UPGRADING

TRAVEL DEMAND FORECASTING CAPABILITIES

U.S. DOT TRAVEL MODEL IMPROVEMENT PROGRAM

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The passage of the Intermodal Surface Transportation Efficiency Act of 1991 and the Clean Air Act Amendments of 1990 intensified concern about the ability of travel-forecasting procedures to meet the requirements of these acts. Recent legal challenges by environmental activists to the efficacy of existing travel-forecasting models make this issue all the more urgent. Although some improvements have been made to these procedures, they are fundamentally the same as those originally developed in the early 1960s.

Current travel-forecasting models have shortcomings. These models were originally developed for long-range planning and forecasting on a regional scale, especially for highways. As the issues and requirements that must be addressed by traditional urban travel forecasting have changed and increased, the models have been adapted or extended to meet new demands. The capability of these procedures to define and estimate the impacts of alternatives to highway-capacity expansion is limited, and they do not reflect changes in the demographic diversity and development patterns of the nation, in transportation and telecommunications technologies, and in computer hardware and software. Factors such as the prevalence of two-worker and single-parent households, increases in vehicle ownership, the trend toward telecommuting and flexible work schedules, exurban growth, and rising immigration are influencing travel behavior and need to be taken into account in travel forecasting.

The quality and depth of planning vary from one metropolitan area to another because of the diversity and complexity of problems, resources, and technical capabilities. Planners must take full advantage of existing procedures where necessary; for example, by iterating back to land use distribution when it would significantly affect the estimates of impacts, or by recalculating capacity restraint to better estimate link speeds. Some metropolitan planners need to reestimate their models with more current data. To advance the state of modeling practice, an extensive program of technical assistance, training, and improved documentation of procedures is crucial.

Existing procedures can be upgraded with new capabilities. The conventional travel-forecasting process consists of four steps: trip generation, which determines the number of trips originating and terminating in each portion of a region; trip distribution, which determines where these trips are going; modal split, which determines the mode of travel; and traffic assignment, which determines the route of travel. Refinements and new techniques that have been developed on a pilot basis or to address specific concerns include procedures to estimate ridesharing and carpool demand, transportation demand measures, pricing options, and small-area planning. These procedures can be further developed and tested to make them more readily available to metropolitan planning agencies.

In the longer term, there is a considerable need to develop a new generation of travel-forecasting procedures. The various components of the existing conventional travel-forecasting process were developed separately and merged into an integrated system. It is time to build a new set of procedures, developed as an internally consistent approach, on the basis of what is now known and what is expected in the future.

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In 1993 the U.S. Department of Transportation and the Environmental Protection Agency established the Travel Model Improvement Program (TMIP) to improve the quality of passenger and freight travel-analysis procedures for federal, state, and local agencies. The program, funding for which has grown from $1.8 million to more than $5 million, pursues five tracks of activity: outreach, near-term improvements, long-term improvements, data needs, and land use.

