TPB REGIONAL TRAVEL DEMAND FORECASTING MODEL

Improvement Efforts

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Overview

- Current TPB production-use travel demand forecasting model (Mark)

- Strategic plan for models development (Mark)

- Spectrum of model designs (Mark)

- Developmental models

  - Currently testing (Ron)

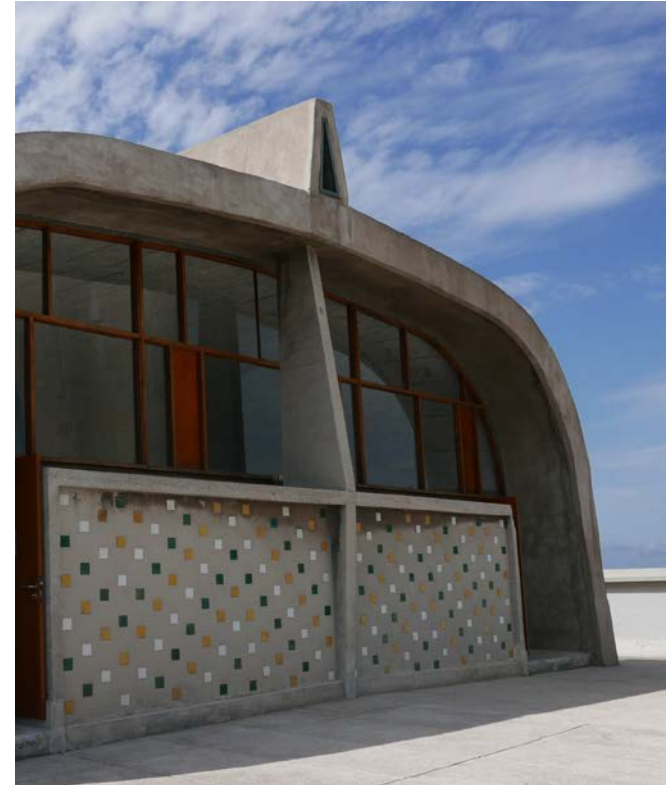 - Future/planned (Mark)

- Concluding remarks (Ron)

Image credit: Mark Moran

Current and planned travel models

- TPB staff always maintains two or more model sets

  - One adopted, production-use model

  - One or more developmental models

Model Role	Name	Ver.	Unit of Analysis	Development Period (FY)	Production Use (FY)	Strategic Plan
Production	TPB TDFM, Gen2	2.3	Trip	2008-2011	2011-2019	N/A
Developmental	TPB TDFM, Gen2	2.5	Trip	2016-2018	2019-2021	Phase 1
Developmental	TPB TDFM, Gen3	3.0	TBD	2019-2021	2022-2023	Phase 2
Developmental	TPB TDFM, Gen4	4.0	TBD	2022-2023	2024-2026	Phase 3

