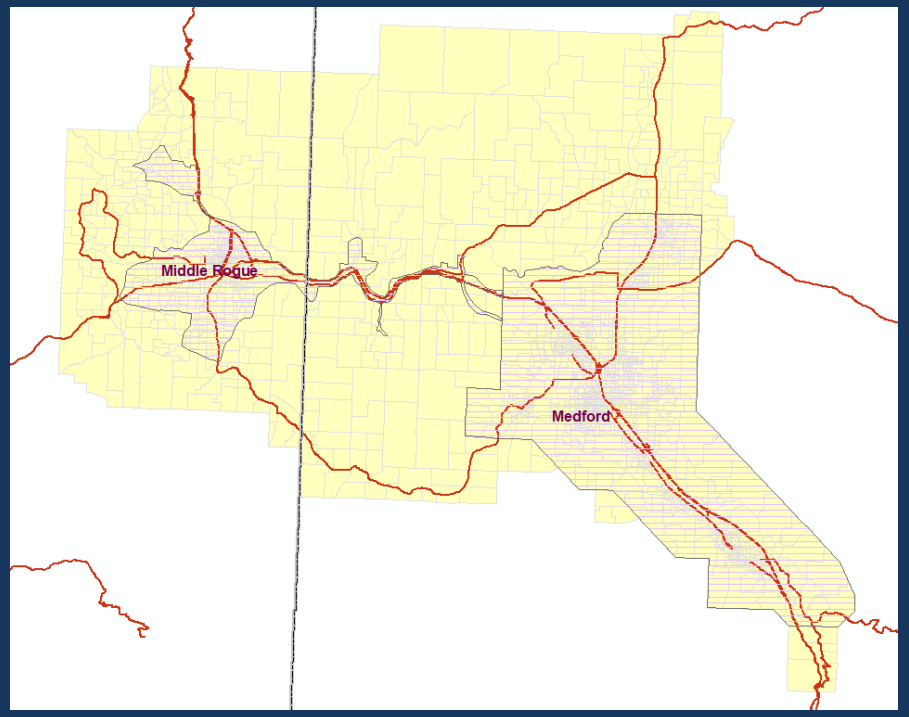
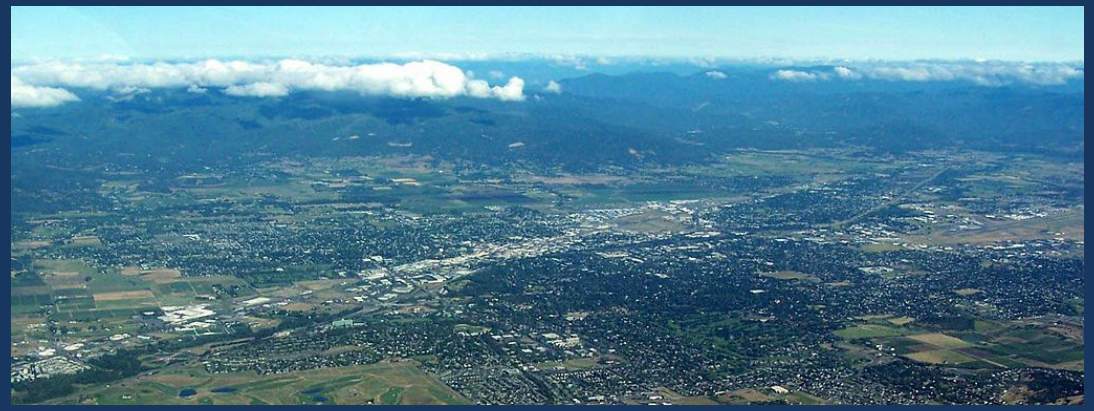
Transitioning from a Trip-Based Model to an Activity-Based Travel Model:



Motivations and Experiences of the Oregon Department of Transportation (ODOT)

