Status report on the COG/TPB travel demand modeling consultant-assistance work program

presented to

Travel Forecasting Subcommittee

presented by

Cambridge Systematics, Inc.

John (Jay) Evans, P.E., AICP

acknowledgements

Tom Rossi, Nikhil Puri, Feng Liu

May 22, 2015

includes corrections

CAMBRIDGE SYSTEMATICS

Overview

- Work Program Update and Status
- Peer MPO Survey Background and Results
- Review of Modeling Best Practices

2

CAMBRIDGE SYSTEMATICS

Work Program Update and Status

Work Program Update and Status

- Task 15.1 – Attend Relevant Meetings and Respond to Ad-Hoc Requests
  - » Review of Prior Consultant Recommendations
- Task 15.3 - Review of Transit Modeling with Respect to FTA Guidance
- Task 15.4 - Modeling with Public Transport
- Task 15.2 – Development of a Strategic Plan for the Improvement of the MWCOG/NCRTPB Regional Travel Demand Modeling Procedures

4

Work Program Update and Status

- Task 15.2 – Development of a strategic plan for the improvement of the MWCOG/NCRTPB regional travel demand modeling procedures
  - » Three task reports
    - #1 Identifying Potential Opportunities for Improvement
    - #2 Status Report on the Use of ABM and DTA at MPOs
    - #3 Strategic Plan for Improvement of the Model

5

CAMBRIDGE SYSTEMATICS

Work Program Update and Status

- Task 15.2 – Development of a strategic plan for the improvement of the MWCOG/NCRTPB regional travel demand modeling procedures
  - » Efforts leading up to the reports
    - Two Surveys – Stakeholder and Peer MPOs
    - Stakeholder Meeting (February 27)
    - Meeting with Senior TPB staff (April 16)
    - Review of modeling best practices
    - Review of prior model assessments

6

CAMBRIDGE SYSTEMATICS

Peer MPO Survey

CAMBRIDGE SYSTEMATICS

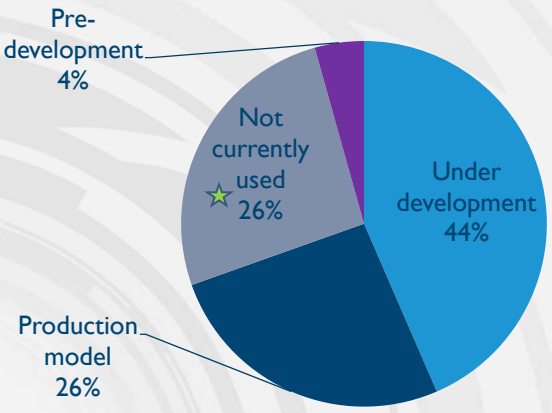
MPO Survey Overview

- 23 MPOs surveyed
  - » Top 20 by population, plus three others
  - » 100 percent response rate
- About the survey
  - » Consisted of 20 questions
    - MPO characteristics
    - General travel demand modeling characteristics; and
    - Specific characteristics regarding activity-based and DTA modeling
  - » Questions were a mix of multiple-choice and open-ended responses

CAMBRIDGE SYSTEMATICS

MPO Survey Responses

Status of Activity Based Model Development



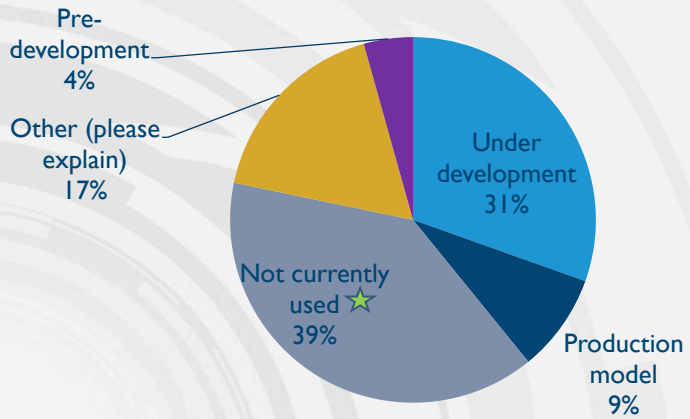
★ Category containing COG

9

CAMBRIDGE SYSTEMATICS

MPO Survey Responses *(continued)*

Status of Dynamic Traffic Assignment



★ Category containing COG

10

CAMBRIDGE SYSTEMATICS

MPO Survey Responses *(continued)*

ABM X Four-Step Model Status		Four-Step Model Status				
		Production model	Not currently used	Not currently used, but was used formerly	Other (please explain)	Grand Total
ABM Status	Production model	1	3	1	1	6
	Under development	10				10
	Pre-development	1				1
	Not currently used	6 ☆				6
	Grand Total	18	3	1	1	23

