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-