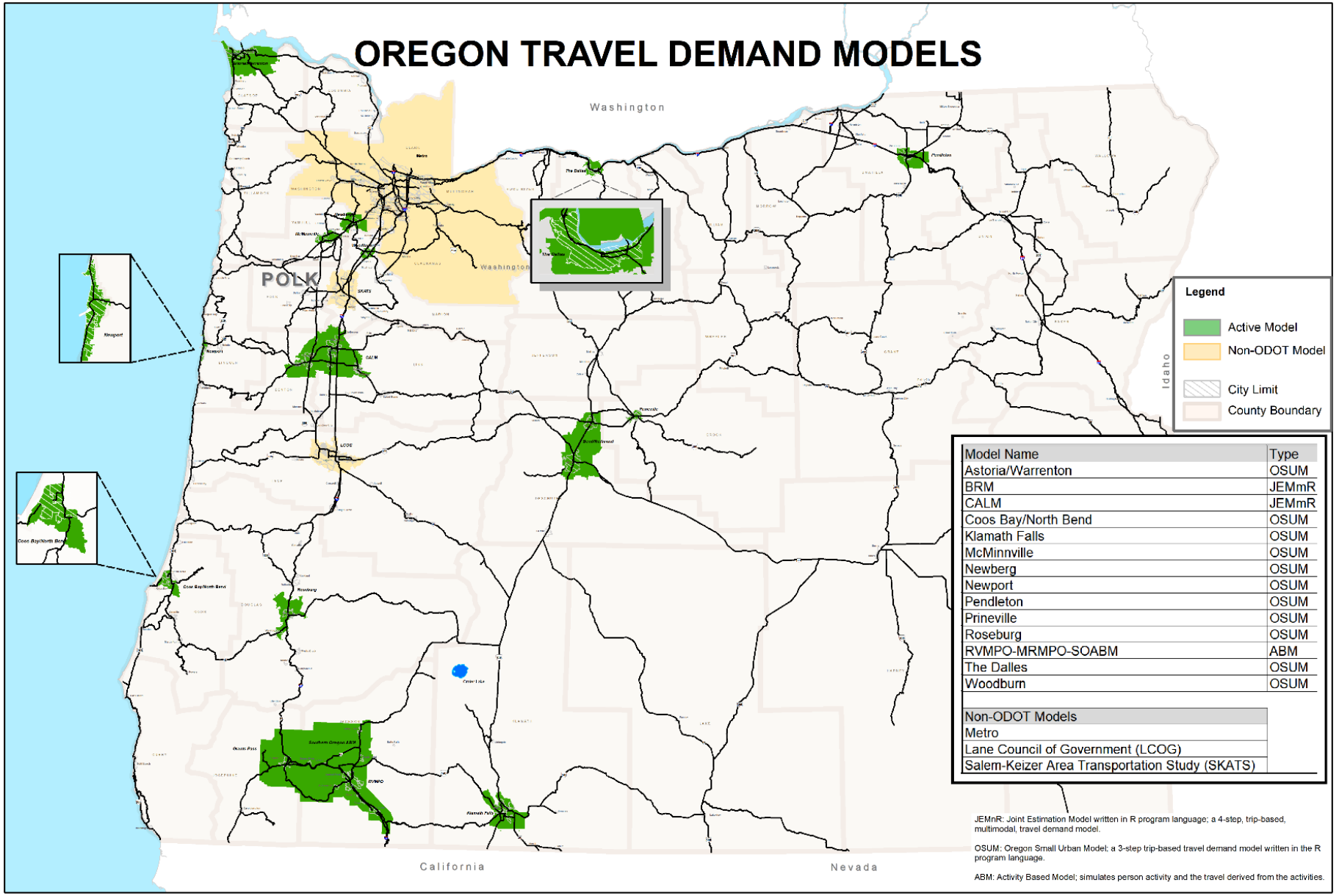
Travel Forecasting Subcommittee (TFS) Meeting
Alex Bettinardi, P.E., ODOT-Transportation Planning and Analysis Unit (TPAU)
January 28, 2022

Overview



- Quick Oregon Modeling Context
- Why an ABM
    - Advantages of ABM
- Challenges in Shifting to an ABM
- Next steps for ODOT

OREGON TRAVEL DEMAND MODELS



Model Name	Type
Astoria/Warrenton	OSUM
BRM	JEMmR
CALM	JEMmR
Coos Bay/North Bend	OSUM
Klamath Falls	OSUM
McMinnville	OSUM
Newberg	OSUM
Newport	OSUM
Pendleton	OSUM
Prineville	OSUM
Roseburg	OSUM
RVMPO-MRMPO-SOABM	ABM
The Dalles	OSUM
Woodburn	OSUM

Non-ODOT Models
Metro
Lane Council of Government (LCOG)
Salem-Keizer Area Transportation Study (SKATS)

JEMnR: Joint Estimation Model written in R program language; a 4-step, trip-based, multimodal, travel demand model.

OSUM: Oregon Small Urban Model: a 3-step trip-based travel demand model written in the R program language.

ABM: Activity Based Model; simulates person activity and the travel derived from the activities.

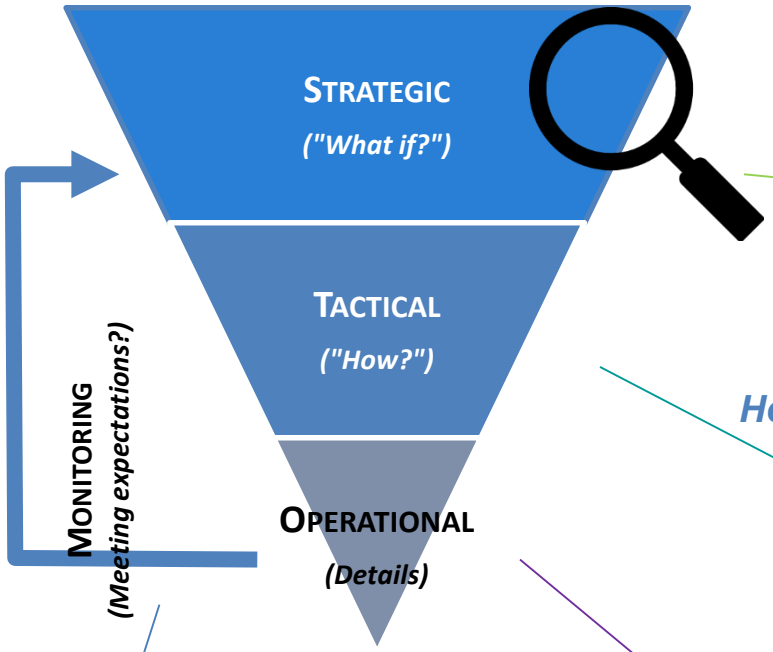
OREGON DEPARTMENT OF TRANSPORTATION
Transportation Planning & Analysis Unit

0 25 50 100 Miles

N

DISCLAIMER:
This product is for informational purposes only and may not have been prepared for or be suitable for legal, engineering or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Context - Oregon Analysis Toolset



What if?

