



















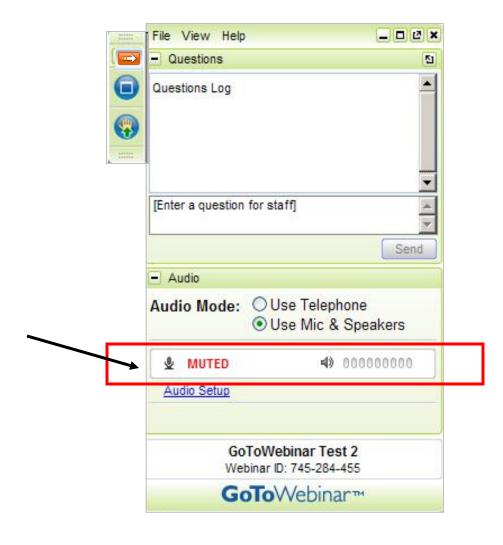


**Advances in Travel Demand Forecasting** 

SHRP 2 Tuesdays Webinar Series

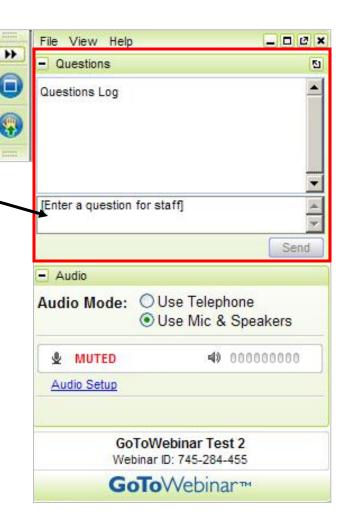
October 1, 2013

#### **All Attendees Are Muted**

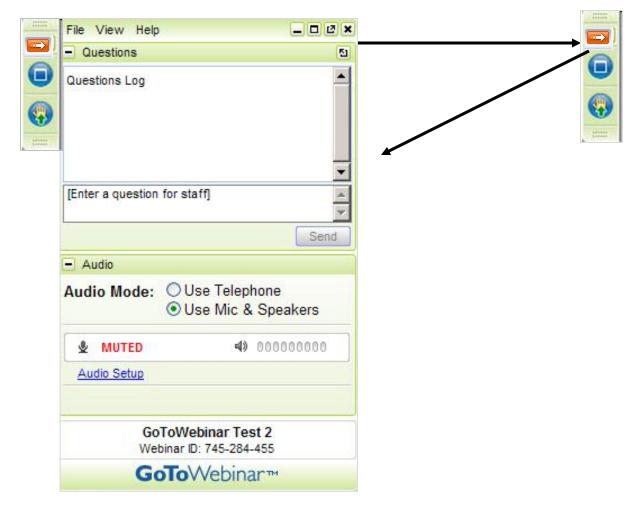


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- Please type your questions into your webinar control panel
- We will read your questions out loud, and state as many questions as time allows.



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# A link to the presentation is in today's reminder email

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#### **PDH Certificate Information**

- This webinar is valued at 1.5 Professional Development Hours (PDH).
- Instructions on retrieving your certificate will be found in your webinar reminder and follow-up emails.
- You must register and attend as an individual to receive a PDH certificate.
- TRB will report your hours within one week.
- Questions? Contact Reggie Gillum at RGillum@nas.edu

# **Today's Learning Objectives:**

- To learn about the dynamic interplay of traveler behavior and transportation network conditions, including mode options.
- To learn about the structure of the Integrated Advanced Travel Demand Model.
- To learn about introducing new equations for estimating traveler responses to congestion and pricing
- To learn how to apply the model to existing network processes and procedures.
- To understand how the primer may help users evaluate whether the new model is right for them and how best to apply it within their own organization.

## **Today's Panelists and Moderator**

- Robert Donnelly, Parsons Brinckerhoff, <u>Donnelly@pbworld.com</u>
- Stephen Andrle, Transportation Research Board, sandrle@nas.edu
- Tom Rossi, Cambridge Systematics, trossi@camsys.com
- Joe Castiglione, Resource Systems Group, <u>Joe.Castiglione@rsginc.com</u>
- Maren Outwater, Resource Systems Group, <u>moutwater@rsginc.com</u>
- Brian Gardner, Federal Highway Administration (FHWA), <a href="mailto:brian.gardner@dot.gov">brian.gardner@dot.gov</a>
- Matt Hardy, American Association of State Highway and Transportation Officials (AASHTO), <a href="mailto:mhardy@aashto.org">mhardy@aashto.org</a>

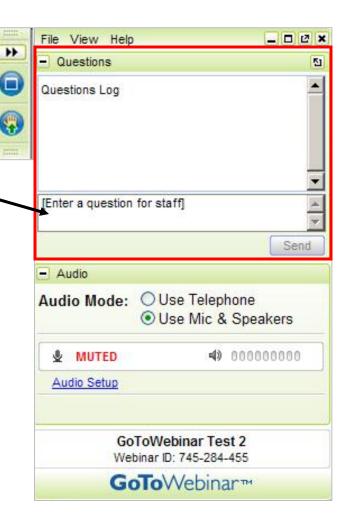


# Now it's time for a poll question.





- Please type your questions into your webinar control panel
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- Matt Hardy, American Association of State Highway and Transportation Officials (AASHTO), <a href="mailto:mhardy@aashto.org">mhardy@aashto.org</a>

## The SHRP 2 Capacity Program

Background and Context for Expedited Planning and Environmental Review of Highway Projects



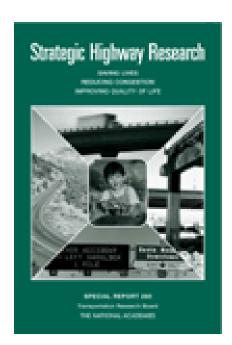
Steve Andrle, Transportation Research Board

#### **SHRP 2 Focus Areas**

- Safety: fielding the largest-ever naturalistic driving study to reduce crashes and save lives through understanding driver behavior
- Renewal: making rapid, innovative construction possible for "ordinary" projects
- Reliability: Providing management and technical tools to reduce congestion through operations
- Capacity: Systematizing collaborative decision making to achieve better, faster project decisions

# **Capacity Background**

- Charge from Congress: "Develop approaches and tools for systematically integrating environmental, economic, and community requirements into the analysis, planning, and design of new highway capacity."
- Highway expansion projects were taking too long, were too often being delayed, or were not able to obtain the necessary approvals in the planning and environmental review process.



