Network
  - Updated to Framework 5
- ⦿ Added approximately 50 new internal TAZ
- ⦿ Matched to SEMCOG TAZ (Following SEMCOG's switch to smaller TAZ) and realigned

# Model Upgrades

- Speed feedback
- Elimination of Stick Links for Transit Assignment
- Intra-University trip
- User Interface
- NCHRP 255 Post Processor
- Reduced number of Special Generators
- MS Access is used to store and process data – Both good and bad

We'll end with an Assignment

## The Model

# Trip Generation

- MiTravel Counts and SEMCOG data
  - Day 2 of MiTravel Counts dropped
    - Goal of +/-10% Standard Error at 90% confidence level
    - When stratified (number of workers by household size by vehicle availability) apparent that Washtenaw County data was not enough alone
- 6,063 surveys used in region
- 614 surveys from Washtenaw County

# Number of Surveys

- Washtenaw Surveys
- Region wide Surveys

Household Size	Vehicles				Total
	0	1	2	3+	
<b>0 Worker Households</b>					<b>141</b>
1	16	65	n/a	n/a	81
2	4	11	33	n/a	48
3	4	3	2	0	9
4+	0	1	2	0	3
<b>1 Worker Households</b>					<b>257</b>
1	2	110	n/a	n/a	112
2	1	17	46	n/a	64
3	0	6	15	7	28
4+	0	6	40	7	53
<b>2 Worker Households</b>					<b>200</b>
2	0	12	81	n/a	93
3	0	4	27	13	44
4+	0	3	44	16	63
<b>3+ Worker Households</b>					<b>18</b>
3	0	0	1	8	9
4+	1	0	2	6	9
<b>Total</b>	<b>28</b>	<b>238</b>	<b>293</b>	<b>5</b>	<b>616</b>

Workers	Vehicles				Total
	0	1	2	3+	
<b>1 Person Households</b>					<b>1,768</b>
0	268	672	n/a	n/a	940
1	38	790	n/a	n/a	828
<b>2 Person Households</b>					<b>1,965</b>
0	50	207	356	n/a	613
1	30	179	434	n/a	643
2	5	53	651	n/a	709
<b>3 Person Households</b>					<b>979</b>
0	27	33	38	11	109
1	20	77	161	89	347
2	3	25	199	167	394
3	0	3	24	102	129
<b>4+ Person Households</b>					<b>1,351</b>
0	11	22	17	11	61
1	19	67	319	93	498
2	3	25	347	192	567
3+	1	5	26	193	225
<b>Total</b>	<b>475</b>	<b>2,158</b>	<b>2,572</b>	<b>858</b>	<b>6,063</b>

# Trip Generation (continued)

- ⦿ Expansion factors developed for workers/households by auto availability
  - Five Trip Types
    - HBW, HBS, HBO, WBO, OBO

# Final Trip Productions per HH

Number of Workers	Vehicles			
	0	1	2	3+
<b>1 Person Households</b>				
0 Workers	2.21		4.10	
1 Workers	3.92		5.03	
<b>2 Person Households</b>				
0 Workers	4.66	6.35	8.81	
1 Workers	6.36	7.86	8.92	
2 Workers	8.04	8.33	9.53	
<b>3 Person Households</b>				
0 Workers	6.54	9.34	9.34	10.61
1 Workers	8.24	13.32	11.91	13.04
2 Workers	9.91	11.26	13.70	14.17
3 Workers	13.08	14.43	14.43	13.40
<b>4+ Person Households</b>				
0 Workers	13.10	17.43	17.43	16.92
1 Workers	14.80	19.90	20.15	19.47
2 Workers	16.47	17.11	20.64	20.15
3+ Workers	19.63	20.27	20.27	21.43

# Trip Attraction

- ◎ SEMCOG developed 16 worker classes from travel surveys
- ◎ Classification
  - Significant data collected from both surveys
  - 16 employment classes condensed to 6
    - Basic, Retail, Service, Education, Health Care, Leisure
  - Including total households 7 trip attraction rate variables
- ◎ Place type for Non-work trips converted to 16 SEMCOG categories

# Total Attraction Rates

Total Attraction Rates	
Basic	2.42
Retail	21.11
Service	4.77
Education	24.93
Health	6.35
Leisure	14.67
Households	1.77
*Trips per employee	

