

Keko: A Transport Model for Everyday Travel

Teemu Itkonen, VTT Oy

28/10/2026 VTT – beyond the obvious

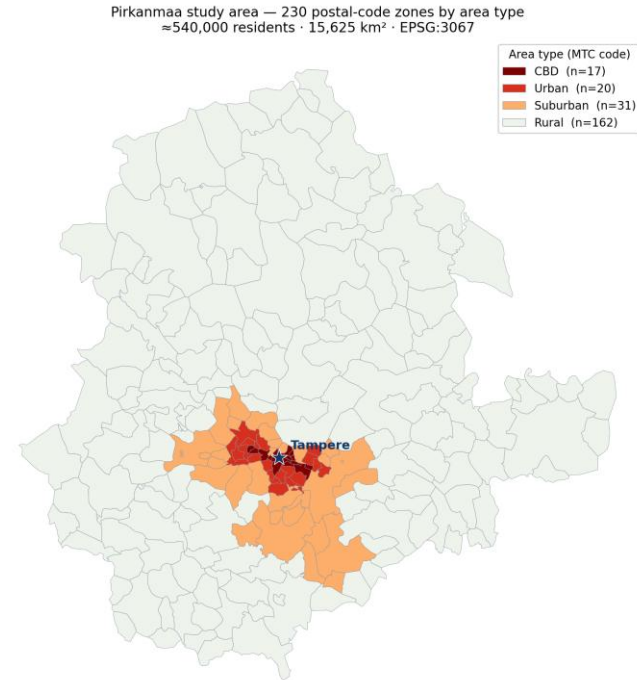
The question a transport model answers

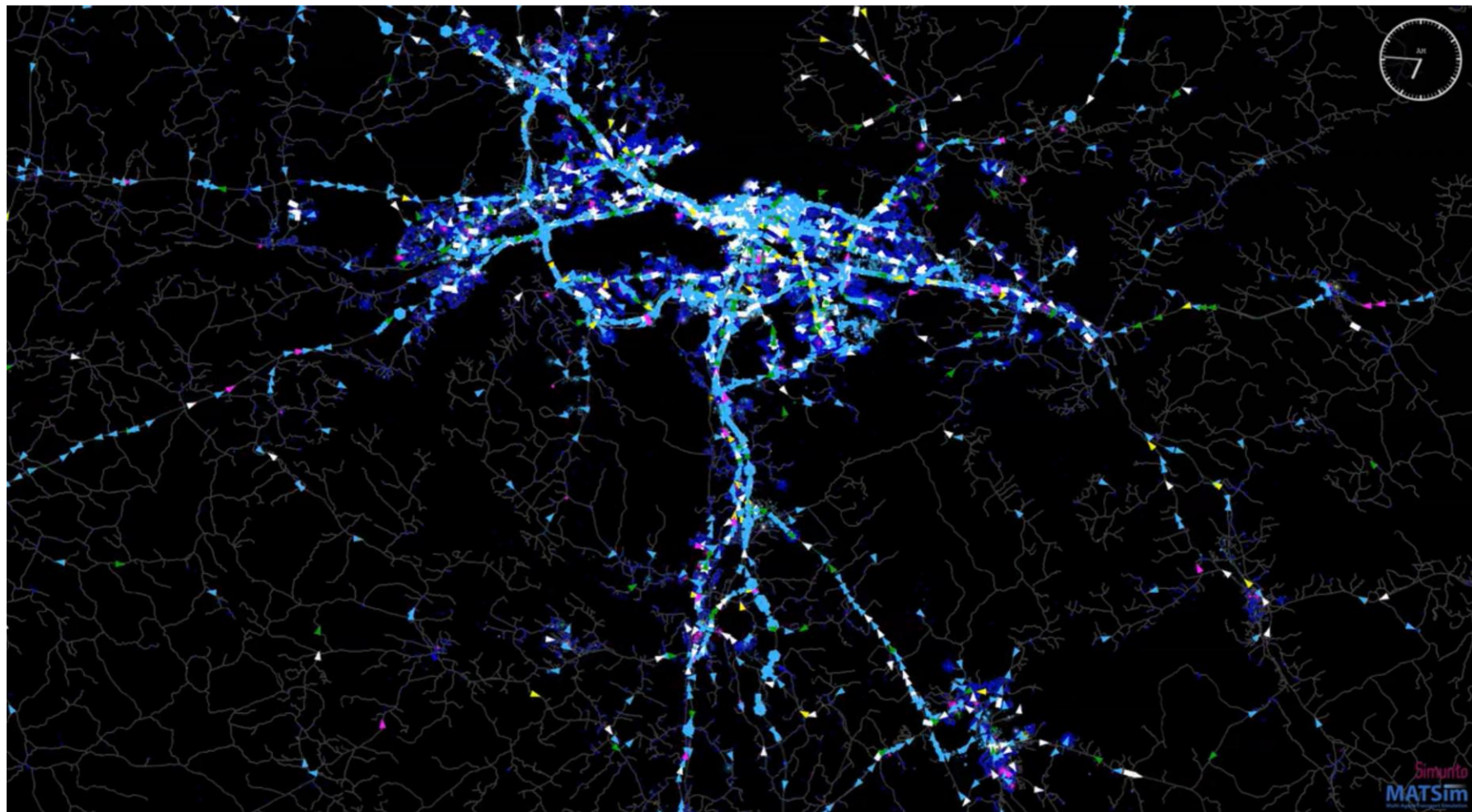
If we modify the transport system, how will it affect travel?

