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Recalibrating travel demand models using Census data and household travel survey data from other jurisdictions: A case study of the Greater Adelaide

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Abstract

Travel demand models are quantitative tools that are used by local, regional and national planning organizations for the development of evidence-based transport policy. Travel demand models can offer insights on current patterns of travel behaviour and provide a framework for predicting changes in behaviour in response to changes in the transport system. Forecasts from travel demand models are used to determine the capacity that new infrastructure must provide; and to facilitate the economic, environmental and social impact assessments of competing initiatives. Concerns are growing that diary surveys may be less viable in the future for several reasons including increasing survey costs. This has led to the intriguing question of whether it is possible to take advantage of data from disparate sources for a region of interest. The potential payoff in terms of substantial resource savings for data collection for all regions regardless of size makes this a particularly appealing avenue of development. Consequently, the objective of this study is to develop and apply a methodology for recalibrating transport demand model parameters that does not require primary data collection. Data from four jurisdictions Melbourne, Brisbane and Perth in Australia and Auckland from New Zealand will be employed to update model parameters for the Greater Adelaide area following the proposed methodological framework. Please note that the submitted extended abstract is based on an ongoing research project with the South Australia Department for Infrastructure and Transportation. It is anticipated all model estimations to be completed for each sub-model for each of the other jurisdictions by October. We will collect a sample of 500 respondents from the Greater Adelaide metropolitan area for validation purposes throughout the month of October.

1. Introduction

Household travel surveys (HTS) have been predominantly the main approach in the past four to five decades for collecting household travel diary data to help better understand how, when, where and why people travel. Various methods have been utilised when implementing HTS such as face-to-face interviews, telephone interviews, computer-assistance, postal survey, web-based survey. Aspects such as increasing survey cost, relying on telephone contact for recruitment and retrieval of data, completeness and accuracy of the data and increasing nonresponse rates have motivated researchers to explore some new promising data collection avenues (Stopher and Greaves, 2007). For example, use of simulation data to supplement samples (Rilett, 2001, Pointer et al., 2004) use of paid panels (Zumkeller et al., 2006) and use of Global Positioning System (Stopher et al., 2008, Bricka et al., 2009). In this study we will be focusing on a data fusion approach to take advantage of data from disparate sources. This

approach is an appealing avenue for all governments regardless of their size to explore travel demand and behaviour in their region with a potential substantial payoff in terms of resource savings for data collection. In this research we argue that travel behaviour could be transferable across space and time and travel data can be taken from other regions and combined with local socio-demographic and spatial characteristics to model or recalibrate travel demand. In particular, this study will use a combination of transport datasets to update and recalibrate Metropolitan Adelaide Strategic Transport Evaluation Model (MASTEM) model parameters.

The South Australia Department of Infrastructure & Transport (DIT) is responsible for the delivery of effective planning policy, efficient transport, and valuable social and economic infrastructure in South Australia. The performance of TDMs currently being used by DIT has been undermined by limited resources. In particular, the current MASTEM - DIT's strategic TDM for the Greater Adelaide metropolitan area - was last calibrated using data from the 1999 Metropolitan Adelaide Household Travel Survey. That data is now nearly twenty years old, and not reflective of current or future travel patterns within the region. There is an urgent need to recalibrate and validate existing models to current data. Hence prompting DIT to initiate the development of a new suite of methodology for recalibrating MASTEM model parameters that does not require primary data collection.

2. Method

Traditionally, TDMs have been calibrated and validated using data collected through surveys that ask participating individuals about their travel patterns over a 1 or 2-day observation period. These data collection methods are expensive. Hartgen and San Jose (2009) report average costs of $487,000 per household travel diary survey, and roughly $150 per response, though they note that "many surveys cost considerably more than the average, and the spread of the data is substantial". Stopher et al., (2011) stated that a CATI survey in Australia costs $150-200 per household, face-to-face surveys are likely in the order of $350 plus per household and a 15-day GPS data would cost around $300 per household. The ongoing Perth Area Travel Household Survey (PATHS) is expected to cost 7 million dollars.

As an alternative, transport planners in smaller urban areas that do not have the resources to invest in their own data collection exercises frequently, use datasets from other comparable jurisdictions to calibrate their TDMs. In many cases, the parameters of the TDM may be borrowed directly from established values reported in the literature. For example, the US National Cooperative Highway Research Program (NCHRP) has drafted a best-practices report on the calibration and validation of TDMs that includes procedures for transferring datasets across jurisdictions and recommended values for a subset of standard model parameters (See Cambridge Systematics, 2012).

This study will apply this methodology to recalibrate MASTEM. In particular, we will use household travel diary and transport cost skims from Melbourne, Brisbane and Perth in Australia and Auckland from New Zealand to update model parameters. Wherever possible, we will augment these datasets with additional information available through the Census and other datasets regularly collected by the Australian Bureau of Statistics (ABS) within South Australia, such as the Australian Census, the Motor Vehicle Census and the Road Freight Movements Survey as well as other Australian Government datasets such as Tourism Research Australia's. In some cases, model parameters have been updated based on established values reported in the literature. This approach will develop an efficient and cost-effective methodology for the calibration of strategic transport demand models in Greater Adelaide that does not rely on primary data collection methods.