# Research Approach

- 1. Compile lessons learned from case studies of successful delivery of 23 large and complex capacity expansion projects from across the United States
- 2. Develop methods to integrate transportation, environmental, community, and economic planning
- 3. Develop methods for addressing issues that were not being adequately addressed in the transportation planning and project development process







## Issues with Travel Forecasting

- TRB Special Report 288 (2007) documented limitations of metropolitan travel demand forecasting models
- There was no feedback between the supply and demand side of forecasting models. What effect do network conditions have on route choice, time choice, mode choice, willingness to pay a toll, etc.
- It was difficult to deal with motorist reaction to pricing and congestion in planning models
- Activity-based models offered promise but were slow to be adopted.
   What are the real costs and hurdles to overcome?
- It was not clear to what extent activity-based model structures could be successfully borrowed
- There is no training guide for activity-based models
- A quick-response model for estimating the travel effects of smart growth strategies was not available

#### What SHRP 2 Did

- Modified existing travel demand and DTA models to operate in a feedback mode. The models were built and estimated for a 5-county region in the Jacksonville, Florida area and the SACOG area in Sacramento.
  - Daysim was linked to Transims in Jacksonville and a test network in Burlington VT.
  - Daysim was linked to DynusT in Sacramento and a transit simulation component was added (FastTrips)
  - Jacksonville demand model parameters were transferred to Tampa to test the feasibility of borrowing a model
- Estimated a series of equations from existing data sets for use in demand models (C04). The C04 results were used in the Jacksonville and Sacramento models

#### Continued

- Bullt SmartGap, a quick—response model based on prior work done by Oregon DOT, EPA, and FHWA. Estimates the travel demand effects of smart growth strategies
- SHRP 2 is in the process of building a primer on activity-based models that shows linkages to land use models and DTA's. The primer will become a part of TF (Travel Forecasting) Resources, a web-based resource being developed at TRB.

#### **Status**

- A "snapshot" of the Jacksonville and Burlington model sets is available. The report is in review and will be available shortly.
- The Sacramento work will be finished by the end of October 2013. The model sets will be available.
- SmartGap, a users guide, and The Effect of Smart Growth Policies on Travel Demand are available now on the SHRP 2 website
- Improving our Understanding of How Congestion and Pricing Affect Travel Demand (C04) is available on the SHRP 2 website
- The Primer is in progress and scheduled for completion in April 2014

# Research Conducted on Other Issues

- 1. Collaborative Decision Making
- 2. Performance measurement
- 3. Analysis of economic benefits of projects
- The relationship between operational improvements and the need for additional capacity
- 5. Joint transportation and environmental planning
- 6. Community visioning, smart growth, greenhouse gas emissions issues
- 7. Dealing with public-private partnership (P3) projects
- 8. Addressing freight issues
- 9. Means to the expedite planning and project delivery process









# Direction of the Technical Coordinating Committee

- Document the decision points in a process that follows the steps used in successful capacity expansion projects
- Organize information on lessons learned from these successful projects around the decision points in the process and make all this information available via a web portal
- The web portal was named "Transportation for Communities - Advancing Projects through Partnerships," and is referred to as "TCAPP."

#### 

#### **Conclusions of Research**

- 1. Collaborative decision-making is a key to success, supported by an effective strategy for enhancing the environment, improving economic vitality, and achieving community goals
- The transportation planning and project development process as practiced and as defined in federal statutes and regulations is an elaborate and complex process that involves a series of decision points
- 3. Improved forecasting tools can better represent the effects of operational improvements and aid decision making
- 4. Decisions need to be agreed to by key decision makers at each point in the process and not revisited
- 5. Many of the key decisions that enable a project to be approved should be made before the NEPA process begins

#### THE RIGHT SOLUTION DELIVERED ON TIME

To Here

Effective Collaborative Decision Making

Effective Strategies for Environmental, Economic, and Community Goals

From Here

# **Upcoming webinars**

- October 29: Bridges for Service Life Beyond 100 Years: Innovative Systems, Subsystems and Components (R19A)
- November 5: Incorporation of Travel Time Reliability into the Highway Capacity Manual (L08)
- November 19: SHRP 2 Economic Impact Tools (C03 and C11)
- December 3: Composite Pavement Systems (R21)
- Learn about future webinars at
  - www.TRB.org/SHRP2/webinars

SHRP2 Tuesdays

May 21: Nondestructive Testing for Concrete Bridge Deck

June 4: Expedited Planning and Environmental Review

Highway Projects (C19)

June 11: Performance Specifications for Rapid Renewal (R07)

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# SHRP2 Project C04: Improving Our Understanding of How Congestion & Pricing Affect Travel Demand

# Advances in Travel Demand Forecasting TRB Webinar October 1, 2013

#### Research Team

- Project Management
  - Robert Donnelly, Parsons Brinckerhoff
- Principal Investigators
  - Peter Vovsha, Parsons Brinckerhoff
  - Mark Bradley, MBRC
  - Hani Mahmassani, NU
- Others
  - Rosella Picado / Surabhi Gupta (Parsons Brinckerhoff)
  - Frank Koppelman
  - Ken Small / David Brownstone (UC-Irvine)
  - Kara Kockelman, UT-Austin
  - Tom Adler, John Bowman, RSG
  - Jean Wolf, GeoStats (Westat)

# Primary Objectives and Focus

- Select and thoroughly analyze travel behavior data in order to formulate approaches to better model impacts of congestion and pricing on travelers and transportation systems ... primarily within an Activity-Based Modeling (ABM) framework
- Focus on key challenging modeling issues:
  - Generalized cost formulation assessment of delays /time in congestion
  - Variation in traveler preferences w/r to travel time, costs, VOT
  - (Un)Reliability of travel
- Site specific testing estimation of new relationships with validation of findings and testing for cross sites / transferability
- Synthesis of findings and general recommendations for model developers, with an emphasis on model structure needed to accommodate the developed functions

#### C04 Data Sources

- Principal Sites: Integrated regional data and implementation testing:
  - Seattle (PSRC)
  - New York (NYMTC, MTA, NYCDOT, PANYNJ)
- Supporting Sites: Project site specific analysis / transferability testing:
  - San Francisco (SFCTA, MTC)
  - Minneapolis: I-394 MnPASS HOT (MnDOT)
  - Chicago (CMAP)
  - San Diego: I-15 ML (SANDAG)
  - Orange County: SR-91 (OCTA)
  - Baltimore Region: DYNASMART-P
  - NY BPM Region: Mode and Route choice demand model implementation with DYNASMART-P

# Model Estimation Approach

- Progressive testing of increasingly more complicated model specifications
  - Basic model estimate parameters for time and cost only in linear function,
  - Explore non-linear and distance effects
  - Perception of travel time by congestion levels and facility type
  - 4. Impact of income
  - 5. Impact of car occupancy
  - 6. Impact of gender, age, and other person characteristics
  - 7. Incorporation of reliability measures
  - 8. Toll-averse bias
  - Situational variability (unobserved heterogeneity) in traveler preferences

# **Specification of an Extended Auto Utility Function in Travel Choice Models**

# Basic Generalized Cost Function (Starting)

#### U=b×Time+c×Cost

- b = travel time coefficient
- c = travel cost coefficient
- VOT = b/c (constant)
- Most of research and nearly all of models in practice use this simple function for auto utilities
- This function is simplistic and masks many important effects of congestion and pricing

