TRANSPORTATION STATISTICS BEYOND ISTEA

PB98-157951

critical gaps and strategic responses

REPRODUCED BY: NTIS
U.S. Department of Commerce
National Technical Information Service
Springfield, Virginia 22161

Bureau of Transportation Statistics US Department of Transportation

TRANSPORTATION STATISTICS BEYOND ISTEA

critical gaps and strategic responses

Bureau of Transportation Statistics US Department of Transportation

About the Bureau of Transportation Statistics

The Bureau of Transportation Statistics (BTS) was established by the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. As the newest operating administration of the U.S. Department of Transportation, the BTS mission is to compile, analyze, and make accessible information about the nation's transportation systems; collect information on intermodal transportation and other areas as needed; and enhance the quality and effectiveness of the Department's programs through research, the development of guidelines, and the promotion of improvements in data acquisition and use.

Bureau of Transportation Statistics products are available from:

Customer Service
Bureau of Transportation Statistics
U.S. Department of Transportation
400 7th Street, SW, Room 3430
Washington, DC 20590

phone	202.366.DATA
fax	202.366.3640
email	orders@bts.gov
statistics by phone	800.853.1351
statistics by email	statistics@bts.gov
fax-on-demand	800.671.8012

All material contained in this report is in the public domain and may be used and reprinted without special permission; citation as to source is required.

Recommended citation: U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation Statistics Beyond ISTEA: Critical Gaps and Strategic Responses,* BTS98-A-01 (Washington, DC: January 1998).

TABLE OF CONTENTS

Critical Gaps in Transportation Statistics 2
Flows of People, Goods, and Vehicles 2
The Transportation System 6
Economic Dimensions of Transportation 9
Transportation Safety 11
Transportation Energy Use 13
Transportation and the Environment 13

State and Local Perspectives 15

Changing Sources of Transportation Data 17

Strategic Responses 19
Understanding Transportation in a Globalized Economy 19
Partnerships for More Effective Information 19
Performance Indicators 21

The Bottom Line 21

Box
Box 1. Expanding the Role of the National Transportation Library 20

Tables
Table 1. Freight Transportation: Selected Data Needs 4
Table 2. Passenger Travel: Selected Data Needs 7
Table 3. Vehicles and Vehicle Use: Selected Data Needs 8
Table 4. Selected State and Local Data Needs 16

US Department of Transportation

Rodney E. Slater
Secretary

Mortimer L. Downey
Deputy Secretary

Bureau of Transportation Statistics

T.R. Lakshmanan
Director

Robert A. Knisely
Deputy Director

Rolf R. Schmitt
Associate Director for Transportation Studies

Philip N. Fulton
Associate Director for Statistical Programs and Services

Principal Authors
Rolf R. Schmitt
Wendell Fletcher
Joanne Sedor

Editor
Marsha Fenn

Reviewers
Felix Ammah-Tagoe
Audrey Buyrn
Russell Capelle
Ronald Duych
John Fuller
Xiaoli Han
William Mallett
Wende O'Neill
Alan Pisarski
Lisa Randall
Basav Sen
Bruce Spear
Robert Zarnetske

Other Contributors
Lillian Chapman
Selena Giesecke

Cover Design
Susan Hoffmeyer

Layout and Production
Gardner Smith
OmniDigital, Inc.

Transportation Statistics Beyond ISTEA: Critical Gaps and Strategic Responses

The United States depends on a large and complex transportation system to unite its citizens, enable economic activity, and connect even the smallest town to the rest of the world. Transportation comprises 11 percent of the nation's Gross Domestic Product, and makes up one-fifth of the typical American household's expenditures. Close to $800 billion was spent in 1995 on transportation, including nearly $140 billion in expenditures by the public sector, of which about 40 percent were federal civilian and military direct expenditures and grants.

The effectiveness and efficiency of transportation relies heavily on sound information. Each day, governments, businesses, and consumers make countless decisions about where to go and how to get there, what to ship and which transportation modes to use, and where to locate facilities and make investments. Transportation constantly responds to external forces such as shifting markets, changing demographics, safety concerns, weather conditions, energy and environmental constraints, and national defense requirements. Good decisions require having the right information in the right form at the right time.

In the years prior to passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991,[1] the quality and quantity of transportation data had reached a low ebb. Many federal data-collection programs had come to an end or had been pared back, reflecting increased costs of traditional methods of data collection, shrinking budgets, and curtailed reporting requirements brought about by economic deregulation. Neither the private sector nor state and local governments filled the data void.[2]

In response to the growing information gap, ISTEA resurrected several key data-collection programs, created the Bureau of Transportation Statistics (BTS), and required BTS to identify information needs on an ongoing basis. This report summarizes key transportation information needs based on the Bureau's experience in responding to requests for statistics from decisionmakers, and on surveys, research, and conferences that BTS has held or co-sponsored with other organizations.

The reauthorization of ISTEA provides an opportunity to reinforce the usefulness of the benchmark data programs established in 1991, expand those programs where warranted to address emerging critical issues, develop approaches for less burdensome data collection, and renew efforts to enhance the organization and sharing of information through the National Transportation Library. These elements, which are contained in the Administration's surface transportation reauthorization bill, are discussed in the Strategic Responses section of this report.

[1] Public Law 102-240, 105 Stat. 1914 (1991).

[2] U.S. Department of Transportation, *Moving America: New Directions, New Opportunities. Statement of National Transportation Policy Strategies for Action* (Washington, DC: February 1990), p. 112.

CRITICAL GAPS IN TRANSPORTATION STATISTICS

ISTEA responded to the most pressing data gaps identified at the end of the 1980s: the volume and geography of freight and passenger flows, the location and connectivity of transportation facilities, and transportation spending throughout the economy. Since ISTEA, through the Commodity Flow Survey, the American Travel Survey, the National Transportation Atlas Database, the Transportation Satellite Account, and the integration and interpretation of data from those programs in the *Transportation Statistics Annual Report*, BTS and its partners have provided insights on patterns of transportation activity and on the functions served by transportation. These insights are essential for understanding transportation markets, consequences, and investment needs. They are also important to public and private entities concerned with economic development, social issues, and the environment.

ISTEA provided a good starting point for meeting key information needs of the transportation community, but critical challenges remain. These challenges can be highlighted by three questions:

- Do we have statistics on the right subjects?
- Are the statistics reliable and accurate?
- Are the statistics understandable and accessible for decisionmaking?

These questions go beyond simple comparisons of existing data sets with a list of topics for which information is desired—the traditional view of a data gap. Data gaps also arise when statistics fail to be relevant, usable, accurate, complete, valid, or timely.

The topics covered by ISTEA-funded information programs are still relevant. The speed of technological, economic, and social change, however, increases pressure for more timely data. Furthermore, decisionmakers are demanding greater geographic and demographic specificity to deal with emerging issues such as connecting former welfare recipients with jobs.

There is also increased demand for information on the cost, speed, and reliability of transportation, on intermodal connections and the condition of transportation facilities and services, and on the relationships between transportation and land use. These demands result from the continuing geographic dispersion of communities and work places, and reflect pressures to increase economic efficiency and accelerate product development and distribution through transportation. In addition, post-ISTEA pressures on the public sector for increased accountability, most notably through the Government Performance and Results Act of 1993,[3] are creating demands for information on the performance of the transportation system and for methods to determine how transportation performance is affected by government programs.

