

## **TRANSPORT SURVEY DATA: WHAT IN THE WORLD IS HAPPENING?**

Martin E.H. Lee-Gosselin, Emeritus Professor, Université Laval, Québec,  
Eric J. Miller, Director, Cities Centre, University of Toronto  
Catherine Morency, Titulaire de la chaire MOBILITÉ,  
École Polytechnique de Montréal  
Matthew J. Roorda, Associate Professor, University of Toronto

Paper prepared for presentation at the \_\_\_\_\_ Session  
of the 2012 Conference of the Transportation Association of Canada  
Fredericton, New Brunswick

### **Abstract**

This paper provides a synopsis, from a Canadian perspective, of priorities, issues and trends from around the world that were discussed at the 9<sup>th</sup> International Conference on Transport Survey Methods in Chile in November 2011. The dominant contemporary issues that cut across 14 thematic workshops included: the maturing of new technological supports to transport surveys; the alignment of surveys with administrative data; cognitive and social processes affecting survey response, especially in surveys about potential behaviour; shifts in the total design of surveys; the data needs of integrated regional models; and survey designs addressing specific policy questions in passenger and freight transport.

These issues were discussed in the context of data collection's being an easy target for budget cuts, while public and private agencies are more and more dependent on decision-support systems using analysis tools and models that are relatively "data hungry". This last is not just a question of the quantity of data, but also of its quality and comprehensiveness, and of the inclusiveness of user groups that are reached by survey samples. Moreover, while metropolitan household travel surveys remain the "bread and butter" of urban transportation planning, a number of other types of survey on the past, current and anticipated behaviour of passenger and freight transport users have become increasingly valuable to decision-makers around the world. This trend was seen as particularly important to scoping shifts in the transport system, while maintaining comparable indicators of transport demand over long periods of time.

### **Acknowledgements**

The 2011 ISCTSC Conference was hosted with substantial financial and logistical support by and through the Complex Engineering Systems Institute of the Universidad de Chile, Chile. The co-chairs of the host committee were Prof. Marcela Munizaga, Universidad de Chile and Prof. Juan Antonio Carrasco, Universidad de Concepción. The conference co-chairs were Dr. Johanna Zmud, Rand Corporation, Washington DC, and Prof. Martin Lee-Gosselin, Université Laval, Québec, Canada. All four authors of this paper were actively involved in running the conference, one as co-chair, two as Workshops Chairs, and one as rapporteur. They are all members of a TAC consultant team investigating transport survey practices in Canada.

## 1. INTRODUCTION

The demand for data from surveys of transport users has become problematic in many countries. At a juncture when data collection is an easy target for budget cuts, public and private agencies are more and more dependent on decision-support systems using analysis tools and models that are relatively “data hungry”. This is not just a question of the quantity of data, but also of its quality and comprehensiveness, and of the inclusiveness of user groups that are reached by survey samples. Moreover, while metropolitan household travel surveys remain the “bread and butter” of urban transportation planning, international experience reveals that a number of other types of survey on the past, current and anticipated behaviour of passenger and freight transport users have become increasingly valuable to decision-makers. This trend is particularly important to scoping shifts in the transport system, while maintaining comparable indicators of transport demand over long periods of time.

To address questions of this type, about every three years ISCTSC, an elected board of specialists in transport survey methods from around the world<sup>1</sup>, organises an international conference to share current developments and identify, through thematic workshops, contemporary priorities for survey research to improve the state of the art. Two series of seven parallel workshops were held at the 9<sup>th</sup> International Conference in Chile in November 2011, which drew delegates from 25 countries<sup>2</sup>.

A detailed description of the conference is available at: <http://www.isctsc.cl/>, including definitions of the workshop themes, but the ground covered (see box) is worth noting, as

