Shining a Light Inside the Black Box

Part 1 of 4

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Speakers

- Fred Ducca, FHWA
- Bill Woodford, AECOM Consult
- Bill Davidson, PB Americas

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“If the world were perfect, it wouldn’t be”

- Yogi Berra

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Motivations

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Motivations

- National Academy of Sciences recently completed a study to gather information needed to determine the national state of travel forecasting practice
- Three main elements
  - Description of state of practice
  - Evaluation of state of practice
  - Recommendation for improvement

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NAS Special Report 288
Description of state of the practice

- No single approach is correct for all applications or all MPOs
- Four-step process remains the basic approach, although there are considerable variations

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NAS Special Report 288
Evaluation of state of the practice

- Current models have inherent structural weaknesses
- But, shortcomings are also related to poor technical practice in the development and use of existing models
  - Inadequate data
  - Optimism bias
  - Insufficient emphasis & lack of effort in validation of models
  - Insufficient quality control of forecasts
- Deficiencies in current practice will not be resolved solely by switching to more advanced models

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NAS Special Report 288
Summary

- Policy makers must have ability to make informed investment and policy decisions about the transportation system
- Study concluded that “current models and modeling practice are not adequate for many tasks to which they are being applied”

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NAS Special Report 288
Recommendations for Improvement

- Implement new modeling approaches that are better suited to providing reliable information to decision makers
- Improve current and future practice since migrating to more advanced models will not solve deficiencies

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FHWA Observations on Current Practice

- NAS Special Report 288 is correct:
  - The fundamental methods need work
  - More importantly, the basic practice of travel forecasting needs work regardless of the methods used
- Therefore, this webinar series focuses on improving the basic practice of travel forecasting

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This Webinar Series

- Focuses on four areas to improve:
  - Data
  - Model testing
  - Transportation supply and travel distribution
  - Translating results into insights for decision-makers
- Speakers
  - Bill Woodford, AECOM Consult
  - Bill Davidson, PB Americas
  - Dave Schmitt (AECOM Consult) will be reviewing questions throughout each session and summarizing them for the speakers at the end of the session

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Series Schedule

- Four sessions of two hours each
  - "Motivations & Data": February 12th, 2008 at 2:30 PM EST
  - "Model Testing": March 11th, 2008 at 2:30 PM EST
  - "Transportation Supply & Travel Distribution": April 8th, 2008 at 2:30 PM EDT
  - "Translating Results Into Insights for Decision Makers": May 13th, 2008 at 2:30 PM EDT
- Please submit questions to chat pod to Dave Schmitt
- Questions will be answered at the end of each session

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Travel Forecasts and Decision Making

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Speaker

- Bill Woodford, AECOM Consult

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"It's tough to make predictions, especially about the future"

- Yogi Berra

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Forecasting Track Record

- To be useful in decision-making, the forecasts need to be reliable
- However, studies examining forecasting accuracy show that the results to date are bleak…

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Forecasting Track Record
Highlight #1

- Flyvbjerg's 2005 study of 210 large transportation infrastructure projects completed 1969-1998
- Findings
  - Half of all road traffic forecasts are wrong by more than 20%
  - Rail passenger forecasts are overestimated in 9 out of 10 cases, with an average overestimation of 100%
  - Both road and rail forecasts have not improved over time
- Concluded that the results "show that it is highly risky to rely on travel demand forecasts to plan and implement large transportation infrastructure investments"

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Forecasting Track Record
Highlight #2

- NCHRP Synthesis 364 (2006) analyzed predicted and actual toll road revenue for 26 US toll road projects completed 1986-2004
- Found that most projects overestimated revenue
  - Actual revenues for 20 of 26 projects were less than projected revenues by more than 20% in their first year
  - Three projects had actual revenue greater than project revenue
- Predictive techniques have not improved with time

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Forecasting Track Record
Highlight #3

- In 2002, FTA required detailed reporting of travel forecasts for proposed major transit projects and lower-cost alternatives
- Reviews found significant problems for most projects in either the models or the comparability of the alternatives
- Strong indication that cursory reporting of travel forecasts hides major errors that lurk in many models and in many coded networks

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Forecasting Track Record
Highlight #4

- Rodier's 2003 study of the 1991 Sacramento travel forecasting model
- Backcasting findings (using actual 2000 land use)
  - VMT overestimated by 5.7%
  - VHT overestimated by 4.2%
  - VHD overestimated by 17.1%
- Historical forecasting findings (using the projected 2000 land use as developed in 1991)
  - VMT overestimated by 11.8%
  - VHT overestimated by 12.8%
  - VHD overestimated by 38.4%

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What Went Wrong?

