New York Best Practice Model 2012 Base Year Update

Executive Session

Presented to - NYBPM Partners & Modeling Community

Presented by -

NYMTC – Lynne Thisse, Project Manager

Cambridge Systematics -Thomas Rossi & Nikhil Puri

CAMBRIDGE SYSTEMATICS

NYMTC
NEW YORK METROPOLITAN TRANSPORTATION COUNCIL

Overview of Training Sessions

- Executive Session
  - Part 1
  - Part 2
- Technical Sessions
  - 4 three-hour sessions
    - Model structure, parameters and input
    - Model setup, highway & transit route coding
    - Building scenarios, model output, and special model uses cases

Presentation Outline

- Part 1
  - What is a travel demand model?
  - How do travel demand models work?
  - NYBPM 2012- enhancements and efficiencies
  - What can the NYBPM be used for?
  - Q&A
- Part 2
  - Model Validation/Calibration
    - What is model validation and why do we do it?
    - Activity-based demand component validation
    - Aggregate results
  - Q&A

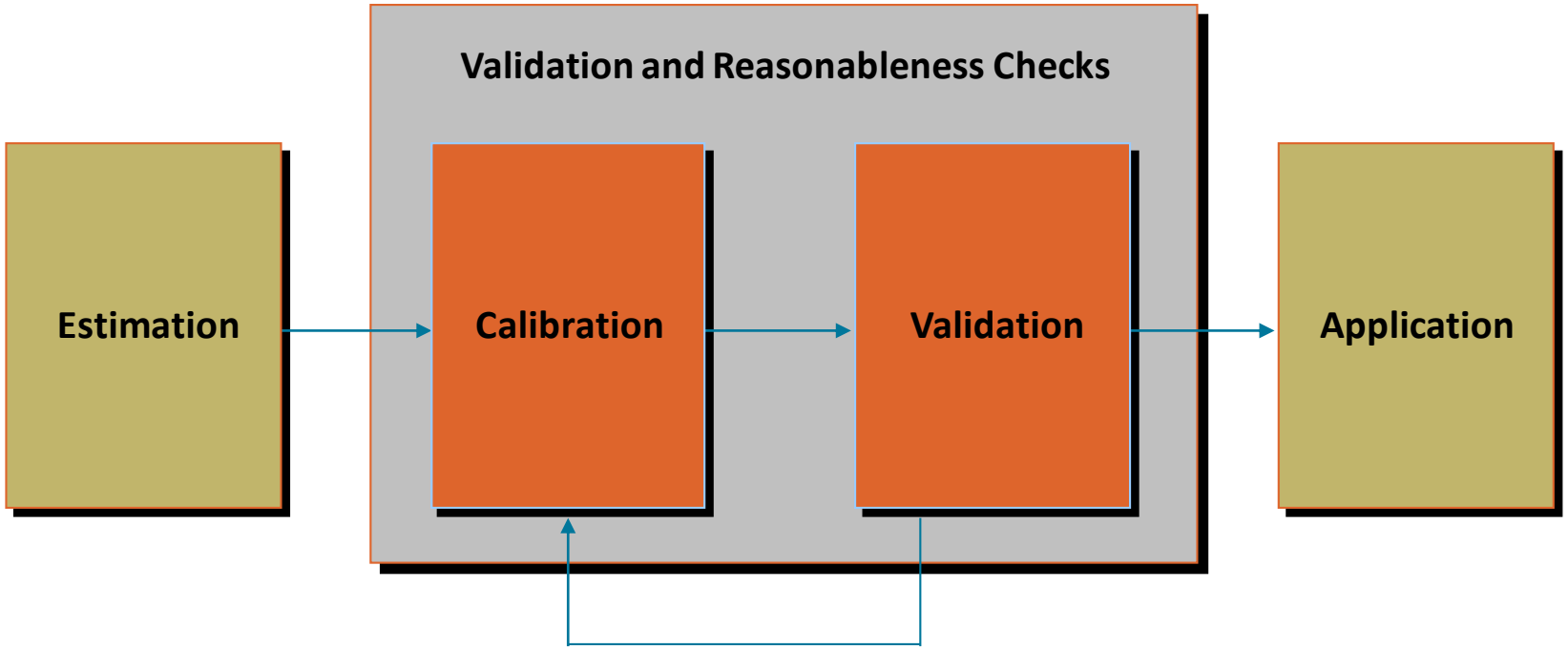
A Travel Demand Model …

- … takes a set of available *input data* …
- … and converts it to a set of *output data*, needed for planning analyses …
- … using a set of *mathematical formulations*…
- … which use *parameters* to perform the conversions

Model Input and Output Data

- Input data
  - Highway and transit networks
    - Highway time and distance, tolls
    - Transit in-vehicle/walk/wait time, cost, transfers
  - Socioeconomic/land use data (population, employment, etc.)
  - Non-residential travel demand
  - Other (e.g., auto operating costs)
- Output data
  - Trip rosters
  - Roadway volumes
  - Transit line volumes and station boardings

The Model Development Process



What a Model Is…and Is Not

- A model is…
  - An analytical tool to provide important information to planners
  - A means to quantitatively estimate the effects of transportation planning, policy, or investment decisions—or external factors—on transportation demand
- A model is not…
  - A crystal ball—it does not predict the future
  - A way to get “the answer” on a planning decision

How an Activity-Based Model Works

- A *synthetic population* representing everyone in the model region is created
  - Includes age, gender, household structure
- Each person's *activities* (work, school, shopping, recreation, etc.) are simulated, along with the *associated travel* needed to achieve the activities
- *Travel choices* (destination, mode, time of day, etc.) are simulated
- All travel is aggregated and assigned to highway and transit networks

NYMTC Has Had an ABM for Years

- One of the first major metropolitan areas to develop one
- Nearly all large U.S. metro areas have one now (or are close to finishing)
- Activity-based approach allows for better analysis of emerging demographics, mobility, and technology

