Innovations in Travel Modeling: Accomplishments and Challenges for the Future

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It is useful and interesting to view the accomplishments of and future challenges for travel modeling over an extended time period. Thirty years is a natural period for me to consider as it goes back to the time of my doctoral studies at MIT. I had the good fortune to be one of a group of students who were intimately involved in travel behavior research at a point in time when substantial and important innovations were being made. It was a period of great excitement for all of us. We would often discuss potential advances to the models we were developing but recognized that the conceptual and computational challenges were beyond our and the professional community's ability to overcome in the then foreseeable future. The same phenomenon was a daily part of my experience during my years as a faculty member at Northwestern University. Students, faculty and practitioners at Northwestern and elsewhere had brilliant insights and ideas about model development only some of which could be implemented.

It is a testament to the creativity and commitment of many people working in the field that now, thirty years later, many of the ideas that we could only imagine at various points in the last thirty years have come into use as tools of research or practice in whole or part. These developments have occurred in three distinct but related aspects of travel modeling covering human behavior and its influence on the demand for travel, land use development and its relationship to activity locations and the performance of the transportation system. These developments were supported by major conceptual advances and the application of enhanced methodology including the increasing realism that could be incorporated in travel and related choice models, the application of duration models, adoption of activity (tour) based approaches to studying travel, widespread adoption of geo-coding of locations, simulation of both travel behavior and transportation system performance in both estimation and prediction and enormous advances in computational capabilities.

Model developers, both academicians and practitioners, sometimes working together, have adopted complex behavioral models, some of which can be estimated only by the use of the use of simulation methods, to more accurately reflect the underlying choice process of persons involved in travel and related activities. The activity approach to the travel and related choice of entire households taking account of interactions among household members, travel purposes, mode use and destinations as well as temporal effects is widely accepted as providing a better understanding of the complexity of human travel behavior and practical, if incomplete, models have been implemented in a variety of contexts. The complexity of person and vehicle movement through the course of the day at the microscopic level is represented using simulations that take account of driver responses to conditions and interactions among elements of the system taking account of network structure and service, random occurrences and temporal variation of demand. The importance of representing land use changes at a detailed level and taking account of interactions between land use and transportation; the representation of land use at a microscopic (parcel) level and the linkage of land use and travel through widespread implementation of GIS systems is increasingly used by researchers and practitioners. Finally, developments in these different areas represented by earlier presentations in this session: choice modeling, activity based analysis, dynamic traffic assignment and land use modeling have been linked together conceptually and have been applied in realistic contexts through extensive development and application of simulation tools.

These developments in travel models have been undertaken by teams of academics, researchers and practitioners, sometimes working in collaboration. Within each area of development different teams have taken distinct approaches that differ in terms of the methodology, model formulation or the problem components addressed. Different teams have undertaken different degrees of model validation and there has been limited assessment of the consistency of results across teams. Further, developments in different modeling areas have, to a large extent, been undertaken by different teams with different disciplinary backgrounds.

Despite these issues, there has been major research progress during this extended period due to at least two major sets of forces. One is the inherent curiosity of many researchers and practitioners; each one trying to better understand the fundamental operations of real world systems and finding ways to represent the underlying relationships in mathematical or other models. The other is the desire among decision makers to better understand the implications of major investment and operating decisions. This desire, which motivates many planners, has been intensified by federal and state legislation and the resolution of legal challenges to decisions taken based on historic modeling methods. Both of these forces are likely to continue into the future.

The development of travel models over the last thirty years has been overwhelming both in retrospect and from the perspective of one viewing the field from the 1970s yet many issues need to be resolved before widespread adoption of these new approaches is likely to be undertaken and the results widely adopted in decision-making. The challenge to implement our expanding ideas is equally or more overwhelming today than it was thirty years ago. Much has yet to be done to enhance, extend, validate and integrate the developments of the last thirty years so that they can be brought into practice in a realistic fashion that is understandable to and usable by practicing planners/engineers and is interpretable to the less technical people who ultimately are responsible for funding the developments and implementing the systems in applied decision-making.

These challenges fall into a number of major categories including:

- <u>Develop a fully integrated model system</u> that builds on advances in knowledge of human decision-making, patterns of development and the operation of transportation systems. This requires a dynamic link between short term travel behavior and system performance and a longer term dynamic link between these elements, jointly, and land use development. Careful representation of dynamic relationships is essential to the development of such integrated systems. This requires that travel behavior during the course of the day (and longer periods) and linkages between household members and, possibly, others be explicitly recognized. It also requires that system performance explicit account for changes in the demand for travel as well as variability in service performances over time and that the interaction between these systems recognize the existence of a continuing process of adjustment rather than a system equilibrium or even a dynamic system equilibrium. Similarly, the temporal pattern of land development and society’s adjustment to it should be considered explicitly.

- Develop and apply techniques for validation of model performance over time, across different groups in the community and between developed regions in terms of a wide range of behavioral and performance measures at different levels of detail. Such validation should demonstrate consistency with historical observations, reasonability of predictions and reasonable sensitivity to both policy and exogenous variables.

- Extend data collection procedures to include all important measures over a range of time periods for a large sample of households, transport facilities and land areas during common time periods.

- Develop institutional support both at the federal and state-local levels to provide funding for research, support for the training of urban/transportation planners and engineers of the future and adoption of advanced models in the larger, more complex regions.

- Develop techniques for summarizing critical measures of effectiveness so that the non-technical citizenry and decision-makers can understand and interpret the results of analysis designed to study specified problems.

Meeting these challenges will require considerable investing of financial and intellectual investment. I believe that the continuing curiosity of researchers and practitioners as well as the desire for improved decision-making support will provide the resources needed to make equally impressive and overwhelming contributions to our state of knowledge and model representation during the next thirty years.