Item #9

Ex-Post Evaluation of COG/TPB Transit Forecasts

Presentation to the TPB Technical Committee
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Background

- The TPB was briefed on the COG Cooperative Forecasting process on March 20, 2013
  - Presentation included a jurisdictional comparison of 2010 land activity forecasts (released in 1994) and actual 2010 land activity

- WMATA subsequently followed up with TPB staff and asked if such a comparison could be developed for transit trips

Research question:

How well have past transit ridership forecasts compared with actual ridership?

Why do practitioners avoid this question?

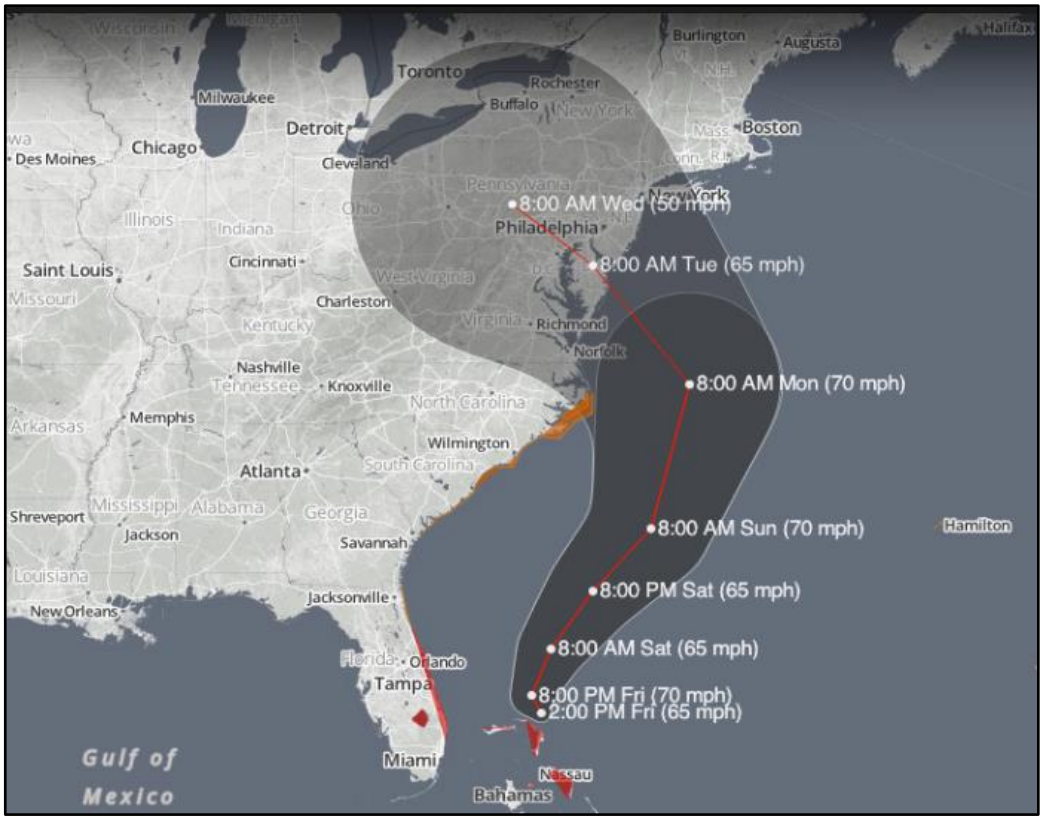
1. The planning process is subject to inherent uncertainty
   - Model inputs and assumptions are subject to error
   - The model is a fixed system; it does not account for influences at work in real time

2. Uncertainty in the process is difficult to understand
   - The process is subject to propagating errors
   - Some errors may be off-setting

3. Obtaining historical forecasts is difficult
   - Detailed model outputs are difficult to retrieve or may not exist
   - Archiving travel modeling forecasts is not a requirement

The hurricane map is a useful analogy

- Approximate path can be forecasted based on known conditions and observed behavior of past storms
- Variables affecting storm are changing in real time
- Uncertainty of the forecasted path increases over the forecasting period



Tracking map for Hurricane Sandy

TPB staff's response:

- 2010 transit ridership forecast from 1994 was compared to a reasonable *approximation* of actual transit ridership
- Known and unknown factors affecting the 1994 transit ridership forecasts were identified
- Improvements to the TPB's modeling practices since 1994 were summarized

What did the transit forecasts look like 19 years ago?