## Perceived Time by Congestion Levels

- U=b×Time+c×Cost
- $= U=b_1\times FFTime+b_2\times Delay+c\times Cost$
- $b_2/b_1 \approx 1.5-2.0$
- Every minute spend in congestion conditions is perceived as 1.5-2.0 min of free driving!
- May serve as a proxy for travel time unreliability:
  - Loses significance if reliability is incorporated directly
  - Useful for simple models that cannot incorporate reliability directly

## Incorporation of Reliability

- U=b×Time+c×Cost
- =  $U_s = b \times Time + c \times Cost + d \times STD/Dist$ 
  - d = coefficient for reliability measure
  - VOR = (d/c)/Dist
  - VOR/VOT= (d/b)/Dist (Reliability Ratio ≈ 0.5-1.5)
  - Typical VOR range:

Trip purpose	Distance	VOR
Work	5 miles	\$54.9/hour
	10 miles	\$27.5/hour
	20 miles	\$13.8/hour
Non-work	5 miles	\$40.8/hour
	10 miles	\$20.4/hour
	20 miles	\$10.2/hour

#### **Toll-Averse Bias**

- U=b×Time+c×Cost
- $U_t = a + b \times Time_t + c \times Cost_t$  (for toll routes)
- $U_{nt} = b \times Time_{nt} + c \times Cost_{nt}$  (for non-toll routes)
  - a = toll bias (toll-averse bias if negative)
- Toll bias represents psychological perception beyond time-cost tradeoffs:
  - Significant toll-averse bias equivalent of 15-20 min even in NY where tolling has long history

# Impact of Car Occupancy

- U=b×Time+c×Cost
- U=b×Time+c×(Cost / Occf)
  - $f \approx 0.6 0.8$
- VOT grows with occupancy but not linearly:
  - Less cost sharing for intra-household carpools
  - Almost proportional cost sharing for inter-household carpools
- Typical cost sharing:
  - SOV=1.00
  - HOV2=0.57
  - HOV3=0.41

## Situational / Unobserved Heterogeneity

- U=b×Time+c×Cost
- $= U = \int (b \times Time + c \times Cost) \times g(b) db$ 
  - **b** = randomly distributed with density g(b)
  - VOT= b/c (becomes randomly distributed)
- Unobserved heterogeneity is significant:
  - VOT is subject to many additional unknown parameters (for example, person taste and psychological type)
  - VOT is subject to situational variability for the same person and trip (trip to important meeting vs. routine trip to work)
  - VOR variance was difficult to explore; the result are inconclusive, better data on travel time variation is needed

## Improved Final Generalized Cost Function

- U=b×Time+c×Cost
- Deterministic version:
  - $U_s = a_s + (b_{1s} + b_{2s} \times Dist + b_{3s} \times Dist^2) \times Time + c_s \times Cost/(Inc^{e_s} \times Occ^{f_s})$   $+ d_s \times STD/Dist$
  - Applicable with any model that generates STD reliability measure
  - If STD reliability measure cannot be produced perceived highway time can be used as a proxy
- Probabilistic version:
  - $U_s = \int [a_s + (b_{1s} + b_{2s} \times Dist + b_{3s} \times Dist^2) \times Time + c_s \times Cost/(Inc^{e_s} \times Occ^{f_s}) + d_s \times STD/Dist] \times g(b_{1s})db_{1s}$
  - Applicable only with advanced microsimulation model

## Where,

#### **VARIABLES**

- TIME = average travel time
- DIST = travel distance
- STD = day-to-day standard deviation of the travel time
- COST = monetary cost including tolls, parking, and fuel
- INC = (household) income of the traveler
- OCC = vehicle occupancy

#### **PARAMETERS**

- a<sub>1s</sub> = alternative-specific "bias" constant for tolled facilities
- b<sub>1s</sub> = basic travel time coefficient, ideally estimated as a random coefficient to capture unobserved user heterogeneity
- $b_{2s}, b_{3s, ...} =$  coefficients reflecting the impact of travel distance on the perception of travel time
- e,f = coefficients reflecting the impact of income and occupancy on the perception of cost
- $\mathbf{d}_{\mathbf{s}}$  = coefficients reflecting the impact of travel time (un)reliability

SHRP2 C04 – Incorporation of Issues and Findings in C10 and in emerging modeling Practice

## SHRP 2 C04 Issues and Findings in C10A

Route Choice:
Toll versus Free

 Traveler-specific coefficients applied in calculation of route utilities

- Incorporated a binary path type Toll / Non-Toll choice model in DaySim+CUBE
- Continuous Income function
- Vertical integration with mode& destination choice models
- Functional form and magnitude for:
  - Toll bias
  - Income and Occupancy effect on cost coefficient
  - Travel time coefficient drawn from log-normal distribution (mean 1.0; Std 0.8 work, 1.0 non-work)
  - Scale parameter for higher level choices (inverse of path type choice logsums)

## SHRP 2 C04 Issues and Findings in C10B

Variable VOT specifications in Mode Choice

- Segmentation of by income group
- SACOG RP survey data did not yield usable locally estimated models of segmented VOT
- Adopted VOT distributions by from recent SFCTA SP analysis analyzed in C04
- VOT=Applied to InVehicleTime (IVT)
- Incorporated travel time (Un)reliability
- Applied with DynusT simulation
- Concept of "extra impedance"
  - TTI = FF / actual speed
  - TTE = Mean Time + **a** \* (80<sup>th</sup> TT 50<sup>th</sup> TT, where
  - a = value of unreliability relative to mean travel time (a value of 0.8 proposed)

# SHRP 2 C04 Issues and Findings in MPO Activity-Based Model Developments

Finding	Applied	
Impact of commuting distance on VOT	CMAP ABM	
Impact of income on VOT	CMAP ABM, MAG ABM, JTMT ABM, MORPC ABM, NOACA ABM, OKI ABM, Ottawa Trans Tour-Based model, SACOG, PRSC, Tampa, Jacksonville	
Impact of car occupancy on VOT	CMAP ABM, MAG ABM, JTMT ABM, MORPC ABM, NOACA ABM, OKI ABM, SACOG, PRSC, Tampa, Jacksonville	
Incorporation of travel time reliability in mode and route choice	Ottawa Trans Tour-Based model, SHRP 2 L04	
Randomized VOT	CMAP ABM, MAG ABM, JTMT ABM, SACOG, PRSC, Tampa, Jacksonville	
New methods of ABM-DTA integration	SHRP 2 L04, CMAP ABM-DTA integration	

Highlighting a Few Statistically-Based Findings and their Policy Implications

1. VOT and Willingness to Pay have a wide range from \$5/hour through \$50/hour across income groups and major travel purposes. There is a significant situational variation (unobserved heterogeneity) on the top of it with the "tail" of the distribution going beyond \$100/hour.

#### **Policy Implications:**

Prices have to be at significant levels to influence congestion. Variability by time of day, vehicle occupancy, and frequency of travel allows prices to have more effect.

2. In parallel with relatively high VOT (Willingness to Pay for Travel Time Savings) there is a *significant negative toll bias* ("threshold" effect equivalent to 15-20 min). This is generally found in both Revealed Preference and Stated Preference data, and supported by research in behavioral economics.

