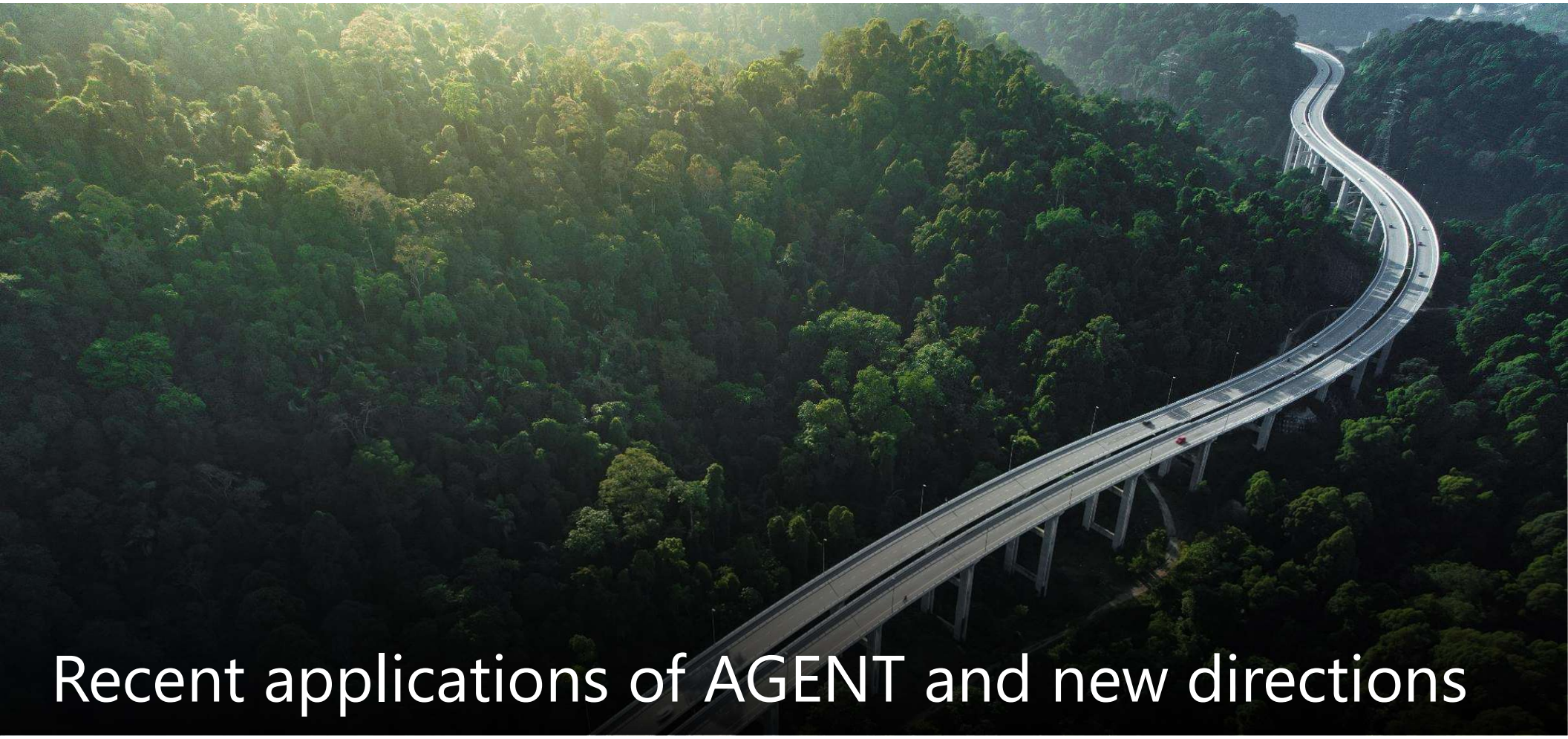
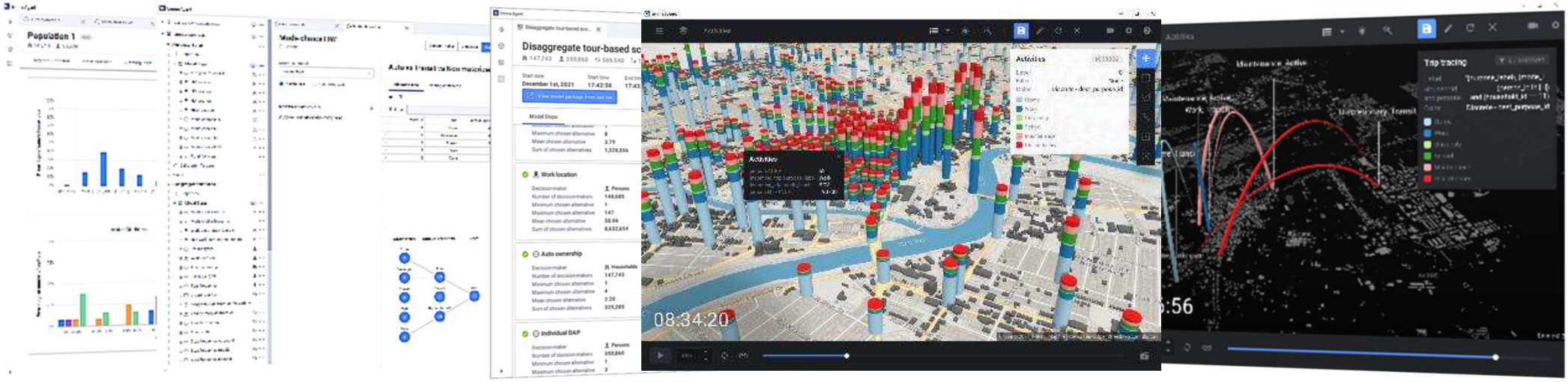


Recent applications of AGENT and new directions

Gaurav Vyas

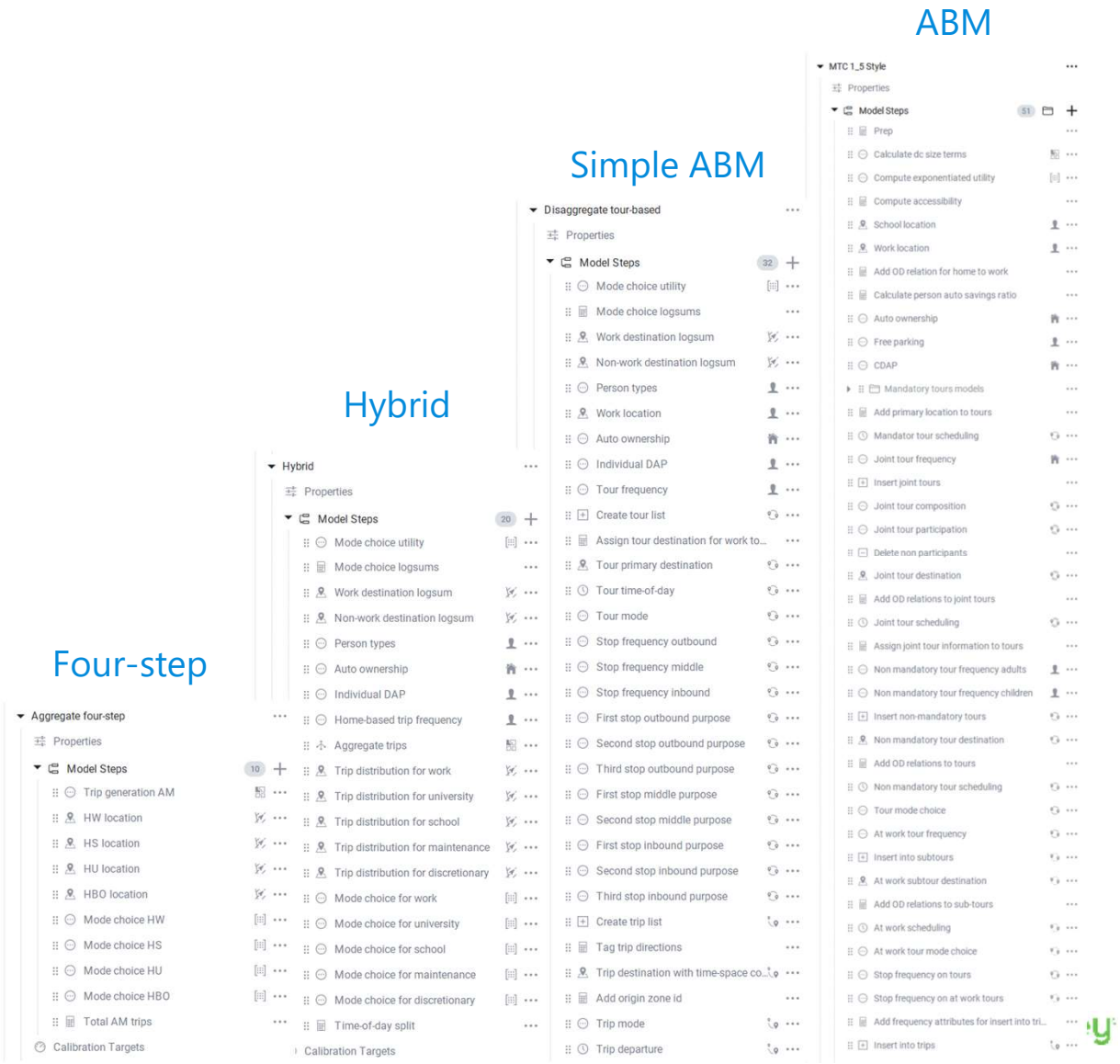
Bentley®

AGENT is a platform to assemble, calibrate and apply travel demand models



Bentley

- Assemble virtually any travel demand model structure from 4-step to ABM
- Enjoy transparent access to a full travel demand model UI
- Maintain different model structures or versions in parallel
- Upgrade and advance models over time with new features



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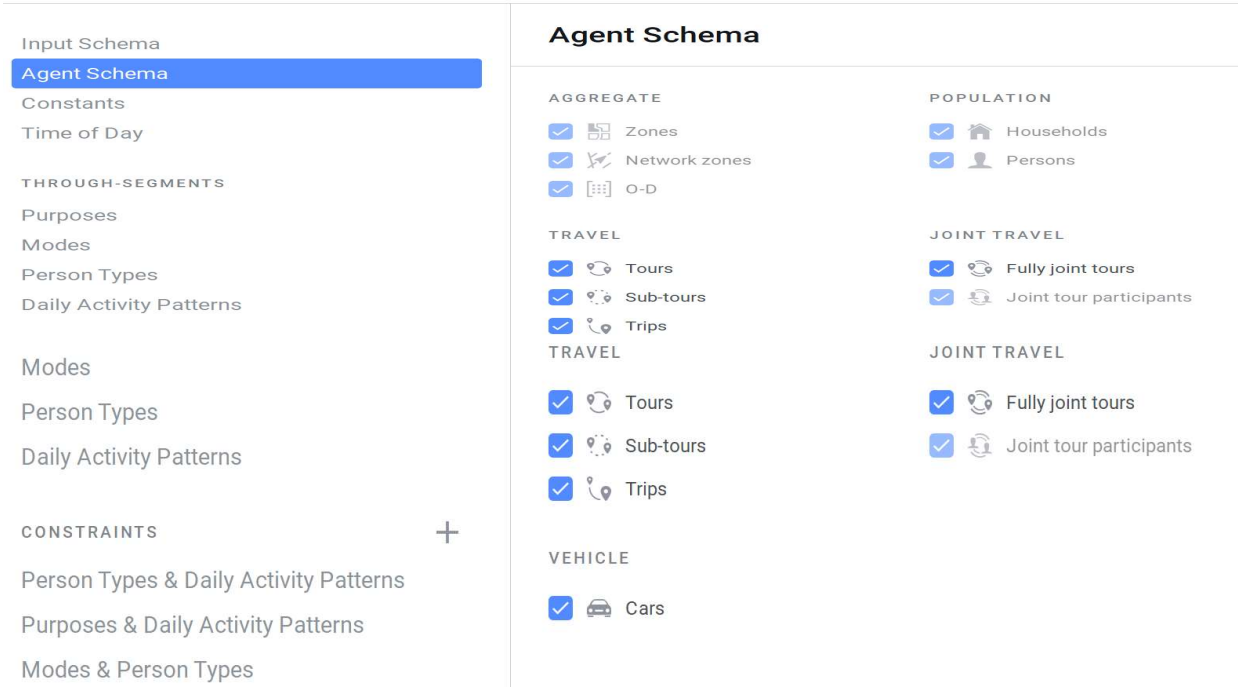

