Maryland Statewide Transportation Model (MSTM)

TRB Meeting Federal Surface Transportation Requirements in Statewide and Metropolitan Transportation Planning: A Conference

September 3 - 5, 2008
Outline

- About Maryland and MD SHA
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    - Zones & Networks
    - Person Models
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- Economic and Land Use Model Summary
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About Maryland and MD State Highway Administration
About Maryland

- **Area** - 10,467 square miles [Maryland is the 42nd biggest state in the USA]

- **Population** - 5,296,486 (as of 2000) [Maryland is the 19th most populous state in the USA]
About MD State Highway Administration (SHA)

- SHA owns, operates and maintains the Interstate, U.S. and Maryland numbered roads.
- SHA roads carry 67% of traffic in the state by approx: 16,731 lane-miles of road and 2,500 bridges.
Project Background
Objectives

- travel demand in non-MPO regions
- corridor studies spanning across multiple MPOs

modeling freight

*Truck Freight Flows, All Commodities*
All truck types; highway freight density in tons
Objectives Contd..

- regional **what-if** scenarios due to
  - land use (BRAC, Rezoning etc.)
  - network changes (ICC, Tolling in VA, DE facilities etc.)
  - policy changes **in/ around** MD (Managed Lanes, Climate Change)

- provide “relatively quick” and “reasonable” answers on an aggregate level for regional policy impacts

- intercity transit modeling (commuter rail, intracity bus services etc.)

- assist MPO modeling efforts with inputs “external” to their model

- tool that connects all the available MPO models together
Model Structure and Components
The model works at three levels:

- Regional Level
- Statewide Level
- Urban Level (Example)
Three-Level Approach

**Top Level: Region View**
- County/state zones; Interstate road/transit network
- Economic Forecast model
- FAF Commodity Flow model
- Long Distance Person Travel model
- Visitor Travel model (optional)

**Middle Level: “State” View**
- Sub-county/aggregated MPO zones
- Arterial network; External Stations
- Short Distance Person Travel model
  - Trip Generation
  - Trip Distribution
  - Mode Split
  - Assignment

**Bottom Level: MPO View**
- MPO TAZs; Sub-arterial network
- No statewide modeling occurs
- MPO model data aggregation to compare with middle layer Statewide model
Model Zones
(Regional & Statewide)
&
Networks
Regional Model Zones (RMZs)

- Used in Regional model
  - FAF2 commodity flow
  - Visitor model
  - Long distance model

- Aggregations of counties nearby MD
- States elsewhere
- 189 RMZs covering North America
- No external stations
Statewide Model Zones (SMZ)

Three levels of nested model zones
1607 Statewide (SMZs) – Used in assignment
3056 Urban (UMZs) – link to MPO TAZs
Roadway Network

- Single network
- Gradual transition from detailed to coarse network representations outside of the statewide level area
- Sources:
  - MPO networks
  - Caliper national network
  - Other (SHA centerline data)
  - DelDOT statewide model network
Model Framework
Model Components

Component models:
ETV: External trip variegator
IER: Internal-external reconciliation
MCA: Multiclass assignment
PLD: Person long distance
PMC: Person mode choice
PTD: Person trip distribution
PTG: Person trip generation
T2T: Tons to truck conversion
TAP: Temporal allocation processor
TTD: Truck trip distribution
TTG: Truck trip generation
UMR: Urban model reconciliation
VPS: Visitor population synthesizer

NHTS long distance survey
Socioeconomic data
FAF2 forecast

VPS
PTG
PTD
PMC
TAP
UMR

PLD
IE+EI trucks
Internal truck flows
Statewide level

IE+EI trucks
Revised IE+EI truck flows
Regional level

Local visitors
IE person flows
LD visitors
Internal person flows

For three time of day periods (AM, PM, OP)

Daily assignment
EE truck flows

IE person flows
Local visitors

IE+EI trucks

IE+EI trucks

IE person flows
Person Travel Models

- Regional Level
  * Visitor Model
  * Long Distance Model

- Statewide Level
Regional Level Person Travel

- **VPS**: Visitor population synthesis (non-residents)
  - Identify place of residence/stay & attributes
    (trip purpose, party size, primary mode of arrival, visit duration)

- **PLD**: Long distance model (trips over 50 miles)
  - Base year trip table: sample from NHTS survey records
  - Trip generation rates for long distance trips
  - Allocate trip ends (SMZ internal, RMZ external)
  - Produce trip table for assignment (EE trips ignored)
Statewide Level Person Travel