# Trip Distribution

## ⦿ Data Sources

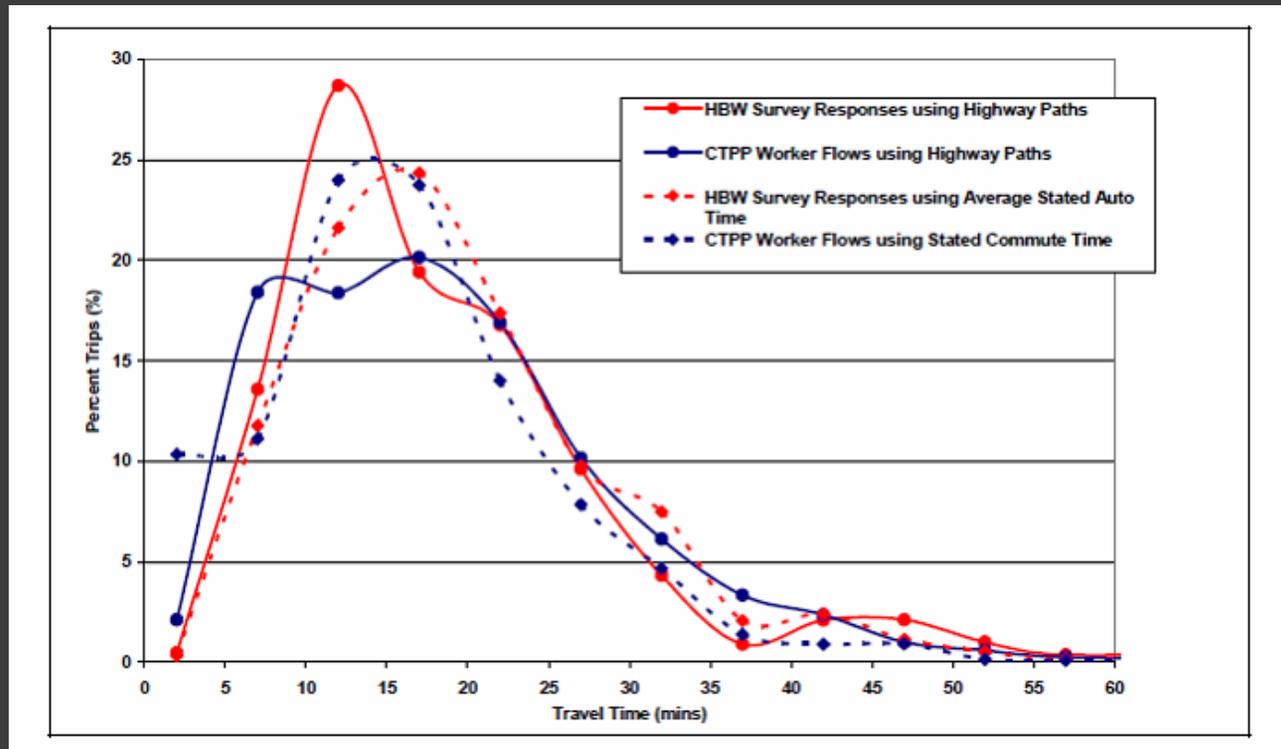
- Combined household travel surveys
- CTPP

## ⦿ Geocoded trips

- Compared Trip Time Distribution Curves for Survey and CTPP using highway paths and stated travel time