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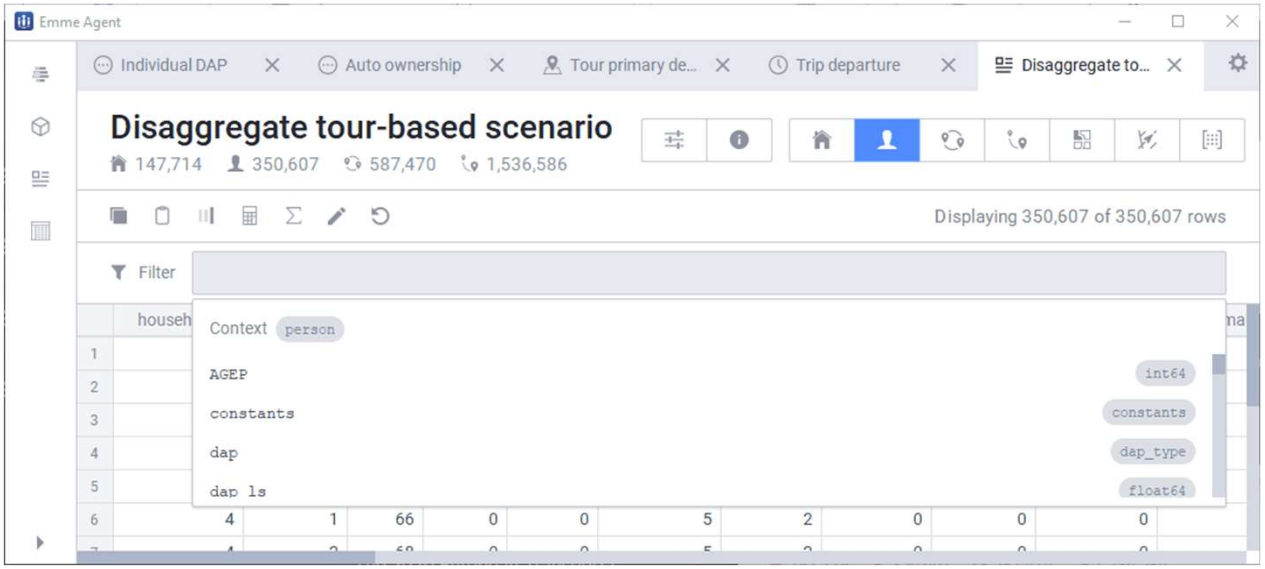
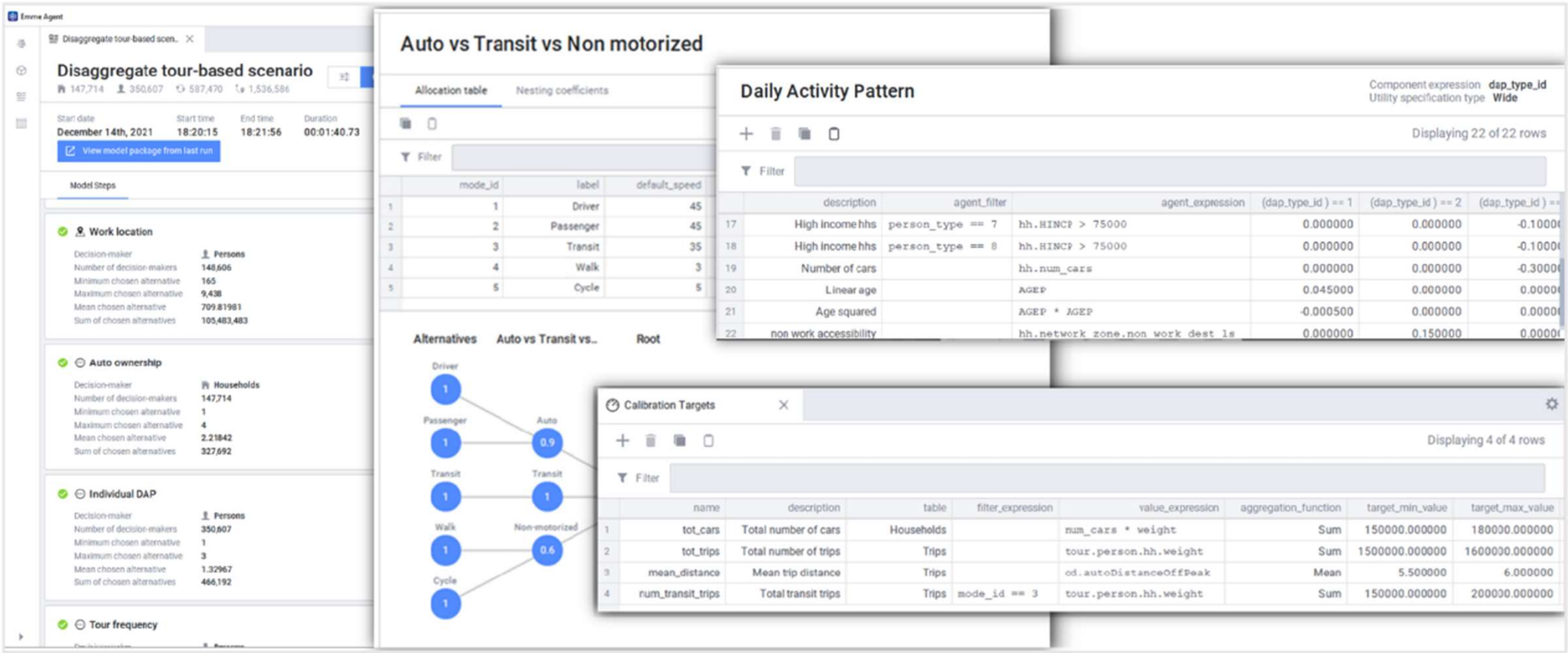


Bentley



Bentley

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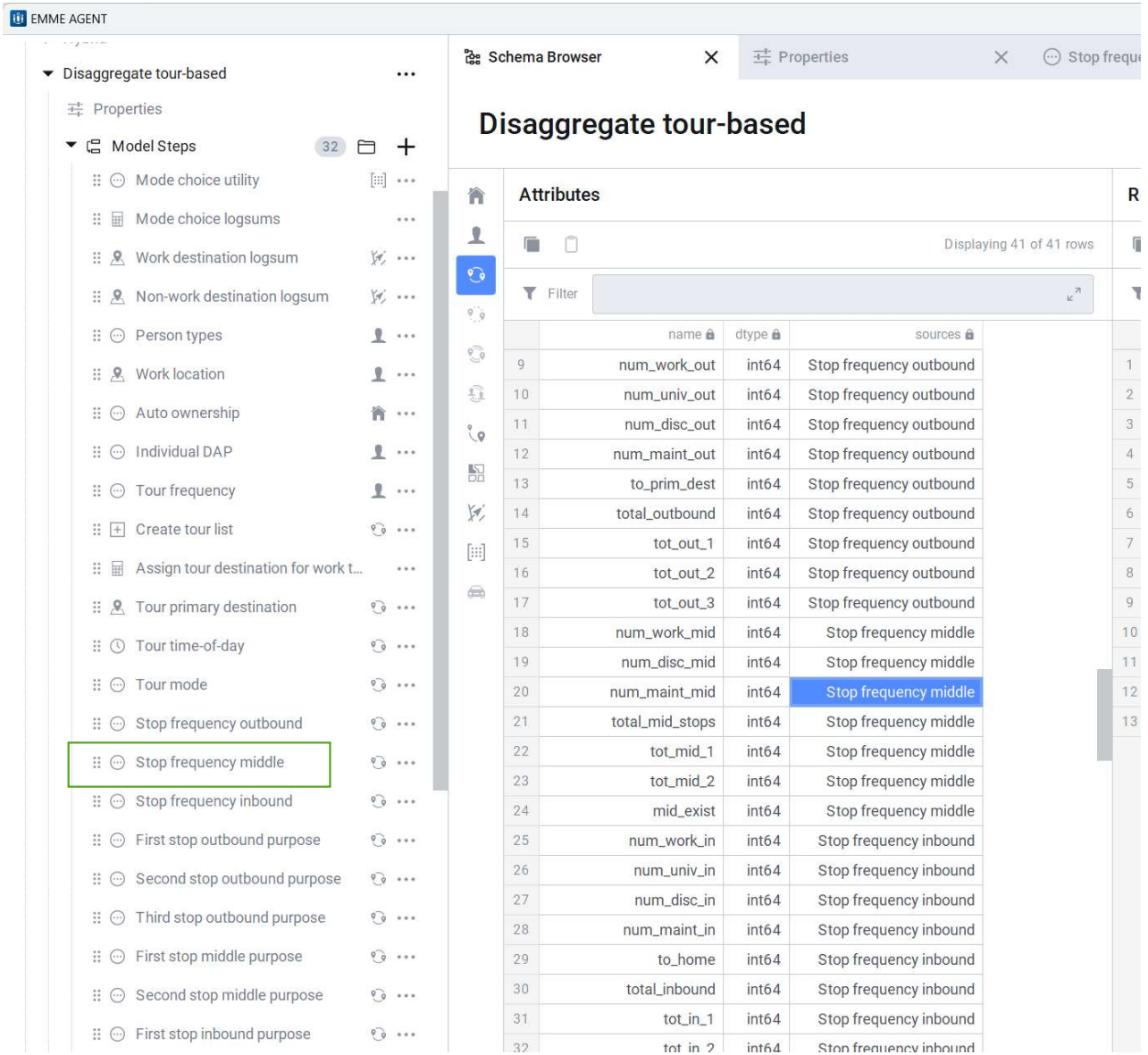
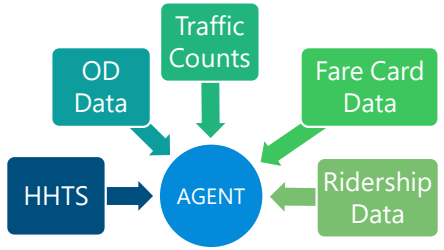
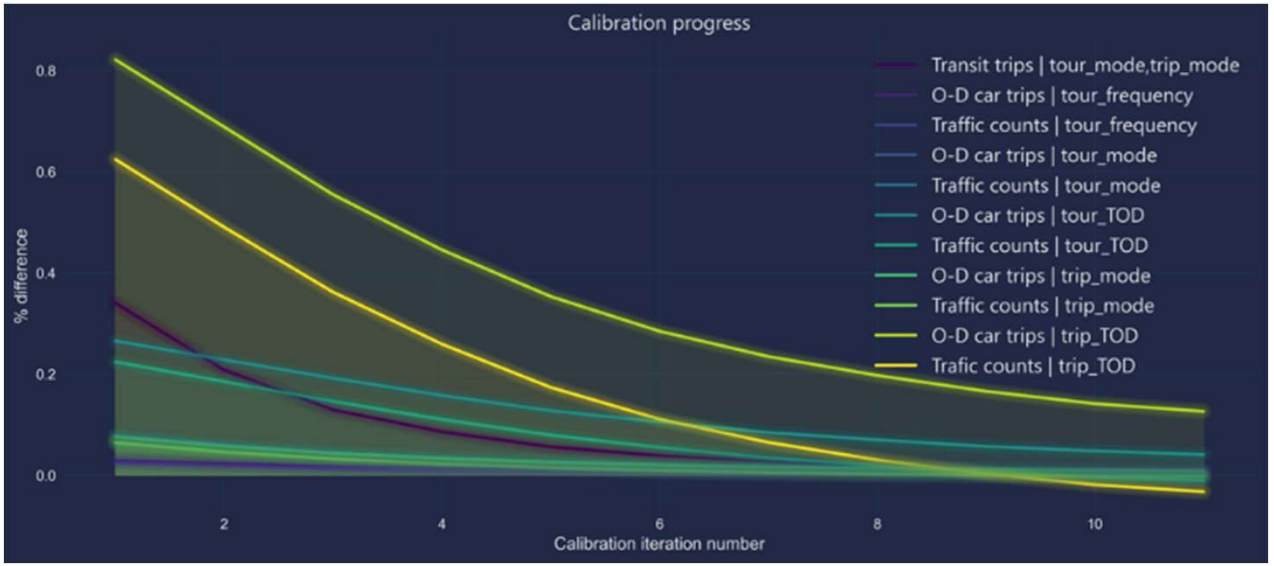


- Leverage automated calibration procedures
- Improve model calibration and validation results
- Minimize risks and costs associated with costly trial-and-error approaches to calibration
- Helps keep travel demand models up-to-date across mobility changes
- Incorporate all mobility data sources including big data