#### Policy Implications:

Pricing makes sense if it is associated with significant travel time savings and reliability improvements to overcome a psychological bias against any tolls.

- 3. Traveler's *responses to congestion and pricing* are dependent on the range of available options. They generally follow the sequence:
  - Primary: route/lane type change, small shifts in departure time (up to ±60 min),
  - Secondary: switch to transit (in transit-rich areas), carpooling
  - Tertiary: principal rescheduling of trips & activities by time-of-day periods
  - Longer term changes in home, work, other locations.

#### **Policy Implications:**

Impact of peak period pricing on congestion level may be minor if the peak period is already spread over 2-3 hours and transit service is limited.

Improvements in travel time reliability are as important as improvements in average travel time. Reliability Ratio (cost of 1 minute of standard deviation versus cost of 1 minute of average time) is in the range of 0.5-1.5

#### **Policy Implications:**

Dynamic pricing, traffic accident management and other strategies that specifically guarantee stable travel times (and avoid non-recurrent congestion) are highly valued by travelers.

Income has a strong although not linear effect on VOT and Willingness to Pay. To account for income effect Cost/Toll variables in travel models should be scaled by Income powered by 0.6-0.8.

#### **Policy Implications:**

Pricing studies need to explicitly consider income distributions and future income growth in each region, corridor, and area. In the absence of locally calibrated models, model parameters from he other region have to be scaled by income differences.

17-June-2010 24

## Principal Conclusions

- Policy implications may be quite significant for:
  - More accurate forecast of response and performance levels
  - Capture of additional benefits associated with tolled roads and managed lanes, particularly with guaranteed reliability
- Universal fully transferable model:
  - Impossible, due to regional specifics, data / model limitations
  - Seed conceptual structures are becoming clear
- Complete operational models incorporating extended behavioral sensitivities
  - Definitely yes!
  - Reliability is extremely important and statistically significant
  - Mostly requires ABM platform
  - Integrated ABM+DTA framework is the best

#### SHRP C10B

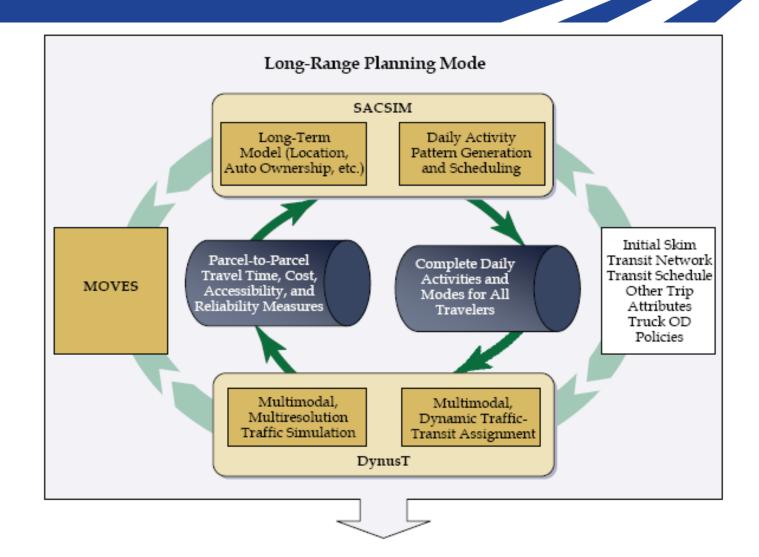
Partnership to Develop an Integrated Advanced
Travel Demand Model with Fine-Grained,
Time-Sensitive Networks

Thomas Rossi, Cambridge Systematics, Inc.

## SHRP C10B Team

- Cambridge Systematics, Inc.
- Sacramento Area Council of Governments
- University of Arizona
- University of Illinois, Chicago
- Sonoma Technology, Inc.
- Fehr and Peers

# Integrated Modeling Approach



## SHRP C10B

- Integration of SACSIM with DynusT
- Implemented in Sacramento, California
- Uses original DaySim model estimated in Sacramento
- Incorporates new transit simulation process (FAST-TrIPS)
- Integration with MOVES
- Testing using policy alternatives in Sacramento

## **Model Features**

- Integrated model components
  - DaySim (tours/trips) → DynusT/FAST-TrIPS (auto/transit simulation)
  - Exogenous trips → DynusT (auto simulation)
  - DynusT → MOVES
- User interface
  - Enables users to create, run, manage scenarios
- Run times for Sacramento regional model about one day per feedback loop
  - 10 iterations of DynusT assignment per loop

## **MOVES Integration**

#### **Main components**

- DynusT processing to prepare network and activity data for MOVES
- 2. MOVES input files set-up using other data sources
- 3. MOVES CO<sub>2</sub> emissions modeling
  - Running exhaust (related to roadway links)
  - Start exhaust (related to traffic analysis zones)

### Other Model Features

- DaySim revised to incorporate variable value of time (for road pricing analysis)
- Travel time reliability incorporated into DynusT
- Feedback process for using travel times from DynusT as inputs to SACSIM
- Conversion of shared ride person tours to vehicle tours

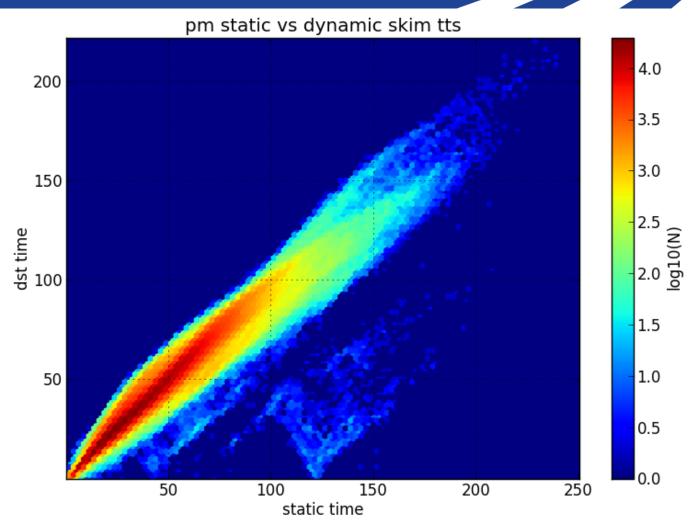
## Policies/Projects Tested

- Scenarios compared between the original SACSIM model and the new C10B integrated model
  - Operations-Oriented Interchange Project
  - New Transit Line
  - Freeway Bottleneck Analysis
- Scenarios tested using only the new C10B integrated model
  - ITS/Arterial Signal Coordination
  - Transit Schedule Coverage Change
  - HOT Lane project