### **International Conference on Transport Survey Methods 2011: Workshop Themes**

- A1. Bringing Location-Aware Technologies into the Travel Survey Mainstream: Complement or Stand-Alone?
- A2. Cognitive and Decision Processes Underlying Engagement in Stated Response Surveys
- A3. Methods for Capturing Multi-Horizon Choices
- A4. Designing New Survey Interfaces and Front-End Software
- A5. Exploring and Merging Passive Public Transport Data Streams
- A6. Validating Shifts in the Total Design of Travel Surveys
- A7. Survey Methods to inform Policy: Environment, Energy, Climate, and Natural Disasters
- B1. Measuring the Influence of Attitudes and Perceptions
- B2. Longitudinal Methods: Overcoming Challenges and Exploiting Benefits
- B3. Post Processing of Spatio-Temporal Data
- B4. Comparative Research into Survey Methods
- B5. Multi method data collection to support integrated regional models
- B6. Alternative Approaches to Freight Surveys
- B7. Collecting Qualitative and Quantitative Data on the Social Context of Travel Behaviour

---

<sup>1</sup> The International Steering Committee for Travel Survey Conferences (ISCTSC)

<sup>2</sup> Previous conferences were held in Germany (1979), Australia (1983), USA (1990), UK (1996), Germany (1997), South Africa (2001), Costa Rica (2004) and France (2008).

these themes were not predetermined, but were derived from more than 140 extended abstracts that were submitted to the ISCTSC in response to the Call for Papers – almost double the number submitted to the previous conference. The themes are thus in themselves an expression of contemporary priorities from the international community of transport survey researchers, and of the lively current interest in the field.

This paper provides only a brief synopsis, from a Canadian perspective, of the priorities, issues and trends from around the world that were deliberated at the conference. A much more substantial account of the deliberations will be available in early 2013, as it has been the practice of the ISCTSC to produce a peer-reviewed post-conference publication, providing an in-depth view of each meeting. The most recent of these (1), (2), (3) have been books of around 700 pages, and a similar-sized volume is in progress for the Chile Conference.

The main part of the paper (Section 2) is organised into six subsections, followed by a brief summing-up (Section 3). Each of the subsections 2.1 to 2.6 discusses a priority cross-cutting issue that we observed from plenary report-outs made by workshop chairs and rapporteurs to have been of key importance in two or more of the 14 workshops. These issues were:

*The maturing of new technological supports to transport surveys, such as Web-based survey interfaces, mobility-aware loggers and smart phones, post-processing methods and interfaces;*

*The alignment of surveys with administrative data (such as transit monitoring or data from electronic fare and toll collection);*

*Cognitive and social processes affecting survey response, especially in surveys about potential behaviour;*

*Shifts in the total design of surveys, including the need for the simultaneous use of multiple methods to obtain usable data from all segments of the population, especially given the change in the marketplace for communications technologies;*

*The data needs of integrated regional models of transport, land-use and their effects on the environment and health;*

*The design of surveys addressing specific policy questions in passenger and freight transport, such as energy and environment effects, and the management of disaster situations.*

Of course, this does not comprise an exhaustive list of the issues of contemporary importance that came up in the conference discussions. But it reflects well current priorities for efforts to improve transport survey methods.

## 2. PRIORITY CROSS-CUTTING ISSUES IN TRANSPORT SURVEY METHODS

The conference organisers had adopted *scoping the future while staying on track* as their main focus. This recognised the need for balance, on one hand, between methodological innovation that keeps abreast of emerging phenomena and, on the other hand, protecting the comparability of survey results over time. Both support the transport policy decision process, but in a context where either or both of methodological opportunity and policy imperatives can drive the demand for data collection. At the beginning of the conference, three invited keynote addresses reviewed this context for transport survey methods from the government, private sector and academic perspectives<sup>3</sup>. Then, the workshops were charged (see box below) to examine the state of the art and identify survey research needs. They were assisted in this by three or four papers that had been selected for presentation in the first session of the workshop, and a varying number of related posters. Each of the fourteen workshops met four times for a total of six hours before reporting out to a plenary.

### Charge to workshops

Our theme for the conference is *scoping the future while staying on track*. We'd like you to develop findings related to this theme. The questions below may help.

- How would you describe the "current track" of your topic? Is it in continuity with the past? Or does it require a paradigm shift?
- What key issues do you see arising in the short term?
- What are the long-term trends?
- What research is needed to move the topic to its next milestone (or into the future)?

In presenting our observations about priority cross-cutting issue in the subsections that follow, it is important to note that the content of ISCTSC conference series is essentially *methodological*. While the series attempts to reflect the state of data collection needs, it is not primarily about policy alternatives or planning applications, for which other forums exist.