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

Example - VisionEval

How?

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

Example – Travel Demand Models (Trip-based and ABM)

Details?

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

Example - Microsimulation

Meeting Expectations?

Monitoring should reflect observed (not modeled) behavior

Example – RITIS analytics

ABM (Activity Based Model) Summary highlights

ABM – models people

Trip Based – models zones or groups of people

Additional detail allows for more (and more detailed) questions to be modeled

The additional information from an ABM comes at a cost of more input level detail and a more complex model

Given the questions being asked and anticipated to be asked…

Increased questions around bike / ped / transit information

Strategic and visioning work was showing a shift toward more pricing and technology questions (AVs)

Funding realities point to less and less large highway expansion projects which is where Trip-based models shine

…the ABM is the planned platform for future travel demand model development.

Other Influences:

- Deals with trip chaining
- Move to Performance Measures / Equity
- Better accounting for peak spreading
- The ability to test congestion pricing
- ABM aligns with ODOT tool suite

Expanded Functionality

Policy Topic	Trip-Based Models	Activity-Based Models
Traditional highway projects		
Transit expansion projects		
Air quality conformity / emissions		
Traffic impact studies		
Bike/walk planning		
Land use planning (mixed uses, transit-oriented developments)		
System management and operations		
Highway pricing studies (such as tolling)		
Equity analysis (including the effects of policies and investments on disadvantaged populations)		
Peak spreading		

Suitability for Analyzing Topic:  *Good*  *Fair*  *Limited**

**Trip-based models may provide less detail than desired; ABMs may require disproportionate work effort with excessive detail.*

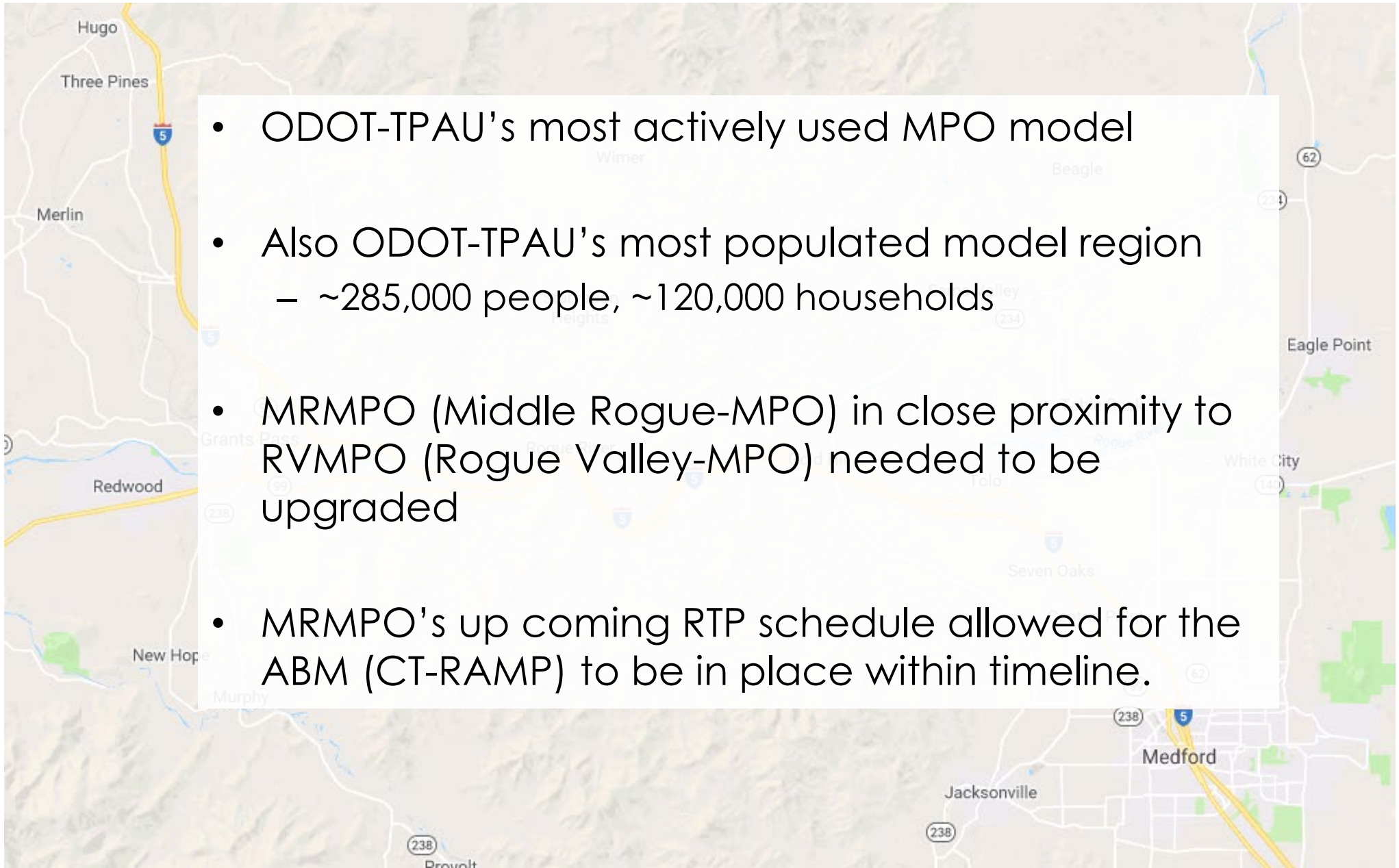
Source: Modified and adapted from information provided by RSG, Inc.

