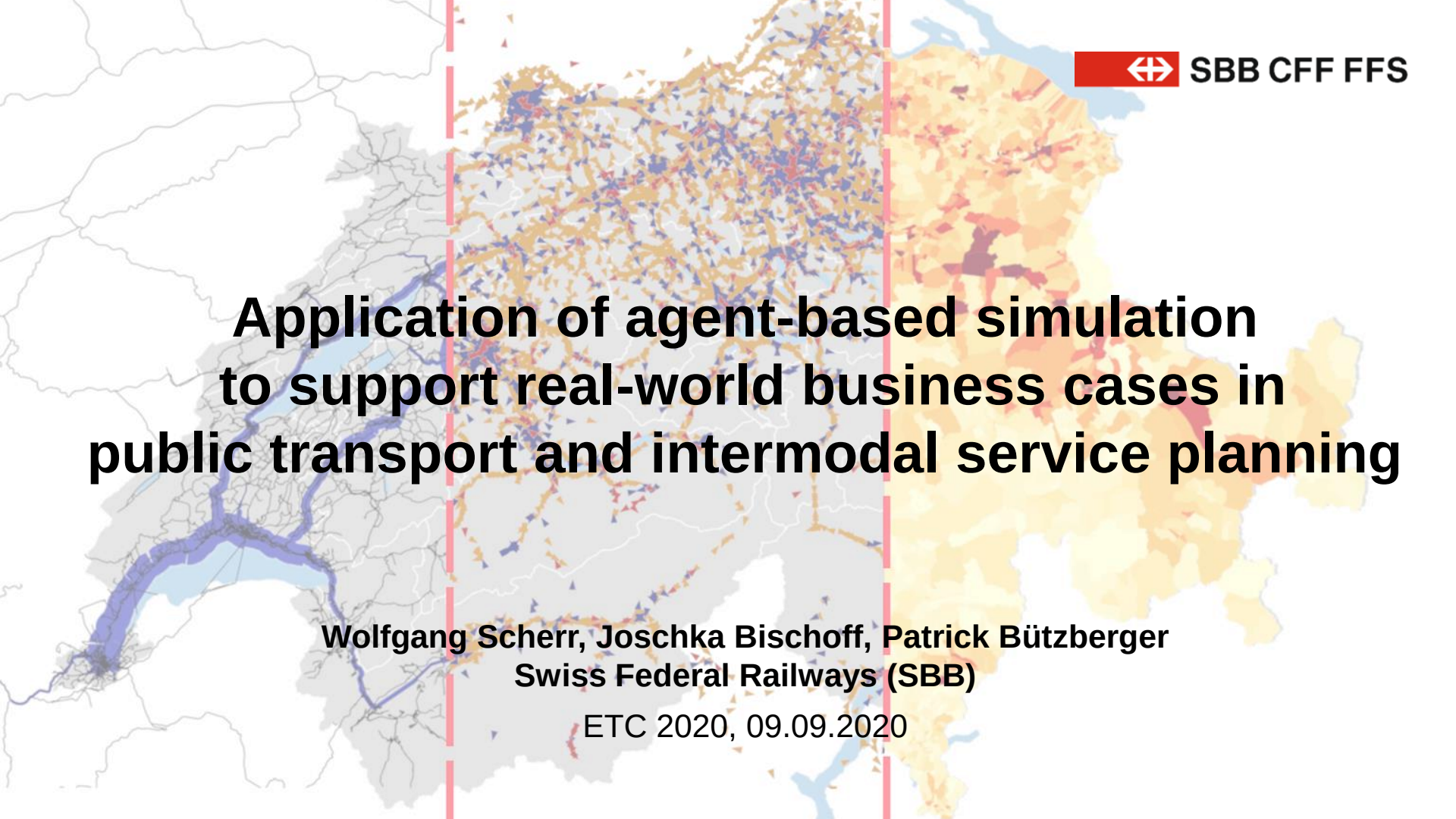

SBB CFF FFS

Application of agent-based simulation to support real-world business cases in public transport and intermodal service planning

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Swiss Federal Railways (SBB)

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Agenda

1. SIMBA MOBi – SBB's agent-based model of Switzerland
2. Applications
   - Classic rail service planning – national scale
   - Bus service planning – small area focus
   - New mobility service planning – local study
   - Long Term forecasting – national scale
3. Benefits and challenges of agent-based modelling
4. Perspective for the industry – the future of agent-based simulation