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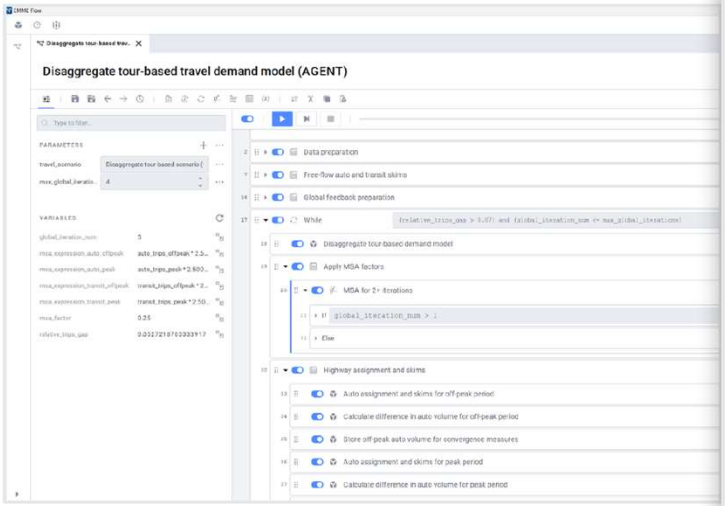
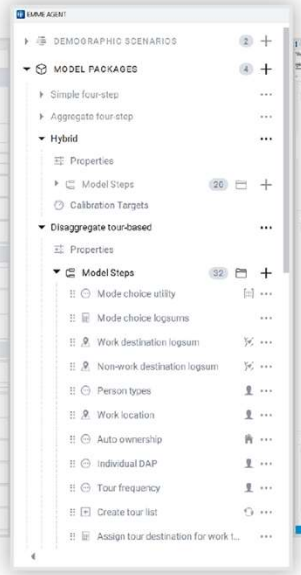
AGENT works with CUBE and EMME

EMME®

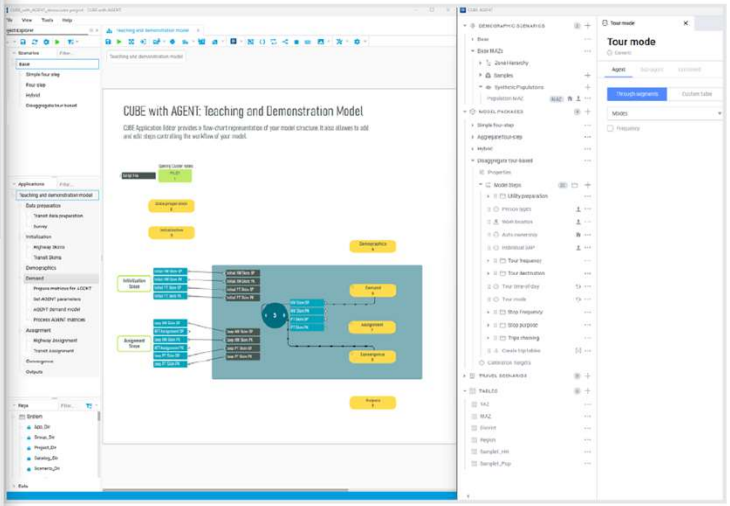


Leverage EMME features like Modeler, APIs, Notebooks, Scenes, and Flow with AGENT.

AGENT®



CUBE™

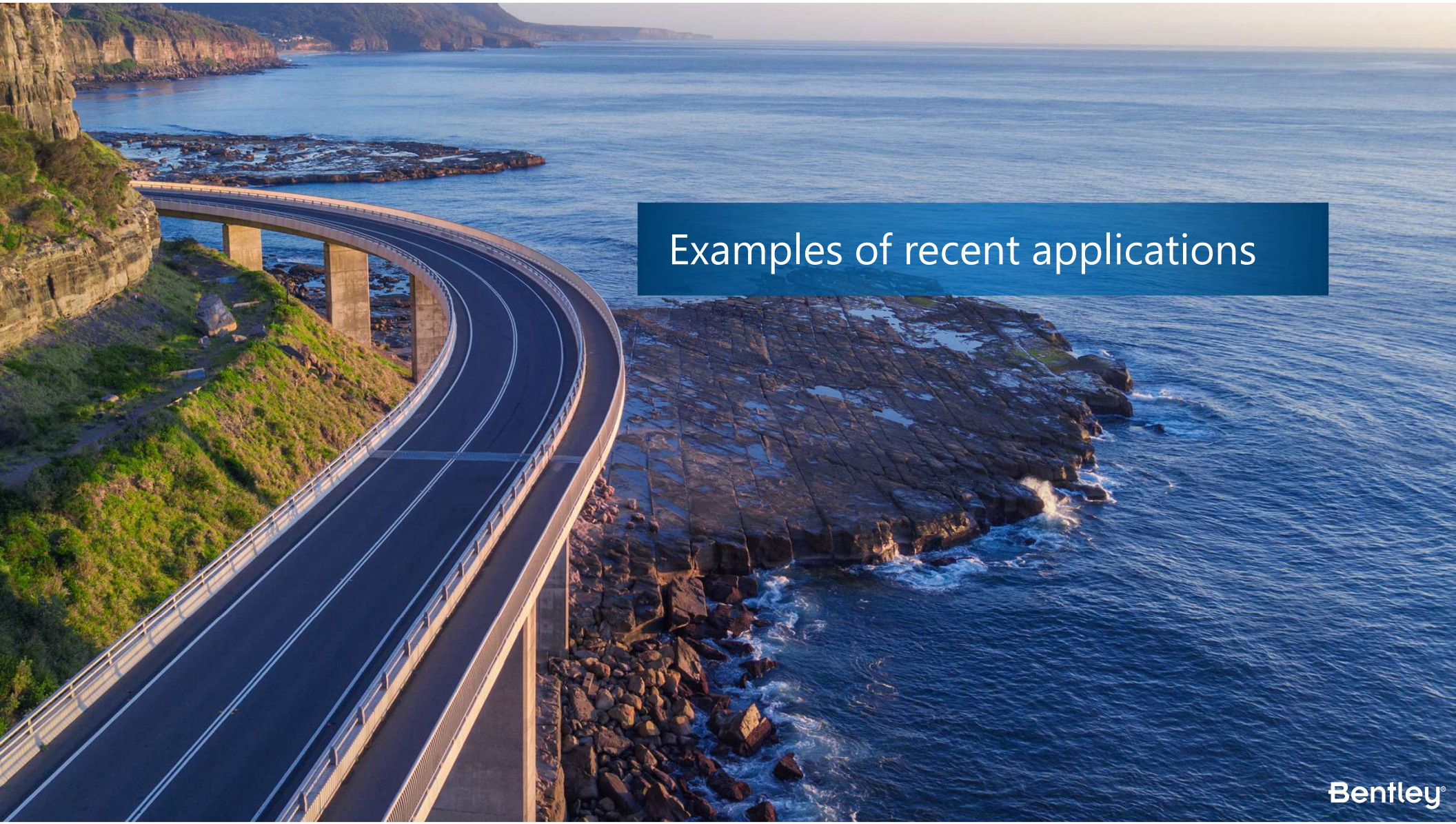


Leverage CUBE features like Application Manager, Scenario Manager, and Voyager with AGENT.

Bentley

AGENT Users

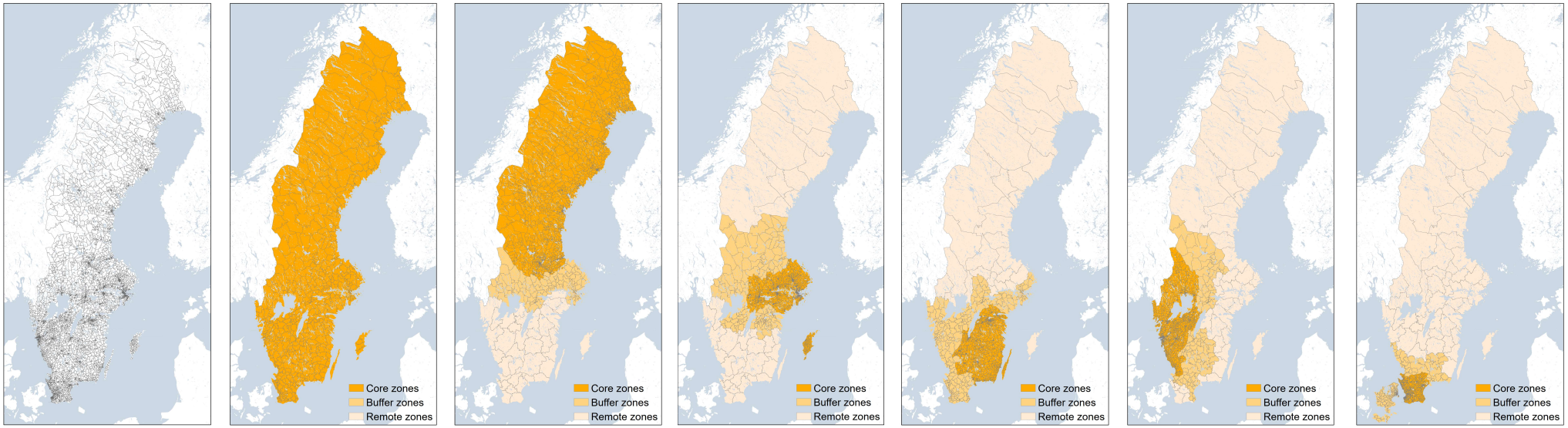
Bentley


Examples of recent applications
Bentley

National model: Sweden

- One model for 5 regions
  - Differential sampling weight to represent “halo” and external zones for each region
- Total population: 10M
  - Effective population after differential sampling: 3-5M

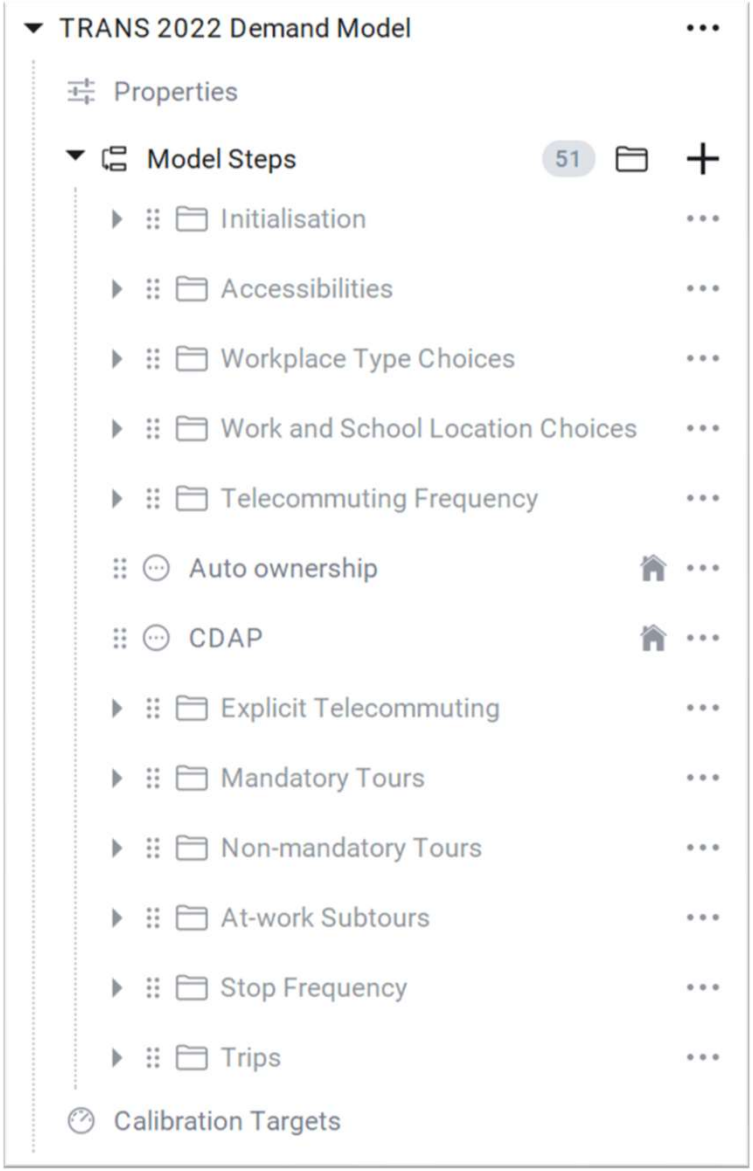
10,997 zones | 682 zones | 2,103 zones | 3,110 zones | 1,952 zones | 2,982 zones | 2,253 zones