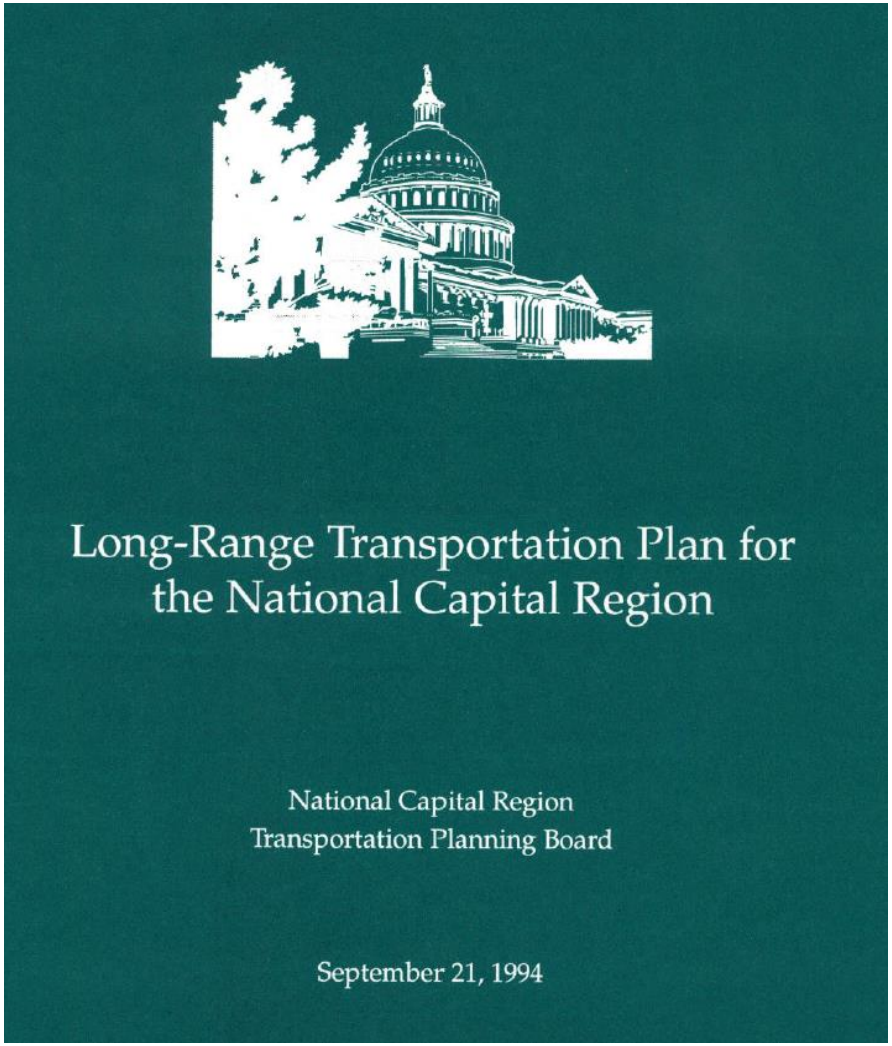
- Transit trips were prepared for the **work purpose** only
- Transit trips were **not distinguished** among sub-modes
- Transit trips did **not include** external trips
- The model did not include a transit assignment process, and therefore, did **not** include the ability to compute **transit boardings** (or unlinked trips)

Modeled transit trips, in 1994, were defined as:

linked /internal /HBW trips only

Source of the 2010 transit forecasts: Long Range Plan Report published in 1994

- Plan was adopted in 1991 and amended in 1993
- Round 5.1 Cooperative Forecasts were used
- Travel model documented in the "Volume A: Current Applications" report (6/30/94)



Inputs to the travel model: Comparison of forecasted/actual HHs

	Round 5.1 1990	Round 5.1 2010	2010	Ratio	Diff.
Jurisdiction:	Base Year	Forecast Year	Actual	Fcst./Act.	Fcst. - Act.
District of Columbia	249,600	252,100	266,700	0.95	-14,600
Arlington Co., VA	78,500	96,300	98,100	0.98	-1,800
City of Alexandria, VA	53,300	64,400	68,100	0.95	-3,700
Montgomery Co., MD	282,000	368,500	361,000	1.02	7,500
Prince George's Co., MD	258,000	326,400	304,000	1.07	22,400
Fairfax Co. & Cities, VA	303,900	398,700	399,500	1.00	-800
Loudoun Co., VA	30,700	65,300	104,600	0.62	-39,300
Prince William Co. & Cities VA	81,400	131,600	147,800	0.89	-16,200
Frederick Co., MD	52,600	92,500	84,800	1.09	7,700
Charles Co., MD	33,000	55,900	51,000	1.10	4,900
Total	1,423,000	1,851,700	1,885,600	0.98	-33,900

