An Overview of Transport Modelling Approaches – A Use Case Study of Helsinki

Shabnam Farahmand
Forum Virium Helsinki
Unioninkatu 24, 00130
Helsinki, Finland
shabnam.farahmand@forumvirium.fi

ABSTRACT

In this paper a general view to transport planning approaches have been articulated with a focus on the simulation models. To this end, different analytical methods have been investigated with regard to the scope of target policies, geographic scales, and modelling techniques. The paper also provides an overview to the transport planning approaches which are specifically applied in the City of Helsinki in close relation to the land use policies. Besides, further discussions have been included to shed light on the approach URBANITE project is seeking. Although there is still a need for overcoming the challenges regarding data-driven decision-making, we see a potential in the project's approach to foster the use of disruptive technologies for accelerating the uptake of the evidence-based policies.

KEYWORDS

Transport planning, scales of analytics, policy-making, transport modelling in the City of Helsinki, simulation

1 INTRODUCTION

Transport planning plays a major role in defining the way public resources such as funds and spaces are used. Transport plans are mainly applied to understand the strategic capacity and consequences of high-level democratic decisions. Hence, it is important to consider the political and societal preferences of relevant stakeholders including citizens [1]. This also explains the urge for developing transparent, open-source, and simplified solutions in order to evoke citizen engagement and public participation [2]. Moreover, the advantage of transport planning models most probably lays in the fact that the scope of identified solutions by these models are inherently geographic [3]. Geographic analysis and tools speed up the uptake of new technologies due to the power and potential to provide evidence for interventions in transport planning [4].

In the following, the different approaches to tackle transport problems based on analysis levels will be addressed. In section 3, a schematic framework for transport planning approaches is suggested with the focus on analytical and simulation techniques. Furthermore, the transport planning techniques applied specifically by the City of Helsinki is included here. Section 4 discusses URBANITE project's global view and argues the advantages and challenges ahead of mobility decision makers.

Information Society 2021, 4–8 October 2021, Ljubljana, Slovenia

2 TRANSPORT PLANNING APPROACHES

There are different approaches to analyze characteristics of a transport network and to evaluate the outcomes of the strategic and/or ad-hoc interventions with the transport. Ni [5] considers the geographic scales of transport planning models and proposes a framework which can enable multiscale traffic modelling which can be seen in Figure 1. In another study, Vassili [6] compares the transport analysis tools based on the scope and complexity of research area and highlights the importance of distinguishing between Analysis, Modelling, and Simulation (AMS) tools. Some of the tools for each scale of geographic analysis are already suggested in Figure 1. In addition to the geographic scale, the purpose of policy making processes to tackle a specific problem is also an important criterion in defining the right approach. Larger geographic scale of analysis can be chosen to support policy making with less data granularity [7]. However, it is reasonable to opt for micro-scale analysis when dealing with ad-hoc interventions in a specific area. This, on the other hand, becomes demanding on obtaining more detailed and comprehensive data.

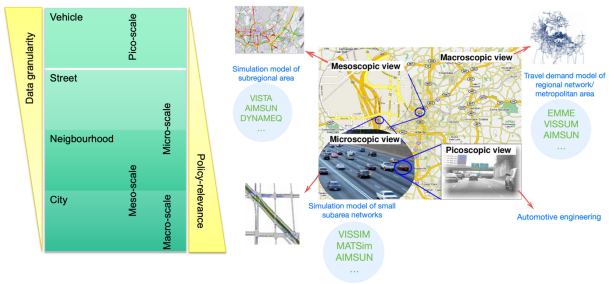

Figure 1. Scales of Transport Planning Approaches; Tools & Solutions

3 TRANSPORT PLANNING APPROACHES

De Dios Ortúzar and Willumsen [8] structured the transport planning approaches into five main stages as problem formulation, data collection, modelling and analysis, evaluation, and implementation of the solutions. In this paper, a new schematic framework is formulated based on Dios Ortúzar and

Willumsen's approach in Figure 2. The framework is modified in accordance with the approach of Helsinki Region Transport (HSL) and URBANITE's global view to provide a clear understanding of current applied techniques as well as a basis for the comparison of the two approaches.

