



Gen3 Model Development Project

Travel Forecasting Subcommittee Meeting

November 19, 2021

IN PARTNERSHIP WITH



Metropolitan Washington
Council of Governments

Discussion Topics

- Goals of the Gen3 Project
- (Re-) Introduction to the ActivitySim project
- Gen3 model design
- Update on Gen3 Phase I Model deployment





Gen3 Model Development Project

Goals of the project

- To ensure that the TPB model is at least state of the practice, when compared to our peer MPOs.
- To ensure that the TPB model can adequately address the policy questions being asked by the TPB and the local area modeling stakeholders.
 - Equity analysis
 - Telecommuting
 - Emerging technologies



Gen3 Model Development Plan

- TPB started a three-year contract with RSG/BMG at the end of 2019
- Initial task orders focused on needs assessment, model design. ActivitySim selected.
- Two phase development
 - Phase I: Model implementation, selective estimation, “light” calibration and validation, sensitivity testing. Formulate scope for Phase II
 - Phase II: Additional enhancements, more thorough calibration and validation, sensitivity testing, training.





Introduction to ActivitySim

ActivitySim Mission

- Create and maintain advanced, open-source, activity-based travel modeling software based on best software development practices for distribution at no charge to the public.
- Activity-based travel models such as ActivitySim predict the travel-related choices of households and individuals in a region.
 - Activity participation
 - Activity locations
 - Travel mode
 - Time-of-day



ActivitySim Principles

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



ActivitySim Agency Consortium/Partnership

- Agencies contribute annually to pooled fund
- AMPO facilitates coordination and provides administrative support
- All funding agency partners participate in decision-making
- New agencies are welcome
- 8 years of successful collaboration

Note: Anyone can download, use, and edit the software and source code, regardless of participation



ActivitySim Consortium Partners

- Metropolitan Transportation Commission
- San Diego Association of Governments
- Atlanta Regional Commission
- San Francisco County Transportation Authority
- Puget Sound Regional Council
- Southeast Michigan Council of Governments
- Oregon Department of Transportation
- Metropolitan Council
- Metropolitan Washington Council of Governments
- Ohio Department of Transportation



ActivitySim Project Management

- Led by Project Management Committee (PMC)
- PMC comprised of agency staff
- PMC sets development priorities and provides technical direction and oversight
 - Implementing advanced state-of-the-practice features
 - Identifying and developing capabilities to respond to new policy and investment analysis needs
- Annual scoping and budgeting