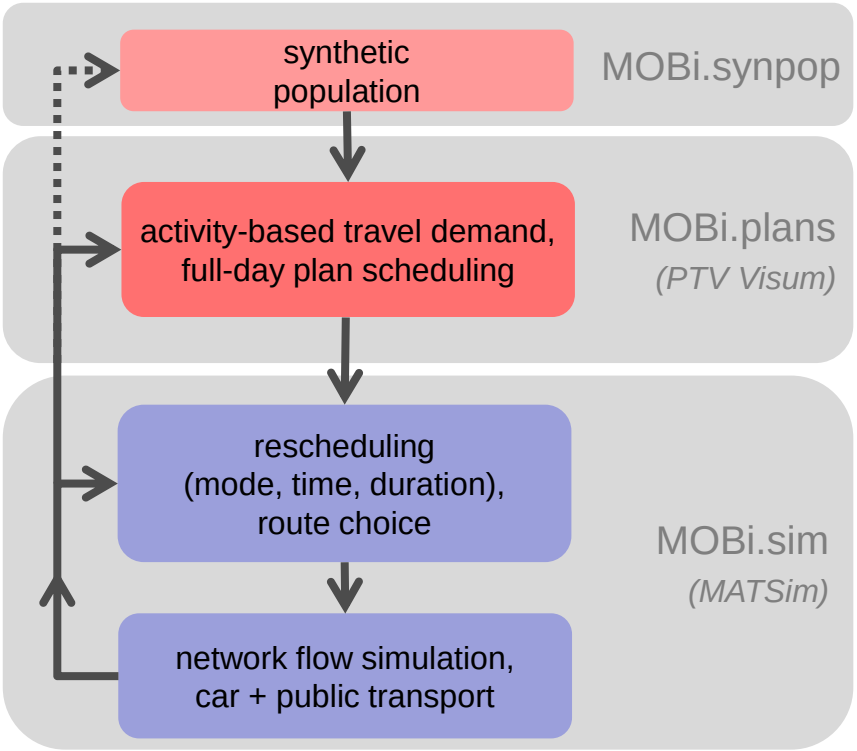
SBB (Swiss Federal Railways)

- Largest rail operator in Switzerland (pop. 8.6 million) :
- 1.3 million passengers per day (2019)
- Punctuality: 90% of pax arrive with < 3 minutes delay
- Renewable energy: > 90% of electric rail power
- 32’500 employees
- Many projects to expand infrastructure and service

SIMBA MOBi: agent-based model of Switzerland

- Why do we model:
  - Support of management decisions and planning processes: service, fleet, finances, corporate strategy, infrastructure
- We maintain two model pillars – both at the national level:
  - A data-driven macroscopic rail-model
  - MOBi: the agent-based model (all mobility with all modes)
  - … and we collaborate with the federal government's national model (4-step)
- MOBi was created 2017 – 2019
  - in application since 2019
  - presented at ETC 2019 in Dublin (focus on development, calibration)

