IMPACTS OF ROAD TRANSPORT AUTOMATION IN RURAL AREAS

A case study for a reference region using the German national transport model DEMO

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Rural areas might profit from road transport automation, but haven‘t been in the focus of current research.

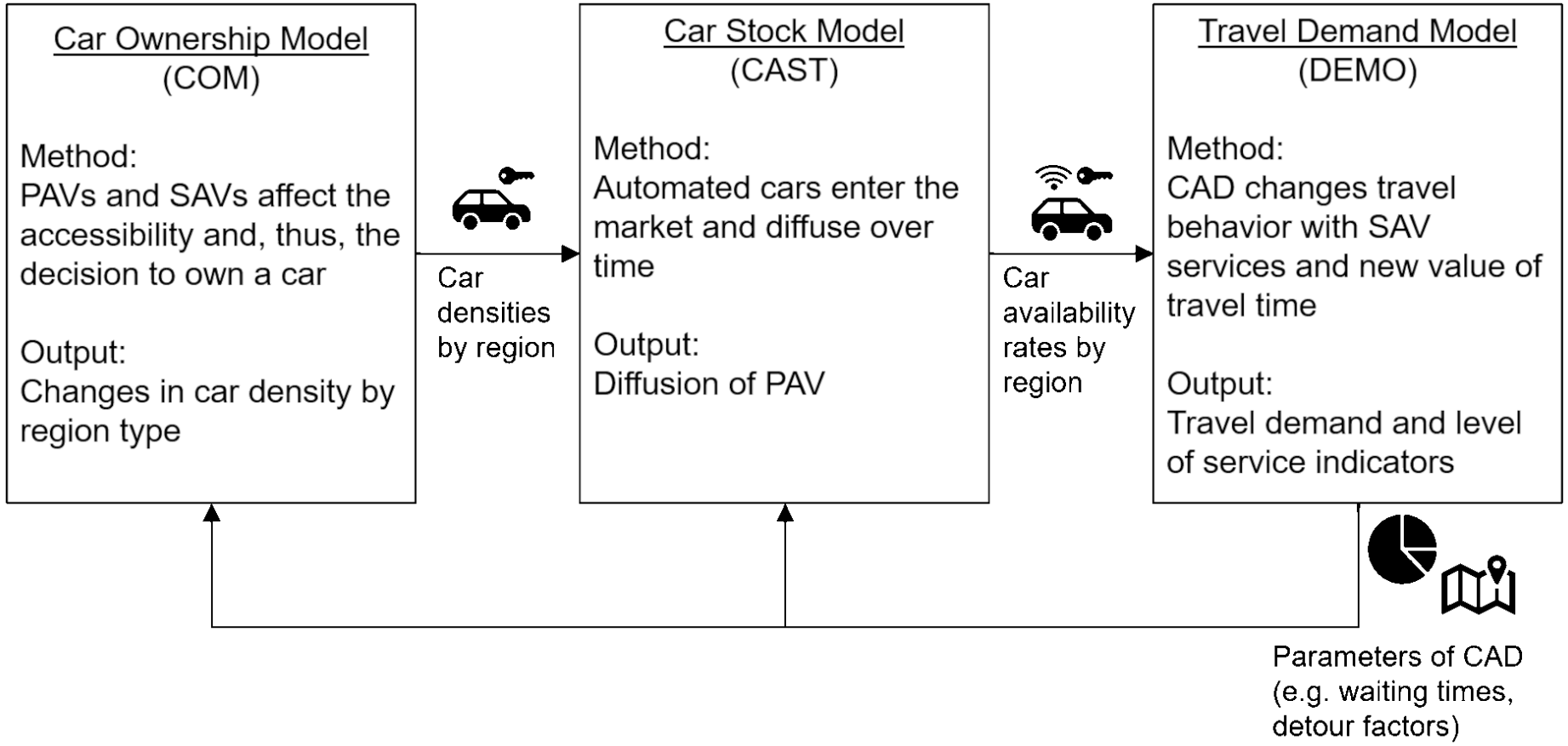
Research project CADIA – Connected and automated driving in Germany and Japan