- A new tram line, a bypass, congestion pricing, a new housing area: each change reconfigures who travels where, when, and how.
- Guesswork is expensive. A transport model allows us test what works and what does not.
- A model turns multiple data sources (surveys, statistics, timetables, road sensors) into one coherent picture of a typical weekday.
- What you get is comparable, evidence-based answers for planning and policy decisions.

Target: A typical weekday in Pirkanmaa

- The Pirkanmaa region, with Tampere as its urban centre.
- ~540,000 residents and ~214,000 jobs.
- 230 postal-code zones spanning ~15,600 km², the spatial units used to estimate travel demand.
- From dense city centre (red) to a large rural periphery (white), classified with the YKR urban–rural data (SYKE).
- This demo targets an average weekday in September 2025





Transport is a two-part game: what people want, and what the system allows

Demand: the Activity-Based Model

“Who wants to go where, and how?”

A synthetic population of virtual residents plans a full day of work, school, shopping and leisure, then chooses car, transit, bike or walk.

Software: ActivitySim



Supply: Dynamic Traffic Assignment

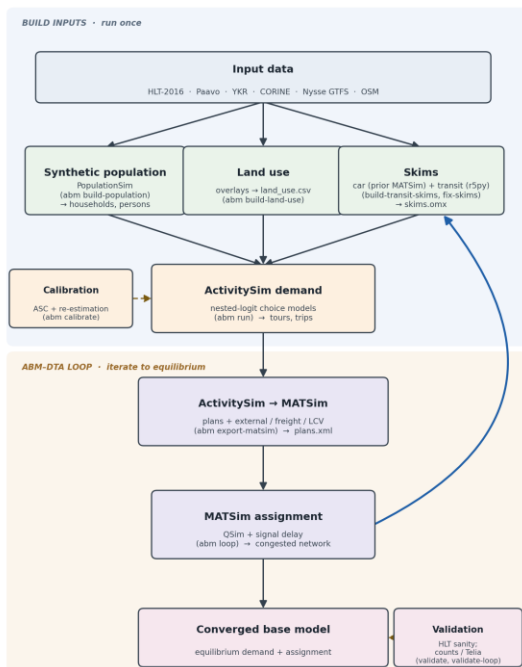
“How does it play out on the network?”

Every trip is simulated on the real road and transit network, producing congestion, delays and travel times hour by hour.

Software: MATSim

The two take turns until demand and supply settle into a realistic equilibrium.