The complete picture of the transportation system and its consequences requires effective information on the flows of people, goods, and vehicles; the facilities and services that carry those flows; and the economic, safety, energy, and environmental consequences of transportation. The specific information gaps for each of these topics are described below.

Flows of People, Goods, and Vehicles

Information on freight activity, passenger travel, and vehicle use is basic for understanding the demand for transportation facilities and services, energy use, sources of transportation revenues, exposure to safety risks, and environmental concerns.

[3] Public Law 103-62, 107 Stat. 286 (1993).

Freight Activity

More than 6 million business establishments in the United States rely on the nation's transportation system to engage in local and interstate commerce and international trade. Although much information exists about freight activity, important data gaps are apparent, as discussed below and summarized in table 1.

To gain information about domestic freight activity, BTS and the Census Bureau undertook the Commodity Flow Survey (CFS) in 1993 and 1997.[4] The CFS provides information on the value, weight, mode, and distance that commodities were shipped by manufacturing, mining, wholesale trade, and selected retail and service industries. The CFS is the only source of nationwide data on the movement of goods from origin to destination by all modes and intermodal combinations (not just terminal-to-terminal moves), and on the geography of commodity movements by truck. The CFS covers both local and intercity freight shipments by for-hire and shipper-owned transportation services. Although the CFS greatly improved our knowledge of domestic freight activities, that knowledge continues to be incomplete. The survey was unable to cover establishments involved in farming, forestry, fishing, construction, and crude petroleum production; households; governments; foreign establishments; and most retail and service businesses.[5] To keep from becoming too burdensome, the CFS does not collect needed national-level information about shipment frequency, travel time from origin to destination, and shipment cost. Since the CFS covers shipments sent rather than received, it covers exports but not imports.

International Freight. Because of dramatic growth in international freight movement and expanding competition between transportation service providers throughout North America, information about the domestic transportation of commodities traded internationally has become increasingly critical to transportation decisionmakers. Limitations of current data sets make it difficult to identify the location, mode, and other transportation characteristics of U.S. imports and exports.

U.S. foreign trade data traditionally have been oriented toward economic transactions rather than physical transportation flows. For example, the Transborder Surface Freight Data, processed for BTS by the Census Bureau, provide information on shipments between the United States and Mexico and the United States and Canada based on trade data filed at Customs Service districts and ports. The location is often misrepresented because trade documents are not always filed where shipments physically cross the border. Intermodal shipments are poorly represented in foreign trade data, because the mode of transport is recorded as the mode upon entry or exit via a Customs port. The domestic leg of the shipment journey (i.e., point of origin to port of export) does not necessarily use the same mode, especially through maritime ports.

Another critical constraint of foreign trade data is the inconsistent availability of shipment weight for surface exports. Having accurate shipment weight, however, is fundamental for estimating and forecasting how international trade impacts domestic transportation infrastructure.

In the mid-1970s, the Census Bureau conducted surveys to address foreign trade data limitations for transportation purposes. Through these surveys, more reliable data were collected on the inland destinations of imports and the

[4] The Federal Highway Administration was a major contributor to the 1993 CFS; work started before BTS began operations.

[5] The national totals for some industries not covered were estimated by Oak Ridge National Laboratory from other data sources. Efforts to estimate state and regional values have been less successful.

Table 1.
Freight Transportation: Selected Data Needs

Type of information	Relevance to public policy, transportation planning, and decisionmaking	Status of information
Domestic movement of commodities		
◆ Type, value, and weight of commodities ◆ Origin and destination (O&D) points ◆ Distance shipped ◆ Modes used	Provides benchmark and trend data on supply and demand of freight transportation, its geographic distribution, and relative roles of each mode in moving goods. Provides data for planning, forecasting, and evaluating transportation needs, and for other purposes (e.g., analyzing relationships between transportation and economic development).	National and state data are available from the 1993 Commodity Flow Survey (CFS)—the first major national survey since 1977. A 1997 survey is in progress. Nationwide data need to be collected on a recurring basis. Some sectors (e.g., farming, fisheries, most retail sectors, and government) are not covered. Imports also are not covered (see below). CFS data are tabulated for national analyses and are difficult for metropolitan areas to use.
System capacity		
◆ Current and anticipated O&Ds ◆ Capacity of links, nodes, and service providers	Helps in evaluating the capacity of the system to serve freight transportation demand.	Publicly available data on system capacity generally exist, but there are gaps for some modes, and data on intermodal facilities are limited. A special need exists for information on railroad capacity and condition to assess mergers, abandonments, safety concerns, and investment proposals. Maps of transportation facilities and services are not detailed enough for many uses.
Costs		
◆ Transportation costs between O&Ds ◆ Prices paid by shippers ◆ Public versus private costs	Helps in evaluating system efficiency and effectiveness from the viewpoint of shippers, transportation firms, customers, and infrastructure providers. Useful for investment analysis and cost allocation.	Information limitations make it difficult to compile a complete national picture. Data collected from a large sample would need to include consistent shipper cost estimates across modes.
Time and reliability		
◆ Travel time between O&Ds ◆ System reliability	Helps in evaluating system's ability to meet user needs. Provides inputs for estimating productivity gains or losses (e.g., congestion costs).	Publicly available information is too limited to compile a complete national picture.
Domestic movement of international trade		
◆ Inland destinations of imports ◆ Modes of shipment ◆ Shipment weights	Rapid growth in imports and exports has heightened the need for timely and reliable data on the impact of global goods movement on domestic transportation infrastructure.	Information is incomplete at best. U.S. foreign trade data have limited utility in tracking domestic transportation associated with imports and exports. The major database covering commodity movements between the United States-Mexico, and the United States-Canada covers land transportation only. The 1993 CFS did not cover foreign origins of imports.
State and local needs		
◆ Geographic detail ◆ Freight demand data	State and local planning and forecasting of transportation needs; assessment of investment requirements.	Local officials often find national-level data difficult to use for planning (see table 4).

Note: Needs for safety, energy use, and environmental data are discussed elsewhere.
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 1997.

origins of exports, the means of transportation between inland locations and the port or border crossing, and shipment weight. These 20-year-old surveys have not been updated despite the growing importance of international trade to the U.S. economy.

Another data gap affecting both domestic and international freight is the lack of detailed information on commodity movements by air. Air freight is a small but growing portion of domestic transportation and carries a significant share of the value of transoceanic trade. Air freight is particularly important for the establishments not included in the CFS, and may be best measured through a sample of air waybill documents.

Local Freight Movement. Although the CFS provides much national- and state-level data, it was not intended for detailed coverage of local activities. Hence, there is a need to provide more focused information about freight movement at the metropolitan level in order to provide insight into transportation demand, the relationships between freight movement and business patterns, and freight flows through key corridors. Such information is beyond the capacity of any one national survey and is best collected locally. To ensure consistency between local and national data-collection efforts and make certain that the data inform metropolitan and local planning agencies, uniform survey instruments and methodologies are needed.

The nation's freight transportation activities are changing rapidly, reflecting the dynamic nature of the national and global economies. Changes in the mix of manufactured products, improvements in information and communications systems, and shifts in centers of global production and trade patterns will continue to affect freight movement in the United States. Continued monitoring of freight movement and sources of change, through the CFS and related programs, will be needed in the years ahead.