TRANS Model: Ottawa

- Development of new regional model in AGENT
- Population: 1.4M
- Calibration data sources:
  - Household travel survey
  - Traffic counts
  - Transit counts

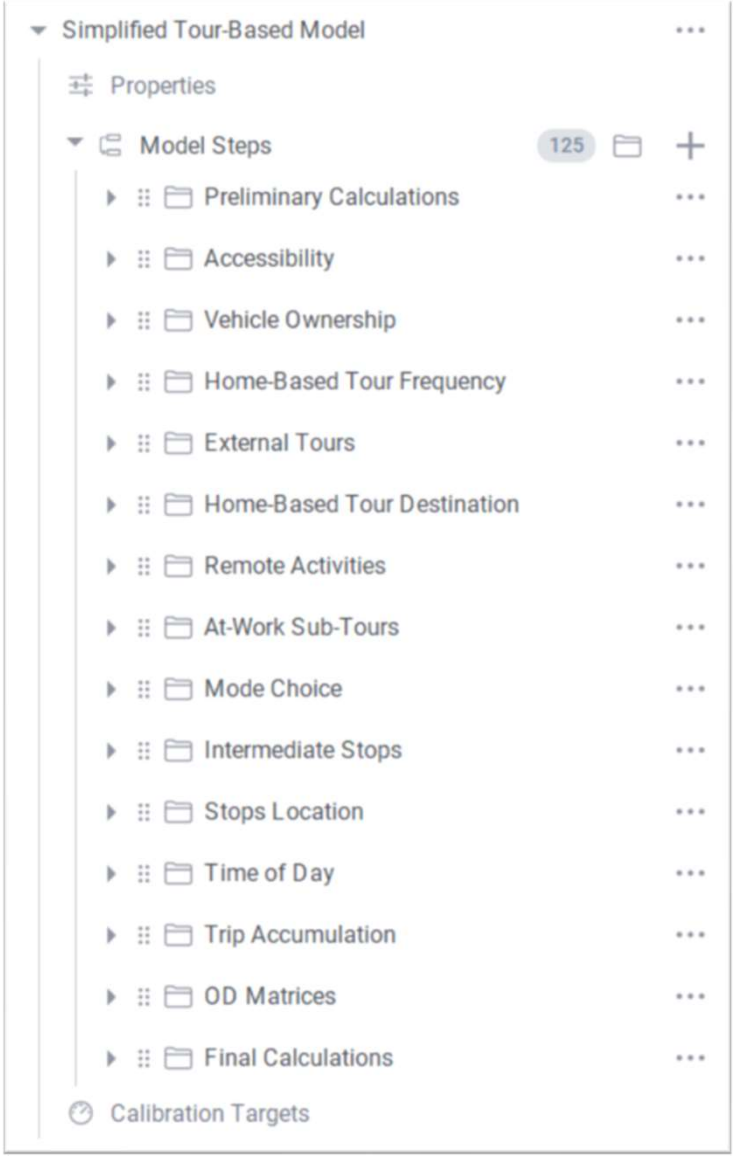
- Runtime for 1 iteration of demand model
  - ~12 mins on Intel® 2.4GHz, 16 cores, 32 GB RAM



Simplified Tour-Based Model (STBM): Perth

- Re-platform demand model to AGENT and auto-calibrate
- Population: 2M
- Calibration data sources:
  - Household travel survey
  - Census
  - Traffic counts
  - Transit counts

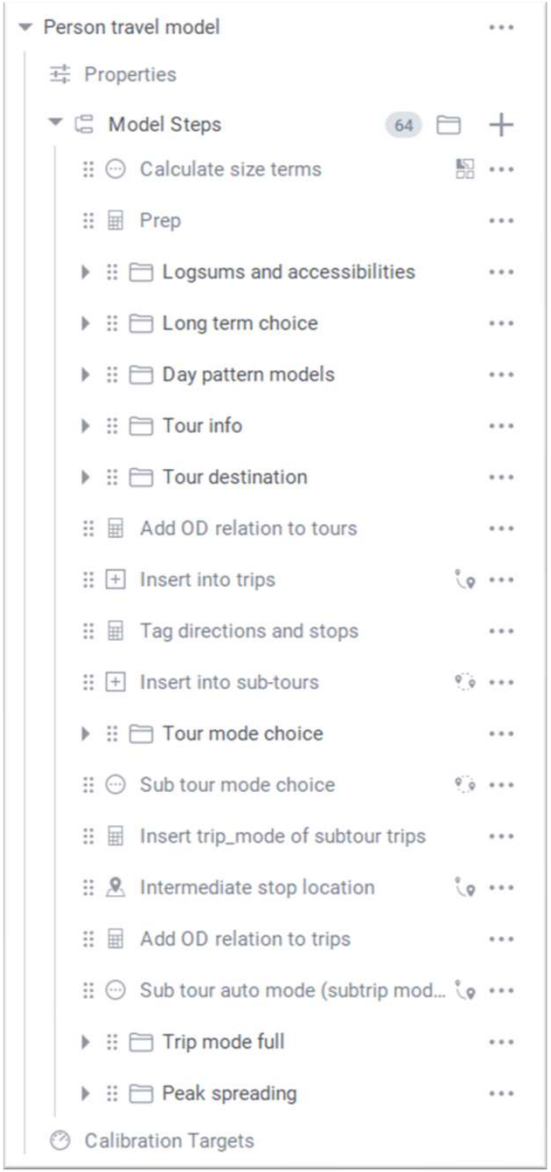
- Runtime for 1 iteration of demand model
  - ~15 mins on Intel® 2.4GHz, 16 cores, 32 GB RAM



Person Travel Model (PTM): Edmonton

- Re-platform demand model to AGENT
- Data-driven day pattern model
- Population: 1.3M

- Runtime for 1 iteration of demand model
  - ~90 mins* on Intel® 2.8GHz, 32 cores, 128 GB RAM

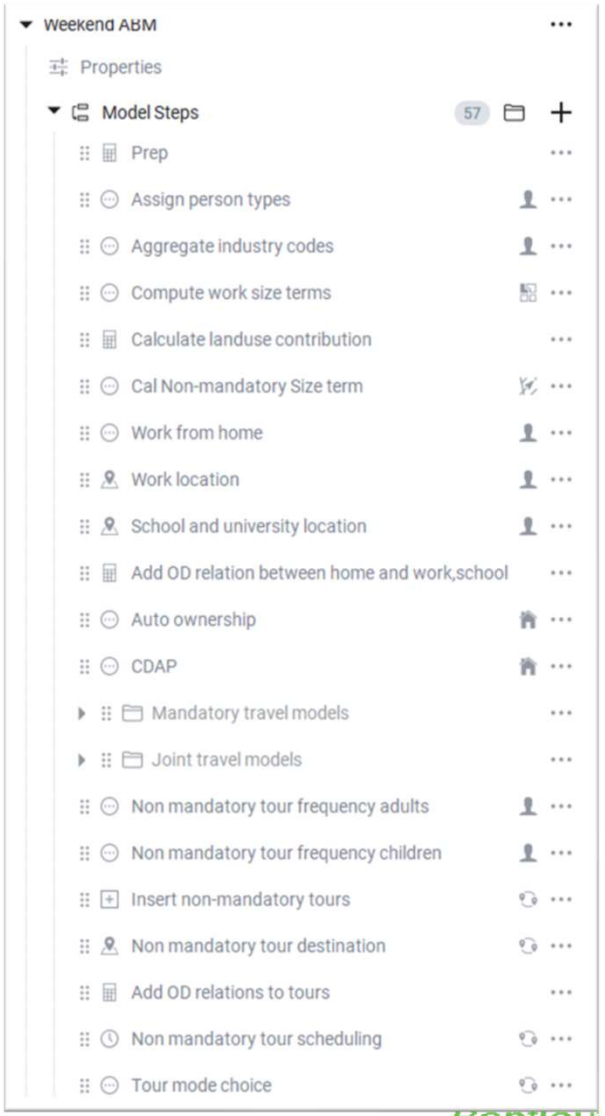


Weekend model: MAG

- ABM for new weekend travel demand model
- Population: 5M

- Transfer of weekday model to weekend:
  - No HTS for weekend travel behavior
  - Available data: AirSage data, traffic counts

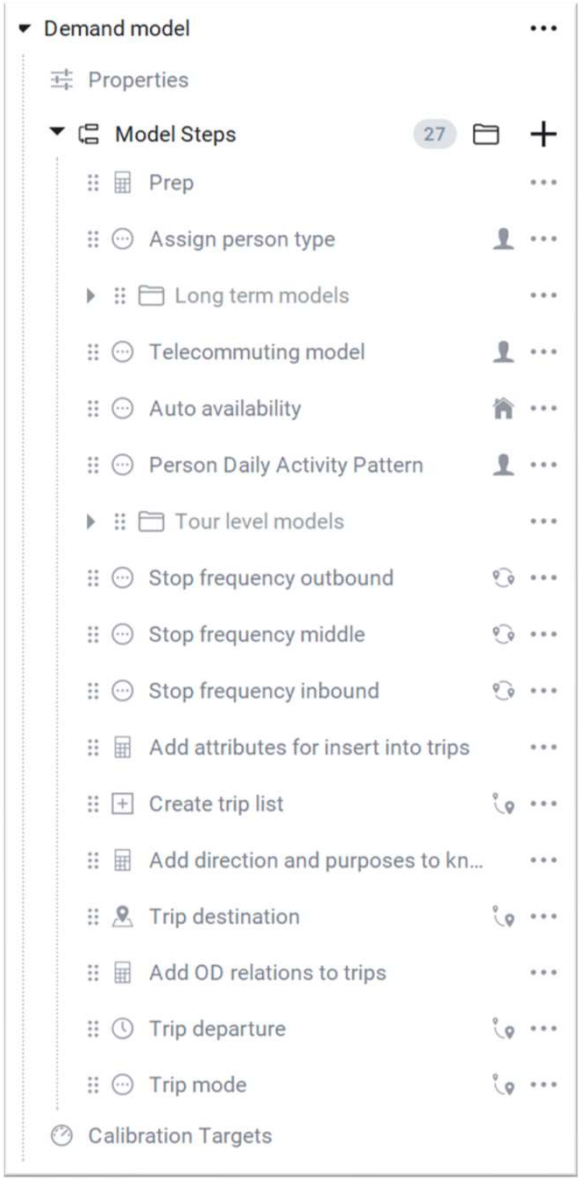
- Runtime for 1 iteration of demand model
  - ~80 mins* on Intel® 2.8GHz, 32 cores, 128 GB RAM

