HOW TO UTILIZE MOBILITY DATA PROVIDED BY MOBILE NETWORK OPERATORS IN TRANSPORT AND URBAN PLANNING

January 26, 2021

SMART MOBILITY

REGIONAL DIRECTOR, MARKKU KIVARI

RAMBØLL

AGENDA

01 Ramboll Smart Mobility and Telia in brief

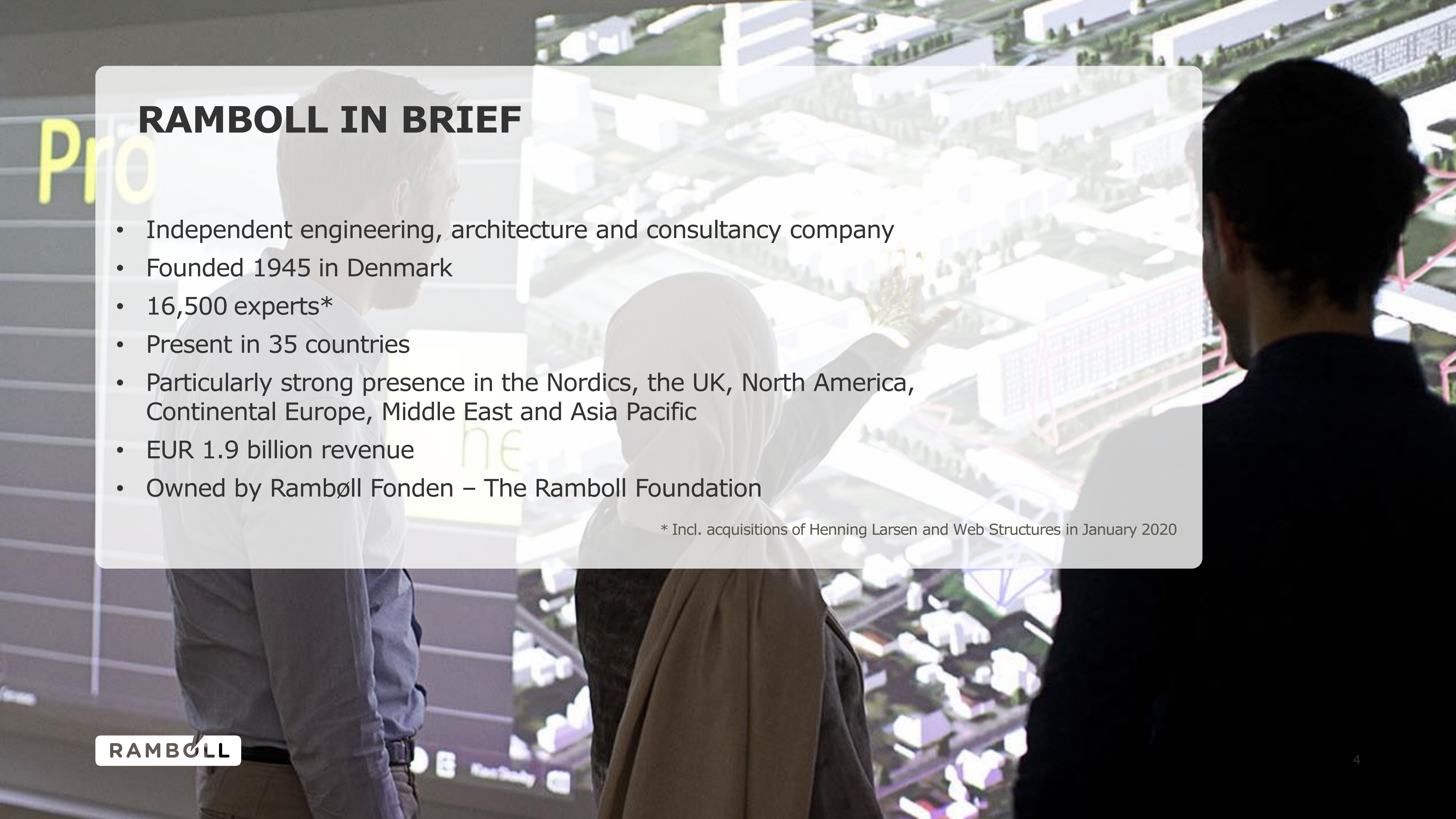
02 Telia's mobile operator data characteristics

03 Applications in planning

04 R&D opportunities

RAMBOLL

RAMBOLL SMART MOBILITY AND TELIA IN BRIEF



RAMBOLL IN BRIEF

- Independent engineering, architecture and consultancy company
- Founded 1945 in Denmark
- 16,500 experts*
- Present in 35 countries
- Particularly strong presence in the Nordics, the UK, North America, Continental Europe, Middle East and Asia Pacific
- EUR 1.9 billion revenue
- Owned by Rambøll Fonden – The Ramboll Foundation

* Incl. acquisitions of Henning Larsen and Web Structures in January 2020

SMART MOBILITY AT A GLANCE

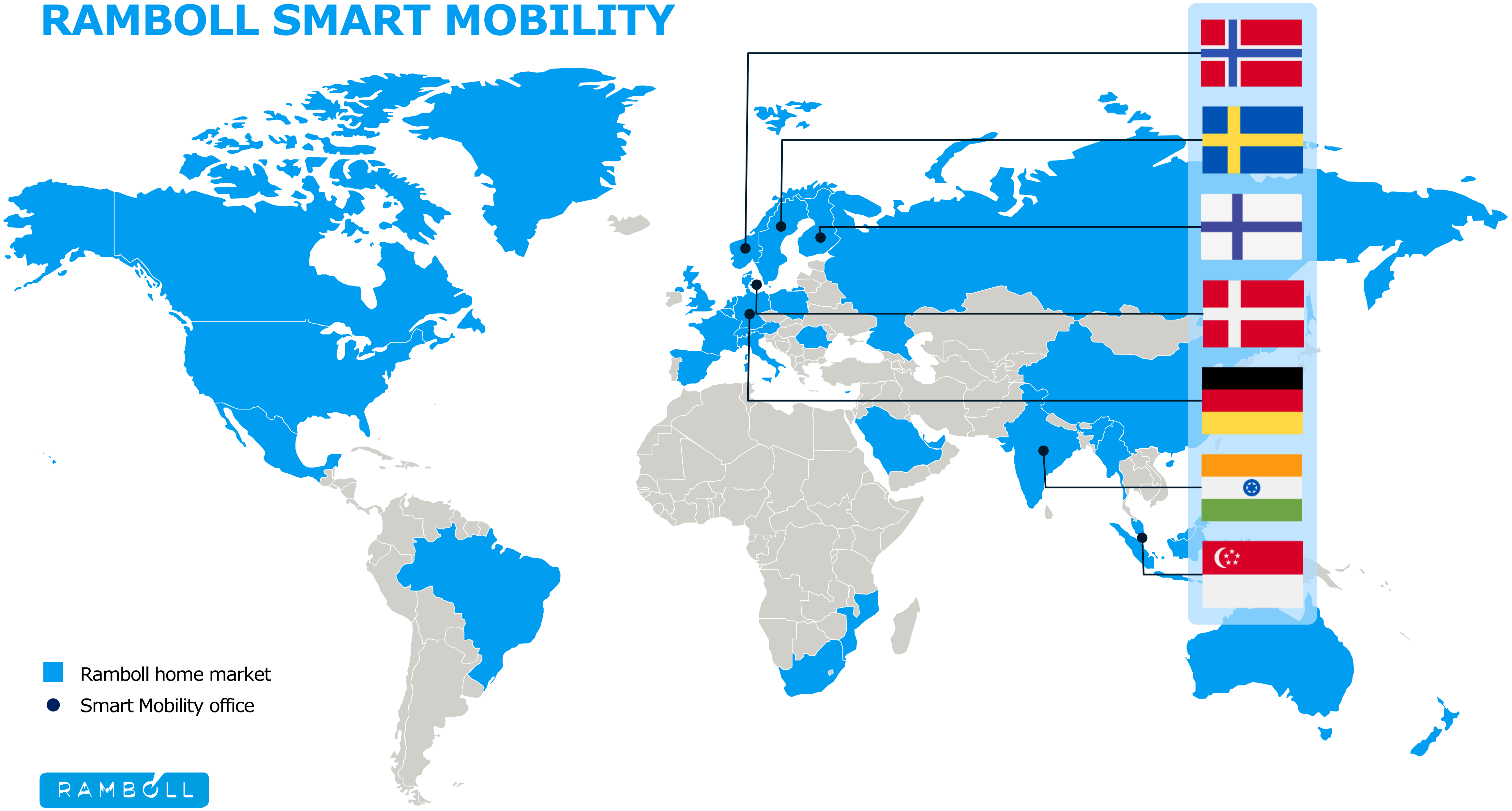
Ramboll offers **world leading expertise in holistic mobility planning** via innovative teams working at the cutting edge of pivotal areas such as Mobility as a Service (MaaS), e-mobility, autonomous vehicles, strategic parking and sustainable, holistic planning.