Current TPB travel demand model

- Name: Generation 2 (Gen2), Version 2.3.70

- Type: Aggregate, trip-based, "four-step" travel demand model

- State-of-the-practice model

- Use of the model
  - Updating and assessing the adequacy of the LRTP
  - Air quality conformity determinations of the LRTP & TIP
  - Project planning studies
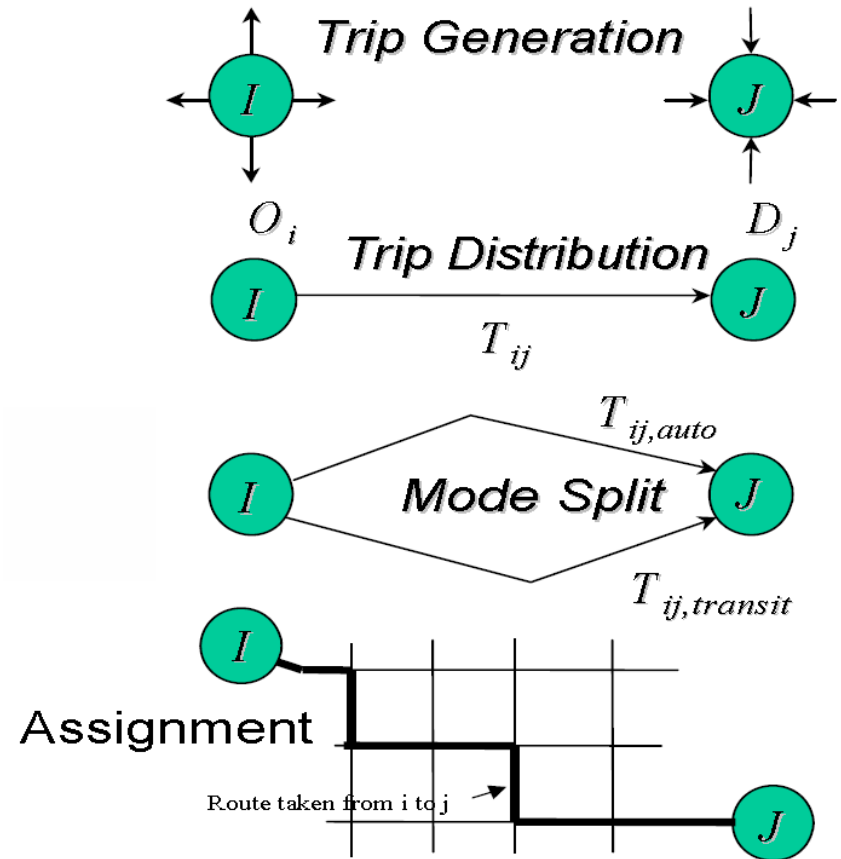 - Special regional studies

Image credit: Meyer, Michael D., and Eric J. Miller. Urban Transportation Planning: A Decision-Oriented Approach. McGraw-Hill Higher Education, 2001. p. 272.

Current TPB travel demand model

- Modeled area: 7 million people; 4 million jobs; 6,800 square miles

- Calibrated: year-2007 conditions

- Validated: year-2010 conditions

- Travel model user's guide is developed for each version of the model (current: 2.3.70)

- All documentation is on the web: www.mwcog.org/transportation/data-and-tools/modeling/model-documentation/
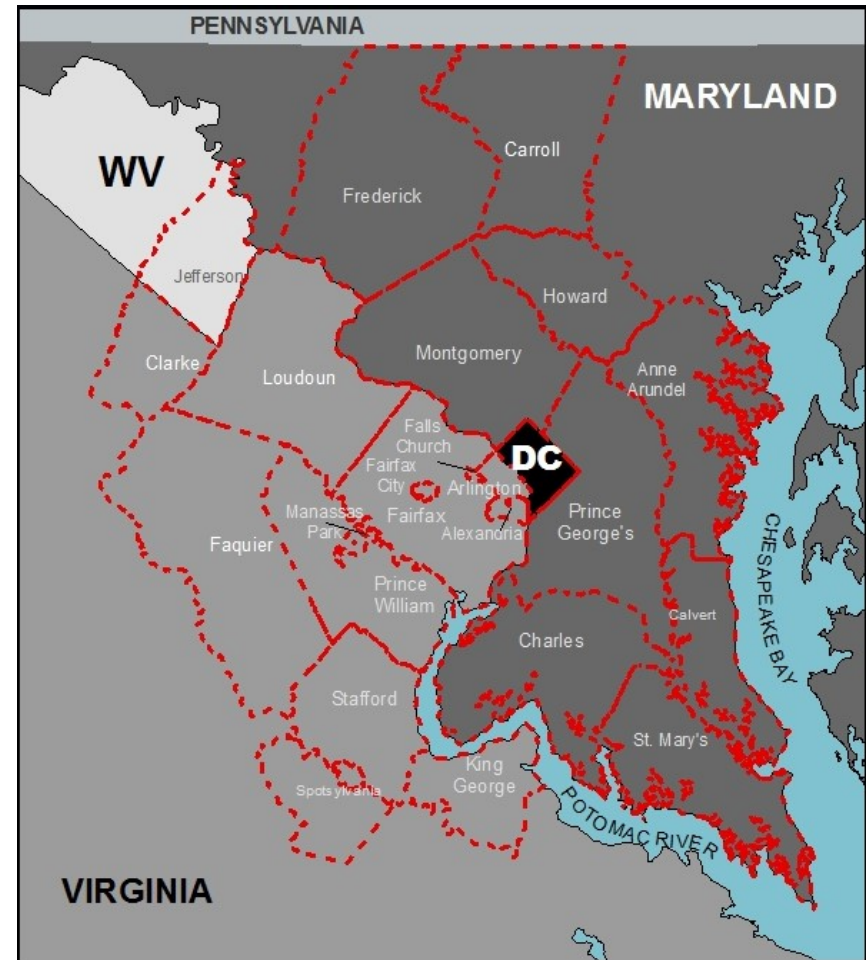