- Models themselves did not fully or correctly understand travel behavior
- Future setting reflected in the model did not correctly reflect the future
- Project characteristics did not occur as planned

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"We're lost but we're making good time"

- Yogi Berra

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What Can Modelers Do?

- Improve models and modeling practice where we can
- Inform decision makers about the insights gained from the forecasts
- Recognize and communicate the dimensions of uncertainty

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What Should Modelers Focus On?
Models

- What the model is saying about how people use the transportation system in the real world, namely:
  - Where people live and work and the relationship between them
  - Characteristics of the transportation system
  - Fraction of people taking modes for specific travel markets
  - How people go through the transportation system

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What Should Modelers Focus On?
Insights

1. Understand the real world transportation system and how people use it…and we need detailed data to do this
2. Develop and apply meaningful testing approaches
3. Understand where the models work and where they don't work
4. Propose and test solutions where problems are found

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What Should Modelers Focus On?
Uncertainties

- Understand key drivers of uncertainty
  - Underlying human behavior
  - Key socio-economic factors (e.g., population and employment)
  - Assumed project or policy characteristics
- Estimate range and likelihood of different scenarios
- Produce alternative forecasts
- Communicate range of possible outcomes

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Data: The Foundation of Effective Models

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Speaker

- Bill Davidson, PB Americas

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"You can observe a lot by watching"

- Yogi Berra

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Understanding the Real World…

- What needs to be in the model is driven by what we need to know about the real world
- Model information that needs to be "real":
  - Demand/travel patterns
  - Commercial vehicle/freight movement/external trips
  - Performance of the transportation system
  - Volumes on facilities/services

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Demand/Travel Patterns

- To be useful in supporting transportation planning and policy making, person trips must accurately represent trips stratified by:
  - Trip purpose
  - Socio-economic characteristics
  - Time of day
  - Mode
  - Sub-mode/occupancy/toll road use/etc.
  - Geography (district-to-district level & trip lengths)

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Demand/Travel Patterns
Example

Estimated Demand/Travel Patterns

	CBD	Urban	Suburbs	Tech Center	Rural	Total
CBD	1,000	1,000	-	-	-	**2,000**
Urban	40,000	1,000	-	1,000	-	**42,000**
Suburbs	7,000	1,000	10,000	35,000	2,000	**55,000**
Tech Center	1,000	3,000	3,000	1,000	-	**8,000**
Rural	1,000	19,000	7,000	3,000	-	**30,000**
Total	**50,000**	**25,000**	**20,000**	**40,000**	**2,000**	**137,000**

Observed Demand/Travel Patterns

	CBD	Urban	Suburbs	Tech Center	Rural	Total
CBD	1,000	-	-	1,000	-	**2,000**
Urban	7,000	10,000	21,000	3,000	1,000	**42,000**
Suburbs	35,000	1,000	5,000	12,000	2,000	**55,000**
Tech Center	2,000	-	1,000	4,000	1,000	**8,000**
Rural	5,000	-	-	20,000	5,000	**30,000**
Total	**50,000**	**11,000**	**27,000**	**40,000**	**9,000**	**137,000**

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Possible Data Sources: Travel Patterns

- CTPP 2000 and its successors are a must for work travel
- Choice-based surveys (e.g., transit, HOV, HOT, toll)
- Passive data collection (e.g., smart cards, cell phones, toll tags)
- Large sample household surveys

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Large Sample Travel Surveys
Experience

Survey	Date Range	Household Sample Size
FHWA Origin/Destination Surveys	1950s-1970s	5%
Chicago Household Survey	1956	3.3%
Transportation Tomorrow Survey (Toronto)	1980s-today	5%
Greater Montreal Area Surveys	1970s-today	5%

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Purposes of Demand-Side Data Collection

- Parameter estimation
  - Disaggregate models → efficient use of data → small sample sizes
  - Supplemented with choice-based samples
- Understanding markets
  - Larger sample sizes are needed to capture the key markets to be represented by the model