Our approach is inclusive, progressive and dialogue based, working side by side with stakeholders in cities around the world for a better future.

Services:

- **Holistic mobility planning**
- **Pedestrian prioritization**
- **Cycling policy and planning**
- **Public transport**
- **Modelling and simulations**
- **Transport economics**
- **Strategic parking**
- **Digital solutions and intelligent transportation systems (ITS)**
- **E-mobility**
- **Mobility-as-a-service (maas)**
- **Autonomous vehicles**

RAMBOLL SMART MOBILITY



TELIA COMPANY IN BRIEF

THE RESULT OF A MERGER WITH TELIA & SONERA 2002

OPERATIONS IN ALL NORDIC AND BALTIC COUNTRIES

ONE OF THE LARGEST CARRIER BUSINESSES IN THE WORLD

TV CONTENT OWNER VIA THE TV & MEDIA UNIT

2019 NET SALES OF SEK 86 BILLION AND EBITDA OF SEK 31 BILLION

HEADOFFICE IN STOCKHOLM

TELIA BRAND IN ALL MARKETS

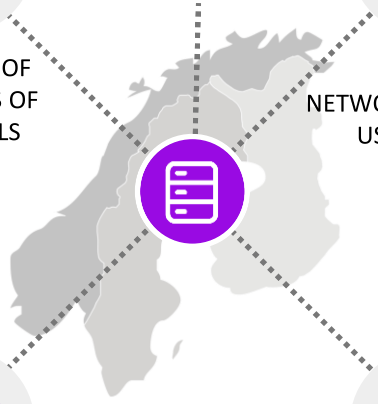
ALMOST 500,000 SHAREHOLDERS

20,800 EMPLOYEES

THIS IS TELIA CROWD INSIGHTS

BASED ON RELIABLE, CONTINOUS & HOLISTIC DATA.

THE DATA



HUNDREDS OF THOUSANDS OF RADIO CELLS

200-400 NETWORK EVENTS PER USER PER DAY

16 MILLION TELIA SUBSCRIBERS

24/7/365 & HISTORICAL DATA

URBAN DEVELOPMENT

TRANSPORTATION

REAL ESTATE

RETAIL

EVENTS

TOURISM

REPORT

DASHBOARD

10011
01101
10101

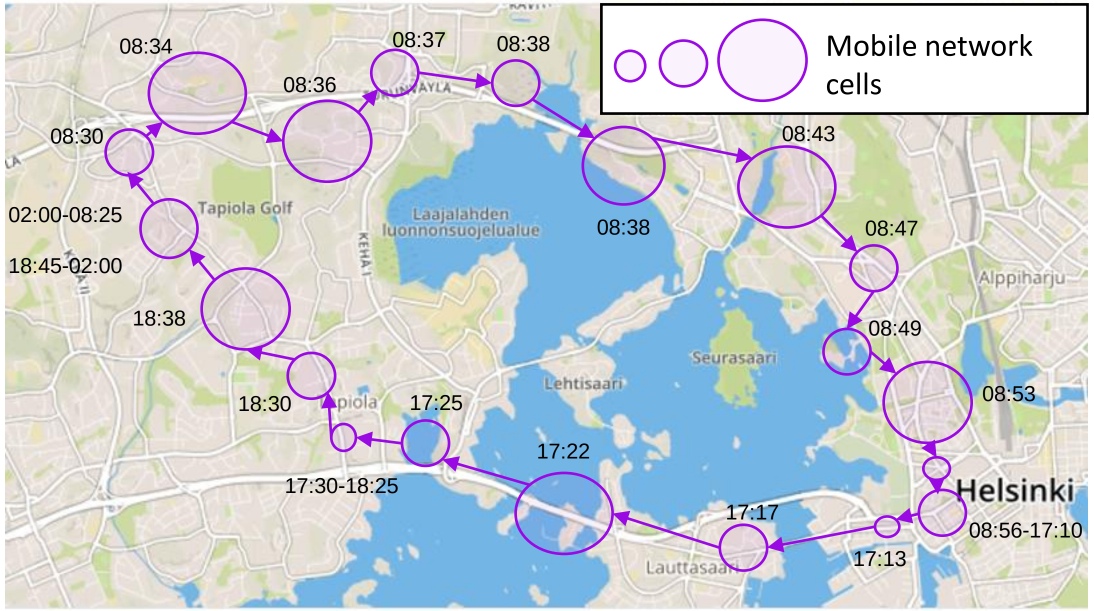
DATA/CSV-FILE

PRIVACY FIRST

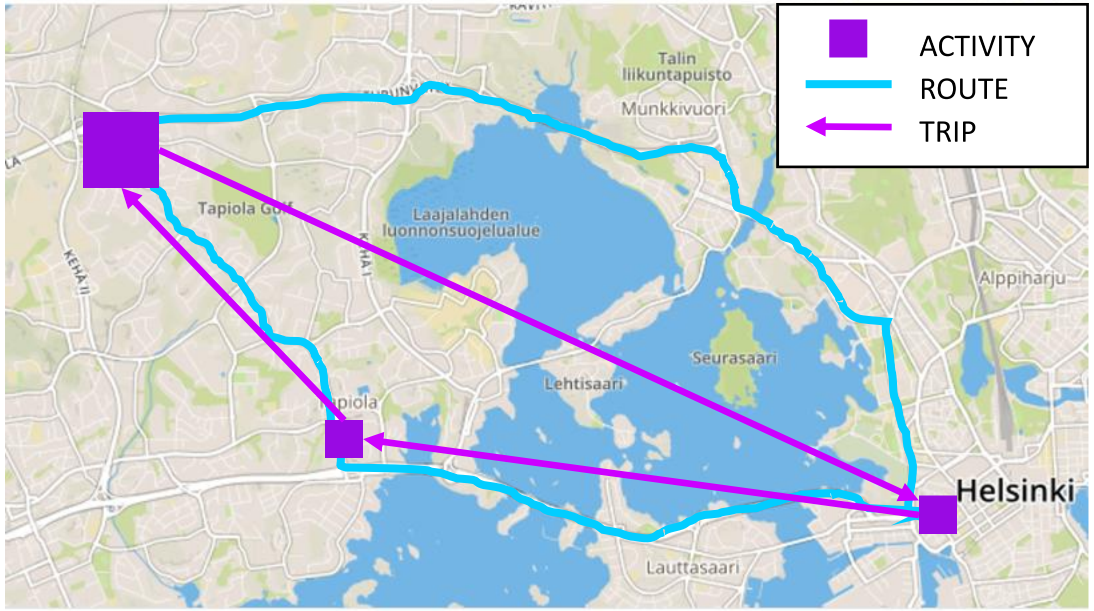
ACCOUNTABLE EXPLAINABLE. TRANSPARENT

TELIA’S MOBILE OPERATOR DATA CHARACTERISTICS

PRINCIPLE OF TRACKING MOVEMENTS



One imaginary subsription



Analysed activities and trips

TRIP ANALYSES

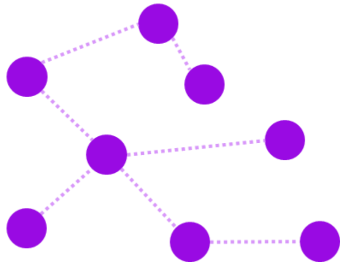
Each trip is defined origin and destination based on breaks and change of direction. Breaks can be set to fit analyses needs.

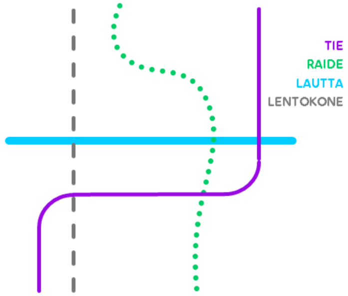
FLOW ANALYSES

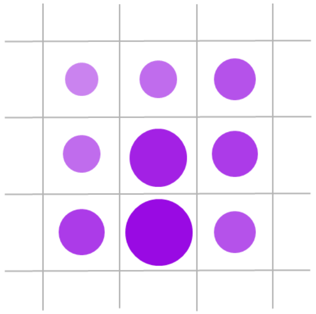
Trips can be assigned to road and railway network

LOCATION ANALYSES

Stationary population (actvities) duirng specific time periods. Recognises based on predefined breaks between trips.







