Technical Note on Recent Developments in Travel Behaviour Analysis

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ABSTRACT: The main objective of the paper is to present recent developments in travel behaviour analysis that appeared at the 2014 Transportation Research Board Annual Meeting in Washington, D.C. The technical note is conceived as a brief review of key presentations and posters dealing with innovative methods in the collection of travel behaviour data, particularly with topics of technological advances in travel behaviour surveys.

KEY WORDS: travel behaviour analysis, travel survey methods, GPS, TRB.

1 TRAVEL BEHAVIOUR RESEARCH AT TRB

TRB Annual Meeting in Washington, D.C. organized by Transportation Research Board of the National Academies is considered to be the largest world conference on transport. The latest annual meeting brought together nearly 12 000 transport professionals, who could choose from more than 4 500 presentations in nearly 800 sessions and workshops focused on a wide range of transport related issues.

The theme of travel behaviour has been in the focus of the Transportation Research Board since its formation in 1973. The Committee on Traveler Behavior and Values started with the promotion of research in the field of disaggregate demand modelling and behavioural models of travel demand. The committee was soon recognized as one of the most progressive and attractive among TRB committees in the sense of the number of papers submitted for each annual meeting (Stopher, 2012). This led to the formation of numerous subcommittees within which some became later full-fledged committees (e.g. survey methods subcommittee). Judging according to the number of papers submitted to TRB and the number of attendants at the committee meetings, the Committee on Traveler Behavior and Values remains, together with the Committee on Transportation Demand Forecasting, one of the most active committees within the TRB Section on Travel Analysis Methods. However, it should be mentioned that the research on travel behaviour still finds substantial support in activities of the Travel Survey Methods Committee and its subcommittees, particularly Household Travel Survey Subcommittee, New Technologies Subcommittee and Stated Response Surveys Subcommittee.

At the 2014 TRB Annual Meeting there were four hot topics that reflected recent technological developments and/or indicated actual need for more intensive research – automated vehicles, big data, extreme weather events and performance management. In the following sections we will focus particularly on the second topic – big data – that seems to be the most relevant for travel behaviour research.

2 RECENT ADVANCEMENTS IN TRAVEL BEHAVIOUR SURVEY METHODS

Travel behaviour surveys have remained for more than 50 years the main source of data for transport planning. Traditional surveys administered in countries all around the world still rely

on well tested methods of personal interviews, survey sampling and statistical inference. However, the problem of decreasing response rate (Atrostic & Burt, 1999) gives rise to doubts about their representativeness. Moreover, several studies showed that traditional approaches to travel surveys suffer from inaccuracies caused by limited abilities of respondents to recall details of their trips (Stopher et al., 2007) or errors done while filling in the questionnaire (Golob & Meurs, 1986).

First attempts to solve above mentioned deficiencies in travel behaviour surveys came along with wider spread of GPS based tracking devices (Guo & Poling, 1995; Murakami & Wagner, 1999) and GSM technologies (Draijer et al., 2000) in the late 1990s. Soon, GPS devices started to be used as a complement to ongoing traditional regional surveys (Bricka & Bhat, 2006) and their pilot use appeared also in national travel surveys in the UK and France (Rofique et al., 2011; Marchal & Pham, 2013). These studies confirmed that even passive tracking can significantly improve precision of time and spatial attributes of trips. On the other hand, it was also shown that the problem with a reliable mode and trip purpose classification still remains the main shortcoming of passive GPS tracking.

Unceasing interest in improvements of technology assisted passive travel surveys is also motivated by increasing occurrance of smartphones that are equipped with GPS and other sensors, and yet more and more frequent willingness of mobile phone operators to collaborate in research related to the use of residual GSM data stored in their data warehouses. Growing interest in the use of GPS devices in travel related surveys is also obvious in the number of papers submitted to TRB Annual Meeting. In 2010, 6.46% of papers presented at the TRB meeting contained words "GPS" and "survey", while in 2014 the number of such papers grew up to 7.77%, which corresponds with 20% increase. Research areas related to the use of GPS in travel surveys can be clustered into four groups – practical experience from data collection, data processing and data use. In the following text we will look closer at recent TRB papers related to each of these topics.

Practical experience from data collection using smartphones were presented in the paper titled "A Smartphone-based Travel Suvey Trial Conducted in Kumamoto, Japan: An Examination of Voluntary Participants' Attributes" (Maruyama et al., 2014). The authors focus on one of the most critical aspects of passive travel behaviour surveys – low response rate and sample representativeness. Only 97 participants out of 13 279 households selected for the survey agreed to participate. Although other studies found that the willingness to participate in GPS surveys is lower compared to traditional surveys using PAPI, CAPI or CATI methods, the response rate lower than 1% is unique. The authors compare descriptive statistics of the sample with descriptive statistics of respondents in a parallel PAPI survey and characteristics of the population to show that the sample structure is far from being representative, especially regarding the following attributes: age and gender. This finding confirms the need for deeper understanding of processes underlying low response rate and low representativeness of samples in passive travel behaviour surveys.

A closer look on motivation to participate in smartphone based survey was presented in the paper "Considering smartphones: User attitudes towards privacy and trust in location-aware applications" (Cottrill, 2014). The author shows that concerns about location privacy depend on the type of application used. The degree of trust concerns noted by the application users is the highest in case of transport related applications. On the other hand, social networking and mobile commerce application face a significantly lower degree of trust. The users also state that they do not trust application developers and administrators when they say that they are not selling their data or that they are not providing them to the government. She concludes that wider acceptance of passive tracking technologies may be enhanced "by developing of transparent and open models of data access, sharing, storage and use".

Data processing topic was covered by two papers that focused on the same issue – identification of trip attributes (transport mode and trip purpose) from GPS data. Feng and Timmermans (2014) compare seven classification algorithms for detection of a transport mode. The authors show that even a relatively small set of attribute variables (e.g. speed, distance to infrastructure, quality of GPS signal, transport mode ownership) can be used for precise

classification of transport mode, and that selection of proper attributes may be more important than the choice of a classification method.

Oliviera et al. (2014) compares two methods for classification of trip purpose, which is, comparing to transport mode classification, much more data demanding. The paper shows that procedures presented in the paper can lead to overall classification accuracy higher than 70% across all trip purposes and around 90% for the most common mandatory activities – work and school. These results confirm the increasing trend in accuracy of trip purpose classification algorithms. The authors also suggest several topics for further research that may bring these procedures closer to practitioners.

The topic of **data use** was presented by four papers. Alesiani et al. (2014) presented a disaggregate model of travel demand derived from publicly available data from communication and social networks. Wang et al. (2014) and Iqbal et al. (2014) presented potentials use of mobile phone data in travel behaviour studies, resp. for estimation of origin destination matrices that can be utilised for example for transport model validation. Finally, Hess et al. (2014) presented a methodically precise study on the use of GPS data for the estimation of route choice models for heavy goods vehicles.

3 CONCLUSION

2014 TRB Annual Meeting confirmed the trend in the use of big data for transport planning. This technical note provided a review of studies related to the use of big data, specifically mobile phone data, in travel behaviour analysis. It can be concluded that although there are still many issues to be solved, the day of a wider use of big data is closer year by year.

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