# Bridging MATSim and MoTMo: From Daily Travel to *Mo*bility *T*ransition *Mo*deling

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## Abstract

MoTMo (Mobility Transition Model) is a large-scale, empirically grounded agent-based model (ABM) developed to simulate the evolution of mobility behavior over multiple decades. Going beyond conventional short-term transport simulations, MoTMo is designed to investigate how individual and societal mobility trajectories unfold in response to demographic change, economic development, and technological innovation. With a strong focus on the interplay between personal life histories and larger systemic trends, the model allows users to investigate how mobility choices and broader developments reciprocally influence each other over time.

Earlier versions of MoTMo focused primarily on how feedback between transport mode choices and their ongoing development – including factors like convenience and eco-friendliness – shape the mobility landscape over time. The current work-in-progress introduces a substantially more detailed demographic process: using MATSim's synthetic population—including home and work locations—as a baseline, the model dynamically updates this population through demographic developments such as migration, births and deaths. Individual life transitions—including becoming a parent, job changes (often accompanied by income fluctuations), and retirement—are modeled as key life course events. These events serve as triggers for agents to re-evaluate their mobility decisions, for example by adjusting the utility associated with different mobility types to reflect their new circumstances. A job change may lead to longer or shorter commutes and thus influence the attractiveness of various transport modes; similarly, becoming a parent can prompt reconsideration of car ownership or the use of additional means of transport. Through this approach, MoTMo moves beyond static population definitions and enables the analysis of interactions between mobility decisions and broader social as well as economic change.

A distinctive feature of MoTMo is its systematic separation between two core processes: the *availability* of mobility tool ownership (particularly car ownership in the current implementation), and their *use* within daily life. Within MoTMo, changes in the availability of mobility option – such as acquisition or abandonment of cars – are determined endogenously by agents' responses to life course events and external influences. For the usage profile the model aims to leverage MATSim's detailed activity-based simulation capabilities through the integration of completed travel plans. However, due to ongoing population turnover and demographic changes, maintaining the initial one-to-one correspondence between MoTMo's evolving population and MATSim's synthetic population presents technical challenges and is currently an active area of development.

MoTMo is designed as a living incremental model: its modular architecture, written in Julia and built on our high-performance agent-based simulation framework Vahana.jl, allows for ongoing development and seamless integration of additional societal processes or mobility technologies. The present work is developed within the DiTriMo project[1], with Berlin and Lausitz as focal regions.

[1] See: https://www.mi.fu-berlin.de/en/math/groups/ag-math4susTrans/projects/ditrimo/index.html

Within the same project, current developments also explore the integration of MATSim-based mobility modeling into an interactive stakeholder dialogue format: the *Decision Theatre* (DT). The DT provides a structured interface between data-driven analysis and participatory decision-making processes, aiming to facilitate societal discourse on sustainable mobility transitions.

A Decision Theatre combines societal and environmental data, computational simulation models, and visualization-supported dialogue formats. It enables stakeholders from policy and civil society to engage with complex systemic challenges, co-develop plausible policy scenarios, and deliberate on their long-term consequences. Interactive visualizations of model outputs—illustrating agent-based travel behavior in response to changes in mobility systems, technological innovation, environmental pressures, and population dynamics—serve as a shared reference point for discussion and foster evidence-informed decision-making..

This approach complements the MoTMo model's long-term perspective by providing a means to explore, communicate, and critically reflect on future mobility developments in a participatory setting. In particular, the integration of MATSim as a core simulation engine in the DT enables high-resolution scenario comparisons that link short-termin individual behavior and structural change with tangible policy options.