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Visum ActivitySim ABM Integration

Metropolitan Washington Council of Governments

March 24, 2023

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AGENDA

01 Introduction

02 Select Visum ABM Users

03 ActivitySim-Visum Integration

04 ABM Output Analysis

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01 Introduction

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ActivitySim

- The world's leading open platform for ABMs
- 20+ years of practical experience in ABM model development, software, and application
- The collective and on-going efforts of 10+ planning agencies with years of cooperation
- Includes PopulationSim for population synthesis
- Comprehensive, full scale, and validated ready-to-go templates for quick and easy setup

https://activitysim.github.io

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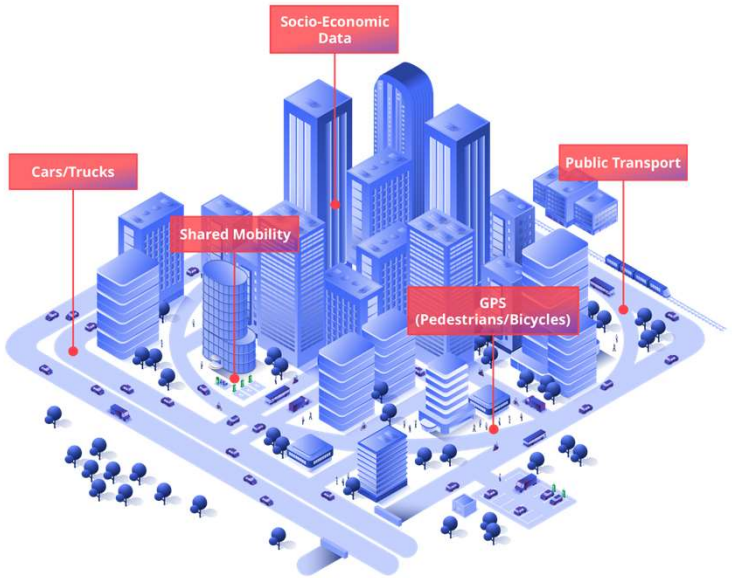
PTV VISUM

- World’s leading transportation planning software
- High-performance algorithms for quick and accurate results
- Detailed traffic flow simulation of large-scale transport networks
- Integrated activity-based demand modeling (ABM)



PTV believes in the benefits of person-centric disaggregate ABMs and has been investing in PTV VISUM for several years to support this more powerful approach to modeling mobility.

Phase 1 for SBB, DVRPC, ODOT, others: data structures and network skimming procedures
Phase 2 for ActivitySim members, RTA, others: integration with ActivitySim

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PTV VISUM 2023 Release

Visum – ActivitySim Integration

PTV VISUM ActivitySim

- ActivitySim Installer
- Direct import from PopulationSim
- Multiple zone system and skimming
- ABM data structures
  - ✓ Locations, households, persons, tours, and trips
- ActivitySim interface in Visum UI
  - ✓ Export ActivitySim inputs
  - ✓ Run ActivitySim
  - ✓ Import ActivitySim outputs
- Assign path probabilities to individual trips
- Integrated data management

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02

Select Visum ABM Users

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Select Visum ABM Users

- **Swiss Federal Railway (SBB)**
  - Switzerland national rail planning model
  - 8mi+ persons; Visum Python-based ABM + matsim

SBB CFF FFS

- **Delaware Valley Regional Planning Commission (DVRPC)**
  - Philadelphia MPO regional planning model
  - 6mi+ persons; PopulationSim + DaySim ABM

DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

- **Oregon Department of Transportation (ODOT)**
  - Southern Oregon MPOs regional planning model
  - 300k+ persons; PopulationSim + CT-RAMP ABM

Oregon Department of Transportation

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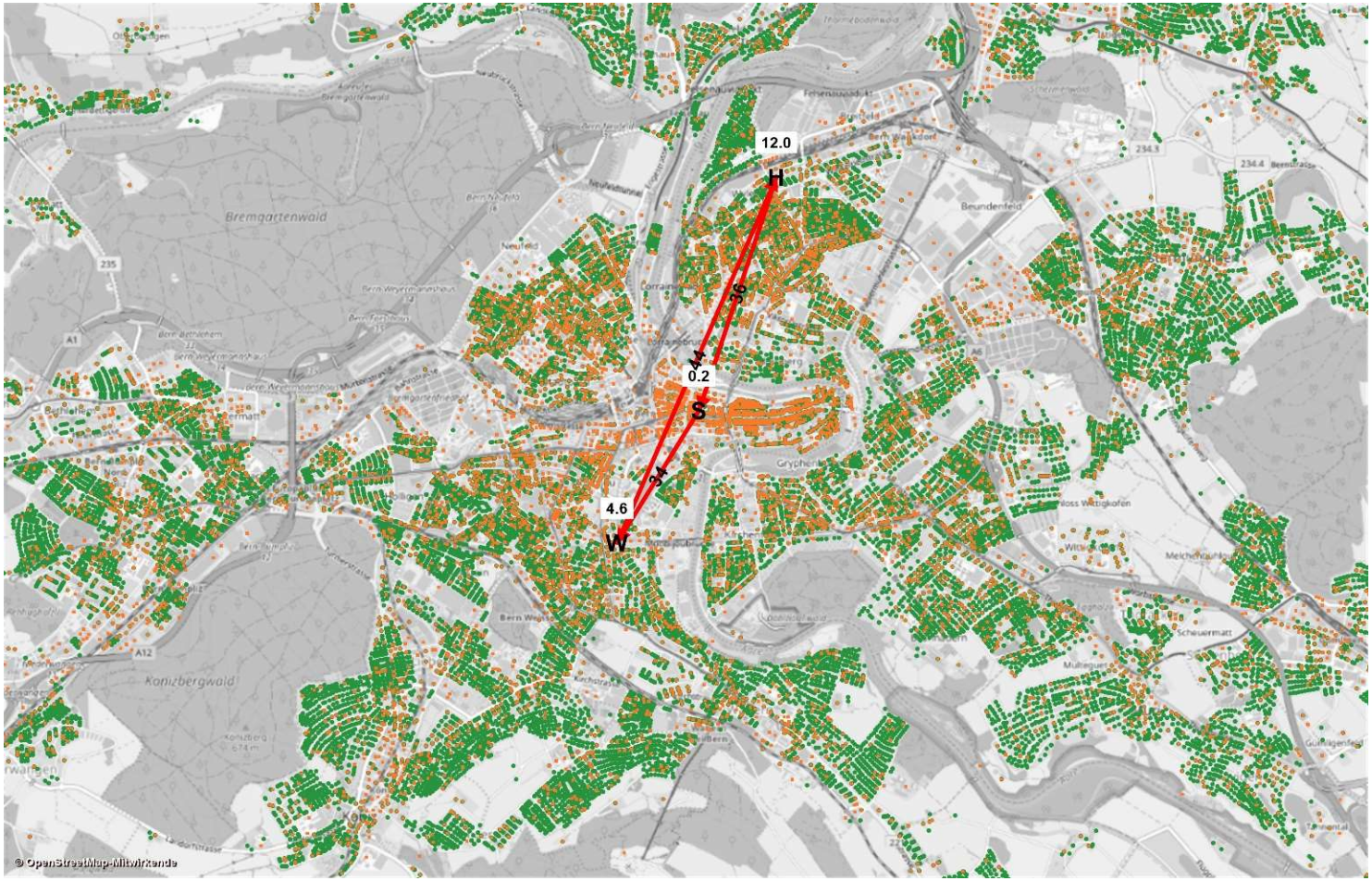
Select Visum ABM Users: SBB CFF FFS



Tracing tours in Visum

- **Details**
  - ID = 1352391
  - Status = Employee
  - Tour = H-S-W-H
- **Activities**
  - H = home
  - W = work
  - E = education
  - S = shopping
  - L = leisure
  - A = accompany/escort
  - O = other

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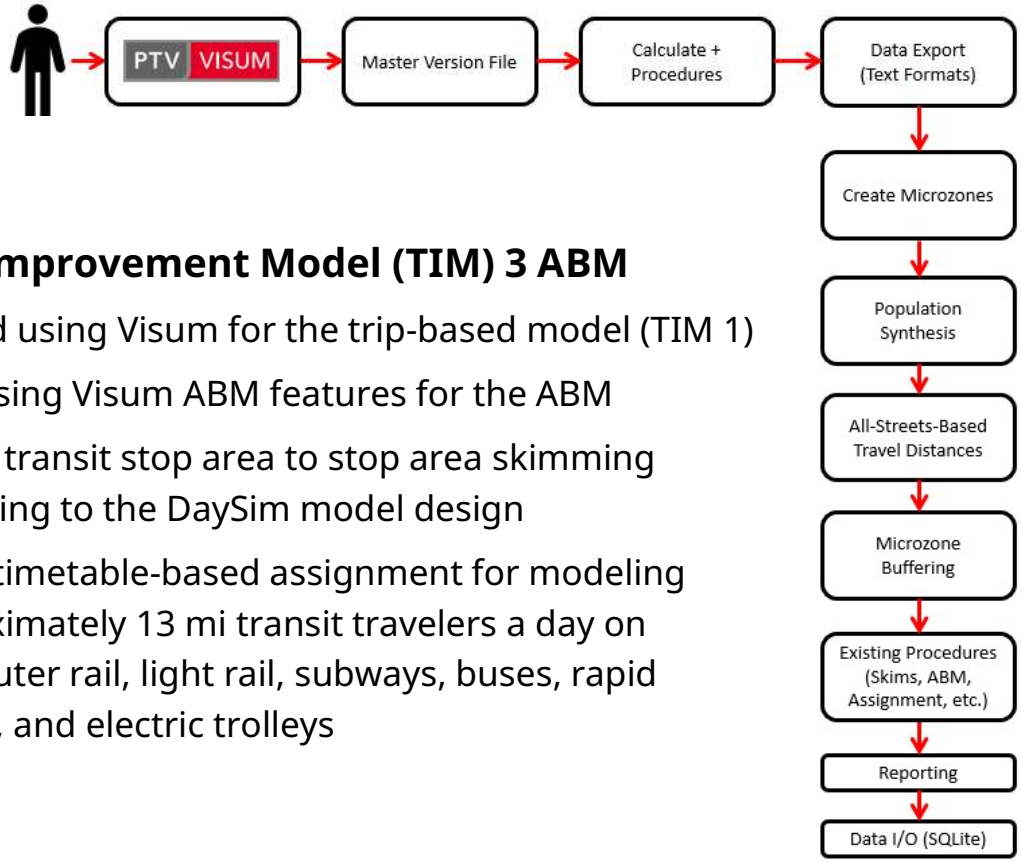
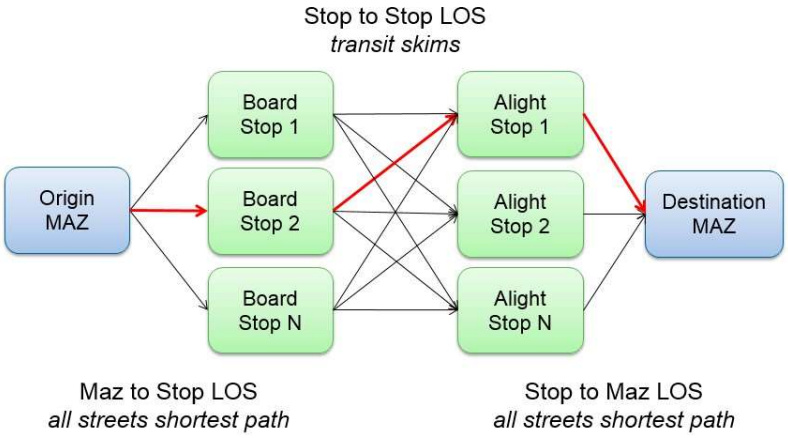
Select Visum ABM Users:

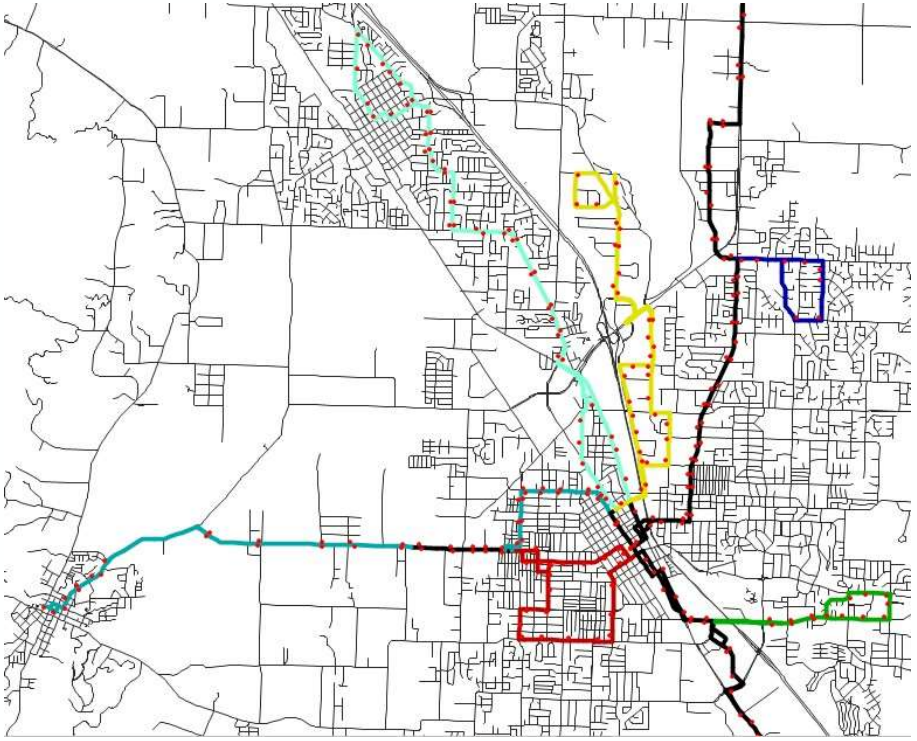


- **Travel Improvement Model (TIM) 3 ABM**
  - Started using Visum for the trip-based model (TIM 1)
  - Now using Visum ABM features for the ABM
  - Added transit stop area to stop area skimming according to the DaySim model design
  - Using timetable-based assignment for modeling approximately 13 mi transit travelers a day on commuter rail, light rail, subways, buses, rapid transit, and electric trolleys

Select Visum ABM Users: Oregon Department of Transportation

- **ODOT SOABM for RTP planning**
  - Includes Visum transit stop area to stop area skims for three-zone system ABM design
  - Includes transit virtual path building (TVPB) in the ABM