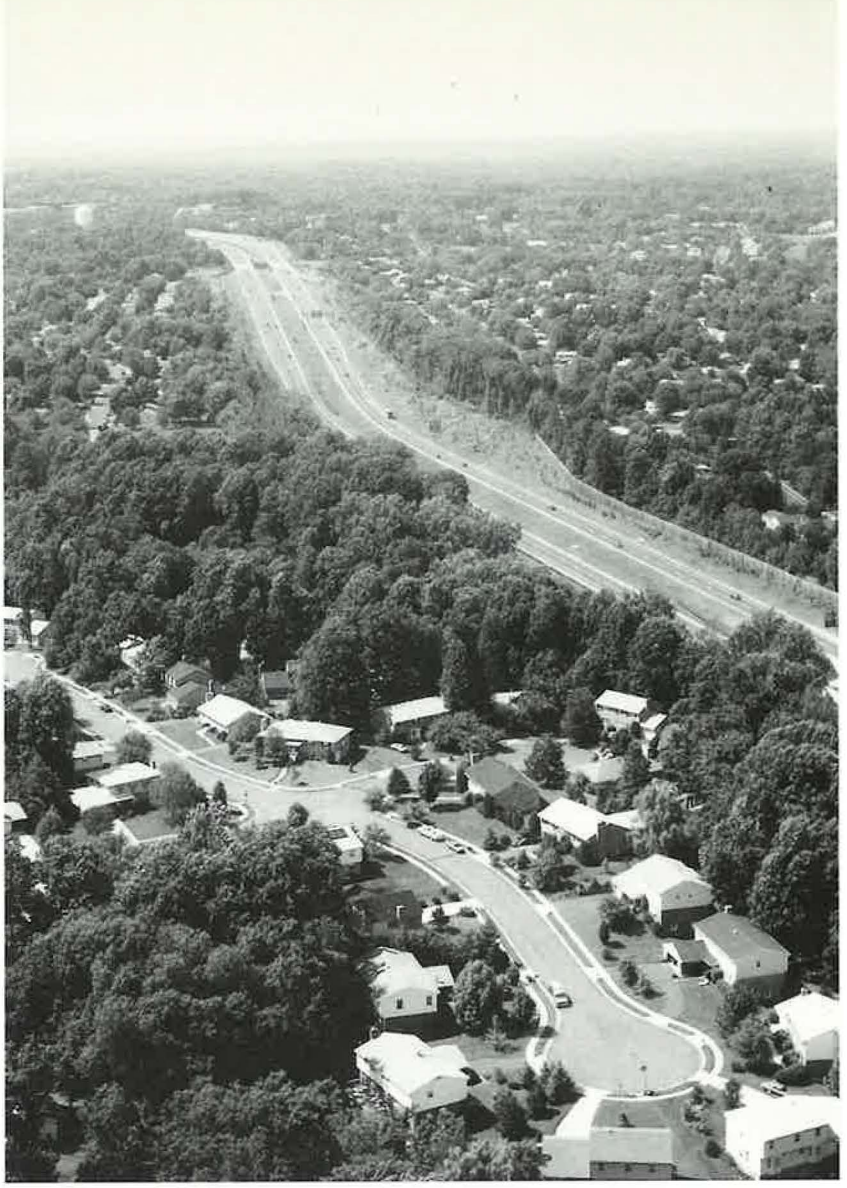
Track A: Outreach

Outreach for the Travel Model Improvement Program runs in two directions: receiving input from users and disseminating results. A review panel was established to represent the broad user community, including metropolitan planning organizations, state governments, environmental groups, developer interests, state air-quality agencies, transit operators, and academics. The panel provides feedback on how well the program is meeting its objectives and represents the program to various user groups. The panel meets two to three times a year, providing guidance on the program, recommending priorities, and occasionally specifying actions that should be taken.

To involve users on a broader basis, a series of conferences was initiated and a newsletter is currently produced. An annual conference presents program results, and specialized conferences deal with specific topics such as activity-based travel forecasting, urban design, telecommuting, and travel behavior. The third annual conference on the entire program will take place in December 1996.

An information clearinghouse has been established on the Internet to provide detailed technical reports on the latest travel-forecasting techniques. The clearinghouse contains publications on planning and travel forecasting from the Travel Model Improvement Program and other sources.

A training and technical assistance center is being established at the Texas Transportation Institute to train users in existing forecasting procedures, advanced procedures, and eventually the Transportation Analysis Simulation System (TRANSIMS), which is being developed at Los Alamos National Laboratory in New Mexico to substantially upgrade current models. Negotiations with other institutions are under way to expand the number of training sites and the scope of training. The eventual goal is for training activities to be self-supporting and to be located at several regional training centers around the nation.



Travel-forecasting models must be adapted to reflect dramatic shifts in U.S. development patterns and individual travel choices.

Track B: Near-Term Improvements

The best new techniques and approaches used in traditional travel forecasting need to be made more widely available to local planning agencies. Track B focuses on immediate improvements to the existing procedure for users to meet new legislative requirements in a timely manner.