---

<sup>3</sup> The speakers were, respectively: Gloria Hutt, Deputy Minister of Transport and Telecommunications for Chile; Rob Sheldon, Managing Director, Accent Market Research, United Kingdom; and Kostas Goulias, Professor, University of California at Santa Barbara with Chandra Bhat, Professor, University of Texas at Austin

## 2.1 The maturing of new technological supports to transport surveys

The majority of new technological supports derive from developments in information and communications technologies (ICTs). The growth of interest in them has been substantial, not least because ICTs are, at the same time, objects of study for their effects on activities and travel, and a source of rapidly diffusing data collection technologies. Furthermore, the conceptual frameworks for the collection of travel behaviour data are being challenged as new needs emerge and some conventional survey practices, such as North America's heavy reliance on landline telephone sampling frames, are now falling short of expectations.

The discussions in many, if not all, workshops took technological supports into account, but these were a particular focus of those examining the mainstreaming of mobility-aware devices (such as GPS loggers, and locatable "smart" phones, tablet computers, etc.), the post-processing of spatio-temporal microdata, and the design of new survey interfaces, notably for Web-based surveys. In all three of those workshops, evidence was cited that the inertia of traditional survey design is strong enough that there is a tendency to "replicate the old methods with technology", rather than seek new designs that optimise the advantages of ICTs. This tendency is driven, in part, by the fear of rupture in the comparability over time of established repeated cross-sectional, continuous, or other longitudinal surveys.

An important counter-current was seen in the promise of using mobility-aware devices to observe travel behaviour over longer periods than are covered by most established travel surveys, which may extend to weeks rather than days. Indeed, a spectrum of observation periods can be envisaged, from multi-day travel surveys up to naturalistic studies of mobility lasting as much as a year or more – something that already exists for samples of vehicles. However, as discussed in (4), an advanced level of automatic interpretation of such passive monitoring, perhaps involving a software training phase, is required if observation periods are long, especially if the sampling unit is a person rather than a vehicle. Although much work is left to do, important strides are being made in areas such as automatic mode detection, and the interpretation of short dwell periods (including mode transfers). Interestingly, some of these strides are being made without the provision of ancillary data, such as GIS layers of road and transit network characteristics, a promising development for parts of the world where such data are incomplete, inaccurate or absent. By contrast, in the domain of Web-based survey methods, including the Web-based Prompted Recall (PR) techniques used in some GPS survey packages, linking to ancillary data seems to be enjoying a rapid growth in popularity. In part, this is because of the "democratisation" of geospatial data sources by facilities such as Google Maps™ and associated visualisation tools.

Support came from the workshops for observing at least seven days of travel in mainstream surveys. Some of the improvements in what might be called "intelligent passive" observation show promise for reducing the respondent burden associated with

seven-day diary methods, while the major use of Web-based tools in such surveys may possibly shift from validation (PR) to keeping respondents engaged and interested.

Notwithstanding these rather optimistic readings, numerous indications of immaturity in technology-based travel surveys were also cited. One indication was a debate over the new classes of selection bias and response bias associated with such surveys, including a sub-debate over technology-aided recruitment, notably the use of social networks to implement “snowball sampling”. Another indication was concern over the lack of standardisation in the interpretation of vast quantities of microdata, obtained as often as once per second from GPS devices and linked sensors such as accelerometers. A third indication was the call for the development of survey-specific firmware on mobility-aware devices to improve processing that is intelligent and, it was hoped, standardised. A fourth was the need to “stay ahead of the game” of protecting the confidentiality of data on personal mobility.

It is probably fair to say that a majority of the international transport survey methods community assume that advanced technological supports will play an inevitably increasing role in the next 5-10 years, especially in surveys of personal travel, and that they may well transform some stages of the data collection “supply chain” radically. However, this is welcome only if quality is achieved at every stage, as has been the preoccupation of methodologists for the past two decades (5). A related finding, by no means limited to technological aids, was the urgent need to increase the rigorous field-testing of new methods and techniques, seeking the viewpoints and perceptions of respondents, analysts and survey designers alike.