Image credit: Jessica Mirr

Current TPB travel demand model

- Strengths

  - Sophisticated, yet well-tested trip-based model

  - Well documented and easy to troubleshoot

  - Model run time (relatively quick compared to an activity-based model)

- Weaknesses

  - Model run time (longer than many would like: 15-17 hours per alt.)

  - Modeling of non-motorized travel (walk & bike)

  - Highway assignment: 1) Static traffic assignment; 2) Algorithm takes many iterations to reach convergence

  - Transit: 1) Not capacity constrained; 2) Distinguishing between transit sub-modes; 3) Does not include external transit trips

  - Not addressed: Transp. Network Companies (TNCs), Autonomous Vehicles

Strategic plan for model development

- Developed between 2014 and 2015; Three reports on our website

- Inputs

  - Review of TPB policy reports: TPB Vision document, Regional Transportation Priorities Plan (RTPP), and Regional Activity Centers

  - Survey of Washington-D.C.-area modeling stakeholders

  - Survey of peer MPOs regarding modeling practices

- Key findings

  - 70% of our peer group were using or developing an ABM

  - Regional DTA is not being pursued to the same extent as ABMs

    - Two (9%) using regional DTA in production

    - Seven (30%) developing regional DTA capabilities

Strategic plan for model development

- Strategic plan (as amended in 2018): 3 phases over 8 years

Phase	Description	Duration (Years)	Fiscal Years
1	Updates to the existing trip-based, four-step model (Gen2: Ver. 2.3 => Ver. 2.5)	3	2016-2018
2	Development of new model (Gen3) with existing data	3	2019-2021
3	Development of new model (Gen4) with new data*	2	2022-2023

* New household travel survey currently underway; To be ready for use in FY 2020. Other data sets could also be available, including transit on-board surveys and big data