Australian Road Research Board [9] categorizes the problem-solving techniques into analytical and simulation techniques. The research implicates that the analytical techniques are sort of closed form mathematical equations which provide statistical results such as forecasts and predictions. On the other hand, simulations are physical mathematical models, the results of which is to project objects moving around in a transport network. It is also possible to check the network state at different time stamps [9] & [10].

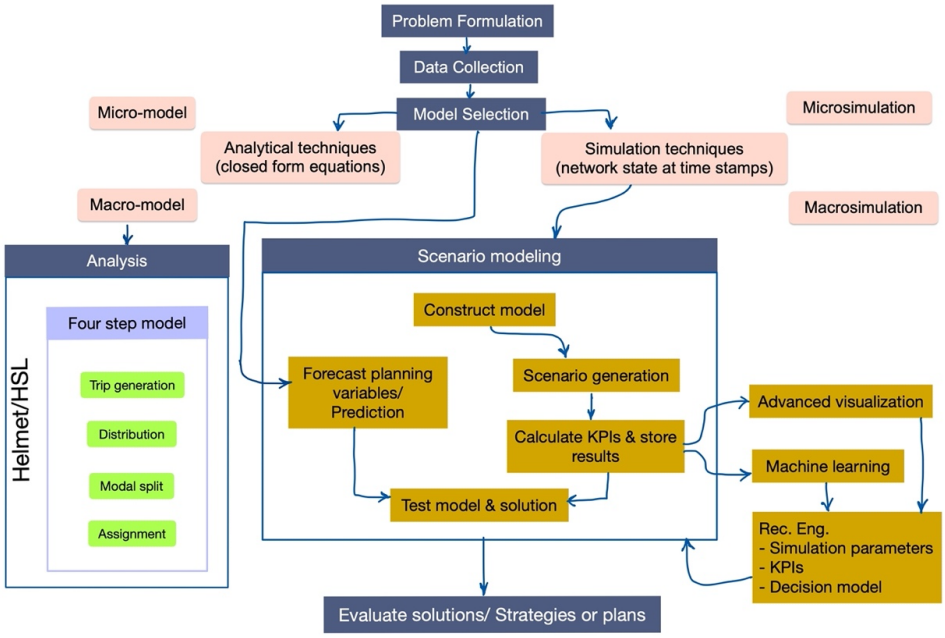

Figure 2. Proposed Schematic framework for Transport Planning[1]

4 TRANSPORT PLANNING – Use Case of Helsinki

The techniques used by the Helsinki Region Transport (HSL) follow an analytical approach to enable strategic transport and land use planning for the city. The model is called "HELMET" and is built with the help of proprietary tool EMME[2]. The statistical mathematical models in the field of transport models are usually referred as travel demand models when considered on a macro-level. These models have Four Step Transport Model (FSM) as the basis although they have evolved to more advanced levels to encompass the intelligence of models' agents [11]. The last version of HELMET model is therefore considering agent-based modelling (ABM) approach when it comes into trip chains analysis [12].

Helsinki Region Transport (HSL) developed its Sustainable Urban Mobility Plan (SUMP) for the City of Helsinki in 2015[3]. In particular, this plan focuses on 1) strengthening the strategic capacity and effectiveness, 2) integrating transport and land use, and 3) clarifying transport policy choices as well as the roles of different modes of transport.

According to the SUMP of Helsinki and on the basis of interviews performed with the City stakeholders, the interrelation between transport planning strategies as well as land use policies has been come into our focus frequently. Stover and Frank [13] suggested that development of transport and land use affect each other continuously in a cycle which is illustrated in Figure 3.

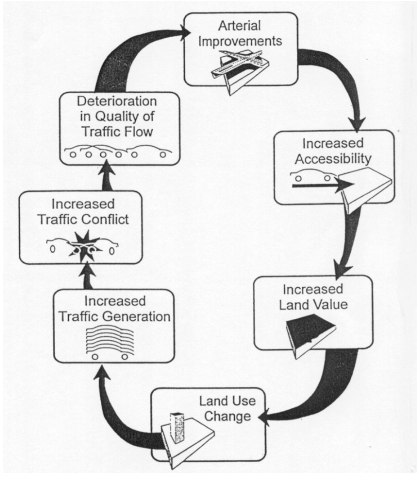

Figure 3. Transportation Land Use Cycle

[1] In blue: the main stages of transport planning processes; in yellow: URBANITE's global view
[2] https://www.inrosoftware.com/en/products/emme/
[3] http://www.bsr-sump.eu/good-example/helsinki-region-transport-system-plan-hlj-2015