To validate findings from the proposed approach for recalibrating MASTEM, a 1-day travel survey will be administered online and a sample of 500 respondents from the Greater Adelaide metropolitan area will be collected.

The current MASTEM is designed based on the traditional four-step travel demand model with the structure shown in Figure 1. It takes as input demographic, land use and transport network data for the Greater Adelaide metropolitan region, and it produces as output flows across the transport network. MASTEM comprises a series of sub-models – ten in total – that are used to generate the final output.

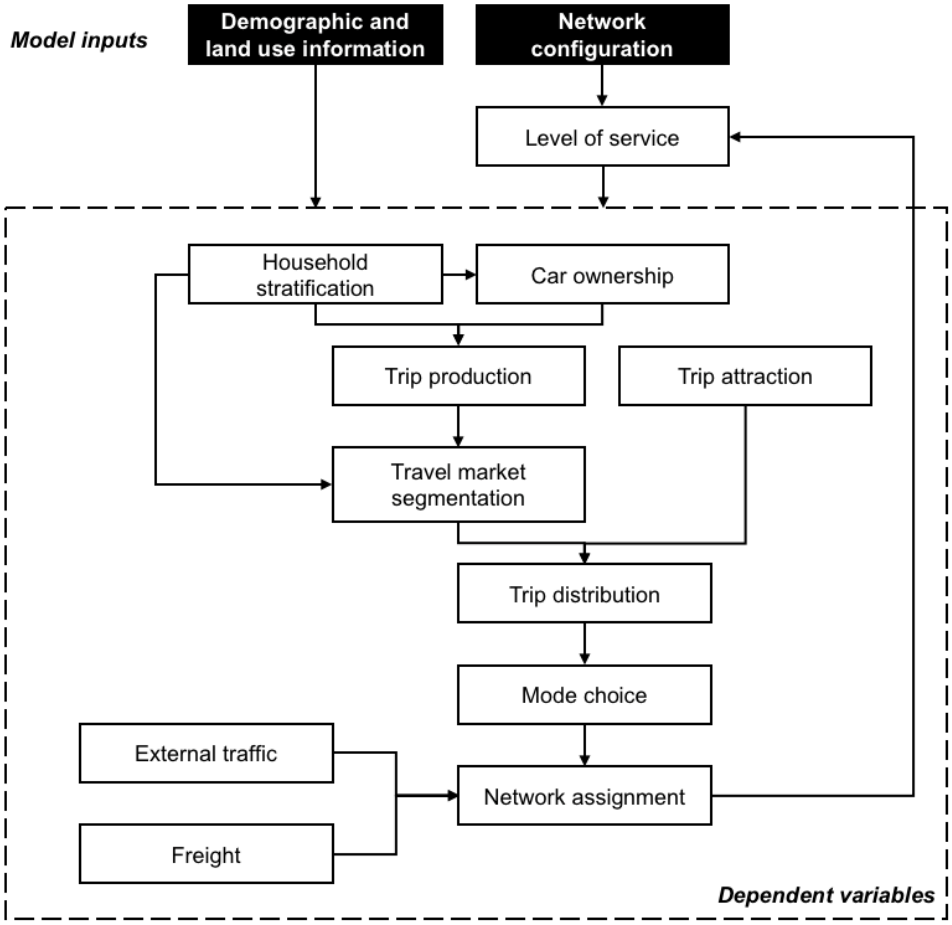

Figure 1: MASTEM model structure

3. Data

Figure 2 provides a snapshot of ways various data sources will be augmented to feed into different sub-models in MASTEM. The publicly available aggregated Census data will be used in household stratification, trip attraction, and travel market segmentation. Disaggregate ABS microdata - secured through the ABS DataLab – will be utilised in household stratification and car ownership sub-models. Other ABS datasets such as Average Weekly Earnings (AWE) and Road Freight Movement (RFM) will be employed in the network assignment and freight sub-models. Primary and secondary education enrolment data will be attained from the Australian Curriculum Assessment and Reporting Authority (ACARA) and higher education data will be obtained from the Australian Government Department of Education, Skills and Employment (DESE) and will be used in the trip attraction sub-model. Household travel diary, transport cost skims and transportation analysis zones (TAZ) will be obtained from the relative transport authorities in each jurisdiction. These datasets will be used to update model parameters in trip

production, attraction and distribution as well as travel market segmentation and mode choice sub-models. In addition to the AWE data, several other datasets will also be employed in the network assignment sub-model such as information from the survey of motor vehicles, data from Austroads, Australian Transport Assessment and planning (ATAP) and the Australian Institute of Petroleum (AIP). Data for external traffic sub-models will be extracted from the Tourism Research Australia dataset. Finally for the freight sub-model in addition to the RFM data, other records from CSIRO freight transit data and freight GPS tracking data are also considered to be applied.