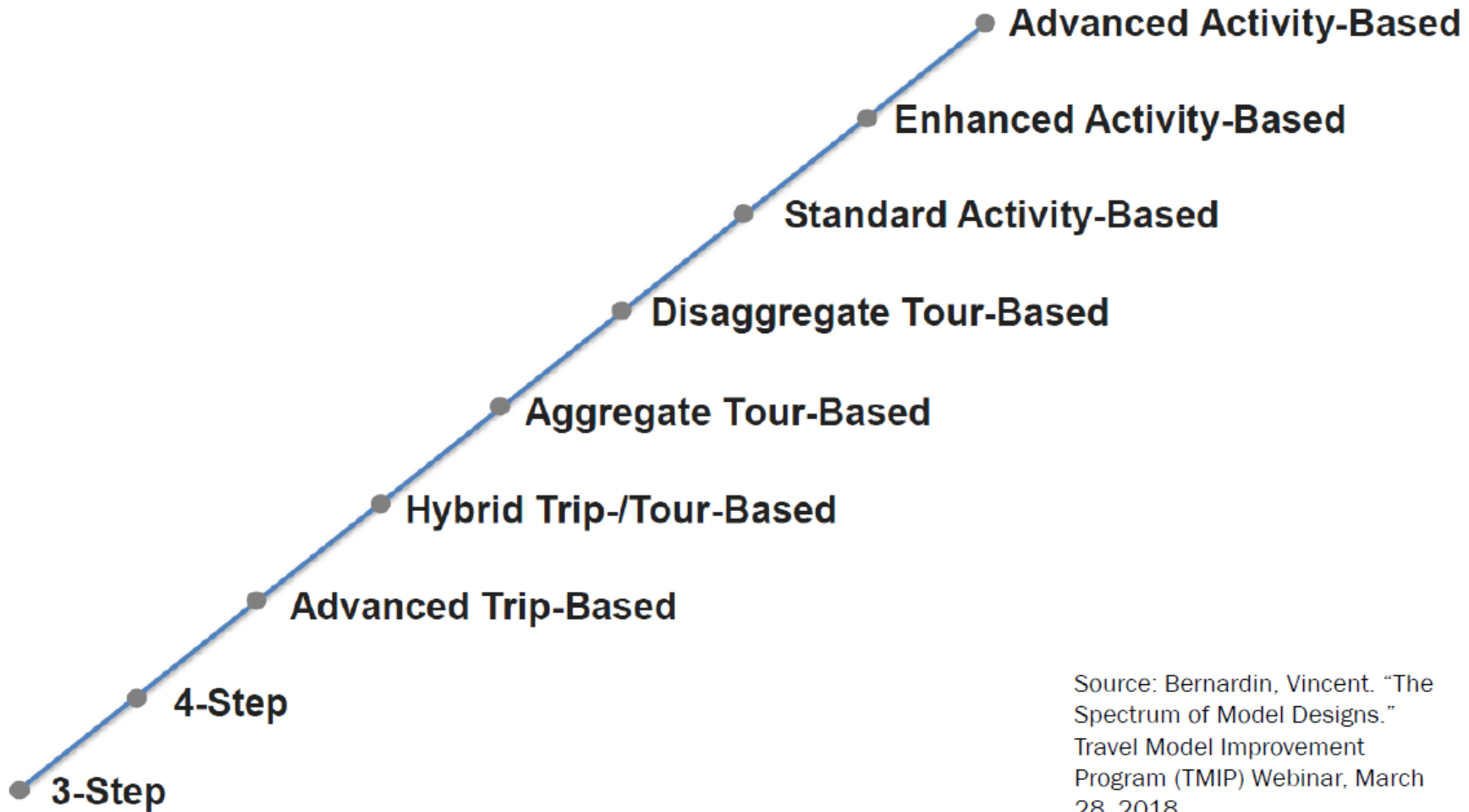
Gen3 model design

Activity-Based Models

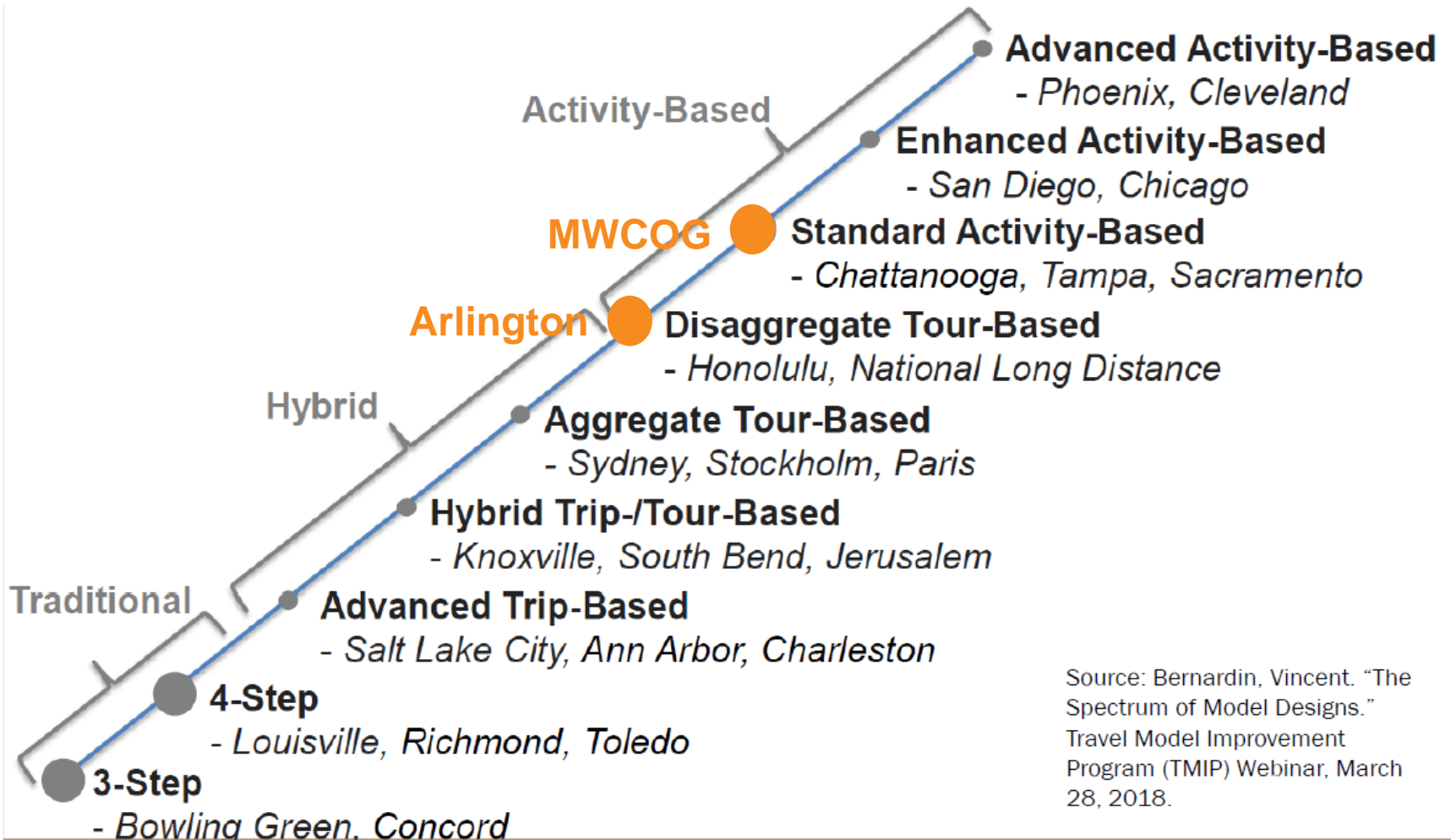
- Predict demand for travel
 - Activity participation
 - Activity locations
 - Travel modes
 - Time-of-day
- Inputs
 - Synthetic population
 - Population, employment and land use
 - Network performance (travel times, costs, transfers, etc.)
 - Behavioral assumptions
- Mostly discrete choice model components
- Disaggregate
 - Individual persons and households modeled
 - Synthetic travel diaries output



Spectrum of Model Designs



Spectrum of Model Designs



Key differences between 4-step model and activity-based model

Trip-Based

- Trips are generated from zonal aggregations of households
- Each trip is independent of every other trip's generation, distribution, mode and timing
- Timing/direction of trips is not an explicit choice (fixed factors)
- Market stratification limited by ability to maintain trip tables throughout model stream

Activity-Based

- Simulation of individual households and persons
- Trips are chained—modeled as part of tours, sub-tours and larger daily activity patterns
- Starting and ending time of activities are modeled choices
- Market stratification is a function of individual and household attributes

Source: Outwater, Maren, and Joel Freedman. "Activity-Based Modeling, Session 1: Executive Perspective." Travel Model Improvement Program (TMIP) Webinar, February 2, 2012. <https://tmip.org/webinars>.