Source: Cambridge Systematics, Inc. Strategic Plan for Model Development, Task Order 15.2, Report 3 of 3. Final Report. Washington, D.C.: Metropolitan Washington Council of Governments, National Capital Region Transportation Planning Board, October 15, 2015.
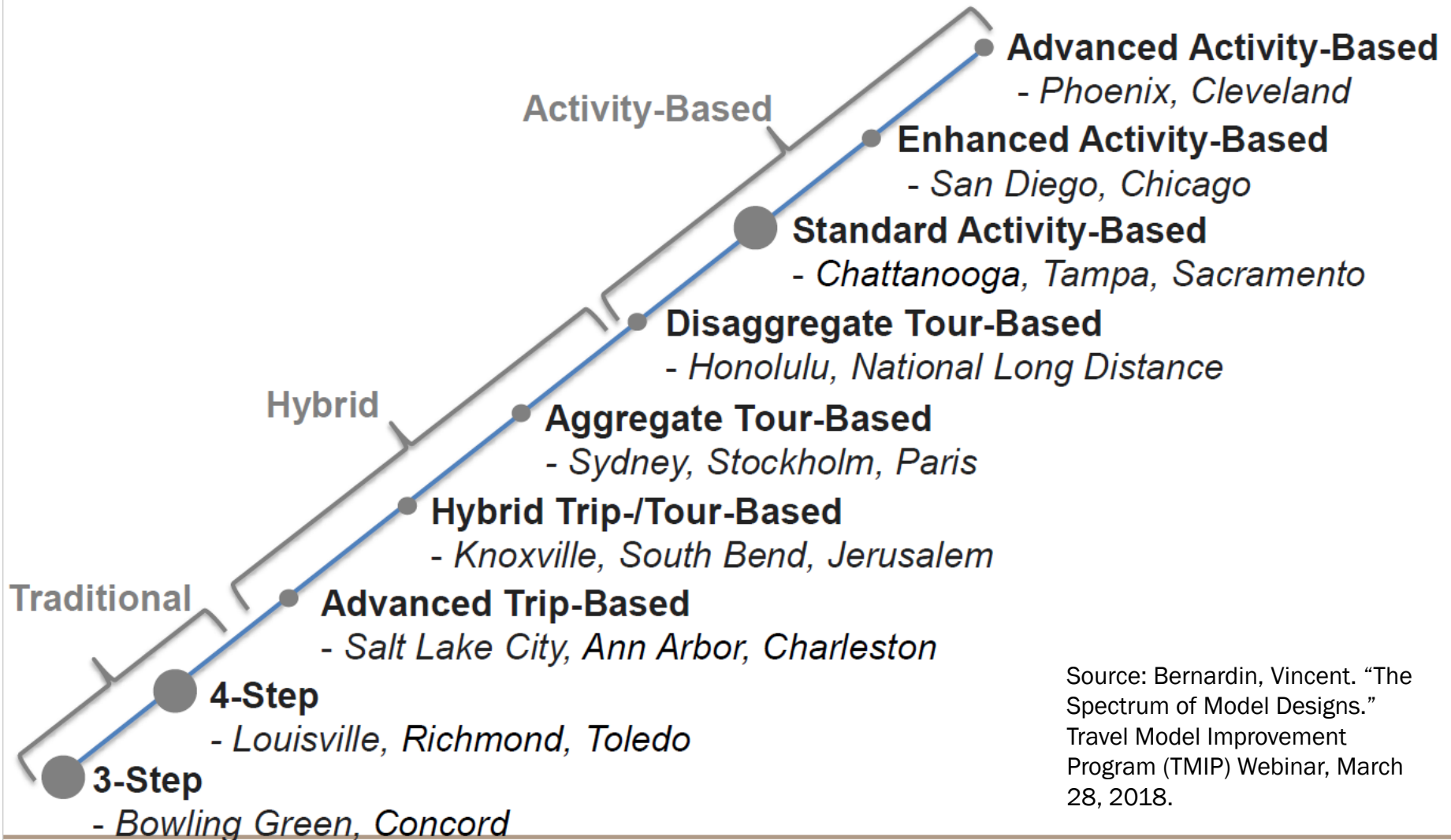
Spectrum of model designs
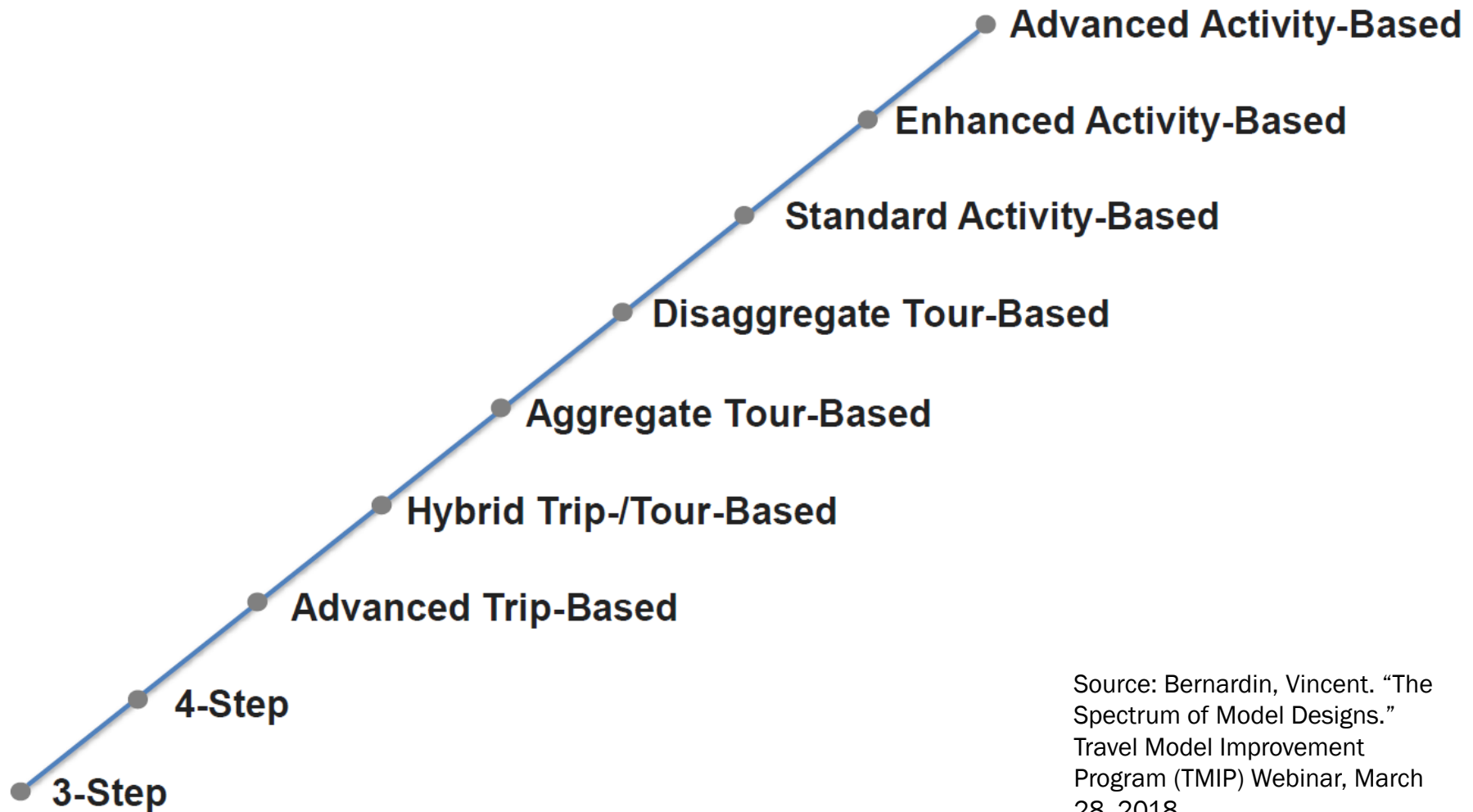
Source: Bernardin, Vincent. "The Spectrum of Model Designs." Travel Model Improvement Program (TMIP) Webinar, March 28, 2018.