- Focus on acceptance, market diffusion and travel demand on a national level
- Partner projects in Japan and Germany

Development of modelling framework to depict long- and short-term mobility decisions on a national level

- Combination of car ownership, car stock and travel demand model
- Implications for national policies
- Spatial differences across Germany
- Extraction of sub-models for specific regions
- Depiction of private autonomous vehicles (AV) and shared AV (SAV)

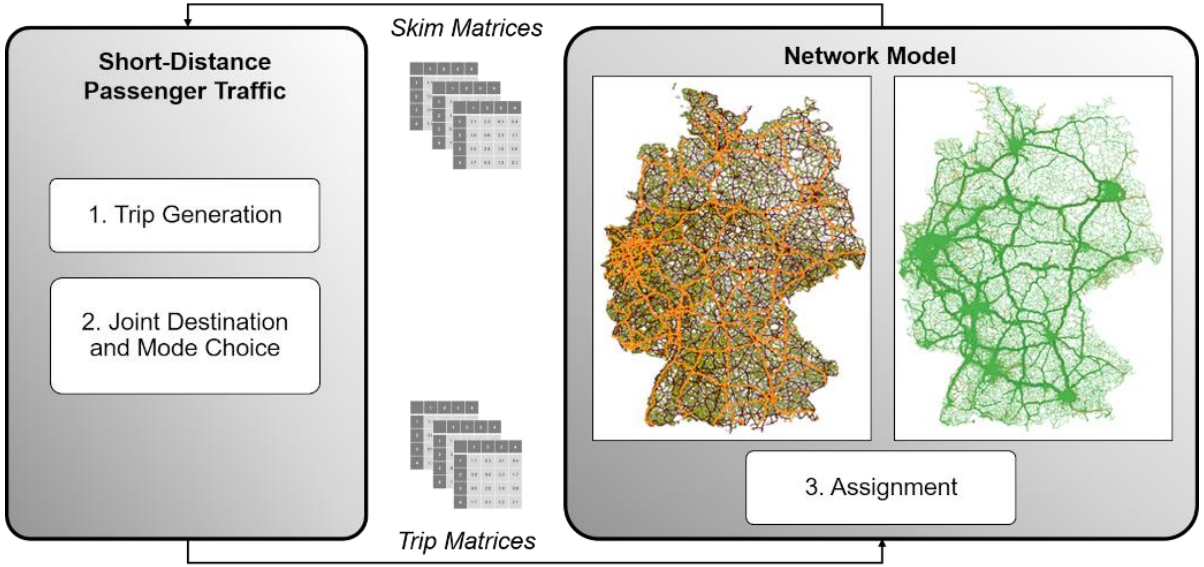
By applying a modelling framework that combines a car stock and travel demand model, the long- and short-term impacts of AV can be included.



The national travel demand model DEMO – forecasting transport for Germany.