From open data to a full day of travel

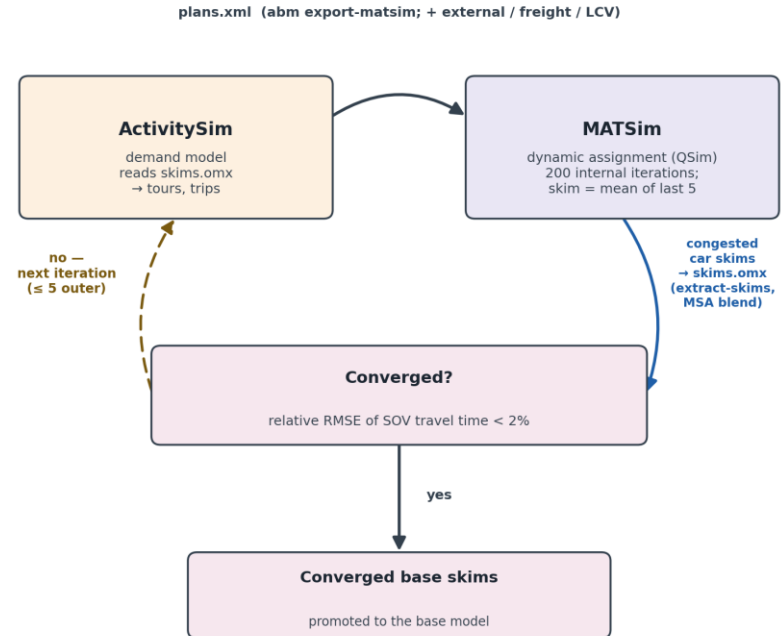


- Build a synthetic population.
- Geography and statistics: land use, employment and school data and initial travel times.
- Calibrate to match local reality.
- Generate everyone's daily plans.
- Simulate the plans on a network with roads and different means of transport.

Open, reproducible, run from one command line.

Demand and supply meet at the equilibrium

- Initial plans assume free-flowing roads, which is unrealistic in rush hour conditions.
- Simulated congestion feeds back into the next round of individual choices.
- People re-route, re-time or switch mode; the loop repeats.
- It stops when travel times settle into an equilibrium, giving a converged, self-consistent base model.



Grounded in real data

National Travel Survey (HLT-2016)

How Pirkanmaa residents actually travel; the main calibration reference.

OpenStreetMap & CORINE

Road network and land cover, showing where people live and work.

Statistics Finland (Paavo)

People, households, jobs and income by postal-code area.

Road & signal sensors

398 traffic counters (LAM + traffic-light detectors) for validation.

Nysse GTFS timetables

Real public-transport schedules for bus and tram.

Telia mobile origin–destination

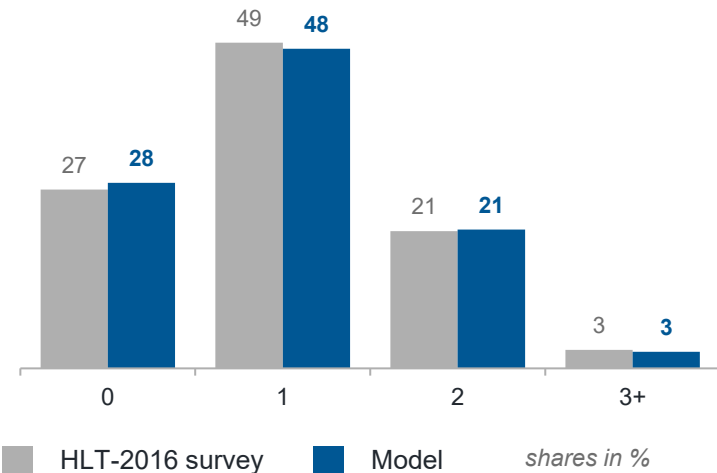
Anonymised movement patterns as an independent cross-check.

All sources are open or licensed for research

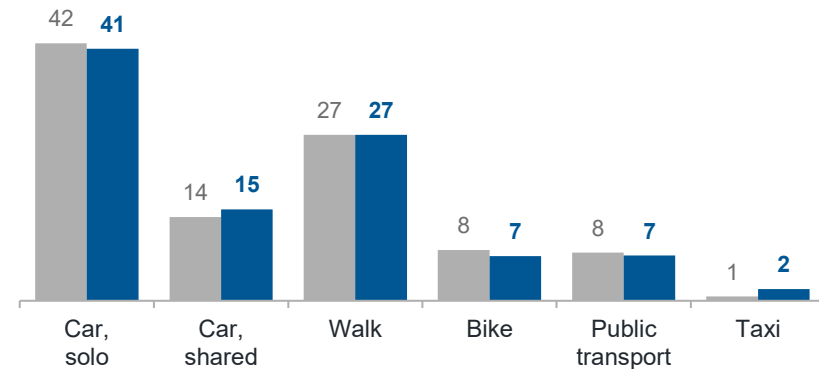
Calibration: tuning the model to Tampere

The demand model's base parameters are from San Francisco. The model gets either calibrated or re-estimated to match Pirkanmaa in the HLT-2016 survey.