Manuals of Practice

Several projects are designed to document planning practice and develop manuals to assist practioners. One such manual is *Short-Term Improvements to the Travel-Forecasting Process,* which documents modest improvements that can be made to existing processes, including data collection and analysis for nonmotorized travel, parking, and mode choice. Metropolitan planning organizations and other user groups have already tested these modifications.

Although most urban travel consists of passenger movement, commercial traffic is a significant variable that is often neglected in the forecasting

process or represented as a percentage of passenger travel. A freight data-collection guide, freight-forecasting guide, and training material are being prepared to address this area of concern.

Analysis of Forecasting Issues

Several projects are designed to analyze issues surrounding the use and performance of travel-forecasting procedures, and provide guidance to assist practioners in obtaining better forecasts. A critical issue facing planning agencies is consistency between travel times in the distribution process and in the assignment process. Methods of constructing feedback loops between these two steps within the four-step forecasting process are being investigated. The effect of the use or nonuse of feedback has been under debate in the estimation of changes in vehicle miles of travel (VMT) for new facilities. Results of this project indicate that although feedback loops do make a difference in travel estimates, the effect is not a consistent increase or decrease in VMT, but is more sensitive to each particular situation.

New Capabilities

New capabilities are being developed that can be incorporated into the conventional forecasting process by state and local agencies. ISTEA has identified peak-hour pricing and congestion pricing as policies that could be considered to address traffic congestion. Methods of handling tolls and user fees in the traditional travel-forecasting process involve converting cost to time, then performing an assignment with the cost as a fixed addition to the time penalty. In multicriteria assignment, time and cost are handled separately, and an equilibrium is reached that minimizes a combination of the two.

Through the Activity Mobility Simulator (AMOS), stated-preference surveys can be combined with activity-based analysis to estimate travel responses to transportation options more accurately. Activity analysis begins with the patterns of activities performed by households, from which travel requirements are derived. Stated-preference surveys collect data on how travelers say they would respond to hypothetical situations. Many policies currently under consideration, such as peak-hour pricing, represent a type of change with which there is no experience and which cannot be analyzed by simply extending current survey methods. AMOS is a practical approach to assessing new options for transportation demand management while providing a more accurate representation of traveler behavior than traditional trip-generation techniques.

Track C: Long-Term Improvements

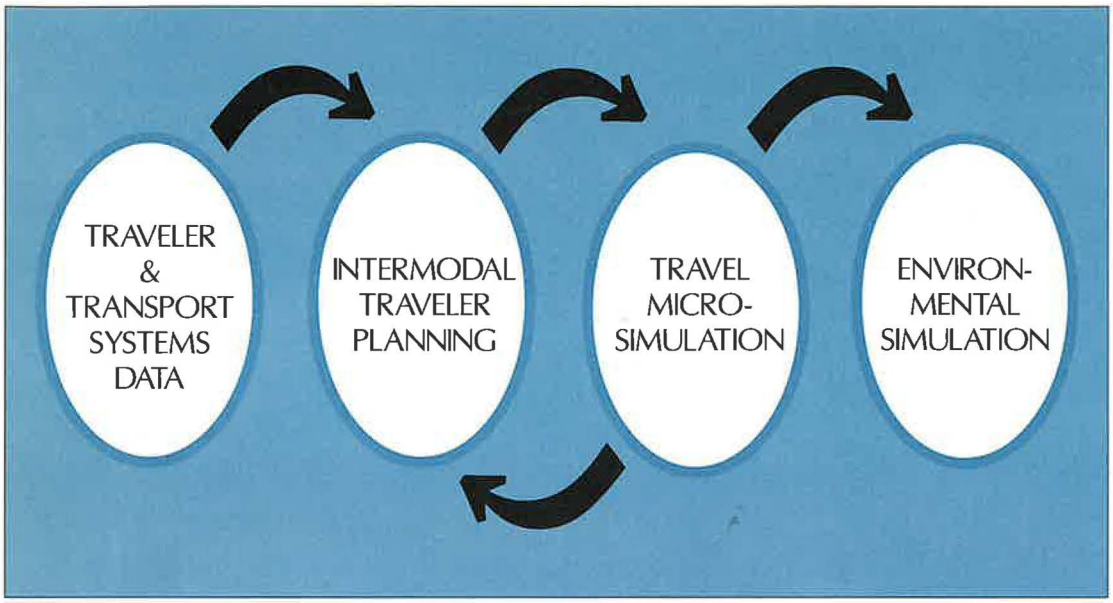
The development of TRANSIMS is a longer-term effort with the potential to substantially improve travel forecasting and impact assessment. This regionwide microsimulation procedure completely redesigns the forecasting process, simulating the behavior of households and individuals, as well as the operation of vehicles on the transportation network. Travel behavior can be modeled more effectively, and far more accurate air-quality estimates are possible than can be produced with current models.