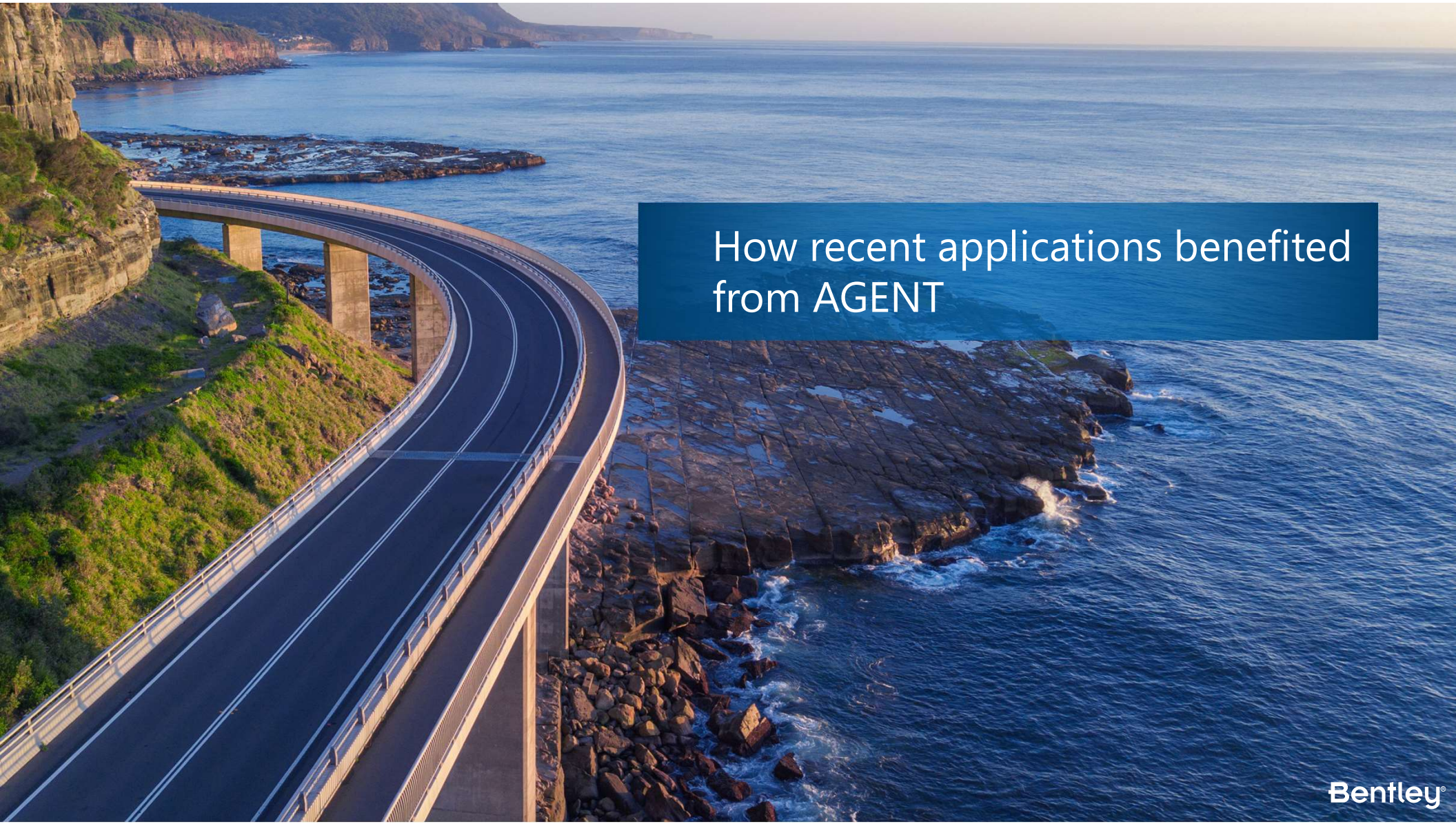


Tour-Based Model: Hong Kong

- Development of new tour-based model for Hong Kong
- Population: 6.8M
- Calibration data sources:
  - Household travel survey
  - Traffic counts
  - Transit counts

- Runtime for 1 iteration of demand model
  - ~40 mins on Intel® 2.4GHz, 16 cores, 32 GB RAM




How recent applications benefited from AGENT
Bentley

Key benefits (1)

Shorter model configuration time

Examples:

Perth STBM → 4-5 weeks

TRANS Ottawa → 3-4 weeks

PTM Edmonton → 2-3 weeks

Easy to understand interface allowed collaboration

Everyone in the team could participate in model updates, QC and validation

Faster runtimes

Re-platformed models experienced substantial improvement in runtime:

- STBM Perth: 35 mins vs 15 mins in AGENT
- PTM Edmonton: 120 mins vs 90 mins in AGENT

Key benefits (2)

Automated calibration

Easier to transfer models from one region to another → Ex: Parts of MAG, ARC, GGHM, 3C for TRANS Ottawa

Accelerated model calibration → Ex: Calibration to HTS in less than a week for TRANS Ottawa

Leverage multiple data sources for model calibration → Ex: AirSage O-D data + traffic counts for MAG weekend Model

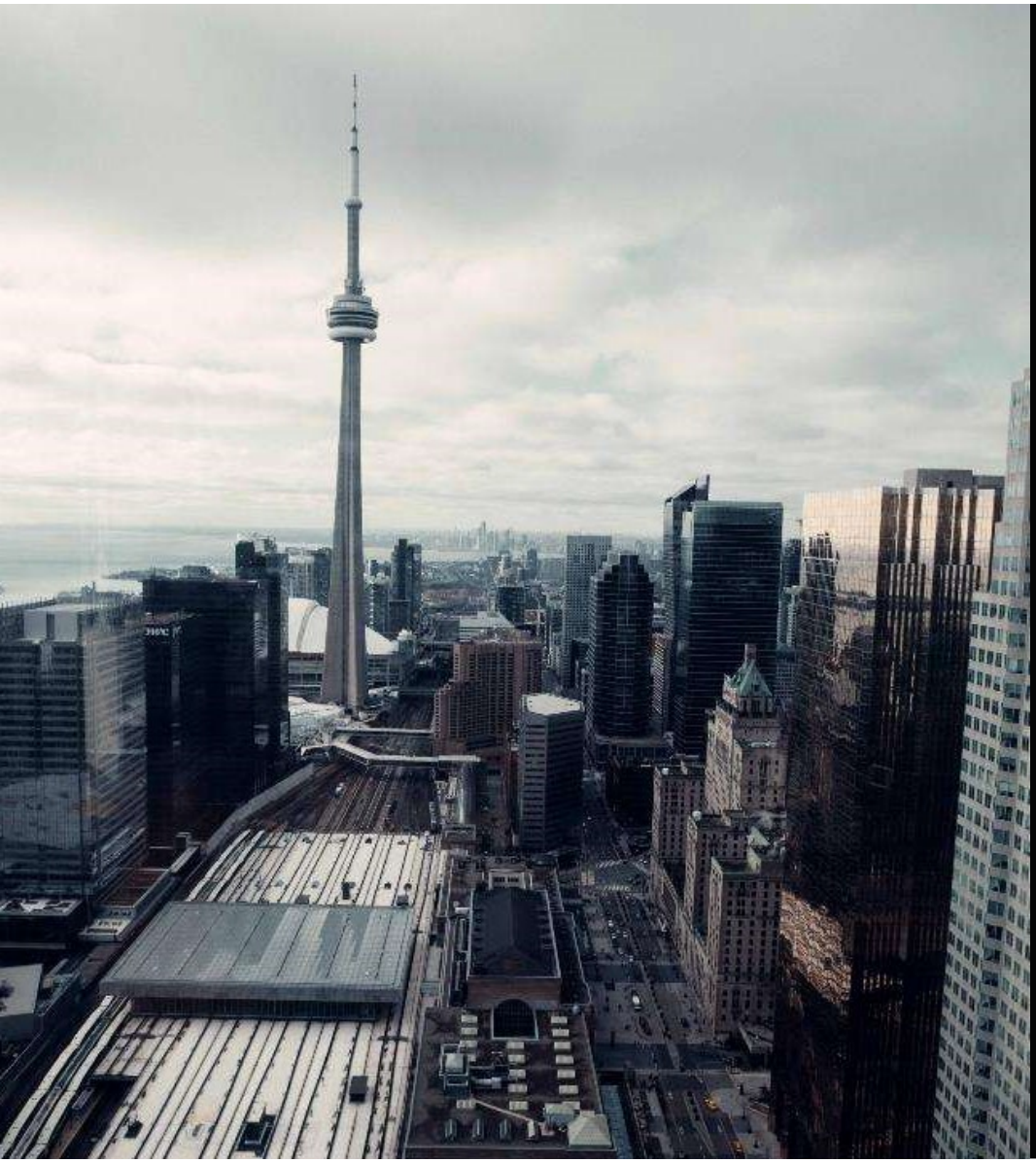
Demand model as a common denominator to understand multiple dataset

Managing stochasticity

Bentley

AGENT provided us with a transparent modelling environment where the complete definition of utility functions, data and model results can be studied without …specific programming skills. Our impression so far [of AGENT] is that we have a model with low cost of maintenance that can be further developed to address new questions.