Cars per household



Main mode of each trip



Trips per person / day
survey 3.14 **model 2.95**

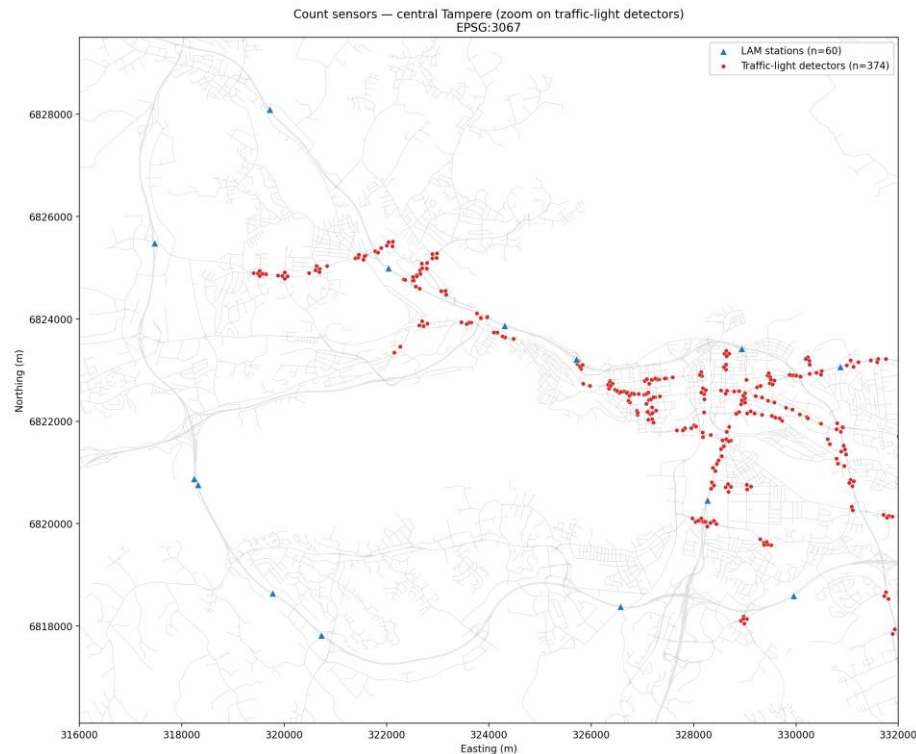
Mean trip length
survey 8.7 km **model 7.8 km**

Trips within own postal area
survey 37 % **model 36 %**

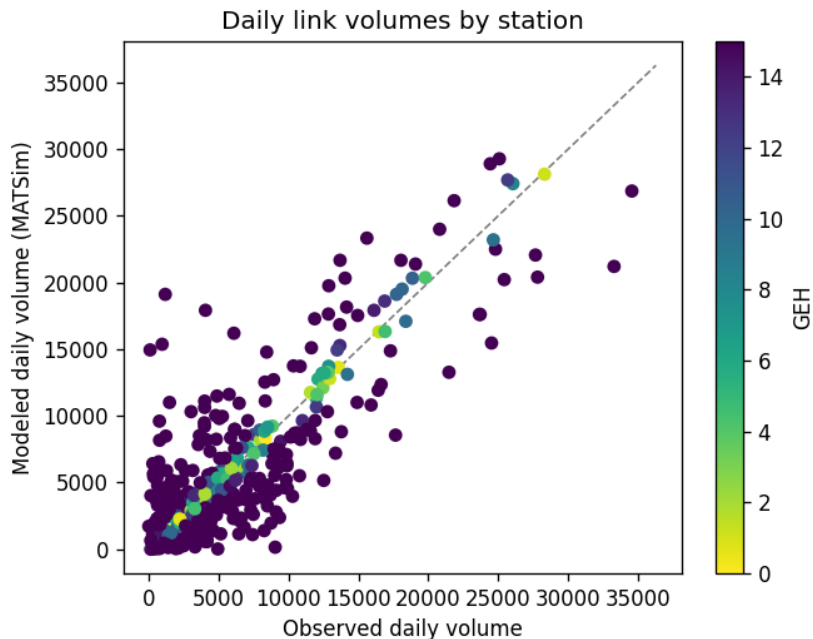
Validation: two independent sets of road sensors