Key difference between disaggregate tour-based and activity-based models

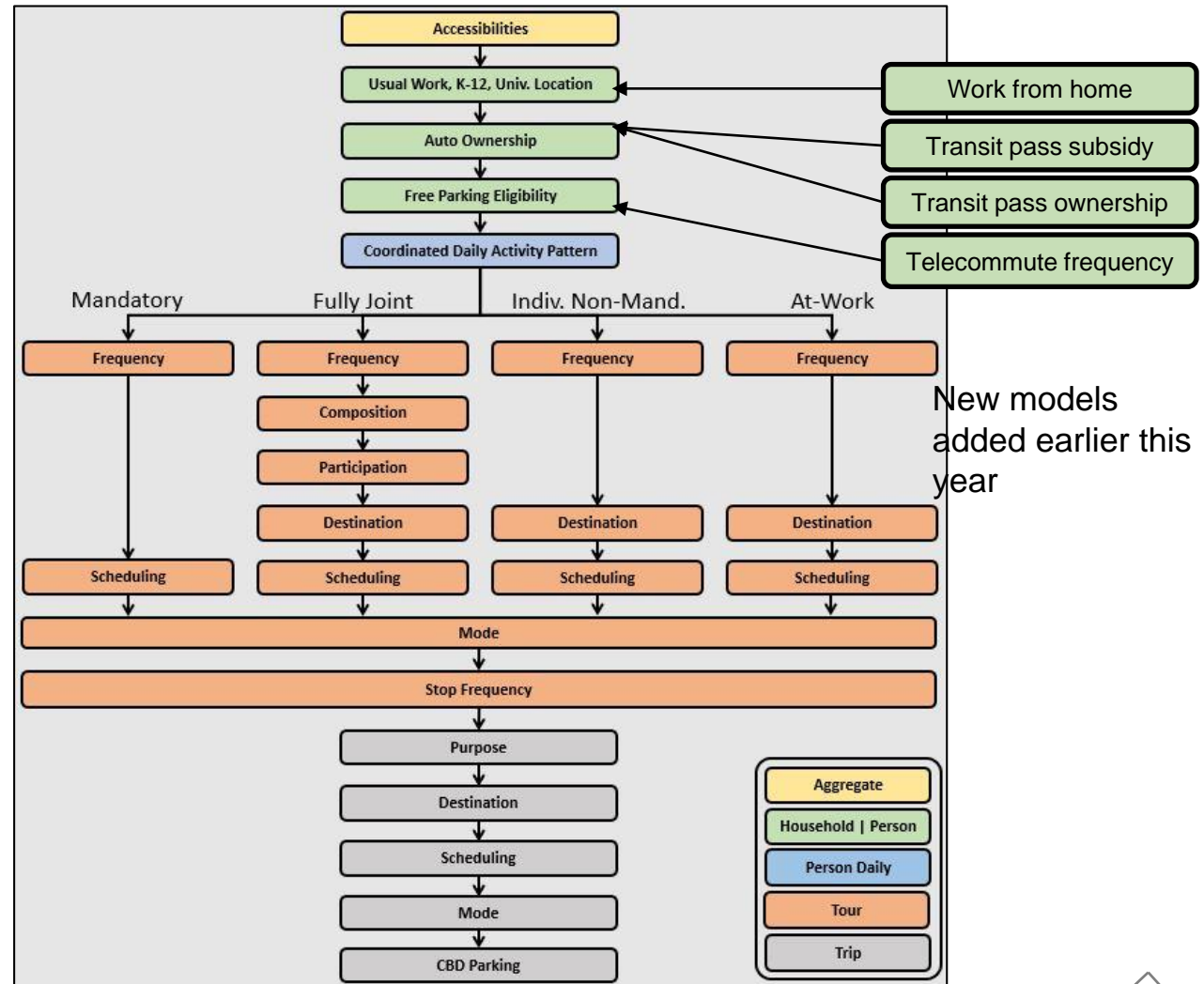
- Tour-based models typically treat tours independently once they are generated; some models only consider households (not persons)
- An activity-based model attempts to schedule activities into time windows; accounting for time at person level
 - Implications for peak spreading effects, responses to changes in travel time and cost by time of day, etc.
 - Implications with respect to modeling age effects, work/student status, ride-sharing, etc.



ActivitySim Example Structure & Components

Example Model Steps

- Accessibilities
- Work and school location
- Auto ownership and parking
- Daily activity patterns (intra-HH)
- Individual tours, joint tours, and stops by activity purpose
 - Frequency
 - Composition
 - Participation
 - Scheduling
- Tour and trip destination choice
- Tour and trip mode choice