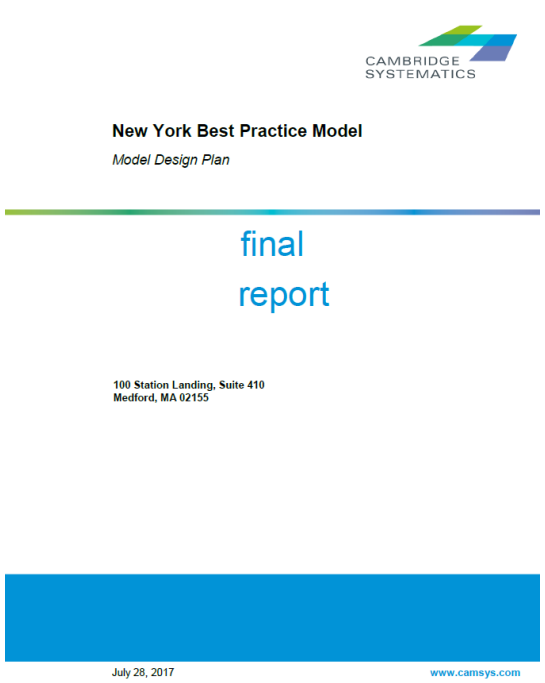
Improvement Goals for 2012 NYBPM

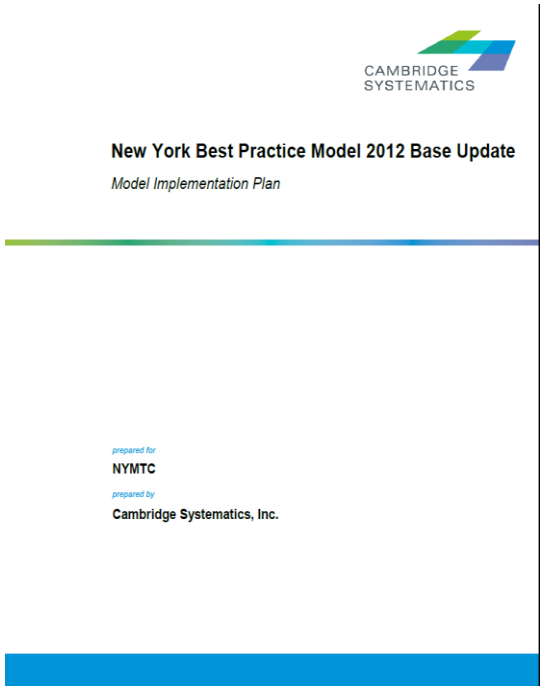
- Transparency/accessibility
- Robust, modern modeling procedures
- Improve network representation using newly available data sourced and procedures
- Systematic, comprehensive validation
- Reporting features

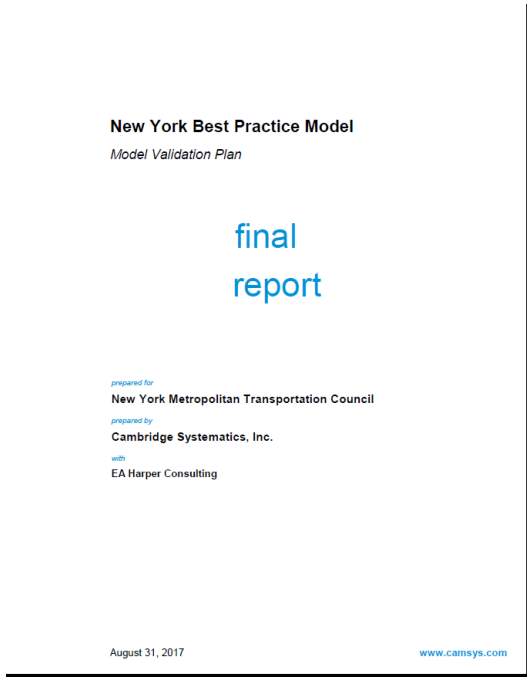
Transparency/Accessibility

- Not a “black box”
- All code and TransCAD scripts are open source or owned by NYMTC (and therefore can be made available)
- Model results stored in databases for easy access
- Customized reporting

Model Design, Implementation, Validation Plans





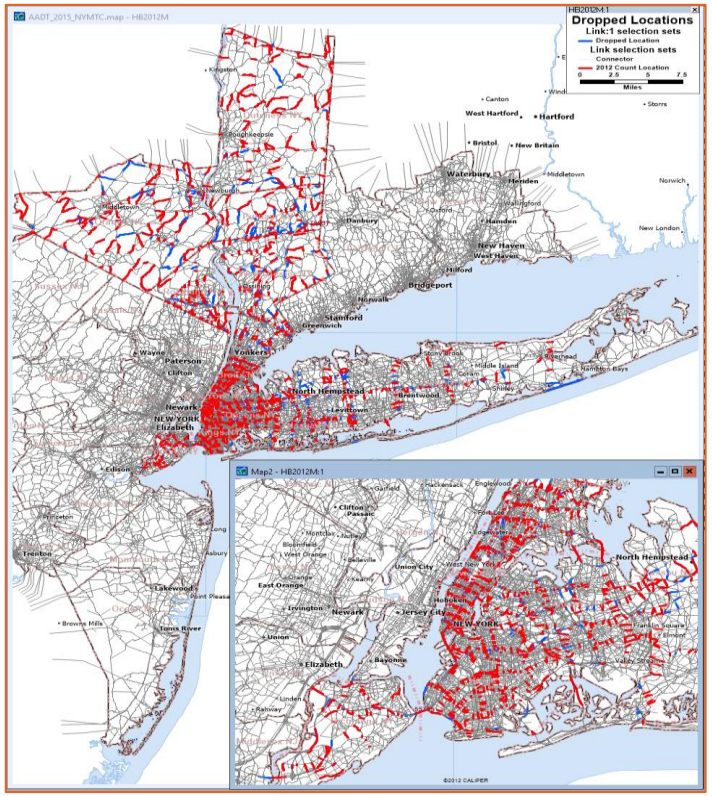


CAMBRIDGE SYSTEMATICS

NYMTC

Data Updates

- Updated and improved accuracy of highway data
  - Revised traffic screenlines
  - Added vehicle classification counts
  - Reduced synthesized data
  - NJ + CT counts added
- Improved validation and reporting