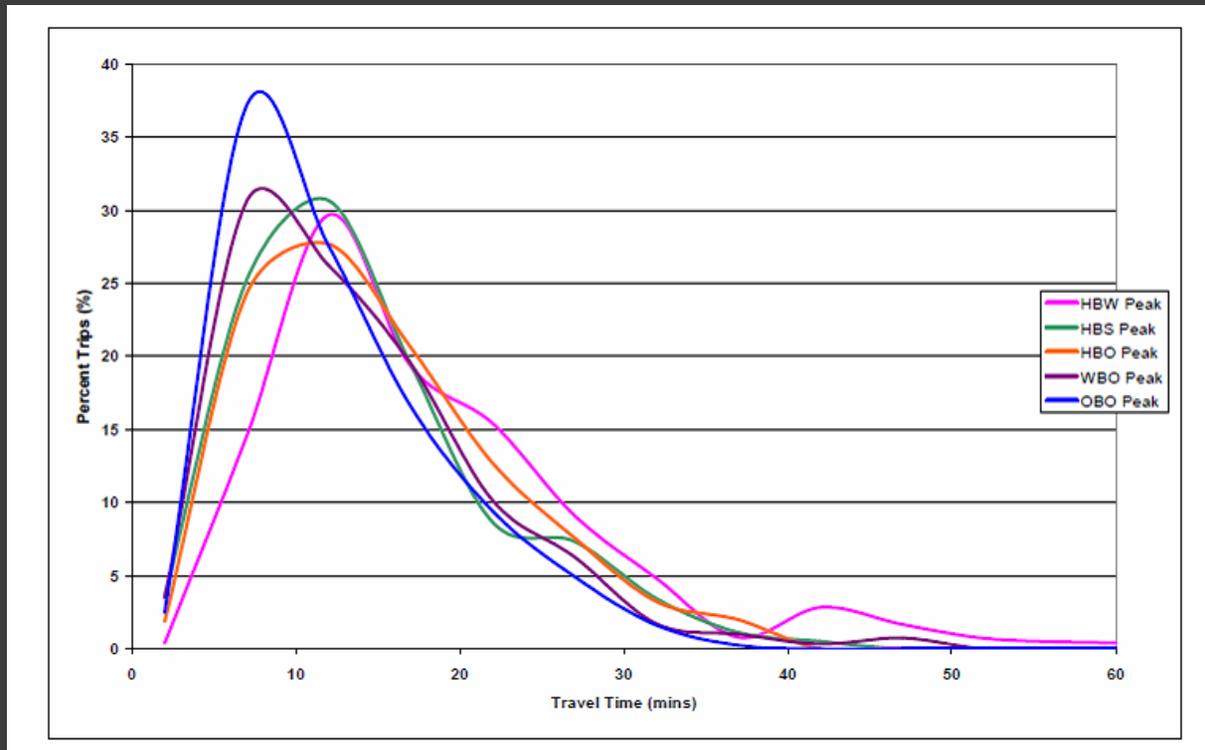
## ⦿ Impedance – Congested Travel time

# Trip Time Distribution Curve

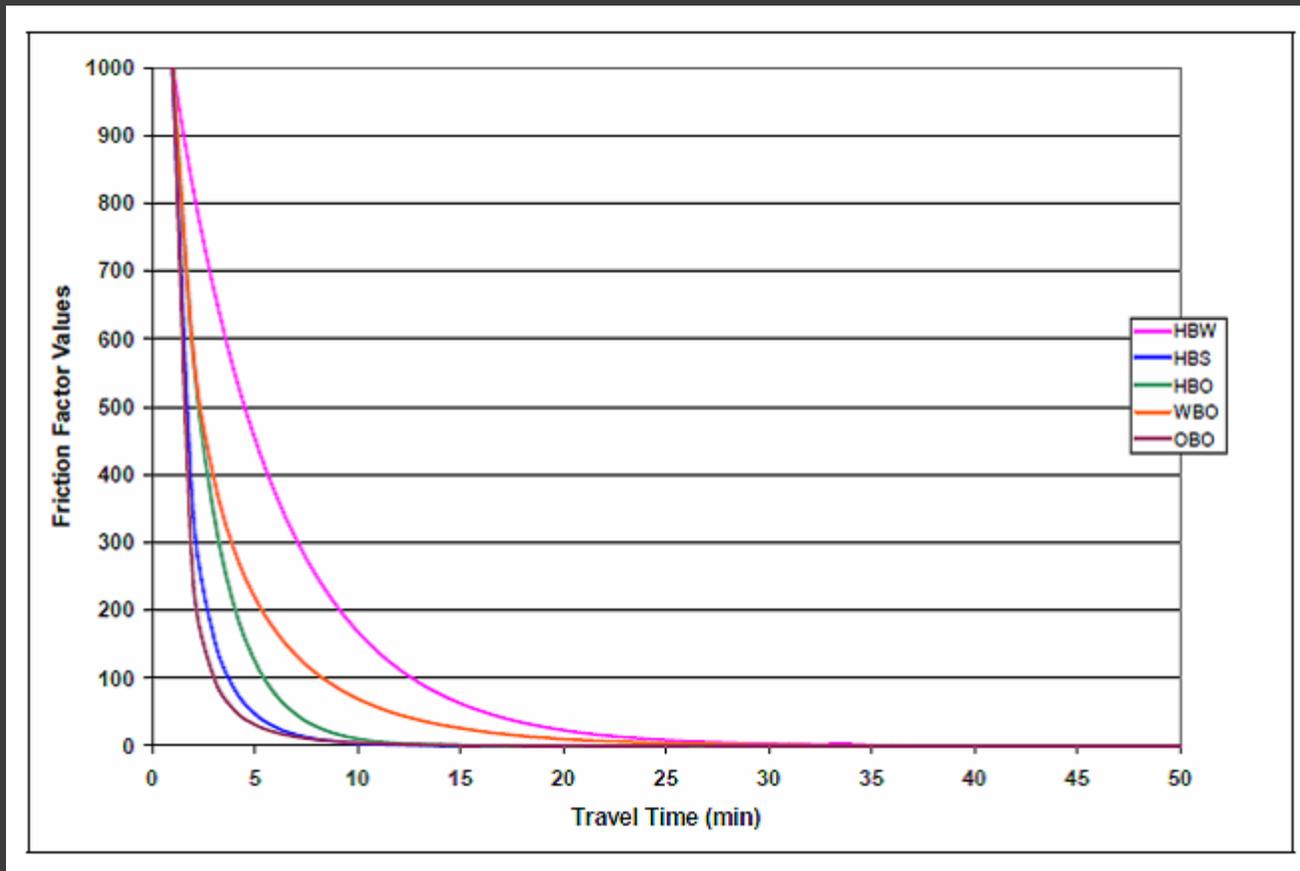


- Determined that household survey data was appropriate to calibrate friction factors

# Peak Trip Time Distribution Curves by Trip Type



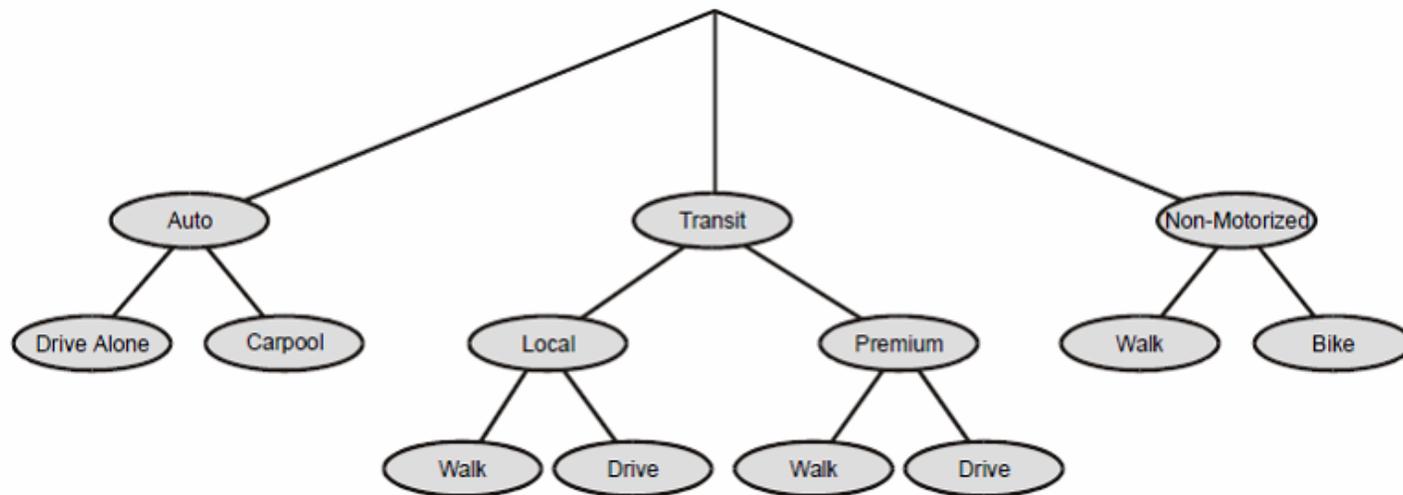
# Peak Friction Factors



# Mode Choice

- ⦿ Complications
  - SEMCOG transit oversample unusable
  - No viable OD data
  - Had to rely in large part on largely outdated data sources
- ⦿ Need to keep mode choice component updateable (new nests)
- ⦿ HBW, HBS, HBO are broken into income tertiles for mode choice