DATA SCOPE IN FINLAND

- Geographical coverage
  - Whole Finland
- Spatial resolution
  - Admin level 1 (AL1) = Counties
  - Admin level 2 (AL2) = Municipalities
  - Admin level 3 (AL3) = Postal code areas
  - Grid = Dynamic grid of Telia (500 x 500 m →)
- Time resolution
  - Hourly, updates every 48 hour
- Activities
  - Homezone, work, other
- Time period
  - 1.11.2018-24.9.2019
  - 1.2.2020 onwards with daily updates

RAMBØLL

- Telia's market share ~ 35 %
- Aggregation and Privacy Loss
  - Fully anonymised (complies EU and Finnish legislation). The privacy-preserving K5 criteria is applied exactly on the queried data set.

odm_table

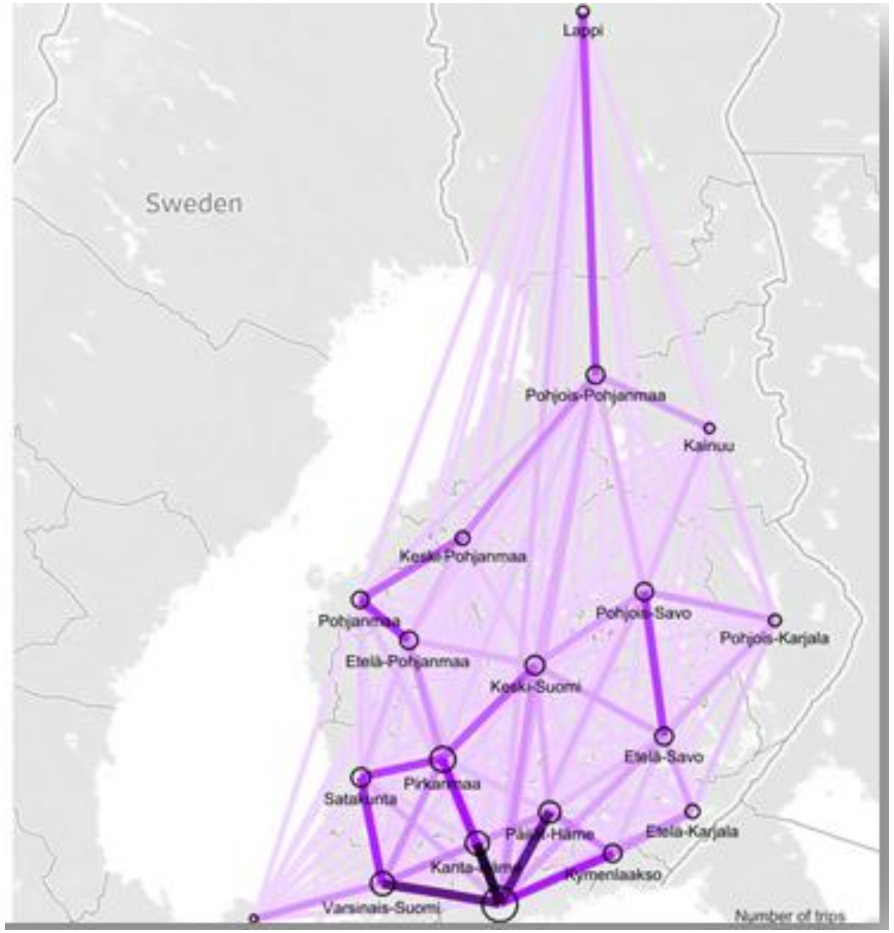
Schema Details Preview

Row	date	hour	origin	destination	people
1	2020-01-01	1	Forus area	Stavanger	365
2	2020-01-01	1	Risavika harbor	Stavanger	48
3	2020-01-01	1	Sola flyplass	Stavanger	6
4	2020-01-01	1	Stavanger	Forus area	336
5	2020-01-01	1	Stavanger	Risavika harbor	20
6	2020-01-01	1	Stavanger	Sola flyplass	13
7	2020-01-01	2	Forus area	Stavanger	149
8	2020-01-01	2	Stavanger	Forus area	182