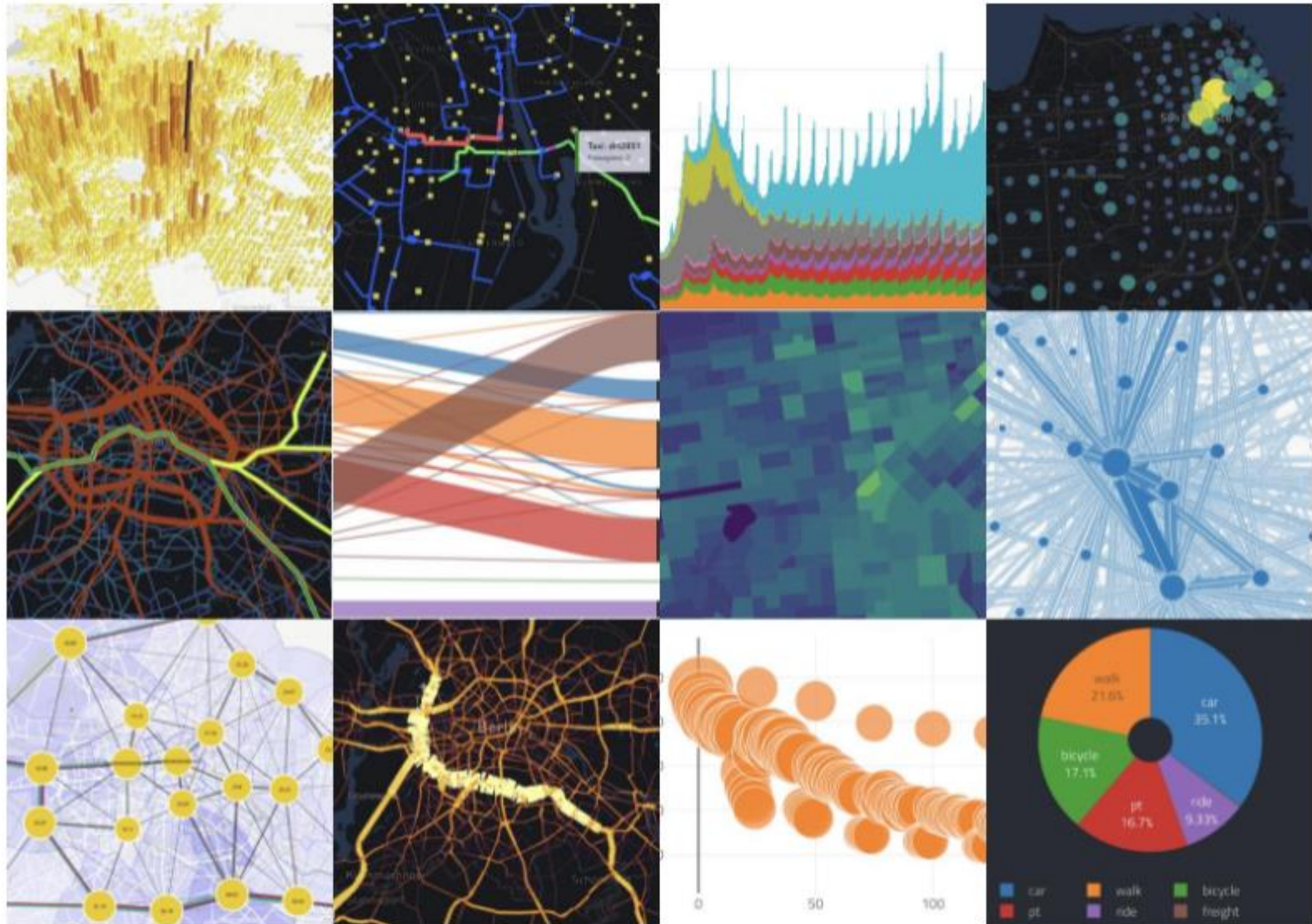
Currently under development

- Vehicle type model
 - Body type x Age x Fuel type
 - Purpose: more explicit modeling of auto operating cost and estimation of greenhouse gas emissions
 - Extension to AVs forthcoming
- Software development tools
 - Repository moved to conda-forge (easier to install and maintain)
 - Benchmarking via airspeed velocity Python package, to ensure that code changes do not unnecessarily affect runtime
- Output visualization toolkit



What is SimWrapper?

SimWrapper is a unique, web-based data visualization tool for researchers building disaggregate, transportation simulations with software such as MATSim and ActivitySim.



Future enhancements (Q4 2021-2022)