The Peer Review Panel

WSP

Oregon Modeling Statewide Collaborative

Why Southern Oregon



- ODOT-TPAU's most actively used MPO model
- Also ODOT-TPAU's most populated model region
  - ~285,000 people, ~120,000 households
- MRMPO (Middle Rogue-MPO) in close proximity to RVMPO (Rogue Valley-MPO) needed to be upgraded
- MRMPO's up coming RTP schedule allowed for the ABM (CT-RAMP) to be in place within timeline.

Experience and Challenges

Training and Cultural Change Challenges

ActivitySim Zone System Options

- One zone
  - Like a traditional model; all land-use data represented at the TAZ level. Skims are TAZ-TAZ
- Two zones
  - Land-use data represented at the microzone level.
  - Auto and transit skims are TAZ-TAZ. Some non-motorized times are MAZ-MAZ
- Three zones
  - Land-use data represented at the microzone level
  - Auto skims are TAZ-TAZ
  - Transit access points used to represent transit stops. Transit skims are TAP-TAP
  - Non-motorized times are MAZ-MAZ and MAZ-TAP using an all-streets network. Software builds MAZ-MAZ transit costs on-the-fly.

ODOT's experience is with 3-zone

ODOT will likely be looking to simplify to one-zone in the future

But the basic lessons are still similar

The ABM requires a lot of the data that the current trip-based model already requires…

Zones and Network

Households / Employment

Schools,
Parks,
Parking

…but there are some new “twists”