Bearing this in mind, the proposed use case scenarios aim to find out the outcomes of the following decisions:

1. Intervention with the traffic network e.g., building a tunnel on the west harbor's junction to lead the main stream of heavy-duty vehicles caused by the arrival of ferries
2. Interventions with the land use in the area as it has been undergoing a lot of changes due to the constructions to turn the harbor into a dense residential area

The results of such analysis will help with understanding the causes of congestions and bottlenecks in the west harbor and serve as a tool for measuring the impacts of different policies on air quality and noise levels. Finally, the results will contribute to comprehending situational and statistical awareness which is one the main pillars of the City's Intelligent Transport System Development Programme 2030[4].

5 Discussions and Future Directions

URBANITE project aims to build microsimulation models which can help cities find out the outcomes of certain policies by applying new technologies and advanced techniques. Building transport models is demanding in terms of costs, time, data, and computation space requirements. However, URBANITE aims to take advantage of machine learning techniques as well of decision support systems to overcome these challenges. Hence, the models will be trained by the results obtained from simulations' input-output space exploration. Additionally, a recommendation engine will be built to provide decision makers with the relevant policies and KPIs tailored for their needs.

The approach facilitates data-driven decision making and will be fundamental in enabling real-time implementation and evaluation of solutions. Although there are still a lot of challenges regarding available data sources whether on the level of required infrastructure for gathering data or the quality of the available data. Recognition of the most relevant data sources and opening the data is a crucial step for the cities if they aim to realize evidence-based decision-making. The other challenge depends on the ability to include the benefits of all stakeholders esp. citizens in building technological solutions. In this regard, cities should come up with the ways to consider interests of all relevant beneficiaries and move towards participatory approaches.

ACKNOWLEDGMENTS

The URBANITE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 870338text here. Insert paragraph text here.

REFERENCES

1. Legacy, C., *Is there a crisis of participatory planning?* Planning theory, 2017. **16**(4): p. 425-442.
2. Peters, M.A., *Citizen science and ecological democracy in the global science regime: The need for openness and participation*. 2020, Taylor & Francis.
3. Lovelace, R., *Open source tools for geographic analysis in transport planning.* Journal of Geographical Systems, 2021: p. 1-32.
4. Jäppinen, S., T. Toivonen, and M. Salonen, *Modelling the potential effect of shared bicycles on public transport travel times in Greater Helsinki: An open data approach.* Applied Geography, 2013. **43**: p. 13-24.
5. Ni, D., *Multiscale modeling of traffic flow.* Mathematica Aeterna, 2011. **1**(1): p. 27-54.
6. Alexiadis, V. and C. Systematics, *Integrated Corridor Management Analysis, Modeling and Simulation (AMS) Methodology*. 2008, United States. Joint Program Office for Intelligent Transportation Systems.
7. Allacker, K., et al., *Energy simulation and LCA for macro-scale analysis of eco-innovations in the housing stock.* The International Journal of Life Cycle Assessment, 2019. **24**(6): p. 989-1008.
8. de Dios Ortúzar, J. and L.G. Willumsen, *Modelling transport*. 2011: John wiley & sons.
9. Bennett, D., et al., *Guide to traffic management part 3: traffic studies and analysis.* 2009.
10. Shone, F., *City Modelling.* Medium, 2020.
11. McNally, M.G., *The four-step model*. 2007: Emerald Group Publishing Limited.
12. Parunak, H.V.D., R. Savit, and R.L. Riolo. *Agent-based modeling vs. equation-based modeling: A case study and users' guide*. in *International workshop on multi-agent systems and agent-based simulation*. 1998. Springer.
13. Stover, V.G. and F.J. Koepke, *Transportation and land development.* 1988.

[4] https://www.hel.fi/static/liitteet/kaupunkiymparisto/julkaisut/julkaisut/julkaisu-16-19-en.pdf