Development of TRANSIMS began with a review of overall legislative requirements and the travel-forecasting needs of metropolitan planning organizations. After identifying objectives, a design for a forecasting process was specified to serve as the basis for the new model. The basic structure has four components: a population and activity estimator, a trip planner, a travel microsimulator, and an air-quality estimation module. These elements are supported by extensive data management and evaluation capabilities. The overall design is well integrated so that the input and output of each component fits smoothly with that of the others, and the variables are handled in a consistent manner throughout the analysis.

The model represents households, individuals within households, and individual travel plans. The population and activity module synthesizes household information from the U.S. Department of Commerce, Bureau of the Census. Activities are estimated for each individual, and travel plans for an entire day are developed from these estimates, reflecting the goals and constraints of each traveler. Alternative methods of estimating these data may be devised as development continues.

The travel microsimulator assigns the travel plans to the network, simulating individual travelers and vehicles. This process includes highway vehicles, public transportation, and freight movements. The result is a second-by-second, regionwide simulation of the entire network. To speed the computations, the microsimulation operates at low fidelity (few driver-decision rules, simplified network) over most of the region and at high fidelity (more complex decision rules and networks) on portions of the region of critical interest.

The air-quality estimation component is a modal-emissions model, which will accept operating data from the microsimulator on drive cycle, engine temperature, and other operating factors to



Basic structure of Transportation Analysis Simulation System.

produce a second-by-second profile of emissions. Atmospheric characteristics in dispersion and air chemistry models are added to obtain an overall estimate of ambient air quality.

An extensive data-management and evaluation component supports the analytical functions of TRANSIMS. The system's tracking operates on a continual basis over a 24-hour period. The large amount of data produced requires that a great deal of attention be paid to data-base design and presentation of results. An analyst's tool box is being developed to manage these data, providing techniques for users to extract information and summarize the data in useable formats for further analysis and evaluation.

The development plan calls for several intermediate operating capabilities (IOC) or field tests to be performed. The first test is under way at the North Central Texas Council of Governments and focuses on testing the traffic microsimulation component. Current planning calls for three additional IOC tests to assess the air-quality, trip-planner, and activity-estimation components. The entire package will be tested after these functions have been evaluated.