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03

ActivitySim Visum Integration

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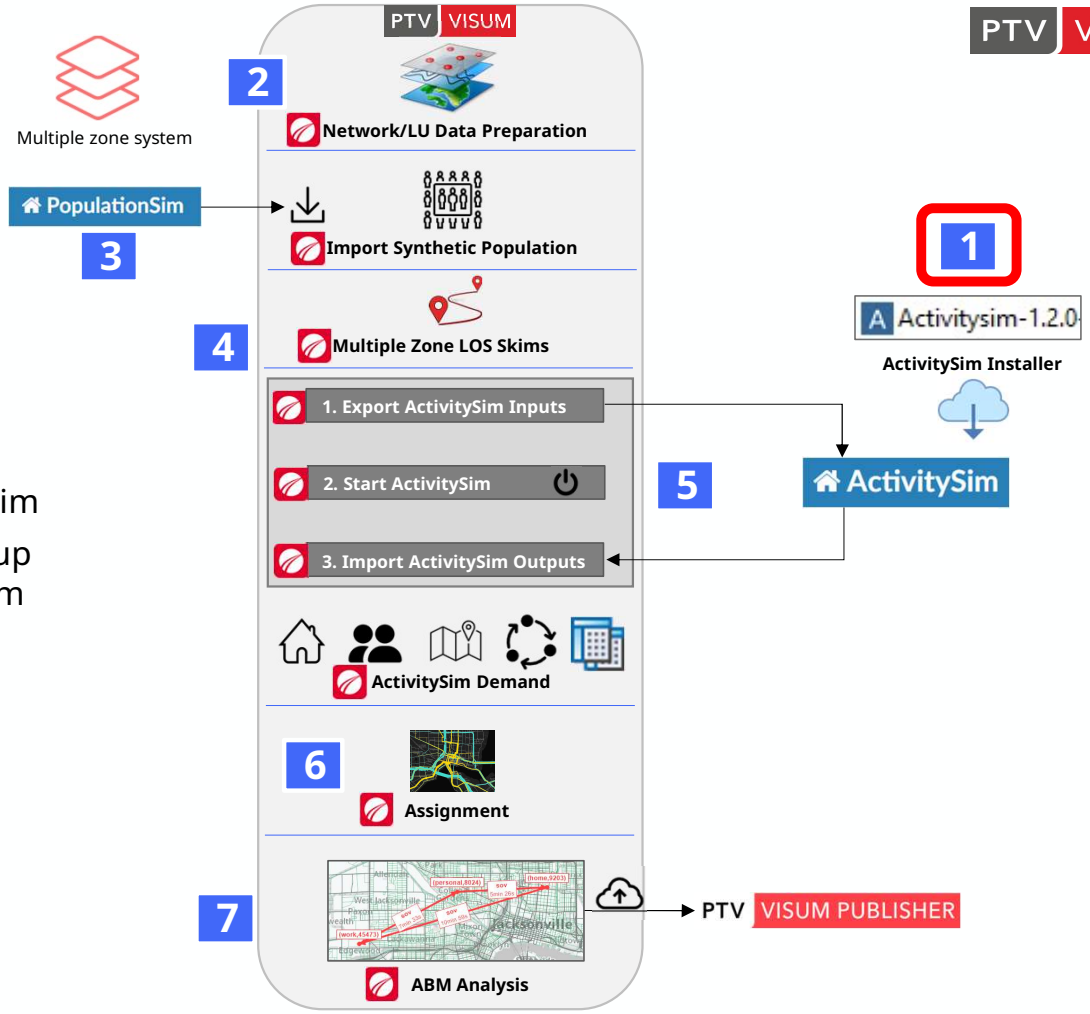
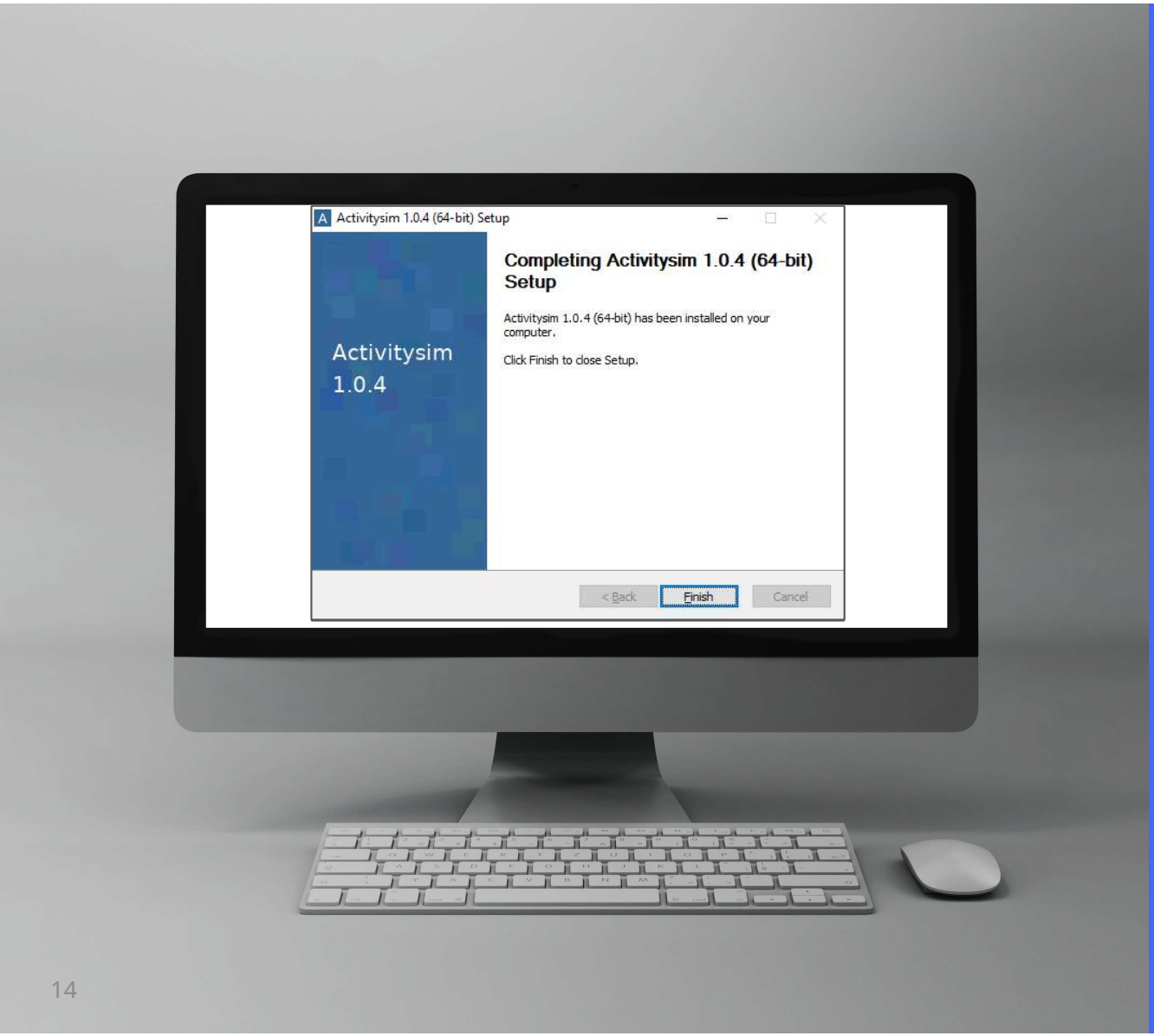
Visum – ActivitySim Integration

ActivitySim Installer

- Download from ActivitySim
- Ensures a consistent setup for integration with Visum



Installing ActivitySim



- Run the downloaded installer
- Keep default settings if not an advanced user
- Note the installation location
- Creating a custom environment not necessary

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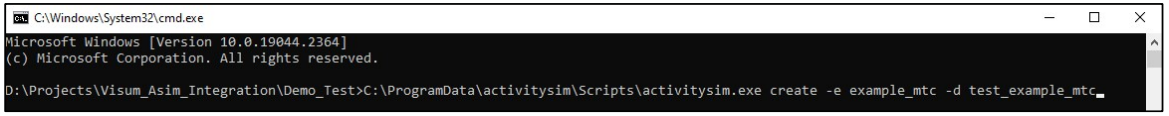
ActivitySim Installer

Accessing ActivitySim Examples

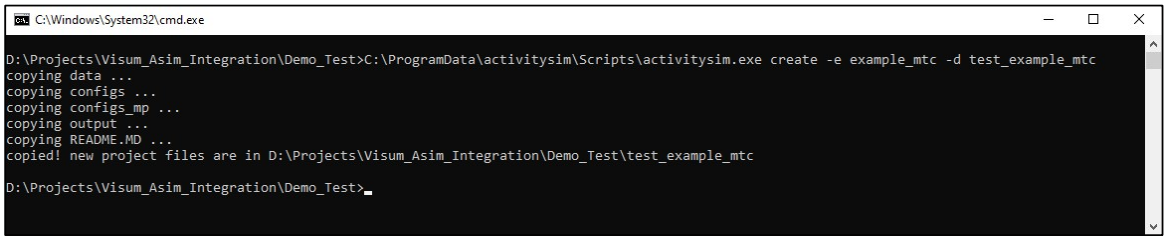
- Follow the instructions from ActivitySim User's Guide
  - Use the installed ActivitySim executable
  - Check if the example is available in the installed version of ActivitySim

1. Open a CMD window in the target directory and run the following command:

C:\ProgramData\activitysim\Scripts\activitysim.exe create –e example_mtc –d test_example_mtc

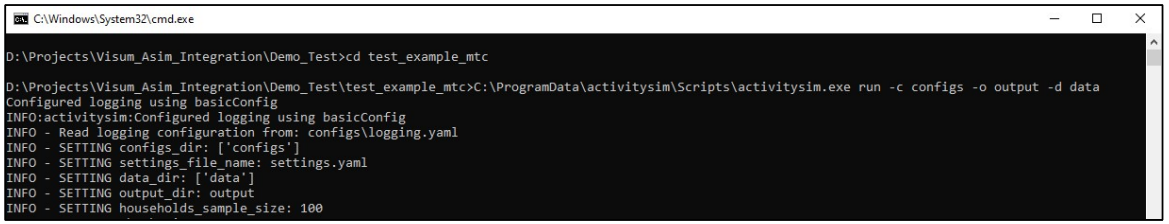


2. Example setup gets copied to the target directory:



3. Run the example from the CMD using the following command:

C:\ProgramData\activitysim\Scripts\activitysim.exe run –c configs –o output –d data



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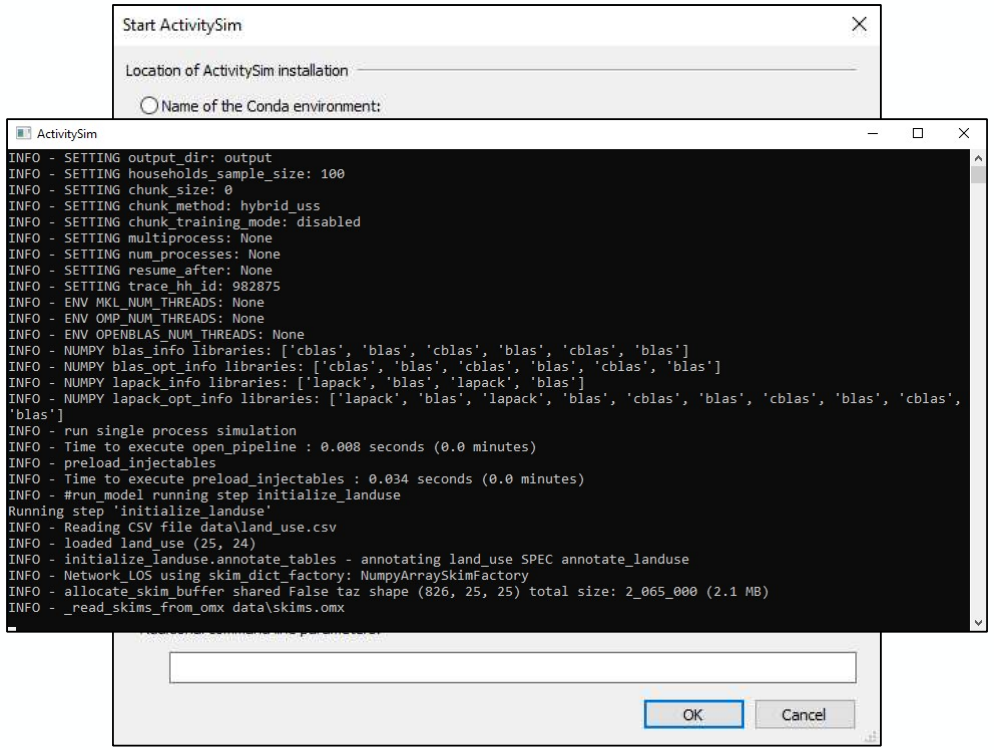
ActivitySim Installer

Running the Example from Visum

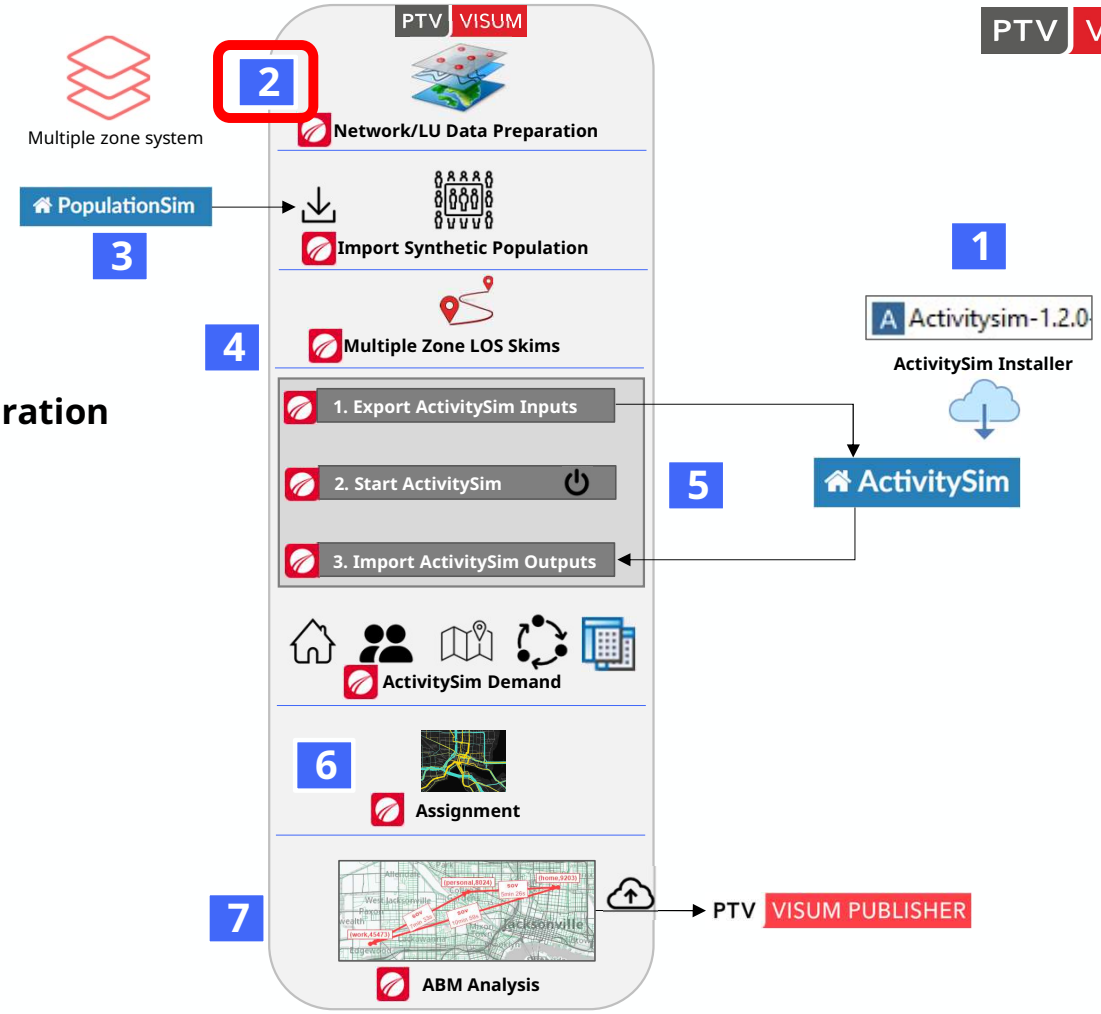
- Add a “Start ActivitySim” procedure
- Point to installed ActivitySim location
- Configure directories
- Run procedure



Visum – ActivitySim Integration

Network/LU Data Preparation

- Zone systems
- Data management



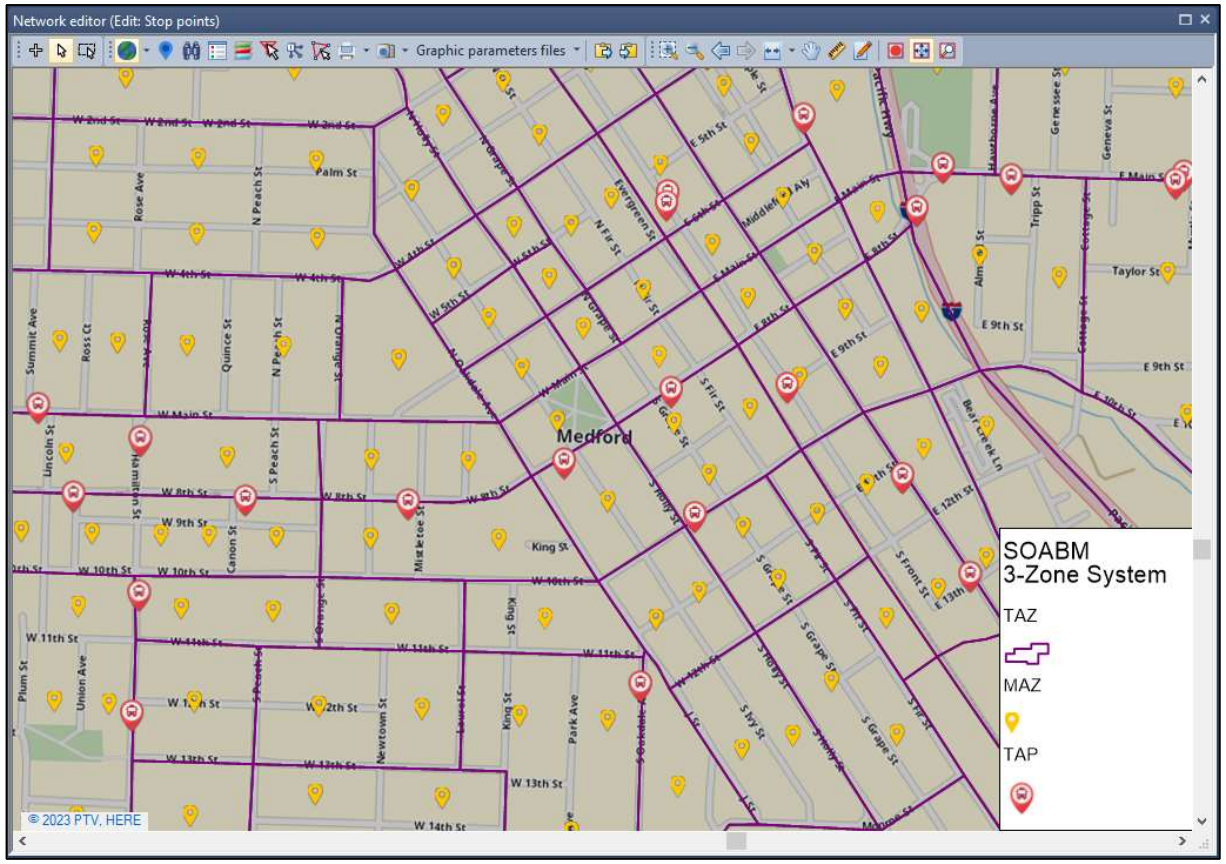
Multiple Zone System

ActivitySim works with multiple zone system configurations

Zone System	Geographies	Example
One	TAZ	MTC TM1
Two	TAZ, MAZ	Jacksonville
Three	TAZ, MAZ, TAP	SOABM