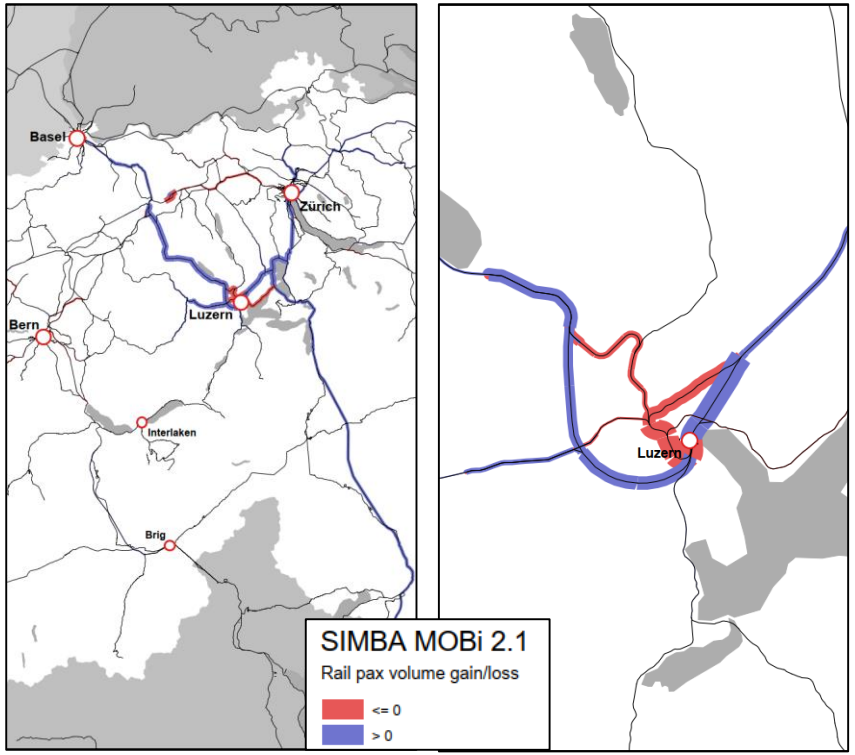
SIMBA MOBi: main behavioural modules



All model steps are agent-based

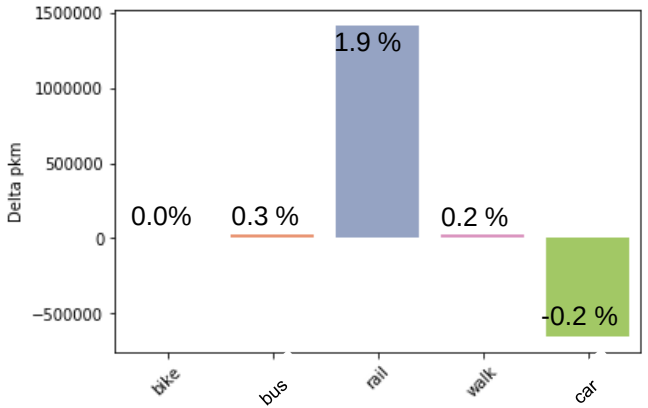
Lucerne case study: National scale rail service planning

- Lucerne: Planned construction of a new railway tunnel
- Depending on the actual placement of the tunnel, an additional train stop may be built
- Model helps determining cost/benefit, customer groups, new rail users and induced demand.



Lucerne case study: National scale rail service planning

- Changes in Passenger Kilometers (PKM) per mode

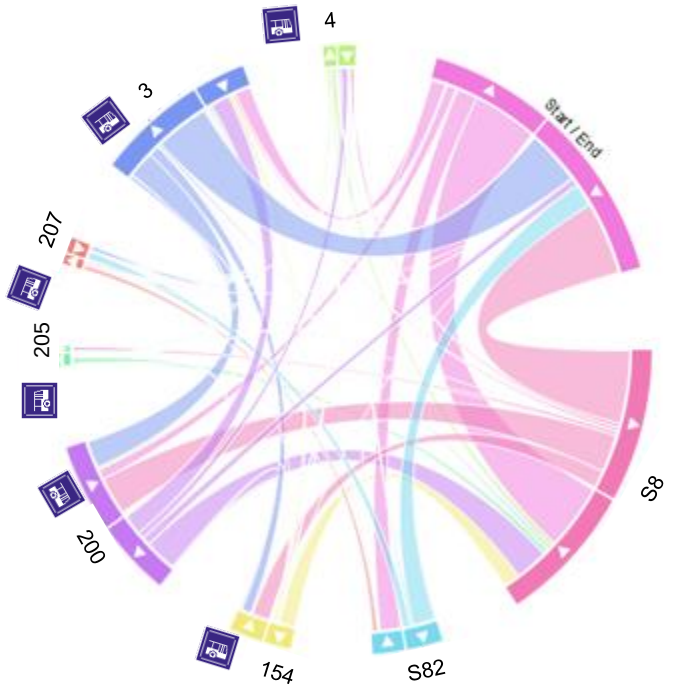


- Additional Rail-PKM:
  - 46% mode switch from car
  - 54% induced demand
    - Longer routes traveled
    - Additional or different trips taken:
      - New work locations
      - Different locations for secondary activities

St. Gallen Case study: small area focus

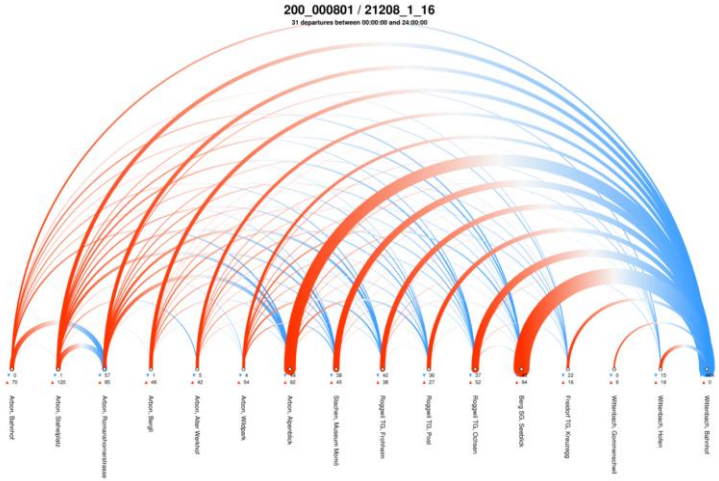
- Urban bus lines in St. Gallen are re-designed to feed urbar railway system rather than going to the city center
  - Less traffic congestion along the central bus corridor
  - Additional transfer for passengers
- New bus lines help to improve feeding