Track D: Data

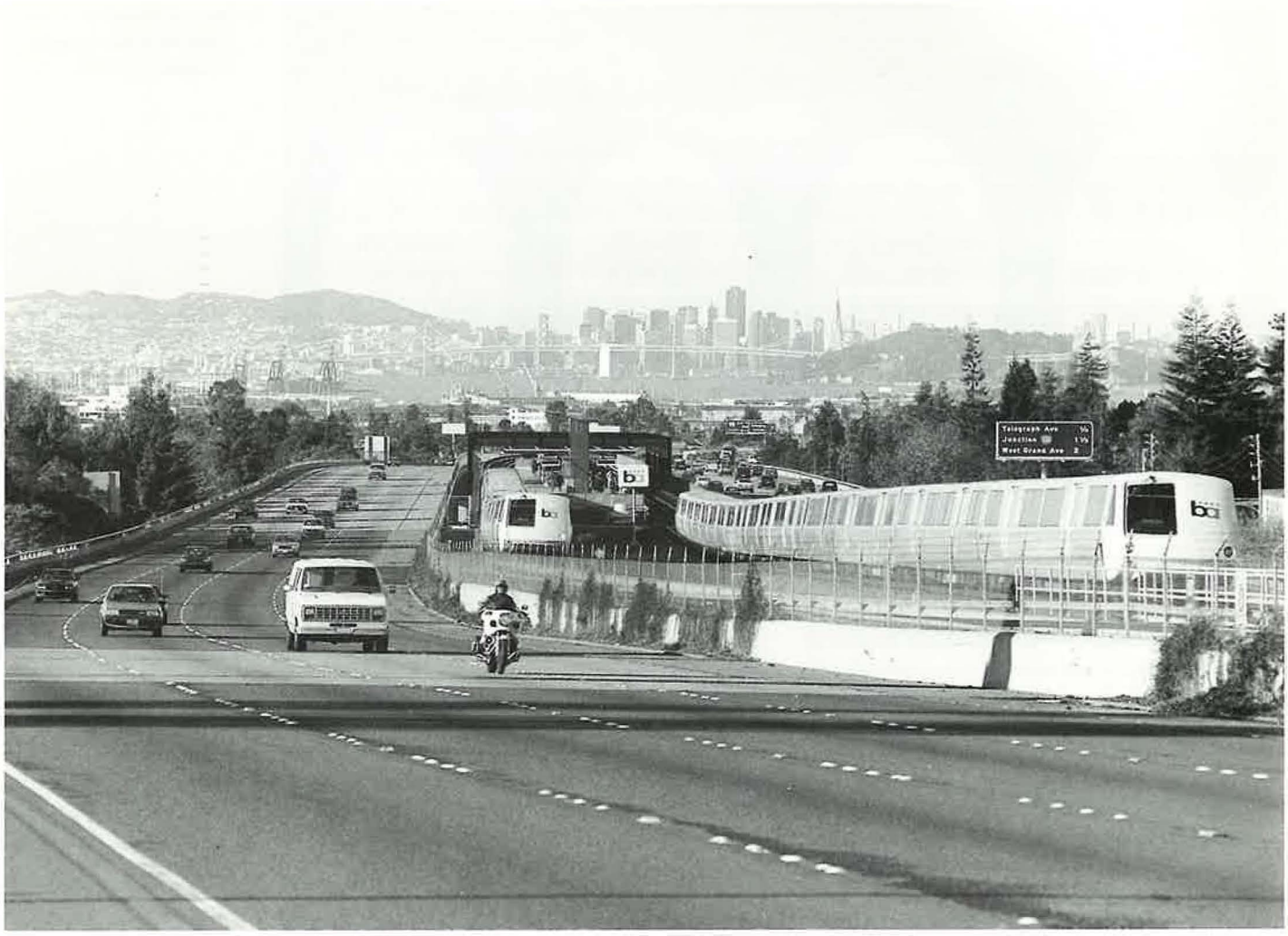
Data needs—both to support the upgrading of current methods and to develop new techniques—are addressed, with the goal of eventually producing guidance to change data-collection programs. Many areas are working with survey data that are more than 20 years old. New procedures will likely alter data needs and use, eliminating the need for some elements and requiring new elements. The first efforts assist regions in updating existing data and improving techniques for collecting new information.

Data collection has focused on quick-start projects in response to immediate data needs and the need to advance the state of the practice. Future directions for this track will shift to advancing the state of the art by examining what data are needed, the precision of data necessary for forecasting, and the sensitivity of travel forecasts to changes in input data.

New Manuals

More than 20 years have elapsed since the last definitive guidance was produced for states, metropolitan planning organizations, and others to use in considering, designing, and implementing travel surveys. *The Travel Survey Manual* provides extensive guidance for developing and implementing the seven most common types of travel surveys: household travel and activity, vehicle intercept and external station, transit on-board, commercial vehicle, workplace and establishment, special generator, and parking. Contemporary and anticipated models require more detailed information than ever before on travel characteristics and on individual travel choices. In addition, travel surveys have become much more complex than in the past, reflecting declining respondent cooperation, increasing analytical demands, and new survey technologies. The manual addresses these and many other important considerations in travel surveys.