Representation of ActivitySim geographies in Visum

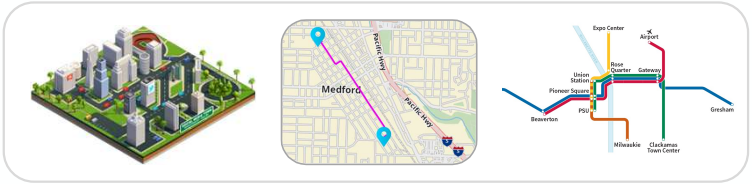
ActivitySim Geography	Visum Network Object
TAZ	Zones
MAZ	Disaggregate Locations (xy)
TAP	Stop Areas



TAZ: Traffic Analysis Zone, MAZ: Micro Analysis Zone, TAP: Transit Access Point

Managing Data for ActivitySim

ABM Supply Data



- Auto network
- Transit network
- Land use data

ABM Demand Data

- Households & persons
- Activities
- Tours & trips

PTV Visum provides an integrated demand and supply data model for efficient and user-friendly management of all model data

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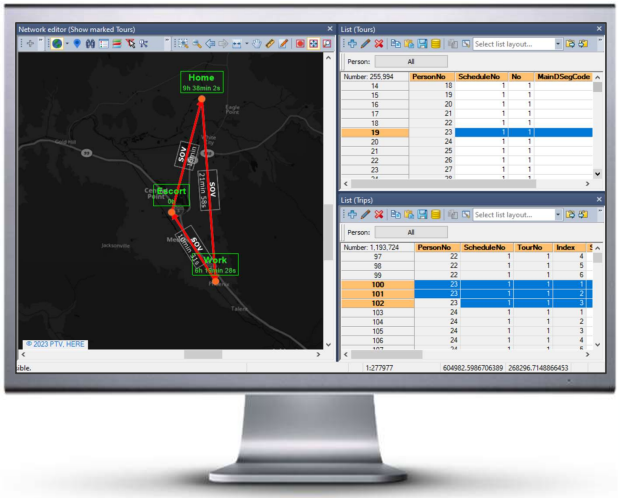
Integrated Demand and Supply Data Model

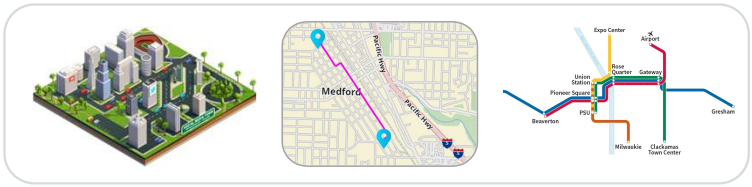
- First-of-its-kind in the market!
- Manage the disaggregate demand and supply data at the same time using the integrated data model
- Relational database with advanced features to edit and visualize data

Integrated Supply/Demand Data Model



ABM Demand

Fully Connected Database

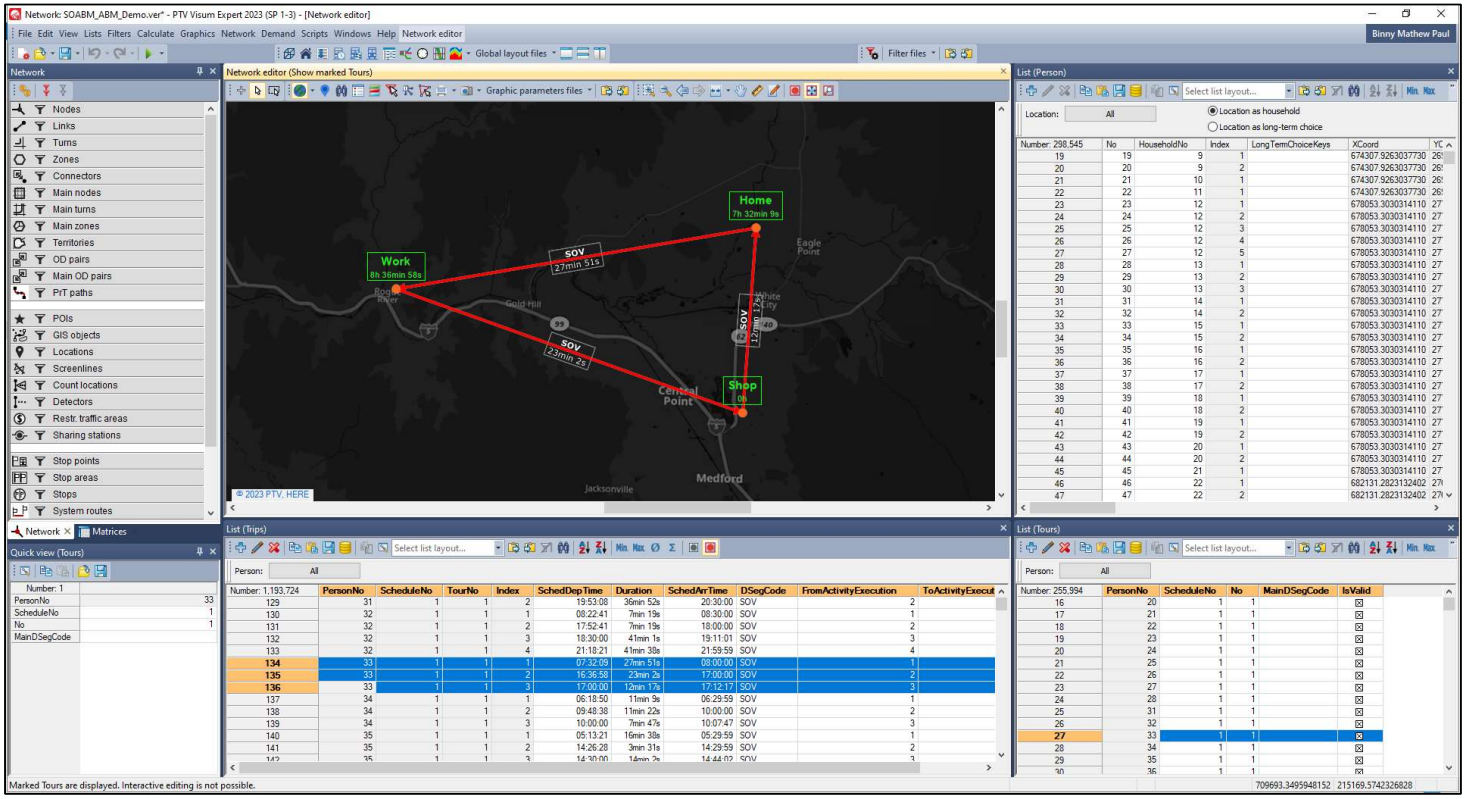


ABM Supply

Demand Objects for ABM

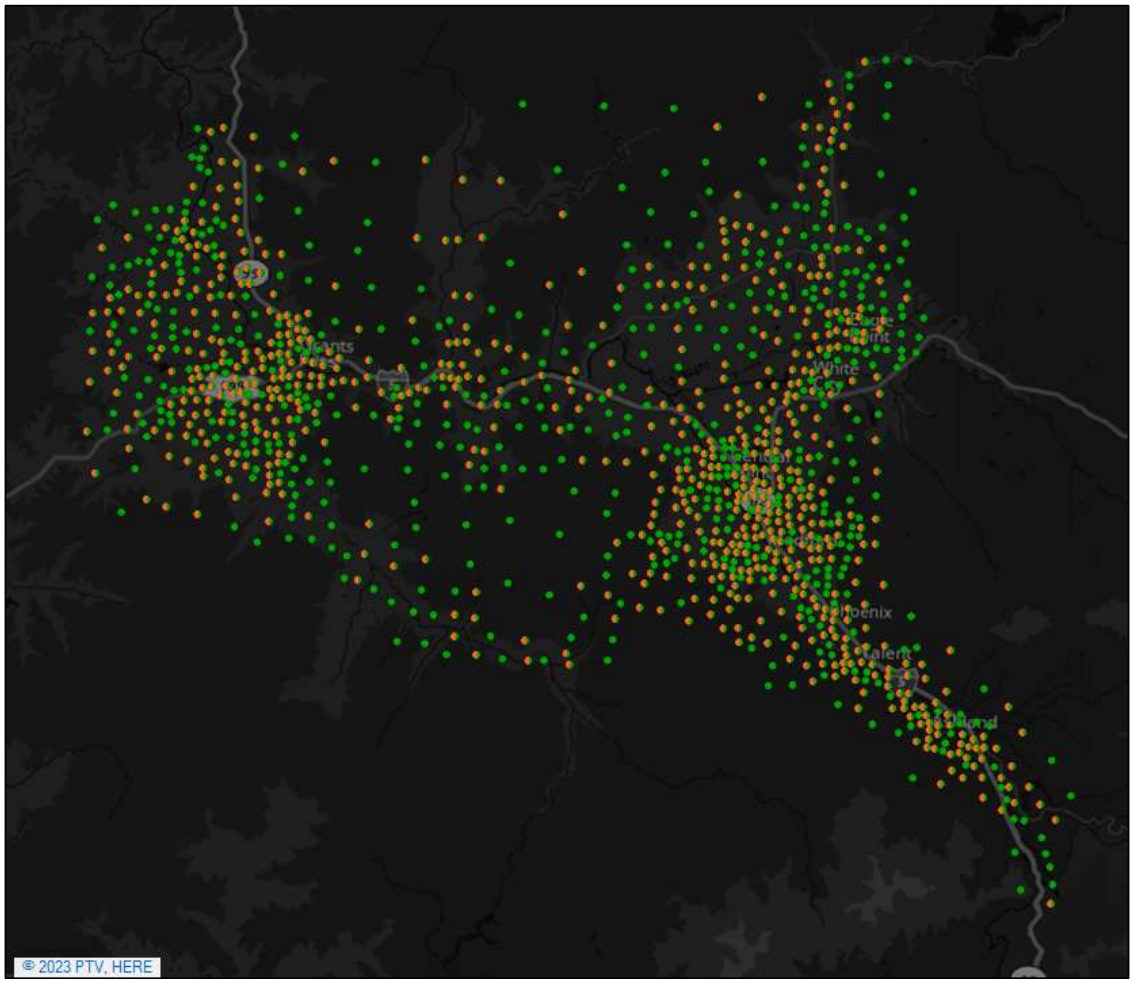
Relational data tables store disaggregate model components as objects

- Locations
- Activity Locations
- Households
- Persons
- Schedules
- Activity Executions
- Tours
- Trips



Example – Home and Work Locations in Southern Oregon

Process ABM demand to generate validation summaries and charts



Home Locations = Green

Work Locations = Orange

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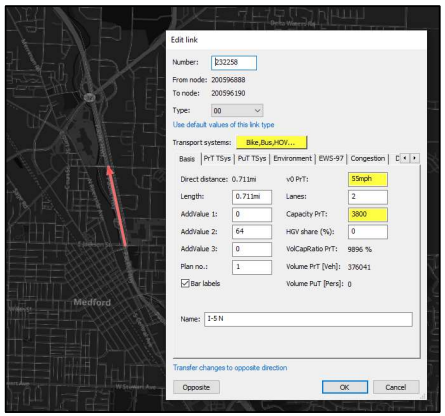
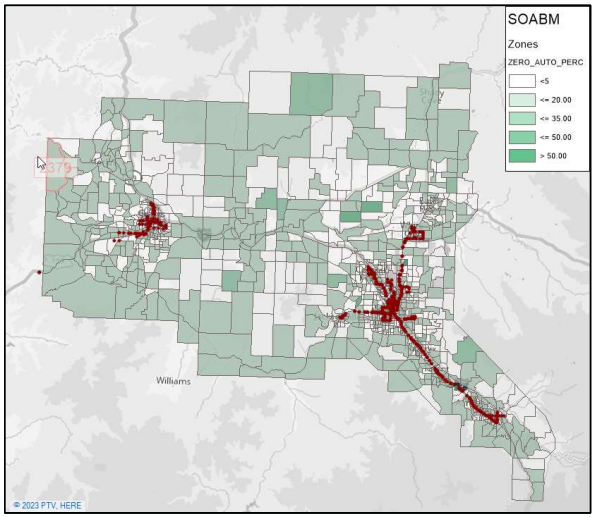
Key Features of Visum Data Model



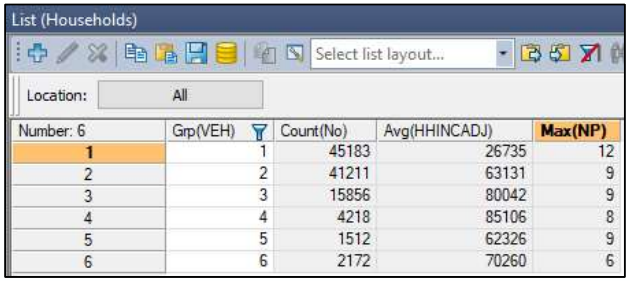
Interactive Editing

- Spatial data changes are passed down to connected databases



Connect Supply & Demand

- Create validation summaries using supply and demand data



Number: 6	Grp(VEH)	Count(No)	Avg(HHINCADJ)	Max(NP)
1	1	45183	26735	12
2	2	41211	63131	9
3	3	15856	80042	9
4	4	4218	85106	8
5	5	1512	62326	9
6	6	2172	70260	6

RDBMS Style Processing

- Perform filter, join, group-by, and aggregation operations on supply and demand data tables

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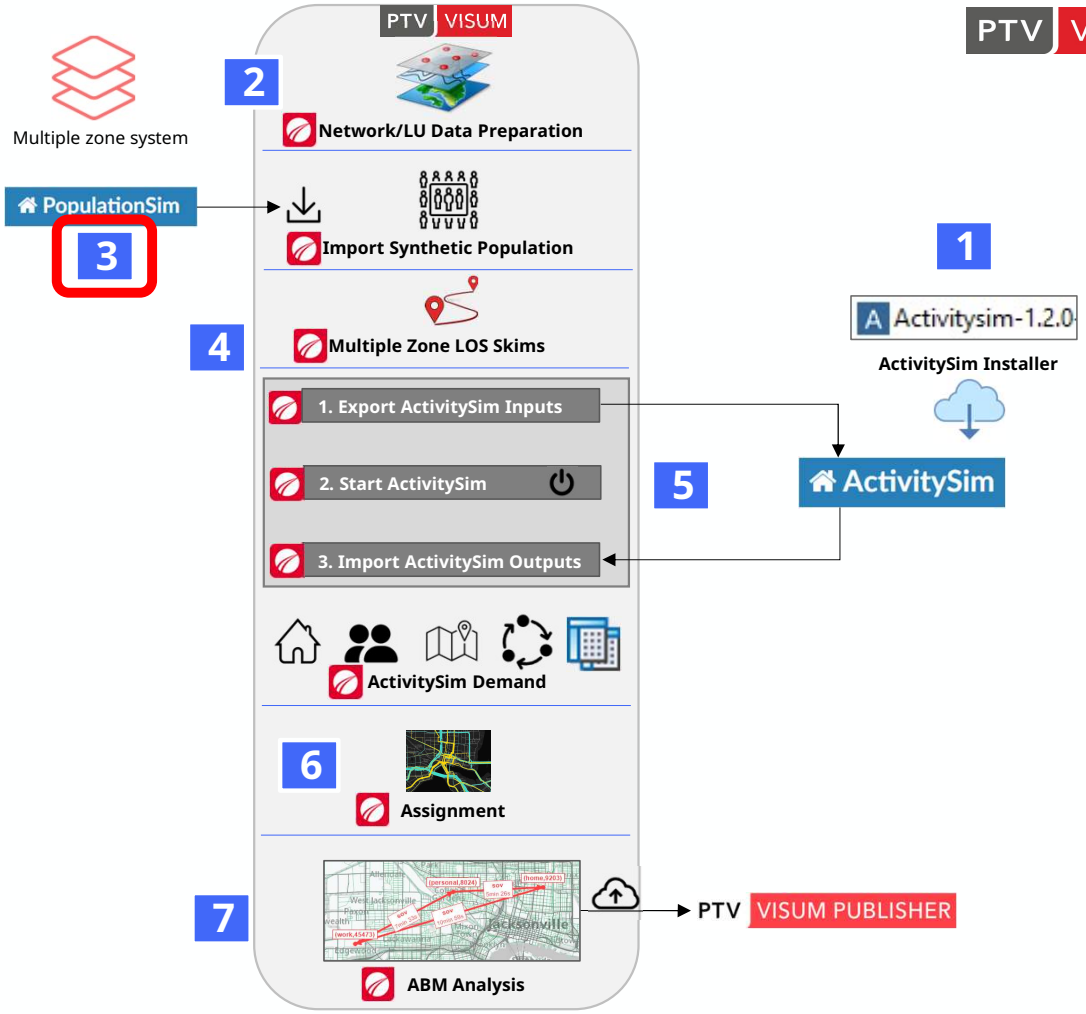
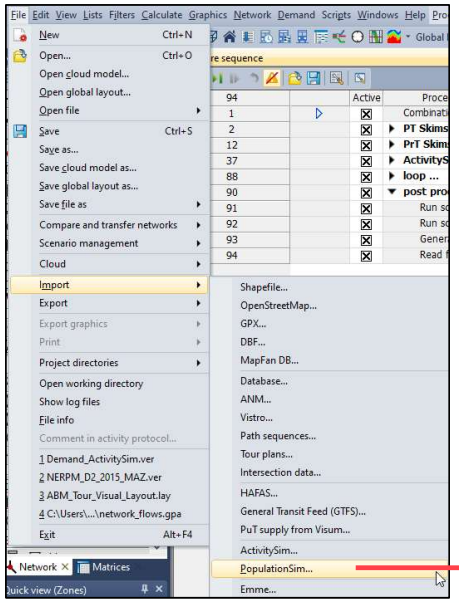
Visum – ActivitySim Integration