The same model specifications that are currently used by MASTEM will be used to re-estimate new data from other jurisdictions separately. To recalibrate the MASTEM parameters for the Greater Adelaide area, it is proposed to average estimates for each parameter, discarding any outliers, and reweighting some parameters to adjust for differences between the Greater Adelaide area and the other jurisdictions using the primary data being collected for the Greater Adelaide area.

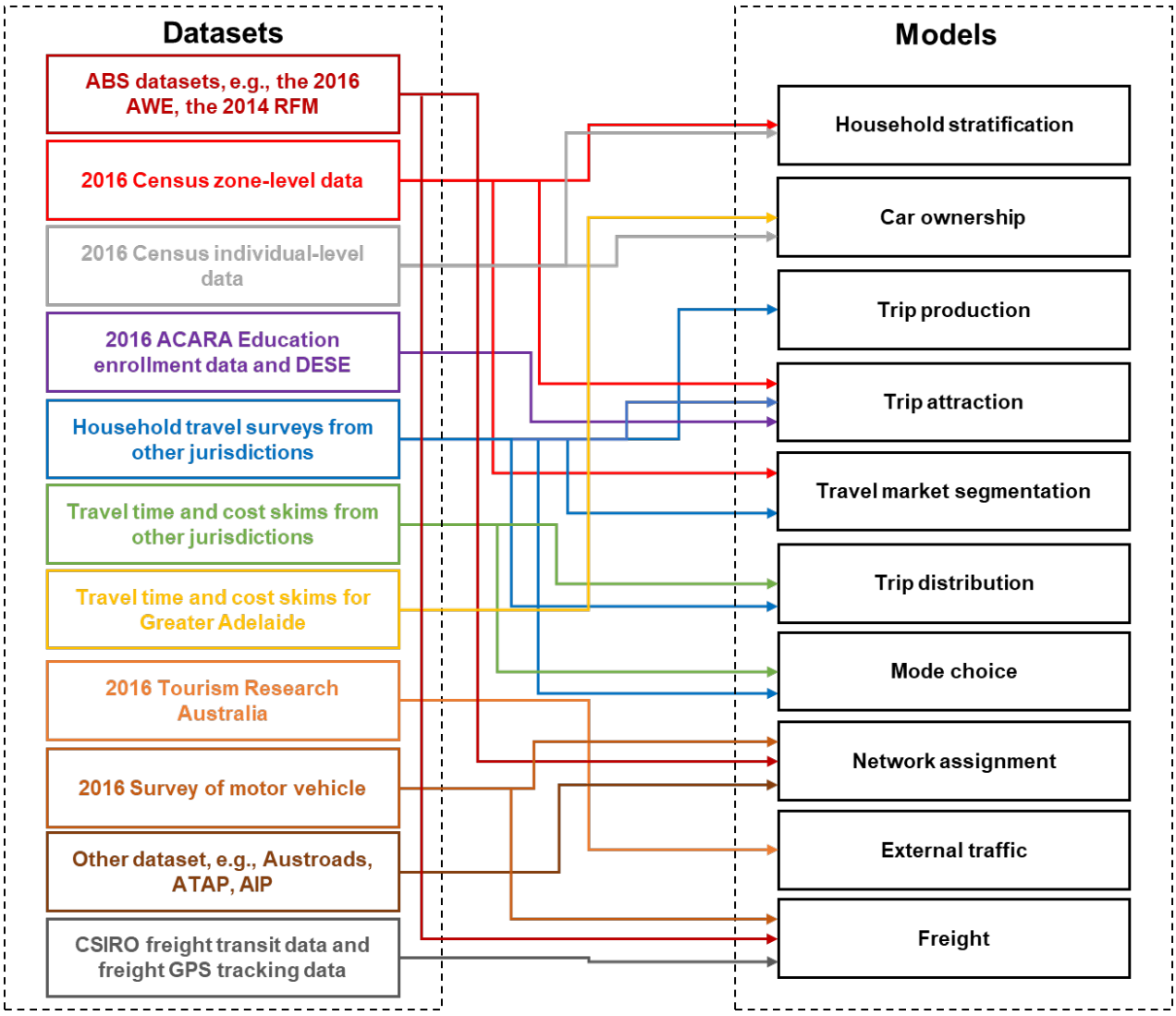

Figure 2: Datasets used for each sub-model

4. Discussion

This study is anticipated to develop and test an efficient and cost-effective methodology for the recalibration of the South Australian strategic transport demand model that does not rely on primary data collection methods. A 1-day travel diary survey will be administered online and a sample of 500 respondents from the Greater Adelaide metropolitan area will be collected to validate the approach.

The proposed methodology is expected to provide several significant benefits compared to the standard approach of collecting household travel surveys. The first benefit is it will significantly reduce the burden of data collection cost and governments do not require to build a case for the expenditures required to undertake the survey. A second benefit is that it will provides an opportunity for regional towns and cities that are not currently identifying, measuring and assessing their transport and travel demand in and around the area to adopt this approach and delivery effective planning policy and efficient transport infrastructure for their region. Finally, it will provide the means to recalibrate and update the travel demand models when new data is available for any of the disparate sources, unlike most HTS that required waiting for data to be collected at intervals of 5, 10 or even more years.

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