Intermodal Transfers at Wittenbach



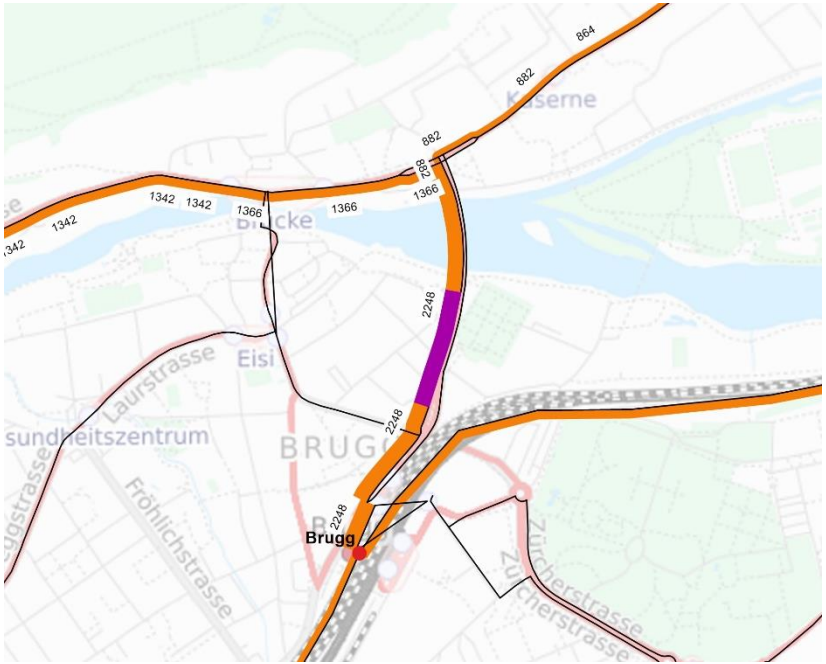
St. Gallen Case study: small area focus

- Changes in bus routes are likely to have a strong effect on overall demand in the affected area
- Passengers are likely to not only change to rail lines, but also use different bus services, which leads to an overall reconsideration of the project