- 60 highway counters on the main roads, from the city out to the region's borders.
- 374 traffic-light detectors, packed into the city where traffic is hardest to route.
- 33 detectors are left out: in the model they sit on the wrong road. 398 count locations remain.

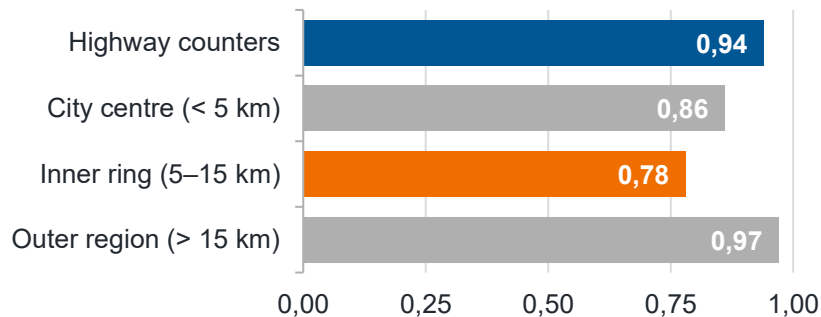
The sensors are split in two: 75% tune how traffic is assigned to the network (training set), the frozen quarter only tests it (test set).



Traffic on the right roads, city volumes about 15 % low



Modelled ÷ observed traffic, typical sensor

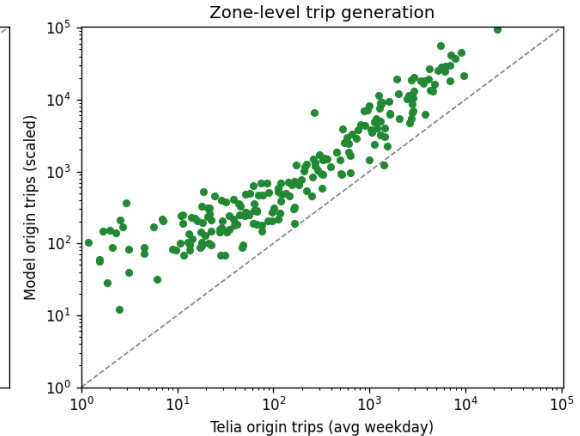
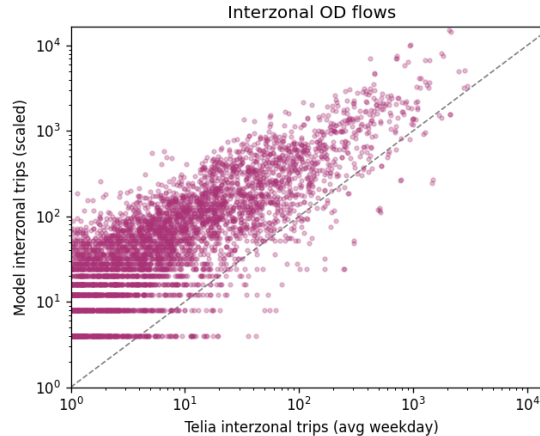


1.00 = model matches the count

- Busy roads are busy and quiet roads quiet: $r = 0.88$ across 398 sensors.
- Inner ring lowest: counts include through traffic and visitors the model only partly covers.
- About 100× larger than run-to-run noise, so real. Hold-out sensors show a similar gap (0.75 vs 0.84 on the tuned ones).

Validation: does it match mobile-phone movement?

- Cross-checked against anonymised Telia mobile origin–destination data.
- Spatial pattern matches well: zone trip generation $r \approx 0.94$, zone-to-zone flows $\log r \approx 0.77$.
- The dots sit above the line on purpose: Telia detects only a fraction of trips, so we compare the pattern, not the absolute totals.