ID	Feature Orange - related to finishing version 1.0 Black - potential improvement for next version Grey - not prioritized at this time	Type	Rank your top 10)					Points	Refine	LOE	230	Funding Allocation										Average	Average with zeros	LOE Share	Share of Total	Seed Suggestion
			MET COUNCIL ARC	MTC	ODOT	PSRC	SANDAG					SEMCOG	SFCTA	MET COUNCIL ARC	MTC	ODOT	PSRC	SANDAG	SEMCOG	SFCTA						
35	Complete estimation mode for trip models	Refinement	1	1	1	1	58	Ben, Jeff	\$40	174	25	30	30	40	40	30	30	40	33	33	83%	13%	35			
9	Telecommute model in cooperation with SEMCOG	Refinement	3	2	9		56	Ben, Joel	\$10	43	10	10	10	10	10	20	20	10	13	13	125%	5%	10			
30	Time of day modeling restructuring (design for v2)	Refinement			4		36	Alex	\$30	130	25	25		20	20	20	20	21	19	63%	8%	25				
32	Vehicle types model (Household-level)	Vehicle Modeling	5	3	4	5	34	Wu, Joe	\$25	109	10	10	20	25	25	25	10	25	19	19	75%	8%	20			
41	Visualization (just reporting improvements, not a website)	Refinement	10	6	6		29	Bill	\$35	152	35	25	25	25	20	25	25	0	23	23	64%	9%	25			
25	Model calibration - partial automation	Refinement	9	9	10	10	23	Ben, Joel	\$10	43	10	10	10	10	10	20	20	10	13	13	125%	5%	10			
17	Transit pass ownership in cooperation with SEMCOG	Refinement			4	4	21	Ben, Jeff	\$25	109	10	20	10	10	25	20	20	25	18	18	70%	7%	20			
40	Performance enhancements	Usability			9	2	17	Joe, Alex	\$20	87	10	10	5	5	10		0	15	8	7	34%	3%				
8	Explicit school escorting / drop-off model	Refinement	6		7	6	14	Ben, Jeff	\$35	152	5	10	15	5	30	30	10	35	18	18	50%	7%	20			
1A	Vehicle tracking (Household-level) design and scope	Vehicle Modeling					13	Dennis, Wu	\$20	87	5	10					0	4	2	2	9%	1%				
31	Multiple Models Management System	Management	8		5		12	Ben	\$25	109	10	20	20	20	10	20	10	10	15	15	60%	6%	25			
16	Air passenger model design and scope	Ancillary Models	7	10		7	12	Ben	\$20	87		10			5	0	5	5	3	3	13%	1%				
24	ActivitySim input checking and error handling (+ some pipeline improvements)	Refinement					9	Ben, Joel	\$20	87	5	10	5	5	5	0	5	5	4	4	22%	2%				
15	Standard Freight / Commerical Goods Movement model review and plan and scope	Ancillary Models				8	7	Ben	\$15	65	20			10	10	15	10	13	8	8	54%	3%				
7	AV and TNC routing review, design, data plan and scope	Vehicle Modeling		7			7	Wu	\$15	65	5	10	15	10	5	15	10	5	9	9	63%	4%				
10	Toll Transponder ownership model design, estimate, calibrate/validate	Refinement					7	Ben	\$20	87	10					0	0	3	1	1	6%	1%				
3	Model workers that work in the model, but live outside like DaySim today	Refinement				9	2	Ben	\$25	109	10	10	30	25	25	25	10	25	20	20	80%	8%	25			
36	Leaner and improved ActivitySim Pipeline (now partially complete)	Refinement																					25			
2	Ability to link with a land use model review and plan and scope	Accessibilities					1											0								
13	Disaggregate accessibilities	Accessibilities					1	TOTAL	\$550	2391	250	250	250	250	250	250	250	250	250	6a	143	Task Total	240			
34	Maintenance and support	Management					0			1043									6b	118	PM	20				
99	version 2 design (time of day, vehicle tracking, AV/TNC, escorting, modeling pricing)						0													260	AMPO	15				





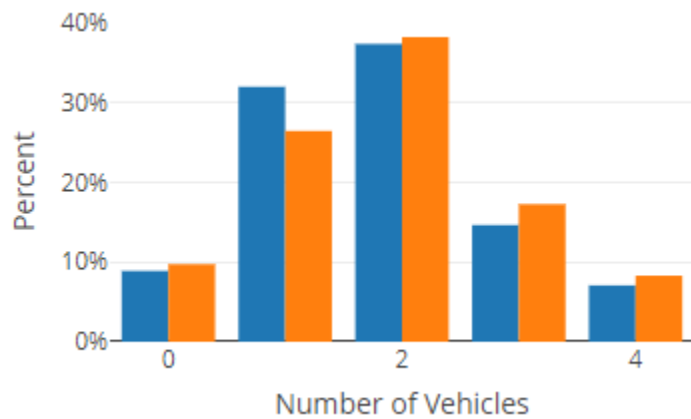
MWCOG Phase I Model Deployment

Phase 1 Development (Task Order 3) Status

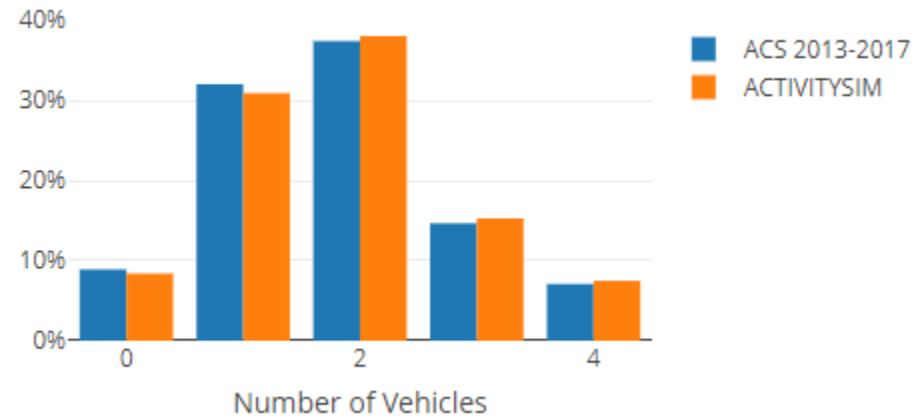
- Model Estimation
 - Estimated tour mode choice and tour destination choice
 - Draft estimation report
- Model Calibration
 - Calibrated auto ownership, tour and trip mode choice, and at-work subtour destination choice models
 - Stop and individual tour frequency model calibration (ongoing)
- Model Validation
 - Preliminary highway validation
 - Transit validation (ongoing)