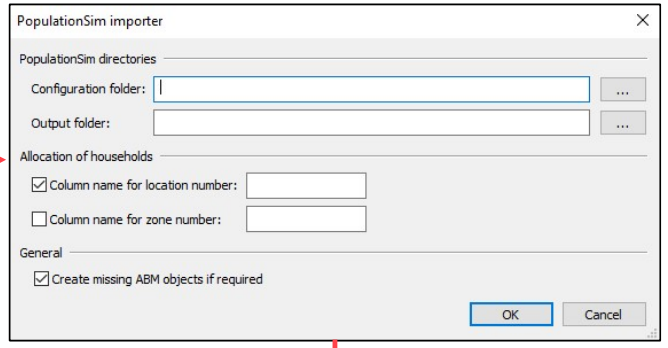


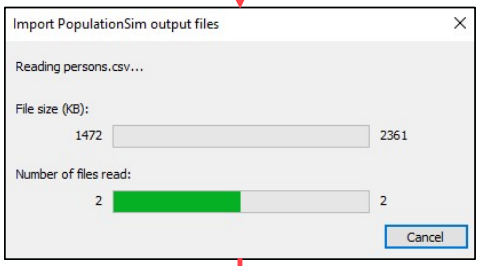
Import Synthetic Population

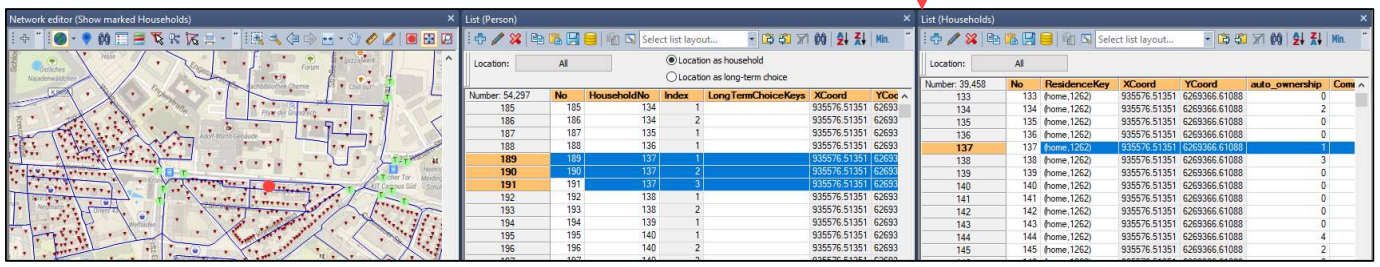
Customized PopulationSim Importer

- The finest spatial units are read in as locations or zones
- Location and zone numbers must match
- Persons and households are imported into **ABM Data Structures** in Visum
- Automate using Python API









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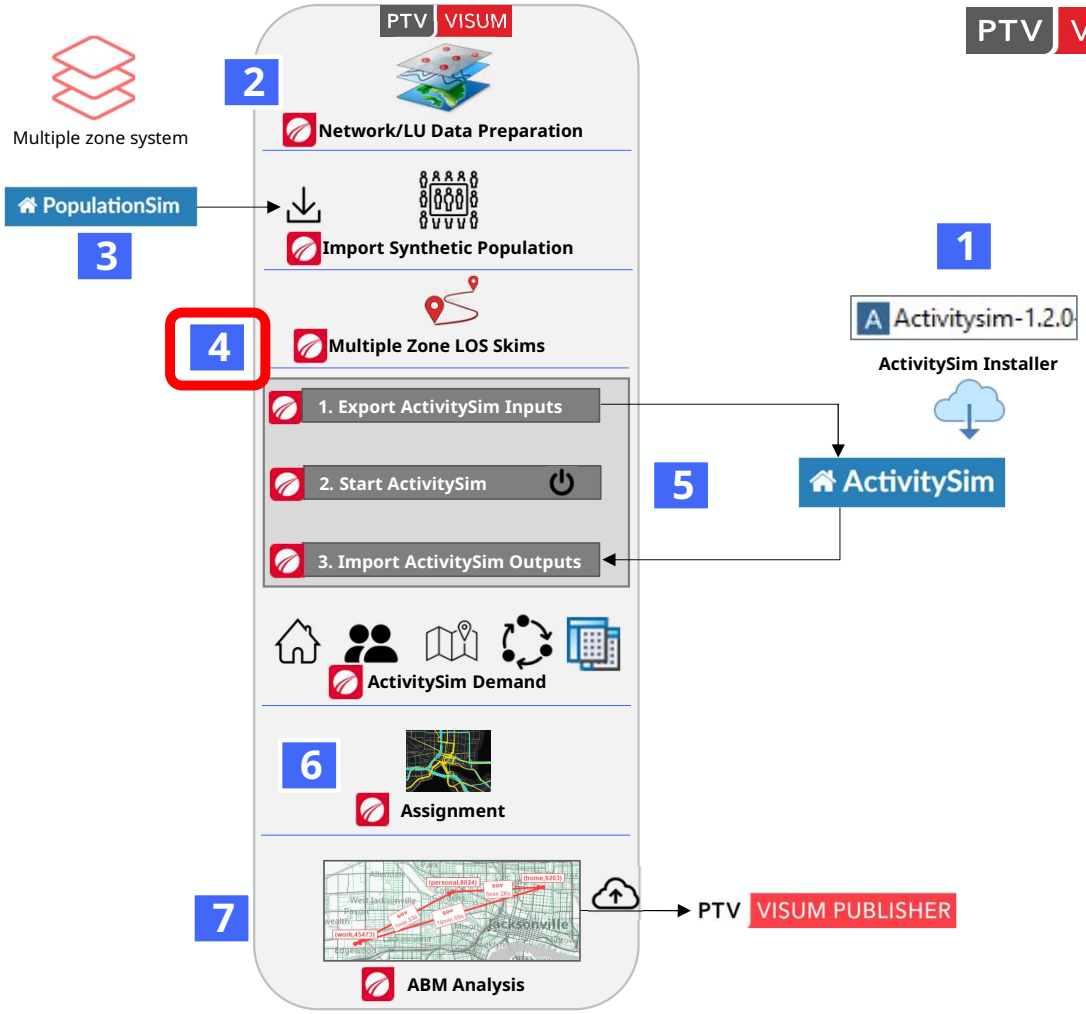
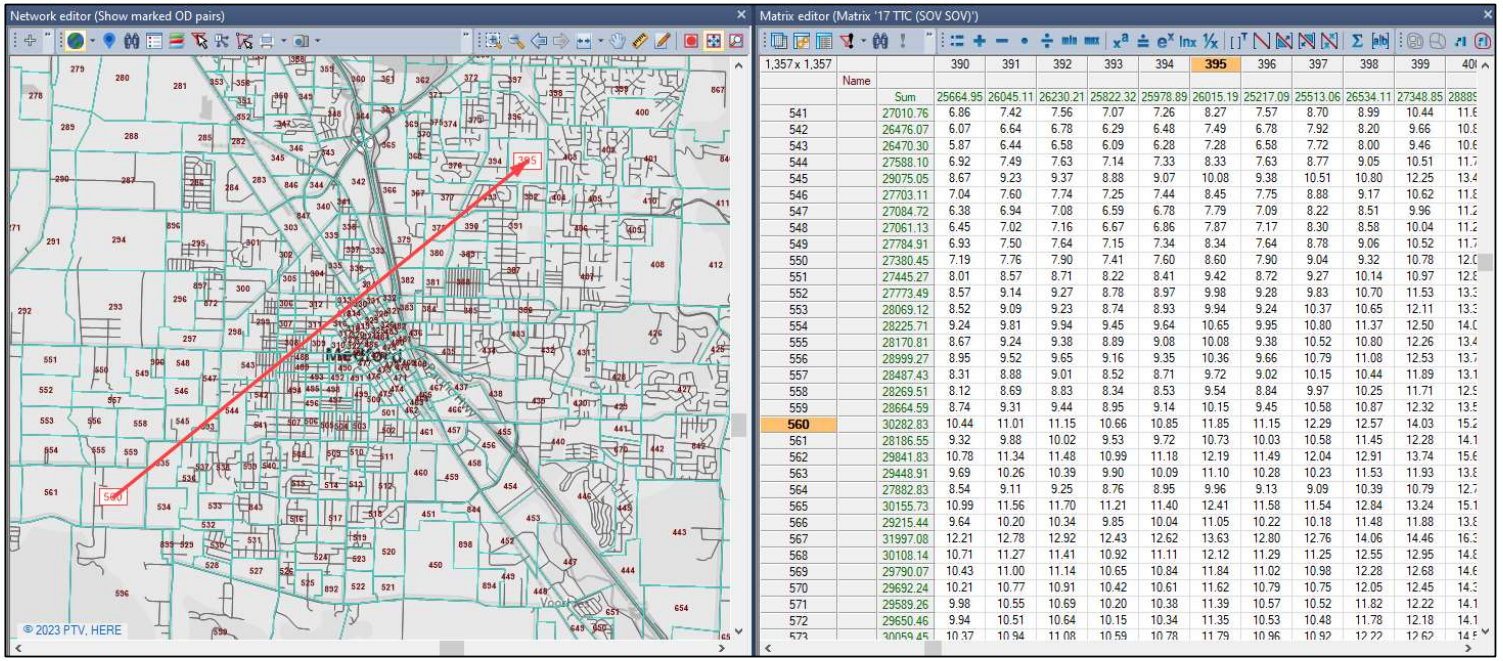
Visum – ActivitySim Integration



TAZ Skimming

TAZ – TAZ Skimming

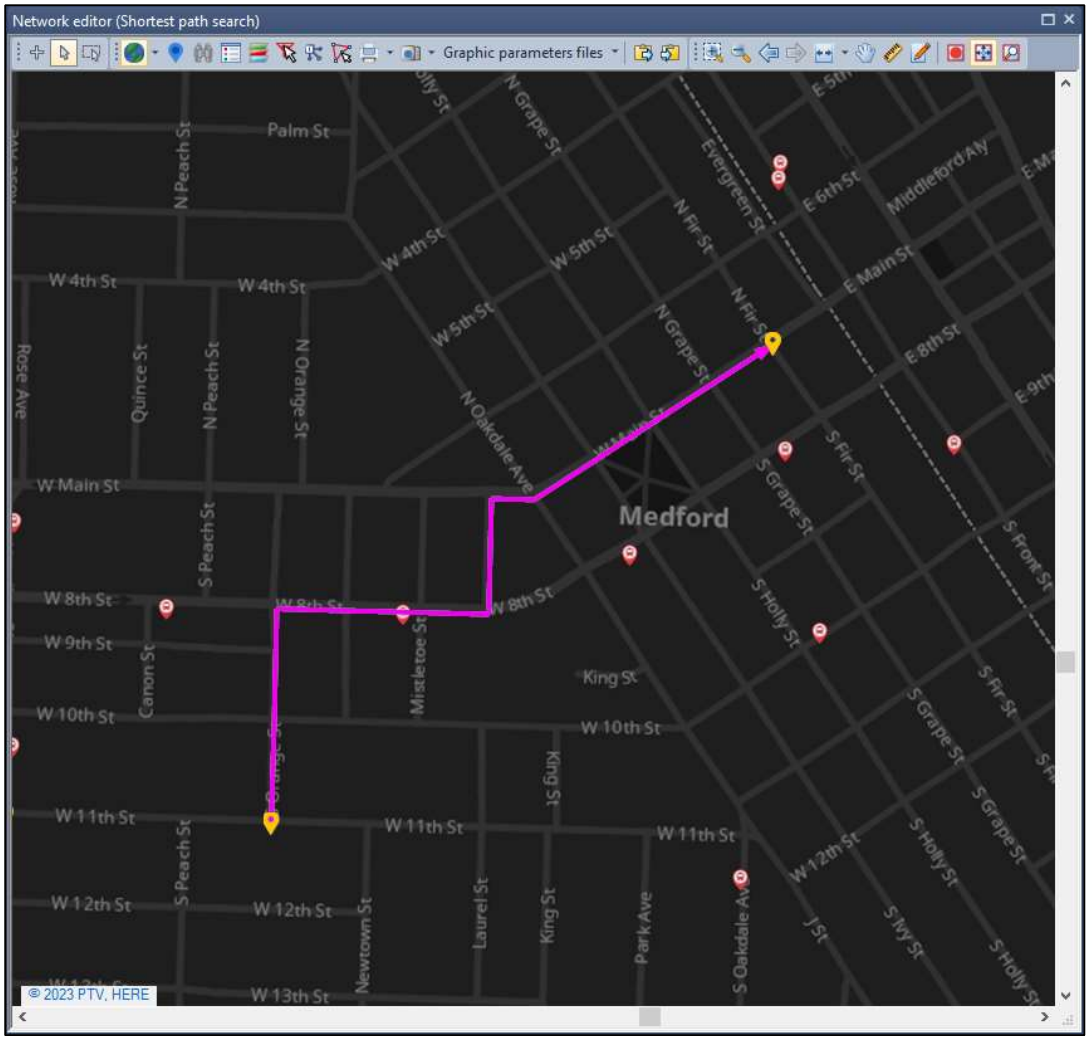
- TAZ skimming
  - Highway skims
  - Transit skims
  - Non-motorized skims



MAZ Skimming

Location-Location Skimming

- MAZ (Location) Skims
  - Generated as part of ActivitySim inputs import
  - MAZ-MAZ skims for non-motorized modes
  - MAZ-TAP, TAP-MAZ skims for Transit virtual path building (TVPB)



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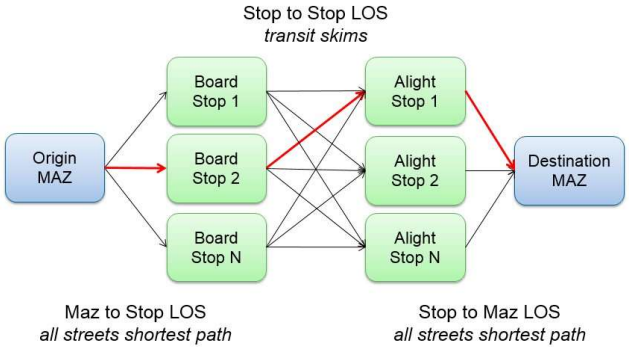
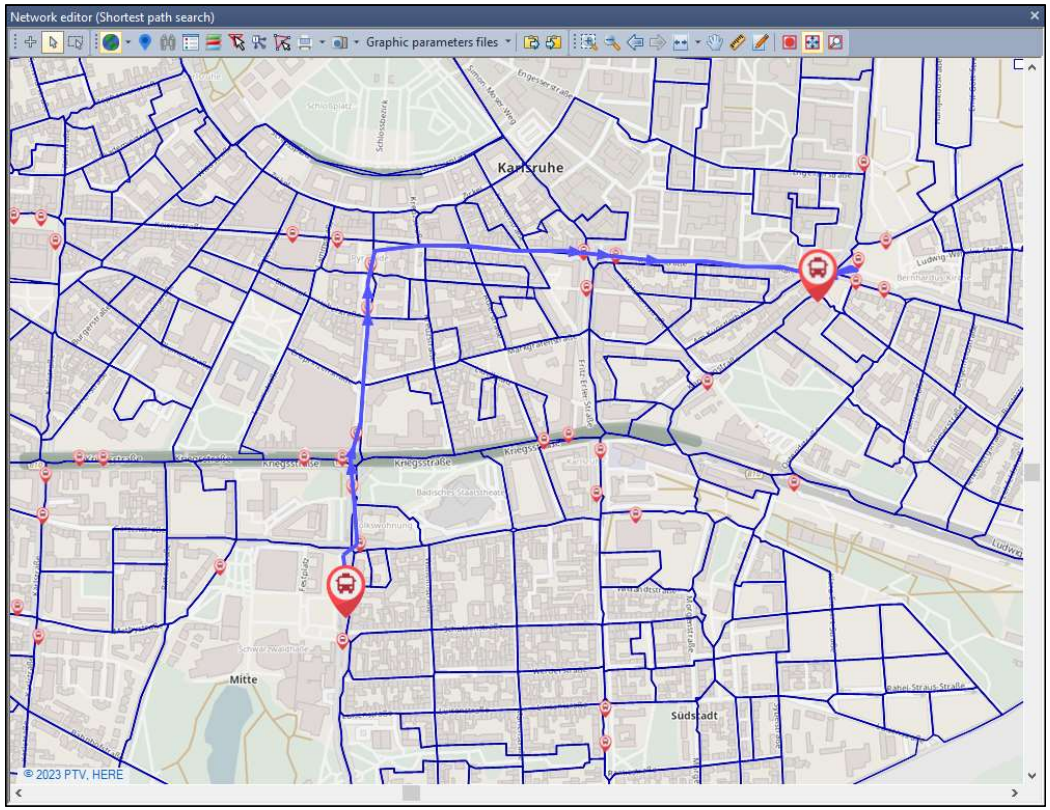
TAP Skimming