Testing the future on the base model

1

Change one thing

A cost, a service, new jobs or new homes.

2

Re-run the model

The full demand–supply loop runs again, starting from the base model's converged travel times.

3

Compare to the base

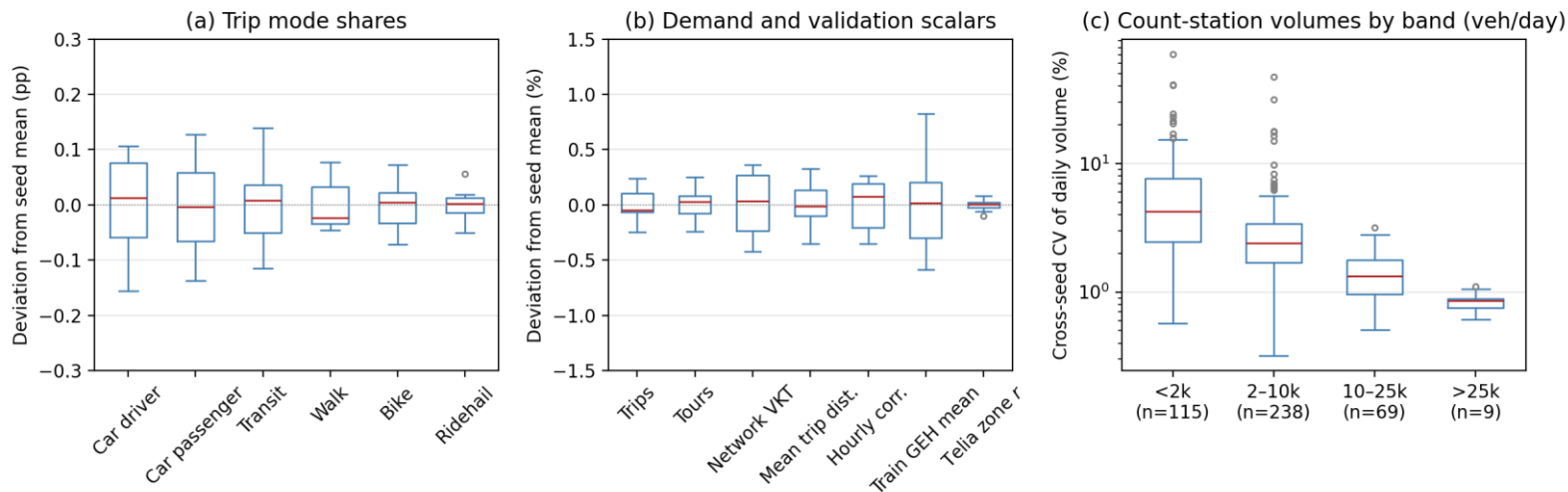
Mode shares, trip lengths, traffic on every road, each difference checked against the model's own random noise.

Three demonstrations so far

- Car operating cost +50 %: a fuel-price or distance-charge shock.
- Hiedanranta (Lielähti) gets 6,000 new jobs.
- Hiedanranta gets the jobs and 18,500 new residents.

Telling real effects from random noise

Seed-noise floor across 10 Monte-Carlo replications (25 % sample, warm-started)



- Base model run 10 times, changing only the random seed.
- The spread shows how big a change must be to count as real.

Real if larger than about

0.3 pp on a mode share
1 % on total vehicle km
5 % on a busy road

Car cost +50 %: people drive less, and shorter trips

- Car running cost raised from 11.4 to 17.1 cents/km.
- Short run: jobs, schools, car ownership and daily routines stay fixed; only errand destinations and travel modes can adapt.
- Long run: everything is re-chosen, including where people work and study.
- All headline effects are 15–26× larger than the random noise.