# Mode Choice Structure



# Trips by Mode

## Production Person Trips by Mode

	DA	SR	LWalk	LDrive	Walking	Bike	Total
Entire Model	965,603	768,566	36,725	6,257	291,645	92,349	2,161,148
Ann Arbor	258,925	204,511	32,926	5,059	237,697	73,755	812,875
Ypsilanti	54,349	42,575	1,758	98	15,982	7,681	122,445
Small Places	58,704	47,497	19	49	6,018	632	112,921
Rest of County	400,934	327,716	2,021	852	31,946	10,280	773,753
Urbanized	633,142	505,271	36,717	5,938	287,851	91,600	1,560,521
Rural	139,772	117,029	7	121	3,793	749	261,473
Custom 1	261,755	206,946	32,996	5,076	237,703	73,755	818,235
Custom 2	54,349	42,575	1,758	98	15,982	7,681	122,445

# Time of Day

- ⦿ AM and PM peak periods determined
  - 7-9 AM
  - 3-6 PM
  - Midday peak was considered but no significant peaking was evident
- ⦿ Converts PA-OD using directional TOD factors (Derived from Surveys)

# Time of Day

- ① Speed feedback replaces initial road network travel times with directional period specific travel times.
  - Peak period trips distributed with peak period times
  - Off peak trips distributed with off peak times

# Traffic Assignment

- ⦿ Peak period utilizes equilibrium assignment
- ⦿ Next six highest hours also equilibrium
- ⦿ Remaining hours assigned all-or-nothing
  - No congestion even in 2035 runs
- ⦿ 12 separate assignments
- ⦿ Congested travel time used as impedance for Assignment

# Transit Assignment

- ◎ AATA and U of M routes
  - Combined ridership of about 50,000 per day
- ◎ Peak period trips are HBW and HBU
- ◎ Other trip types are assigned off peak
- ◎ Validated to route group

# Route Group “Validation”

Route Group	Observed (Daily Boardings)	Modeled (Daily Boardings)	% Diff.
1	4,415	5,225	18%
2	8,507	7,192	-15%
3	1,698	1,184	-30%
4	1,568	1,073	-32%
5	1,912	2,199	15%
6	1,311	1,197	-9%
7	1,122	1,699	51%
UM	33,075	36,029	9%
WAVE	45	21	-53%
<b>Total</b>	<b>53,653</b>	<b>55,819</b>	<b>4%</b>

# Speed Feedback

- ◎ First iteration
  - Generation, Distribution, Transit Paths, Mode Choice, Traffic Assignment (only AM peak and highest off peak hour)
- ◎ Intermediate iterations
  - Distributions, Mode choice (with transit paths from first iteration), Traffic Assignment
    - Repeat until convergence criteria is met
- ◎ Final iteration
  - Rerun transit paths and full traffic/transit assignment

# Speed Feedback Convergence

- ⦿ Check for change in RMSE
  - Convergence at  $< 1\%$  change in RMSE

# Truck Components

## ⦿ Data Sources

- Limited classification count data
- Outdated External Station Survey

## ⦿ Application in model

- EE and IE/EI only
- Factored into Passenger Car Equivalents (PCE)
- Include TOD factors

# Validation of VMT by Area Type

Area Type	MDOT Standard	TMIP/FHWA Guideline	2005 WATS RTM (Model VMT / Count VMT)	2005 WATS RTM (Model Volume Sum / Count Sum)
CBD – Ann Arbor	+/- 10%	n/a	2%	17%
CBD – Ypsilanti	+/- 10%	n/a	-17%	-18%
CBD – Total	+/- 10%	n/a	-2%	6%
Urban	+/- 10%	n/a	-5%	- 2%
Suburban	+/- 10%	n/a	-2%	- 1%
Rural	+/- 10%	n/a	0%	2%
Region (County)	+/-5%	+/- 5%	-1%	0%

# Validation of VMT by Facility Type

Facility Type	MDOT Standard	TMIP/FHWA Guideline	2005 WATS RTM (Model VMT / Count VMT)	2005 WATS RTM (Model Volume Sum / Count Sum)
Freeway	+/- 6%	+/- 7%	-3%	-6%
Major Arterial	+/- 7%	+/- 10%	-4%	-1%
Minor Arterial	+/- 10%	+/- 15%	-1%	2%
Collector	+/- 20%	+/- 25%	5%	n/a
Region (County)	+/-5%	+/- 5%	-1%	0%

# Special Generator

- ◎ 1998 Model had 13 Special Generators
- ◎ 2007 Model only has U of M
  - No good data from U of M
    - Borrowed Generators based on available data
    - Production allocation

# Handling U of M

- ⦿ Universities primarily condensed into one major area
- ⦿ Michigan has four distinct campuses spread across Ann Arbor
- ⦿ How can we handle the multitude of trips between campuses?