Stop Area – Stop Area Skimming

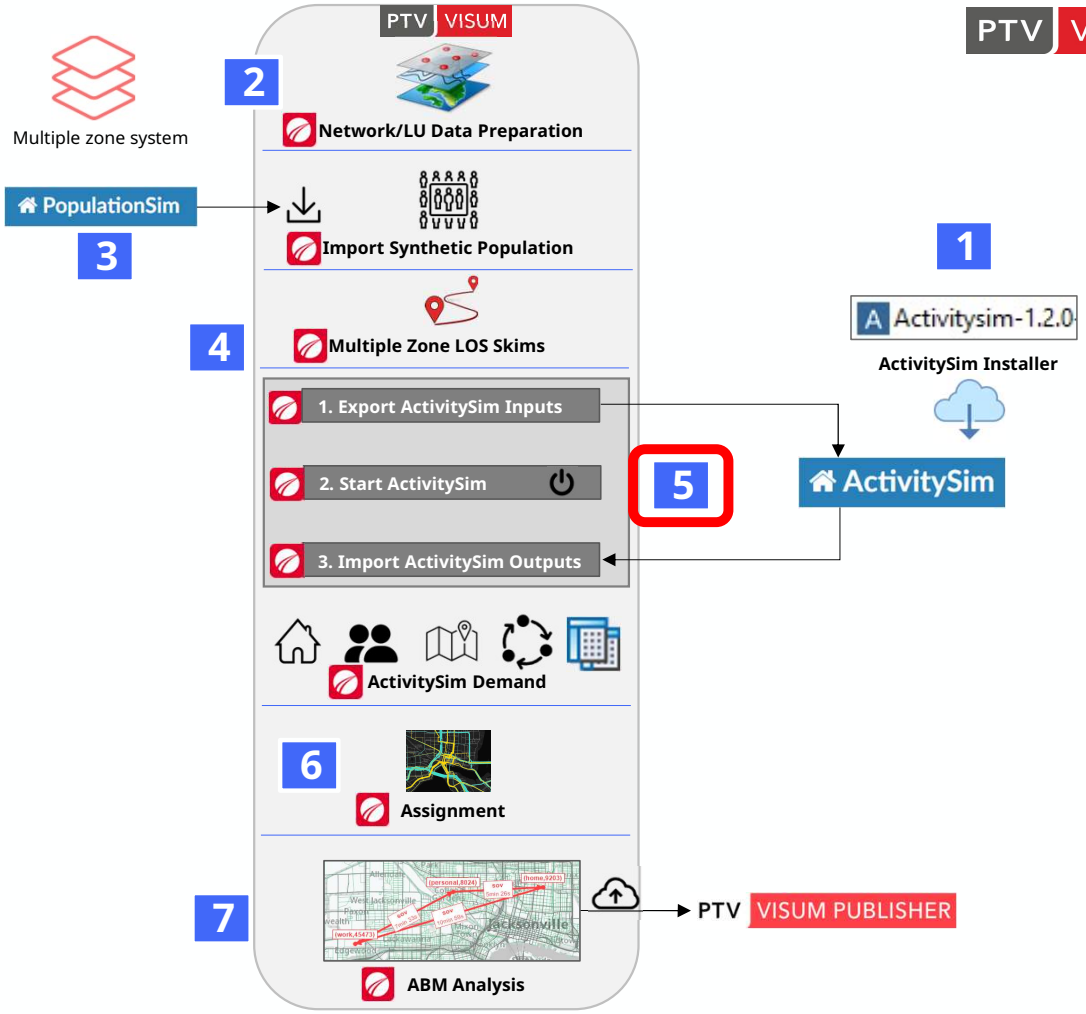
- TAP (Stop Area) Skims
  - Transit skims for 3-zone system ABMs
  - For transit virtual path building (TVPB)



Transit virtual path building

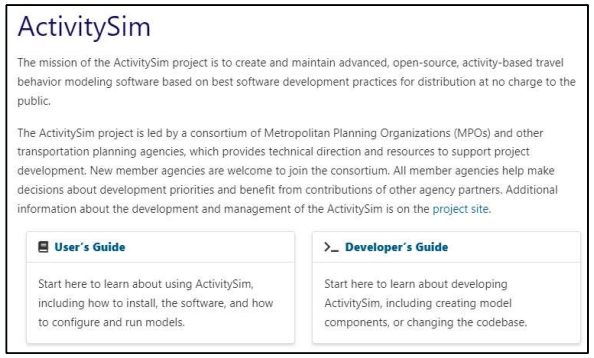


Visum – ActivitySim Integration



Setting up ActivitySim

https://activitysim.github.io/activitysim/v1.2.0/



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) 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. Additional information about the development and management of the ActivitySim is on the project site.

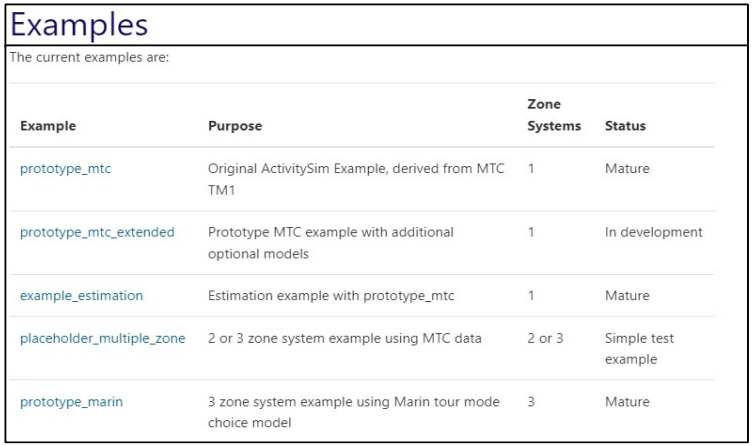
User's Guide

Start here to learn about using ActivitySim, including how to install, the software, and how to configure and run models.

Developer's Guide

Start here to learn about developing ActivitySim, including creating model components, or changing the codebase.

https://activitysim.github.io/activitysim/v1.2.0/examples



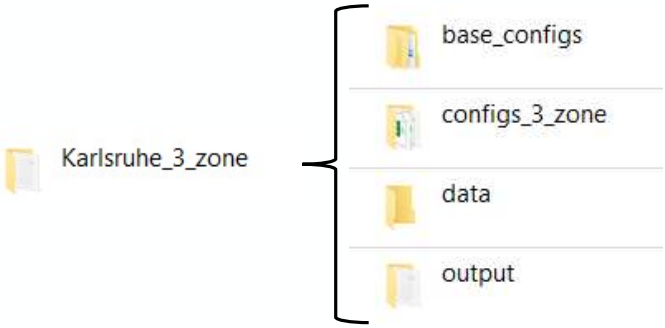
Examples

The current examples are:

Example	Purpose	Zone Systems	Status
prototype_mtc	Original ActivitySim Example, derived from MTC TM1	1	Mature
prototype_mtc_extended	Prototype MTC example with additional optional models	1	In development
example_estimation	Estimation example with prototype_mtc	1	Mature
placeholder_multiple_zone	2 or 3 zone system example using MTC data	2 or 3	Simple test example
prototype_marin	3 zone system example using Marin tour mode choice model	3	Mature

Configuring ActivitySim setup

- Start with an example
- Follow instructions in ActivitySim User's Guide to configure settings for your application
- Configure procedure steps in Visum to point to the configs and inputs



A configured ActivitySim setup is a prerequisite for Visum-ActivitySim interfacing

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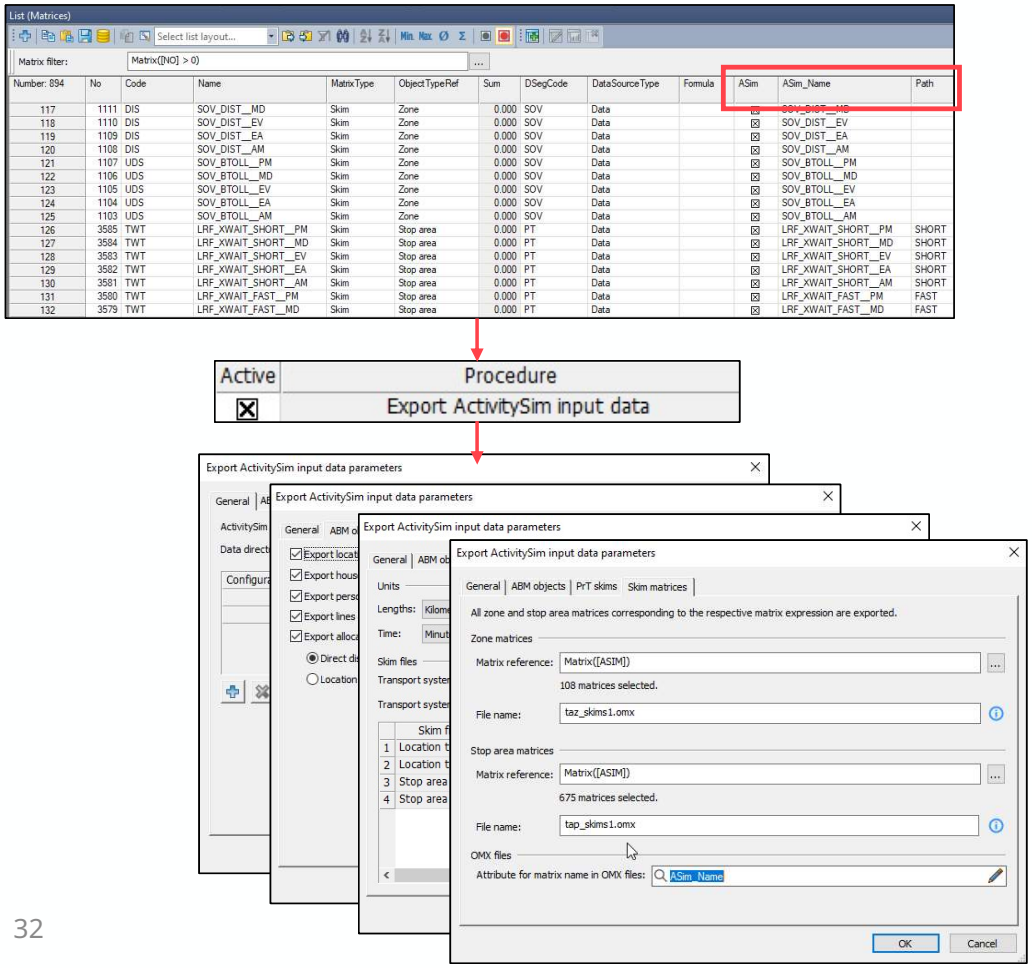
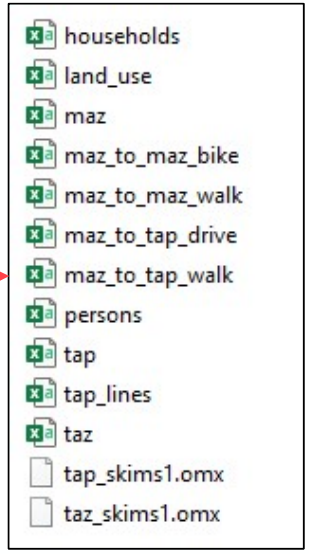
ActivitySim Interface





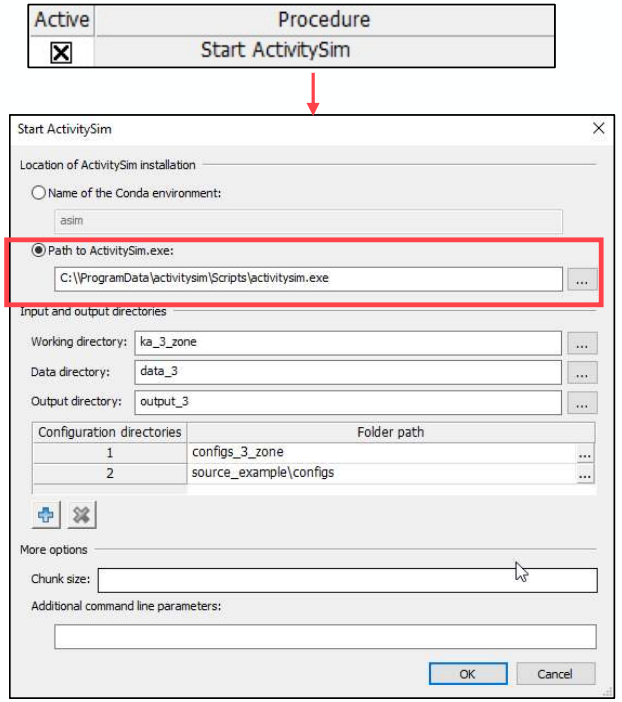
1. Export ActivitySim Inputs

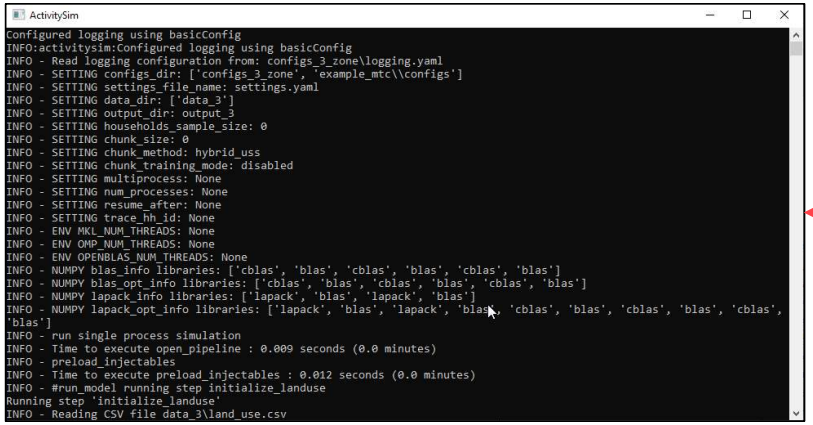
- Mark skim matrices for ActivitySim export
- Procedure step “Export ActivitySim input data”
- Exports skims in OMX and CSV format
- Exports land use and synthetic population files

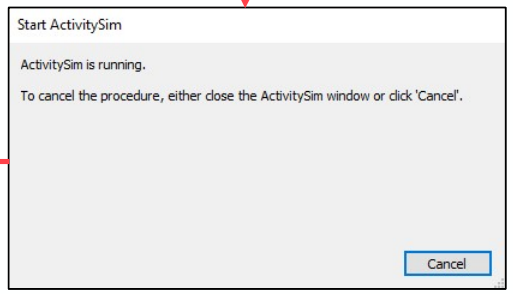
ActivitySim Interface

2. Start ActivitySim

- Procedure step “Start ActivitySim”
- Point the procedure to the installed ActivitySim executable
- Benefits
  - Runs ActivitySim from the same software
  - Shows errors and stops the model run
  - Configurable



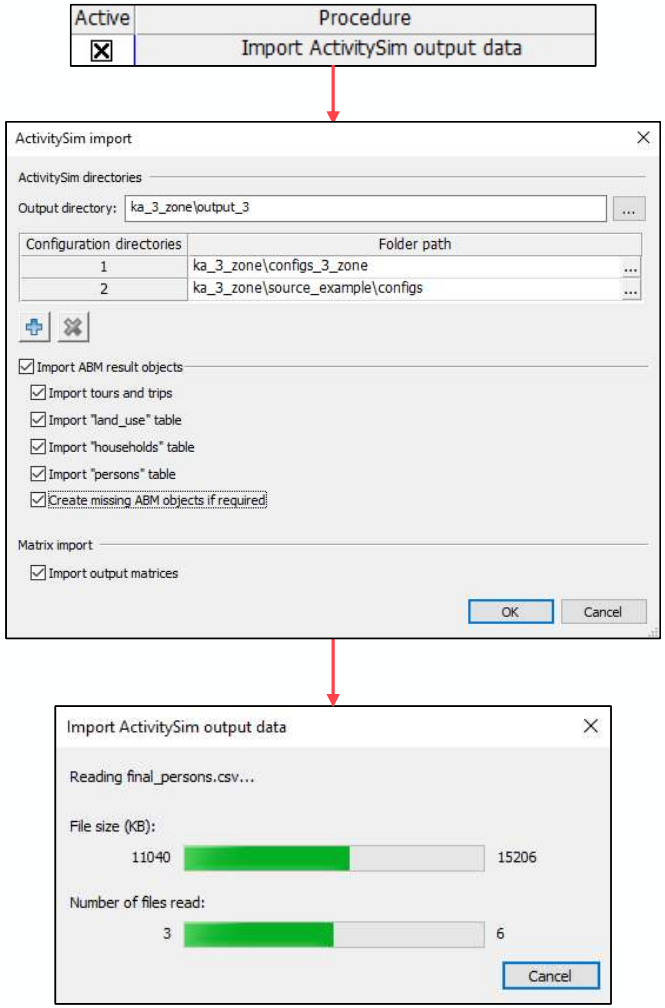




ActivitySim Interface

3. Import ActivitySim Outputs

- Procedure step “Import ActivitySim output data“
- Specify the output and configs folder of the ActivitySim setup
- Mark ABM outputs and matrices to be imported
- ActivitySim outputs are loaded into the following ABM Objects
  - Household, Person, Tour, Trip, Activity Execution, Schedule
- Imported matrices can be processed for assignment



