SEMCOG

The Southeast Michigan Council of Governments

SEMCOG Travel Models

Liyang Feng, Ph.D. P.E.

Transportation Modeling Group

A Presentation for
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Predicting the impacts that various policies and programs will have on travel in the urban area.

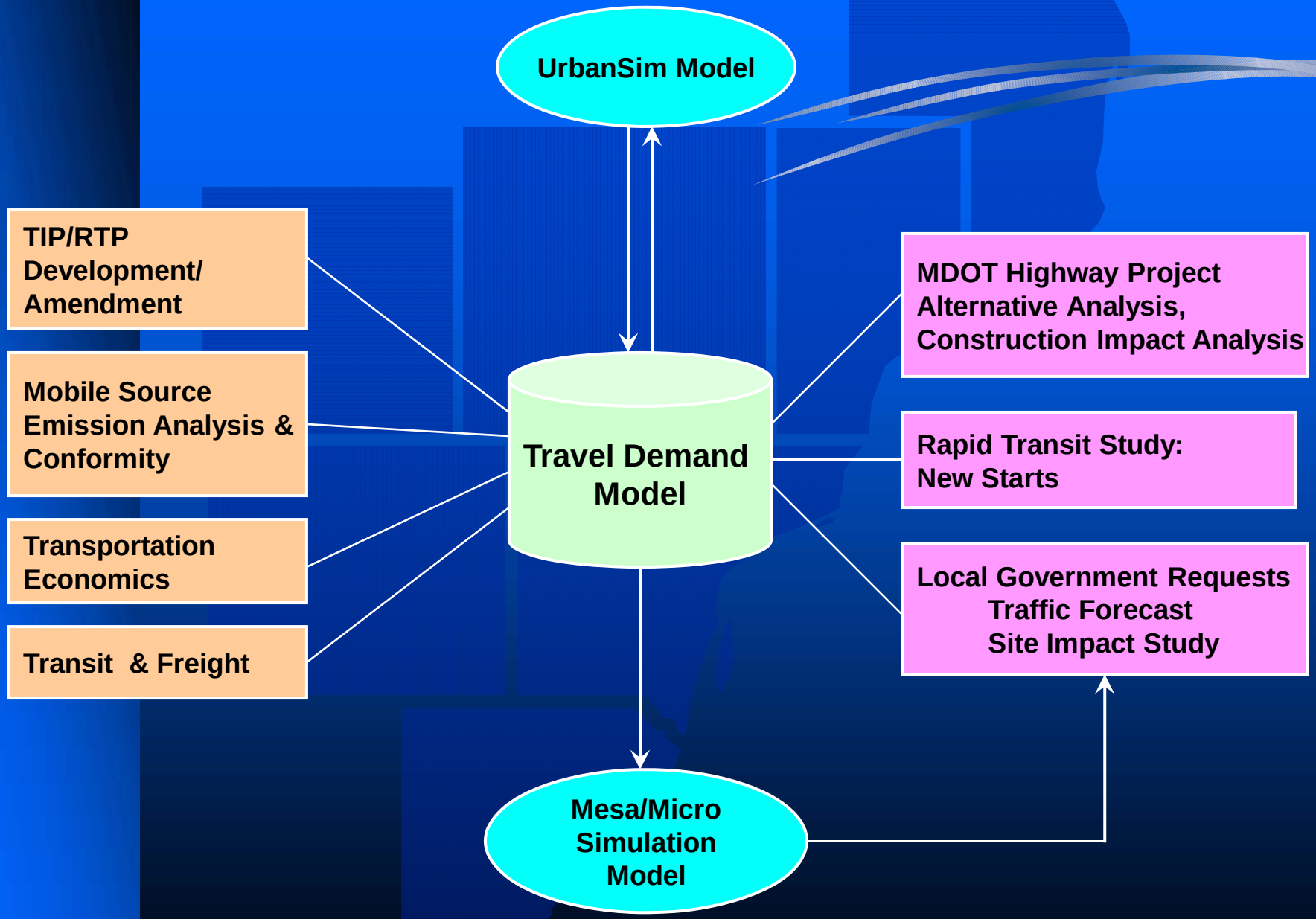
- FHWA UMTA 1977

Modeling Objectives

- Consistent with “state-of-the-practice” modeling
- Tools that support transportation decision-making processes, e.g. FTA new starts, RTP and TIP development, local project development, tec.
- Information required to estimate vehicle emissions for conformity determination