Some additional detail needed

Reviewing at the zone (TAZ) level,

But inputs are actually at a sub zone (MAZ) level

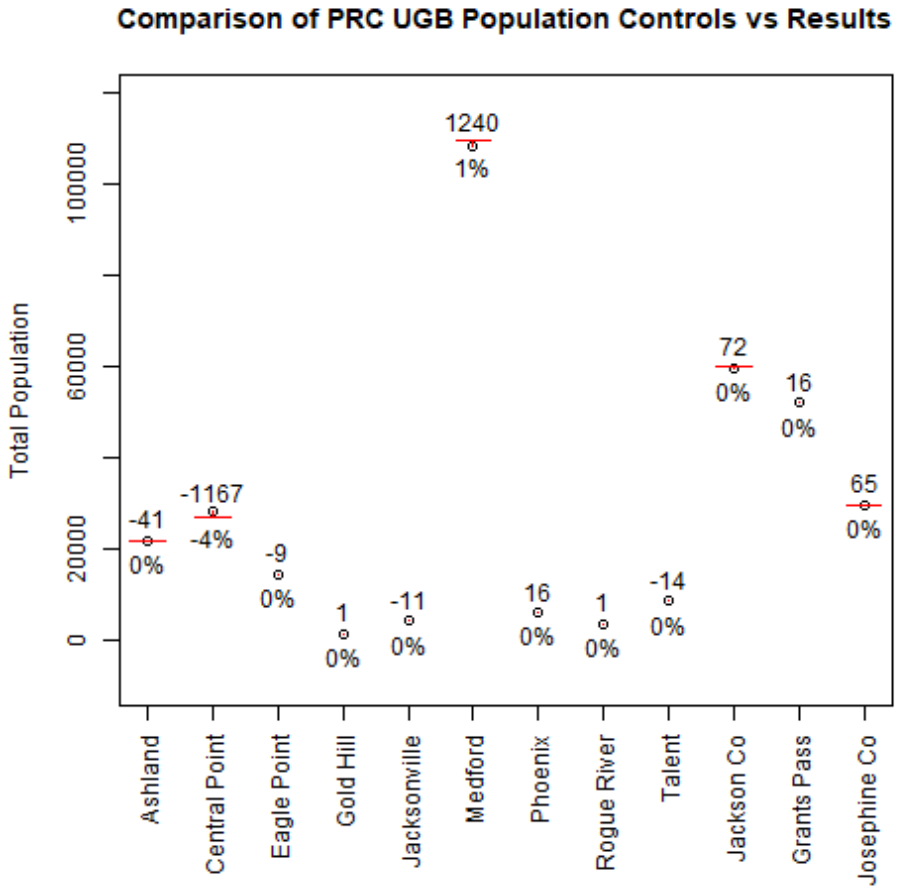
Some additional employment categories

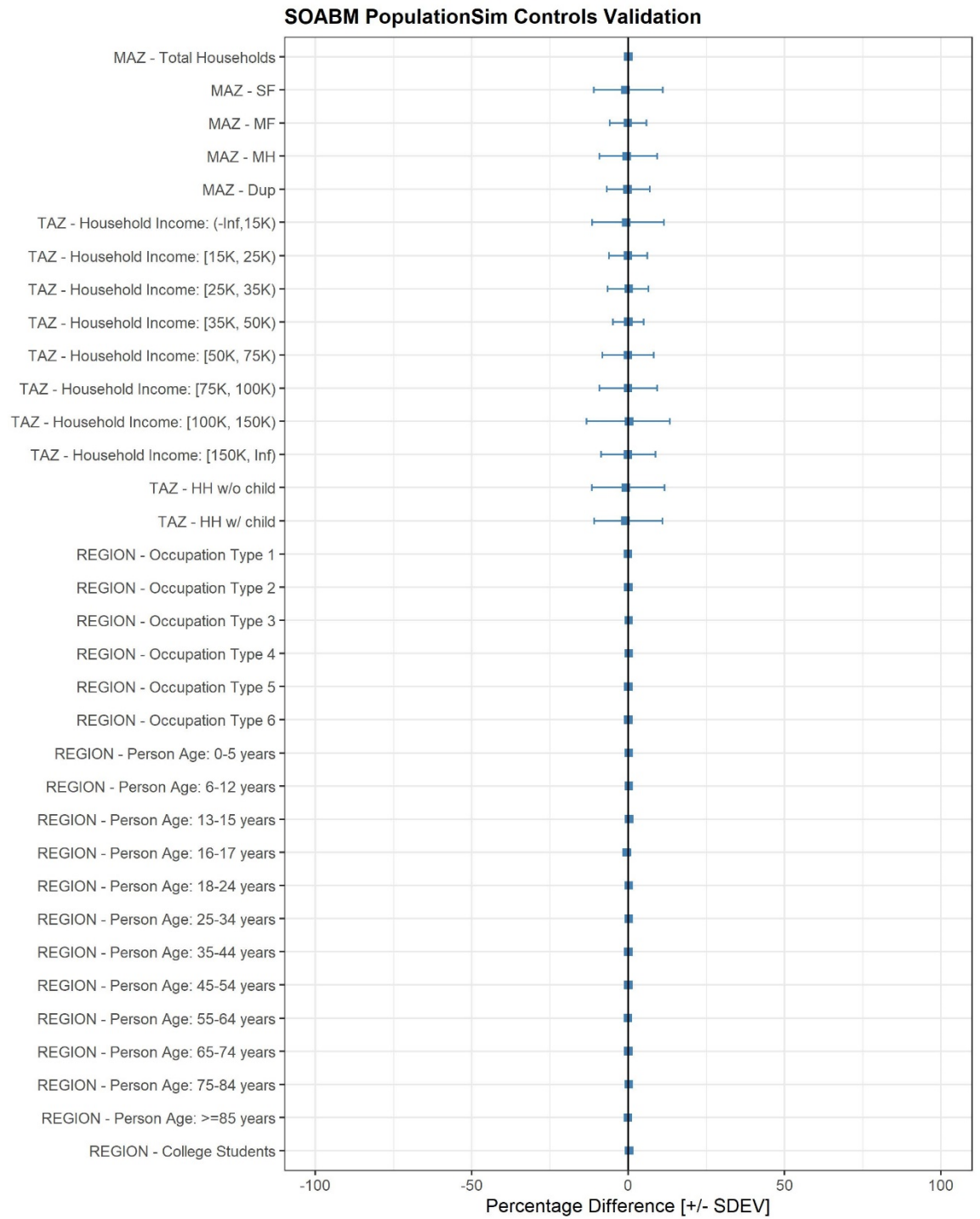
And Household detail

Active Mode (bike / walk) connections

Additional parking inventory detail

Still perfecting the art of Population Synthesis





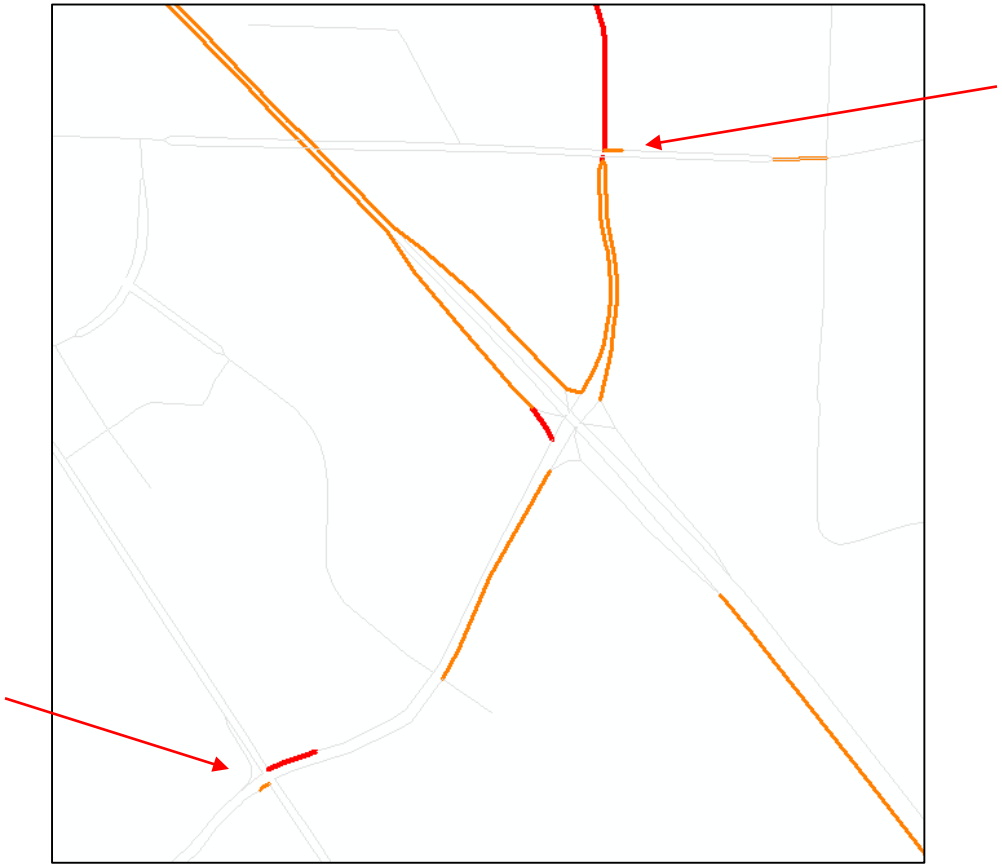
Trip or Activity, your model is only as good as your Estimation

TSysSet	Allowed transport systems (i.e. modes, transit systems descriptions are found here):
	SOV = Single-occupant non-toll vehicle
	SOVToll = Single-occupant toll vehicle
	HOV2 = High-occupant 2 person non-toll vehicle
	HOV2Toll = High-occupant 2 person toll vehicle
	HOV3 = High-occupant 3+ person non-toll vehicle
	HOV3Toll = High-occupant 3+ person toll vehicle
	Truck = All Trucks (note - the truck mode can be tolled in assignment, on the network, but the tolls will not impact destination choice or mode switching).
	Bike* = Bike mode allowed
	Walk* = Walk mode allowed
	It should be noted that CT-RAMP uses TSysySet to create bike and pedestrian networks. Bike and walking is only allowed where TSysSet is coded for those modes. See the Non-Motorized page for additional information.

PARKAREA	Parking model code:
	0 - Unconstrained parking
	1 - Trips with destinations in this MAZ may choose to park in a different MAZ, parking charges apply (downtown)
	2 - Trips with destinations in parkarea 1 may choose to park in this MAZ, parking charges might apply (1/4 mile buffer around downtown)
	3 - Only trips with destinations in this MAZ may park here, parking charges apply (outside downtown paid parking, only show cost no capacity issue)