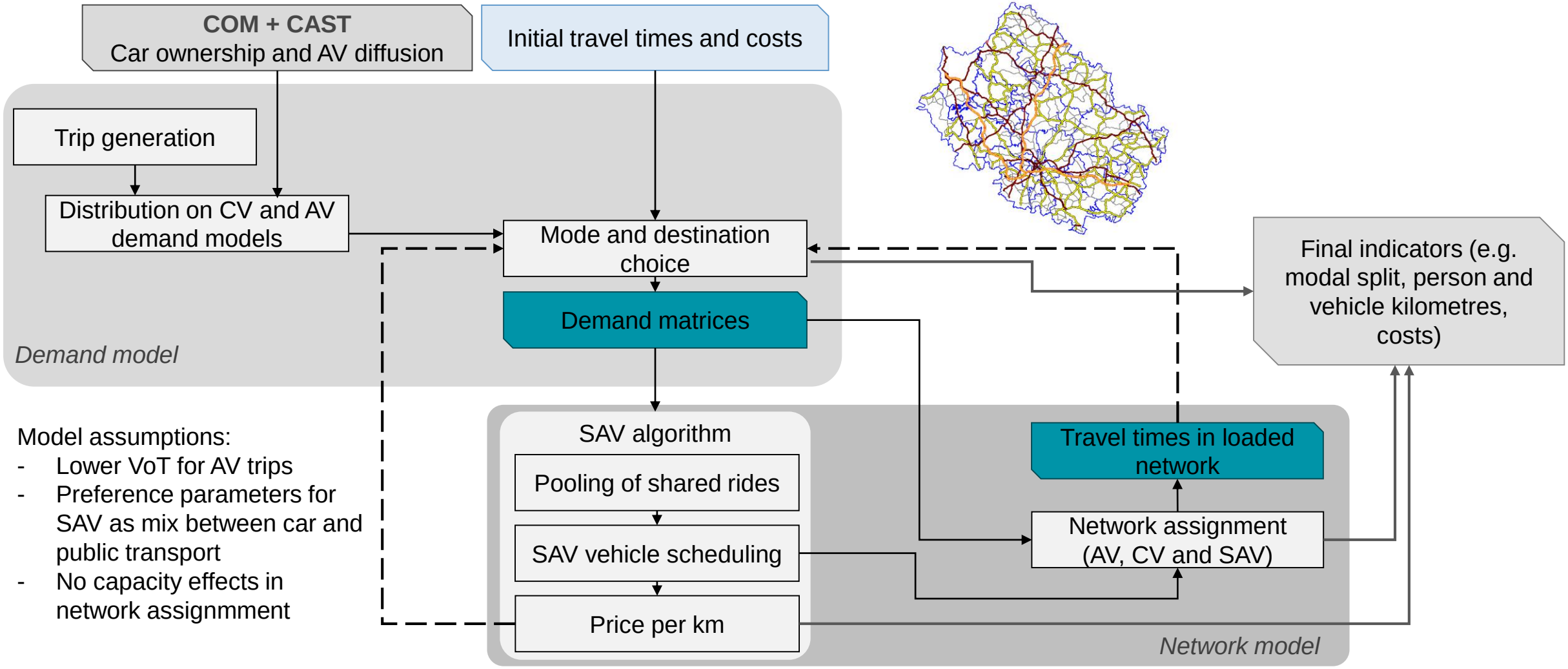
Macroscopic 4 step model

- Synthetic model, validated and calibrated[1]; ~ 6,600 TAZ
- NHTS MiD 2017, value of time study[2]
- Forecasting travel developments and assessing the effects and impacts of policy measures and new services
- Structural and socio-economic attributes of Germany and its regions