CAMBRIDGE SYSTEMATICS

NYMTC

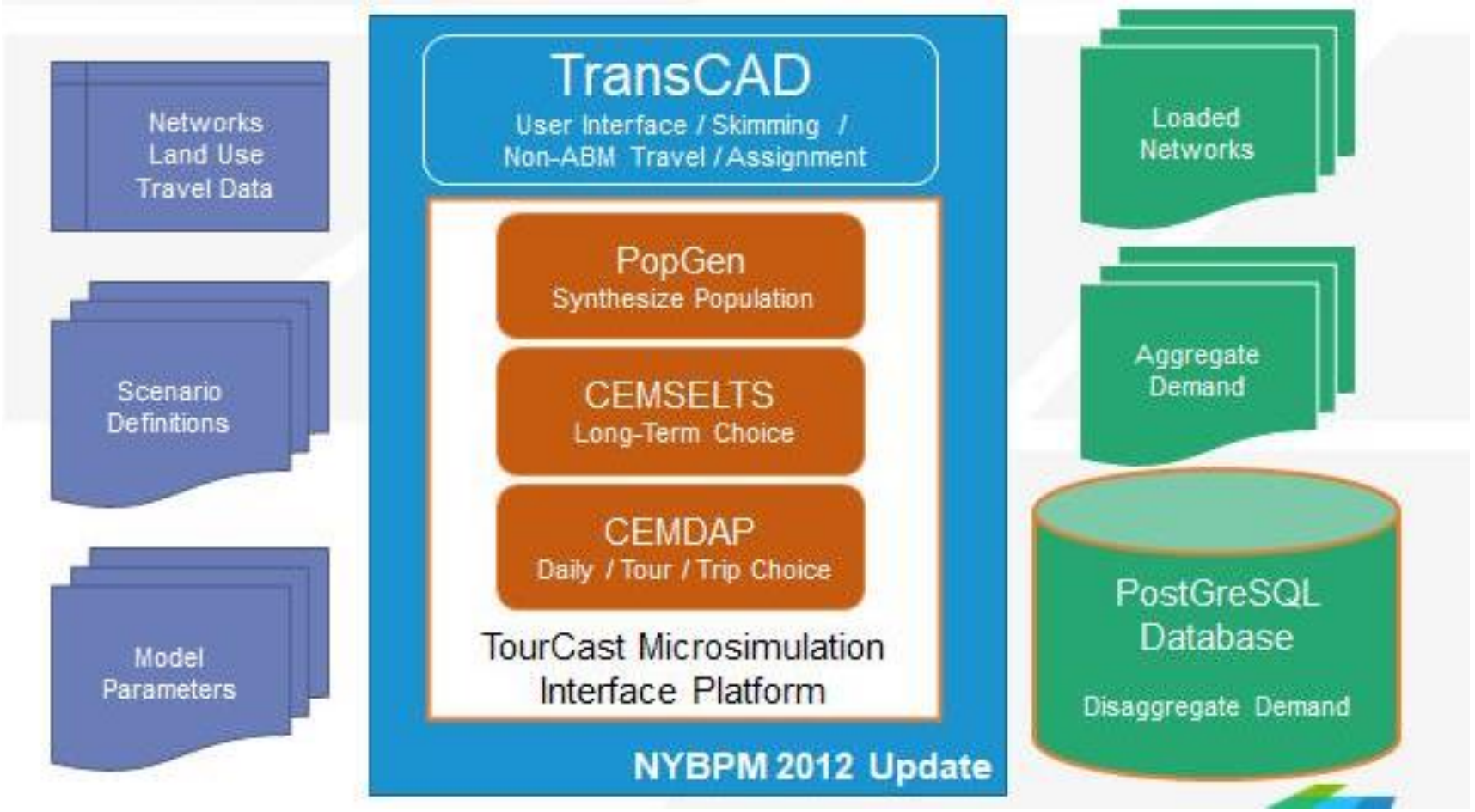
Transit Data

- A more comprehensive transit validation dataset with improved reporting
  - Disparate data from a variety of sources
  - Stop-to-stop
  - District-to-district
  - Station boardings
- 2010/2011 Regional Household Travel Survey (RHTS) for mode share
- Emphasis on simplifying transit reporting
  - Hub-bound travel, station groupings, origin-destination tables
  - Will be available with the final model deliverable

Networks

- Significant amount of roadway detail added
- Conflated and integrated Transit + Highway network
  - More accurate General Transit Feed Specification (GTFS) transit travel times- positive impact on all core model components
  - Improved transit times for all time periods
  - Easier and more efficient transit project updates where GTFS available
- Incorporated familiar project coding procedures
- Automated select transit coding functionalities

Core Model Components (about 70 components total)



CAMBRIDGE SYSTEMATICS

NYMTC

Robust, Modern Modeling Procedures

- Overall structure based on modern research and tested in previous settings
- Specifically adapted and revised for the unique New York area environment
- Made optimal use of local survey data (RHTS/RES) for model estimation and validation

CAMBRIDGE SYSTEMATICS

NYMTC

Systematic, Comprehensive Validation

- Based on industry standard procedures
- Validation plan followed closely
- Every component validated and reviewed by NYMTC staff and Steering Committee members
- Aggregate results examined intensely
- When something didn't work, we explored and made adjustments as appropriate

Model Validation and Calibration

- Currently finishing up
- Validation plan
  - Check results of all components
  - Revise parameters/models as needed
  - Examine aggregate results (e.g., highway volumes, transit demand)
  - Sensitivity testing