	4 - Only trips with destinations in this MAZ may park here, parking charges do not apply (outside downtown, free parking)
HSTALLSOTH	Number of stalls allowing hourly parking for trips with destinations in other MAZs. Note that number of stalls is used to calculate an average distance-weighted parking cost for each MAZ in mode choice, since the actual parking location is unknown when the choice of mode is made. Lots with more spaces will affect the weighted parking cost more than a lot with few spaces.
HSTALLSSAM	Number of stalls allowing hourly parking for trips with destinations in the same MAZ
HPARKCOST	Average cost of parking for one hour in hourly stalls in this MAZ, $2010 dollars
NUMFREEHRS	Number of hours of free parking allowed before parking charges begin in hourly stalls. A 0 indicates that parking charges begin immediately (most common).
DSTALLSOTH	Stalls allowing daily parking for trips with destinations in other MAZs
DSTALLSSAM	Stalls allowing daily parking for trips with destinations in the same MAZ
DPARKCOST	Average cost of parking for one day in daily stalls, $2010 dollars
MSTALLSOTH	Stalls allowing monthly parking for trips with destinations in other MAZs
MSTALLSSAM	Stalls allowing monthly parking for trips with destinations in the same MAZ
MPARKCOST	Average cost of parking for one day in monthly stalls, amortized over 22 workdays, $2010 dollars.

https://github.com/RSGInc/SOABM/wiki/Networks-and-Zone-Data

More Detail in VDF Requires Additional V/C Output Thought



$$T_f = T_0 * \left[1 + \alpha_1 * \left(\frac{V}{C_s}\right)^{\beta_1}\right] + P * \frac{c}{2} * \left(1 - \frac{g}{c}\right)^2 * \left[1 + \alpha_1 * \left(\frac{V}{C_i}\right)^{\beta_1}\right]$$