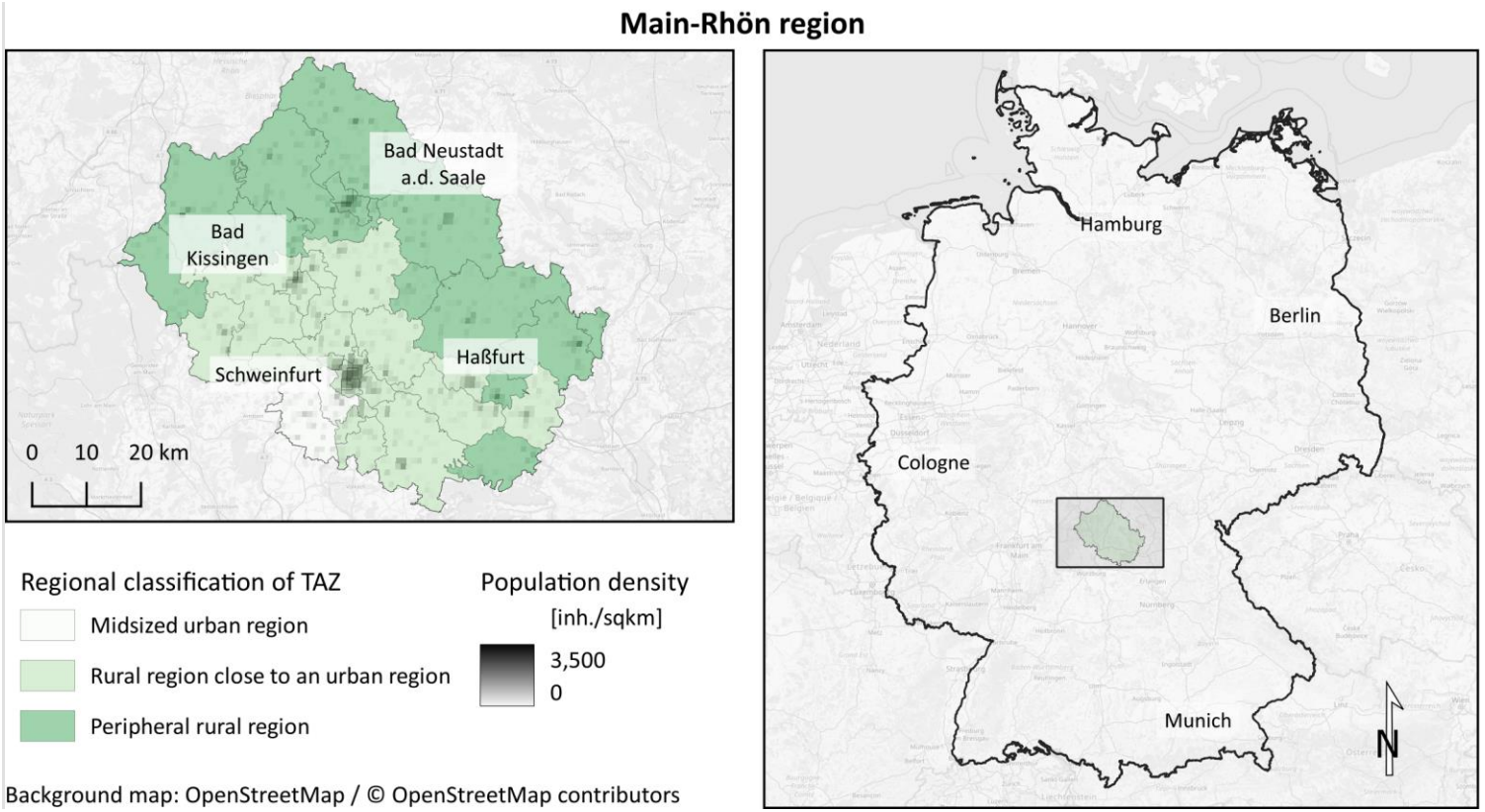
[1] Winkler, Christian; Mocanu, Tudor (2017): Methodology and Application of a German National Passenger Transport Model for Future Transport Scenarios. In: Proceedings of the 45th European Transport Conference.
[2] Ehreke, Ilka; Hess, Stephane; Weis, Claude; Axhausen, Kay W. (2015): Reliability in the German Value of Time Study. In: Transportation Research Record 2495 (1), S. 14–22. DOI: 10.3141/2495-02.

The classic 4-step model is supplemented with algorithms to include private AV and SAV as mobility options.



The Main-Rhön region in Bavaria is used as representative rural region.

- ~ 4,000 km² and 432,000 inhabitants
- Mostly classified as rural according to RegioStaR, with central city Schweinfurt
- Low population and building density, low public transport supply
- Travel demand model:
  - 41 TAZ
  - Road and public transit network



The impact of road-transport automation is measured by comparing two automation scenarios with a baseline scenario for 2050.

Private AV

- Private AV are available in the mass market.
- There are no other AV-related services.

Full Potential

- Private AV are available in the mass market.
- SAV services in the form of on-demand car- and ride-sharing and as feeder to railway stations are available for the whole region.