Spectrum of model designs

Advanced Activity-Based
- Phoenix, Cleveland

Enhanced Activity-Based
- San Diego, Chicago

Standard Activity-Based
- Chattanooga, Tampa, Sacramento

Activity-Based

Disaggregate Tour-Based
- Honolulu, National Long Distance

Aggregate Tour-Based
- Sydney, Stockholm, Paris

Hybrid

Hybrid Trip-/Tour-Based
- Knoxville, South Bend, Jerusalem

Advanced Trip-Based
- Salt Lake City, Ann Arbor, Charleston

Traditional

4-Step
- Louisville, Richmond, Toledo

3-Step
- Bowling Green, Concord

Source: Bernardin, Vincent. "The Spectrum of Model Designs." Travel Model Improvement Program (TMIP) Webinar, March 28, 2018.

Comparison of two modeling approaches

Trip-Based Model (current TPB model)	Activity-Based Model (ABM)
Trips are generated from zonal aggregations of households	Trips are generated based on the simulation of individual households and persons
Each trip is independent of every other trip	Trips are chained into tours, which allows continuity of information
Timing/direction of trips is not an explicit choice (fixed factors)	Starting and ending time of activities are modeled choices
Geographic scale: TAZ	Geographic scale: Parcel, MAZ, or TAZ

Source: Outwater, Maren, and Joel Freedman. "Activity-Based Modeling, Session 1: Executive Perspective." Travel Model Improvement Program (TMIP) Webinar Series, February 2, 2012.

Gen2/Ver. 2.5 model: Background

- Reflects **incremental refinements** to the **existing** Ver 2.3 model that are:

  - Of immediate interest to TPB questions, stakeholder interests

  - Viable and practicable within the Ver. 2.3 framework

- Ver 2.5 developed/implemented by Cambridge Systematics, Inc. during FY 2017

- 2014 validation year

- Under evaluation by TPB staff during FY 2018

Gen2/Ver. 2.5 model: Features/Refinements

- **Non-motorized modeling:** Model includes more robust explanatory variables that will better respond to the connection between land development and non-motorized trip making (land activity density, land activity mix, & urban form variables)

- **Transit modeling:** Model employs an updated transit path-building program (PT), a simplified model choice model structure and a more detailed transit assignment process. These interconnected refinements should improve the model's ability to address transit ridership by sub-mode.

- **Managed-Lane Modeling:** Model includes highway markets (trip tables) that are distinguished by Value-of-Time (VOT) segmentation. Assignment of vehicles to priced facilities will more explicitly account for driver differences in the willingness to pay for time savings. These refinements should improve demand on priced highway facilities.

Gen2/Ver. 2.5 model: Drawbacks of refinements

- **Increased computing time:** Increased market segmentation incurs longer turn-around times. Staff has noted an 80% increase in the time required to execute the V2.5 model, relative to the V2.3 model running time. Staff is investigating options to address excessive running times.

- **Greater complexity:** The time to analyze and evaluate Ver 2.5 results is longer than that of the Ver 2.3 model. Staff is writing utilities to facilitate assessment of modeling results. Complexity poses challenges regarding the acceptance of the model by external stakeholders.

- **Set-up time requirements are more elaborate:** The zonal file and network inputs need to be redesigned and maintained.

Gen2/Ver. 2.5 model: Evaluation

What is the checklist for adoption?

- Are the refinements acceptable to TPB staff and the TFS?

- Is the model performance comparable/better than that of existing model?

- Do sensitivity tests demonstrate logical, rational and reasonable outcomes?

- Are the differences in travel forecasting metrics, relative to existing forecasts, explainable and acceptable?

- Do costs (e.g., longer running times, complexity) justify the benefits?

Gen3 model

- Approach for soliciting consultant assistance

    - First: Request for Information (RFI)

    - Followed by: Request for Proposals (RFP)

- We do not know of others who have taken this approach

- More common: Simply conduct an RFP

- Advantage: RFI allows staff to learn about the latest techniques that are being used and that should be part of the RFP

Gen3 model

- RFI
  - Includes product requirement document (PRD)
  - Goal: To solicit input from interested vendors/consultants about their proposed solution to our Gen3 modeling needs, as described in the PRD.

- RFP
  - Includes the scope of work (SOW) and may reference a revised PRD
  - Contents of the SOW (and revised PRD) guided by information obtained in the RFI process
  - Goal: To select a consultant to develop Gen3 travel model
  - Will follow COG's normal contracting procedures

Gen3 model: Current status

- Oversight of the Travel Forecasting Subcommittee (TFS)

  - Draft copy of PRD was offered to public-sector members

    - Reviewers were not allowed to share draft PRD with others

  - Seven agencies requested a copy; Five sent feedback on draft PRD

  - PRD was updated to reflect TFS review

- RFI advertisement period: 1.5 months, closing July 12

- Next steps

  - TPB staff to review vendor responses to RFI: July

  - RFP advertisement: Sept. to Oct. 2018 (1 month)