SEMCOG Travel Models

- A full scale multi-modal regional travel demand forecast model
- MPO area: seven counties with 4,630 sq miles
- 4.81million population, 1.92 million HHs & 2.04 million employment (2005)
- 2,899 traffic analysis zones, with approx. 135 million weekday VMT


UrbanSim Model
TIP/RTP Development/ Amendment
Mobile Source Emission Analysis & Conformity
Transportation Economics
Transit & Freight
Travel Demand Model
MDOT Highway Project Alternative Analysis, Construction Impact Analysis
Rapid Transit Study: New Starts
Local Government Requests Traffic Forecast Site Impact Study
Mesa/Micro Simulation Model

Travel Model Versions

- E1: Translated from original TRANPLAN model (2001)
- E2 – E4: Different MGF and TransCAD versions, with various model improvements.
- E5: Updated version using 2005 HH survey data, with TransCAD 5.0

Data Used in Model Development

- Survey data
  - 2005 household travel survey
  - 1996 SEMCOG's Commercial Vehicle Survey for internal trips
  - 2001 On-board Transit Survey
  - 1995 external station survey
- 2035 Socioeconomic data
- SEMCOG Traffic Count Database System

Travel Model Steps

- Network and Zone Development
- Trip Generation
- Trip Distribution
- Time of Day
- Mode Choice
- Highway and Transit Assignment

Highway Network

- Freeways, arterials, collectors, some local streets, ramps, & non-highway links & centroid connectors
- Attributes: Capacity, free-flow speed, distance, # of lanes, functional class, area type, etc.
- E5: derived from MGFv5 w/ approx. 34,400 links

Network & Zones

Model Version	E2	E4	E5
RTP	2025	2030	2035
# of TAZs	1,505	1,505	2,899
Total Links	19,533	23,090	34,425
Centroid Connectors	2,769	4,209	9,528
Avg CC/Zone	1.84	2.80	3.29

Transit Network

- Transit routes, walk and auto access links, park & ride lots
- Mode, fare, dwelling time, headway, operation period, speed, etc.
- E5: completely re-coded based on published 2007 schedule
- Transit modes: bus, express bus, BRT, light rail, commuter rail

Trip Generation

- Cross-classification for production
- Regression for attraction
- Six internal trip purposes: HBW, HBSH, HBSC, HBO, NHBW, NHBO
- Three commercial vehicle classes
- Internal-external (IE) / External-external (EE) trips

HBW Production Rates

Workers/ Household	Autos/household			
	0	1	2	3+
1	1.34	1.13	1.38	1.46
2	2.27	2.06	2.31	2.39
3+	3.51	3.30	3.55	3.63

1994 HH Survey

Workers/ Household	Autos/household			
	0	1	2	3+
1	1.14	1.14	1.34	1.46
2	2.06	2.06	2.26	2.38
3+	3.89	3.89	4.09	4.21

2005 Travel Survey

Trip Rate Comparison

	1994 HH Survey		2005 HH Survey	
Trip Purpose	% of Trips	Trips/ Household	% of Trips	Trips/ Household
Home Based Work	16%	1.4	15%	1.4
Home Based Non-Work	53%	4.6	55%	5.4
Non-Home Based	32%	2.8	30%	3.0
Total	100%	8.7	100%	9.8

Attraction Models

		Total Emp	Households	Retail	Other	Emp Acres
E4/1994 HH Survey	HBW	1.390				
	HBO		2.211	3.394	0.570	
E5/2005 HH Survey	HBW	1.210				
	HBO		1.610	2.501	0.711	2.462