Passenger Travel

The Nationwide Personal Transportation Survey (NPTS) and the American Travel Survey (ATS) are key elements in the intermodal transportation database called for in ISTEA. The NPTS, sponsored by the Federal Highway Administration and others in 1969, 1977, 1983, 1990, and 1995, provides detailed information on local daily travel and some information on long-distance trips in the United States.[6] The NPTS characterizes the frequency and purpose of trips, the modes of transportation, the number of household vehicles, and vehicle occupancy rates. The 1995 American Travel Survey, sponsored by BTS, provides needed information on long-distance passenger movements by members of U.S. households. Its smaller predecessor, the National Travel Survey, was last conducted in 1977. The NPTS and the ATS are planned to be repeated in the year 2000.

The ATS and NPTS together do not answer many questions asked about passenger travel. For example, data are needed on travel costs, fuel use, economic activities served, and the domestic travel of foreign visitors. Also needed are greater geographic detail on routes where local travel is concentrated and information on trips in the 50- to 100-mile range (because data for these distances are poorly reported in both the NPTS and ATS). In addition, there is a need for more information about passenger travel by transportation-disadvantaged people, including many persons with disabilities, elderly people, and low-income families without cars. Table 2 summarizes information needs for passenger travel.

Vehicles

Although extensive information is maintained for aircraft, ships, and railcars, much less is

[6] The NPTS collects data on both local and long-distance trips; however, it is not designed to capture complete information about long-distance travel.

known about the more than 200 million motor vehicles in the United States. Keeping track of changes in the vehicle fleet and its use is an important data challenge. (See table 3 for a list of detailed vehicle information needs.) In recent years, for example, there have been rapid changes in the number and types of personal use vehicles, and a blurring of traditional distinctions between business and personal use vehicles. Pickup trucks and vans are often used as personal vehicles, while many businesses use cars to deliver goods and services (e.g., fast food delivery).

Accurate data on the number and type of motor vehicles and how they are used, reliable information about vehicle occupancy rates for cars, light trucks, and buses, and load factors for heavy trucks are important for many reasons. Such data help in developing assumptions about the future growth in transportation, and are needed in calculating fees and cost allocations among highway users. The data are also important for evaluating safety risks to travelers using particular transportation modes, and the energy efficiency and environmental impacts of the U.S. transportation system.

Funding allocations and other major decisions need annual, accurate, state-by-state estimates on the number and type of motor vehicles, the mileage they are driven, and their uses. The Federal Highway Administration is evaluating alternatives for improving the quality of vehicle data it receives from the states. Better vehicle information could also be obtained by expanding the Truck Inventory and Use Survey (TIUS) to include automobiles and buses. The TIUS currently includes light trucks and vans, as well as heavy trucks, and is a critical source of information on miles traveled, vehicle age, fuel consumption, and economic activities served. BTS is considering options for expanding the survey and conducting it annually rather than once every five years.

The Transportation System

The transportation system that carries freight, passengers, and vehicles includes facilities and services connecting geographic locations.

Facilities data cover the location, connectivity, use, and condition of individual highways, railroads, rail transit lines, airports and air space, ports and waterways, pipelines, and intermodal terminals. Such data need to be assembled and updated on a regular basis to monitor the state of the U.S. transportation system for planning and investment decisionmaking. Detailed data are generally available on the location and connectivity of major highways, most railroads, rail transit facilities, public-use airports, and ports and navigable waterways. Facility-specific use data are available for ports and waterways, airports, and a sample of highways. Data on the use of specific railroad segments can be estimated. Although the location of truck and rail terminals is generally known, especially those identified by states when defining intermodal connector roads to the National Highway System, publicly available information about the use of those facilities is often limited. Detailed information about the location, connectivity, and use of pipelines is currently being developed by a cooperative effort between the pipeline industry and the federal government.

More information is needed on the location, connectivity, capacity, and condition of railroads to assess mergers, abandonments, and safety concerns, and to evaluate proposals for public investment in railroad capacity improvements and intermodal facilities. Some of the requisite data were last collected in the 1970s, and are now obsolete, given ongoing changes in ownership and trackage rights.

There is also a need for information on transportation facilities and services that link the United States to other nations, especially Canada and Mexico. This information would comple-

Table 2.
Passenger Travel: Selected Data Needs

Type of information	Relevance to public policy, transportation planning, and decisionmaking	Status of information
Domestic passenger travel		
♦ Characteristics of travelers ♦ Travel purposes and frequency ♦ Origin and destination (O&D) points, and distance traveled ♦ Modes used	Provides benchmark and trend data to estimate supply and demand of passenger transportation, its geographic distribution, and relative roles of each mode in supplying services. Provides data useful in evaluating investment decisions.	Nationwide data need to be collected on a recurring basis. Daily travel has been tracked through five Nationwide Personal Transportation Surveys (NPTS) since 1969. The 1995 American Travel Survey (ATS) provides the most detailed data on long-distance travel (one-way trips, 100 miles or longer) since 1977. Although the NPTS and ATS together provide a good picture of daily and long-distance travel, the picture is less clear for trips between 50 and 100 miles. The NPTS does not include O&D data.
System capacity		
♦ Current and anticipated O&Ds related to links, nodes, and service providers ♦ Capacity of links, nodes, and service providers	Helps decisionmakers evaluate the physical ability of the system to service basic demand for passenger transportation, and set priorities for investment.	Publicly available data are generally adequate. Intermodal facilities data are limited. Congestion data and surge capacity data are quite limited, especially for peak-period demand.
Costs		
♦ Transportation costs between O&Ds ♦ Price to the traveler ♦ Public versus private costs ♦ Household travel costs	Helps evaluate system efficiency and effectiveness from the standpoint of passengers, service providers, and infrastructure providers.	Data exist for commercial modes, but complex fare structures complicate estimation of prices paid by travelers. Consumer Expenditure Surveys identify household transportation costs (mostly for automobile ownership and use). In time, ATS and NPTS data may be combined with other sources to produce a more detailed national picture.
Time and reliability		
♦ Travel time between O&Ds ♦ System reliability	Helps evaluate system effectiveness and quality in meeting user needs. Provides information needed to estimate quality of life and/or productivity gains or losses (e.g., time spent and cost incurred while stopped in traffic).	National travel time data are not available for most passenger trips. Travel time/on-time performance data exist for Amtrak and major air carriers. Some journey-to-work travel time data are collected in the decennial census. Congestion and other system reliability data are hampered by lack of common definitions and cross-jurisdictional data-collection problems.
International travel		
♦ Travel patterns of foreign visitors within the United States ♦ Travel patterns of U.S. citizens in other countries	International business travel and tourism are growing rapidly, producing new demands for information about their domestic transportation impacts and implications.	Data are scarce on foreign visitors in the United States after their arrival at a U.S. gateway. Data on U.S. travelers in other countries are also scarce.
State and local needs		
♦ Traveler demand and use data ♦ Travel behavior data ♦ Socioeconomic data	Important for state and local planning and forecasting; assessment of investment requirements; identification of needed services, including those for transportation-disadvantaged persons; and evaluation of different strategies to influence transportation demand.	Improved data are needed on congestion, travel time and speed, and trip chaining. More data are needed to determine the travel requirements of persons with disabilities, low-income households, and households without cars. Also see table 4.

Note: Needs for safety, energy use, and environmental data are discussed elsewhere.
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 1997.