## **2.2 The alignment of surveys with administrative data**

In this context, surveys include not only the “bread and butter” household multi-mode travel surveys but also a variety of intercept surveys that are typically single-mode, such as roadside screen-line and cordon surveys, on-board surveys on buses, tramways and trains, and terminal surveys: such surveys typically include questions on the travel in progress and travel habits, and may include “market” research such as satisfaction with existing services and choices among hypothetical alternatives. Administrative data is, or could be, assembled from “passive” sources such as fare systems, on-line travel planners, network inventories, road toll systems, parking systems, shared vehicle systems or even financial transactions. An emerging area of methods concerns the eventual fusion of a wide range of survey and administrative data, which had been the subject of a workshop in the preceding conference in the series (6). The 2011 discussions had a broad upstream focus: this was the *complementarity* and the intentional alignment of data sources, for example through the progressive harmonisation of temporal and spatial data structures. Such alignment would create a common ground for aggregate-to-aggregate comparisons, and could lay the groundwork for data fusion at a later stage. This is a vast subject, and the main arena chosen for the 2011 discussions was that of public transport, although the workshop on the post processing of spatio-temporal data faced this issue as well.

The availability of large data sets from passive public transport data streams such as smart cards, web-based services, and simplified count techniques, provides particularly interesting opportunities to gather information about the demand and performance of public transport systems. In many cases, alignment among different administrative data sets was identified as a valuable first step in exploiting those opportunities before attempting to align these data with surveys.

The keynote paper delivered by Goulias and Bhat (7) concerned the data requirements of emerging large-scale microsimulation model platforms. It included an unabashed exploration of a “data collection paradise” that inspired a number of workshops to do the same. In the case of the workshop on exploiting and merging passive public transport data streams, the participants focussed on an ideal smart card system, including some features that do not yet (and may never) exist. The smart card paradise would issue every individual who travels with a single, non-transferable card (or a smart phone application that also keeps a continuous stream of waypoints) that can be used to pay for and give access to, and egress from, all transport-related services regardless of mode, and would even unlock the door at the user’s work location. The system in which this card/app operates would have advanced vehicle location and passenger counting capabilities, and would perform a number of types of data validation faultlessly, including through regular interactive surveys of users. Among other benefits, this would allow the continuous estimation of Origin-Destinations matrices without alighting stop imputation, and the continuous estimation of performance indicators. For the analysis of activity/travel behaviour, the card/app would be linkable to other data such as key socio-demographic variables and the user’s home location. Finally, highly trained professionals would integrate all the resulting data at the regional level and ensure it is used to support transportation planning decisions.

Like many such “blue sky” exercises, the smart card paradise hinted at novel solutions, in this case, new kinds of data architectures, and new types of interactions between public regulators, operators, researchers and users. It also helped sort out nearer-term and longer-term priorities for aligning and merging data. Nearer term priorities included better validation of methodologies (e.g. for quality control or imputation), the generalisation of performance indicators, and the comprehensiveness of integrated data on urban dynamics. In the longer term, the priorities included serious reflection and research on establishing the most appropriate and effective role for passive data streams in the general data collection framework, and on the implications for integrated regional modelling platforms. It was pointed out that researchers and planners may be on unfamiliar ground when confronted with near-universe sets of continuous data as opposed to sampled data that is usually sporadically collected, but that this could encourage the emergence of more dynamic models of the transport system. Finally, the range and quality of synoptic information available for use by both planners and individuals in such an ideal situation would bring some of the aspirations of the ITS industry closer to reality.

### 2.3 Cognitive and social processes affecting survey response, especially in surveys about potential behaviour

Surveys sometimes fail to meet expectations because respondents are disinterested or disengaged. This can be easy to explain. For example, respondents are often expected to distinguish between genuine telephone surveys and sales calls that are disguised as surveys. Having been deceived once, a respondent may refuse to answer any call that announces their selection to participate in a survey. In other circumstances, respondents may have accepted to take part in a survey, and be totally convinced of its bona fide, but their pattern of responses defies any reasonable logic, and this may (or may not) indicate disengagement with the survey task. This is particularly problematic in stated response (SR) surveys, i.e. those used to assess expected behaviour in hypothetical situations, and especially those employing Stated Choice experiments in which respondents are expected to trade off alternatives whose attributes (e.g. travel time, travel cost, comfort, etc) are varied in accordance with an experimental design. Apparent disengagement may manifest itself in a variety of ways, such as over-rapid responses to questions that require some deliberation, high levels of incomplete responses, or unlikely patterns of responses. For example, is a respondent who simply picks the cheapest alternative in every question telling us he is bored, that he didn't understand the instructions, or that he uses that simple heuristic to make choices in real life? Although these problems have been long been discussed in relation to decision theory (e.g. see (8)), we picked this issue as a priority because, recently, survey designers are increasingly looking for tools to explain dubious response patterns and modify survey designs accordingly.