Uncongested Signal Delay

Mid-link BPR function

Intersection congestion adjustment

https://github.com/RSGInc/SOABM/wiki/soabm-volume-delay-function-definition

Similar issue with VMT

Table 4: 2045 RTP SOABM_v2 Scenario Ashland Resident II, IE and EI vs All to/from Ashland Travel Stats						
2045 RTP SOABM_v2 Scenario	II	IE	EI	Total	II% of Total	% of Total
Ashland_PopOnly_autoTrips	56,248	9,605	9,584	75,437	75%	76%
Ashland_PopOnly_autoVMT	86,812	133,730	131,448	351,990	25%	56%
Ashland_PopOnly_autoTripsPerCapita	1.59	0.27	0.27	2.13	75%	
Ashland_PopOnly_autoVMTPerCapita	2.45	3.77	3.71	9.93	25%	
Non-Ashland_Pop_autoTrips	3,347	10,156	10,157	23,660	14%	24%
Non-Ashland_Pop_autoVMT	5,203	132,123	136,863	274,189	2%	44%
All Ashland_autoTrips	59,595	19,761	19,741	99,097	60%	
All Ashland_autoVMT	92,015	265,853	268,311	626,179	15%	
All Ashland_commercialVehTrips	3,369	1,034	1,033	5,436	62%	
All Ashland_commercialVMT	4,648	13,532	13,570	31,750	15%	

Again, Extra Detail = Expanded Functionality

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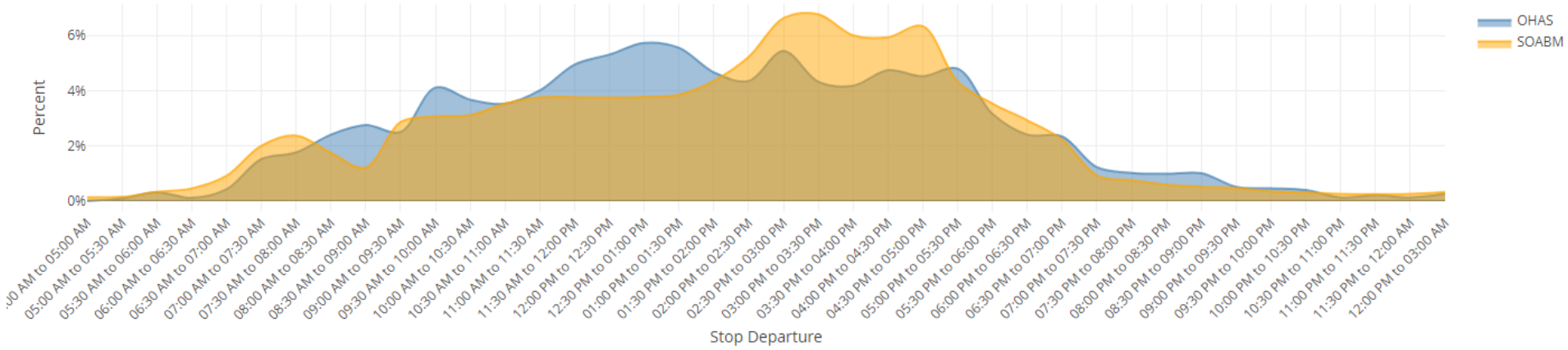
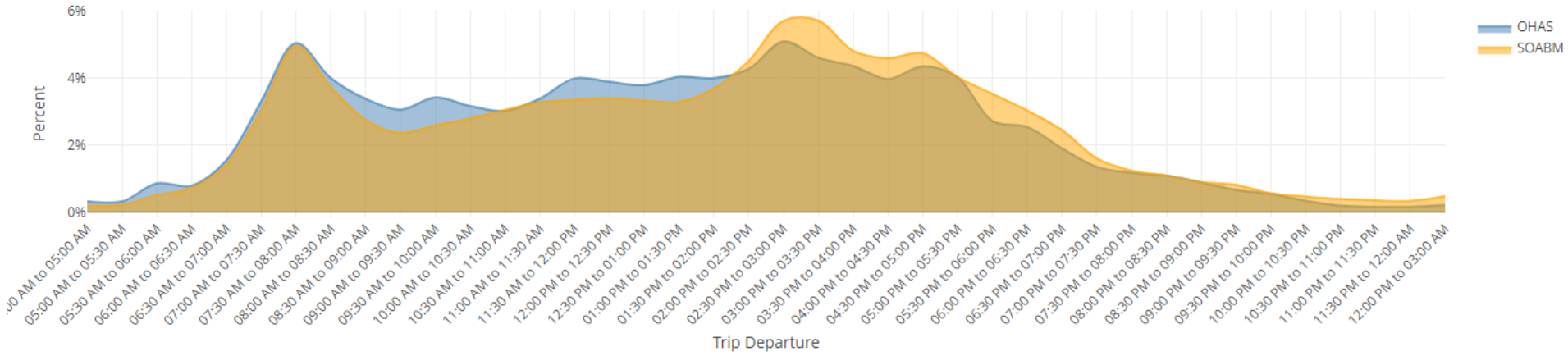
Automated Input and Output Checkers are a Must



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*****************************************