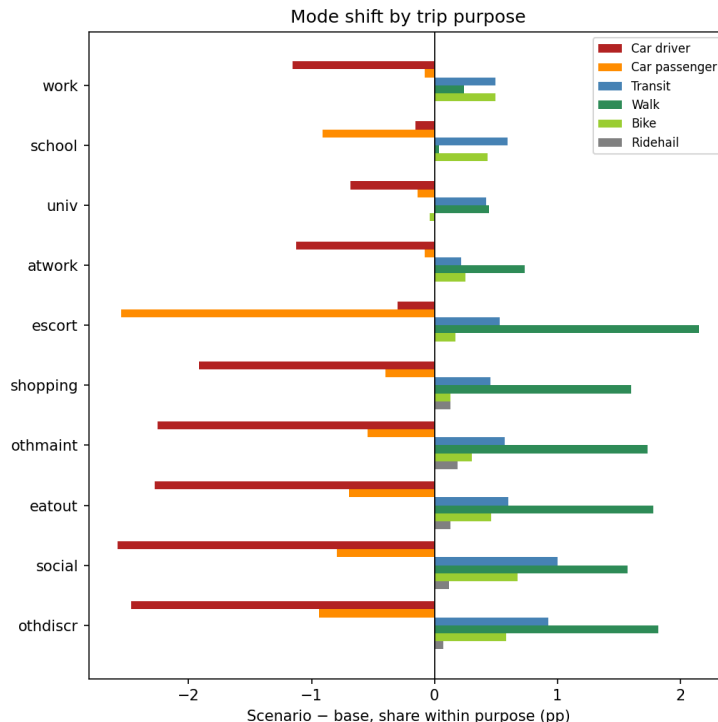
	Base	Short run	Long run
Drive-alone share	39.9 %	−1.5 pp	−1.8 pp
Walk share	23.6 %	+1.2 pp	+1.4 pp
Bike share	5.7 %	+0.4 pp	+0.4 pp
Public transport share	15.4 %	+0.6 pp	+0.7 pp
Mean trip distance	7.6 km	−4.8 %	−6.7 %
Vehicle km driven		−4.4 %	−6.1 %
CO ₂ estimate (t/day)	1,724	−76	−104

Drive-alone, walk, bike and public-transport shares do not add to 100 %: shared rides make up the rest.

Within weeks, drivers switch modes. The bigger effect would come over years, as jobs, schools and homes are reselected towards shorter trips.

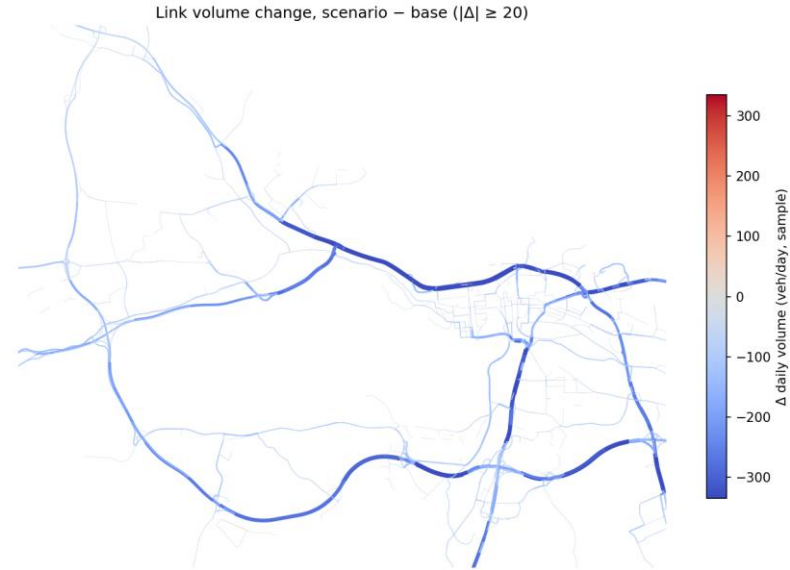
Errands change first, commutes barely

- Shopping, eating out, social and other errand trips lose 1.9–2.6 pp of their car share, mostly to walking.
- Escort trips (driving children and others) lose 2.6 pp of car passengers.
- Work, school and university trips shift only 0.2–1.2 pp: in the short run their destinations are fixed.
- The number of trips for each purpose is unchanged: people change how they travel, not whether.