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Large Sample Travel Surveys

- What sample size is sufficient to gather detailed travel pattern information?
  - No definitive answer at this time, other than today's typical sample size is not sufficient for adequately reviewing person trip table
- Alternative data collection strategies may be required to collect larger samples
  - GPS receivers
  - Cell phone records

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Commercial Vehicle, Freight Movement and External Trips

- A good understanding of the following elements is needed to be useful
  - Key generators and attractors
  - Common paths/movements
  - Volumes by vehicle type
- High variability of freight activity among areas suggests that freight models should be designed initially with aggregated data and supplemented with locally-collected data

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Locally Collected Data: Possible Sources

- Automated weigh-in-motion studies
- Passive data collection (e.g., toll tags)
- Vehicle classification counts
- Facility-specific survey
- Cordon surveys

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Supply-Side Data

- Input data must be correct and quality-checked
  - Highway
    - Determinants of capacity, time of day restrictions/movements, signalization, turning movement restrictions, free-flow speeds, number of lanes
  - Transit
    - Schedules, speeds, fares, park-ride locations, connectivity between lines
- More importantly, collect data to test the outputs!
  - Time of day congested speeds and times for both highway and transit
  - Point-to-point travel times by mode
  - Time of day volumes

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Possible Data Sources: Travel Times

- A good understanding of travel times on all freeways, key arterials and bus routes is required
- Possible data sources
  - Freeway speed/travel time monitoring systems
  - Large sample speed/travel time survey (focused on both point-to-point and link-specific times)
  - Public time tables/AVLs
  - Cell phone location data

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Possible Data Sources: Volumes

- Reconciled and quality controlled traffic counts by time of day
  - Reconciled for different years and consistency between different sources
- Farebox, smart card records
- Automated passenger counters
- Manual station counts

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Data: What Should We Be Doing Differently?

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How Should We Gather Data?

- Collect data to test model outputs
- Design model structure before beginning data collection efforts
- Maximize passively-collected data
- Take advantage of innovative techniques

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The Need for Different Data for Different Reasons

- Input data → model estimation, QA/QC
  - Household survey
  - FAF Commodity Origin-Destination Database
  - Posted speed
  - Regional transit boardings
- Output data → comparisons
  - Detailed person demand/travel flow data
  - Detailed freight demand/travel flow data
  - Actual peak and off-peak speeds
  - Transit boardings by stop
- Traffic counts alone are not sufficient for meaningful comparisons

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Design Model Structure Before Collecting Data

- Include plan to collect data needed for inputs and model testing
  - Example: time of day highway assignments
    - Input data: Trip departure/arrival times, Freight departure/arrival times
    - Testing data: Speeds and volumes by time of day
  - Example: treating a major university as a special generator
    - Input data: student enrollment, students on vs. off-campus, student parking data, number of employees by income group, percentage of students that work on-campus, ZIP codes of employees and students
    - Testing data: ZIP codes of employees and students disaggregated to TAZ, campus circulator ridership, parking occupancy by lot

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Design Model Structure Before Collecting Data

Example: Ohio DOT Timeline

Year(s)	Activities
1997-1999	Model specification developed and finalized
2001-2003	Household surveys conducted
2003-2005	Model development, calibration & validation

- Model specifications included data needs and household interview scope of services
- Duration between initial thoughts on model specifications to validated model is about 8 years

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Maximize Passively-Collected Data
Examples

- New York City Transit develops O/D trip tables from fare media
- Portland Metro
  - Derives freeway capacity estimates (from volumes), speeds and volume-delay curves from ITS data
  - Gathers transit speed data from vehicle AVLs

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Maximize Passively-Collected Data
Examples (cont'd)

- Mid-Willamette Valley Council of Governments (Salem OR) is capturing intersection-level traffic count and classification data using controller card that sends video data directly to the MPO for processing

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Take Advantage of Innovative Techniques
Example

- Chicago Metropolitan Agency for Planning conducting regional household survey
  - Emphasized outreach to improve response rates from populations
  - Extensive use of GPS data to identify under-reporting problems

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What Should You Be Doing?

- Set up a separate task in your UPWP to identify a data collection plan that relates to the model development and testing
- Be creative in using the wealth of data that is routinely being collected by other organizations
- Don't underestimate the resources needed to collect and process data

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Questions

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