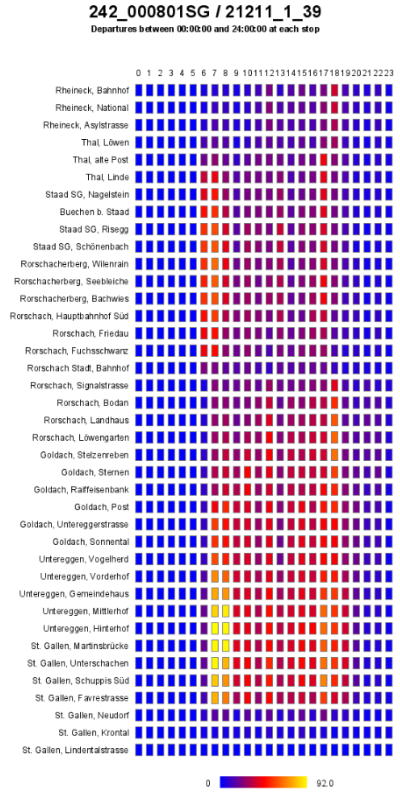


Passenger flow along a bus line

Flow analysis



Rail transfers using a specific link



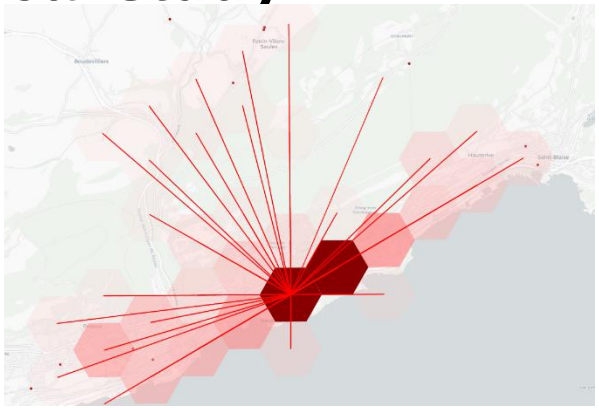
Flows along bus routes during the day

New mobility service planning – local study

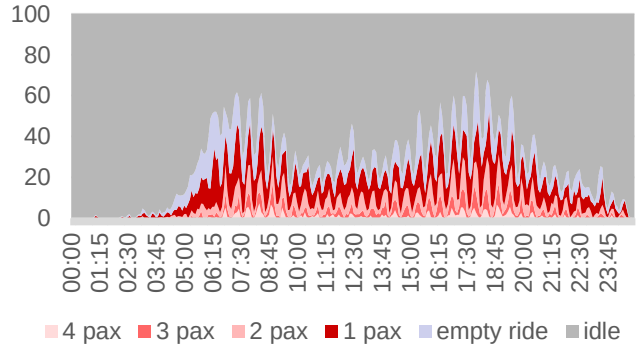
- The underlying MATSim simulation comes with extensions to simulate ridesharing and ridehailing services
- Truly microscopic approach:
  - Detailed simulation of fleet vehicles and dispatching
  - Microscopic passenger demand
- Simulation study (technical test) in a rural area in Cantone Neuchâtel
  - operations and demand analysis
  - competition with conventional public transport

New mobility service planning – local study

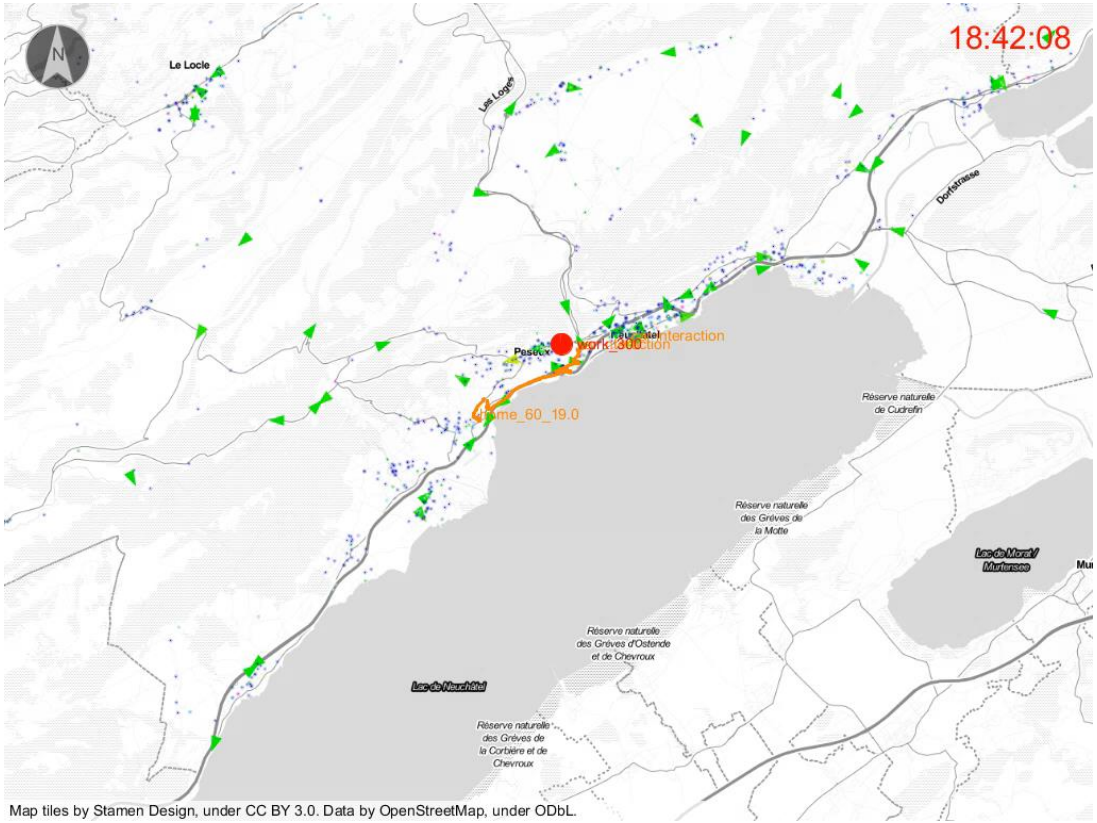
- Feeder service to and from Neuchâtel train station
- Feeder is mainly used along the shore line of the lake
  - This is also the main axis for ordinary bus services
- Vehicle utilization oscilates around train departures and arrivals
  - Relatively high share of empty rides