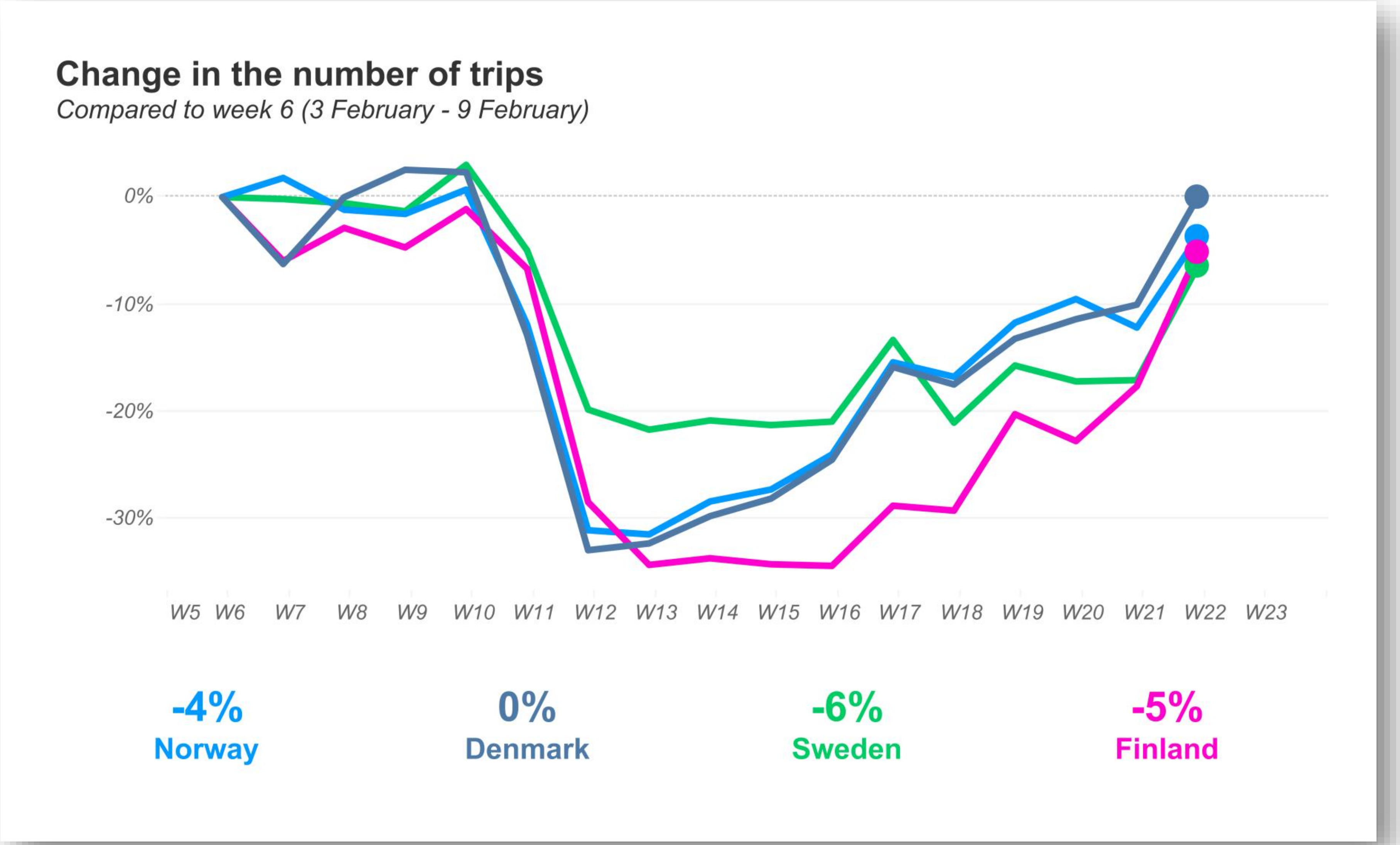
APPLICATIONS IN PLANNING

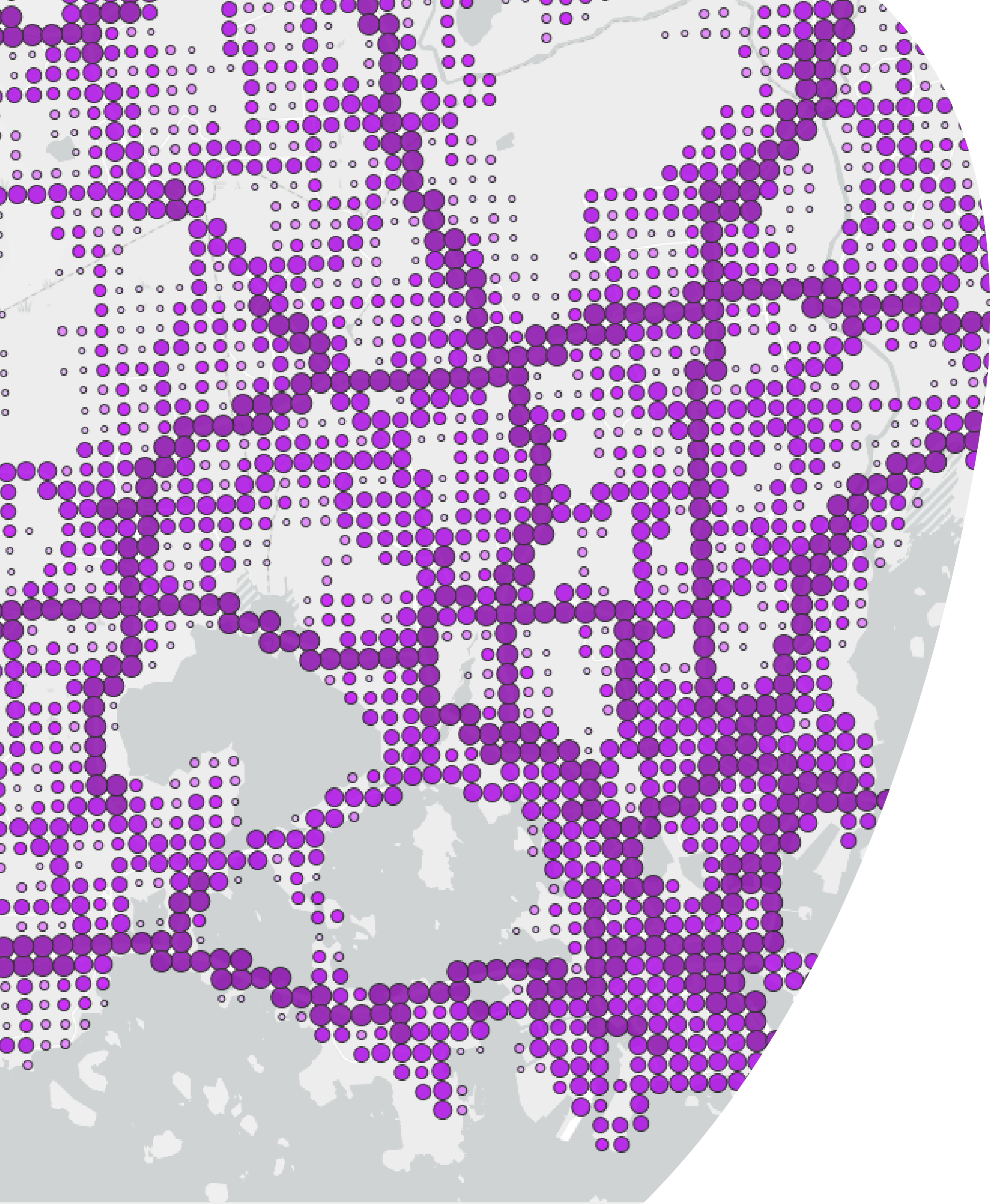
APPLICATIONS IN TRANSPORT PLANNING AND URBAN DEVELOPMENT

- **Before and after analyses** of major infrastructure projects or transport system level measures (PT service changes, road pricing etc.)
- **Impact analyses** (catchment area, major incidents/weather conditions).
- **Transport modelling** input data /calibration (total demand O-D matrices (daily, hourly)).
    - Modal split (air, train, road) for long distance trips.
- **Public transport planning** (Hourly demand between areas).
- **Urban development/livelyhood** (catchment area, duration of staying)



CHANGE OF TRIPS IN NORDIC COUNTRIES (SPRING 2020)

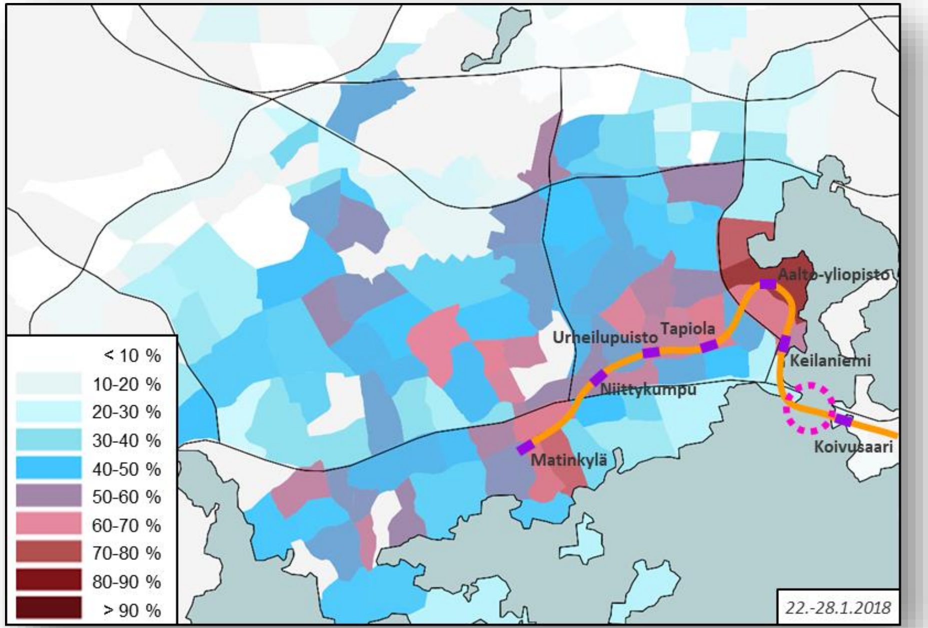


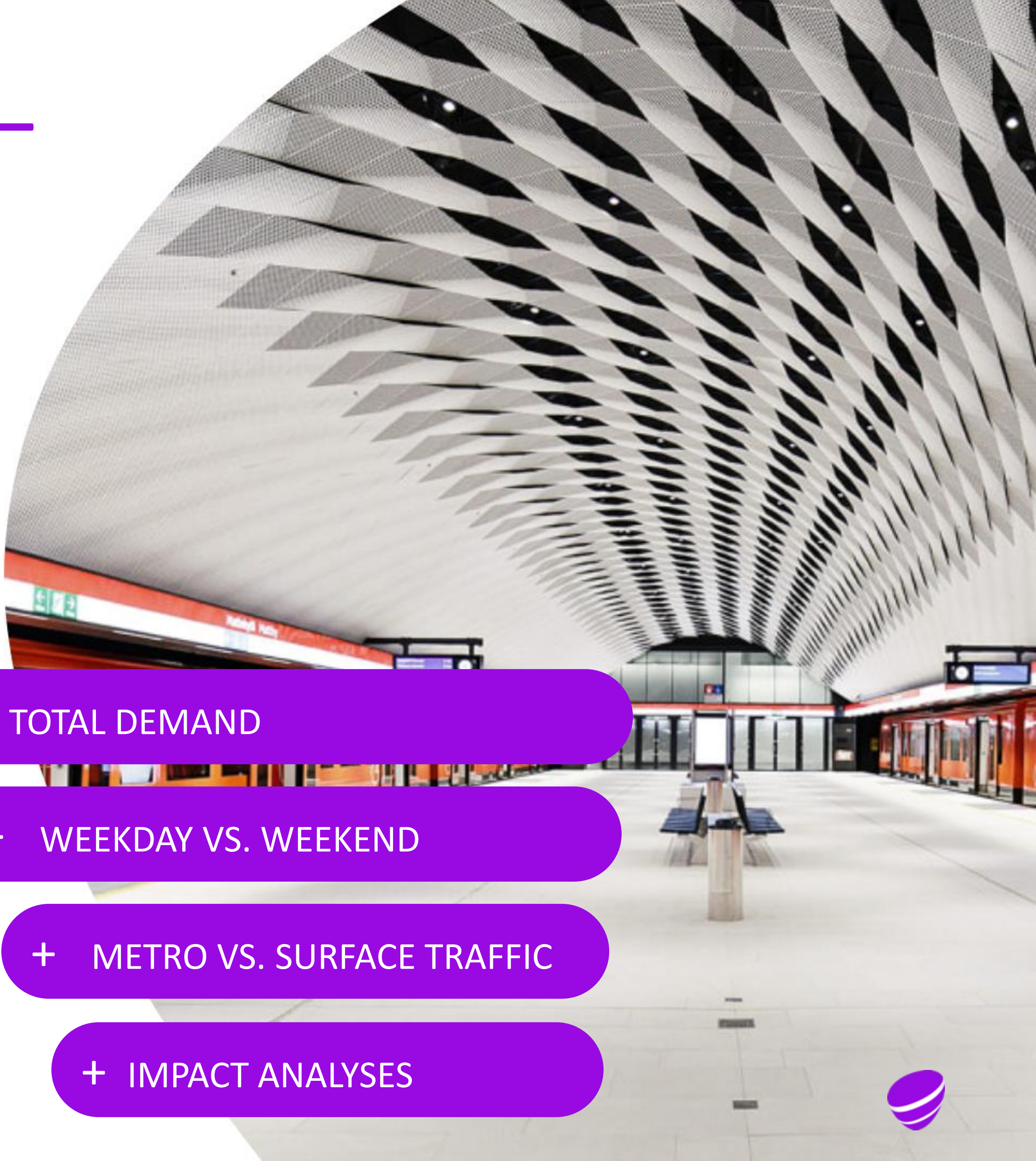


DATA ENABLES FOLLOWING APPLICATIONS

- URBAN PLANNING
- AREAL DEVELOPMENT ANALYSES
- TRAFFIC DEMAND ANALYSES
- TRANSPORT PLANNING
- RETAIL AND REAL ESTATE
- EVENTS
- TOURISM
- OUTDOOR MARKETING