# U of M (Champions of the West)

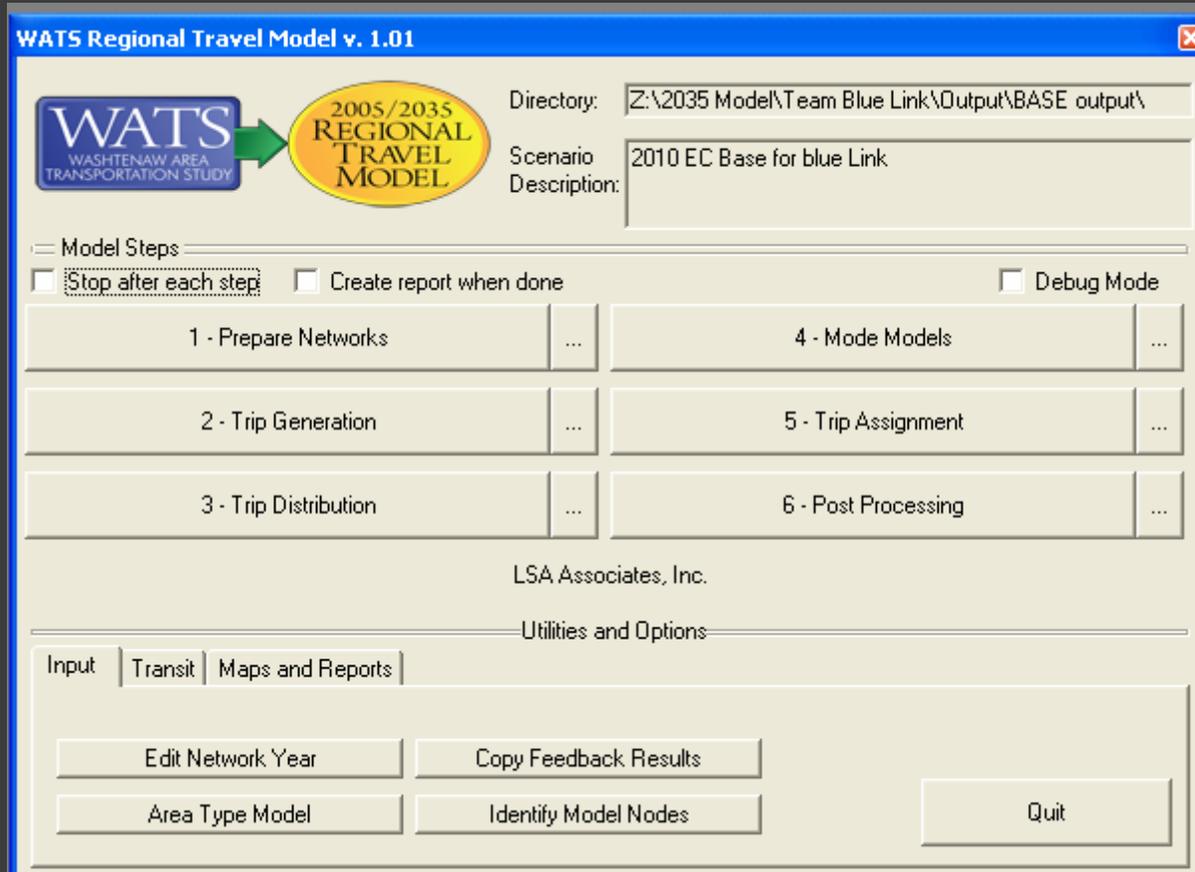
- Special generator
- Intra-university trip
  - “University based university”
  - Borrowed Trip Rates from University of Colorado Study
    - HBU (Applied to on campus residences)
    - OBO (applied to number of enrolled students)
  - Trip P and A’s allocated to campus and then to TAZ
  - Only modes are walk, bike or walk access transit

# Uses of Model

(in addition to the obvious ones)

- Rough estimates of emergency response
  - Lots of interest from local fire teams
  - Challenge to relate TransCAD time bands to reality
- Ann Arbor and University of Michigan Connector Study
  - Demand on high ridership corridors