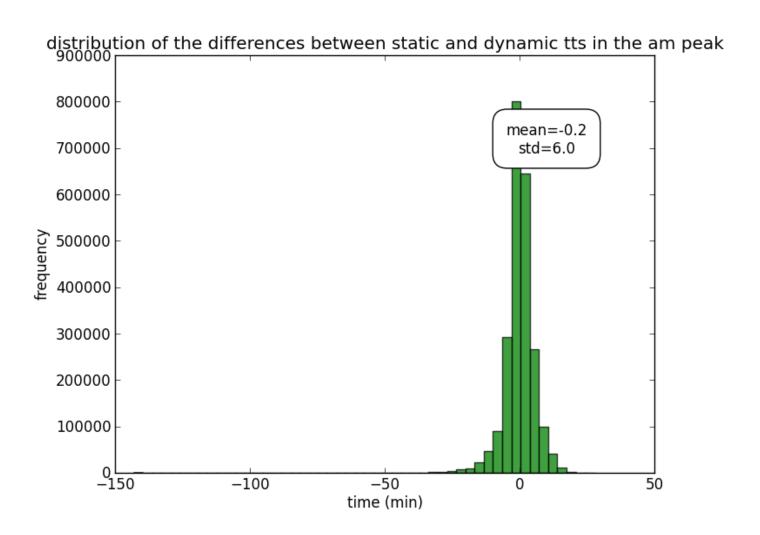
## Some Interesting Results...

- Removal of freeway bottleneck (still analyzing)
  - Logical changes in vicinity
  - Some changes away from project
  - Due to simulation noise?
- Doubling frequency on transit route
  - Static model shows large ridership increase, reductions on nearby routes
  - C10 model shows almost no change in ridership
  - May be due to bus bunching resulting in unchanged wait times

# Comparison of Static And Dynamic Skim Times



# Comparison of Static and Dynamic Skim Times



## Project Status – Final Tasks

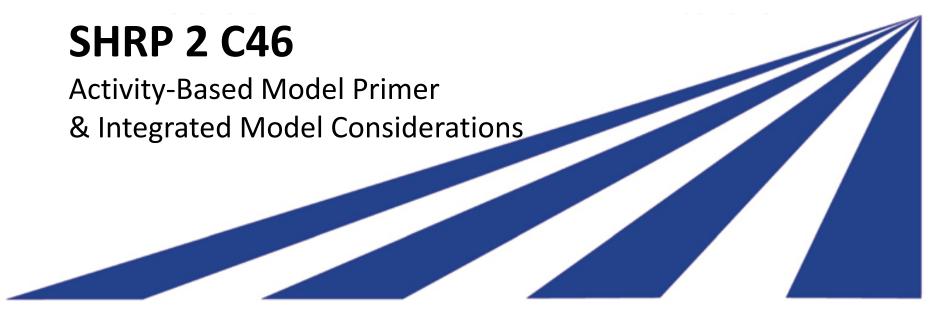
- Documentation of policy/project testing
- Final project documentation
- Finalization of integrated model and software

## For Further Information...

- Thomas Rossi, Cambridge Systematics
  - trossi@camsys.com
- http://www.shrp2c10.org/SHRPC10Portal/Home.aspx
- www.dynust.net

#### **SHRP 2 C10A**

Partnership to Develop and Integrated Advanced Travel Demand Model with a Fine-Grained, Sensitive Network Model



Joe Castiglione, RSG

## C10A Project Team

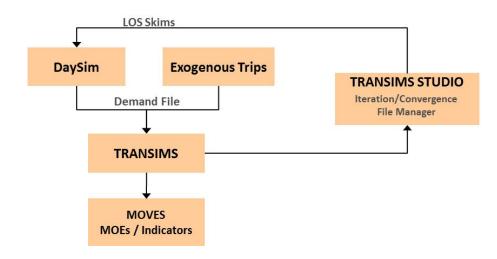
- RSG
- AECOM
- Dr. John Bowman
- Dr. Travis Waller, UNSW
- Dr. Mohammed Hadi, FIU
- Dr. Ram Pendyala, ASU
- Dr. Chandra Bhat, UT Austin
- NFTPO

## C10A Objectives

- Develop an operational "integrated" model
  - Advanced demand model
  - Time-dependent network supply model
- Demonstrate value of model
  - Validation / calibration
  - Sensitivity tests
- Implement in a framework that is easily transferable to the local jurisdictions for policy analysis
- Incorporate findings from other SHRP 2 efforts

## What is an integrated model?

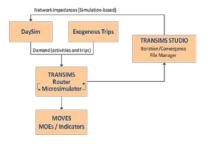
- A model system in which different models exchange information in a systematic and mutually dependent manner
  - AB info to DTA
  - DTA network impedances to ABM
- C10A model components
  - Daysim "activity-based" model
  - TRANSIMS network simulation model
  - MOVES
- C10A integrated model system implemented in both Jacksonville, FL and Burlington, VT



# Why develop an integrated model?

- Current models are limited
  - Not sufficiently sensitive to travel behavior and network conditions
  - Unable to represent the effects of policies such as variable road pricing and TDM
- Integrated model systems represent demand changes and network performance better
  - Peak spreading, mode choices, destination choices
  - Capacity and operational improvements such as signal coordination, freeway management and variable tolls

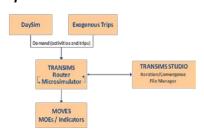
#### Planning & Operations



#### **Planning**



#### **Operations**



# How can an integrated model be used?

## Freeway Tolling

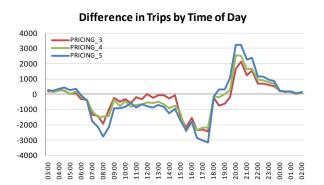
- Vary tolls by detailed time of day and facility
- Demonstrate shifts by time of day and purpose

## Travel Demand Management

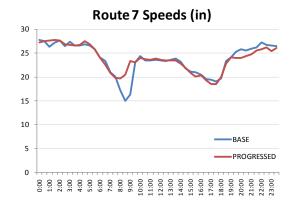
- "Flexible Schedule" scenario
- Demonstrate that fewer work activities results in more non-work activities

### Operations

- Corridor signal progression
- Challenging to code and interpret results



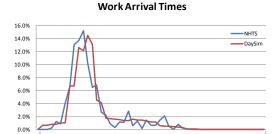
Tours by Purpose (Fulltime Workers)			
	Original	Adjusted	Adj/Orig
Work	94,408	78,472	0.83
School	115	140	1.22
Escort	8,070	9,023	1.12
Pers Bus	13,519	16,848	1.25
Shop	10,531	12,938	1.23
Meal	3,817	3,842	1.01
Soc/Rec	13,076	14,360	1.10
Workbased	27,949	23,211	0.83
Total	171,485	158,834	0.93

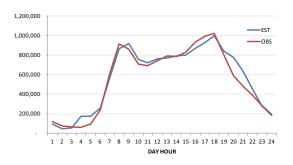


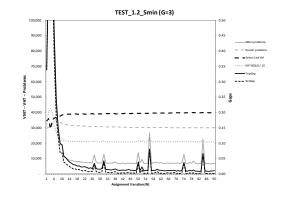
## C10 Lessons Learned

### Data development

- Simulation network sensitivity
- Detailed alternative scenario assumptions
- Transferability
- Calibration / Validation
- Configuration
  - Convergence
  - Consistency
- Application