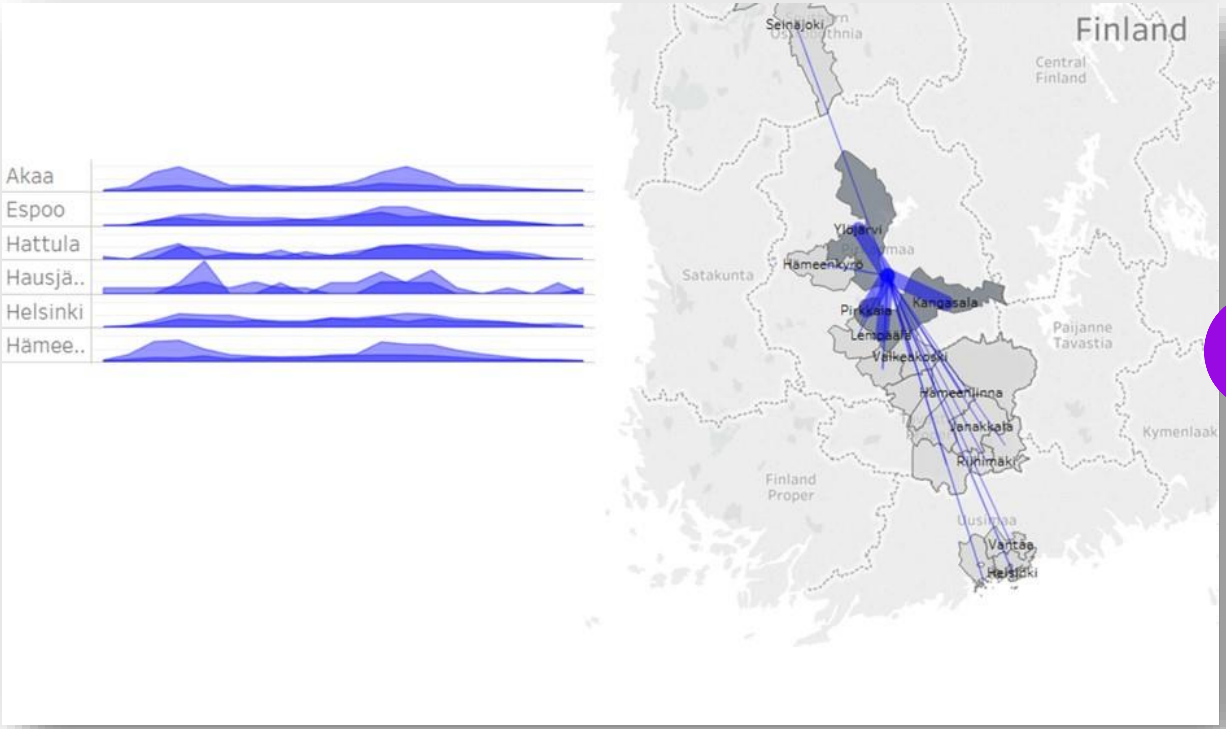
HELSINKI REGION TRANSPORT – BEFORE AND AFTER ANALYSES OF WESTERN METROLINE





- + TOTAL DEMAND
- + WEEKDAY VS. WEEKEND
- + METRO VS. SURFACE TRAFFIC
- + IMPACT ANALYSES

HELSINKI – TAMPERE CORRIDOR – AREAL DEVELOPMENT



+ O-D ANALYSES REGIONAL LEVEL

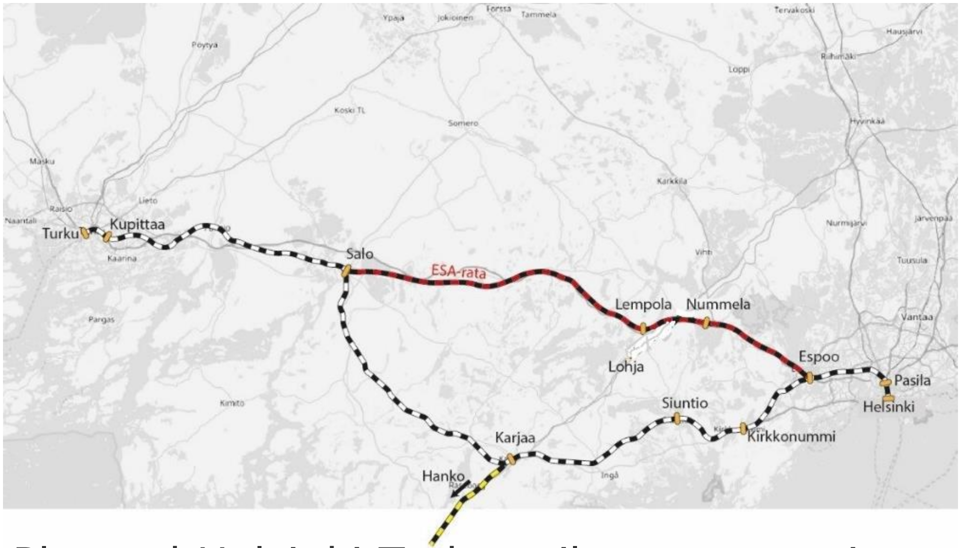
+ COMMUTING ANALYSES

+ TOTAL DEMAND

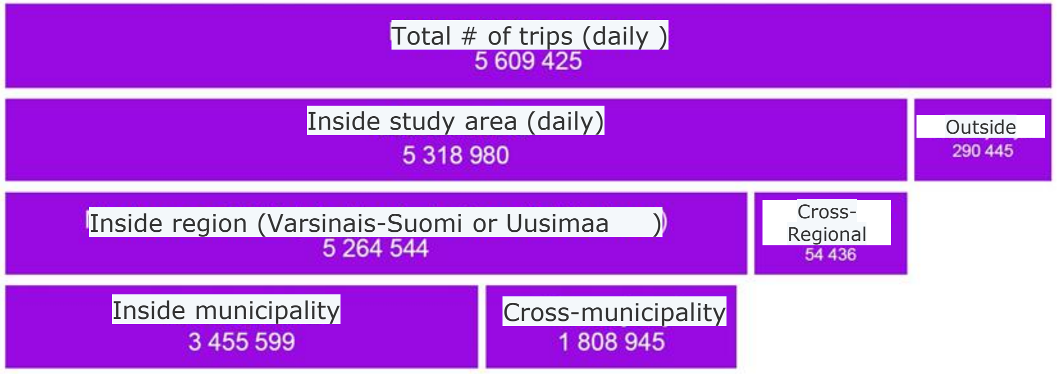
+ SEASONAL VARIATION

TRAVEL DEMAND BETWEEN HELSINKI – TURKU RAIL IMPROVEMENT (1 HOUR TRAIN)

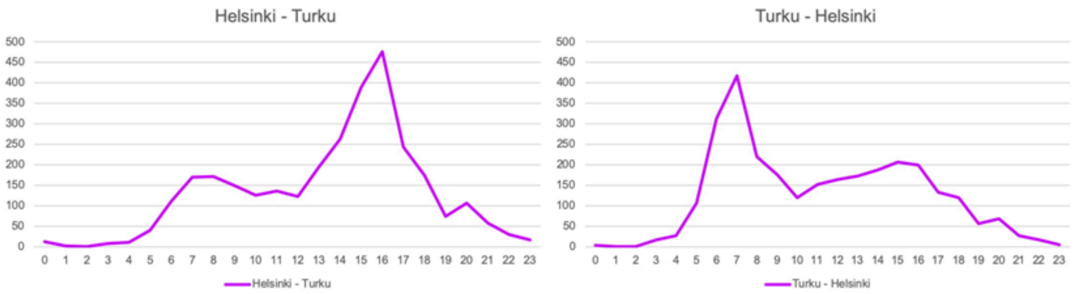
Problem: no reliable picture of the total demand between cities due to not having information of the car and bus traffic travellers between cities (current train travel demand was known).



Planned Helsinki-Turku railway connection.



Daily trip volumes of planning area.



Starting time of trips between Helsinki-Turku and Turku -Helsinki

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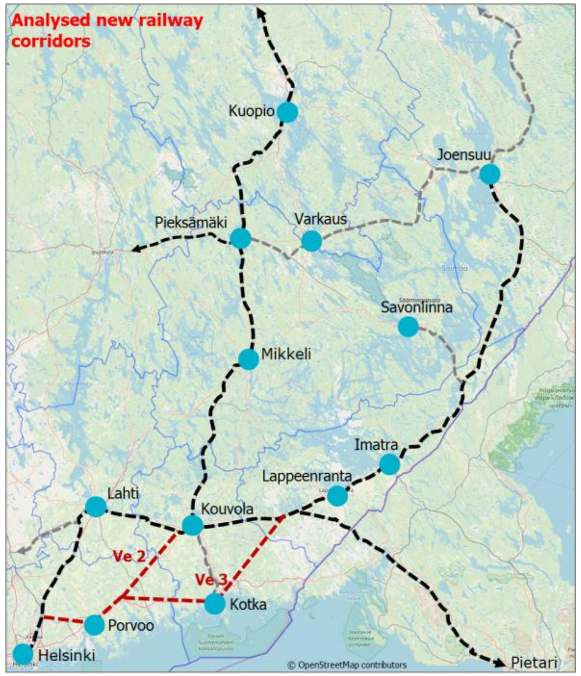
EVALUATION OF EASTERN FINLAND RAILWAY CONNECTIONS

Problem: Total demand of the transport corridors was not known

=> Estimation of travel potential by train was done by adjusting National Railway transport model demand with total demand observed from Telia data.