Table 3.
Vehicles and Vehicle Use: Selected Data Needs

Type of information	Relevance to public policy, transportation planning, and decisionmaking	Status of information
Truck inventory and use ◆ Numbers by vehicle class, size, and weight ◆ Age of fleet ◆ Vehicle-miles traveled (vmt) ◆ Load factors	Useful for truck size and weight studies, highway cost allocation, assessment of infrastructure impacts and needs, evaluation of trends and conditions in safety, energy use, and the environment, and for many other purposes (e.g., analyzing truck/rail competition).	The Census Bureau's Truck Inventory and Use Survey (TIUS), conducted every five years, provides much needed data. In addition to heavy trucks, the TIUS includes light trucks and vans, many of which are used as passenger vehicles. Different vmt estimates exist, reflecting different data-collection purposes and methodologies of estimators.
Passenger vehicle inventory and use ◆ Numbers by class, size, and weight ◆ Age ◆ Vmt ◆ Vehicle occupancy	Useful in highway cost allocation, and in evaluating safety, energy use, and environmental trends and conditions.	No survey comparable to the TIUS covers all passenger vehicles. A more expansive survey to include all passenger vehicles is under consideration. Different estimates of the number of vehicles exist, reflecting estimators' use of different registration sources and vehicle definitions.
International data ◆ Truck and cargo characteristics for non-U.S. vehicles entering the United States ◆ Travel profiles for non-U.S. vehicles once in the United States	Useful in evaluating effects of foreign trade and non-U.S. carriers on domestic transportation infrastructure, modal shares, safety, and the environment.	The U.S. Customs Service collects some data on Mexican trucks, currently restricted to border areas, but geographic accuracy is unreliable. Canadian truck data and Transborder Surface Freight Transportation Data can be combined to estimate some movements.
State and local needs ◆ Truck data ◆ Passenger vehicle data	Important for state and local planning and forecasting of transportation needs; assessment of infrastructure investment.	TIUS data could have important local applications, but metropolitan planning organizations may need assistance in making optimal use of this data.

Note: Needs for safety, energy, and environmental data are discussed elsewhere.
Source: U.S. Department of Transportation, Bureau of Transportation Statistics, 1997.

ment efforts to measure the overall condition, performance, and use of the transportation system within this country, and guide efforts to reduce physical barriers between domestic businesses and international markets.

Services data include the geographic domains of carriers and the amount and type of service provided within those domains. Publicly available data exist about the geographic location and services offered by commercial airlines and long-distance water carriers. The ownership and trackage rights of railroads for each part of the rail network are known, but relatively little is known about the levels of service provided on each segment. The Federal Transit Administration has compiled, on a one-time basis, data on the location of public fixed-route bus service. Geographic knowledge of truck and intercity bus operations is limited. Such data would improve the analysis of facility and service availability and future needs.

From the perspective of travelers and shippers, time, reliability, and cost data are important factors in measuring the performance of

transportation services. National information on scheduled travel time and on-time performance is limited to major air carriers and Amtrak. Journey-to-work travel times are also reported in the Decennial Census of Population and Housing and the Nationwide Personal Transportation Survey. Only anecdotal information exists on travel time and reliability of other passenger trips, which account for the majority of travel, or about freight transportation.

Before economic deregulation, carrier filings provided cost data specific to individual services and segments of the transportation network. Most of these data are no longer available in a publicly accessible form, reflecting the loss of reporting requirements after deregulation, extensive replacement of published tariffs by contract rates, and market innovations that complicate cost accounting. The most detailed information today is for commercial aviation. Such data are essential to understand the economic consequences of transportation, the degree of competitiveness within the transportation sector, the financial health of carriers, and other economic conditions that concern public agencies, shippers, and the investment community.

The geographic context of the transportation system includes political boundaries and physical features, the distribution of population and economic activities that require transportation, and environmental conditions and human activity affected by transportation. The Decennial Census of Population and Housing collects a wealth of data on the demographic and economic characteristics of residents at a neighborhood scale. As the decennial census long form includes questions on journeys to work, demographic and economic characteristics of workers at their place of work can also be mapped on a neighborhood scale. This provides the only nationwide source of information on economic activity finer than the county level of geographic detail.

Data that shed light on the economic and land-use impacts of transportation are required to understand relationships between public policy and the ability of transportation to serve users. The skeletal and circulatory functions provided by the transportation system encourage development in some places and discourage development in others. With economic growth comes economic opportunity but also environmental impacts, which vary across regions. Understanding the interactions among transportation, economic development, and land use is central to an appreciation of the long-term consequences of infrastructure investment. Yet, the regional economic database to support this understanding has been diminished by budget cuts at the Bureau of Economic Analysis. In addition, a consistent scheme for classifying land uses by type of economic activity and a mechanism to collect land-use data on a national scale needs to be developed.

Economic Dimensions of Transportation

Transportation is a key business cost and a basic enabler of economic activity. Understanding the economic dimensions of transportation is essential to determine effective public and private investment in transportation infrastructure, prioritize transportation projects, estimate the number of jobs created by transportation spending, understand regulatory costs, monitor competitiveness and the economic health of the transportation sector, and forecast revenues from transportation facilities and activities. This understanding requires data on how much transportation buys from other industries, how much other industries spend on transportation, the value of transportation capital, and productivity.

BTS has focused its initial resources, in a joint effort with the Bureau of Economic Analysis of

the Department of Commerce, to measure how much transportation buys from each industry and how much each industry spends on transportation. This joint effort is known as the Transportation Satellite Account and is designed to identify spending on for-hire and shipper-owned transportation services. Transportation has historically been underrepresented in the U.S. national accounts[7] because spending on shipper-owned transportation, such as truck fleets operated by large grocery chains, has been treated as internal to the shipper's industry, and the value generated by these services has been counted as output of the shipper's industry. Measures of physical transportation activity, particularly from the TIUS, are now being used to estimate this economic activity. When the results of this project are available in 1998, BTS will be able to estimate the contribution of transportation to the cost of specific industries and products, and analyze how changes in the cost of resources consumed by transportation (such as gasoline) might affect the industries and products that use transportation.

Once the Transportation Satellite Account is published, BTS plans to develop a capital stock account to measure the value of transportation infrastructure. To develop this account, a better analytic understanding of the depreciation and obsolescence of transportation facilities is needed. Several conceptual issues, such as basing measures on economic concepts of wealth versus potential productivity, must be resolved.

As discussed in chapter 6 of BTS's *Transportation Statistics Annual Report 1995*, conceptual issues are also a problem in measuring productivity. For example, the productivity of trucking appears very low because businesses are spending more per ton shipped than in the past, but the tons shipped do not reflect quality improvements and technological changes that permit businesses to buy faster and more reliable trucking services. The transportation community must resolve these conceptual issues if it is to measure whether the economy is getting more or less for its transportation dollar.

Many of the concerns addressed by national accounts and productivity analyses are pertinent to states. In particular, states require data and analytical tools to answer three questions:

1. *What is the appropriate level of investment in transportation to encourage economic health?* The importance of this question is underscored by the reauthorization of ISTEA and legislative proposals involving transportation finance in several states. A better understanding of the economic transactions among states in the movement of goods and people is needed. A promising approach to developing state statistics that reflect these transactions is to relate the national accounts to data from the Commodity Flow Survey and the American Travel Survey.
2. *How should projects be prioritized within a multimodal transportation program?* The answer to this question requires the development of cost and benefit measures that can be applied across modes, involving both passenger and freight transportation. The need for better measures of transportation benefits was emphasized in the International Conference on Measuring the Full Social Costs and Benefits of Transportation.[8]
3. *How much revenue is likely to flow from tolls, regionwide taxes, and other sources?* The need for better revenue forecasting models was emphasized in the National Conference on Information Needs to Support State

[7] The national accounts are a comprehensive and detailed record of U.S. economic activities and interactions between sectors of the economy. The Bureau of Economic Analysis created this database using Census Bureau information.