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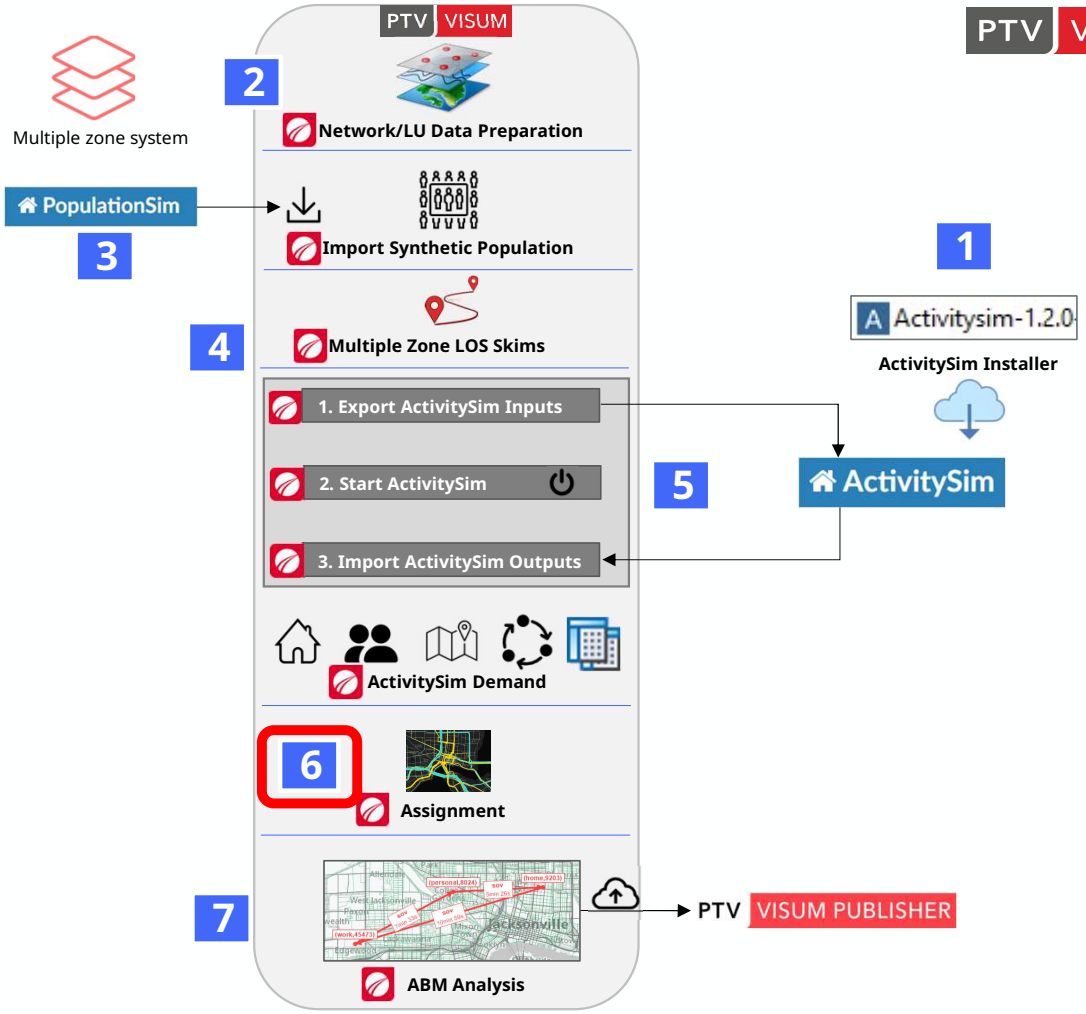
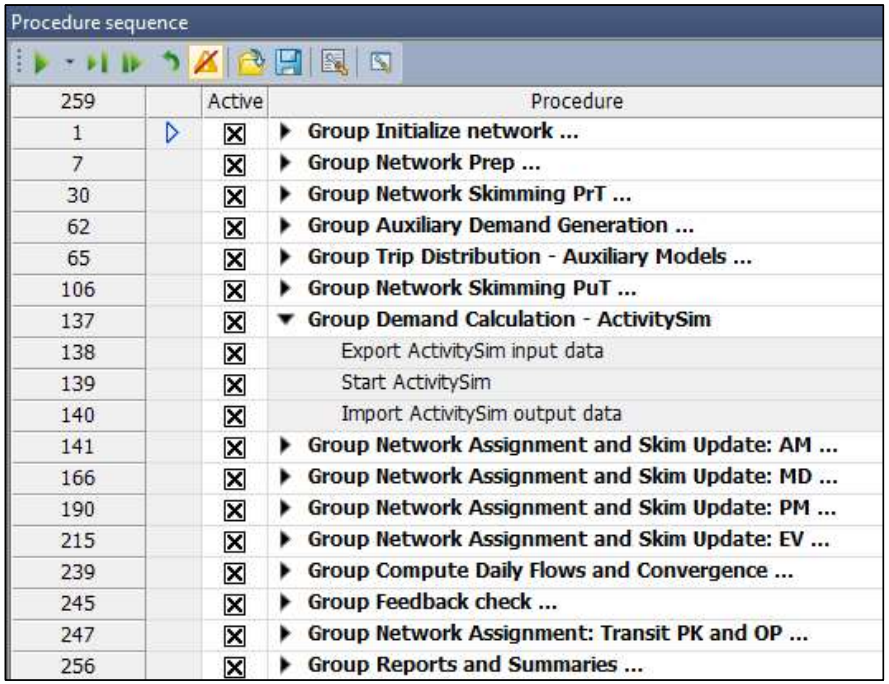
Visum – ActivitySim Integration



Assignment & Feedback

- Use state-of-the-art assignment algorithm for highway, transit, and non-motorized demand
- Assignment procedure assigns path probabilities to individual trips
- Implement feedback loop and MSA averaging
- Add auxiliary model components
- Generate reports and summaries using Visum's Python API

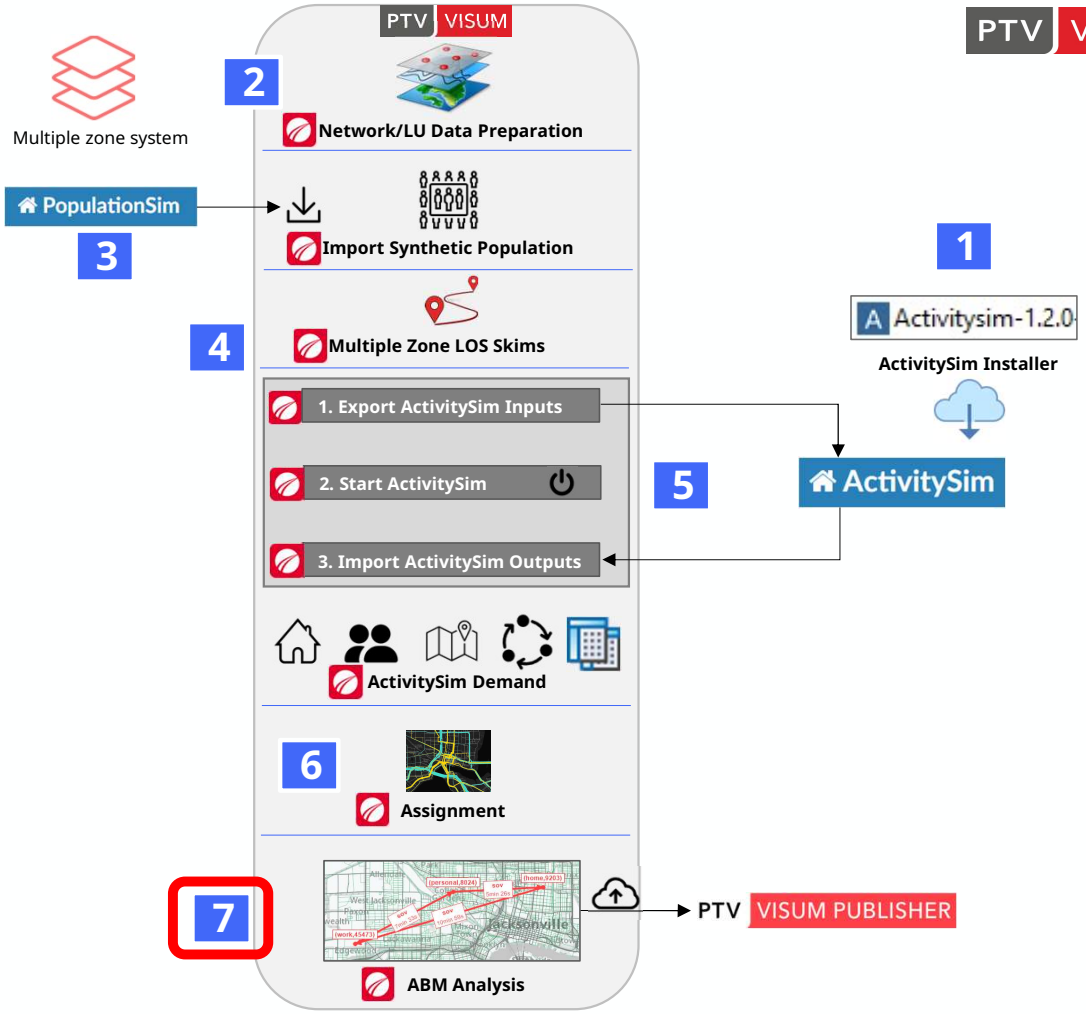
Procedure Sequence with ActivitySim



PTV GROUP

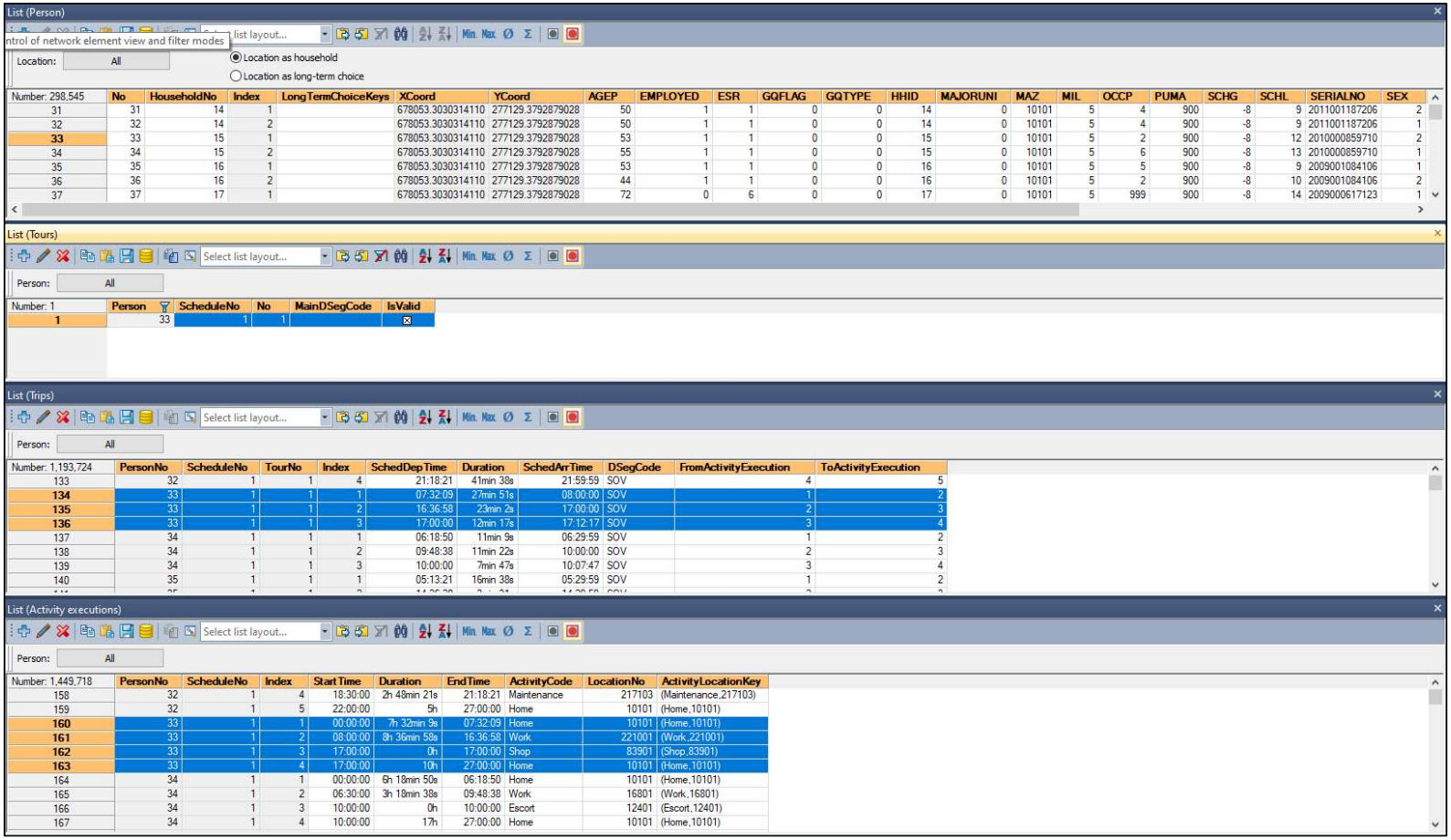
04 ABM Output Analysis

Visum – ActivitySim Integration



ABM Output Analysis

Example Daily Schedule – Person 33 (SOABM)



List (Person)

Location: All

Location as household

Location as long-term choice

Number: 298,545

No	HouseholdNo	Index	LongTermChoiceKeys	XCoord	YCoord	AGEP	EMPLOYED	ESR	GQFLAG	GQTYPE	HHID	MAJORUNI	MAZ	MIL	OCCP	PUMA	SCHG	SCHL	SERIALNO	SEX
31	14	1		678053.3030314110	277129.3792879028	50	1	1	0	0	14	0	10101	5	4	900	-8	9	2011001187206	2
32	14	2		678053.3030314110	277129.3792879028	50	1	1	0	0	14	0	10101	5	4	900	-8	9	2011001187206	1
33	15	1		678053.3030314110	277129.3792879028	53	1	1	0	0	15	0	10101	5	2	900	-8	12	2010000859710	2
34	15	2		678053.3030314110	277129.3792879028	55	1	1	0	0	15	0	10101	5	6	900	-8	13	2010000859710	1
35	16	1		678053.3030314110	277129.3792879028	53	1	1	0	0	16	0	10101	5	5	900	-8	9	2009001084106	1
36	16	2		678053.3030314110	277129.3792879028	44	1	1	0	0	16	0	10101	5	2	900	-8	10	2009001084106	2
37	17	1		678053.3030314110	277129.3792879028	72	0	6	0	0	17	0	10101	5	999	900	-8	14	2009000617123	1

List (Tours)

Person: All

Number: 1

Person	ScheduleNo	No	MainDSegCode	IsValid
33	1	1		☒

List (Trips)

Person: All

Number: 1,193,724

PersonNo	ScheduleNo	TourNo	Index	SchedDepTime	Duration	SchedArrTime	DSegCode	FromActivityExecution	ToActivityExecution
32	1	1	4	21:18:21	41min 38s	21:59:59	SOV	4	5
33	1	1	1	07:32:09	27min 51s	08:00:00	SOV	1	2
33	1	1	2	16:36:58	23min 2s	17:00:00	SOV	2	3
33	1	1	3	17:00:00	12min 17s	17:12:17	SOV	3	4
34	1	1	1	06:18:50	11min 9s	06:29:59	SOV	1	2
34	1	1	2	09:48:38	11min 22s	10:00:00	SOV	2	3
34	1	1	3	10:00:00	7min 47s	10:07:47	SOV	3	4
35	1	1	1	05:13:21	16min 38s	05:29:59	SOV	1	2

List (Activity executions)