	Helsinki	Vantaa	Espoo	Lahti	Kouvola	Mikkeli	Kuopio	Lappeenr.	Imatra	Joensuu	Savonlinna	Kotka	Porvoo	*Yhteensä*
Helsinki				4 495	1 334	737	619	814	140	362	200	715	6 518	***15 996***
Vantaa				1 941	642	372	378	275	64	190	91	313	2 576	***6 881***
Espoo				878	291	199	133	176	37	68	66	148	905	***2 913***
Lahti	4 102	1 915	773		1 419	309	132	229	41	64	57	148	222	***9 433***
Kouvola	1 240	592	225	1 284		520	105	794	147	63	40	3 135	248	***8 409***
Mikkeli	576	290	134	264	489		384	322	51	84	279	72	34	***3 098***
Kuopio	569	274	119	127	119	382		70	25	558	163	20	16	***3 282***
Lappeenranta	748	285	159	194	797	335	73		4 823	110	173	206	48	***7 964***
Imatra	107	54	24	34	137	49	26	4 837		60	157	40	12	***5 545***
Joensuu	368	185	71	63	63	87	580	121	65		242	19	8	***1 941***
Savonlinna	129	72	39	33	31	252	145	155	124	210		19	9	***1 345***
Kotka	665	304	126	153	3 224	74	18	226	44	19	23		236	***5 122***
Porvoo	5 620	2 423	797	222	257	44	18	51	15	10	10	232		***9 704***
Yhteensä	***14 178***	***6 434***	***2 482***	***9 706***	***8 816***	***3 468***	***3 404***	***8 086***	***5 586***	***1 861***	***1 630***	***5 076***	***10 838***	***82 908***

Total demand according to the Telia data.



Juna %	Helsinki	Vantaa	Espoo	Lahti	Kouvola	Mikkeli	Kuopio	Lappeenra	Imatra	Joensuu	Savonlinn	Kotka	Porvoo	*Yhteensä*
Helsinki				20 %	8 %	7 %	24 %	37 %	35 %	50 %	5 %	4 %	0 %	***12 %***
Vantaa				5 %	8 %	8 %	9 %	17 %	22 %	46 %	5 %	3 %	5 %	***8 %***
Espoo				8 %	6 %	1 %	15 %	10 %	12 %	20 %	5 %	1 %	0 %	***7 %***
Lahti	22 %	8 %	13 %		18 %	18 %	11 %	9 %	4 %	12 %	15 %	6 %	4 %	***17 %***
Kouvola	10 %	9 %	8 %	17 %		22 %	33 %	6 %	13 %	28 %	14 %	5 %	1 %	***9 %***
Mikkeli	7 %	7 %	2 %	17 %	24 %		6 %	8 %	3 %	8 %	0 %	6 %	10 %	***7 %***
Kuopio	22 %	9 %	18 %	12 %	33 %	7 %		8 %	6 %	2 %	0 %	19 %	9 %	***13 %***
Lappeenranta	37 %	17 %	19 %	13 %	14 %	7 %	8 %		1 %	21 %	4 %	5 %	8 %	***7 %***
Imatra	35 %	22 %	15 %	3 %	14 %	1 %	6 %	1 %		9 %	6 %	2 %	8 %	***3 %***
Joensuu	50 %	45 %	22 %	13 %	26 %	10 %	1 %	24 %	9 %		18 %	13 %	11 %	***25 %***
Savonlinna	5 %	5 %	5 %	14 %	12 %	0 %	0 %	4 %	2 %	19 %		1 %	8 %	***5 %***
Kotka	4 %	3 %	4 %	6 %	5 %	5 %	19 %	6 %	2 %	13 %	1 %		0 %	***5 %***
Porvoo	0 %	4 %	0 %	0 %	1 %	6 %	4 %	1 %	2 %	3 %	2 %	0 %		***1 %***
Yhteensä	***12 %***	***7 %***	***10 %***	***15 %***	***9 %***	***7 %***	***13 %***	***7 %***	***3 %***	***25 %***	***6 %***	***4 %***	***2 %***	***8 %***

Modelled railway traffic demand (National Railway traffic model).

PROS AND CONS

Pros:

- Most comprehensive data available on mobility (Total O-D)
- Enables before-after analyses (even without preplanning)
- Continuous recording of mobility, and updated data available quite soon (48 h).
- Enables analyses of historic events afterwards when needed.

Cons:

- Not statistically sound sampling, but huge number of observations partly compensates this
- **Does not include socio-economic or demographic backgroud information (*)**
- **Does not recognise modes in urban traffic (*)**
- ”Noise” in the trip data for short trips (less than 2 km)

(*) These can be partly amended with sophisticated modelling

R&D OPPORTUNITIES

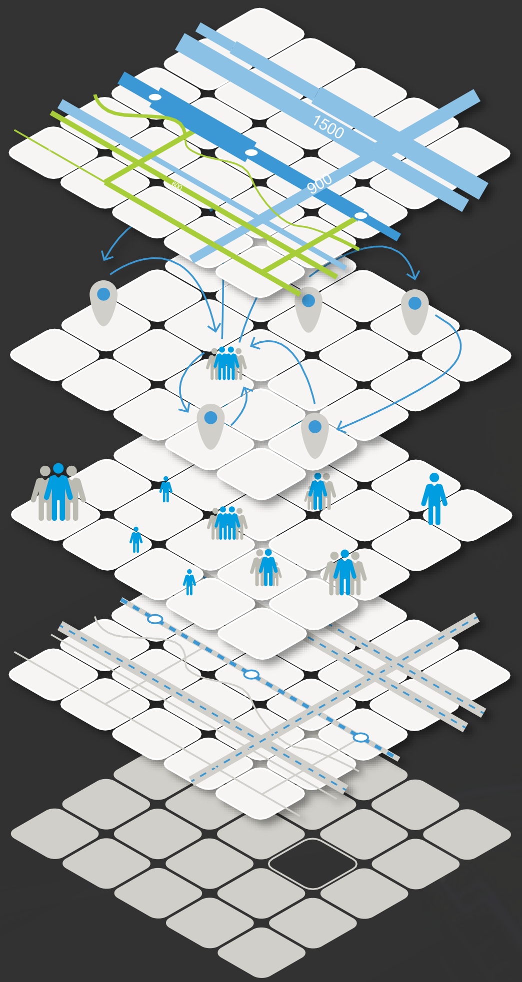
BRUTUS

BRUTALLY DETAILED TRANSPORT MODELLING

Highly detailed analysis of the socio-economic effects of transport policies

A state-of-the-art agent-based travel demand model

A State-of-the-Art Agent-based Multi-modal Modelling Engine



Modern Modelling Engine

Brutus is a individual-level simulation model, which is designed to meet today's design problems, making use of modern technical solutions and computing capabilities. Empirical models are applied using Random Utility Modelling to simulate single households' and individuals' decision-making situations.

In some use cases, travel demand is simulated in Brutus whilst the assignment on the network is handled by other more traditional and well established (aggregate) transport models like Emme or VISUM. In these hybrid models we can integrate Brutus with external tools and show results through Brutus UI.

Cycling and walking trips can also be extracted from Brutus to detailed microsimulation models such as Vissim.

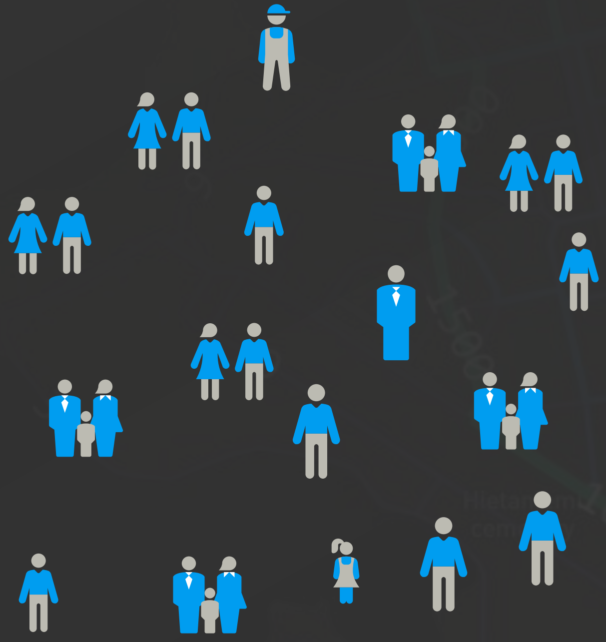
How it works?