[8] David L. Greene, Donald W. Jones, and Mark A. Delucchi (eds.), *The Full Costs and Benefits of Transportation: Contributions to Theory, Method and Measurement* (Berlin: Springer-Verlag, 1997).

and Metropolitan Transportation Decision-making into the 21st Century.[9]

Transportation Safety

Transportation has become safer in recent decades, whether viewed in absolute numbers of fatalities or normalized by exposure. Nationwide, however, 44,394 people died in transportation-related crashes or accidents in 1995. About 94 percent of these fatalities involved motor vehicles.

There is a sizable body of data with which to track trends in transportation safety. The most detailed data are for highway vehicles and modes involving commercial passenger transportation. Significant data limitations remain, however, that hinder informed decisionmaking on safety issues. Data needs include: 1) more uniform reporting of crashes and incidents throughout the nation; 2) comprehensive and consistent measures of risk exposure, especially with respect to hazardous cargo; 3) comprehensive information on the causes of crashes and incidents, including human factors, weather and other environmental factors, and equipment and infrastructure failures; and 4) more accurate and complete reporting of injuries and costs.

Safety statistics are difficult to compare across different data systems because of inconsistent definitions and reporting criteria. For example, thresholds and scales for reporting injury severity are not uniform among modes. Inconsistent information about injuries complicates cross-modal analysis.

More accurate, comprehensive, and consistent measures of risk exposure could help our understanding of the relative importance of factors contributing to transportation crashes and improve our analysis of safety trends. Better exposure measures require data not only on the numbers of fatalities, injuries, and accidents, but also data that indicate the overall level of transportation activity (e.g., number of licensed drivers, vmt, person-miles traveled, hours flown). Improving data on vmt and passenger car occupancy rates (such as through a vehicle inventory and use survey) could be helpful in safety analysis (see table 2).

Analyses of safety trends for nonmotorized modes—bicycling and walking—suffer from the absence of exposure measures (such as hours of exposure to traffic). Moreover, bicyclists and walkers often take trips too short in length to be counted in national travel surveys. Furthermore, trips that begin and end at a residence, without an intermediate stop, are typically not counted, thus excluding much recreational bicycling and walking. Yet, more than 6,400 pedestrians and bicyclists died in 1995 in crashes involving motor vehicles. This was 15 percent of all transportation fatalities in that year. In addition, exposure measures for recreational boating—an activity that claims more than 800 lives annually—are inadequate.

There is also a need for exposure information on specific populations (e.g., children or elderly drivers). For example, inadequate exposure data on children under five years of age makes the evaluation of some transportation risks difficult.

Moreover, better exposure measures and incident data are needed for evaluating the risks associated with the transportation of hazardous materials. Because all modes are involved in transporting these materials, multiple data sources must be reviewed and analyzed to establish risk levels.

Even with adequate data, analysts must contend with different ways to combine the data into measures of safety risk. For example, air carrier rates could be reported on a per aircraft-

[9] Transportation Research Board, National Research Council, *Conference on Information Needs to Support State and Local Transportation Decision Making into the 21st Century* (Washington, DC: National Academy Press, March 1997).

departure (trip) basis or on a per aircraft-mile basis. A per trip basis is more appropriate than the aircraft-mile measure for air, because most airline accidents occur during takeoff or landing. There is, however, a distinct correlation for air carriers between fatalities per aircraft-mile and fatalities per trip,[10] although there is no correlation in the risk of fatality between the two measures for any given trip. For recreational boating, rates are best shown per exposure-hour,[11] rather than in relation to distance.

Within modes, data-collection efforts need to take into account changes that could affect safety, such as changes in consumer preferences for vehicles. For example, more people are buying sport utility vehicles and light trucks for personal use, making crashes between these vehicles and smaller passenger cars more likely. Moreover, when data on risk exposure are broken down by vehicle type and other considerations, such as time of day and highway type, the data may not be accurate enough for rigorous statistical analyses. Data on crashes involving two modes of transportation, such as highway vehicles and trains at grade crossings, need special attention to avoid double counting. Better information is needed on safety incidents involving freight and passenger modes, which often share the same road or facility, but have their own set of risks.

With state governments assuming increasing responsibility for safety, standardizing and computerizing local, state, and national safety databases are important issues. Greater standardization of basic measures of loss across modes and throughout the country would help. Examples include injury and accident reporting thresholds, how to tally injuries to crews and operators and to pedestrians and other people not in a vehicle, and how to avoid double counting in collecting statistics about cross-modal crashes and incidents.

In addition, more comprehensive data are needed on factors contributing to crashes and incidents. Human error, equipment problems, and environmental conditions (e.g., weather) account for most crashes and incidents, but modal profiles vary significantly. In particular, there is a special need for better information about how these factors interact when there are multiple causes of crashes. It would also be useful to have quantitative information about risks arising from adverse weather conditions to compare with risks during fair weather.

The underreporting of transportation injuries, along with inconsistencies in injury reporting, further complicates the assessment of transportation safety. The consequences of injury may be as devastating as those of motor vehicle fatalities in terms of time and money lost. The reporting of injuries, however, is less comprehensive and consistent than the reporting of fatalities. Data about the number, severity, and costs of injuries from highway crashes are inadequate. More comprehensive data await linkage of highway crash reporting and medical data systems, a step being taken by at least 14 states with the urging of the National Highway Traffic Safety Administration.

Finally, as decisions are made about how to improve transportation safety, a key question will be what safety strategies can bring the greatest benefits to the traveling public. This question is important for all modes, but especially on the highways where most transportation fatalities occur. Good program evaluation methods are needed to develop data for selection of the most appropriate strategies as well as for monitoring results.

[10] This is because the average trip length for air carriers has changed very slowly.

[11] Some exposure data are available for commercial waterborne transportation. The Army Corps of Engineers collects data on U.S. vessels involved in domestic trade in U.S. waters. The Census Bureau collects data on U.S. and foreign vessels involved in foreign trade with domestic ports.

Transportation Energy Use

For nearly a half century, transportation has accounted for about one-quarter of total U.S. energy use, and since the 1980s for about two-thirds of U.S. petroleum consumption. Petroleum-based fuels satisfy 95 to 97 percent of transportation energy demand.

There is a continuing need to improve estimates of vmt by type of vehicle. In the energy arena, data on vmt by vehicle type are essential for estimating the sensitivity of vehicle travel to fuel price and fuel economy, and for understanding how vehicle choice and use affect energy demand.

For many years, such information was provided through the Energy Information Administration's Residential Transportation Energy Consumption Survey (RTECS). As the survey was eliminated following publication of its 1995 results, RTECS fleet fuel economy estimates and household vehicle use data will no longer be available. RTECS was unique in that it provided odometer-based travel estimates for a statistical sample of U.S. household vehicles, and the data could be matched to vehicle make and model miles-per-gallon (mpg) estimates for each vehicle in the sample. RTECS mpg estimates are not actual in-use fuel economy estimates, but are rather Environmental Protection Agency (EPA) test numbers adjusted to better represent real-world operating conditions. Actual in-use fuel economy estimates based on odometer readings and fuel purchases would allow a better evaluation of impacts of the Federal Automotive Fuel Economy Standards over time. RTECS data were the next best thing.