## **C10A Conclusions**

- Integrated model system
  - is more sensitive to a wider range of policies
  - produces a wider range of statistics of interest to decisionmakers
- Level of effort required to effectively test different types of improvements varied widely
- Debugging the model system, and individual scenarios was the greatest challenge
- Must have willingness to investigate and experiment

## C46 Objectives

- Develop Primer on activity-based (AB) travel demand models
  - Practical, how-to guide for practitioners and managers
  - Explain concepts and implementation
  - Consider linkages between AB models and dynamic network models and land use models
- Develop Implementation Considerations Report

## Primer on Activity-Based Models

### Three primary sections

- Moving to AB Models
  - For agency managers
  - Capabilities, sensitivities
- Technical roadmap
  - For modeling managers
  - Component selection, linkages, data and resource requirements
- AB concepts and algorithms
  - For practitioners
  - Design, components, development tasks

# Implementation Considerations Report

- Examine benefits, barriers, practical issues agencies face in migrating from "traditional" to "advanced" approaches using SHRP2 products
- Identify challenges and strategies for overcoming
- Inform implementation

The Strategic Highway
Research Program 2
Capacity Program

Smart Growth Area Planning Tool (SmartGAP)

The Effect of Smart Growth Policies on Travel Demand

Maren Outwater RSG

October 1, 2013

#### **Overview**

#### **Purpose**

 Provide tools, methods, and resources to evaluate smart growth policies on travel demand

#### **Objectives**

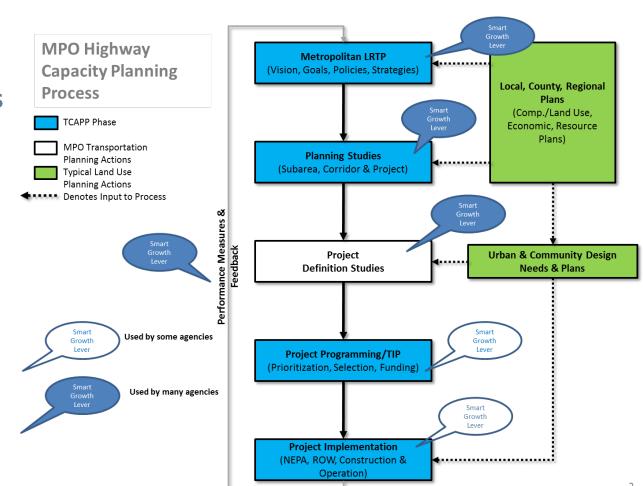
- Understand critical decision points in the transportation planning process and how smart growth approaches affect demand for capacity
- Research the dynamics and inter-relationships of smart growth strategies with the performance of a transportation investment
- Identify range of features and capabilities that new tools need to represent
- Facilitate improved communication, interaction and partnerships between decision-makers and planners in transportation and land use arenas

#### **Decision Points for Smart Growth in the Planning Process**

## Process maps for State DOTs and MPOs

Areas where smart growth levers can be used

- Policy Studies
- Planning studies
- Programming
- Implementation



#### **Key Practitioner Information Needs**

Based on interviews with planning officials

Most agencies are interested in scenario planning as a strategy for evaluating smart growth

Develop a regional scenario planning tool

Many agencies need coordination, cooperation, and communication with local governments on land use policy, since land use regulations are governed by local governments

 Develop a tool that can be used by land use and transportation planners to provide opportunities for interaction on common goals

#### Agencies also want to understand

- Induced demand, TDM and urban form
- Congestion reduction
- Outcomes and performance

### **Background Research**

Topic	Well-established Relationships	Gaps in Research
Built environment impact on peak auto demand	Impact on daily travel	Impact by time of day
Mobility by mode and purpose	Impact on daily travel	Impact by trip purpose
Induced traffic and induced growth	Capacity expansion on an expanded facility	Route shifts, time of day shifts, mode shifts, induced trips, new destinations, growth shifts on the network; effects of operational improvements, land use plans
Relationship between smart growth and congestion	Localized effects	Macro-level or regional effects
Smart growth and freight	Freight is necessary for population centers	Impacts of loading docks, truck routing, full-cost pricing, freight facilities and crossings, inter-firm cooperation, stakeholder communication

#### Smart Growth Area Planning Tool (SmartGAP)

Developed for regional decision-makers of transportation and land use policies

#### **Evaluates regional scenarios**

- Built environment
- Travel demand
- Transportation supply
- Policies

Considers households and firms individually

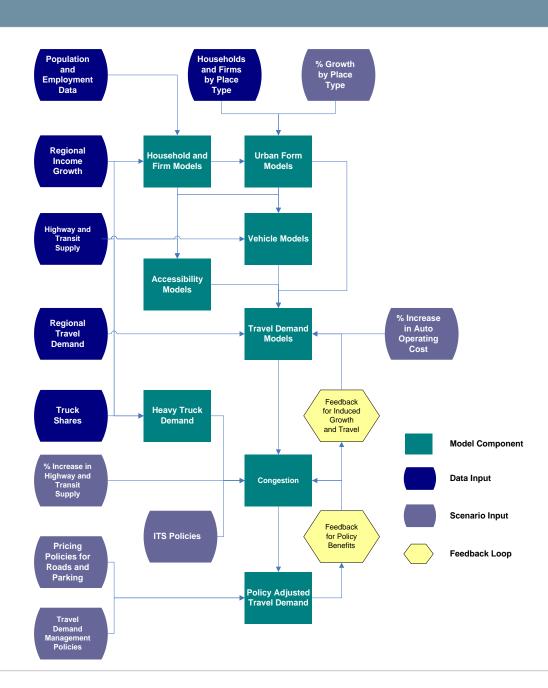
Easy to use and freely distributed

#### **PLACE TYPES**

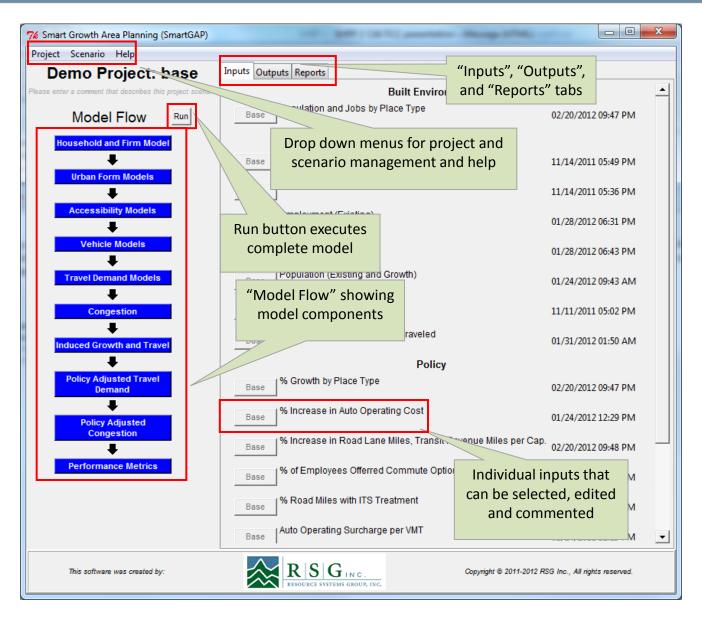
	Area Type			
Development Type	Urban Core	Close in Community	Suburban	Rural
Residential	✓	✓	✓	
Employment	✓	✓	✓	
Mixed-Use	✓	✓	✓	
Transit Oriented Development	✓	✓	✓	
Rural/ Greenfield				✓