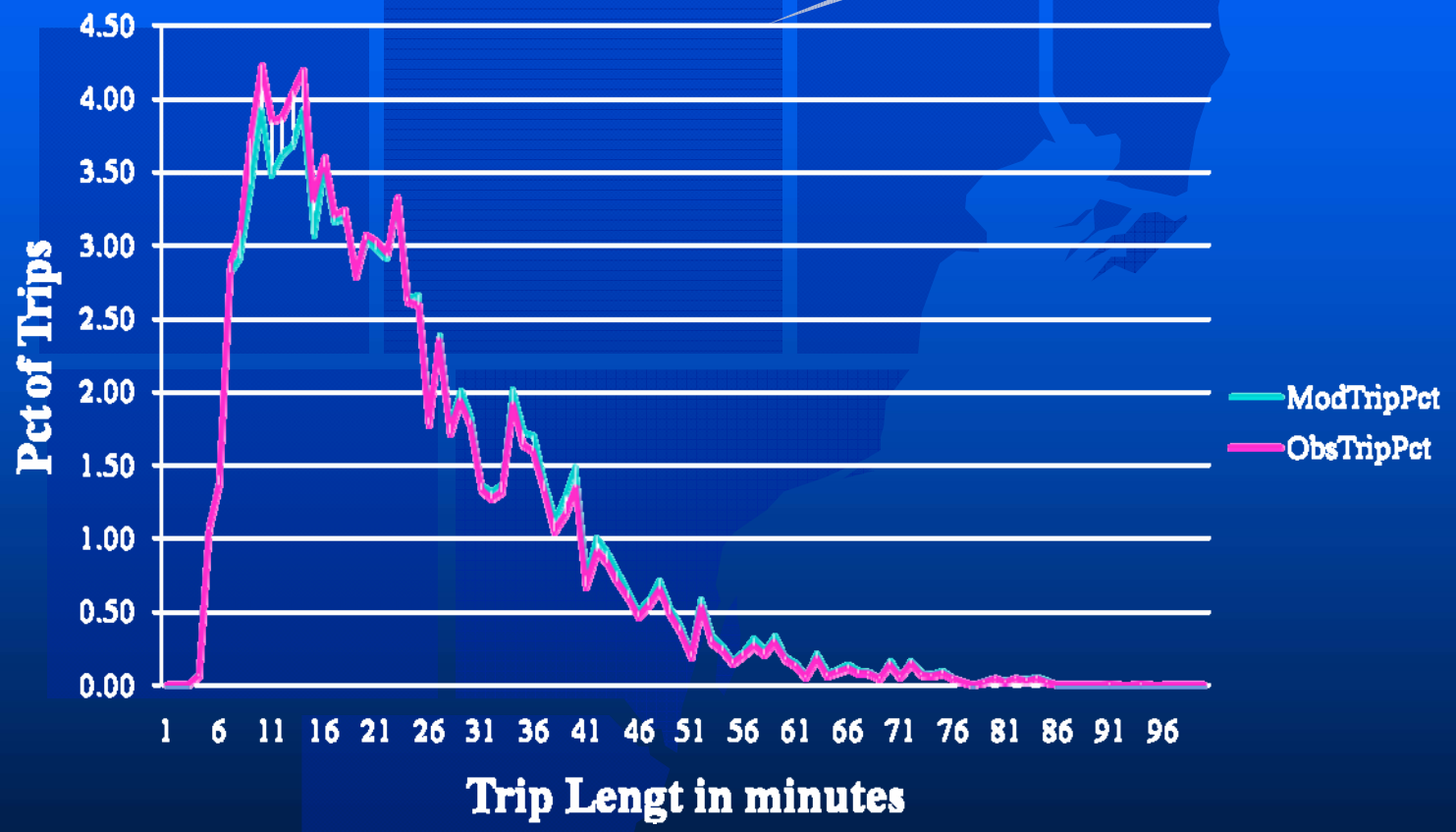
Trip Distribution Models

- Gravity model for trip distribution
- E4 time skim was attached as initial trip length
- Three formulations were tested
  1. Friction Factors
  2. Gamma function
  3. UTPS

Average Trip Length

Trip Purpose	Friction Factor				Gamma Function			
	Observed	Model	Diff%	CR	Observed	Model	Diff%	CR
HBW	24.03	25.03	4.2%	90.0%	24.23	25.21	4.1%	86.0%
HBSH	13.25	13.96	5.4%	90.3%	13.16	13.76	4.6%	75.8%
HBSC	11.54	11.79	2.2%	87.8%	11.51	11.81	2.6%	71.6%
HBO	14.39	14.83	3.1%	94.1%	14.29	14.82	3.7%	82.9%
NHBW	19.75	20.78	5.2%	88.5%	19.39	21.38	10.3%	78.1%
NHBO	13.88	14.54	4.8%	91.7%	13.82	14.50	4.9%	83.3%

