Transport planning and traffic engineering

Using System Dynamics to cope with demographic issues in spatial and transport planning

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The Institute of Transportation, TU Wien, has a long tradition using System Dynamics to analyse mobility and complex spatial systems. Applications range from simple qualitative models using Causal-Loop-Diagrams to complex quantitative models using Stock-Flow-Modelling techniques. Causal-Loop models have been used to analyse phenomena like rebound effects in transport or urban sprawl of cities. Qualitative Causal-Loop models are typically the first step in the development of operative quantitative simulation tools. The main quantitative models developed at the Institute of Transportation are the dynamic, integrated land use and transport interaction model MARS (Metropolitan Activity Relocation Simulator) and the dynamic long-distance travel model LUNA (Simulating the demand for Long-distance travel Using a Non-OD -matrix based Approach). MARS simulates the interaction between transport and location choices of households and companies in case study areas on urban, regional or national level. MARS employs a multimodal transport sub-model. Case study specific MARS is able to deal with the following means of transport: walking, bicycle, motorcycle, car and public transport (road and rail based). MARS is designed to assess transport, economic and environmental effects of scenarios and policy instruments and to identify best performing strategies. MARS has been used in more than twenty case studies in Europe, Asia and America. Currently MARS is used as part of the doctoral programme URBEM (Urban Energy and Mobility System, urbem.tuwien.ac.at). The goal of URBEM is integrated and inter-disciplinary research to develop scenarios for a path to a "sustainable, supply-secure, affordable and liveable city", using the example of Vienna. URBEM is a joint undertaking TU Wien and the Viennese utility Wiener Stadtwerke. LUNA addresses long distance holiday and business trips. LUNA models the population in eighteen age groups in five year time steps, ten different household types and three income groups. Five different modes of transport are available in LUNA: private car, bus and coach, railway, air and maritime. The model LUNA was explicitly designed to assess effects of demographic issues like ageing of the population and migration. LUNA can act as add on to MARS to include long-distance travel of the population of a case study area into the environmental assessment of the effects of different scenarios and policies. Both MARS and LUNA are “white box” models, i.e. all cause effect relations and equations are visible for clients and users. Test versions of MARS and LUNA which can be run with the freely available Vensim® model reader (www.vensim.com) can be downloaded from the Institutes webpage (www.ivv.tuwien.ac.at)

Figure 1: Example Causal-Loop-Diagram attractiveness car

Figure 2: Example Modal Split case study Hanoi