

Activity-Based Mobility Model: Estonian Case Study

Philip Milan Knirsch, Eva Lotta Juurma, Erki Saluveer, Martin Haamer, Age Poom, Anto Aasa, Peeter Leets, Ago Tominga

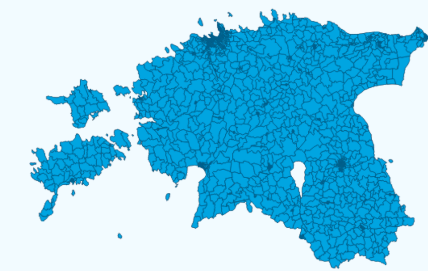
Motivation & Objectives

- The Prototype for a Data-Driven and Open Mobility Model for Estonia (LAAM) project aims to implement a fully-open source, activity-based model capable of simulating complete daily activity diaries, including tours, trips, and mode choices of the entire Estonian resident population for a representative weekday.
- A central objective is to enable the Transport Authority of Estonia to perform high-fidelity scenario planning through which the behavioural impacts of policy interventions, such as changes to the built-environment, (transit) fares, the road network as well as impacts of demographic change can be evaluated.
- The project uses ActivitySim, an open-source ABM platform as its core simulation engine, making LAAM one of the first implementations of this framework outside of North America.
- A secondary objective is to systematically document the data requirements, methodological adaptation needs, and limitations encountered when transferring an ABM framework to Estonia.

Methodology

- ActivitySim is agent-based: every synthetic person and household in the Estonian population passes individually through a sequential chain of discrete choice submodels, with each submodel computing utilities and choices being made over available alternatives.
- Utilities are a function of person and household attributes, land-use/zonal characteristics and level-of-service impedances.
- The core organising principle is the tour, a sequence of trips beginning and ending at an anchor location such as home or work. This enforces consistency across time, activity sequences & mode constraints in decisions within a day.
- In ActivitySim long-term decisions are made first, followed by daily, tour- and trip-level decisions, with previous individual and household-level choices informing subsequent choices.
- Transfer of our donor model (MTC) to an Estonian context requires a comprehensive assessment of every submodel's coefficient basis against available Estonian data.
- The principal work comprises generating model inputs, identifying for which submodels we require and are able to perform re-estimation & calibration and then performing it against available Estonian data.

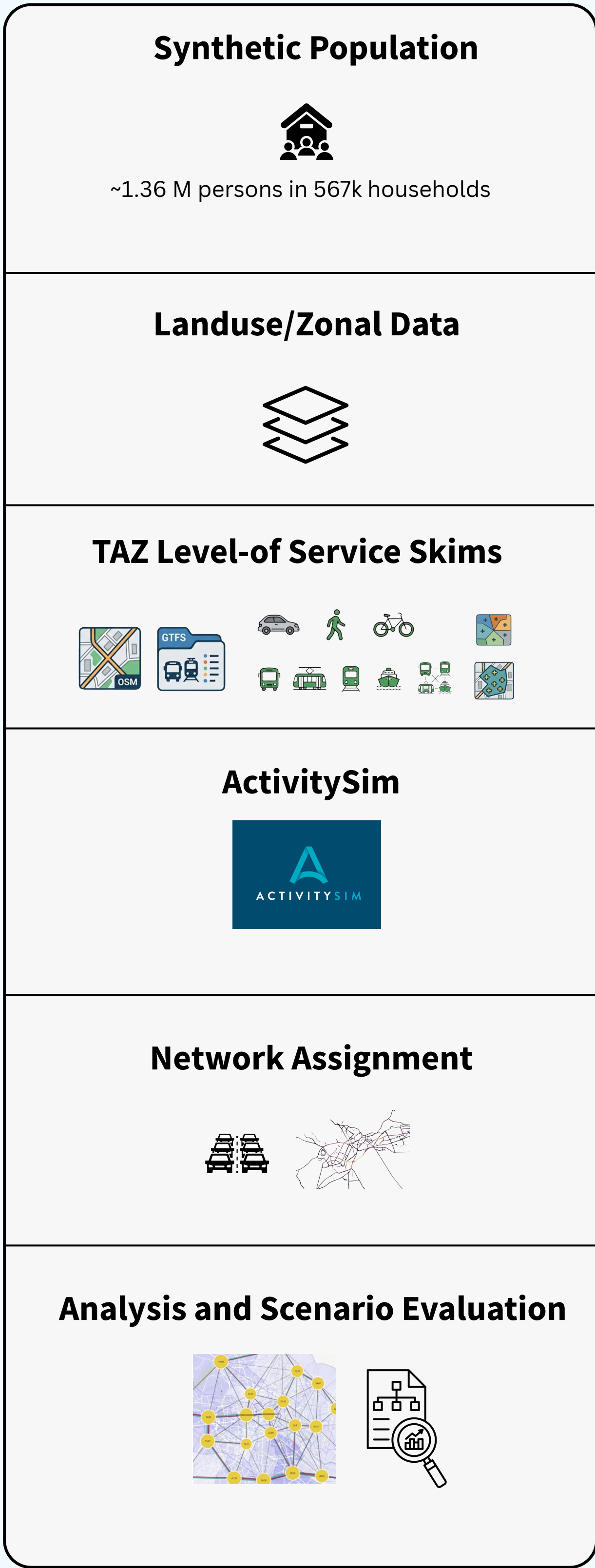
Single Zone System (TAZ)