#### **SmartGAP Process**

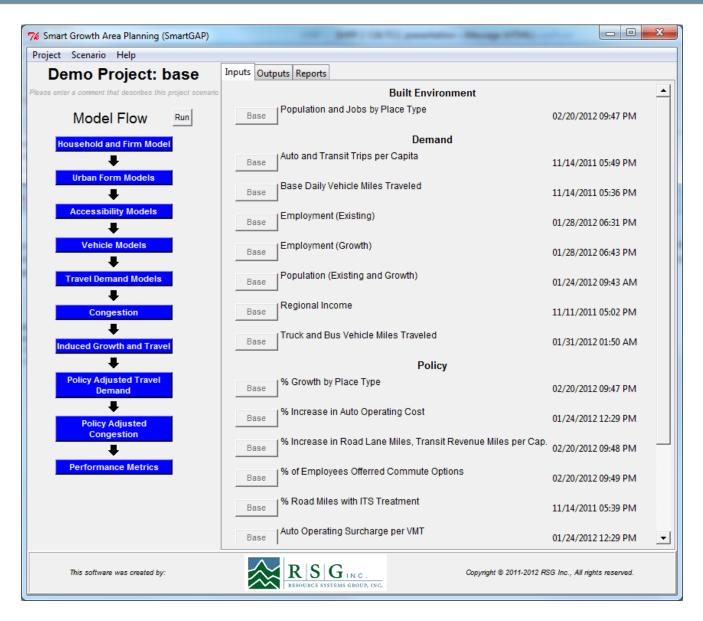
Evaluates transportation impacts of smart growth strategies



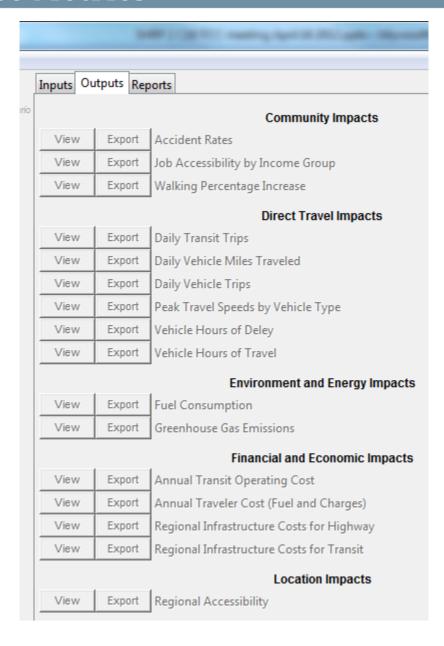
#### **Graphical User Interface**



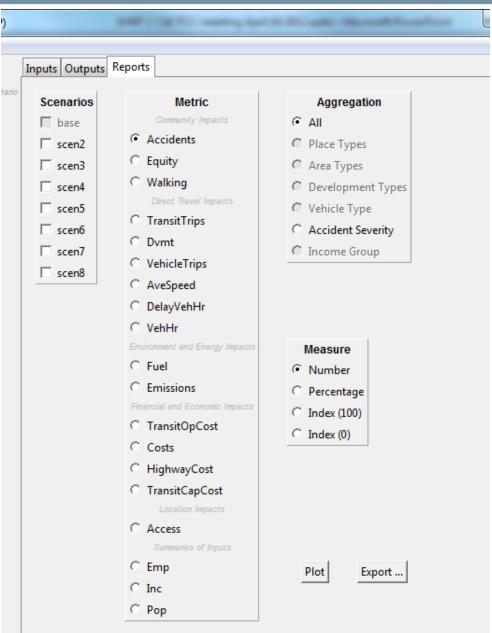
#### **Input Data**



#### **Performance Metrics**



#### **Model Reports**



#### Distribution and Use of SmartGAP

#### Available on SHRP 2 Web Site

 Final Report, Software and User's Guide <a href="http://www.trb.org/main/blurbs/168761.aspx">http://www.trb.org/main/blurbs/168761.aspx</a>

#### **SmartGAP Installation**

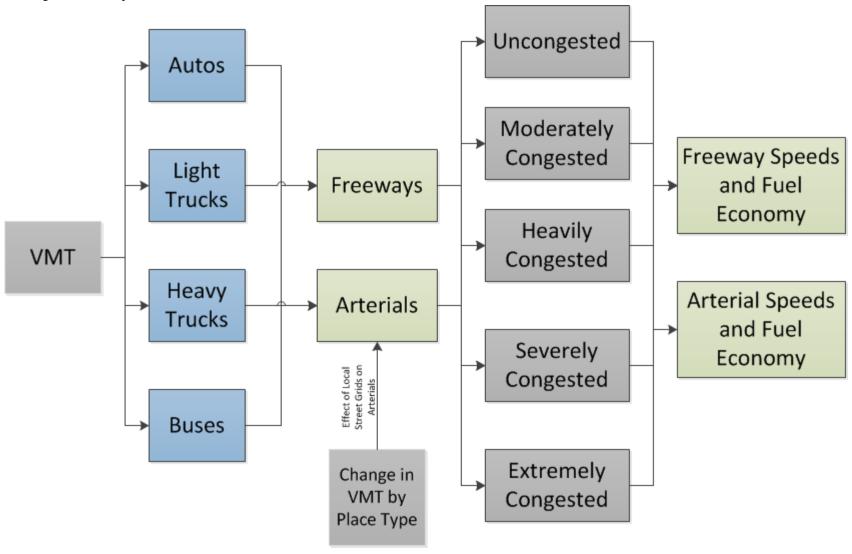
- Install by simple unzipping to a location on your computer's hard drive, e.g. c:\SmartGAP
- Consists of text file scripts, csv file input files, and .Rdata binary files holding containing models

#### R is an open source statistical software platform

- SmartGAP runs in R so R must be installed on the computer
- SmartGAP uses several add in packages to R which it will download automatically the first time it is run
- R is available at: <a href="http://cran.r-project.org/">http://cran.r-project.org/</a>

#### **Congestion Impacts**

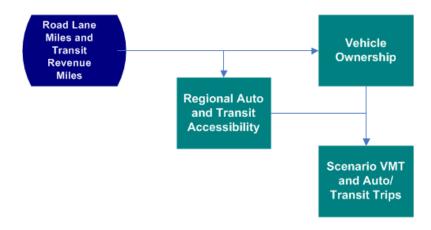
Accounts for recurring and nonrecurring congestion on local streets, arterials and freeways



#### Induced Demand and Urban Form Effects on Travel

Predicts the change in VMT for each household due to changes in urban form and the short and long term induced demand effects of increases in transportation supply.