Vehicles per Household			
Vehicles	Expanded RHTS data	Model Results	Percentage Point Difference
0	23.5%	23.8%	0.2%
1	31.8%	32.0%	0.2%
2	29.9%	29.6%	-0.3%
3	10.0%	9.8%	-0.3%
4+	4.8%	4.9%	0.1%
veh/hh	1.22	1.20	-0.9%

CAMBRIDGE SYSTEMATICS

NYMTC

Aggregate Model Validation

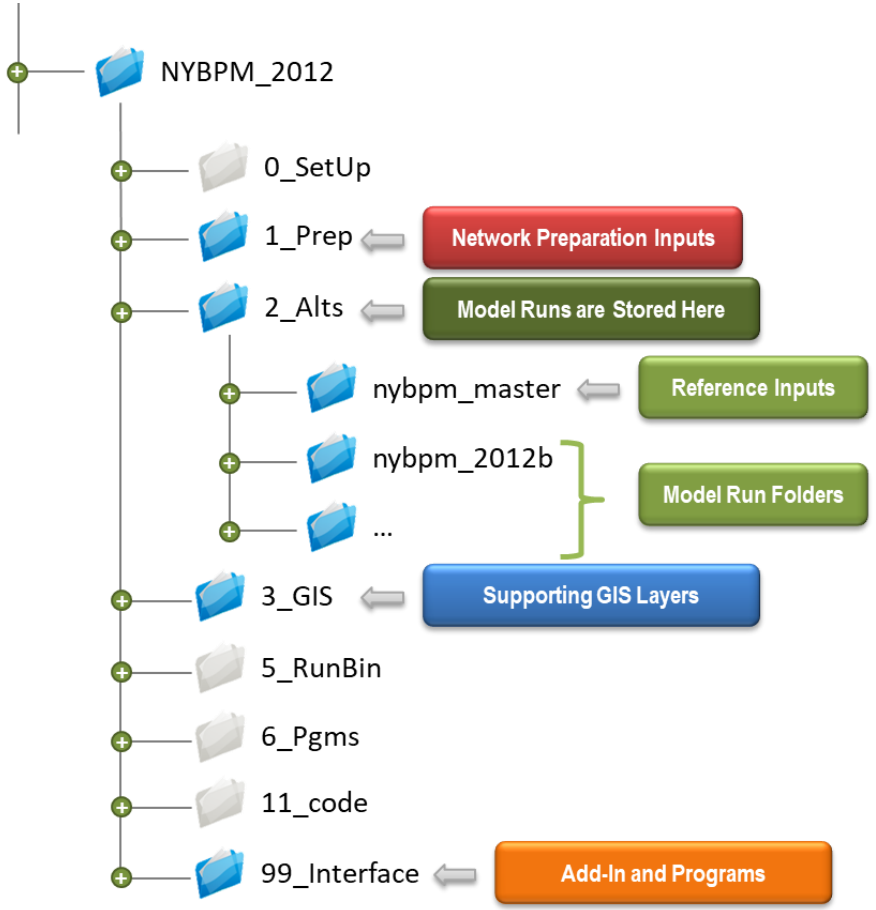
- Compare volumes to counts
  - % vehicle miles traveled difference by facility type
  - Screenline crossing comparisons
  - Major route/crossing comparisons
  - Comparing volumes on individual links
- Transit comparisons
  - Comparisons at station group, geography, service type levels
  - Not straightforward due to variety of services, transfers, data inconsistencies

Modeled VMT / Count VMT (Daily, All Vehicles)				
	Model VMT	Count VMT	Total	Target
Interstate/Freeway/Tollway	13,898,937	13,413,130	3.6%	7%
Principal Arterial	6,914,402	7,264,617	-4.8%	10%
Minor Arterial	3,507,136	3,645,011	-3.8%	10%
Major Collector	804,773	743,297	8.3%	15%
Minor Collector	181,201	198,792	-8.8%	15%
Local Street	31,861	56,185	-43.3%	
Ramp	93,171	126,702	-26.5%	
Total	25,431,481	25,447,734	-0.1%	1%

CAMBRIDGE SYSTEMATICS

NYMTC

Overall Folder Structure



- Intuitive folder structure, maintaining familiarity
  - Name and path are flexible
  - Some simplification and re-organization
  - Removes or deprecates outdated/unused files
- Consistent Concepts
  - Many functions and locations are consistent with the 2010 model