- 18 MPOs have production four-step models
- 6 MPOs have production ABMs (New York, San Francisco, San Diego, Sacramento, Columbus, and Denver)
- 10 MPOs are developing ABMs
- 1 MPO has an ABM in pre-development (Boston)
- 6 MPOs do not currently use an ABM

☆ Category containing COG

11

MPO Survey Responses *(continued)*

DTA X Four-Step Model Status		Four-Step Model Status				
		Production Model	Not Currently Used	Not Currently Used, but was Used Formerly	Other (please explain)	**Grand Total**
DTA Status	Production Model	2				**2**
	Under Development	6	1			**7**
	Pre-Development	1				**1**
	Not Currently Used	7 ☆	2			**9**
	6 Other (please explain)	2		1	1	**4**
	Grand Total	**18**	**3**	**1**	**1**	**23**

Of the 18 MPOs with production four-step models:

- 2 have production DTA models (Portland and Phoenix)
- 6 have DTA models under development (Chicago, Twin Cities, Baltimore, Atlanta, Detroit, and San Diego)

☆ Category containing COG

12

MPO Survey Responses *(continued)*

ABM X DTA Status		DTA Status					
		Production model	Under development	Pre-development	Not currently used	6 Other (please explain)	Grand Total
ABM Status	Production model		2		2	2	6
	Under development	2	4	1	2	1	10
	Pre-development					1	1
	Not currently used		1		5 ☆		6
	Grand Total	2	7	1	9	4	23

Of the 10 MPOs that have ABMs under development:

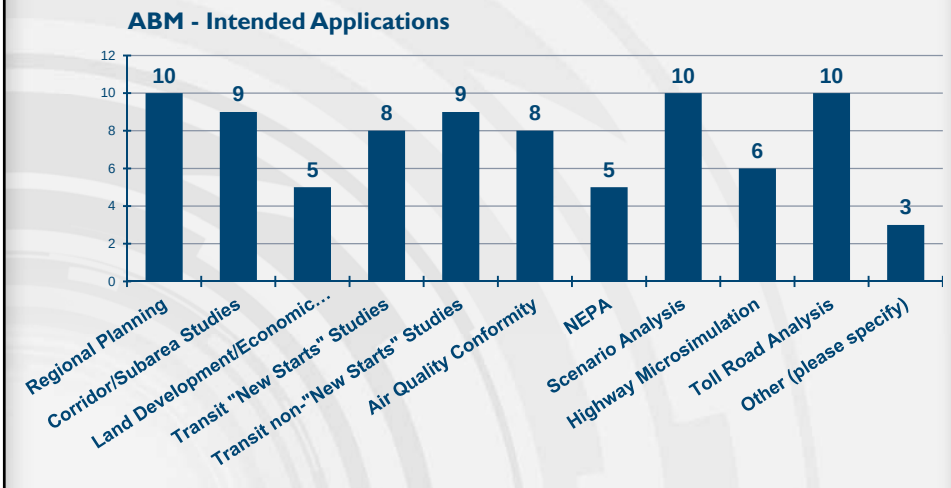
- 2 have DTA production models (Portland and Phoenix)
- 4 have DTA models under development (Chicago, Twin Cities, Baltimore, Atlanta)
- 1 has a DTA model in the pre-development phase (Southern California Association of Governments)