Phase 1 Calibration – Auto Ownership



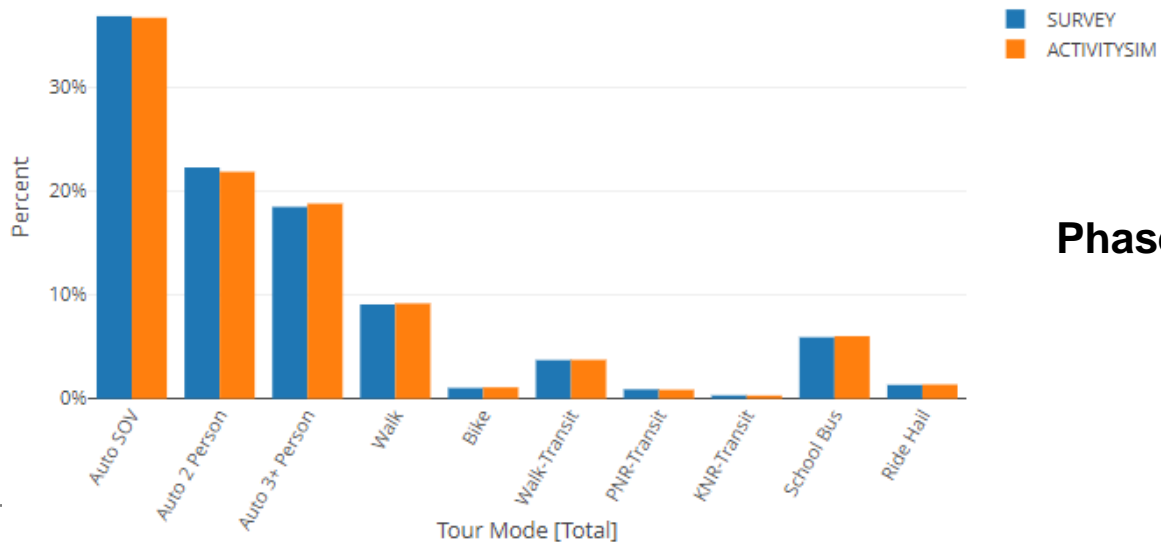
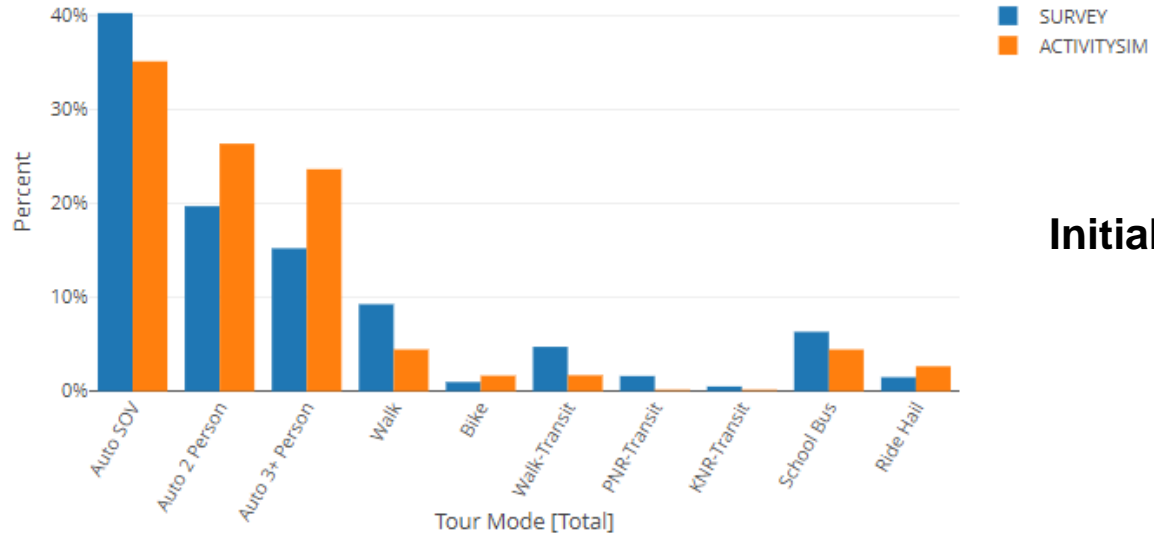
Initial Implementation