This is in fact quite a complex problem area, and it was addressed in the conference in two ways.

The first way was through a workshop that dealt specifically with cognitive processes underlying disengagement in SR surveys. It concluded that a sweeping assumption that any inexplicable response patterns simply replicates the respondents real-life approach to decision-making, tempting as it may be, does not survive serious scrutiny. A series of experiments were recommended to improve the detection of low engagement with the SR survey tasks, including background logging of response times and patterns in the case of computerised choice experiments, to identify causes of low engagement, and to explore correlates of those causes with personal and contextual characteristics.

The second way was via the exploration of the role of social processes as part of the agenda of a workshop on qualitative and quantitative observations of the social context of travel behaviour. Much of the discussion revolved around an iterative procedure in which qualitative data provides relatively simple stories that explain quantitative findings and leads to a more complex analytical understanding. But this procedure also throws light on the social context of responses to surveys. This is because possibly the greatest challenge to instrument designers is dealing with *framing*, which translates to the context that respondents assume is "behind" the questions posed. Once again, this is particularly problematic for SR surveys, especially if some of the hypothetical behaviours are perceived to be socially desirable or undesirable.



## 2.4 Shifts in the total design of surveys

The term “total design”, originally coined by survey methodologist Don Dillman, implies quality at every stage of a survey from conception through to the archiving of the data collected. We also refer to these stages above as the data collection supply chain. The principles of total design apply to any class of survey, but the issue of a significant *shift* in total design refers most particularly to metropolitan household travel surveys, which we noted in the introduction as the “bread and butter” of urban transportation planning.

In the United States, an important shift occurred in the mid 1990s. In a number of metropolitan areas, this was primarily the result of the adoption of changes in travel diary instruments, seeking higher quality and more complete travel data by focussing on the sequence of activities and trips, rather than treating trips in relative isolation. There were consequences for survey procedures, not least of which was the investment of greater effort in a smaller sample of households compared to earlier waves of the same survey. Interestingly, Canada did not follow this shift, and to this day most large metropolitan areas still use relatively attenuated instruments on very large samples, mostly reached by telephone.<sup>4</sup>

The current main source of change in metropolitan household travel surveys concerns sampling and contact, and was already mentioned in Section 2.1: the rapid evolution of the telecommunications marketplace. In the first place, landlines are no longer the preferred type of telephone service in many, especially younger, households who may use mobile phones for most local calls and VOI phone services for long-distance calls. Secondly, sampling frames of telephone numbers have increasingly loose geographical ties. This is a trend in most of the countries represented at the Chile Conference. The implications were discussed in workshops on total design, longitudinal (including continuous) surveys and comparative survey research. According to these discussions, no simple solution is available, even though, as discussed above, methods based on mobility-aware devices and the Web are expected to become much more commonplace in the next 5 to 10 years. At the same time, new impulsion has been given to the rigorous comparison of survey modes, and the elaboration of designs offering respondents a choice of survey mode as an option to increase the inclusion of hard-to-reach subpopulations.

## 2.5 The data needs of integrated regional models

In the past decade, integrated regional models of transport, land-use and their effects on the environment and health have grown in importance as planning decision support tools for metropolitan areas and states. Two workshops deliberated on the data inputs to such models. One looked at multi-method survey packages and the other at collecting data on

---

<sup>4</sup> The reasons for this difference between the US and Canada are not important here, but are discussed in a forthcoming TAC Project Report *Changing Practices in Data Collection on the Movement of People*, expected publication date early in 2013

the interaction between day-to-day tactical decisions (such as destination and travel mode) and longer-term strategic decisions (such as residence location or vehicle access). In addition the already cited keynote paper (7) was on a closely related topic.

One of the findings of the multi-method workshop was that transport and land-use models will be progressively embedded in a comprehensive system of integrated urban models that also includes population demographics, markets for education, jobs and houses, the demographics of firms, and flows of energy, water, waste and pollution. This will bring both challenges (e.g. the interoperability of data methods), and opportunities for the exchange of data.