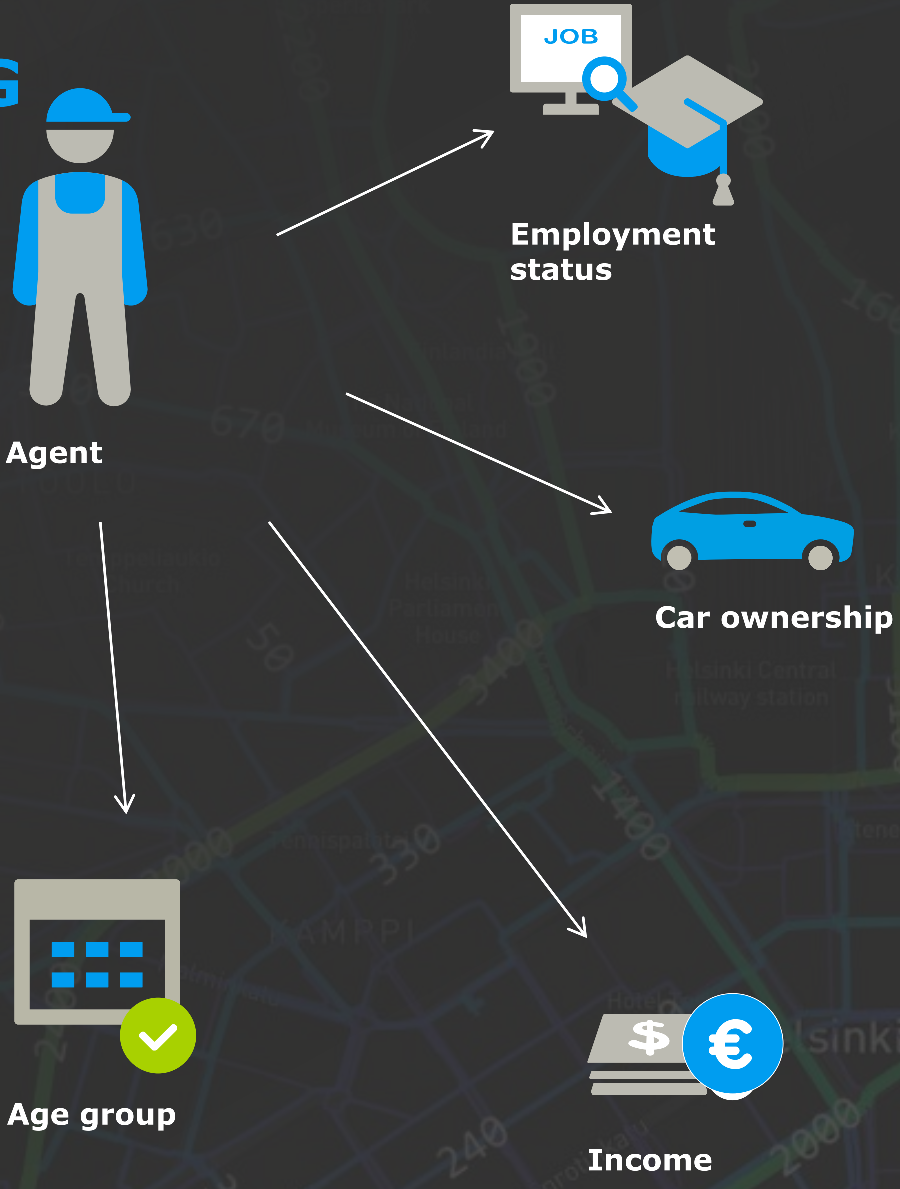
1. Brutus represents land-use in a dense grid containing information about socio-economic activities and population. Synthetic agent population is generated to closely resemble the study area population.
2. The grid cells are connected via a multimodal transport network that contains car roads, public transport lines and bicycle and pedestrian paths.
3. An activity pattern is generated for each person in the model. For that, travel survey data or data from a MaaS platform is used.
4. Traveling between activities is modelled as travel chains simulating a detailed activity diary of each agent.
5. All trips are assigned to the travel modes and routes that are most attractive in terms of time, cost and level of service.

AGENT-BASED MODELLING DESCRIBING INDIVIDUAL PEOPLE

Each individual person in the model area is represented by an agent, and each agent is a member of a family. For each agent we determine relevant characteristics such as employment status, age and home location. These characteristics help to better describe the travel behavior of the agent and therefore the person that the agent represents.

It also allows for detailed equity analysis of the modelling results as the impacts of measures can be evaluated for different population segments.

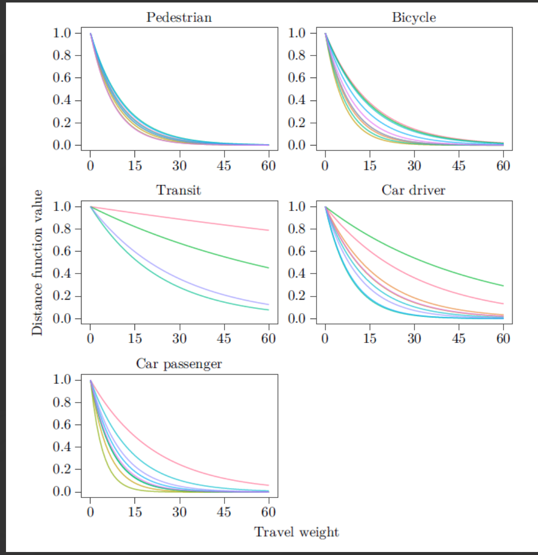


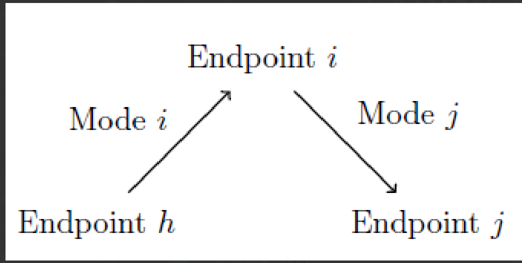


SIMULATION OF TRAVEL IN ACTIVITY CHAINS

Traditional models do not simulate how people travel. Instead, they are aimed at calculating how many traffic there is between area A and B.

BRUTUS models activities of people and simulates where the agents undertake these activities and how the agents travel between these locations. This opens more analysis opportunities and allows for additional applications such as analysis of for instance electric vehicle charging demand.





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Wide range of applications on top of the Modelling Engine

Cycling Flows

High spatial resolution and detailed urban structure description makes Brutus very suitable for analysing cycling routes. This will be done of course on top of multi-modal demand analysis.

Pedestrian Flows to Transport Hubs

Pedestrian flows arriving to public transport hubs can be analysed with Brutus and detailed land-use data. When needed, with tailored data processing, we can refine the analysis to a city block or building level.

Strategic Transport System Planning

We have been able to cover most policy impacts like regulation, pricing, service provision and investments to be able to be estimated long into the future to provide a solid foundation for policy recommendations over this time horizon.

Road Works

Road works are an important sources of traffic hindrance and safety issues. With Brutus we can assess how different users changes their routes so that authorities can ensure safety during these roadworks.

Equity / User Group Analysis

The impact of measures can be evaluated for different segments of the population. For example, the health benefits for a bicycle measure for specific socio-economic groups can be determined

Accessibility / Location Analysis

The detailed multimodal network and dense land-use grid in Brutus, together with detailed population segments provide a strong basis for detailed and comprehensive accessibility/location analyses.

On-demand Mobility Demand Analysis

As the demand (density) for on-demand service impacts heavily on the service definitions and potential service quality and system efficiency, we combine Brutus with an on-demand simulation system and use an iterative approach.

EV Charging Network Analysis

Brutus can help policymakers and private companies to understand where the demand for charging facilities is highest and determine the best places are for charging locations.

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HOW BRUTUS WORKS

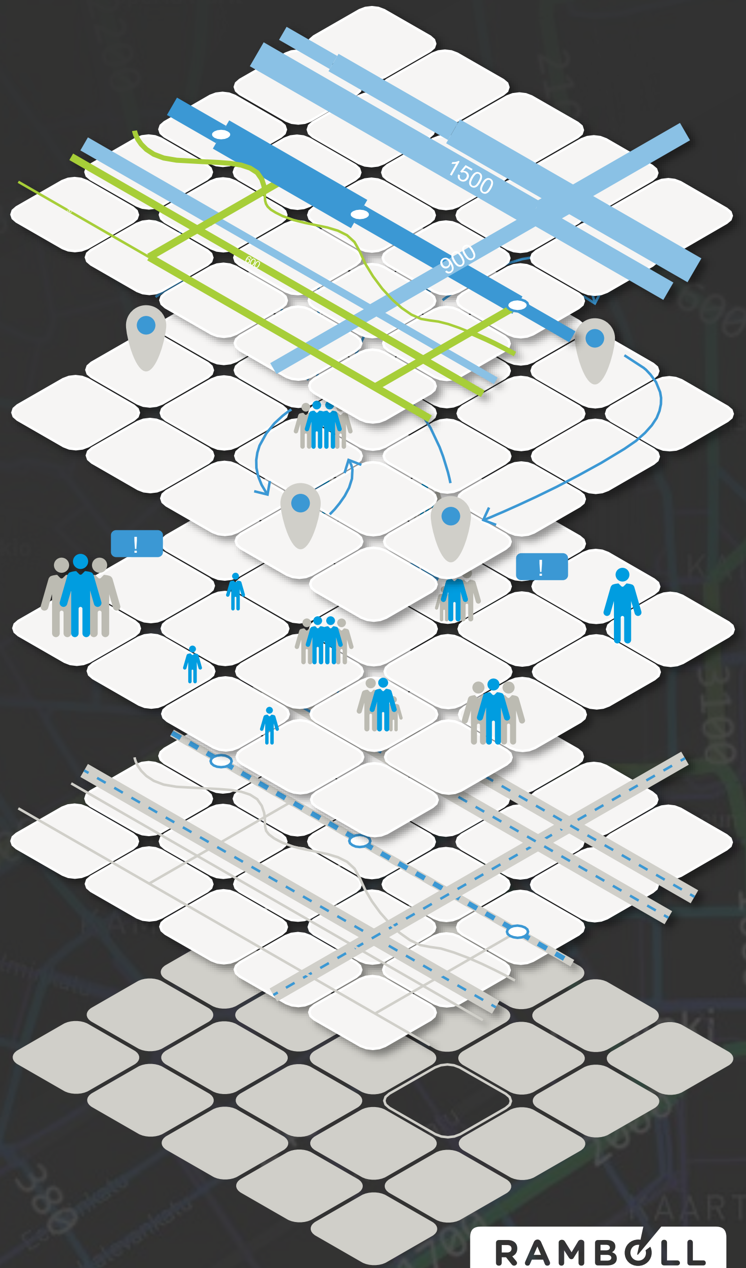
5) All trips **assigned to the travel modes and routes** that are most attractive in terms of time, cost and level of service.