Inputs to the travel model: Comparison of forecasted/actual jobs

	Round 5.1 1990	Round 5.1 2010	2010	Ratio	Diff.
Jurisdiction:	Base Year	Forecast	Actual	Fcst./Act.	Fcst. - Act.
District of Columbia	747,300	885,900	783,500	1.13	102,400
Arlington Co., VA	183,100	264,600	223,300	1.18	41,300
City of Alexandria, VA	92,200	125,000	106,000	1.18	19,000
Montgomery Co., MD	465,500	625,000	510,100	1.23	114,900
Prince George's Co., MD	310,400	426,600	342,600	1.25	84,000
Fairfax Co. & Cities, VA	443,900	653,300	680,000	0.96	-26,700
Loudoun Co., VA	39,300	85,800	143,700	0.60	-57,900
Prince William Co. & Cities VA	84,500	151,400	143,600	1.05	7,800
Frederick Co., MD	54,000	106,000	98,700	1.07	7,300
Charles Co., MD	38,700	52,500	62,200	0.84	-9,700
Total	2,458,900	3,376,100	3,093,700	1.09	282,400

Assessment of Rnd. 5.1 forecasted land activity

- Households forecasts were more accurate than job forecasts (0.98 vs. 1.09 e/o ratios)
- Households in the "core" jurisdictions were underestimated slightly (~5%)
  - An under-estimation of transit trips would be expected
- Montgomery and Prince George's County jobs were over-estimated (>20%)
  - This would tend to bias the O-D pattern of transit trips estimated by the model

Derivation of 2010 observed, linked HBW transit trips
(shaded cells indicate derived figures)

	1994	2007	2010	
Total Avg. Daily Metrorail-Related Trips[1]	517,300	726,100	750,600	
Non-Resident Metrorail-Related Trips[2]	25,300	33,700	34,800	← 4.64% of 750,600
Resident Metrorail-Related Trips[2]	492,000	692,400	715,800	← 750,600 – 34,800
Non-Resident Metrorail Percentage	4.89%	4.64%		
Resident HBW Metrorail Trips[2]	329,400	476,800	492,900	← 68.86% of 715,600
Resident HBW Metrorail Trip Percentage	66.95%	68.86%		
Regional HBW Total Transit Trips[3]	476,500	755,700	781,200	← 492,900 / 63.09%
HBW Metrorail Trip Percentage of Total Regional HBW Transit Trips	69.13%	63.09%		

1) Source: WMATA - Avg. weekday Metrorail ridership computed by EDADS Editing System (revised 6/2011)

2) Source: 1994 and 2007 WMATA Metrorail On-Board Surveys; 2010 figure based on 2007 percentages

3) Source: MWCOG inventories of regional transit (bus, commuter rail, Metrorail) trips; 2010 figure based on 2007 percentage

1994: FY-97 Models Development Program for COG/TPB Travel Models, COG/TPB Staff June 1997 (page 3-58)

2007: Calibration Report for the TPB Travel Forecasting Model, Version 2.3, on the 3,722-Zone Area System, COG/TPB Staff, January 2012 (page 9-9)

Model Output:
Global estimate/observed results for transit

Forecasted 2010 HBW Transit Trips:	802,000
Actual/Derived 2010 HBW Transit Trips:	781,200
Difference:	20,800
Pct. Difference:	2.7%

Factors that were not accounted for in the model:

- Features of the transit system:
  - the New York Avenue Metrorail station
  - the DC Circulator
- The employer-based transit subsidy program (SmartBenefits®)
- The economic recession
- Joint development around Metrorail stations
- Growth in non-motorized travel, in the “inner” jurisdictions particularly

The TPB travel model has steadily evolved since 1994

Model Component/Step	Volume "A" Model (1994)	Version 2.3.52 Model (2013)
Extent of the Study area	12 jurisdictions	22 jurisdictions
Zonal matrix size	1,478	3,722
Trip Purposes	4 resident purposes	5 resident purposes
	2 truck purposes	2 truck purposes
	no commercial purpose	1 commercial purpose
Trip Generation	HBW motorized person rates	HBW motorized person rates
	Non-HBW auto driver rates	Non-HBW motorized person rates
	applied at (293) district level	applied at zone level
Trip Distribution	non-stratified trip-tables	HB purposes are income stratified
	applied at district level	applied at zone level
Mode Choice	HBW purpose model only	All Purposes modeled
	1 transit choice set	11 transit choice set
Traffic Assignment	1 daily trip table loaded	6 trip tables loaded by 4 time periods
	4 -iteration capacity restraint	User Equilibrium / 10^-4 rel. gap critereon
Speed Feedback	trip distribution affected	trip distribution and mode choice affected
	HBW purpose affected	All trip purposes affected

Conclusions

- TPB staff has evaluated 2010 transit forecasts developed almost 20 years ago against actual 2010 ridership
- Despite land activity (input) errors, incomplete system assumptions, and unaccounted factors, the estimated trips were within 3% of the actual figure
- The TPB travel model has evolved, and will continue, to evolve, in ways that benefit transit forecasts
- Best way to minimize uncertainty: Improve inputs
  - A great deal of TPB staff resources are dedicated to updating modeling inputs each year