Vehicle utilization



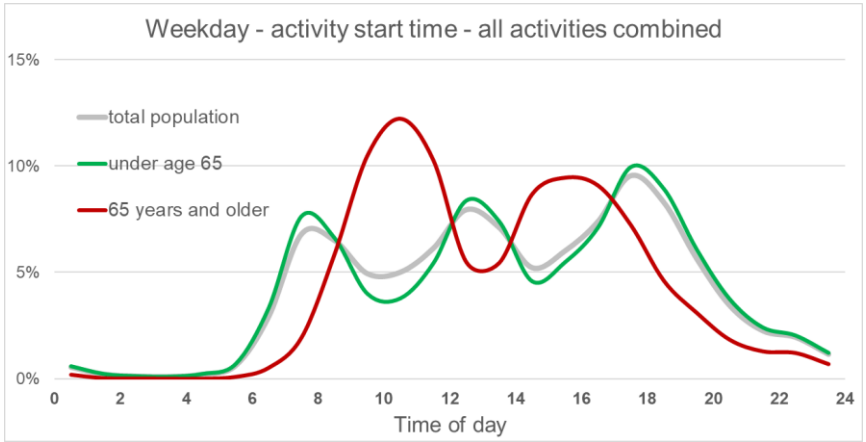
An insight into the simulation



Long Term forecasting (work in progress)

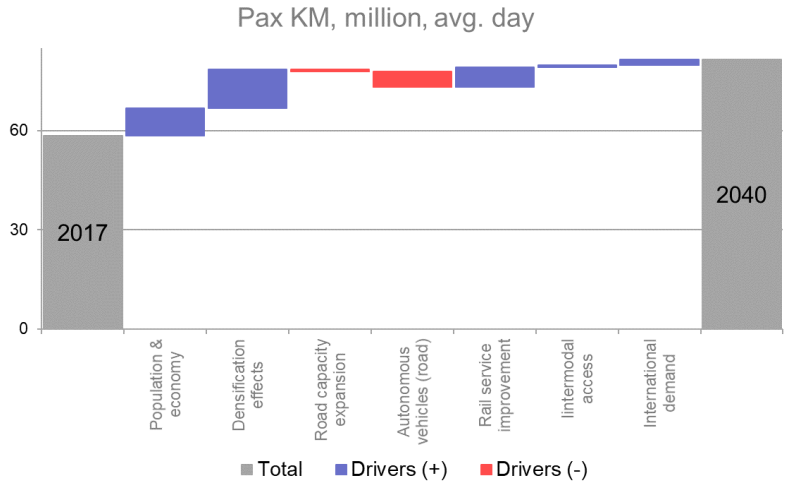
Demographic change

➔ An increasing senior population will impact of day distribution



Separation of partial effects

➔ Isolation of the impact of the main drivers of rail demand



Benefits of agent-based modelling

→ **High resolution** of travel demand
- in **time**: 24-hour distribution of demand and capacity use
- in **space**: small area focus, door-to-door analysis
- according to **person attributes**: focus on specific traveller groups

→ Ability to simulation **future mobility**
- future modes: ridesharing, autonomous vehicles
- demographic change

→ Contribution to **innovation** in our industry
- bringing research into real-world application

Challenges of agent-based modelling

- → Complexity of the approach
  - Staff time and staff skills
    - need for internal research on methods and software development
  - Computer resources
- → Know-how transfer from academic research to practice
- → Working with software, that is not always mature
- → Coping with
  - computation time
  - variability of results

What is the perspective for the industry?

- → Agent-based simulation is ready for practice in large-scale transportation planning
- → We have seen many advancements of software
  - MATSim (open source): improved algorithms and computation time
  - PTV Visum: new data model for activity-based micro-demand
  - Simunto: a GUI für MATSim
- → The SBB experience:
  - It took three years to become operational
  - Many requests for application of the agent-based model
  - Model application still requires involvement of the development team

Connecting people …

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Further reading (publications about MOBi)

- Scherr, W., Bützberger, P., Manser, P. (2019). SIMBA MOBi: Microscopic Mobility Simulation for Corporate Planning. ETC, Dublin, Ireland.
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- Scherr, W., Bützberger, P., Frischknecht, N. (2018). Micro Meets Macro: A Transport Model Architecture Aiming at Forecasting a Passenger Railway's Future. STRC, Ascona, Switzerland.
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