Emerging Modeling Resources

Jeremy Raw, P.E. FHWA, Office of Planning November 8, 2023

Email: jeremy.raw@dot.gov



Federal Highway Administration

Presentation Overview

- Planning Challenges and Modeling Needs
- Selected Model Resources Under Development
 - VisionEval
 - TMIP-EMAT
 - GeoEconomic Multimodal System (GEMS)
 - National Household Transportation Survey (NHTS)

Planning Challenges

- Transportation: Connecting People with What They Need
 - Getting from "Point A" to "Point B"
- Traditional Performance Targets:
 - Mobility
 - Safety
 - Efficiency

The Scope of Transportation Planning is Expanding

- For Example...
 - Economic Activity and Access to Destinations
 - Equity, Resilience, and Sustainability
 - Financing System Development, Operation, and Maintenance

How We Meet Transportation Needs is Changing

- New Business Models
 - Freight on demand
 - App-based connectivity
 - Remote work
- Land Use Priorities
 - Livable communities / active transportation
 - Transportation system as an impediment (not just an opportunity)

How We Meet Transportation Needs is Changing

- New Transportation Technologies
 - Electric Vehicles
 - Connectivity / "ITS 2.0"
 - Automation
 - Micromobility

How We Fund Transportation is Changing

- Highway Trust Fund / Gas Tax / Road-Use Fees / VMT Tax
- Tolling
- Managed Lanes
- Other Pricing Policies

Less Clarity on What Comes Next

- COVID and its aftermath
- Sea-level Rise
- "Virtual" Economy / Remote Work / Home-Based Shopping

Bottom Line: Complex Needs with Uncertain Outcomes

What Models Do

- Models Can:
 - Assess how well people's needs are being met
 - Understand possible outcomes of complex interactions
 - Evaluate possible impacts of future conditions, policies and projects
- Models Cannot:
 - Tell us what will happen
 - Tell us what to do
 - Resolve uncertainty

The Life-Cycle of Models ("STORM" Diagram)



Strategic Models can help with long-term visioning/ policymaking/funding/resilience analysis, but sacrifice detail.

Tactical Models use fixed assumptions (e.g. a single economy, fixed fuel prices) to work out how to best implement allotted funding.

Operational Models help with short-term implementation details (e.g. signal timing).

Key Research Themes for Emerging FHWA Tools

- Assess a wider range of interacting outcomes
 - ... more factors, less detail
- Support Decision-Making under Uncertainty
 - ... make the best decision possible given what we know
- Find robust solutions
 - ... handle whatever comes at us

Resources Under Development

- Strategic Planning / Scenario Planning
 - VisionEval
- Planning under Uncertainty
 - TMIP-EMAT
- Geospatial Analysis
 - GeoEconomic Multimodal System (GEMS) model
- National Household Transportation Survey (NHTS)

VisionEval

VisionEval Strategic Modeling System



VisionEval Performance Measures

Mobility

- Daily VMT per capita
- Annual walk trips per capita
- Daily Bike trips per capita

Economy

- Annual all vehicle delay per capit
- Daily household parking costs
- Household (HH) vehicle operating cost (fuel, taxes, parking)
- HH ownership costs (depreciation, vehicle maintenance, tires, finance charge, insurance, registration)

Land Use

- Residents living in mixed use areas
- Housing type (SF: MF)

Environmental

- GHG emissions per capita, per HH
- Commercial and Transit GHG/mile

Energy

- Fuel consumption per capita (gallons)
- Fuel efficiency (net miles per gallon)
- Annual external social costs per HH (total/% paid)

VisionEval Key Features

- Rapid Scenario Evaluation
- Scenario Planning
- Strategy Development

"Understand the Problem" rather than "Implement the Solution"

https://visioneval.org/docs



Travel Model Improvement Program Exploratory Modeling and Analysis Tool

TMIP - EMAT

TMIP-EMAT

- Turn a large model into an exploratory tool
- Develops "Meta-Models" (a "model of the model")
- Meta-Models can rapidly explore a wide range of scenarios
- Assess risks under scenarios impractical to evaluate otherwise

Can also be used to test sensitivity and applicability of a model



TMIP-EMAT





Scope

TMIP-EMAT Workflow Details

Model

Analyze

Step 1: Scoping—Define uncertainty and decision space

Scoping

- Strategy levers
- Measures
- Uncertainties

Where necessary, leverages
 Core Model outputs to produce
 Meta-models that can quickly explore the range of uncertainty



Meta-models are regression models of the Core Model outputs that run very fast.