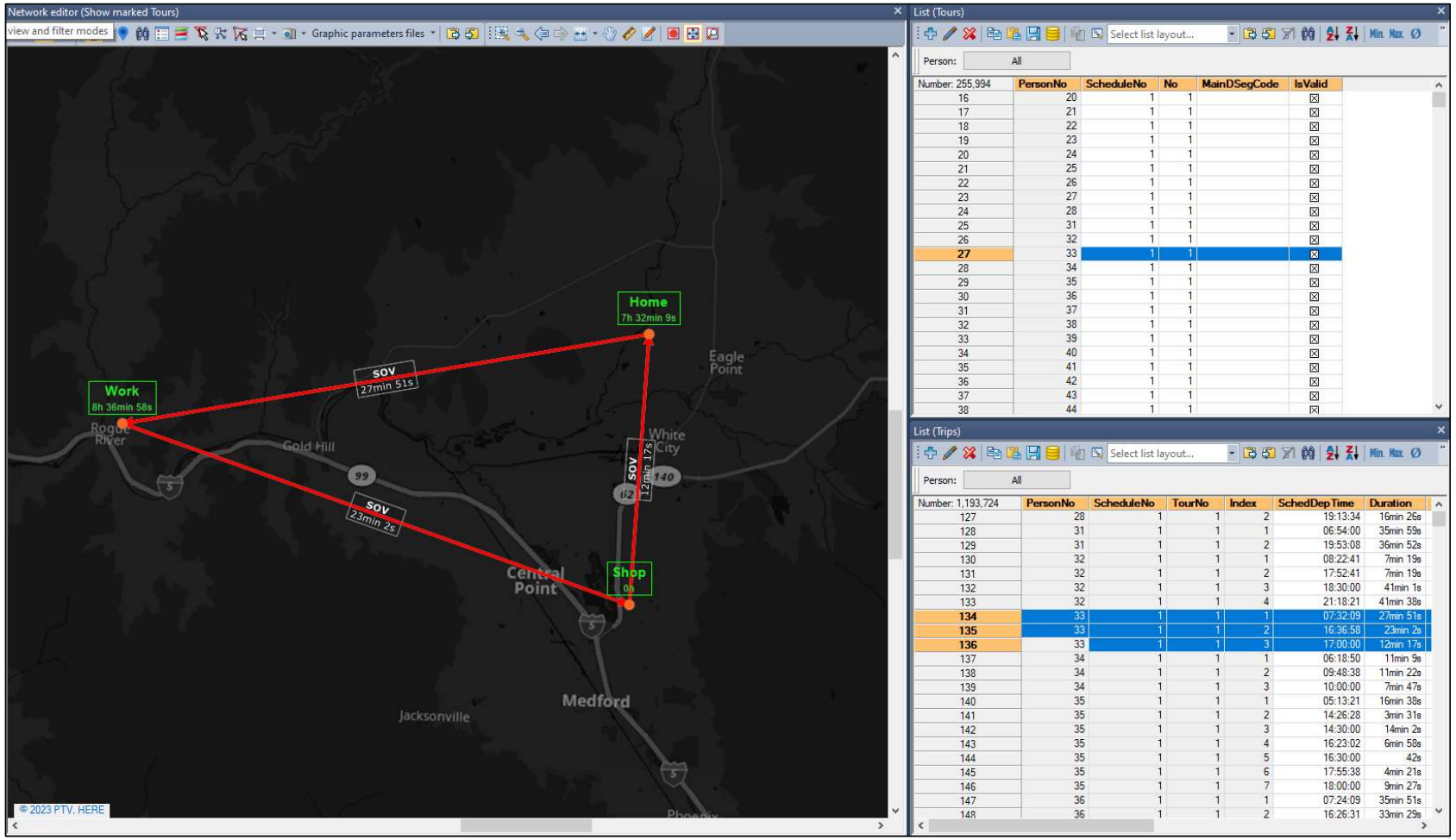
Person: All

Number: 1,449,718

PersonNo	ScheduleNo	Index	StartTime	Duration	EndTime	ActivityCode	LocationNo	ActivityLocationKey
32	1	4	18:30:00	2h 48min 21s	21:18:21	Maintenance	217103	(Maintenance,217103)
32	1	5	22:00:00	5h	27:00:00	Home	10101	(Home,10101)
33	1	1	00:00:00	7h 32min 9s	07:32:09	Home	10101	(Home,10101)
33	1	2	08:00:00	8h 36min 58s	16:36:58	Work	221001	(Work,221001)
33	1	3	17:00:00	0h	17:00:00	Shop	83901	(Shop,83901)
33	1	4	17:00:00	10h	27:00:00	Home	10101	(Home,10101)
34	1	1	00:00:00	6h 18min 50s	06:18:50	Home	10101	(Home,10101)
34	1	2	06:30:00	3h 18min 38s	09:48:38	Work	16801	(Work,16801)
34	1	3	10:00:00	0h	10:00:00	Escort	12401	(Escort,12401)
34	1	4	10:00:00	17h	27:00:00	Home	10101	(Home,10101)

ABM Output Analysis

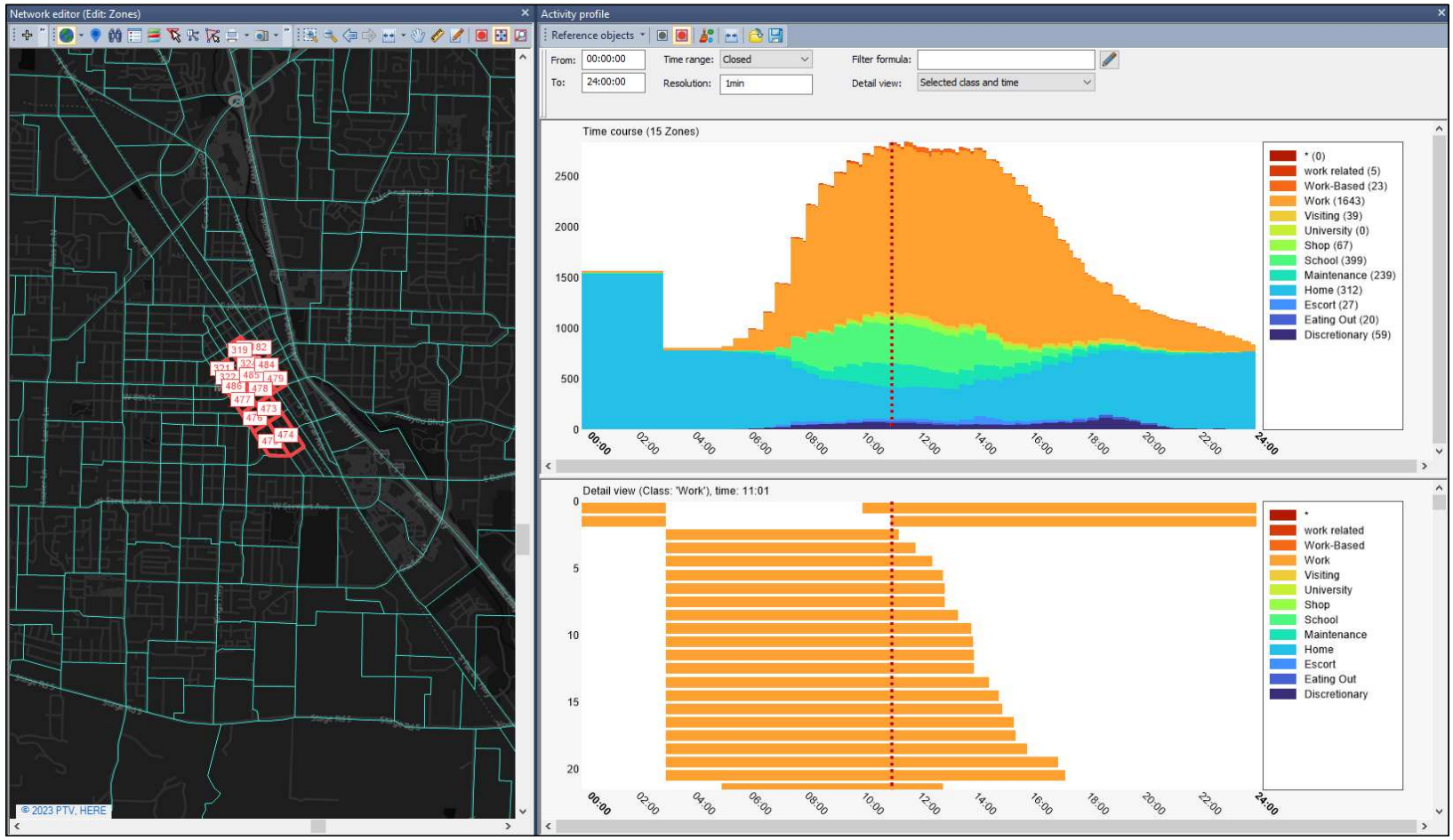
Tour/Trip Tracing (Person 33)



PTV GROUP

ABM Output Analysis

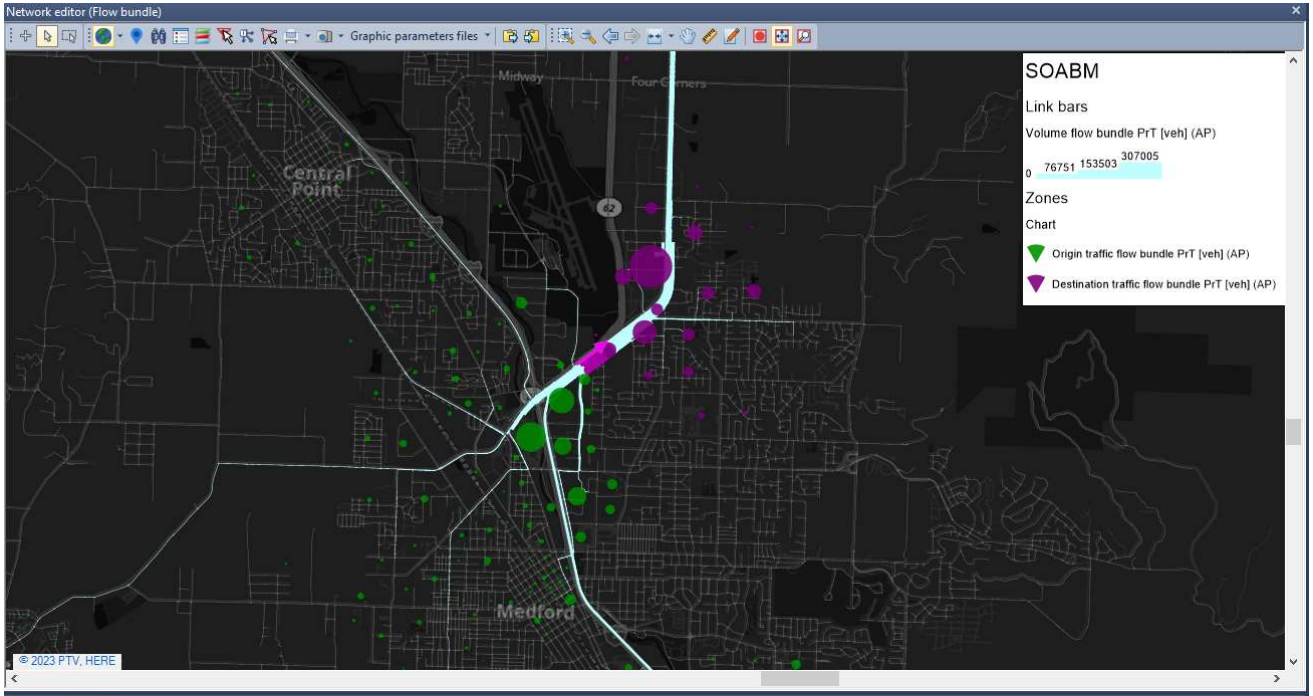
Activity Profile in Downtown Medford



PTV GROUP

ABM Select Link Analysis

What is the income of users of the select link and where do they live?

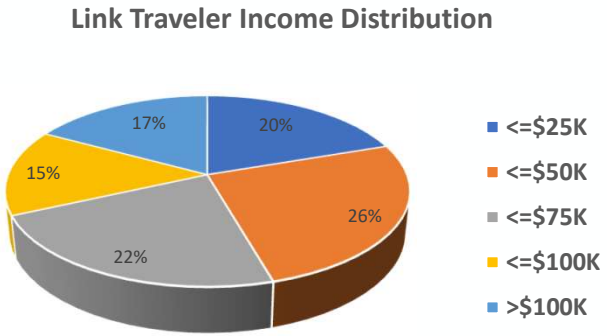


List (Path sequences)

Select list layout...

Path sequence set: 1 Tours | Selection: Flow bundle routes | Origin zone filter: All

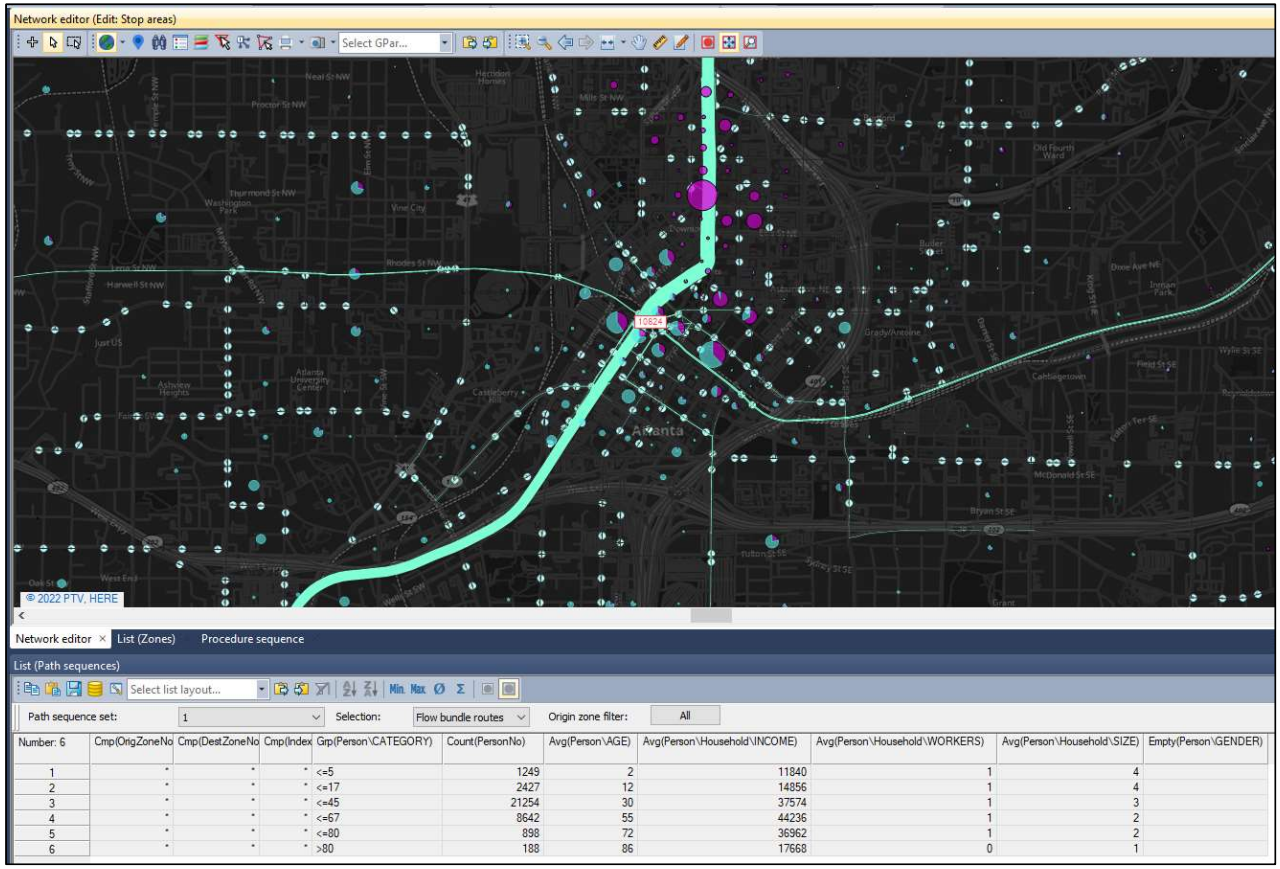
Number: 5	Count(Person\	Grp(Person\Household\ INCOME_GRP)	Avg(Person\ AGEP)	Avg(Person\Household\ HHINCADJ)
1	5126	<=$25K	41	9993
2	6691	<=$50K	43	35675
3	5884	<=$75K	42	61409
4	3809	<=$100K	48	84097
5	4433	>$100K	43	163387



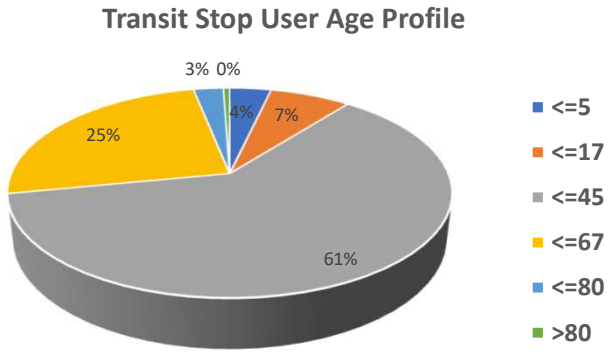
PTV GROUP

ABM Select Stop Analysis

What is the age distribution of transit riders at the selected stop?