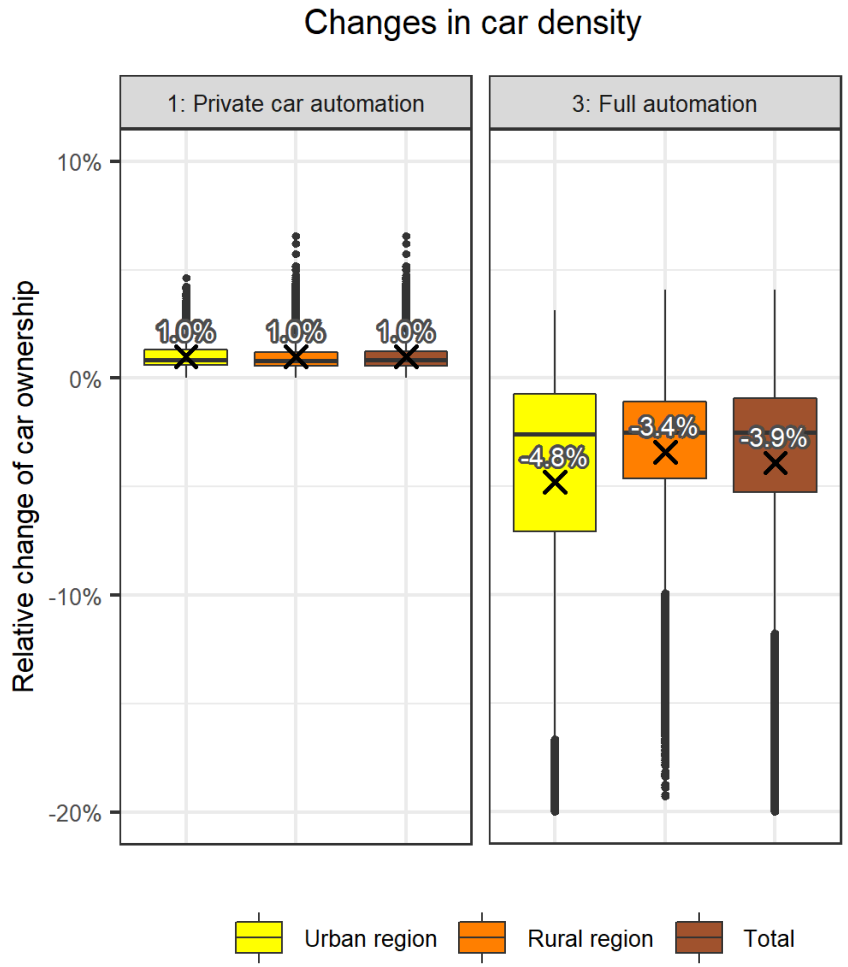
The results from the car ownership and car stock model are motorization rates and the share of private AV.

Car ownership

- Simulation of the influence of accessibility (car and public transit) on household car ownership
- With SAV in rural regions, car density could decrease by 3%