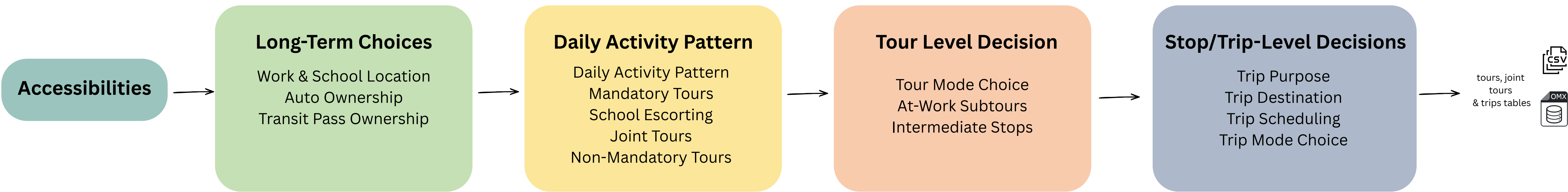
~3 000 Zones

STATISTICS
ESTONIA

PopulationSim



Model Components



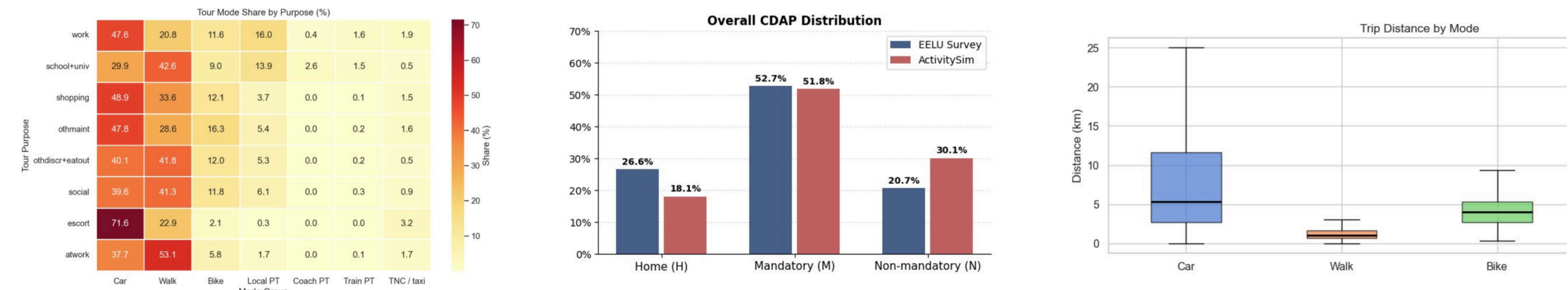
Estimation, Calibration & Validation

- Model estimation uses disaggregate data to statistically fit utility coefficients to determine how explanatory variables such as travel time, cost, demographic attributes and situational variables affect choices. For this both Statistics Estonia register data (for long-term choices such as auto ownership) and national population mobility survey (EELU 2026) data for daily, tour and trip level decisions are employed.
- Calibration refers to the process of adjusting specific parameters (mostly ASCs) to better match observed data when applying the model on the synthetic population. Calibration targets are drawn from aggregate data sources, such as EELU 2026 observed mode shares.
- Model validation is applied on independent outputs such as traffic counts and ticketing data. This concerns the full modelling pipeline and counts need to be primarily evaluated on a Network Assignment Level.
- Sensitivity analysis is further performed to evaluate whether behavioural responses to controlled changes in inputs are plausible (magnitude and direction) in order to provide confidence that the model can produce realistic predictions beyond the calibrated base year.

Findings & Limitations

- Inputs to ActivitySim can be generated for Estonia - with the model running on an Estonian synthetic population, land use, and multimodal LoS skims.
- Comparison of model outputs against EELU-observed mode shares and activity rates reveals systematic deviations highlighting the need for comprehensive re-estimation and calibration against Estonian data.
- A primary limitation is the person-level sampling of EELU, which precludes re-estimation of intra-household interaction submodels forcing these models to retain donor coefficients. Data availability represents a broader structural challenge.
- Model development identifies two future priority actions: (1) a transition to household-level travel survey methodology and (2) a dedicated Estonian Value-of-Time study to empirically ground time and cost sensitivities in observed travel behaviour.
- There is a big interest for an Estonian national scale mobility model. Communicating the model capabilities, scope and limitations to diverse stakeholders requires ongoing evaluation and management of expectations.

Initial Results



Conclusion

- LAAM establishes a proof of concept for a fully open-source, activity-based modelling pipeline for Estonia
- The model is under active development, with ongoing work focused on completing calibration-estimation, advancing output validation and performing sensitivity and scenario testing.
- Balancing between data availability, model complexity, end-user expectations and policy needs proves to be a challenging task.