These models are “data hungry”, but it is neither justifiable nor affordable to measure everything all the time. It was recommended by Goulias *et al* that a strategic design for efficient data collection be developed with a core household, person and base diary, accompanied by a rotation of a dozen or so more specialised “satellite” surveys of revealed activity/travel/scheduling behaviour, stated responses, in-depth explorations, vehicle tracking, residential and other event histories, etc. The overall design would seek an optimal balance between quantity, quality, comprehensiveness, and the inclusiveness of user groups. There are close links to the validation of shifts in the total design of household travel surveys and as with those shifts, important changes are anticipated in the coming 5 to 10 years.

## **2.6 Survey designs addressing specific policy questions in passenger and freight transport.**

It is in the context of specific policy questions that survey methodologists must often be at their most flexible and creative. As was discussed in a workshop on surveys on environmental topics (among them energy, climate change and natural disasters), and in another on alternative approaches to freight surveys, this is because they must usually please a diversity of organisational and political interests who may not share the same world view, and this in turn can lead to “mixed signals” about social desirability of policy options. Most surveys in this domain are needed for the evaluation of current or future interventions or policies, requiring a wide range of revealed behaviour and stated response methods. In some cases, data is directly sought on the attitudes of the public, and another workshop focussed specifically on this.

Much of the discussions centred on the most useful role for survey research in this context, a question not easily answered. Indeed, the “environmental” workshop observed that it was difficult to reconcile the research priorities identified by participants in the workshop who had a social science training with the priorities identified by those who were transport engineers, but noted that some progress on this had been made by the end of the workshop.

### 3. SUMMING UP

The authors observe from successive conferences in the ISCTSC series that differences in transport survey methods from around the world are slowly diminishing. For example, the recent developments and experiments in technology-aided surveys, including Web-based methods have widened a debate that not long ago was confined to the relative merits of personal interview, telephone interviews and postal questionnaires. All the major country players in that debate have been engaged in survey research that includes technologies. At the same time, the notion of “quality at every stage” has become orthodox.

Problems remain. Transport survey researchers are constantly seeking ways to improve response rates, which have declined in many countries. However, one of the central messages of the Chile Conference is that innovation, and the thorough testing of innovations should be our main preoccupation for the immediate future.

### References

1. BONNEL, P., LEE-GOSSELIN, M.E.H., ZMUD, J, & MADRE, J.-L. (Eds.) (2009): *Transport Survey Methods: Keeping Up with a Changing World*, Emerald, Bingley, 675pp.
2. STOPHER, P.R. & STECHER, C. (Eds.) (2006): *Travel Survey Methods: Quality and Future Directions*, Elsevier, Oxford
3. STOPHER, P.R. & JONES, P.M. (Eds) (2003): *Transport Survey Quality and Innovation*, Pergamon, Oxford
4. LEE-GOSSELIN, M.E.H., DOHERTY, S.T. & SHALABY, A. (2010): "Data collection on personal movement using mobile ICTs : old wine in new bottles?", in: WACHOWITZ, M. (Ed) : *Movement-Aware Applications for Sustainable Mobility*, IGI Global, pp 1-14
5. TRANSPORTATION RESEARCH BOARD (2008) (Lead authors: STOPHER, P. R. & ALSNIH, R.): *Standardized Procedures for Personal Travel Surveys*, NCHRP Report 571, National Cooperative Highway Research Program, Washington, D.C.
6. POLAK, J.W. & CORNELIS, E. (2009): Best Practices in Data Fusion: Synthesis of a Workshop, in: BONNEL, P., LEE-GOSSELIN, M.E.H., ZMUD, J, & MADRE, J.-L. (Eds.) (2009): *Transport Survey Methods: Keeping Up with a Changing World*, Emerald, Bingley, pp 613-620
7. GOULIAS, K., BHAT, C. & PENDYALA, R. (2011): Total Design Data Needs for the New Generation Large Scale Activity Microsimulation Models, Keynote address to the 9th International Conference on Transport Survey Methods, Termas de Puyehue, Chile
8. PAYNE, J.W., BETTMAN, J.R. AND JOHNSON, E.J. (1993): *The adaptive decision-maker*. Cambridge University Press,