CAMBRIDGE SYSTEMATICS

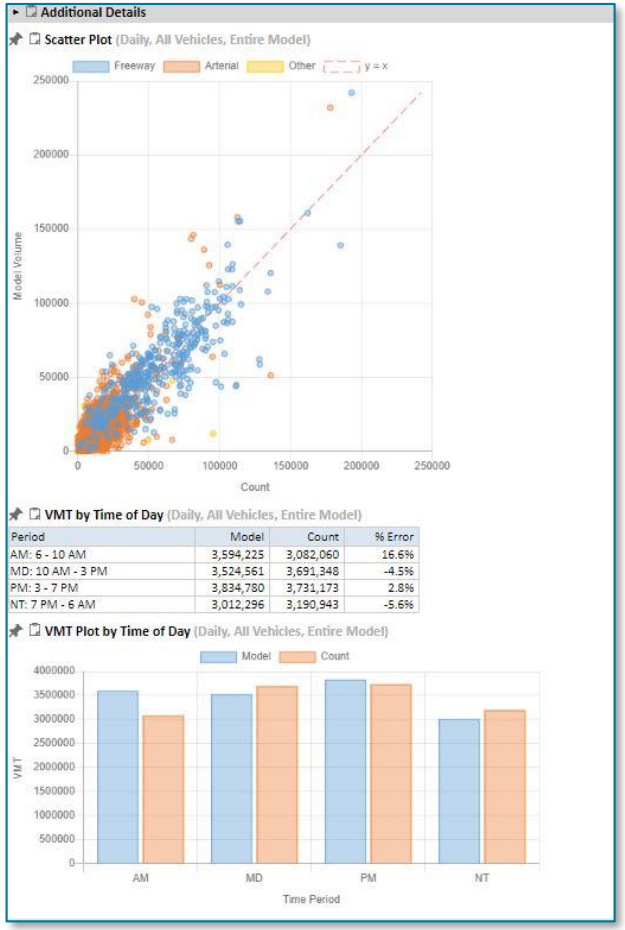
NYMTC

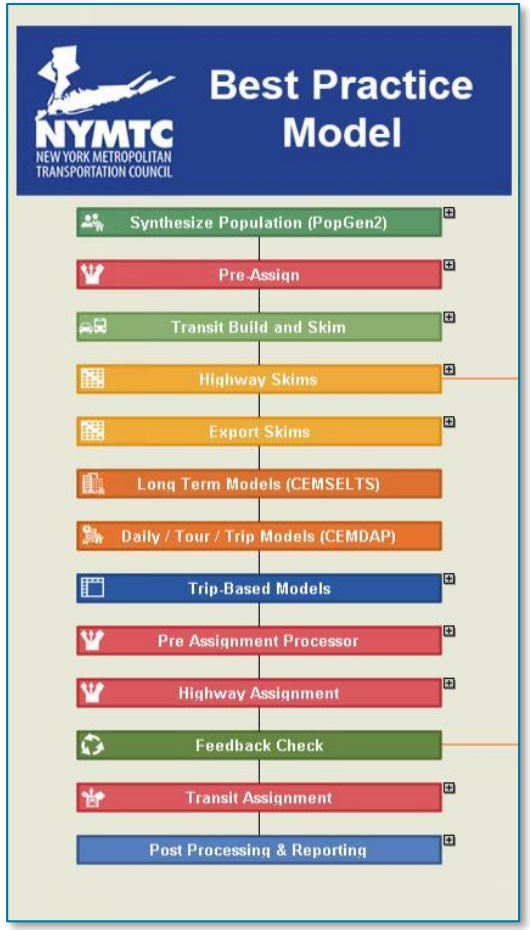
Reporting Features

- Take advantage of latest TransCAD capabilities
- Customized to NYMTC's needs and desires
- Database of all model results

TransCAD Graphical User Interface & Reporting

- Customized to NYMTC's requirements
- More intuitive flowchart interface and reporting
- Improved model parameter management
- Streamlined utilities
- Multi-threading capabilities





CAMBRIDGE SYSTEMATICS

NYMTC

What does this all mean?

- Transparent, easy-to-use user interface
  - Does require a basic understanding of modeling
- Simulates regional travel well
  - Ideal for air quality conformity
  - Existing and future conditions
  - Geographic coverage
  - Auto+ taxi+ truck+ subway+ commuter rail + bus
    - Distinguishes between commuter and local buses;
    - Select Bus Service
- Ability to model corridors and subareas

CAMBRIDGE SYSTEMATICS

NYMTC

What can I use the NYBPM for?

- Regional planning
  - Long range transportation plans (land use, network, pricing)
  - Air quality conformity (VMT, VHT, Speed)
  - Subarea/corridor analysis (VMT, VHT, Speed)
  - Truck volumes
- Policy analysis
  - Pricing/tolling (mode shifts, diversions)
  - Peak spreading
- Project analysis
  - Scenario and long-range planning
  - Equity analysis (impacts on low-income populations)

What can I use the NYBPM for? (continued)

- Transit planning
  - Mode shifts as a result of improved service
  - Impact of Transit Signal Priority
  - Demand for a new ferry service?
- Changing travel behavior
  - Testing work-from-home impacts
  - Active transportation
  - Technology-driven changes (open road tolling, Uber/Lyft, etc.)

Questions?

CAMBRIDGE SYSTEMATICS

NYMTC

Part 2 Model Validation/Calibration & Model Structure

Systematic, Comprehensive Validation

- Based on industry standard procedures
- Validation plan followed closely
- Every component validated, and reviewed by NYMTC staff and Steering Committee members
- Aggregate results examined intensely
- When something didn't work, we explored and made adjustments as appropriate

Purpose of Model Validation

- Confirm that model accurately reflects travel behavior in the region, under existing and potential future conditions
  - Run model for base year, compare to observed data for 2012
  - Examine sensitivity of model results to key variables (e.g., travel time, cost, demographic changes)
  - Ensure that results are reasonable for required types of planning analyses

Dealing with Limitations

- Data limitations
  - Observed data does not cover everything modeled
  - Errors and uncertainties in observed data
  - Inconsistencies among observed data sources
- Model limitations
  - Limitations in data used for model development
  - Simplifications (even in a complex model)
  - Aggregation errors (even in a mostly disaggregate model)

Summary of Validation Plan

- Tests for major component segments
  - Input data/synthetic population
  - Activity patterns
  - Location choices
  - Mode choices
  - Time of day
  - Highway assignment
  - Transit assignment

Summary of Validation Plan (continued)

- Guidelines for validation tests
  - Numeric where appropriate
- Single pass validation
- Full feedback validation
- Sensitivity testing/temporal validation

Summary of Model Validation

- The remaining slides present selected validation results
- These results represent the “conformity ready” model version dated 6/15
  - Focus on highway related results for conformity analysis
  - Validation continues with improving results
- Highlighted cells indicate results we are paying particular attention to during remaining validation work

Component Validation Templates

- Compare model results by segment to observed data
- Segments defined by:
  - Relevance to travel choice
  - Geographic subarea
  - Observed data sufficiency

Vehicles per Household			
Vehicles	Expanded RHTS data	Model Results	Percentage Point Difference
0	23.5%	23.8%	0.2%
1	31.8%	32.0%	0.2%
2	29.9%	29.6%	-0.3%
3	10.0%	9.8%	-0.3%
4+	4.8%	4.9%	0.1%
veh/hh	1.22	1.20	-0.9%

