4 Interviews und Expertenmeinungen

4.1 Sketch planning future neighbourhoods with agent-based traffic simulation

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In a recent project for the Singapore planning agencies, we had to come up with propositions of new urban designs for a self-driving, dynamically routed, transit-on-demand future. Can such a transit system make public transport a preferred mode, realising Singapore's vision of going car-lite? Can the city be retrofitted to maximise the benefits from this new technology, or do we need to design new neighbourhoods from the ground up? The project highlighted the shortcomings of the so-called predict-and-provide approach to urban planning and design that has produced cities built more for machines than humans. We realised that, especially when trying to plan and design for new modes of transportation, there is a need for decision support in the early, sketch planning phase of the urban design process.

The challenge

Urban planning and design is an expensive, intricate process requiring coordination across many disciplines. It is risky, resulting in buildings and infrastructure costing millions to construct and maintain, both in terms of dollars consumed and tons of CO_2 produced. Planners need to produce a complex, interwoven dynamic system; deciding not only where to put static elements like buildings, gutters, sidewalks and roads, but also to make educated inferences about the numbers and kinds of people and goods the system will produce and attract, the means of connection between them and the rules to govern it all. Bad urban planning generally results from the 'five ‚i's': influence, inertia, illiteracy, inconsistency and interference[114]. Influence, interference and illiteracy respectively represent external pressures: money, power and public backlash from lack of transparency, understanding and participation. What remains are endogenous threats: the inertia of disciplinary silos and slow adoption of new technologies, and inconsistency of, e.g. zoning decisions or suitability of infrastructure for emerging modes of mobility.

Urban planning is path-dependent. Making the right decisions early in the process will have a profound impact on its outcome: as the plan passes through more hands, it becomes harder and more expensive to change and re-iterate earlier steps. But those early decision-makers frequently have very little decision support and are instead forced to rely on experience, intuition and rules-of-thumb. The demand for urban space will only increase in the coming decades, especially in the developing world. The array of smart city technologies that promise to solve our problems can only work if they are properly integrated into the overall design at the cost of increased complexity, introducing more potential sites for failure.

Sketch planning future neighbourhoods with agent-based traffic simulation

We developed a prototype tool, based on the open-source agent-based traffic simulation platform, MATSim[115], that provides a pathway towards the early integration of emerging technologies. The approach is designed to provide decision support in the early ‚sketch planning phase' of the urban design process, where agility and uncertainty are high. The aim is to understand the impact of urban design and policy decisions on mobility flows and accessibility, through a process of iterative design experimentation.

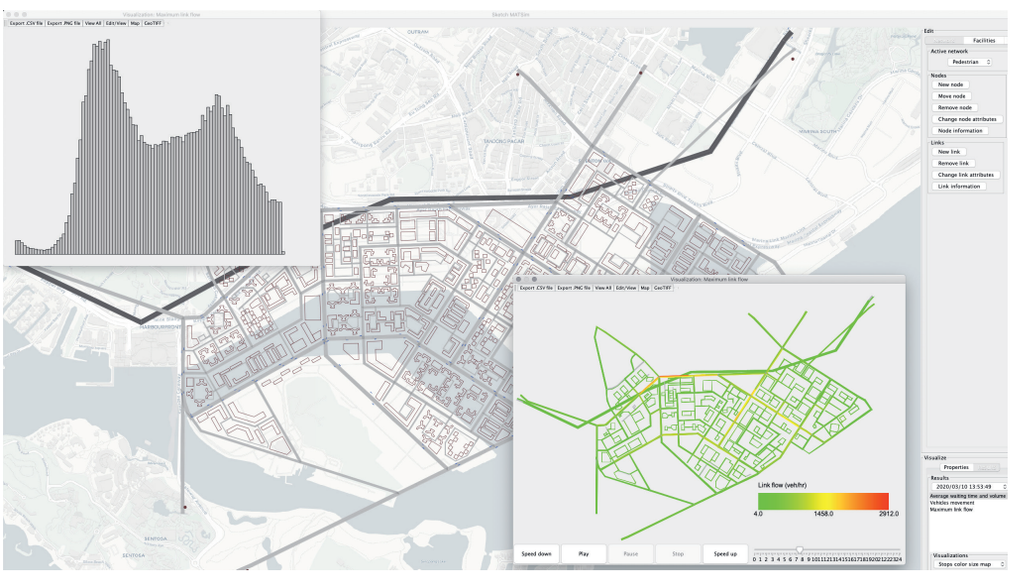
We designed the tool, provisionally called SketchMATSim, with an audience of urban planners, designers, real-estate developers and other non-transport planning audiences in mind. These users need not be familiar with the underlying technologies of machine learning and agent-based simulation that drive the tool, making it possible to plan for disruptive emerging mobility technologies, like ride-sharing, mobility-as-a-service, self-driving vehicles, etc. Through scenario planning, tinkering and experimentation, the urban form co-evolves with the mobility flow it is likely to produce.

114 Nussbaum/Spessot (2017).
115 MATSim (2019).

The urban designer produces a set of inputs in the form of GIS shapefiles: a massing of building stock, land uses, and a transportation road network. Other inputs can include parking lots, transit stops, electric vehicle charging depots. Through a graphical front end, the user can specify scheduled transit services, as well as dynamic, mobility-on-demand. The system then transforms these elements into a MATSim model and runs a simulation on the cloud, feeding back performance indicators such as travel times, levels of congestion on the network, waiting time at transit stops, empty kilometres driven by taxis and pooled rides, etc.
The current focus is mainly on modelling accessibility and mobility, as these are crucial performance measures of urban design: not only through the direct cost of transportation and emissions but also the lost opportunity cost of not doing something useful when we move between activity locations. However, we found that, through iterative experimentation, we come to consider far more than simply motorised mobility. Through active engagement with the design, the feedback of understanding accessibility across all modes, encourages early consideration of the psychological and health costs of living in neighbourhoods that do not support active mobility, or neglect ageing and vulnerable population groups‘ personal mobility needs. We are therefore working on including an explicit model of active mobility modes and their integration with transit.
With this approach we have collapsed a process typically conducted by teams of people across several line departments over weeks and months into an interactive, largely cost-free application that can be run by a single user or small group of investigators. By being able to compare design propositions across a range of performance indicators, the user has the ability to investigate the interactions between traditional and new smart mobility technologies. Early integration of emerging technologies in the urban design will maximise benefit compared to late-stage retrofitting, highlighting counter-intuitive inconsistencies in design decisions early in the planning process.

We cover the approach in a recent book chapter dedicated to the topic of the modelling and design of smart mobility systems.[116]

Abb. 4: MATSim model



116 Fourie et al. (2020).