4) All work, shopping or other activities modelled as **travel chains**.

3) Simulation searches the households from the grid and matches them with those found in the travel surveys – or **Big Data** from the MaaS-platforms.

2) Urban structure connected with the **multimodal transport network**.

1) **Population and land-use** represented as a dense grid.



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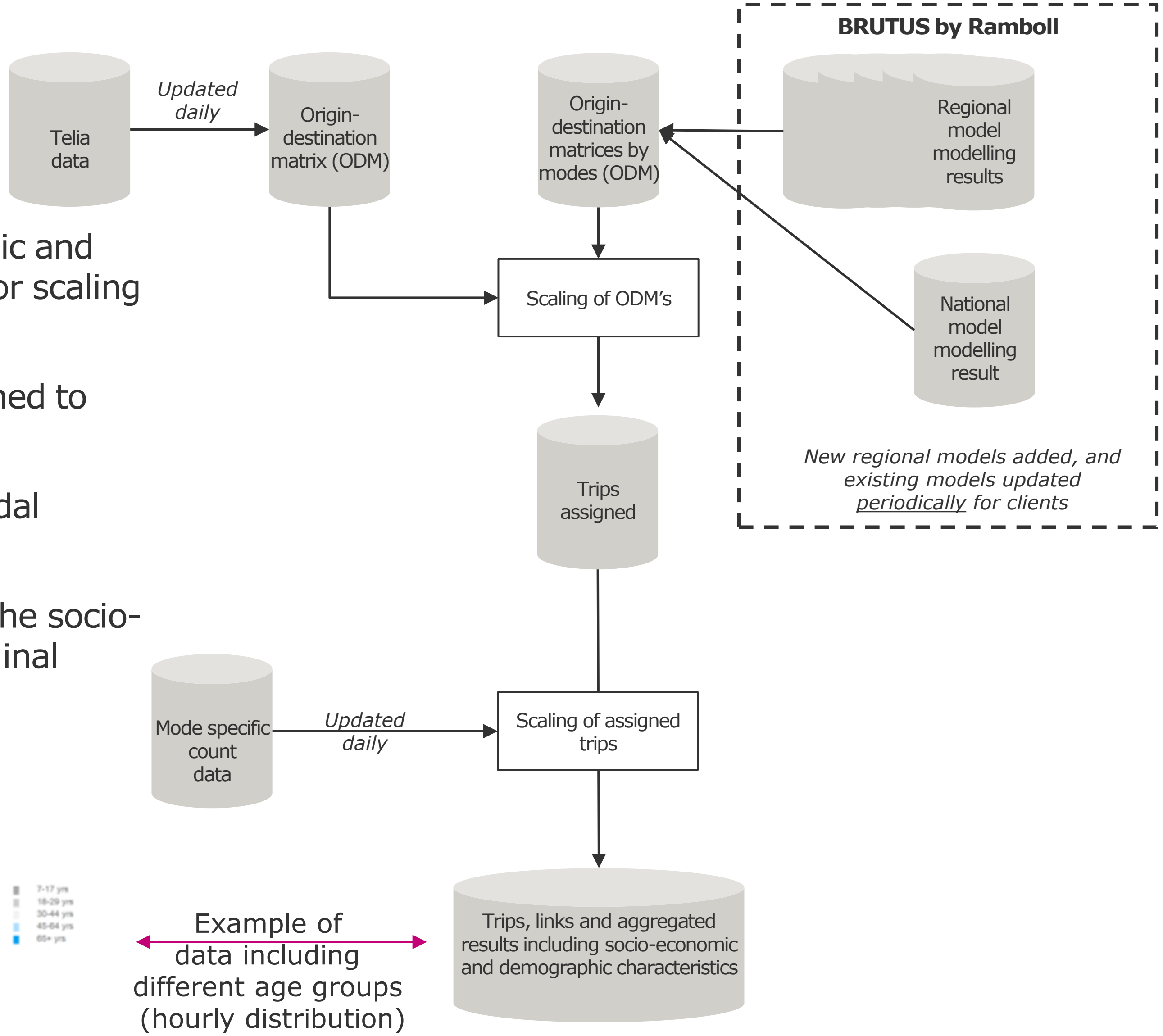
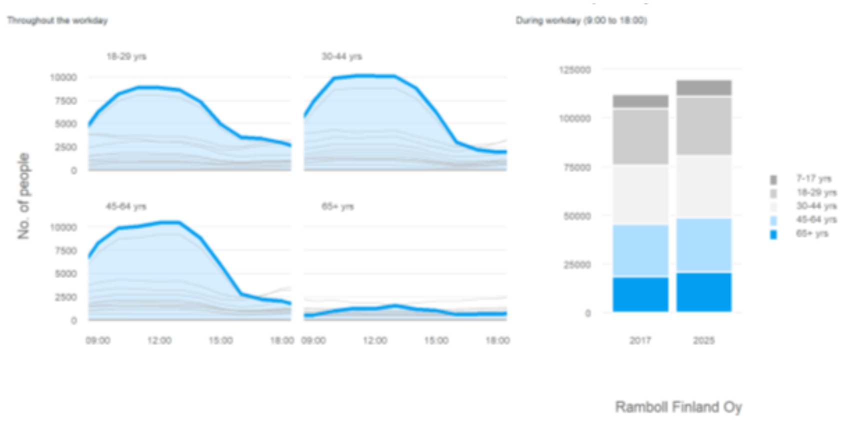
HOW TO ENHANCE TELIA MOBILITY DATA WITH ADVANCED MODELLING

1. Telia data can be enhanced to represent socio-ecoomic and demographic characteristics of travellers by using it for scaling the simulated activity based modelling results.
2. Scaled demand matrices for each mode will be assigned to networks
3. Assigned trips cab be scaled (if needed) by using modal counts.
4. As a result the assigned trips for each mode include the socio-economic and demographic information from the original model.





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LIVEABLE CITY - LIVCY

TOOLBOX FOR SUSTAINABLE URBAN DEVELOPMENT

LIVEABILITY OF CITIES IS A MUCH TALKED TOPIC – BUT HOW CAN WE MEASURE, DEVELOP AND MONITOR THE LIVEABILITY OF CITIES ON A SPATIAL LEVEL?

LAUNCH ESTIMATED Q1/2021

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3 GOOD HEALTH AND WELL-BEING

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

13 CLIMATE ACTION

LIVCY is a GIS-based data platform that takes into account the complexity of liveability by analysizing its elements from connectivity, urban structure, functions and experiences.

Through LIVCY compound index, LIVCY provides easily understandable data for the designers, decision makers and developers to make better choices when designing a more sustainable and liveable city for its citizens.

LIVCY MODEL

CONNECTIVITY

URBAN STRUCTURE

FUNCTIONS

DATA VIEW ON LIVEABILITY

(quantitative data)

- GIS DATA AND ANALYSIS
- MOBILE NETWORK DATA
- EXPERT ASSESMENTS AND OBSERVATIONS

LIVCY compound index

Accessibility index	Intensity index

+

EXPERIENCES & ENGAGEMENT

USER VIEW ON LIVEABILITY

(qualitative data)

- MAP BASED QUESTIONNAIRES (SOFTGIS)
- SURVEYS
- INTERVIEWS

=

EXAMPLE VIEWPOINTS & EXTERNALITIES

- Easiness Of Daily Living
- Walkability & Safety
- Healthiness And Wellbeing Of Citizens
- Quality Of Our Built Environment
- Communality & Happiness
- Circular & Sharing Economy Potential

RAMBOLL

THANK YOU
QUESTIONS?

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