The RTECS gap could be largely filled if the Truck Inventory and Use Survey were expanded to include passenger cars and other types of vehicles, as discussed earlier. Such a survey would improve on RTECS by including vehicles owned by businesses, as well as by households, but the current TIUS survey methods would have to be adapted to allow odometer-based vmt estimates. Additional processing of the survey results would also be required to add mpg estimates. As is indicated in table 3, there are many reasons for broadening the TIUS to include passenger cars and other vehicles. A fuller vehicle inventory and use survey is under consideration, but has yet to be launched.

In 1995, the NPTS included (for the first time) odometer-based vmt estimates for household vehicles. The NPTS does not permit accurate estimates of fleet fuel economy, however, because it does not identify vehicles in sufficient detail to allow them to be matched with their EPA mpg values.

Transportation and the Environment

Because of its enormous extent and heavy use, the U.S. transportation system inevitably has undesirable environmental impacts. Many laws have been enacted in the last 25 years that have reduced the environmental impacts of transportation below what they otherwise would have been.

As policies for management of environmental impacts of transportation have evolved, so too have information needs. For example, metropolitan transportation plans must be analyzed for conformity with the Clean Air Act at a level of geographic detail that can only be supported by the decennial census. If the long form and its journey-to-work questions are not included in the year 2000 census, the transportation community may have to spend well over $100 million to replace the needed data.

Questions about the costs relative to the benefits of further environmental improvement are increasingly raised, as are concerns about the dampening effects of regulation on the economy. Scientific and technical questions continue to arise concerning the nature of environmental impacts on human health and the ecosystem, and on the technological capacity to address those impacts. At the same time, there is increasing interest in environmental policies that address

such goals as pollution prevention and sustainable development.

Developing the information needed for such broader analyses will require a common measure for comparing different environmental effects. Many disciplines—economics, environmental science, risk analysis, and medical research, for example—would need to work together to translate environmental impacts into dollar values.

A good deal of progress in data collection and dissemination has been made over the past 25 years, particularly on air quality. A nationwide air monitoring system records daily variations in air quality at about 4,000 sites nationwide. Moreover, emissions estimates of mobile sources of air pollution are much improved. Indeed, EPA recently improved its estimation of motor vehicle emissions in real-world conditions.

Unfortunately, other aspects of environmental quality are less well documented. Until recently, EPA's inventory of toxic emissions focused on manufacturing, making it of little use for understanding transportation emissions. Data are even scantier for transportation-related impacts on surface and groundwater resources, animal habitats, and land use.

Fairly accurate data are available on the annual amount of oil and other petroleum products spilled in and around U.S. waters by vessels. Data are available on the frequency and cleanup status of petroleum leaks from underground storage tanks, and on leaks over a certain size from hazardous liquid pipeline facilities. Little is known, however, about the net amount of contaminants released into the environment (after cleanup efforts), the amount of water contaminated by spills, exposure to contaminants, and health effects to humans and wildlife. Also, only limited studies have been performed to quantify highway and airport runoff and its impact on the environment. Very little information is available about the quantity of automotive oil illegally dumped into the environment by households.

At present, there are no comprehensive indicators of the exposure of Americans to transportation noise. The localized nature of noise, as well as its characteristics of attenuation, makes national exposure difficult to quantify. Exposure to aircraft noise around commercial airports has been calculated, but there are no recent estimates of exposure to highway and rail noise.

Land use and habitat degradation are topics about which very little is known on a national scale. Accurate trends of land area occupied or affected by the four major transportation modes are not available, although the amount of infrastructure in place has been quantified. Furthermore, understanding of the extent to which habitat fragmentation and depletion affect wildlife species as a whole is limited—although a few studies on specific kinds of wildlife have been conducted. Destruction of wetlands is a topic that has recently received much attention from both private and public organizations concerned about the environment. The amount of wetlands degraded or destroyed due to the construction of transportation infrastructure is not known. The picture may improve when the U.S. Fish and Wildlife Service of the Department of the Interior completes a National Wetlands Inventory.

For the most part, the current environmental management system continues to treat each kind of pollution separately, even though there are complex interactions among different media. Similarly, most analyses of transportation's environmental impacts focus on individual modes—motor vehicles, aircraft, rail—rather than on comparative environmental performance among modes. Moreover, a complete analysis of the environmental impacts of transportation would need to take into account upstream activities (e.g., oil field development, petroleum refining, and vehicle production) that make transportation possible. In

conducting such analyses, special care to avoid double counting impacts would be needed.

Finally, a weakness of environmental data is that they do not show the effect of pollutants produced by transportation. To what extent does transportation pollution damage human health? What are the effects of transportation pollution on crop yields? How and to what extent do transportation activities affect ecosystems? These are difficult questions, but they must be answered in order to assess the actual environmental impacts resulting from transportation.

Such an effort will likely be an important part of developing indicators of progress toward sustainability. Proponents of such an approach have proposed goals of sustainability like the conservation of nature, stewardship of natural resources, and improvements in health and the environment. Appropriate indicators are needed to measure progress toward the goals that are adopted.

STATE AND LOCAL PERSPECTIVES

In recent years, transportation decisionmaking has become more decentralized. States and local governments are assuming more responsibilities that were once carried out by the federal government. Because of deregulation and privatization of government services, the private sector also is playing an increasing role in carrying out functions once performed by government. Far from reducing the need for national-level transportation information, these changes are creating new needs and demands for reliable data.

In March 1997, a national conference on state and local information needs[12] identified data requirements to support transportation decisionmaking across a broad spectrum of issues (see table 4). Conference participants included planners, engineers, and executives from state and metropolitan organizations.

According to conference participants, state and local governments need more geographically-specific data on freight and passenger flows, and on special traffic generators (e.g., sports events). There is a particular need for data on trade throughout North America, and its implications for state and local infrastructure planning and use. States and localities also need information that would help them meet the requirements of the transportation-disadvantaged. For example, many low-income people in central cities have limited access to employment opportunities in the distant suburbs, the location of many entry-level jobs. Information on the types and locations of employment opportunities, the location of welfare recipients, and the availability of transportation options by time of day is needed to help connect people with jobs in response to changes in federal and state welfare programs.

Another category of needs covers improved methodologies for collecting and displaying data. Geographic information systems (GIS) and other communications tools hold much promise for presenting data in clear, concise, and compelling ways for data users. Inconsistencies in geographic data formats and definitions hinder progress in this area, and improvements are needed in methodologies to integrate geographic data with other kinds of information.

New approaches to training are needed, because sophisticated models, complex analysis, and large data sets are no longer restricted to experienced users in the largest public agencies and private firms. Personal computers and CD-ROMs allow small planning agencies, local transportation firms, citizen groups, and individ-

[12] See footnote 9. The conference was sponsored by the Transportation Research Board, the Bureau of Transportation Statistics, the Federal Highway Administration, the Federal Transit Administration, the American Association of State Highway and Transportation Officials, and the Association of Metropolitan Planning Organizations.