        Summary of Input Checker Fails

*****************************************

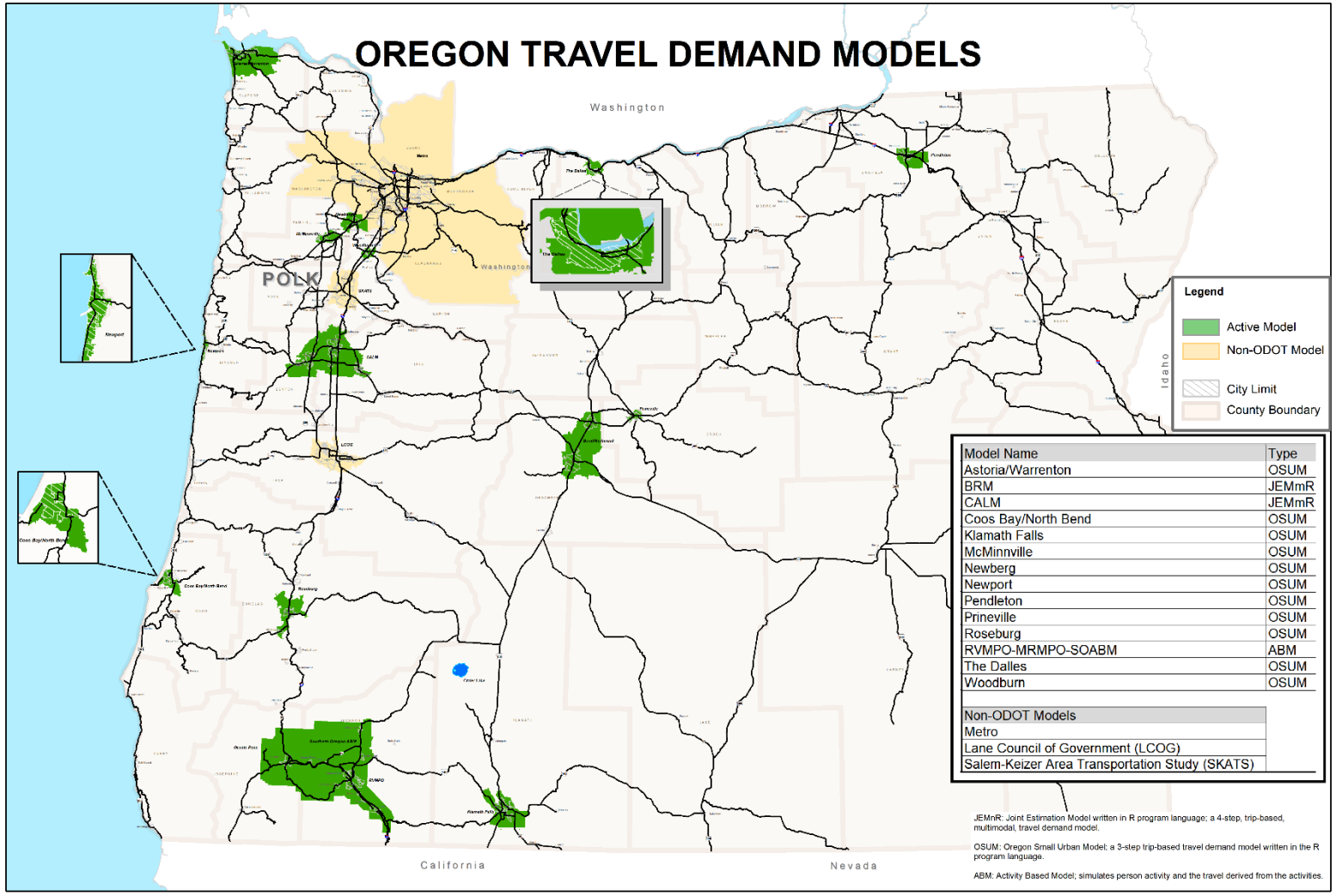

Number of Fatal Errors: 0


Number of Logical Errors: 10


Number of Warnings: 1
```

Next Steps

Current Travel Demand Model Development within ODOT Paused



All models except SOABM are trip-based

SOABM, built on CT-RAMP has been in operation 2-3 yrs

Scoping Estimation of Next Generation of Models

PERSONAL TRAVEL IN OREGON:
A SNAPSHOT OF DAILY
HOUSEHOLD TRAVEL PATTERNS

Oregon
Modeling
Statewide
Collaborative

ActivitySim

An open platform for activity-based travel modeling

Why ActivitySim

Why ActivitySim

Principle	Brief Description
Collaborative	One open common platform / code base that is shared by all users
Cost effective	Reduced development and maintenance costs and economies of scale through pooled funding
Practical	Easy for agencies and modelers of different skill levels to use to produce reasonable and reliable estimates and forecasts
Extensible	Can be customized and extended for new features and region specific needs
Performant	Makes efficient use of computing resources, including memory, storage, and processors

https://github.com/ActivitySim/activitysim/wiki/Administration

Why ActivitySim

ActivitySim

The mission of the ActivitySim project is to create and maintain advanced, open-source, activity-based travel behavior modeling software based on best software development practices for distribution at no charge to the public.

The ActivitySim project is led by a consortium of Metropolitan Planning Organizations (MPOs), Departments of Transportation (DOTs), and other transportation planning agencies, which provides technical direction and resources to support project development. New member agencies are welcome to join the consortium. All member agencies help make decisions about development priorities and benefit from contributions of other agency partners.

https://activitysim.github.io/

Shared Dollars, Also Shared Knowledge and Resources

Questions / Discussion