Step 3: Simulation (populate outcome space) and analysis

Monte Carlo simulation of experiments

Measures by Experiment

Risk analysis

Exploratory analysis

Diagram Source: Cambridge Systematics

TMIP-EMAT Key Features

- Turns Regional Model into exploratory tool
- Explore scenarios
- Test model sensitivity
- Integration with VisionEval (forthcoming)



GeoEconomic Multimodal System

GEMS

GeoEconomic Multimodal System (GEMS)

- Under Development as ArcGIS Extension (no release yet)
- Geo-Spatial Exploration of Transportation Policies
 - Macro-level impacts of regional- or national-level policy changes
 - Least-cost solutions and investment strategies preserving equitable accessibility
- Considers:
 - Socio-Economic Characteristics
 - Land Use Context
 - Transportation Network

GEMS Key Outputs

- Vehicle Miles Traveled (VMT) and Person Miles Traveled (PMT) by mode
- Congestion and speed for each mode
- Accessibility to destinations for different population groups using different modes
- Mode share by different population groups
- Externality costs including safety, noise, emissions, and environmental costs
- Costs to system users, owners, and operators

National Household Transportation Survey



"Next Gen" National Household Transportation Survey

- Take advantage of new data sources (passive OD data)
- Switch to a biennial household survey
- Pool resources to take advantage of economy of scale
- Collect both trip rate and OD data



NextGen NHTS Components

National survey core travel behavior data

- National survey data collected on a biennial basis starting in 2022
- Probability-based sampling approaches
- Independent surveys every other year
- Smaller data collection effort than previous NHTSs

National OD data

- National OD (passenger and truck) on collected on an annual basis, 2020-2024
- 583 OD zones (primarily MSA based)
- Includes air, rail, highway (passenger vehicles and buses), and active travel (bike, pedestrian, etc.) and ferry trips

OD Zones (583 Zones)



Source: <u>https://www.fhwa.dot.gov/policyinformation/analysisframework/04.cfm</u>

Current NextGen NHTS Data Collection and Delivery Status

Core data

- 2022 data collection complete (collected January 2022-January 2023)
- 7,500 households surveyed under two approaches: address based and panel frame
- Data release circa end of 2023
 November 15, 1pm Eastern <u>https://nhts.ornl.gov</u>
- Procurement work for 2024 core data collection underway

OD data

- 2020 national passenger and truck data released June 2022
- 2021 national passenger and truck data released April 2023

NHTS Participation

- Continues to have pooled fund participation
- Participants can purchase additional data
- Currently (Fall 2023)
 - 14 states
 - 5 local agencies
 - Two other organizations participating

NHTS Tools and Resources

- Data files
- Technical and supporting documentation
- Interactive analytics & visualizations for both survey core and OD data



https://nhts.ornl.gov/

FHWA Contacts

VisionEval Project Manager	TMIP-EMAT Project Manager
Jeremy Raw, PE	Sarah Sun
202-680-9573	202-493-0071
Jeremy.Raw@dot.gov	<u>Sarah.Sun@dot.gov</u>
GEMS Project Manager	NHTS Program Manager
GEMS Project Manager Mona Asudegi, PhD	NHTS Program Manager Danny Jenkins, PE
GEMS Project Manager Mona Asudegi, PhD 202-366-1067	NHTS Program Manager Danny Jenkins, PE 202-366-1067