Less traffic almost everywhere

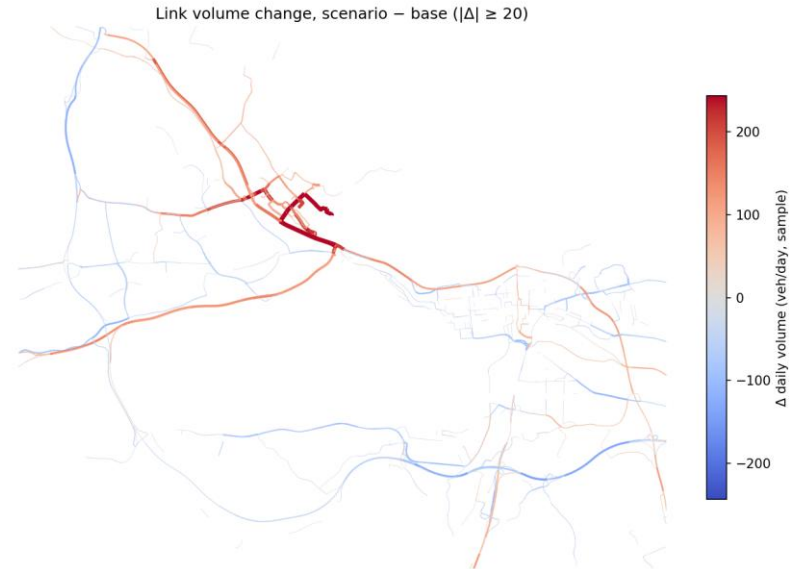
- Traffic falls on nearly every road in central Tampere.
- Biggest drops (up to 7.5 %) on the ring road and the southern radial, where the longest car trips run.
- Rush-hour travel times barely change: on an average weekday the network is not congested enough for less traffic to speed it up noticeably.



Red = more traffic, blue = less (daily vehicles, 25 % sample).

6,000 new jobs: traffic re-routes, it doesn't grow

- Lielahhti rises from the region's 13th to 5th largest job area.
- The model fills the new jobs about 1 : 1, with workers drawn from across the region, most from the city centre and the university/TAYS area.
- Region-wide totals stay within noise: no more trips or driving, just different directions. The Paasikiventie corridor gains 9–23 %.
- Commutes get longer (13.6 → 14.2 km): jobs move away from the most accessible location while homes stay where they are.

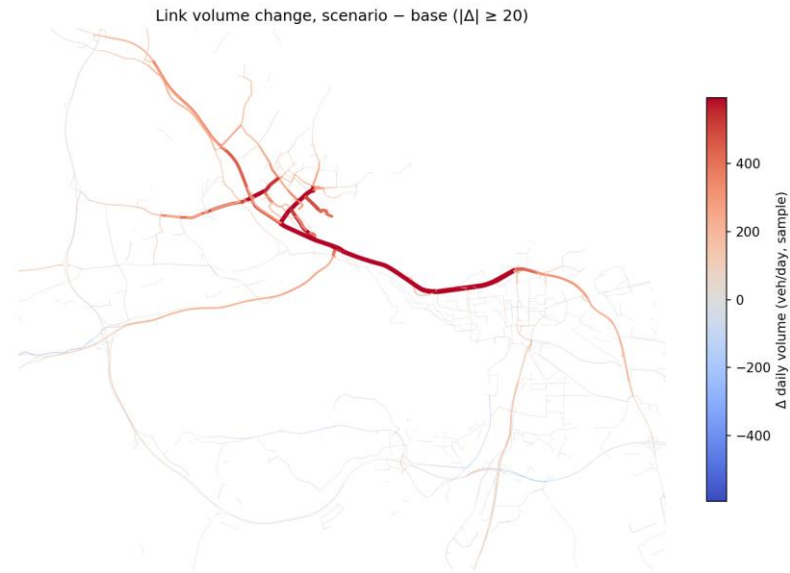


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Add 18,500 residents: more travel, less driving each

- Population +3.4 %, trips +3.7 %, but driving only +1.5 %: 1.9 % less driving per person.
- People living and working in the district: 6.5 % → 15.7 %.
- Residents' commutes shorten from 10.8 to 10.1 km.
- New traffic concentrates on Paasikiventie and the district's own streets.

Indicative only



Red = more traffic, blue = less (daily vehicles, 25 % sample).

A deployed base model for Tampere, ready for use

- Test transport and land-use scenarios before investing
- Open tools and (mostly) open data, reproducible and extensible to other locations
- A reusable prototype and guide for future VTT and City of Tampere models

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the obvious

Thank you!

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