13

☆ Category containing COG

CAMBRIDGE SYSTEMATICS

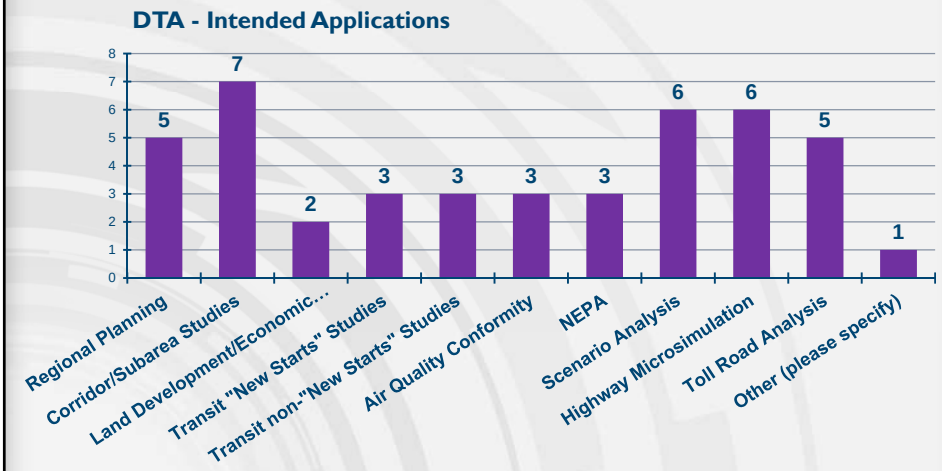
MPO Survey Responses *(continued)*



14

CAMBRIDGE SYSTEMATICS

MPO Survey Responses *(continued)*



15

CAMBRIDGE SYSTEMATICS

Review of Modeling Best Practices

16

CAMBRIDGE SYSTEMATICS

Several Topics Explored

- Activity Based Models (ABM)
  - » Advantages, disadvantages, common characteristics, and different approaches
- Relevant Baltimore Metropolitan Council (BMC) ABM features
- Dynamic Traffic Assignment (DTA)
- Integration of ABM and DTA models
- Transit and mode choice modeling
- Non-motorized travel
- Road pricing

17

CAMBRIDGE SYSTEMATICS

Activity-Based Models
Analytical Advantages

- *More*-accurate representation of travel behavior. Therefore, expected to produce *more*-accurate results for policy/project testing
- Consider trip chaining
- Disaggregate application – reduces aggregation error
- Can be easier for decision makers and public to understand as compared to four-step modeling concepts
- Ability to perform certain types of analyses more readily
  - » Environmental justice
  - » Road pricing
  - » Peak spreading

18

CAMBRIDGE SYSTEMATICS

Activity-Based Models
Potential Disadvantages

- More complex – more components, and some have more complex formulations than conventional models
- Can be more expensive to develop
- Run times can be longer
- Need to managing simulation error in activity-based models
- Hardware requirements could be greater than for simpler models
- Some custom software will be required for activity-based models (but there are common platforms)

19

CAMBRIDGE SYSTEMATICS

Activity-Based Models
Common Characteristics

- Disaggregately applied: each person's activities and travel simulated individually
- Individuals' characteristics are defined by a population synthesizer
- Population control variables – persons, workers, income
- All include an auto ownership model
- Many components common to all modern models
- Most models analyze time of day in hours or half hours
- All models use aggregate equilibrium assignment (for now)

20

CAMBRIDGE SYSTEMATICS

Relevant BMC ABM Features

- Estimated from 2007-2008 Household Travel Survey
- Uses TourCast and Citilabs Cube software platforms
- BMC model includes D.C. and all of Maryland within MWCOG region
- Project remains on track for completion in 2016

21

CAMBRIDGE SYSTEMATICS

Dynamic Traffic Assignment

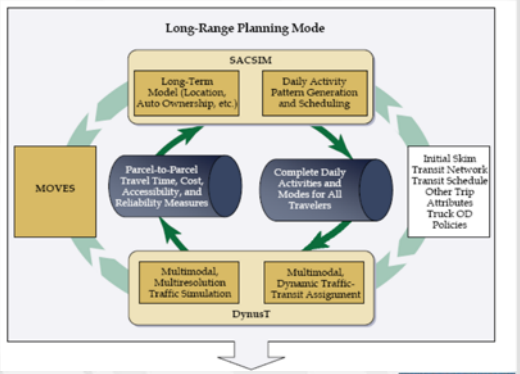
- Different fidelity (micro, meso, macro); different results
- More realistic and sensitive than static models
- More input data
  - » Links, lanes, pocket lanes, and traffic signals and signs
  - » Time-varying origin-destination tables or disaggregate trips/tours
  - » Counts, travel times, queue lengths
- Model development
  - » Calibrate speeds, capacities, or other parameters
  - » Always check for both convergence and stability
  - » More congestion; more instability

