TEACHING MATERIAL GUIDANCE

1) Title of the material

Bin Hariz, M.; Said, D.; Mouftah, H.T. A Dynamic Mobility Traffic Model Based on Two Modes of Transport in Smart Cities. Smart Cities 2021, 4, 253-270. https://doi.org/10.3390/smartcities4010016

https://www.mdpi.com/2624-6511/4/1/16

2) Which section of the SUMP it is relevant to?

The authors presented a new dynamic mobility traffic (DMT) scheme which combines public buses and car ride-sharing (it can be a part of Mobility as a Service tool) and applying them to smart mobility management. Therefore, the article can be linked to the second, third and fourth sections of the SUMP circle related respectively to the determination of planning framework, analysis of the mobility situation (in particular the analysis of problems and opportunities for all modes of transport - **subsection 3.2**.), scenario building and joint evaluation (development of scenarios of possible futures - **subsection 4.1**.) and vision and strategy development (arguments for stakeholders – **subsection 5.1**).

3) Which Mobility Manager knowledge this material is the most relevant to?

It is related to Data analysis for mobility planning (section 5 of the Mobility Manager competencies) especially 1a (a. data collection and analysis) and 1b (transport modelling and simulation).

4) Problem approached and content overview

Problem approach – the applicability of dynamic transport models in passenger flow management with different modes of transport. This paper focuses on transport models in smart cities. The authors of the paper proposed a new dynamic mobility traffic (DMT) system that combines public buses and car ride-sharing. The main objective is to improve transport by maximising passenger satisfaction based on real-time data exchange between the region manager, public buses, car ride-sharing systems and users. OpenStreetMap and OMNET++ were used to implement a realistic scenario for the proposed model in a city such as Ottawa. The DMT system was compared to a multi-loading system used in a school bus. Simulations showed that passenger satisfaction increased when the right combination of transport modes was used. In addition, compared to another scheme, the DMT system can reduce the stress level of using car ride-sharing and public buses during the day to a minimum level.

The authors of the model assumed that all public buses and ride-sharing vehicles are connected to a mobile application to track all participants in real-time. A DMT algorithm was proposed to manage the demand for the transport service. After receiving periodic information about the availability of public buses and cars (available seats and time to reach the station), DMT calculates the time taken by each available vehicle (having empty seats) to reach the destination from the current position of the passenger. It distributes the results in descending order. The result is compared with the passenger's maximum arrival time, and the first public bus with an equal or lower value is selected. For the passenger to determine whether to continue with the same public bus or to change to another bus, the time taken to reach the destination by the last bus is compared with the result of the previous process. The passenger chooses the public bus in the shortest possible time. The same process occurs if a shared car is chosen as the means of transport for the entire journey. On the other hand, the passenger can choose a combination of public bus and ride-sharing car during the journey. The model gives him the optimal combination with the fastest arrival time and the least cost.

The contributions of this work are summarised as follows:

1. A new dynamic mobility model (DMT) based on a game-theoretic scheme is formulated.

2. A new algorithm for managing the mobility service needs of passengers is proposed. Optimal transport planning is provided for each passenger, whether by public bus, car or both modes, to reach the goal in a reduced time and at the lowest possible cost.

3. Simulations have been carried out to evaluate the developed system.

4. A comparison with a previously introduced multi-loading system proved the effectiveness of DMT.

5) Who could be interested in this material?

The article is aimed at students and those looking for inspiration in Mobility as a Service solution and transport modelling when such measures are applied in SUMP.

6) What is worth mentioning as an innovative factor for the reader?

The applicability of dynamic transport models in passenger flow management with different modes of transport is presented.

In this paper, a dynamic mobility traffic (DMT) model is developed that allows passengers to use car ride-sharing and public buses together or one of them during their trip in the shortest time and for the lowest fare. At each station, passengers can be informed of the capacity of the public car or bus that will pass through the station and the current position of each car or bus. In practice, OMNET++, OpenStreetMap and SUMO simulation software were used to implement DMT. Part of the Ottawa city map was used as a case study using OpenStreetMap. SUMO was used to create random street traffic, mainly including public bus and car traffic. The results indicate that the average stress levels associated with the use of ridesharing cars and public buses alone are similar. These stress levels are higher than the stress levels associated with using cars and buses in the optimal combination. Furthermore, the results highlight that passengers experience lower satisfaction when using public buses alone. Similarly, passenger satisfaction levels increase when an appropriate combination of public buses and cars is used for transport, thus achieving a lower cost and faster arrival at the destination. Furthermore, the DMT is compared with a multi-load model. The result of this comparison shows that the DMT presented in the article is better in terms of lower fares and faster arrival time than the multi-loading model. The proposed model can easily be applied to cities other than Ottawa because the equations take into account the different traffic conditions and different urban road designs that are generated by SUMO. The model is appropriate for short trips rather than long trips and a small city area.

7) Limitations

This paper presents a dynamic model (DTM) that considers only two modes of transport - bus transport and car-sharing. In reality, travellers can choose between more modes. However, the approach presented can be a starting point for developing models that include more travel options.