  - Vendor selection: Oct. to Nov. 2018

  - Start of contract: Late Nov. 2018

Concluding remarks

- TPB staff is steadily moving ahead with a deliberative and collaborative strategic development plan

- Staff maintains a keen interest in the travel modeling development efforts conducted at peer MPOs

- Our ultimate objective as travel forecasters is to provide answers to TPB member questions

- Travel forecasting obstacles are growing each year as new technologies emerge

- Model development activities must be complimented by an active and on-going data collection program

- TPB's travel forecasting methods must be responsive to stakeholder needs

Acknowledgements

- Travel Forecasting Subcommittee, especially

  - Catherine Vanderwaart, Washington Metropolitan Area Transit Authority

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  - David Kline, Fairfax Co. Dept. of Transportation

  - Harun Rashid, Northern Virginia Transportation Authority

  - Yuanjun Li, Montgomery Co. Planning Dept., Maryland-National Capital Park and Planning Commission
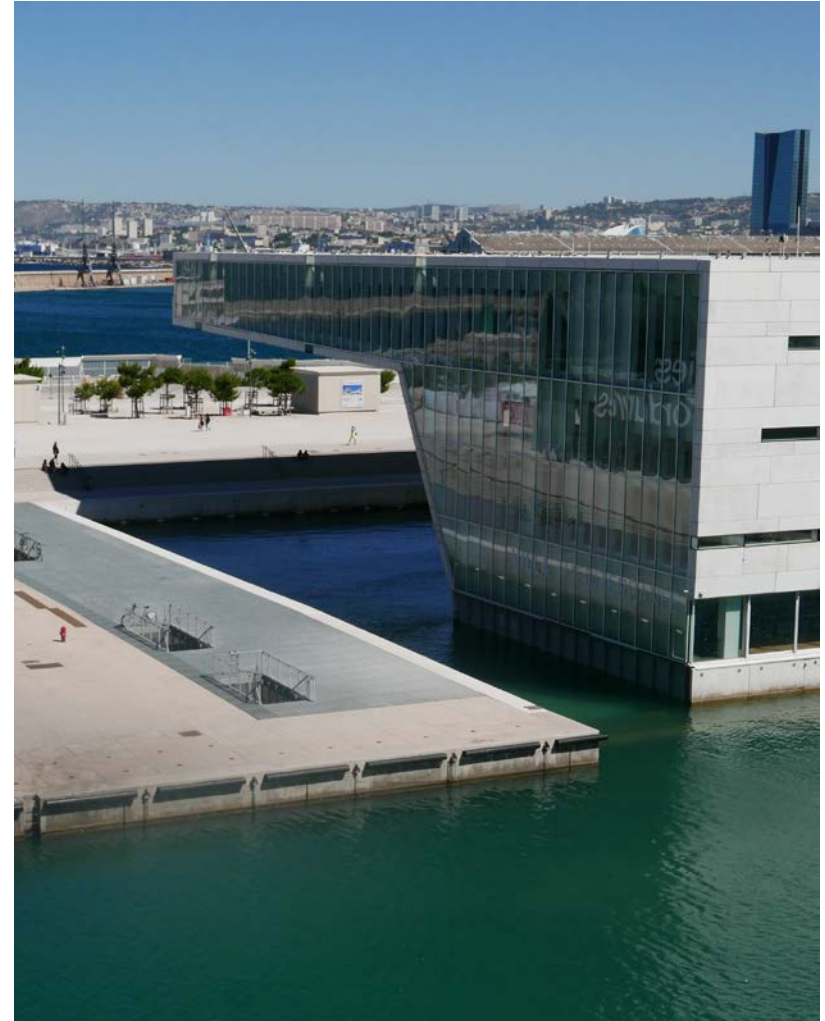
- TPB staff, especially Ray Ngo and Meseret Seifu

Image credit: Mark Moran

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