RHTS data shares by HHSize

Autos	Total	1	2	3	4+
Total	100%	100%	100%	100%	100%
0	24%	43%	19%	15%	13%
1	32%	48%	30%	26%	20%
2	30%	7%	41%	34%	40%
3+	15%	2%	11%	25%	27%

Model shares by HHSize

Autos	Total	1	2	3	4+
Total	100%	100%	100%	100%	100%
0	24%	44%	18%	15%	12%
1	32%	47%	31%	26%	20%
2	30%	7%	40%	39%	38%
3+	15%	2%	11%	20%	30%

CAMBRIDGE SYSTEMATICS

NYMTC

Socioeconomic Data Checks

Measure	Control	Model
Population	22,025,103	22,029,241
Households	8,086,279	8,086,275
Persons per Household	2.72	2.72
Autos per Household	1.42	1.41

Socioeconomic Data Checks (continued)

Measure	Control	Model
Total Labor Force	10,335,483	10,327,697
Total Employment	10,208,383	n/a
Workers per Household	1.28	1.28

Selected Model Results

Household Income

Income Level	RHTS	Model
Less than $15,000	9.8%	9.7%
$15,000 to $29,999	15.8%	15.8%
$30,000 to $49,999	15.3%	14.7%
$50,000 to $74,999	16.3%	15.9%
$75,000 to $99,999	12.3%	14.1%
$100,000 to $149,999	15.3%	20.4%
$150,000 to $199,999	7.7%	3.1%
$200,000 or more	7.6%	6.4%

Subregion	Less than $15,000	$15,000 to $29,999	$30,000 to $49,999	$50,000 to $74,999	$75,000 to $99,999	$100,000 to $149,999	$150,000 to $199,999	$200,000 or more
Total	**0%**	**0%**	**-1%**	**0%**	**2%**	**5%**	**-5%**	**-1%**
Manhattan	1%	2%	3%	2%	3%	4%	-5%	-10%
Other NYC	-4%	-5%	-4%	-1%	3%	8%	-1%	3%
Long Island	4%	3%	2%	-1%	0%	2%	-8%	-3%
Westchester-Putnam-Dutchess	3%	4%	1%	1%	2%	3%	-9%	-5%
Rockland-Orange	2%	2%	-3%	-2%	-2%	4%	-4%	3%
Bergen-Passaic	0%	1%	1%	-1%	2%	5%	-6%	-3%
Essex-Hudson-Union	-2%	-1%	-2%	-1%	2%	6%	-4%	1%
Middlesex-Morris-Somerset-Mercer	5%	3%	1%	-1%	-1%	2%	-8%	-2%
Monmouth-Ocean	0%	3%	0%	-1%	1%	4%	-4%	-2%
Hunterdon-Sussex-Warren	4%	4%	0%	-2%	1%	1%	-8%	0%
Connecticut	0%	2%	-1%	0%	1%	4%	-3%	-4%