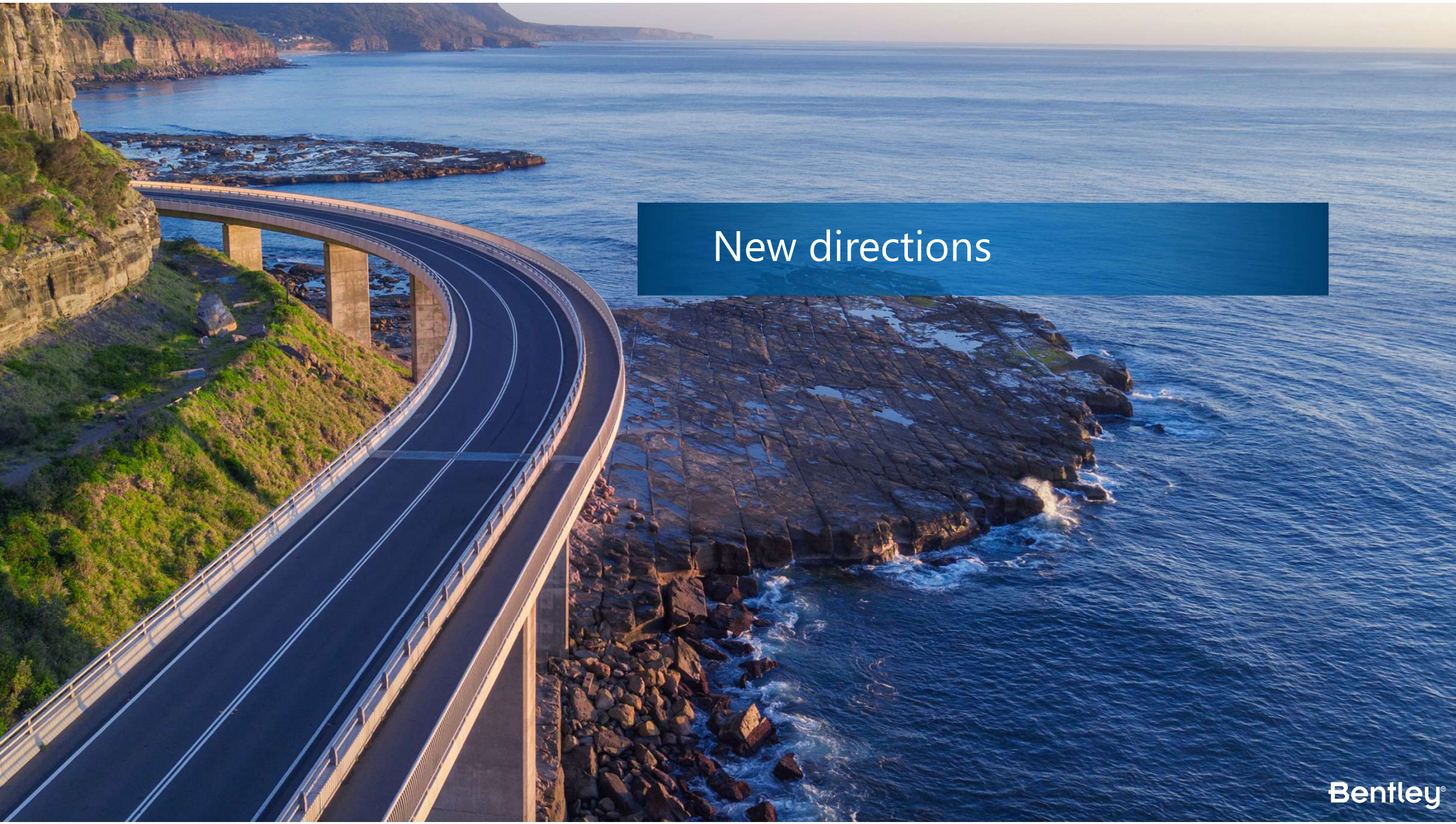
- Svante Berglund
Trafikverket, Sweden



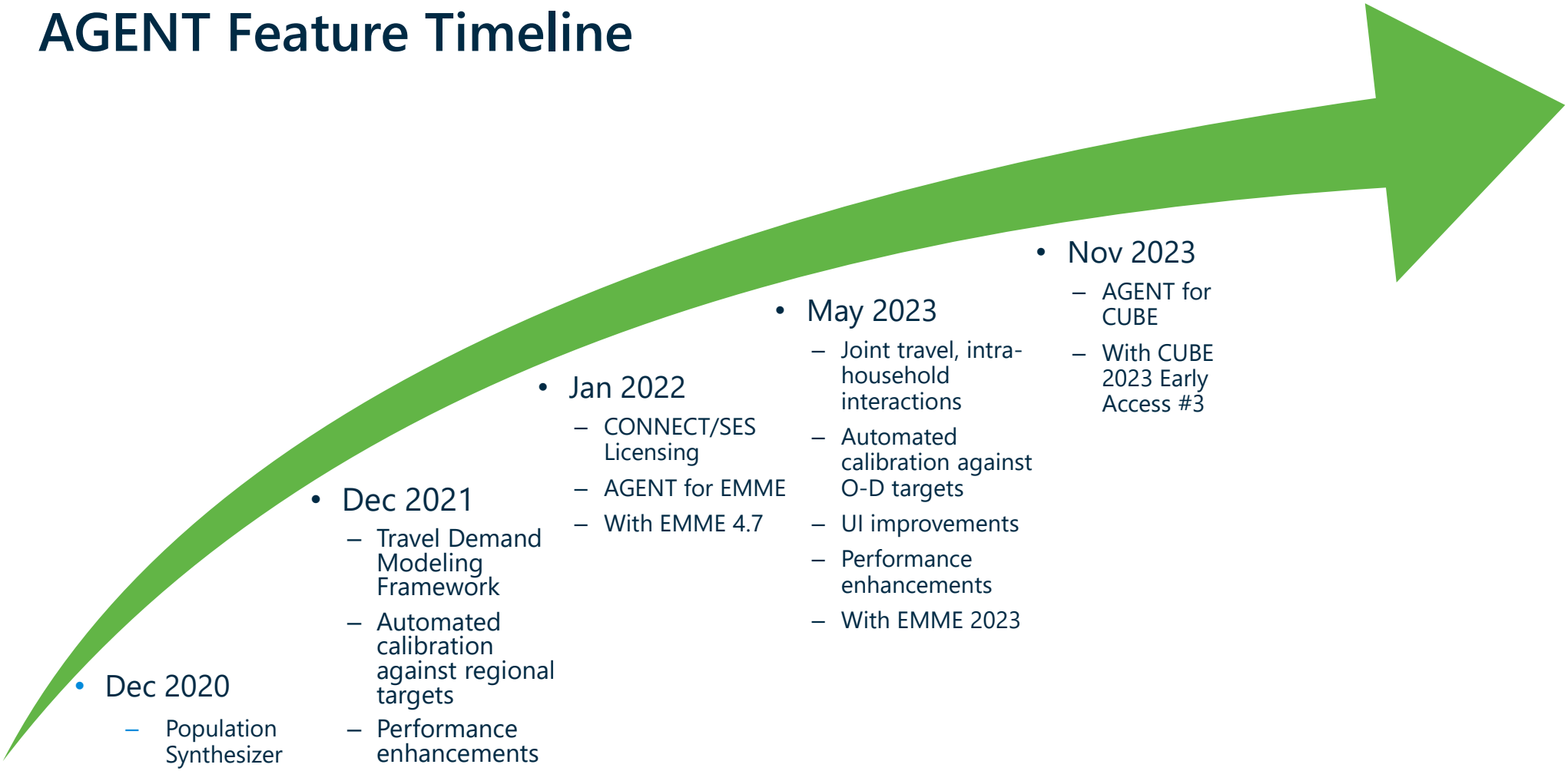
[AGENT's] easy to use interface, calibration frameworks, multi level and comprehensive use of big data sources, and pre-built modelling paradigms has provided practitioners and users flexibility and access to cutting edge ideas that was previously out-of-reach without a significant investment in time and resources.

- Mausam Duggal
National Director, Transportation Planning and Science,
WSP Canada

CN Tower in the Middle of Toronto by Sam Kolder, edited


New directions
Bentley

AGENT Feature Timeline



- Dec 2020
  - Population Synthesizer
  - With EMME 4.5
- Dec 2021
  - Travel Demand Modeling Framework
  - Automated calibration against regional targets
  - Performance enhancements
  - With EMME 4.6
- Jan 2022
  - CONNECT/SES Licensing
  - AGENT for EMME
  - With EMME 4.7
- May 2023
  - Joint travel, intra-household interactions
  - Automated calibration against O-D targets
  - UI improvements
  - Performance enhancements
  - With EMME 2023
- Nov 2023
  - AGENT for CUBE
  - With CUBE 2023 Early Access #3

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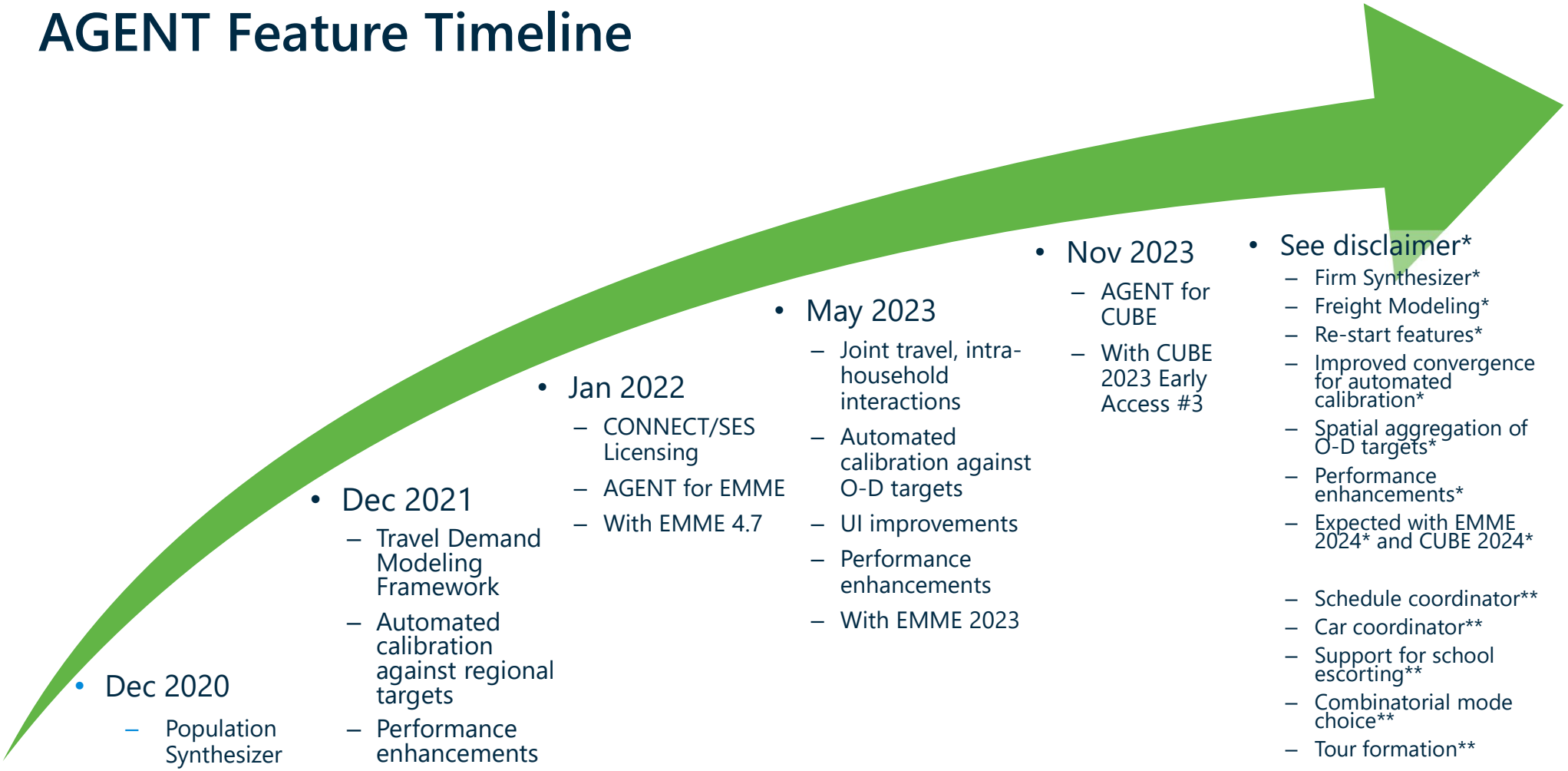
Disclaimer Statement

Release plans and timelines are forward-looking estimates and projections only. There can be no assurance that Bentley will be able to meet such estimates or projections by the dates specified, or at all. Do not make purchase decisions based on forward looking roadmaps.

Bentley

AGENT Feature Timeline



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  - With CUBE 2023 Early Access #3
- See disclaimer*
  - Firm Synthesizer*
  - Freight Modeling*
  - Re-start features*
  - Improved convergence for automated calibration*
  - Spatial aggregation of O-D targets*
  - Performance enhancements*
  - Expected with EMME 2024* and CUBE 2024*
  - Schedule coordinator**
  - Car coordinator**
  - Support for school escorting**
  - Combinatorial mode choice**
  - Tour formation**

** Tentatively scheduled for next release*
*** In development*

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Time-space constraints

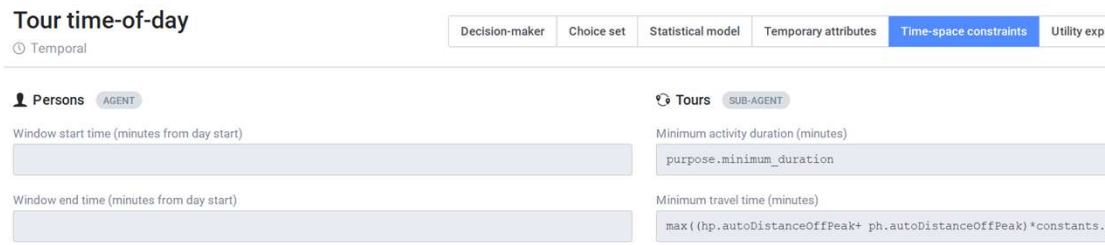
Location and temporal choice models have optional configuration for time-space constraints:

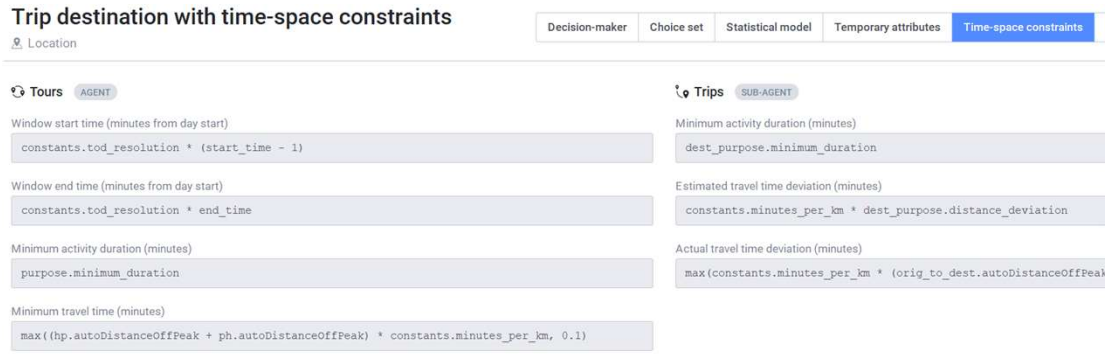
- Estimated/minimum activity duration
- Preliminary travel time

Preliminary travel time can be very different from mode/time-of-day specific travel time:

- Results in schedule inconsistencies

Choice models cannot fully incorporate all time-space constraints → Need an optimizer to resolve schedule inconsistencies





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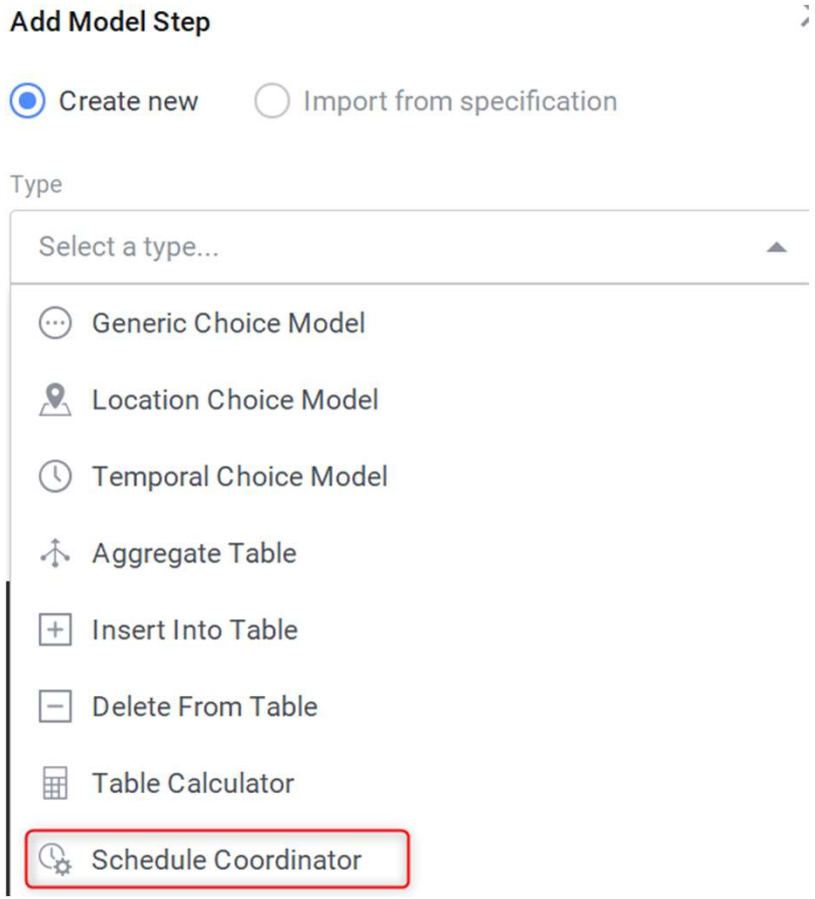
Schedule Coordinator