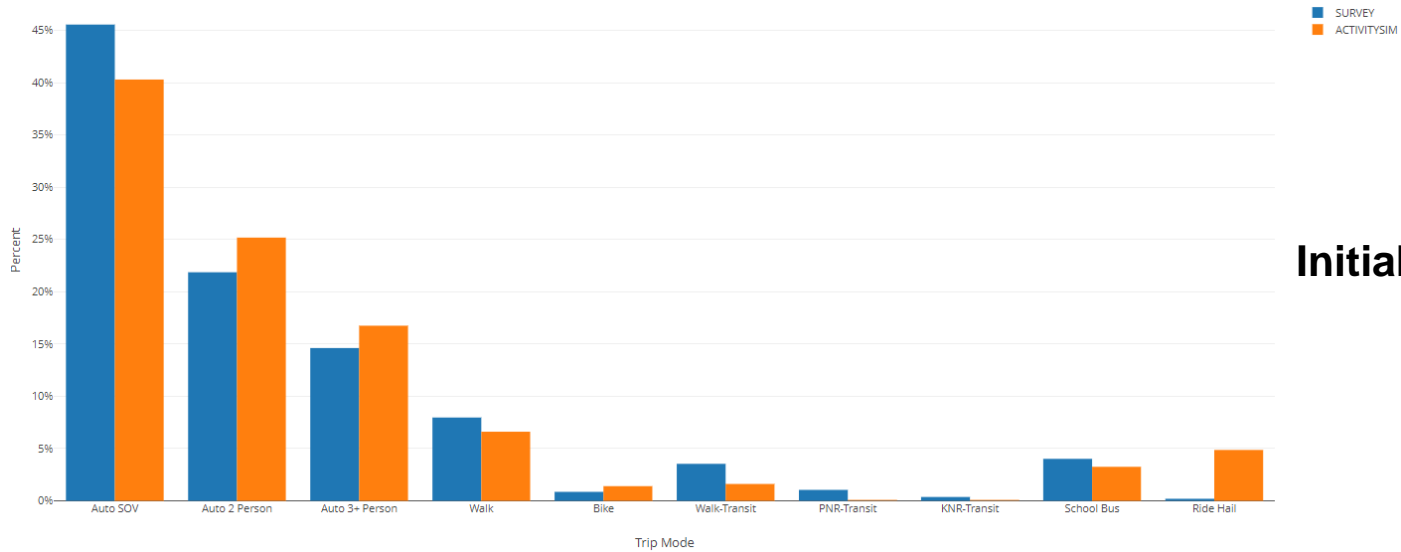
Phase 1 Calibration



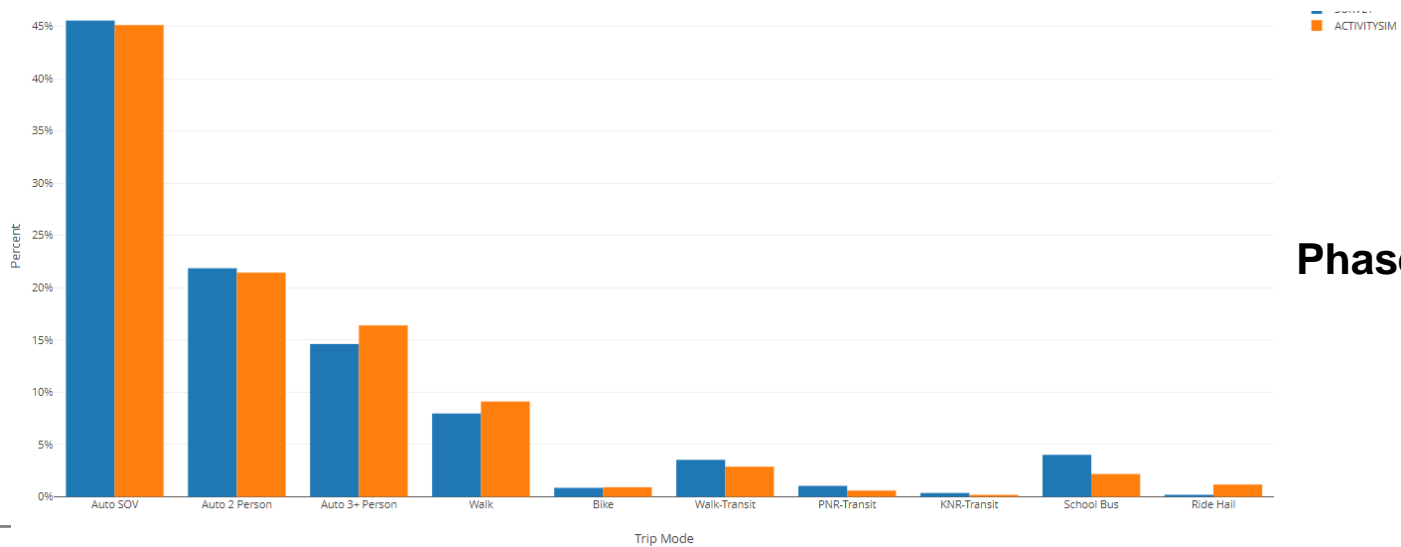
Phase 1 Calibration – Tour Mode Choice



Phase 1 Calibration – Trip Mode Choice



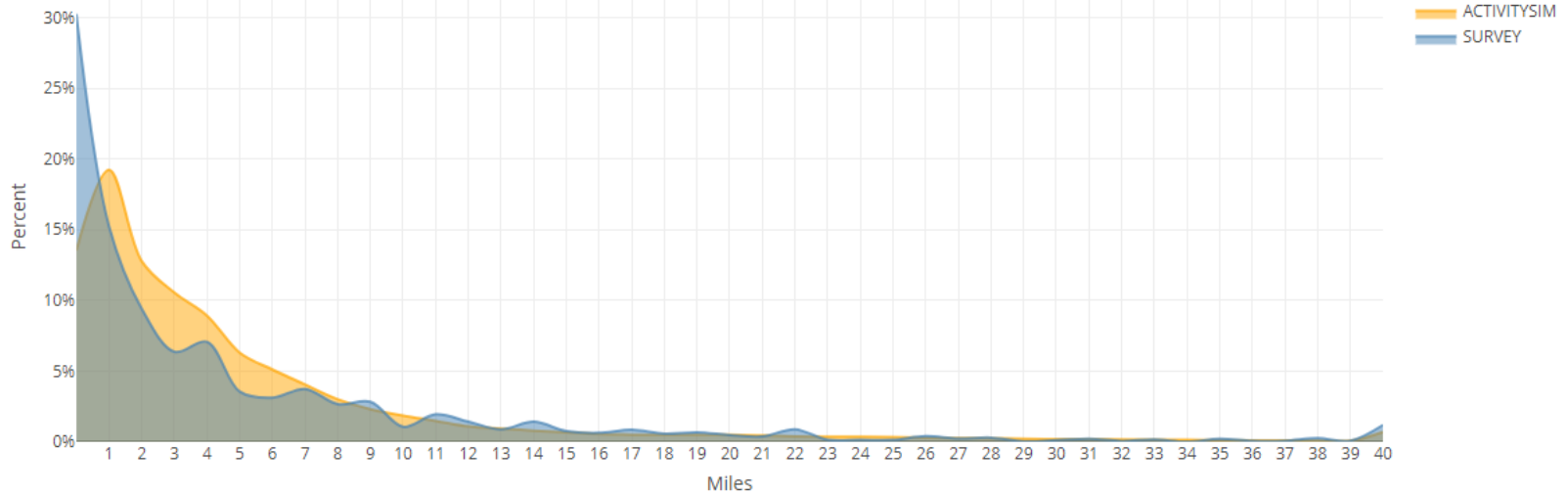
Initial Implementation



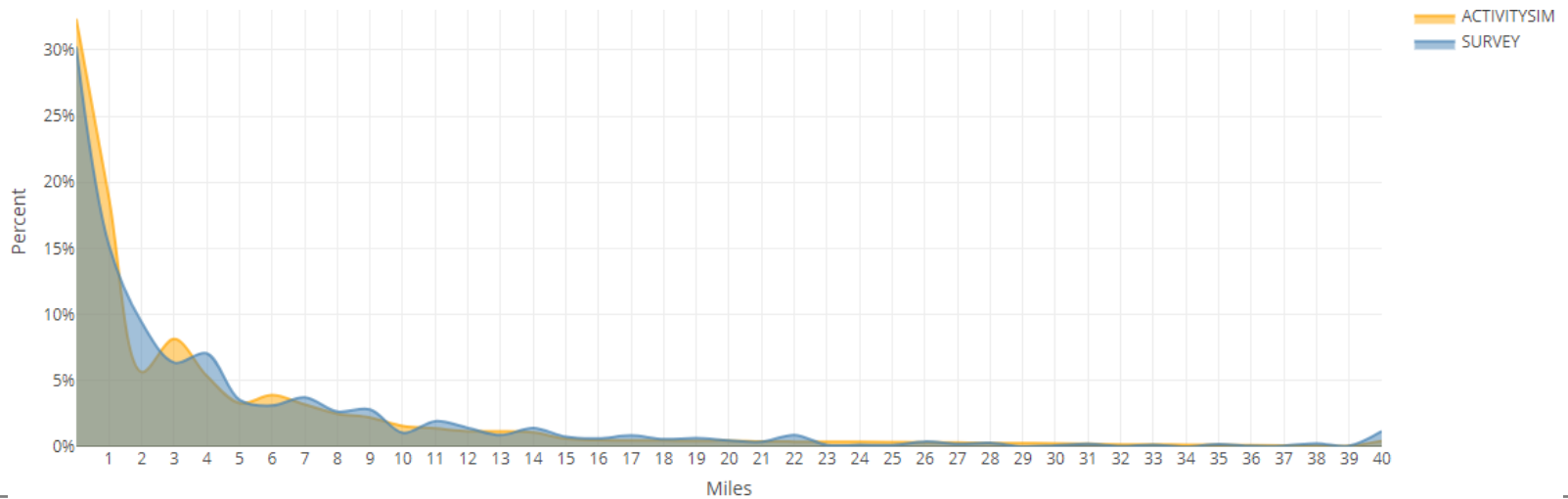
Phase 1 Calibration



Phase 1 Calibration – At-work Subtour Destination



Initial Implementation



Phase 1 Calibration



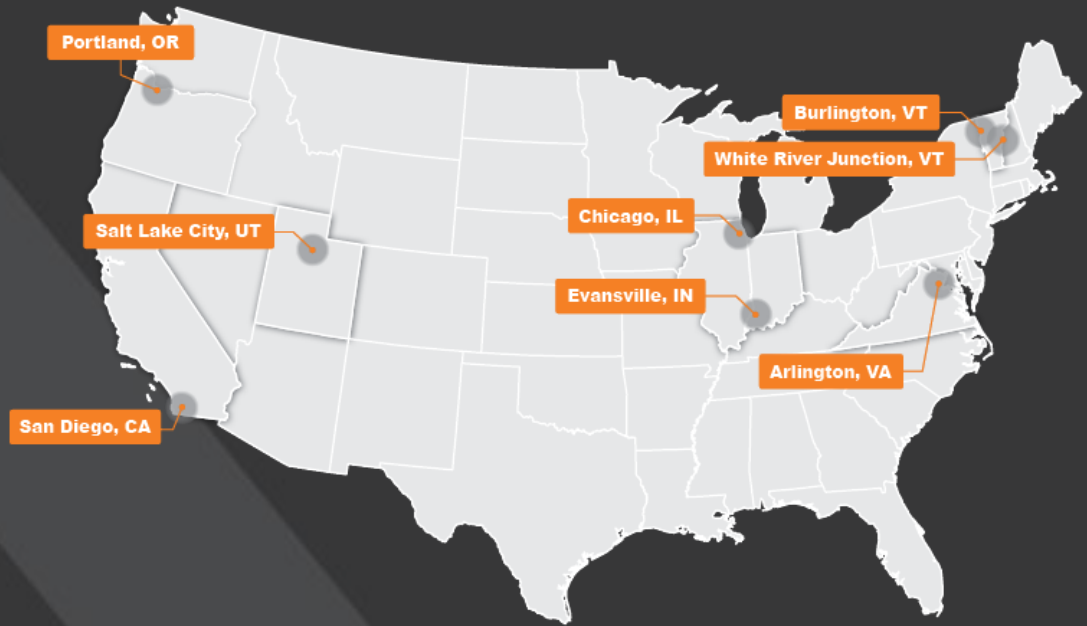
Next Steps

- Calibrate stop frequency and individual non-mandatory tour frequency models
- Finalize transit and highway validation
 - Benchmark highway validation against 2018 Ver. 2.4 Model performance
 - Benchmark transit validation against 2014 Ver. 2.4 Model performance
- Sensitivity testing in December
- Documentation complete by late February
- Starting on scope for Phase II



QUESTIONS?





the science of insight



Joel Freedman

SENIOR DIRECTOR

Joel.Freedman@rsginc.com