Table 4.
Selected State and Local Data Needs

Type of information	Observations
Socioeconomic	
◆ Demographic data ◆ Employment and business locations ◆ Household income and expenditures	Extensive baseline data are collected at specified periods (e.g., Consumer Expenditure Survey, Consumer Price Index, County Business Patterns). Additional or emerging data needs: 1. population groups that may have many transportation-disadvantaged people (e.g., persons with disabilities, the elderly, low-income households, job seekers affected by welfare reform, immigrants, and households without cars); 2. number of temporary users of transportation at the state or local level (e.g., part-time residents, college students, migrant workers, and tourists).
Financial	
◆ Government revenue streams ◆ Project cost estimates	Information is available but often not detailed or timely enough to meet state and local planning needs.
Supply and system characteristics	
◆ Extent (links, terminals, other facilities) ◆ Capacity ◆ Condition	Greater geographic specificity is needed in maps of transportation facilities and services; ideally, maps at the 1:100,000 scale should be available for all urban and rural areas. The Highway Performance Monitoring System and the National Transit (Section 15) Database provide useful data, but their reporting requirements could be revised to reflect state and metropolitan planning organization (MPO) input to better meet their needs. Flexible methods for collecting data on physical deterioration of pavement and other infrastructure are needed.
Demand and use	
◆ By business establishments ◆ By socioeconomic groups ◆ Trade-related	Much baseline data are available, but greater geographic and temporal detail is often needed. Additional or emerging needs include more data on: 1. special traffic generators (e.g., sports stadiums and airports); 2. corridor-level demand and use; 3. effects of different strategies on system use (e.g., traveler information and transportation demand measures); 4. state and local movement of internationally traded goods. See also tables 1 and 2.
Systems operations	
◆ Reliability and trip time ◆ Congestion ◆ Freight operations ◆ Unintended consequences ◆ Cross-jurisdictional data	Data on system reliability and congestion are fragmentary: traffic operation systems data could be tapped to develop a clearer picture, although definitional and institutional problems would first need to be addressed. Systems operations data also might provide useful information to monitor unintended consequences for safety and the environment. In all these areas, greater data sharing among and across jurisdictions is needed for a more complete picture.
Adapting national data sources to state and local needs	
◆ Add-on questions to national surveys to provide more detail at state and local levels ◆ Continuous measurement ◆ Assisting state and local data users	States and localities often need additional or finer level data than are available from national surveys. In the near future, data now collected once every 5 or 10 years may be collected on a continuous measurement basis. This could improve the timeliness of data for transportation planning and modeling, but could require research to determine necessary adjustments to transportation models. Research also is needed on new data-driven models that better reflect recent trends (e.g., just-in-time delivery). State and MPO planners could make greater use of existing national databases (e.g., TIUS and CFS) in addressing local needs, but impediments (such as limited time and familiarity with the databases) exist. A variety of mechanisms—handbooks, training workshops, conferences, and electronic media (e.g., websites and specially designed software)—could be used to broaden use of this data.

Key: CFS = Commodity Flow Survey; TIUS = Truck Inventory and Use Survey.
Note: Safety, energy, and environmental data needs are discussed elsewhere.
Source: Summarized by U.S. Department of Transportation, Bureau of Transportation Statistics, 1997, based on source in footnote 9.

ual consultants to manipulate data sets that required expensive mainframe computers just two decades ago.

While personal computers have been a boon to transportation analysis, the analyst still needs to take the time to understand how to use the new tool correctly. Otherwise, traditional methods could be applied inappropriately to new issues and data. For example, it is relatively easy with a personal computer to apply the classic four-step urban travel demand forecasting process to estimate local, statewide, or national commodity movements. This could produce misleading results as shippers and carriers respond to very different forces than do households and individuals in using the transportation system. There is also a danger that some analysts will load and tabulate large data sets from CD-ROMs with off-the-shelf database packages without closely examining documentation, producing results that seem plausible but may be entirely wrong. For example, the TIUS characterizes vehicle weight in several ways; the appropriate measure depends on the application. Novice users might use the first weight variable they encounter.

These problems create an important challenge for BTS and other data providers to accelerate research on alternative forms of data presentation, modeling, and analysis, and to place significant emphasis on training. The training challenge is particularly daunting, because data customers are no longer limited to analysts in a few large agencies.

Conference participants also discussed institutional concerns, focusing on establishing public-private partnerships to coordinate data collection and access among all levels of transportation decisionmakers.

CHANGING SOURCES OF TRANSPORTATION DATA

The U.S. Department of Transportation (DOT) uses four basic sources of transportation data:

- surveys,
- reports from service providers,
- reports from government agencies, and
- administrative information from management and traffic control systems.

Surveys are often expensive, can burden individuals and businesses with paperwork, and are sometimes the least timely way to collect data, but may be the only means available in some cases. For example, few people keep consistent records of their household travel unless they are participating in a survey. Reports from service providers, such as filings by carriers for regulatory purposes, also can be burdensome, because the cost of data collection is shifted from the data-collection agency to the respondent. The least obtrusive sources of data are byproducts of management and control systems, such as counts of vehicles on a turnpike based on toll collections.

As information technology advances, unobtrusive methods of measurement are improving in both sophistication and coverage. When monitoring and control systems can be tapped, the quantity and quality of data increase dramatically while the costs and burden to the respondent plummet. For example, every ticket collected by the airlines is processed through a clearinghouse. The ticket information is used to allocate revenues when the ticketed travel is not completed on the originating airline. The clearinghouse is an excellent source of data about commercial passenger air travel geography and on ticket prices for all domestic origins and destinations. BTS is working with industry to tap the clear-

inghouse as a replacement for the current data-collection system.[13] If the clearinghouse could be used, data collection would be fully automated, thus eliminating any reporting burden on the carrier. Also, because 100 percent of the travel is measured directly and only after the travel is completed, there would no longer be errors from sampling or itinerary changes.

Switching to unobtrusive forms of data collection is not a panacea. Setup costs, both fiscal and institutional, can be high, and the nature of the data being collected may change, as illustrated by trucking data. Formerly, much of these data were obtained for highway planning purposes by stopping trucks at temporary roadside stations and weighing the trucks with portable scales. The operating expenses of temporary weigh stations limited the number of observations that could be made. The time burden placed on drivers encouraged some to avoid the scales and thus make the data less representative. By switching to weigh-in-motion sensors in the pavement, data-collection costs fell, the number of observations increased by orders of magnitude, truckers were no longer inconvenienced, and bias from scale avoidance was eliminated. The only information so obtained, however, was the weight and spacing of each axle. In the past, the driver could be asked about the load, trip origin and destination, and other characteristics. This additional information must now be obtained through surveys or other intrusive data-collection strategies.

In time, intelligent transportation systems (ITS) may allow the replacement of many surveys and carrier reports, particularly if traffic control, shipment management, and other systems can be integrated. Almost all of the information obtained in roadside interviews of truck drivers, plus other freight information, could be captured from monitoring systems that public agencies are considering to manage congestion and collect user fees. Similar information could be captured from monitoring systems used by carriers to track their vehicles, shipments, and drivers.

In the near term, however, important barriers impede full realization of the potential of ITS for data collection. First, most systems are designed to manage day-to-day or minute-to-minute conditions, in itself a challenge. Additional requirements for integration and archiving of data are often secondary, especially if integration must be achieved across organizations. There are also legal issues, privacy concerns, and limitations on the use of proprietary data that need to be resolved. Private companies are reluctant to share information with their competitors. Individuals are concerned that personal information provided to a government agency may be available to others. Public agencies are worried that data could be used against them in court; for example, observation by an agency of an unsafe condition before a crash could possibly be used by a victim to sue later for failure to correct the problem.

For these and other reasons, enormous amounts of data generated in transportation monitoring and control functions are not saved. The transportation community must continue to depend on more costly and burdensome data collection until technological and institutional issues can be resolved.