Selected Model Results

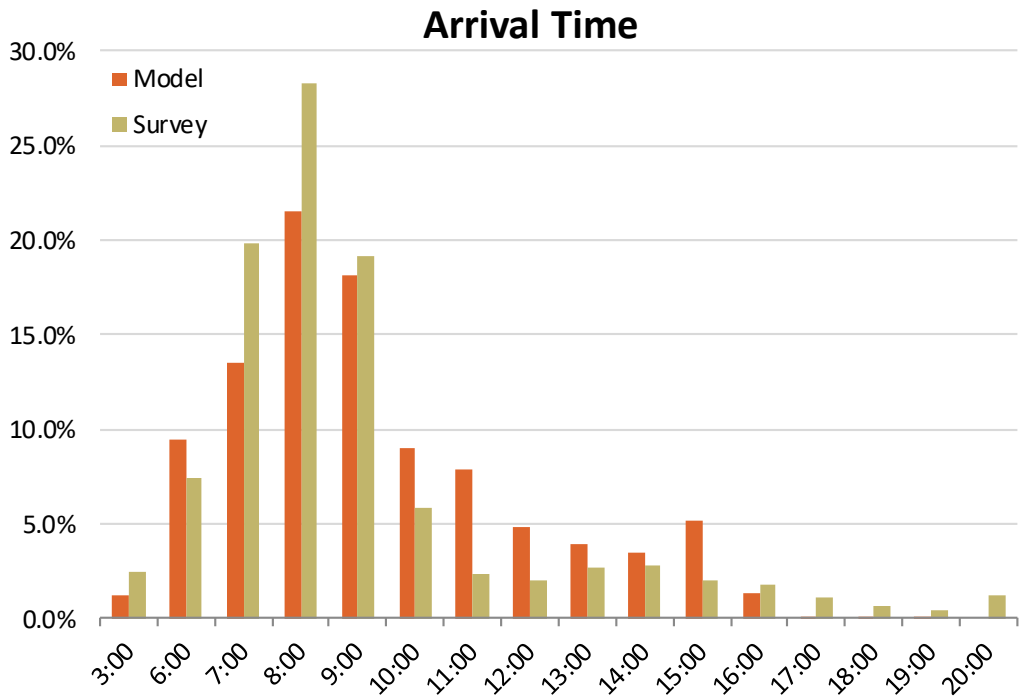
Residential Tenure and Housing Type

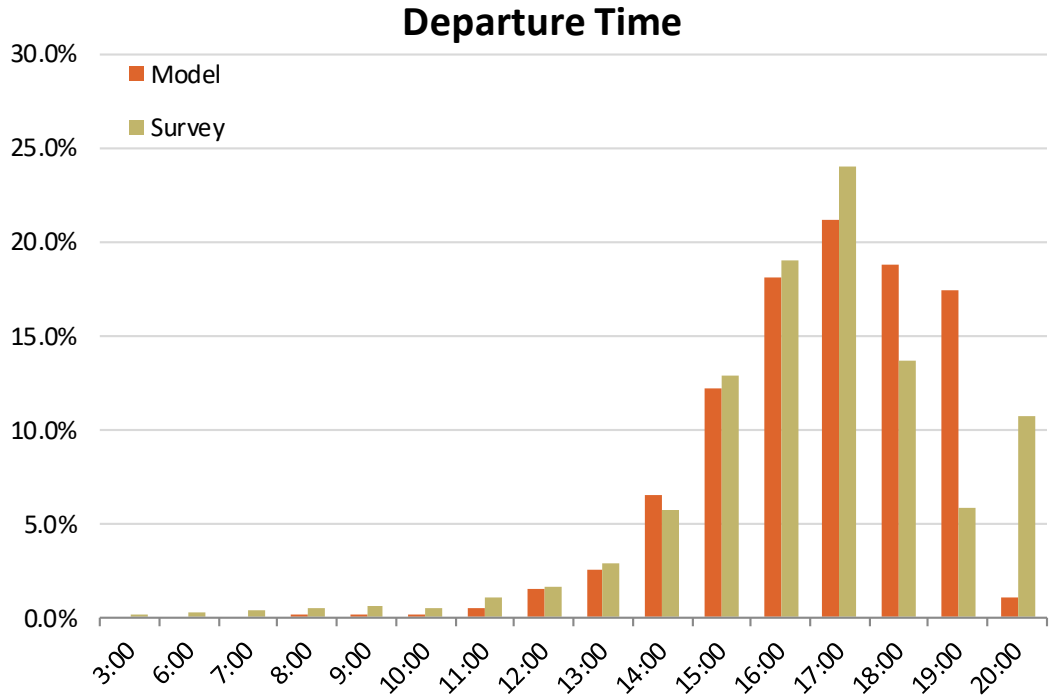
Own/Rent	RHTS	Model
Own	45.5%	45.7%
Rent	54.5%	54.3%

Housing Type	RHTS	Model
Single Family Detached	45.5%	45.1%
Single Family Attached	8.0%	5.5%
Apartment	46.1%	48.3%
Other	0.4%	1.1%

Results as of 6/15/2020

Selected Model Results
Work Arrival/Departure Times





Time Period	Expanded RHTS data		Model Results	
	Arrival to work	Departure from work	Arrival to work	Departure from work
AM pk (6-10)	74.7%	1.8%	62.7%	0.1%
PM pk (3-7)	5.5%	69.6%	6.7%	70.2%

Average Duration (hours)	Expanded RHTS data	Model Results
Male	7.63	7.55
Female	7.40	7.35
All	7.52	7.45

CAMBRIDGE SYSTEMATICS

NYMTC

Results as of 6/15/2020

Selected Model Results
Worker Trip Mode Share

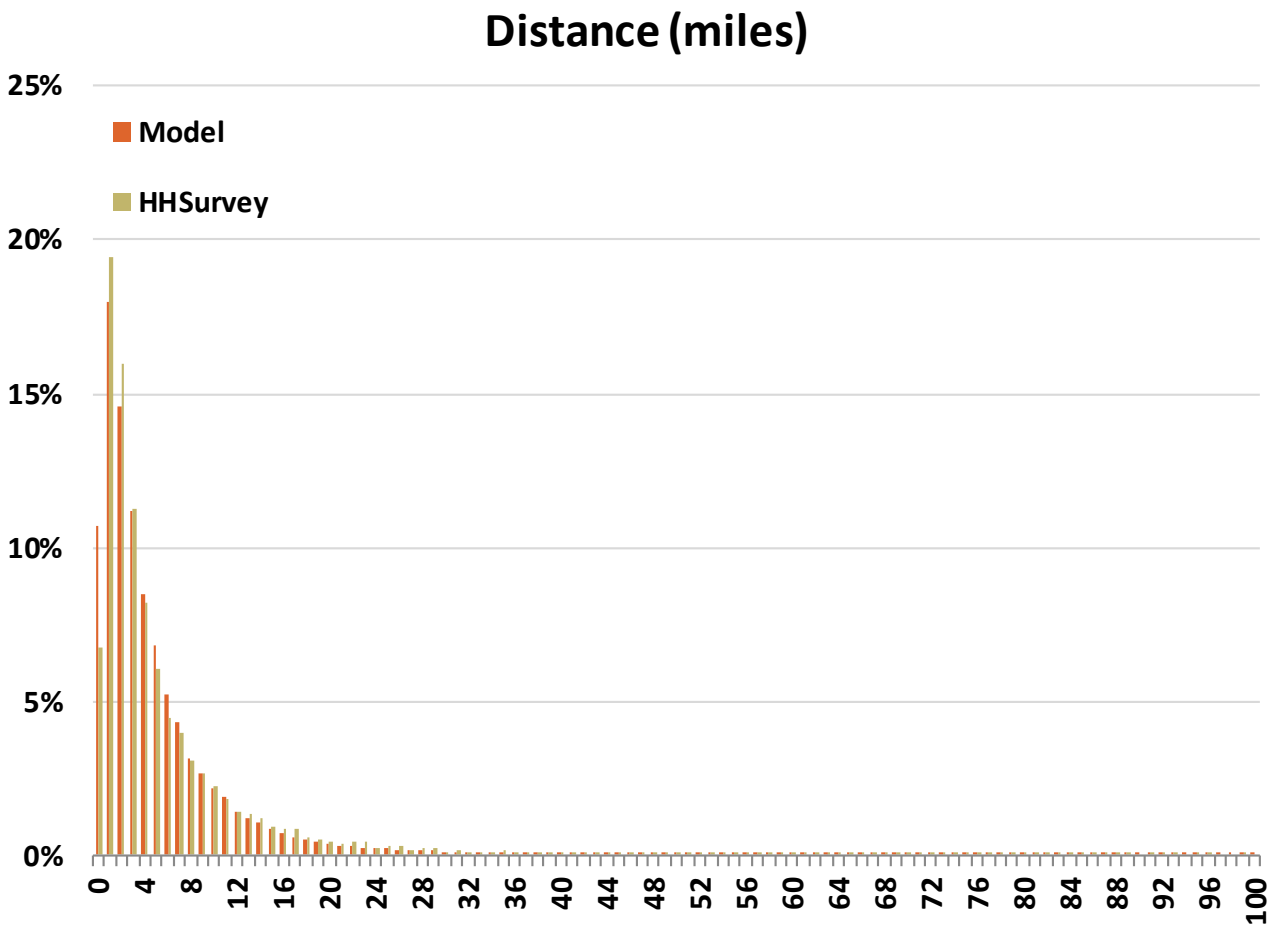
Trip Mode Share	Expanded RHTS data	Model Results
SOV	56.4%	51.9%
HOV 2	5.6%	8.0%
HOV 3	1.0%	3.2%
Taxi	1.5%	1.9%
Commuter rail/bus – auto access	4.8%	0.5%
Commuter rail/bus – walk access	3.7%	7.7%