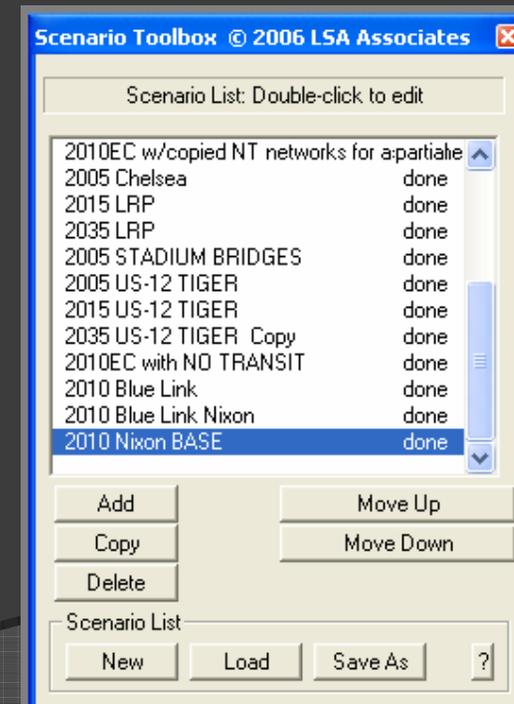
# Interface



# File Management

- Scenario Manager

- Easily change source location for inputs and identify destination of output files



**Scenario Editor** [X]

Scenario Name:

Input Dir:

Output Dir:

Input | General | Output

	Filename: Double-click to change location	Status
1	Z:\2...isting Plus Committed(final for LRP)\2010EC\RoadwayNetwork.dbd	<Exists - Required>
2	Z:\2035 Model\WATS Model\Input\TPEN.DBF	<Missing - Optional>
3	Z:\2035 Model\WATS Model\Input\WATSDatabase.mdb	<Exists - Required>
4	Z:\2035 Model\WATS Model\Input\WATS_taz.dbd	<Exists - Required>
5	Z:\2...ting Plus Committed(final for LRP)\2010EC\committed_transit.ts	<Exists - Required>
6	Z:\2035 Model\WATS Model\Input\MODE.bin	<Exists - Required>
7	Z:\2035 Model\WATS Model\Input\MODEXFER.bin	<Missing - Not Used>
8	Z:\2035 Model\WATS Model\Input\SplitFactors.mtx	<Missing - Not Used>
9	Z:\2035 Model\WATS Model\Input>Select.qry	<Exists - Optional>
10	Z:\2035 Model\WATS Model\Input\Kfac.mtx	<Exists - Required>

File Description:

**Scenario Editor** ✕

Scenario Name:

Input Dir:

Output Dir:

Scenario Description

Mode Settings

Mode Split

Mode Choice

Scenario Settings

Assignment Settings

Constrained (Equilibrium)

Unconstrained (ADN)

Speed Settings

Run Speed Feedback

Initialize Speeds

**Scenario Editor** [X]

Scenario Name:

Input Dir:

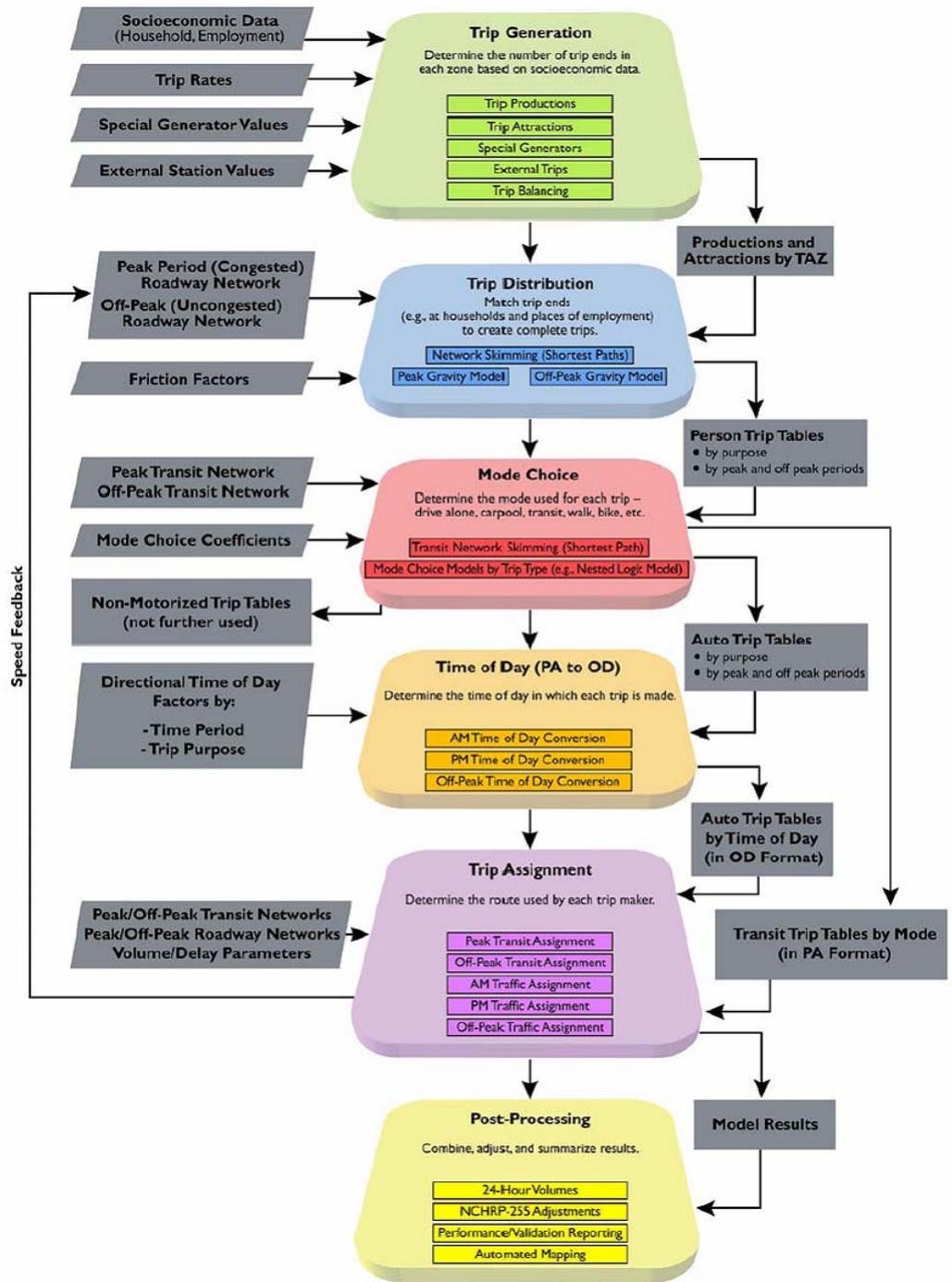
Output Dir:

Input | General | Output

Stages	Filename: Double-click to change location	Status
Network Preparation	1 Z:\2...Local Assistance Output\UM\2010UM\asn_AutoOP.mtx	<Exists>
Trip Generation	2 Z:\2...Local Assistance Output\UM\2010UM\asn_AutoAM.mtx	<Exists>
Trip Distribution	3 Z:\2...Local Assistance Output\UM\2010UM\asn_AutoPM.mtx	<Exists>
Mode Choice	4 Z:\2...Local Assistance Output\UM\2010UM\Flow_OP1.bin	<Exists>
<b>Trip Assignment</b>	5 Z:\2...Local Assistance Output\UM\2010UM\Flow_OP2.bin	<Exists>
Post-Processing	6 Z:\2...Local Assistance Output\UM\2010UM\Flow_OP3.bin	<Exists>
	7 Z:\2...Local Assistance Output\UM\2010UM\Flow_OP4.bin	<Exists>
	8 Z:\2...Local Assistance Output\UM\2010UM\Flow_OP5.bin	<Exists>
	9 Z:\2...Local Assistance Output\UM\2010UM\Flow_OP6.bin	<Exists>
	10 Z:\2...Local Assistance Output\UM\2010UM\Flow_OP7.bin	<Exists>

File Description:

# Model Flow



# Summary Report

- ◎ VMT/VHT by Area
- ◎ Freeflow VMT by Area
- ◎ Assigned Trips by Mode by Area
- ◎ Congested VMT/VHT by Area
- ◎ Further broken down into AM and PM peak and off peak
- ◎ ...and much much more!
  - All for two easy payments of \$100,000!

# Lessons learned

- ⦿ Establishing the difference between “Done” and “Done done”
  - Tying payment to products instead of hours is good but exercise caution
- ⦿ Plan to start many months before you think to start
  - Get as much data as possible needed for the consultant as early as possible
  - Looking forward to working with SEMCOG to Garth-imize the data so it can be more easily shared

# Future

- ⦿ Looking to initiate update to mode choice this year
  - AATA completed new OD survey
  - SEMCOG working on OD survey
  - Establish how best to incorporate expanded scenario planning