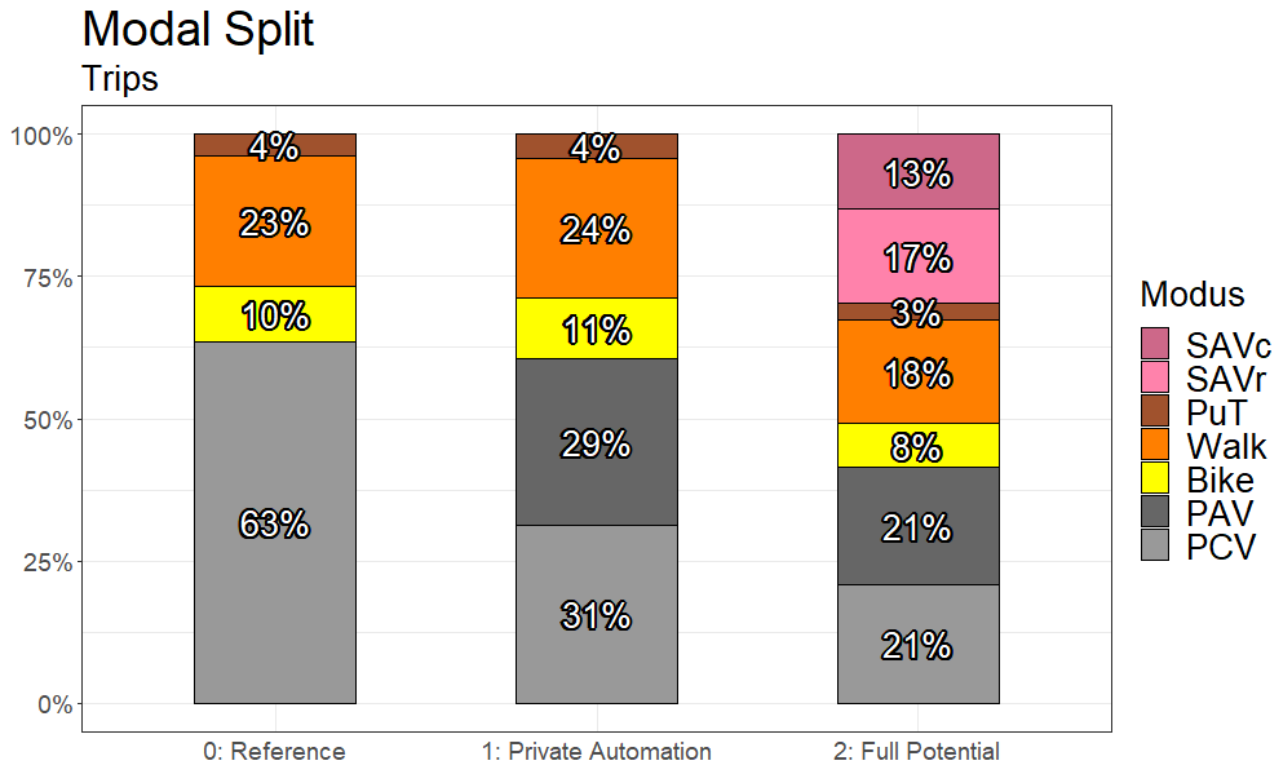
Technology diffusion

- Diffusion of AV in private fleet for rural areas ~44%
- With SAV, diffusion is lower at ~41%



Especially the introduction of SAV and their mobility services leads to changes in travel behaviour.