Trip Mode Share	Expanded RHTS data	Model Results
Subway/ferry – auto access	0.8%	0.2%
Subway/ferry – walk access	15.4%	8.9%
Local bus – auto access	0.0%	0.0%
Local bus – walk access	4.5%	9.6%
Walk	5.6%	7.3%
Bike	0.7%	0.9%

Trip Mode / Auto Per Worker	Expanded RHTS data				Model Results			
	Zero Auto	<1	1	>1	Zero Auto	<1	1	>1
SOV	0.8%	31.4%	70.9%	81.9%	1.2%	29.6%	72.3%	77.7%
HOV 2	2.8%	10.9%	4.8%	4.9%	2.0%	9.0%	9.4%	9.0%
HOV 3	0.8%	1.8%	1.1%	0.6%	0.9%	3.2%	4.1%	3.4%
Taxi	3.8%	2.7%	0.7%	0.6%	6.9%	1.5%	0.7%	0.5%
Commuter rail/bus – auto access	0.8%	2.4%	6.5%	6.0%	0.0%	0.3%	0.7%	0.7%
Commuter rail/bus – walk access	4.6%	6.3%	3.7%	1.6%	10.6%	12.7%	5.2%	4.7%
Subway/ferry – auto access	0.5%	0.8%	0.9%	0.8%	0.0%	0.1%	0.4%	0.2%
Subway/ferry – walk access	50.3%	26.8%	6.5%	1.7%	25.7%	15.3%	2.3%	1.1%
Local bus – auto access	0.0%	0.5%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Local bus – walk access	16.9%	7.0%	1.4%	0.6%	30.8%	14.6%	2.2%	1.2%
Walk	15.9%	8.6%	3.2%	1.2%	20.4%	11.4%	2.5%	1.5%
Bike	2.6%	0.7%	0.2%	0.2%	1.6%	2.2%	0.3%	0.1%

Results as of 6/15/2020

Selected Model Results
Non-Worker Stop Location Choice



Average Distance (miles) by Subregion	Expanded RHTS data	Model
Manhattan	2.58	2.29
Other NYC	3.94	3.74
Long Island	7.05	7.29
Westchester-Putnam-Dutchess	5.44	4.88
Rockland-Orange	8.49	8.00
Bergen-Passaic	5.61	5.65
Essex-Hudson-Union	4.65	4.72
Middlesex-Morris-Somerset-Mercer	6.47	6.27
Monmouth-Ocean	7.41	7.26
Hunterdon-Sussex-Warren	11.26	10.77
Connecticut	5.06	4.73
Region	5.41	5.07

CAMBRIDGE SYSTEMATICS

NYMTC

VMT by Functional Class (on links with counts)

Functional Class	Traffic Count	Model	% Diff.	Target
Interstate/Freeway/Tollway	13,413,130	13,898,937	3.6%	±7%
Principal Arterial	7,264,617	6,914,402	-4.8%	±10%
Minor Arterial and Below	4,618,142	4,769,987	-3.2%	±15%
TOTAL	**25,447,734**	**25,431,481**	**-0.1%**	**±1%**

Total Model VMT (all links) = 358,654,552
Total Model VMT/household = 44.4

Results as of 6/15/2020

Major Crossings Summary

Crossing	Traffic Count	Model	% Diff.
Arthur Kill	144,952	159,212	10%
Hudson River	711,055	839,032	18%
The Narrows	193,100	242,153	25%
East River	1,013,835	1,191,131	18%
Harlem River	610,639	623,625	2%

CAMBRIDGE SYSTEMATICS

NYMTC

Major Route Summary

Route	Count VMT	Model VMT	Model/Count
Southern Parkway	592,060	631,075	1.07
I-84	553,893	546,739	0.99
Long Island Expressway	430,696	417,348	0.97
Shore Parkway	313,086	242,221	0.77
Palisades Interstate Parkway	302,697	388,744	1.28
Brooklyn-Queens Expressway	275,978	294,539	1.07
I-684	248,069	288,390	1.16
Cross Island Parkway	245,932	194,670	0.79
FDR Drive	243,551	302,832	1.24
I-87	224,298	179,629	0.80
Northern State Parkway	209,526	302,654	1.44
Belt Parkway	207,923	205,011	0.99

Results as of 6/15/2020

Trip Mode Share Summary

Mode	RHTS	Model
Commuter rail/bus	4%	6%
Subway/ferry	10%	9%
Local bus	4%	6%
TOTAL TRANSIT	18%	20%
Auto	65%	64%
Non-motorized/other	17%	16%

CAMBRIDGE SYSTEMATICS

NYMTC

Remaining Validation Work

- Continuing to work with NYMTC staff and the Steering Committee to issue the final validated model
- A major focus is on transit validation, including mode choice and additional comparisons to observed data
- Improving major crossings
- Improving the first between modeled volumes and counts
  - Checking questionable counts
  - Network corrections/cleaning
- Minimal impact on the conformity results

Questions?

CAMBRIDGE SYSTEMATICS

NYMTC