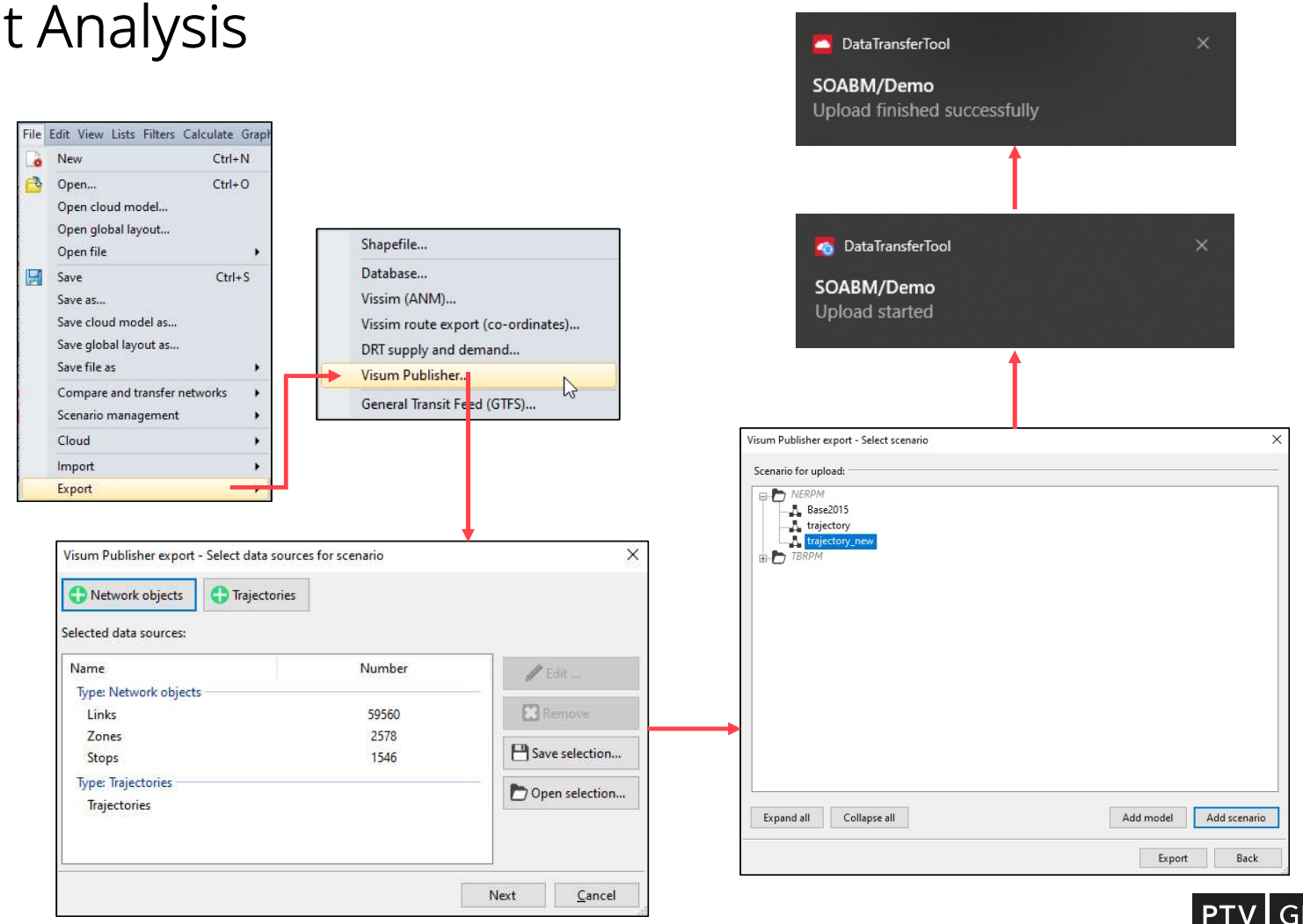
Number: 6	Cmp(OrigZoneNo	Cmp(DestZoneNo	Cmp(Index	Grp(Person\CATEGORY)	Count(PersonNo)	Avg(Person\AGE)	Avg(Person\Household\INCOME)	Avg(Person\Household\WORKERS)	Avg(Person\Household\SIZE)	Empty(Person\GENDER)
1	*	*	*	<=5	1249	2	11840	1	4	
2	*	*	*	<=17	2427	12	14856	1	4	
3	*	*	*	<=45	21254	30	37574	1	3	
4	*	*	*	<=67	8642	55	44236	1	2	
5	*	*	*	<=80	898	72	36962	1	2	
6	*	*	*	>80	188	86	17668	0	1	



PTV GROUP

ABM Output Analysis

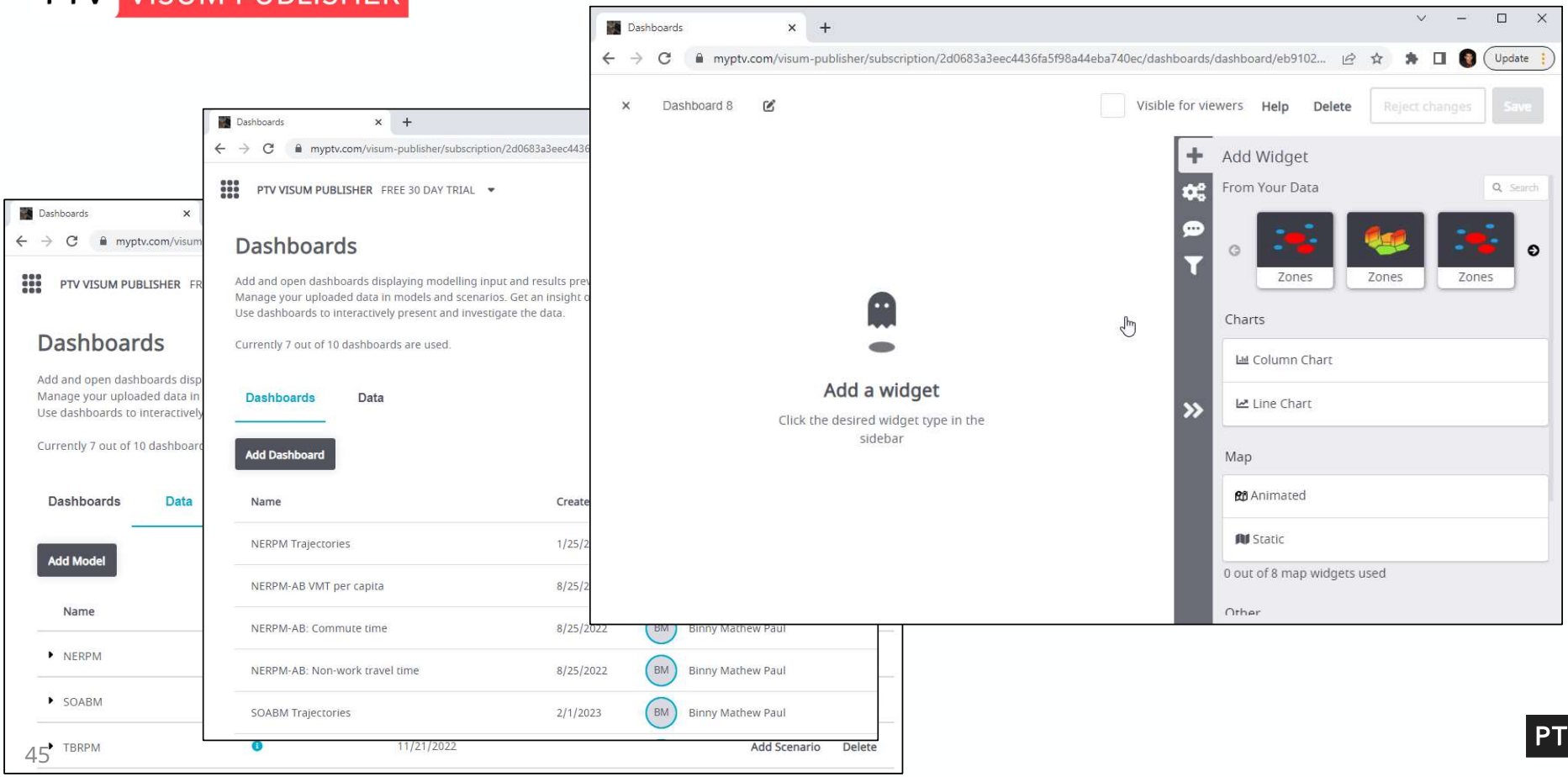
- Export model outputs to PTV Cloud directly from Visum
- Create custom dashboards on MyPTV



ABM Output Analysis

PTV VISUM PUBLISHER

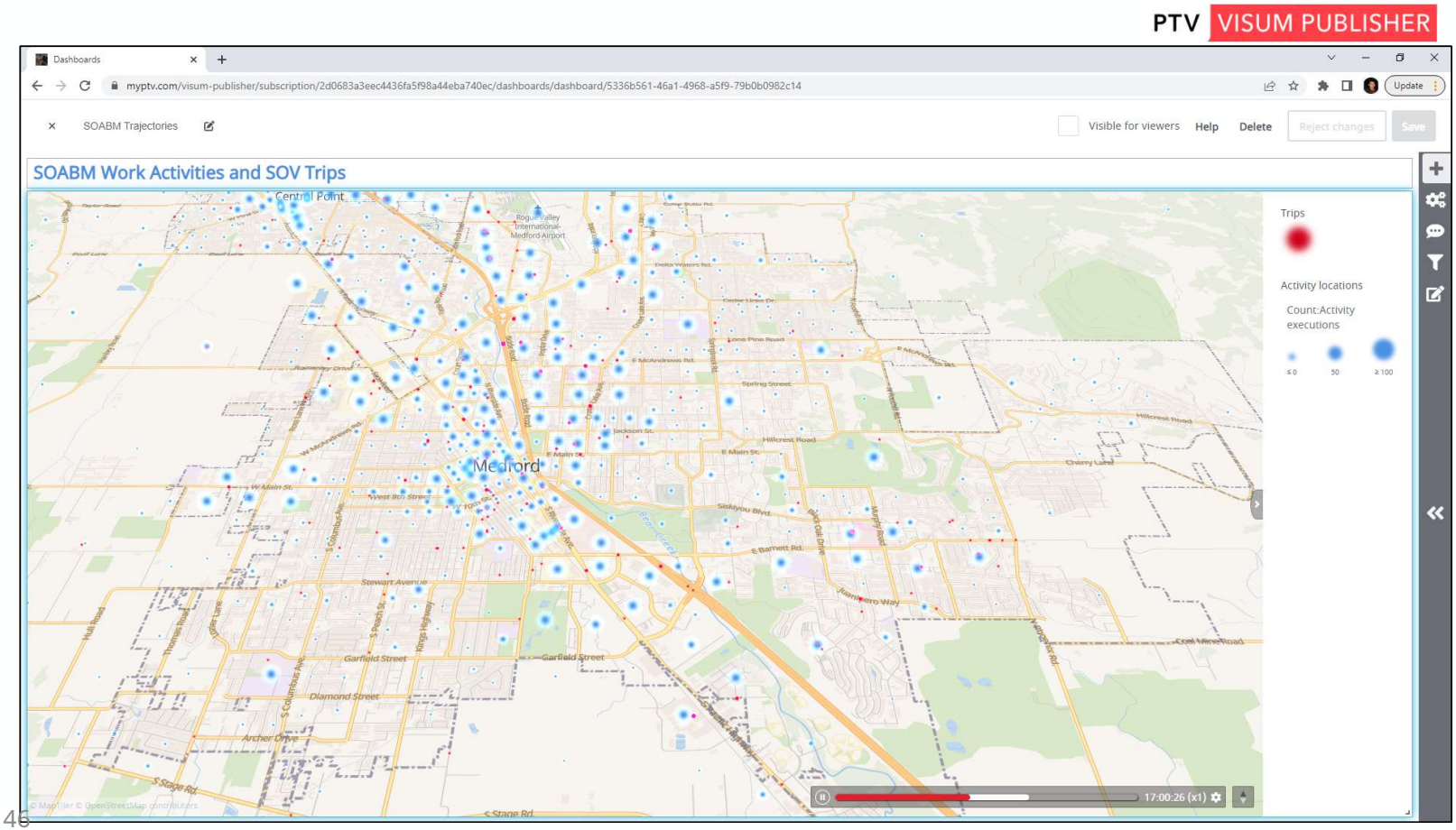
Create custom dashboards and animations using the uploaded data



PTV GROUP

ABM Output Analysis

Share ABM Results Online with PTV Visum Publisher



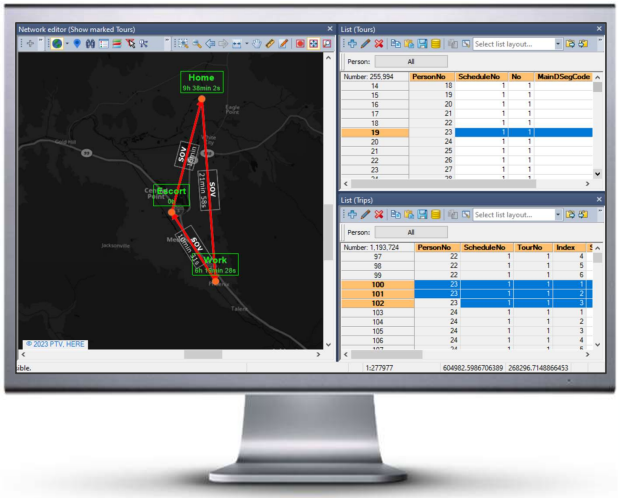
- Share ABM results online with PTV Visum Publisher
- New cloud-based solution for collaboration

Benefits of PTV VISUM – ActivitySim Integration

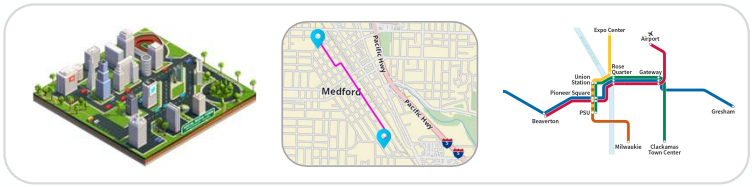
1 True data management

Manage ABM demand and supply data at the same time in one integrated data model

Integrated Supply/Demand Data Model



ABM Demand

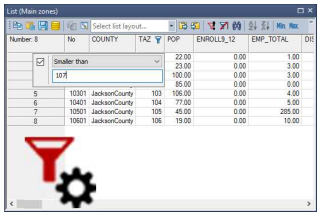


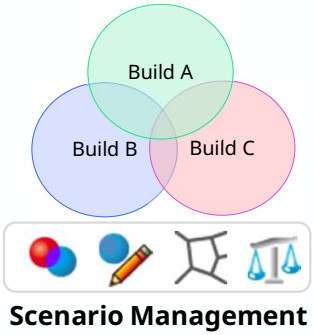
ABM Supply

Fully Connected Database

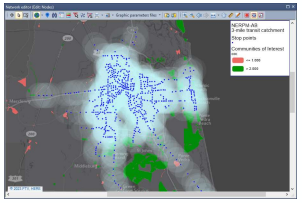
Benefits of PTV VISUM – ActivitySim Integration

Filters



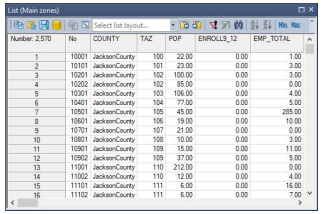


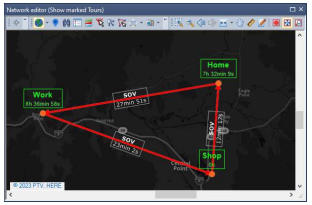
Scenario Management



Graphics Parameters

Lists





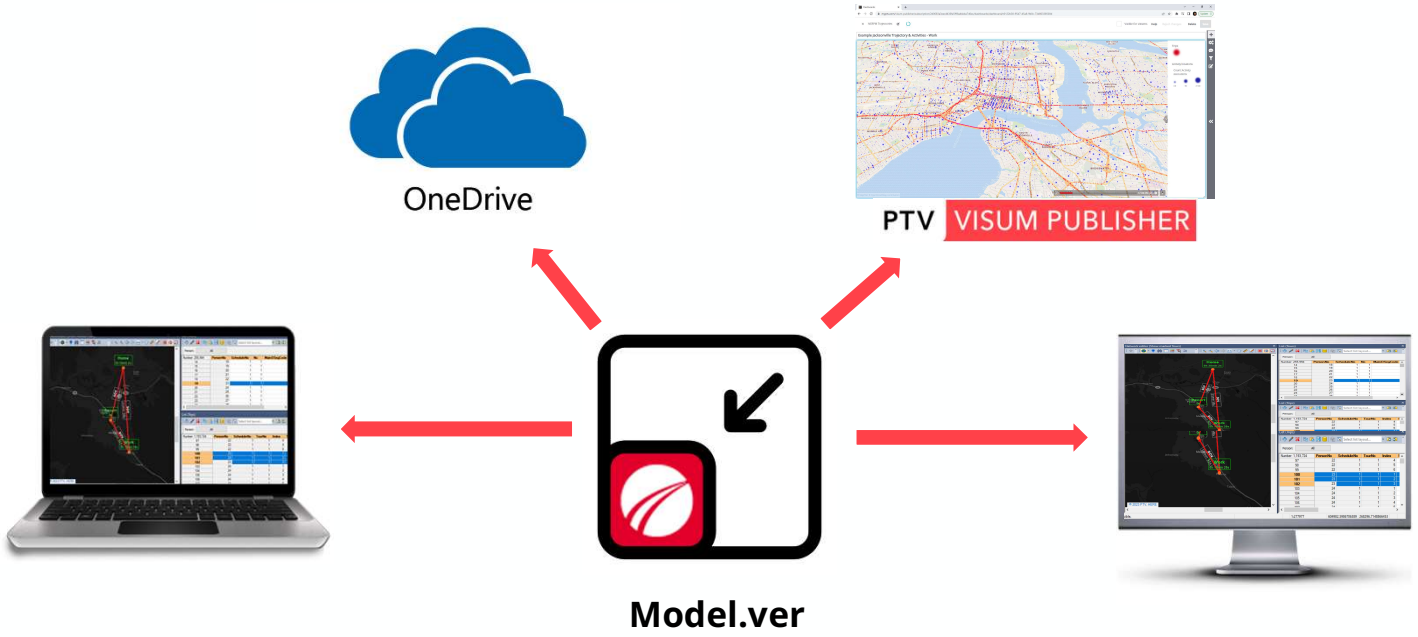
Advanced Analysis

2 Ease-of-use

Use PTV Visum's powerful and familiar tools – lists, filters, graphic parameters, scenarios, etc. – for model application and analysis

PTV GROUP

Benefits of PTV VISUM – ActivitySim Integration



3 Portability

Store a complete model scenario – both demand and supply – in one compact file for collaborating with others

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Benefits of PTV VISUM – ActivitySim Integration

4 Enable advanced analysis

Harness the power of ABMs for answering today's pressing planning questions

Transportation Equity

Volpe Center, DOT

Active Transportation

Advanced ABM Analysis

Vehicle Fleet

Climate & Sustainability

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Benefits of PTV VISUM – ActivitySim Integration

5 Improved runtime and performance

Get quick and accurate results with Visum's high-performance algorithms

Faster model runs

State-of-the-art algorithms

Accurate, stable, and consistent results

Novel features with every release

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QUESTIONS

?

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Icons from www.flaticon.com