No comprehensive manual of validation methods exists. Highway, transit, and combined modes are covered in a new manual that describes validation and the data necessary to support it.



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Increased attention to alternative modes places greater expectations on travel forecasters to anticipate mode choice changes.

Current Practice

Portland, Oregon, has a state-of-the-art program for data collection. The Portland survey instrument includes multiday activity diaries, in-home and out-of-home activities, full-week coverage, transit use, and all household members. Trip ends are geocoded to *x-y* coordinates for application within a geographic information system. Other relevant data bases (such as those on land use, parking, and building permits) are closely coordinated and integrated with survey data. A case study describes the entire data-collection program for transportation planning in the Portland region and chronicles the steps and decisions that shaped current data-collection activity. The documentation is designed to assist other regions in enhancing their data-collection programs.

The general state of the practice of travel surveys in the United States is assessed in a scan that identifies the types and frequency of surveys across the country and compares them with surveys in other countries. The degree to which state-of-the-art survey techniques are being put into practice is examined.

Track E: Land Use

Both ISTEA and CAAA require that land use and transportation become more integrated in the planning process. The best existing land use models in the United States are more than 20 years old. Proponents of neotraditional development claim that effective urban design can reduce single-occupant vehicle travel and perhaps total trip making, but no tools are available to estimate specific effects.

Transportation planners realize that effective transportation planning requires an understanding of the location of demand, or land use, and that changes in transportation can affect the location of demand. Many local governments use trip-reduction ordinances and land use zoning to help manage congestion. Yet the land use–transportation connection is probably one of the

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weakest links in the transportation planning process. The projects in the land use track are oriented toward providing immediate support in data collection, analytical techniques, and integration of land use planning with transportation planning. The level of effort in this track is relatively modest compared with the necessity to substantially upgrade land use forecasting procedures and will need to be increased in the future.

Feedback Between Transportation and Land Use

Interaction between land use and transportation-forecasting procedures ensures consistency between the two; for example, that decisions about where housing will be needed are arrived at on the basis of congested travel time instead of free-flow time. The Travel Model Improvement Program is addressing the conditions under which this feedback makes a difference in travel estimates, methods of providing for this interaction, and the likely changes its inclusion will make in forecasts. Preliminary results indicate that in congested areas, feedback does make a difference but that it is impossible to determine in advance what the effect will be.

Land Use and Demand Management

Claims have often been made that site design significantly affects travel and mode choice and that changing site design is a viable method for managing transportation. The Travel Model Improvement Program collected data on urban design from more than 300 activity centers in the Los Angeles area and correlated them with data on ridesharing and transit use. The result is a report on the relationship of urban design to trip-making behavior, in which a clear, although modest, relationship is established between pedestrian-friendly urban design and willingness to carpool or use transit.

Land Use Forecasting Case Studies

The Travel Model Improvement Program is documenting examples of current land use forecasting techniques in the United States, including land use forecasting models, expert panels, and combinations of the two. Data bases prepared to support land use planning and geographic information systems for data management are also being documented.

Future Directions

The Travel Model Improvement Program is still evolving. During its early phase the focus was on designing and setting a general direction. About two years ago the focus began to shift toward product development and testing. The program, which has involved the user community and structured itself to meet both near-term and long-term needs, will continue to be oriented toward meeting the needs of state governments and metropolitan planning organizations. In the future, its primary emphasis will be on product delivery and implementation.

The Internet address for the Travel Model Improvement Program information clearinghouse is http://tmip.tamu.edu. To receive the TMIP newsletter, contact Lynette Engelke at the Texas Transportation Institute, 1600 Lamar Boulevard, Suite 112, Arlington, Texas 76011 (telephone 817-277-5503).