Category	Urban Form Description	Elasticity for Change in VMT
Density	Household/Population Density	-0.04
Diversity	Land Use Mix (entropy)	-0.09
Design	Intersection/Street Density	-0.12
Distance to Transit	Distance to Nearest Transit Stop	-0.05



#### **Transportation Policies**

## Predicts the Change in VMT for each Household due to Transportation Policies

#### **Pricing Policies**

- VMT charges
- Parking pricing

#### **ITS** strategies

- Freeways
- Arterials

## **Travel Demand Management Strategies**

- Ridesharing
- Transit Passes
- Telecommuting
- Vanpool Programs

#### Pilot Tests: Objectives for each Region

#### Atlanta Regional Commission (ARC)

- Large MPO setting
- Test success of scaling to large area (e.g. run time issues)
- Plan to compare with detailed land use scenario test results (INDEX)

#### Thurston Regional Planning Commission (TRPC)

- Smaller/medium MPO setting
- Test network installation for multi-user access

#### Maryland DOT (MDOT)

- DOT setting
- Test larger urban/suburban county and smaller rural county
- Plan to compare with regional travel demand model results

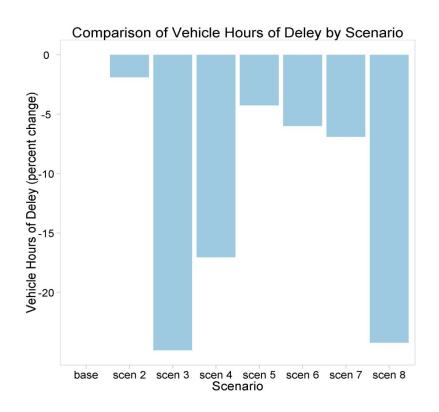
#### **RSG** Test Bed for Portland Metro Region

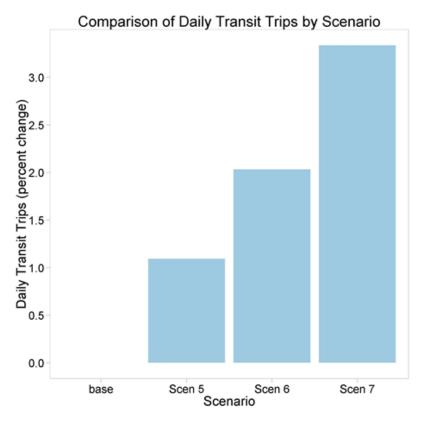
- Used for debugging purposes and reasonableness testing of the model components and the performance metrics
- Results generated for the 8 standard scenarios, plus pricing scenarios

### **Test Scenarios**

Scenario	Land Use	Transportation	Policy
#1	Baseline	Baseline	Baseline
#2	Baseline	+ 20% in Transit Supply	Baseline
#3	Baseline	+ 20% in Roadway Supply	Baseline
#4	Baseline	Baseline	+20% in Lane Miles with ITS
#5	Shift 10% of Population and Employment to Close in Community and 10% to Urban Core. Proportional reduction from Suburban Area	Baseline	Baseline
#6	Shift 20% of Population and Employment to Close in Community and 20% to Urban Core. Proportional reduction from Suburban Area	Baseline	Baseline
#7	Shift 30% of Population and Employment to Close in Community and 30% to Urban Core. Proportional reduction from Suburban Area	Baseline	Baseline
#8	Shift 30% of Population and Employment to Close in Community and 30% to Urban Core. Proportional reduction from Suburban Area	+20% in Transit Supply	+20% in Lane Miles with ITS

#### **Example Performance Metrics from the Pilot Tests**





### **Changes in Vehicle Hours of Delay in Atlanta**

Delay decreases most with additional lane miles and ITS to reduce congestion.

#### **Transit Trips in Olympia**

The transit trip metric is based on land use effects only

#### **Pilot Test Summary**

- Performance metrics were consistent with expectations
- Installation and input file preparation were easy
- Regional policy scenario testing is useful for
  - Smaller MPOs, local jurisdictions without advanced travel demand models
  - Bigger MPOs, state agencies to pre-screen policy scenarios before undertaking extensive travel demand modeling exercises that are resource intensive
- Run times are reasonable

#### **SmartGAP Summary**

#### Use

SmartGAP can evaluate smart growth policies on travel demand

#### **Features**

- Represents critical decision points in the transportation planning process and how smart growth approaches affect demand for capacity
- Includes the dynamics and inter-relationships of smart growth strategies with the performance of a transportation investment
- Facilitates improved communication, interaction and partnerships between decision-makers and planners in transportation and land use arenas



## Contact

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# Advances in Travel Demand Forecasting

# Considerations for Implementing New Technologies and Methods (SHRP2 Capacity C10)

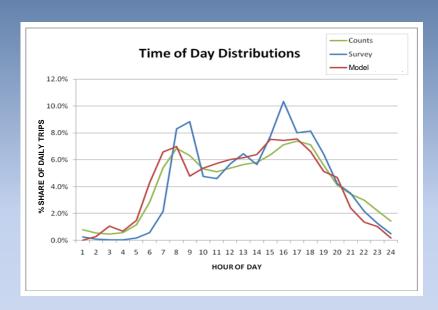
Brian Gardner, FHWA Matt Hardy, AASHTO

# Planning, Programming, Project Development

- Continuing emphasis on management and operations
- Strategic reconfiguration scenarios
- Congestion, tolling, and pricing
- Support other, higher fidelity analyses

Need better representation of dynamic systems in planning models

### **Current Technologies**



FHWA 2013

- Activity-Based
   Demand Models
  - Time-space constraints
  - Scheduling
- Dynamic Network Models
  - Times and costs change over time

## Implementation

- Activity-Based Models
  - Increasing number of regional planning agency deployments
- Dynamic Network Models
  - Subarea, project, and corridor level deployments
- Joint Interaction & Application

# Translating SHRP2 Methods & Lessons into Practice

- Data
  - Users, Networks, Controls, Validation
- Methods & Software
  - Interaction, Interpretation
- People
  - Public Agencies, Consultants, Developers

## Implementation

- In 2012, the AASHTO Board of Directors approved funding the implementation of SHRP2 products
  - Funding came from State Planning and Research money
  - AASHTO is committed to the successful implementation of SHRP2
- The AASHTO Standing Committee on Planning (SCOP) and FHWA are developing a SHRP2 Capacity Strategic Implementation Plan
  - Five "bundles" of projects:
    - Freight Modeling
    - Analytical Tools
    - Economic Analysis Tools
    - Process
    - TCAPP
  - All of the products discussed here are part of the Analytical Tools bundle

### What's Next

- Implementation Planning Workshop in CY 2014 Q1
- Implementation Assistance Program
- For more information:

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www.fhwa.dot.gov/goshrp2/
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www.fhwa.dot.gov/planning/tmip/

http://shrp2.transportation.org/Pages/default.aspx