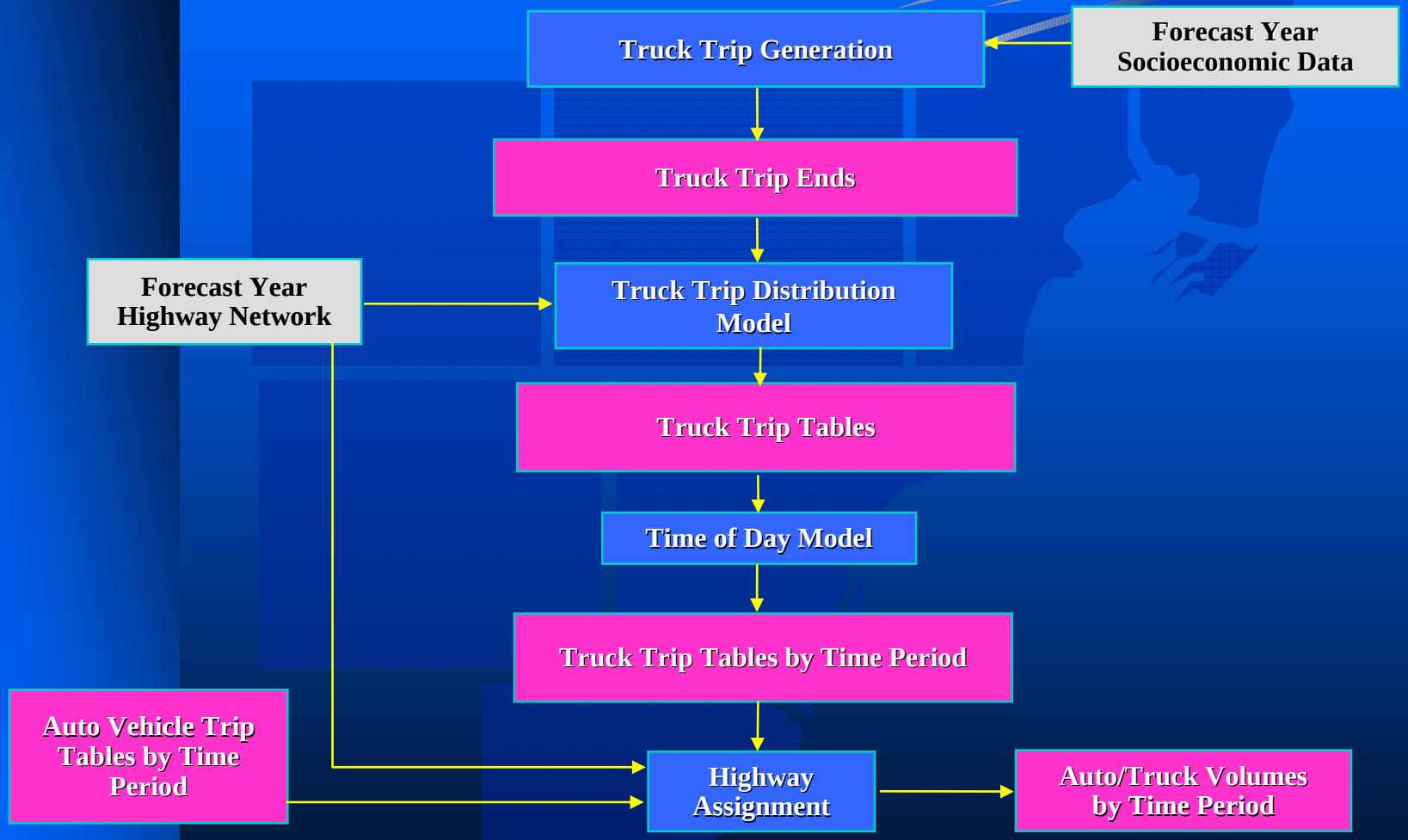
HBW Trip Length Distribution



External Travel Models

- External stations classified by roadway type
- Trip generation based on zone size and distance from regional boundary
- Gravity model for trip distribution
- Models based on 1995 external station survey data

Truck Modeling Process



Time of Day

- Four periods defined from household survey data
  - Morning peak (07:00 – 09:00)
  - Mid-day (09:00 – 15:00)
  - Afternoon peak (15:00 – 18:00)
  - Off peak (18:00 – 07:00)
- Time of day (TOD) factors applied after trip distribution
- TOD factors are by purpose and based on 1994 household survey

Mode Choice

- Developed based on 1994 household & 2001 On-board Transit Survey
- Multinomial models: drive, walk to transit, drive to transit
- Auto availability considered
- Performed reasonableness check and adjusted based on other metro area practice