Creates a consistent individual schedule of activities and trips in continuous time given:

- Sequence of activities and trips for each individual
- Travel times from the time sensitive network model
- Original crude / inconsistent schedule coming from prior ABM choices
- Joint trips of HH members



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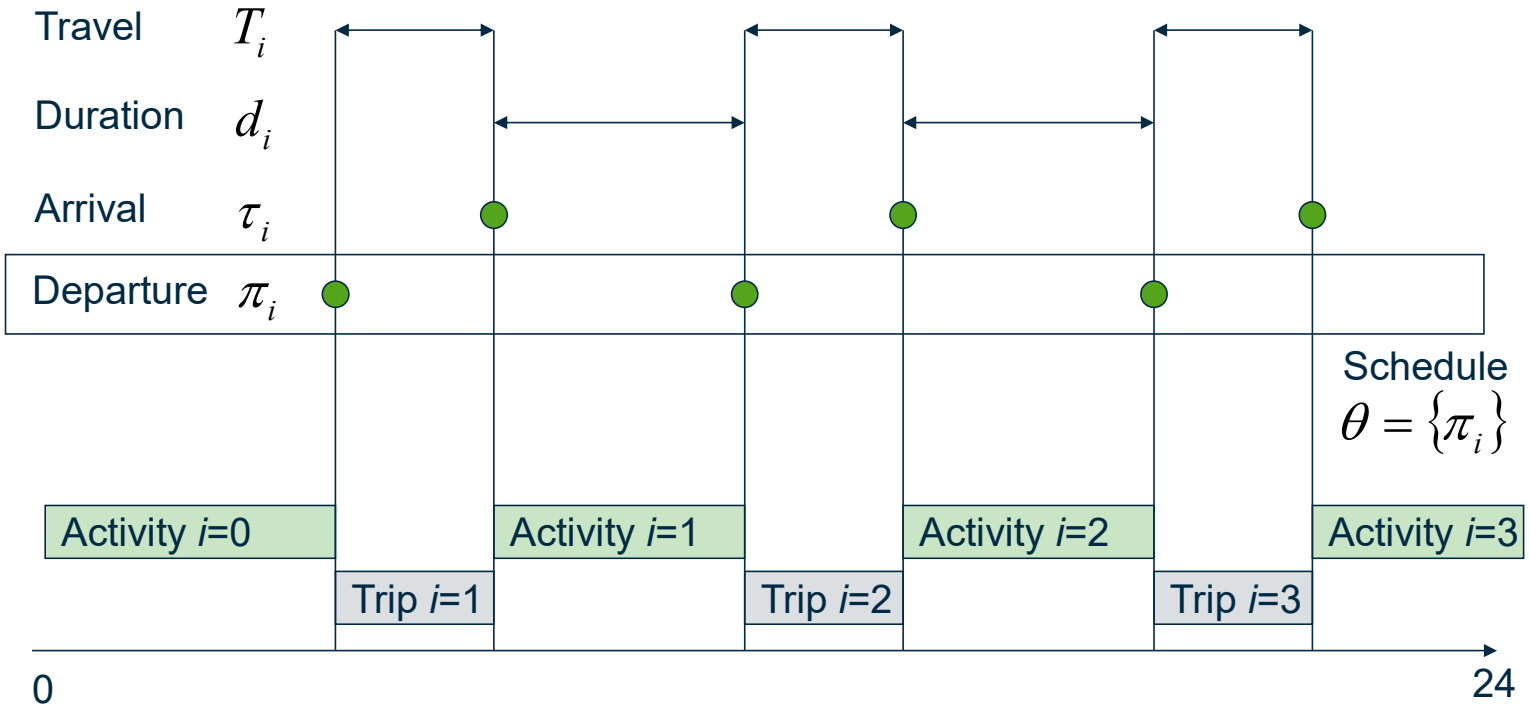
Individual schedule consistency



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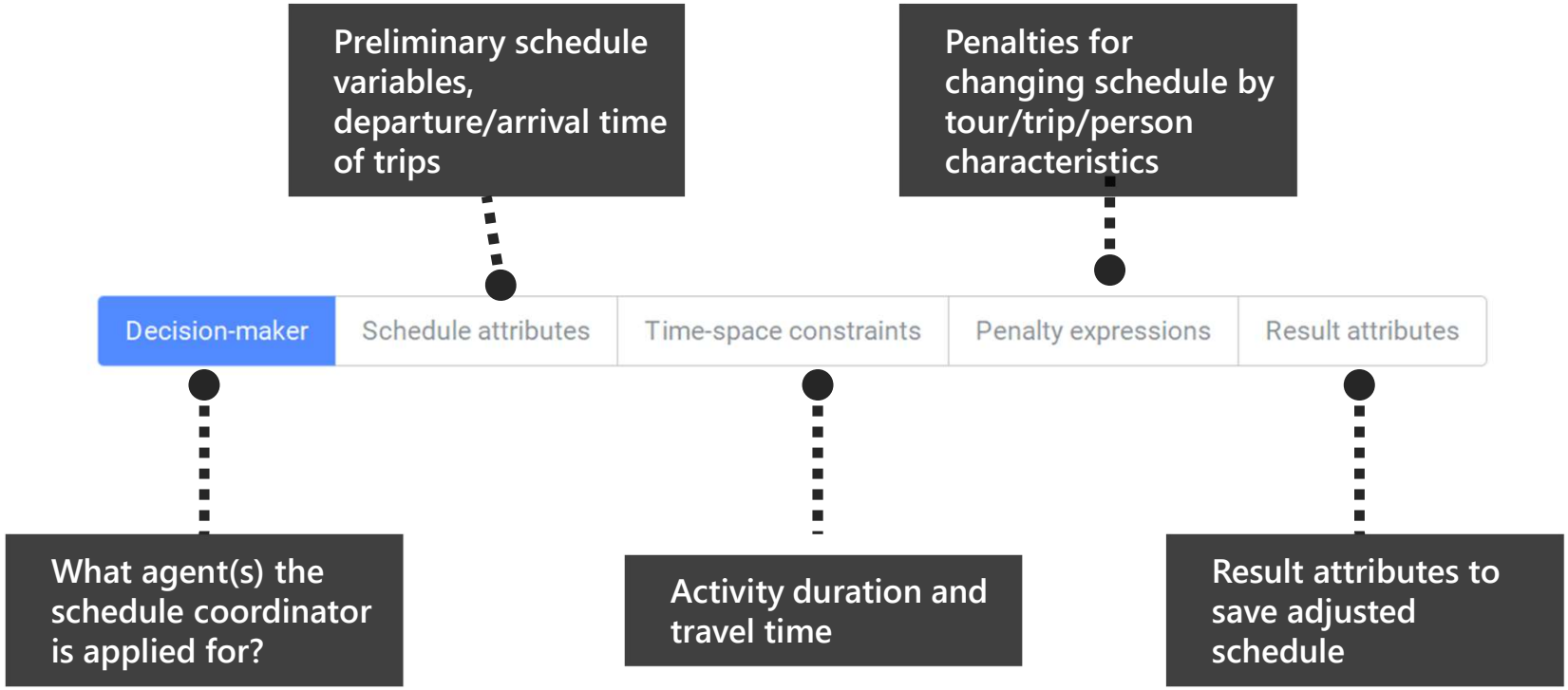
Schedule coordinator interface



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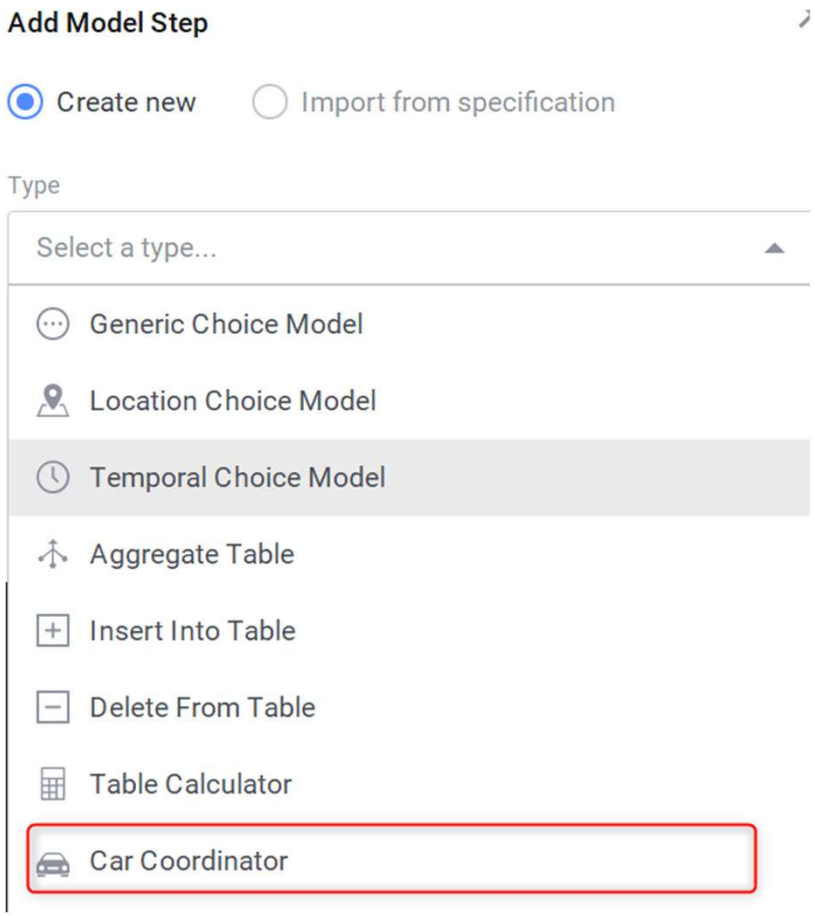
Car Coordinator

Allocates household cars to auto trips within household ensuring time-space constraints with following key considerations:

- Car size matching party size
- Car type preferences for trips (EV range)
- Car trips cannot overlap in time
- Close chain of consecutive trips for each car
- Car repositioning and parking options for autonomous vehicles



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Specification of car type dimensions of interest: Example

3 fuel types


Gas/diesel


Hybrid


Electric (EV)

×

6 body types


Motorcycle


Mini


Regular


SUV


Van


Pickup

×

2 automation levels


Regular (RV)