- **PTG: Trip Generation**
  - Based on BMC/MWCOG structure, uses BMC-COG HH survey
  - Vary motorized rates by area type
  - 3 work and 3 non-work-related trip purposes by 5 income groups

- **PTD: Trip Distribution**
  - Gravity model
  - Exponential impedance function using mode choice logsums
  - Market segments by HH income
  - Recalibration for SMZ system

- **PMC: Mode Choice**
  - Nested logit structure
  - Expanded, consolidated transit network
  - Recalibration of mode-specific constants

- **MCA: Multi-Class Assignment in CUBE Voyager**
Freight Models

Regional Level

Statewide Level

140 FAF2 Zones → 3,241 Counties

disaggregate

1,607 SMZ

aggregate

132 RMZ
Regional Level Freight Model

- **FAF2 Commodity flow Forecasts**
  - Flows between 130 US FAF zones
  - 41 SCTG commodities by mode
  - Domestic and Foreign flows
  - 2002, 2006, 2010-2035 in 5 year intervals

- **T2T: Tons to trucks**
  - Conversion based on CFS & VIUS
  - Only truck mode assigned to network

- **MCA: Multi-class assignment**
  - Initial assignment of daily truck flows to RMZs
  - Using I/O make/use factors + employment by industry sector
  - Disaggregate internal end to SMZs

*Figure 2: FAF2 zones near Maryland*
Statewide Level Freight Model

For the statewide model, these county-to-county flows are disaggregated to zones using employment. Outside the statewide model area, these flows are aggregated to regional zones.

- Hybrid of BMC, MWCOG, QRFM2 methodologies

- **TTG: Truck trip generation**
  - SMZ trip ends: employment by type, households, and area type
  - RMZ trip ends obviate need for external stations
  - Apply shares to split into light, medium, heavy trucks

- **TTD: Truck trip distribution**
  - Gravity model using vehicle time/cost impedance and segmented distance terms
  - Off-peak auto and truck time/cost (including tolls)

- **IER: Internal-external reconciliation**
  - Reconcile Regional-Statewide I-E/E-I truck flows
  - Match base year observed counts
Transit Network

- Integrated urban-intercity transit network
  - No easy solutions
  - Have to reflect system access and connectivity

- Proposed approach
  - Adopt BMC transit route structure as starting point
  - Incorporate selected routes from MWCOG network
  - Add intercity bus and rail components
  - Rebuild access structures
  - Adapt fare systems to new network and zones

- Refine approach as development proceeds
Systemwide Assignment

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IE person flows
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IEE person flows
Internal person flows
Internal truck flows
IE+EI trucks
IE+EI trucks
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For three time of day periods (AM, PM, OP)

Daily assignment

Regional level

Statewide level
Validation Approach

Goal is to have a fully functioning model in Phase 1 that would have been calibrated only at the aggregate, system-wide level. This would be followed with further refinements at a finer level.

- **Individual models**
  - **Person**: MPO-based targets, CTPP JTW
  - **Truck**: limited data, rely on SHA traffic counts, employ matrix estimation adjustments as needed

- **Full model**
  - Count and VMT by facility type and area type, for auto & truck
  - HPMS VMT by facility type by county
  - Cordon & ScreenLine comparisons
  - Major intercity flows (auto, truck & transit passenger)
  - SHA/MPO review
Concurrent & Future Efforts
The Maryland Scenario Project

- To take an informed and careful look at alternative long term development scenarios;
- To conduct a quantitative assessment of each scenario;
- Use scenarios to identify robust policy decisions.
Deliverables

- **Regional Planning Applications**
  - Travel demand for non-MPO regions
  - Refine MPO models with external station data inputs
  - Long Range Plans, Highway Needs & Project Prioritization

- **Corridor studies spanning across multiple regions**

- **Study changes in land use and networks**

- **Intermodal Components**

- **Freight Model Applications – Freight Plan Scenarios**

- **Study of Highway Performance Measures**
Maintenance & Upkeep

- update the model with latest socio-economic data
- review of statewide model zones and networks
- add GIS based visualization and query tools
- develop in-house capabilities to use statewide model
- extensive validation of MPO forecasts/ studying the similarities and differences for future step
- study feasibility to add special generators, distribution centers etc.
Thank you from our team!!