Coefficient Adjustment

Coefficients	E4 Model		E5 Model	
	Work	Non Work	Work	Non Work
Auto IVTT/ Drive Access IVTT	-0.0522	-0.019	-0.02784	-0.019
Auto Mileage Cost	-0.00413	-0.00657	-0.00413	-0.00657
Auto OVTT/Terminal		-0.0408		-0.0408
Parking Cost	-0.00413	-0.00657	-0.00413	-0.00657
Transit Fare	-0.00413	-0.00224	-0.00413	-0.00657
Transit IVTT	-0.00928	-0.00224	-0.02784	-0.019
Transit OVTT	-0.0186	-0.00673	-0.0558	-0.0504
Access/Egress Time	-0.0186	-0.00673	-0.0558	-0.0504
PEVa (Dest/Attrac)	0.05	0.07	0.05	0.07
PEVb (Origin /Produc)		0.07		0.07
Pop_Density		0.056		0.056
MSadj1		-1.01		-1.25
MSadj2		-1.01		-1.25

Highway Assignment

- Multi--class user equilibrium assignment:
  - Single occupant auto, 2 person carpool, and 3+ person carpool
  - Light, medium, and heavy trucks
- Modified BPR volume-delay flow curve
- Generalized cost functions, with value of time (15c/minute) and auto driving cost (35c/mile)

Assignment Calibration

Volume-Based Statistics: 2004-06 AWDT

Filters	Cnt Mean	Mod Mean	Obs	Per Error	PRMSE	R Squared
System	14,279	14,112	6,982	-1.2%	53.0%	0.689
FC=1&2 Freeway	42,390	41,076	320	-3.1%	36.9%	0.605
FC=4 Maj. Arterial	24,553	23,278	1,735	-5.2%	39.8%	0.357
FC=5 Min. Arterial	12,663	12,441	2,403	-1.8%	48.4%	0.382
FC=6 Collector	4,037	5,724	1,656	41.8%	117.3%	0.142
Obs:>= 50K	67,039	55,589	155	-17.1%	31.3%	0.257
Obs:25-50K	33,149	27,944	1,003	-15.7%	33.2%	0.160
Obs:10-25K	16,368	15,900	2,472	-2.9%	41.1%	0.213
Obs:5-10K	7,324	8,779	1,490	19.9%	74.7%	0.059
Obs:< 5K	2,514	5,102	1,862	103.0%	213.0%	0.030
COUNTY=1 DET	15,768	15,679	584	-0.6%	62.9%	0.712
COUNTY=2 WAY	16,699	15,252	971	-8.7%	49.1%	0.686
COUNTY=3 OAK	16,912	17,107	2,383	1.2%	48.6%	0.637
COUNTY=4 MAC	16,669	14,578	1,031	-12.5%	47.5%	0.674
COUNTY=5 WAS	10,112	10,933	871	8.1%	49.7%	0.761
COUNTY=6 MON	5,997	7,838	410	30.7%	90.8%	0.570
COUNTY=7 STC	10,686	8,756	143	-18.1%	41.1%	0.796
	6,773	8,111	589	19.7%	72.5%	0.700

Transit Assignment

- Transit trip tables assigned based on shortest path (TransCAD pathfinder)
- Walk access trips subject to maximum walk time of 18 minutes
- Auto access trips must go through park-and-ride lot

Transit Network Parameters

Variables	E4 Model	E5 Model
Max. # of Transfers	3.00	3.00
Value of Time	0.02	0.08
Fare	1.25	1.25
Transfer Fare	0.40	0.25
Drive Time Weight		3.00
Wait Time Weight	2.40	2.40
Dwell Time Weigh	-	-
Walk Time Weight	2.40	2.40
Max Drive Time	45.00	45.00
Transfer Penalty Time	3.00	6.00
Max Wait Time	20.00	20.00
Min Wait Time	2.00	2.00
Layover Time	5.00	5.00
Max Access Time	18.00	18.00
Max Egress Time	18.00	18.00
Max Transfer Time	18.00	18.00
Max Total Cost	6.50	20.00
Max Walk Access Paths	10.00	10.00
Combination Factor	-	0.50

Feedback Among Model Steps

- Uses method of successive averages (MSA) for feedback
- Convergence based on changes in link volumes and adjusted to balance needs and computation time
- Weighted averaging method of computing daily travel times

Current Projects

- E6 Model Development
- MOVES application development
- 2010 On-Board Transit Survey
- Novi-Farmington Hills subarea demonstration project
  - Micro-simulation using TransModeler
  - Dynamic Traffic Assignments (DTA)

Projects Under Consideration

- Multi-year model development plan
- TMIP peer review
- External model improvement using 2005 HH survey
- Destination choice model, synthetic population, & advanced traffic assignment method
- Activity based model preparation
- Signal database

Challenges

- Balance needs and resources
- Address more policy related questions

Thank you very much ☺

A SEMCOG presentation