Demand responsive transit simulation of Wayne County, Michigan

Author(s):
Kagho, Grace Orowo; Hensle, David; Balać, Miloš; Freedman, Joel; Twumasi-Boakye, Richard; Broaddus, Andrea; Broaddus, Andrea; Axhausen, Kay W.

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Demand Responsive Transit Simulation of Wayne County, Michigan

Grace O. Kagho[1+], David Hensle[2], Milos Balac[1], Joel Freedman[2], Richard Twumasi-Boakye[3], Andrea Broaddus[4], James Fishelson[3], Kay W Axhausen[1]

[1]Institute for Transport Planning and Systems (IVT), ETH Zurich; [2]Resource Systems Group (RSG); [3]Ford Motor Company [4]Ford Greenfield Labs
[+]Corresponding author; grace.kagho@ivt.baug.ethz.ch

1 Introduction

We model and simulate a hypothetical Demand Responsive Transit (DRT) service in Wayne County, Michigan. In this context, we define DRT as a shared fleet of vehicles with an option for pooling, and with travelers picked-up and dropped-off at their desired locations, serving as a quasi-public transport that allows vehicles to modify their routes based on service demand.

The **Objective** of this study is to understand the demand potential of DRT for Wayne County based on fleet size, cost and vehicle capacity factors. For the effectiveness of the designed DRT, we try to answer the following questions:

- What is the demand for the new service and how will this affect fleet size and vehicle utilization?
- How does DRT fare affect demand?
- How do service-design parameters affect user experience in terms of wait time and total trip time due to detour allowances?
- How will the DRT service impact mobility in Wayne County in terms of system-level vehicle kilometers travelled (VKT)?

2 Methodology

We create a **high fidelity transport network**, and a computational schema to **convert a trip-based travel demand model** into inputs for developing a calibrated **agent-based model in MATSim** (1), an open-source mobility simulation platform with **an integrated DRT module**. This required a further step of developing and calibrating a mode choice model to estimate demand for the DRT service.

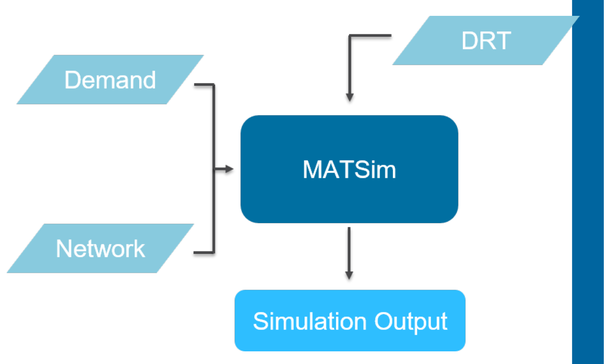

Fig. 1 MATSim Framework for DRT demand in Wayne County

The SEMCOG E-7 trip-based model (2) was used as the base travel demand for this work. It contains more than 20 million person trips across six counties, 2899 travel analysis zones, 8 trip purposes, and 15 trip modes.

Processing the SEMCOG Model

- Convert from Production-Attraction matrices to Origin-Destination
- Apply appropriate Production-Attraction matrices to OD factors
- Convert person trips to vehicle trips
- Discretize floating point numbers
- Extract trips in the MATSim model subarea (Wayne County)

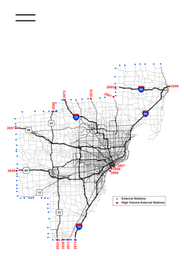

Fig. 2 Transport Network of South East Michigan

Mode Choice Model

A discrete mode-choice extension of MATSim (3) was used to simulate agents' mode choice decisions. A multinomial logit model based on travel costs and other travel characteristics is used in this work. Utility parameters for public transit are used for DRT mode.

Demand Responsive Transit

We ran 16 DRT scenarios between time of day 00:00 AM and 4:00 PM, with varying levels of fleet sizes (100, 250, 500, 1000), fares (2 and 4 USD) and vehicle capacity (4,7), as a method of demand estimation and to understand the impact of DRT on operational, user, and system-level performance indicators.

3 Results

The most important findings from the study are:

- Potential demand for DRT in Wayne County ranges between 16000 to 35000 trips per day depending on the fare
- The County's relatively low density results in low potential for ride-sharing
- DRT riders are sensitive to cost. An increase of the fare from $2 to $4 reduces the demand by about 50%.
- The income level of the people that use DRT is comparable to the income level of those that use PT.
- The majority of the DRT passengers use the service for relatively shorter trips with average trip distances between 5 and 7km.
- The figure below summarizes the demand for DRT in Wayne County. The demand at the $2 and $4 levels are shown with lines, and served/rejected trips shown with bars.

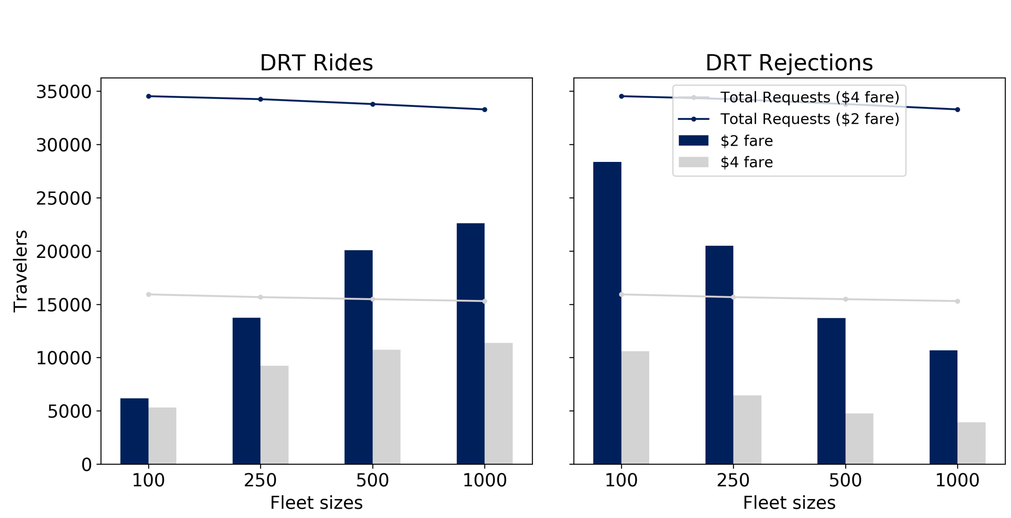

Fig. 3 DRT demand (Requests, Rides, Rejections)

4 Conclusion

Presently the results show reasonable demand for the service, low empty distance, and that the average VKT per vehicle lowers with increasing fleet sizes. However, there is still the need to optimize the DRT service parameters to maximize the efficiency of the system and improve ride sharing. Hence we identified several possible further improvements of the methodology. For future scenarios, we plan to test different service parameters as well as vehicle relocation strategies while optimizing the service area served. This should potentially increase the share of pooled rides as well reduce the VKT in the region.

5 References

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