Modal split

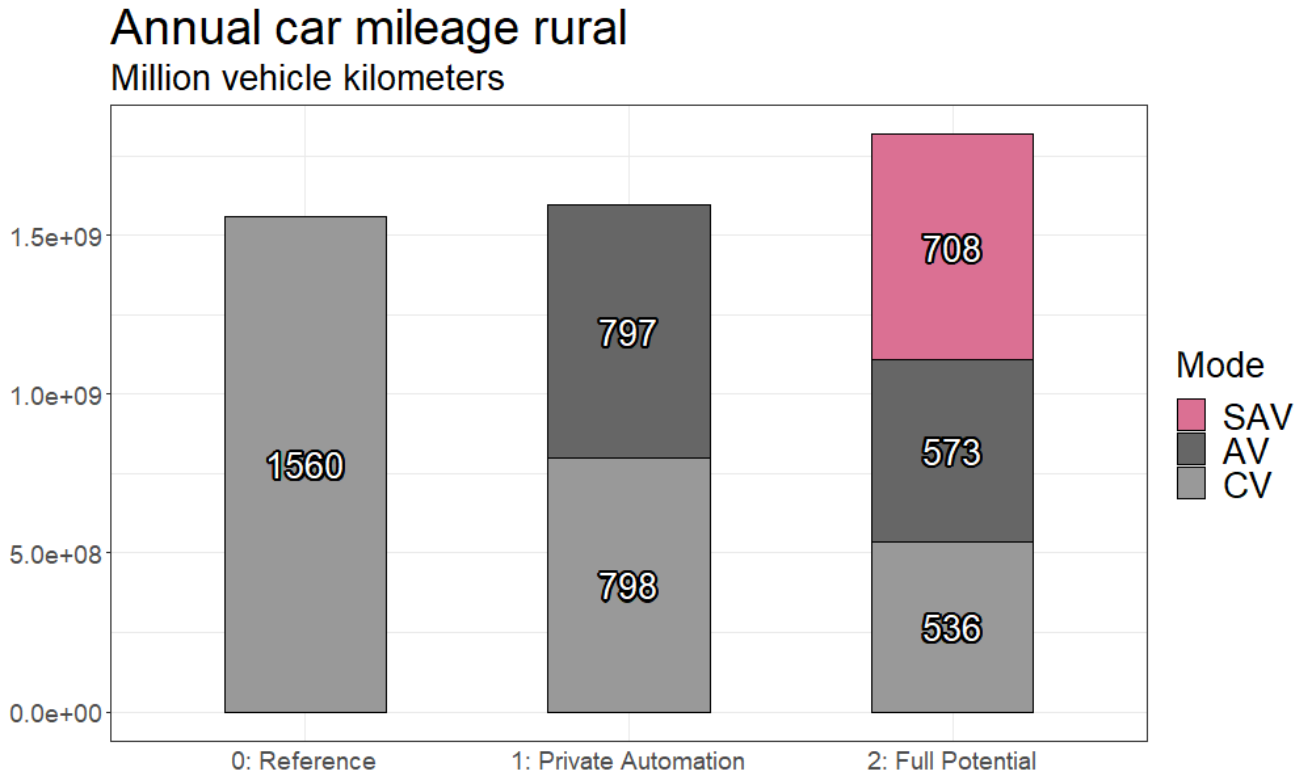


- Car travel times and distances increase with the introduction of private AV
  - +1-2% on average
  - AV trips take 5% longer than CV trips
- SAV lead to a reduction in overall trip lengths and durations
  - Mean distance reduced by 8%
  - Mean travel time reduced by 13%

Automated driving leads to higher vehicle kilometres travelled, especially with the introduction of SAV.

Vehicle kilometres

- Lower kilometres travelled by private cars with SAV
- Modal shift towards SAV services leads to higher overall vehicle kilometres travelled
- No higher congestion observed



SAV services are used as demand-responsive transport, either alone (car-sharing) or with other passengers (ride-sharing).

- Service indicators determined using pooling and vehicle scheduling algorithm[3,4,5]
- All trip requests are served with a common fleet for car- and ride-sharing
- Maximum wait time of 10 min
- 43% of all SAV trips are ride-sharing trips

Fleet size	7099
Vehicles per km²	1.8
Vehicles per 1,000 inhabitants	16.4
Occupancy rate	1.2
Occupancy rate (Ride-sharing only)	1.4
Share of empty mileage	5%
Average detours for ride-sharing	+15%
Daily mileage per vehicle	292.3km

[3] Friedrich, M., M. Hartl, and C. Magg (2018): A Modeling Approach for matching Ride-sharing Trips within Macroscopic Travel Demand Models, Transportation, vol. 45: pp. 1639-1653.
[4] Hartleb, Johann; Friedrich, Markus; Richter, Emely (2022): Vehicle scheduling for on-demand vehicle fleets in macroscopic travel demand models. In: Transportation 49 (4), S. 1133–1155. DOI: 10.1007/s11116-021-10205-4.
[5] Thomsen, N (2022): Implementing a Ride-sharing Algorithm in the German National Transport Model (DEMO), Transportation Research Record (2022) 036119812211270. https://doi.org/10.1177/03611981221127015.

Road transport automation impacts the rural transport system, especially with accompanying services like MaaS.

- Automation impacts travel behavior on multiple levels
  - Model framework with car ownership models allows inclusion of long-term household decisions
  - Consecutive model framework complex, but worthful as models replace assumptions
  - Popularity of SAV services shows potential for public transport in rural areas with high level of service
  - Introduction of rural MaaS might be useful even without fully autonomous driving
  - SAV lead to an increase in vehicle kilometers traveled

DLR, Oguchi, T., Fleischer, T, Taniguchi, A. (2023):
Acceptance and diffusion of connected and automated driving in Japan and Germany.
Springer Nature, in press.

Thank you for listening!

Topic:	**Impacts of road transport automation in rural areas** A case study for a reference region using the German national transport model DEMO
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