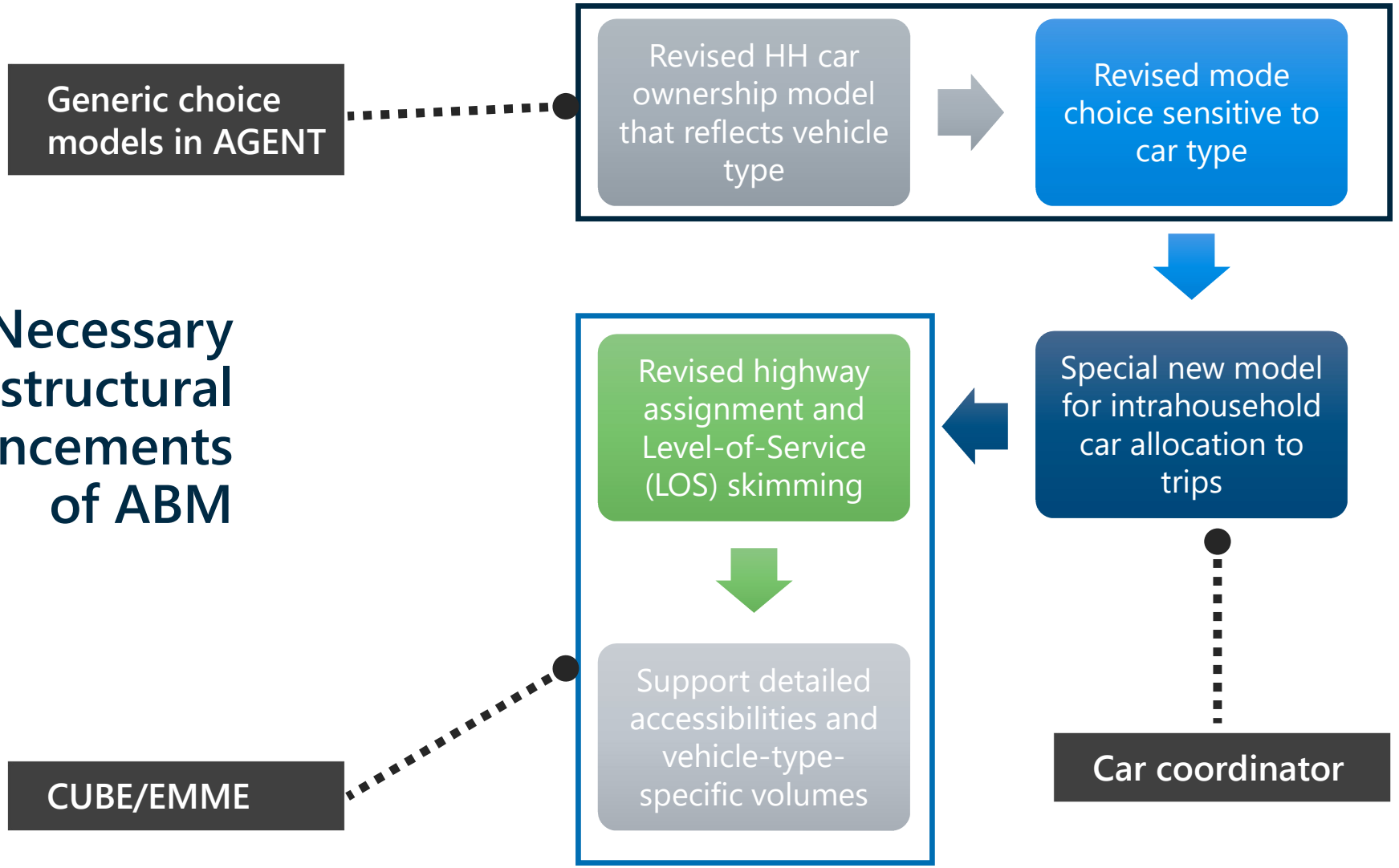

Autonomous (AV)

18 car types for individual car segmentation

HH segmentation

Bentley

Necessary structural enhancements of ABM



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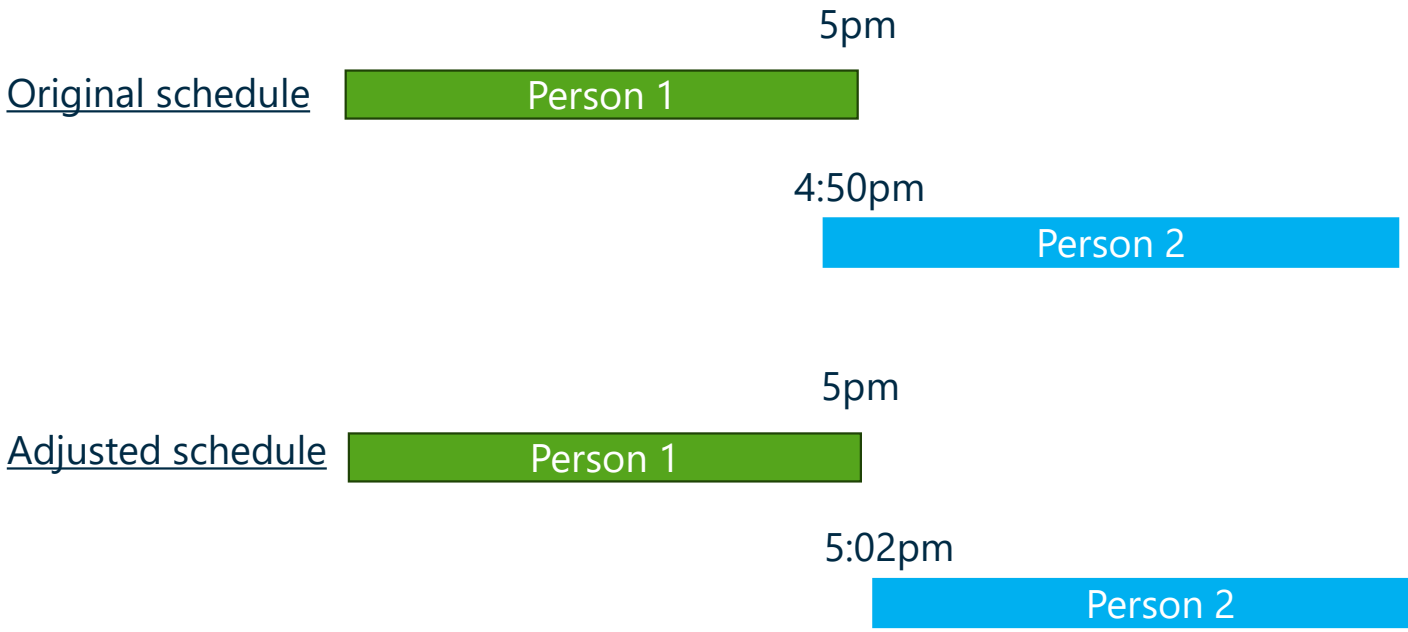
Why not conventional discrete choice?

- Infeasible choice set size for conventional discrete choice
- Choice models cannot incorporate (minor) adjustment in schedule to accommodate car allocation



Person 1 and 2 cannot share a car without change in schedule

Car coordinator allows adjusting schedule to accommodate car allocation

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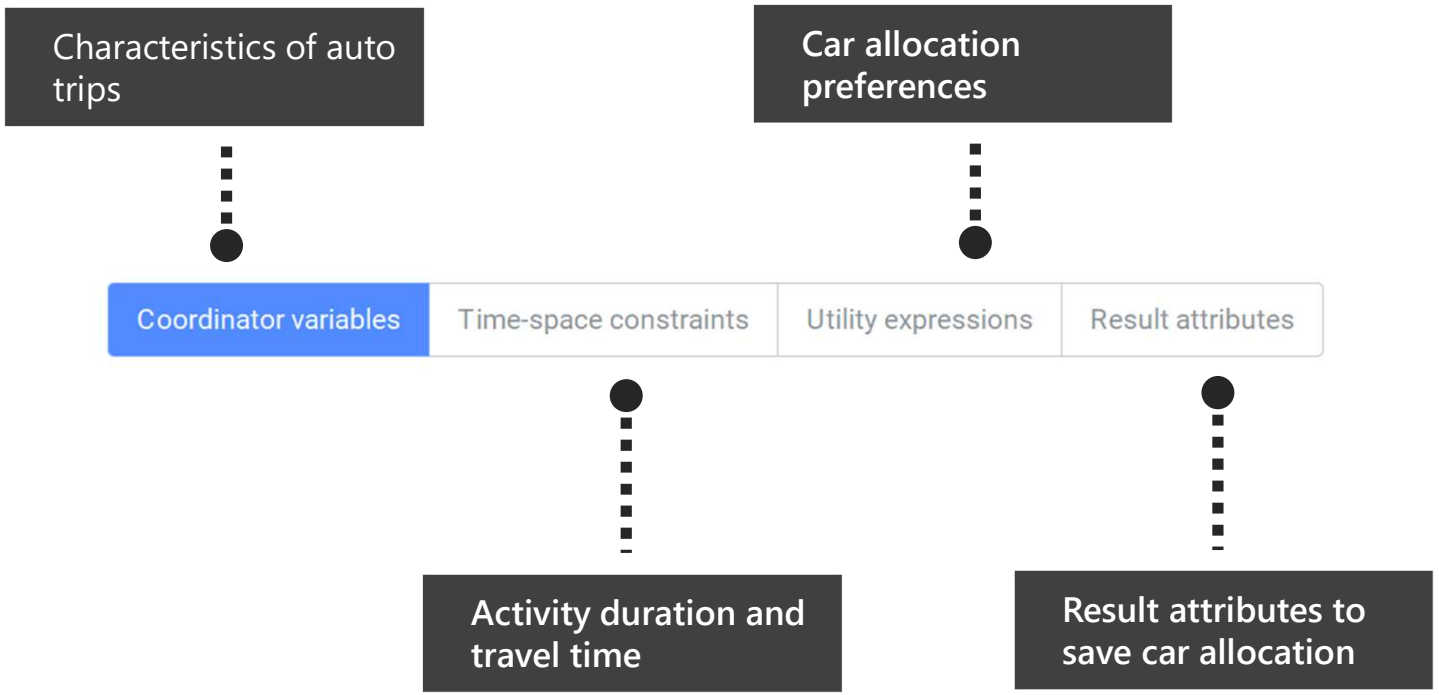
Car coordinator interface



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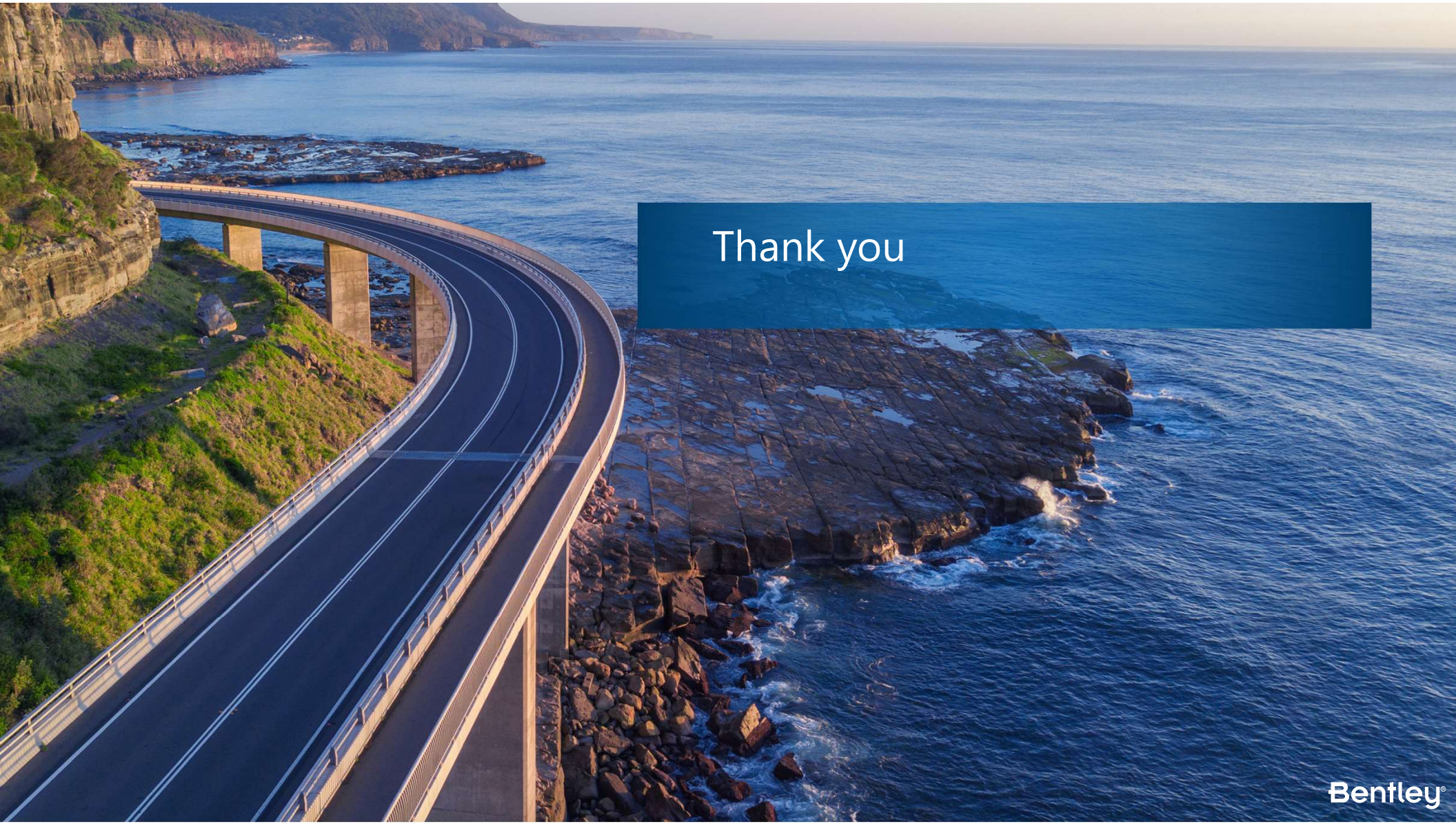
Thank you
Bentley