Improvements need to be made in the traditional forms of data collection. The use of computers for telephone and personal interviews can reduce costs and respondent burden by speeding up the interview, improve data quality by providing immediate feedback for unlikely answers, and improve timeliness by automating the com-

[13] The BTS Office of Airline Information currently collects the data by sampling every 10th airline ticket sold. Airlines submit computerized ticket images or special data files. The results can be affected by sampling error and by changes in passenger itineraries after the ticket is purchased.

pilation of field data. The Census Bureau is gaining extensive experience with using computer-aided interviewing, and the Federal Highway Administration has sponsored research on the use of inexpensive, handheld computers for data collection.

STRATEGIC RESPONSES

Reauthorization of ISTEA provides an opportunity to reinforce the benchmark data programs established in 1991, expand those programs to include critical topics such as the domestic transportation of international trade, develop new technologies for less burdensome data collection, and renew efforts to enhance the organization and sharing of information through the National Transportation Library (see box 1). BTS has proposed a three-element strategy in the Administration's reauthorization bill.

Understanding Transportation in a Globalized Economy

Responding to the enormous growth of international trade and the emergence of travel and tourism as one of the largest and fastest growing global industries, BTS proposes to: 1) measure the domestic transportation of commodities traded internationally and the domestic travel of foreign visitors; 2) monitor the condition and performance of the international transportation links between the United States and its global partners; and 3) compile and analyze information on world trends that affect the domestic transportation system. Among other activities, these efforts could include three new programs to reduce critical data gaps:

- *Survey of Domestic Transportation of International Trade.* BTS would sample import and export documents and conduct a followup survey to obtain information on the modes of transportation used, and the weight and correct geography of shipments.
- *Transborder Travel Survey.* BTS would survey domestic travel by international visitors in the United States by all modes of transportation. In the case of visitors from Canada, BTS would work with the Canadian government to obtain needed information from the Canadian Travel Survey. This data-collection program could replace a survey now conducted by the U.S. Department of Commerce that is limited to visitors leaving by commercial airline.
- *Air Cargo Waybill Survey.* BTS would sample shipping documents to measure the origin, destination, weight, and value of goods moving by air, and identify the commodity (where possible). Coverage would include the fast-growing air courier industry.

BTS will also continue to work with the U.S. Coast Guard, the Maritime Administration, and the U.S. Army Corps of Engineers to improve the quality, comparability, and efficiency of their maritime transportation data programs.

Partnerships for More Effective Information

BTS was asked by nearly 200 stakeholders at the National Conference on Information Needs to Support State and Local Transportation Decisionmaking into the 21st Century to make national data more useful at the local level, and to provide technical assistance for local data collection and analysis. The stakeholders recognized that the required effort involves federally encouraged information sharing at state and local levels as much as federally provided data and technical assistance. BTS proposes three responses.

First, BTS proposes a series of enhancements to federal data programs to improve their relevance to state and local transportation decision-

Box 1.

Expanding the Role of the National Transportation Library

The most complete, accurate, relevant statistics are of little use if they are not made readily available in usable forms. Information must be organized in ways that allow users to find what they seek quickly, yet encourage users to find other relevant information that was not part of their original search.

The transportation field today consists of professionals working in a complex amalgam of disciplines with rapidly changing knowledge bases. Transportation agencies not only must have engineering expertise to carry out construction and maintenance projects, but must also have the wherewithal to perform or evaluate economic analysis, demographic and social science research, cartographic and spatial analysis, statistical analysis, information management, and many other specialties. These agencies are staffed not just by engineers, but by geographers, demographers, economists, market researchers, computer scientists, business administrators, and lawyers.

There is an acute need for a systematic approach for organizing transportation-relevant information from each of the component fields, and making pertinent literature and data accessible and broadly available. In many fields, libraries perform this organizational function. For example, the National Library of Medicine (NLM) is far more than a collection of books and magazines. It helps organize and makes accessible the knowledge base of the medical profession, works with a network of libraries to disseminate that knowledge in many print and electronic forms, and provides the corporate memory of past successes and failures from which lessons for the future can be drawn. Carrying out these functions requires resources: the budget of the NLM exceeds the amount spent on *all* major data-collection programs by administrations within the Department of Transportation by 50 percent.

The transportation community has chronically underinvested in these broad library functions. Federal collections have been lost by agency closures (as in the case of the Interstate Commerce Commission) or severe budget reductions. State and local agency libraries are not effectively networked and suffer similar budget woes. No single organization in the transportation field has the mandate to provide leadership in capturing and preserving transportation's corporate memory, and organizing and sharing the knowledge base in useful ways.

The National Transportation Library (NTL) is a modest beginning to redress this problem. Started by the Bureau of Transportation Statistics (BTS) as an Internet site, the NTL was designed as an electronic depository for documents and data from all levels of government. Most documents in the library are provided by state departments of transportation and metropolitan planning organizations. The library is a platform on which planners and researchers from state and local agencies can share accomplishments and experiences directly.

For the NTL to achieve its potential, BTS must expand the electronic collection, begin identifying and capturing the physical collections of agencies that can no longer maintain them, establish cataloging and related services, and work with university and agency libraries to establish a network for sharing the collections, experiences, and knowledge of the transportation community.

makers. One element would be to extend the national Transportation Satellite Account and related economic analysis methods to the state level. Methods and data would be provided to help states determine economic levels of transportation investment, prioritize transportation projects across modes based on economic criteria, and forecast transportation revenues.

Second, BTS proposes a program of technical and financial assistance to state agencies, metropolitan planning organizations, universities, and others that integrate local data collections and analyses among themselves and with national counterparts. The program would build repositories of transportation data and information on the Internet, develop better methods of data use and analysis, and work with the private sector to ensure that DOT provides American businesses with meaningful information in an appropriate format in a timely fashion. The program would include grants to enhance the local capacity for data analysis, implement the National Spatial Data Infrastructure mandated by Executive Order 12906, and encourage data sharing through the National Transportation Library.

Third, BTS proposes to develop, with universities and others, methods of transforming raw data from electronic data interchange systems, traffic control systems, and other forms of intelligent transportation systems into statistical information of wider utility than the purpose for which it was originally collected. These technologies offer major opportunities to improve timeliness of many kinds of statistics and minimize the burden to the public of responding to government requests for information. Both technical and institutional issues, however, must be resolved to turn operational data into an effective information resource for transportation planning and policy analysis at all levels of government.

Performance Indicators

In response to requests for assistance in developing measures to support the Government Performance and Results Act, and to requests by states and metropolitan planning organizations for help in developing performance measures for their own purposes, BTS proposes a program of research, technical assistance, and data quality enhancement to support performance measurement. Research is needed to establish a national system of performance indicators, and to update and extend the studies of program evaluation methods to transportation issues in the 1990s. BTS also proposes to establish a clearinghouse and other forms of technical assistance to help states and metropolitan planning organizations develop their own performance measurement methods. Data quality enhancement is needed in several programs sponsored by BTS and other DOT modal administrations to meet the validity and precision requirements of performance measurement. Both more timely performance measurement and improved data quality would be served by implementation of an annual vehicle use survey and by an annual version of the Nationwide Personal Transportation Survey.

THE BOTTOM LINE

The extent to which BTS pursues these strategies will depend on the funding made available by Congress. If successfully pursued, these strategies will enable BTS to measure in a more complete, accurate, and timely manner the importance of transportation (including transportation's positive and negative consequences) and to provide insights to decisionmakers on how to make transportation better unite what geography divides.