22

CAMBRIDGE SYSTEMATICS

ABM-DTA Integration (C10B Sacramento)

- ABM and DTA model travel behavior at the disaggregate level
- C10 projects created the first integrated ABM and DTA models in our industry outside academia
- C10B Sacramento
  - » ABM: SACSIM
  - » DTA: DynusT
  - » Transit: FAST-TrIPS



23

CAMBRIDGE SYSTEMATICS

ABM-DTA Integration (C10B Sacramento)

- Policies tested:
  - » Extended transit service
  - » Interchange design
  - » Relieve freeway bottleneck
  - » Increase transit frequency
  - » Delete bus line
- Challenges:
  - » DTA was 80% of the model run time
  - » DTA performance affected overall convergence

24

CAMBRIDGE SYSTEMATICS

Recent Advances in Mode Choice Modeling

- Reducing the number of modal alternatives and the complexity of nesting
  - » Sufficient data to validate such models does not exist
  - » Alternatives defined by mode or technology labels (e.g., 'light rail' or 'express bus') do not accurately reflect choices
- Validation of transit path building using 'prediction-success' tables based on transit rider surveys

25

CAMBRIDGE SYSTEMATICS

Transit Route Choice Decisions

- Decisions not made in the same way as auto route choice decisions
- Minimizing impedance for transit path choice is more complex:
  - » Out of vehicle time and out of pocket costs (fares, and sometimes parking) are more important relative to in-vehicle time
  - » Transfers have a perceived disbenefit
  - » Riders value the various components of travel impedance differently, resulting in different path choices
- Static transit assignment processes consider bus/train routes, not individual runs

26

CAMBRIDGE SYSTEMATICS

Non-Motorized Travel

- Now explicitly modeled in nearly all large urban areas (though not always through the entire model)
- Included in mode choice models through a separate non-motorized nest
- Many areas now considering walk and bicycle travel separately
  - » Some areas starting to consider assignment of bike trips though this is new ground
- Automated passive bicycle and walk data collection methods starting to become popular

27

CAMBRIDGE SYSTEMATICS

Modeling Road Pricing

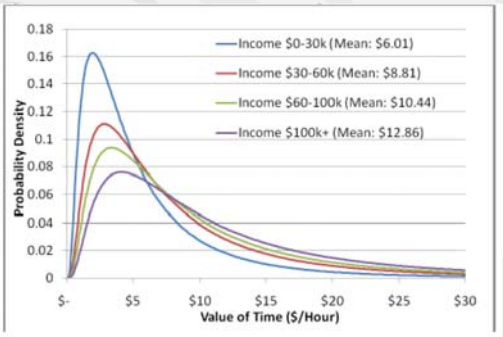
- Some models include toll versus free in mode choice
- If this is not dealt with in mode choice, toll road choice handled in assignment
  - » Trip tables in highway assignment may be segmented even if there are not "toll" and "free" trip tables
  - » All auto users see the same times and costs within a segment

28

CAMBRIDGE SYSTEMATICS

Additional Features Available in ABMs Related to Road Pricing

- Transponder ownership
- Simulated values of time
  - » Based on a probability distribution
  - » Segmented by tour purpose and income level



29

CAMBRIDGE SYSTEMATICS

Enhanced Road Pricing Treatment
Longer-term enhancements

- For ABMs
  - » Estimate (or assert) VOT distributions
  - » Define a set of VOT ranges
  - » Simulate specific values of time for each person
  - » Obtain skims for each VOT level
  - » When applying the mode choice model for each person, use the skims pertaining to that person's VOT
- For ABMs with static assignment
  - » Segment highway assignment by VOT level
- For ABMs with DTA
  - » Use VOT for each traveler when simulating traffic

30

CAMBRIDGE SYSTEMATICS

Next Steps

Next Steps

- Completing deliveries on all tasks before the end of June
- Task 15.2: Complete drafts of Supporting Reports
  - » #1 Identifying Potential Opportunities for Improvement
  - » #2 Status Report on the Use of ABM and DTA at MPOs
- Task 15.2 will end with a draft strategic plan to permit additional time to obtain stakeholder review and comments

32