

## **APPENDIX A**

### **SUMMARY OF RECENT DATA NEEDS IDENTIFICATION EFFORTS**

## **A1. IRVINE, CALIFORNIA CONFERENCE**

A conference titled Information Needs to Support State and Local Transportation Decision Making into the 21st Century was held in Irvine, California, March 2-5, 1997. The conference was sponsored by several agencies — Transportation Research Board, Bureau of Transportation Statistics, Federal Highway Administration, Federal Transit Administration, American Association of State Highway and Transportation Officials, and Association of Metropolitan Planning Organizations. The proceedings of the conference was published by the Transportation Research Board in 1997.<sup>1</sup> The participants of the conference represented a variety of transportation-related organizations including state departments of transportation, metropolitan planning organizations, federal agencies, universities, and private consulting companies. The discussions and deliberations that took place at the conference covered a variety of issues related to transportation-related data including:

1. The types of data needed for planning and policy analysis;
2. Data collection requirements and methods;
3. Current data collection programs and institutional arrangements;
4. Improvements needed in data; and
5. Future trends.

The findings with regard to data needs are presented in the proceedings in an organized manner under different categories and subcategories. These findings are presented below in an itemized manner using the groupings and categories used in the report.

### **I. Socioeconomic Data**

1. Demographics
  - Emerging and critical population subgroups
  - Household characteristics of nonpermanent residents
  - Vehicle ownership and availability
2. Economics
  - Changes in patterns of building and development
  - Tax data that reflect economic activity
  - Military base abandonments and conversions
  - Housing market data
  - Tourists and visitors
  - Business establishments

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<sup>1</sup>*Information Needs to Support State and Local Transportation Decision Making into the 21st Century*, Proceedings of a Conference, Irvine, California, March 2-5, 1997. National Academy Press, Washington, D.C., 1997.

- Transportation investment to support business locations
  - Employment and worker characteristics
  - Geocoding of employment
  - Characteristics of multi-job holders
  - Labor force
  - Transportation access to employment opportunities
  - ES202 employment data
  - Shifts in population and employment
  - State-level employment and labor
3. Land Use
- Tax assessment data
  - Local land use policies
  - Economic development plans
  - Land use ratios per capita
  - Suitability of vacant land
  - Values of land overlaid against transportation improvements

## II. Financial Data

1. Revenue Forecasting
- Truck registration
  - Federal and state sales taxes
  - Sales and fuel tax revenues
  - Expenditures of fuel taxes by businesses and households
  - Long-range substate-level financial projections
  - Financial impact of transportation system pricing
  - Finance streams to support maintenance
  - Cash-flow prediction at all levels of government
  - Returns on different investment strategies
  - Toll charges and revenues
  - Carrier revenues
  - Data for toll facility analysis
2. Alternative Financing
- Statutory limits on creative financing
  - Public-private partnerships
  - Administrative costs associated with privatization
3. Cost and assets
- Capital and operating costs of transportation systems
  - Costs of programs and services
  - Infrastructure costs
  - Life-cycle costs
  - Costs of rights-of-way, construction, and raw materials
  - Capital costs
  - Expenditures by levels of government for each highway functional class
  - Expenditures by revenue source
  - Letting costs
  - Highway and other transportation cost allocation

### III. Supply and System Characteristics Data

#### 1. Networks and Facilities

- Geographic detail about the location and connectivity of transportation infrastructure
- Capacity and speed of network links and other facilities
- Operating restrictions by time of day
- Tolls and other facility-specific charges
- Functional class of each highway segment
- Condition measures for pavement, bridge, and other physical infrastructure
- Materials used in construction and maintenance
- Jurisdiction of each agency responsible for operation and maintenance of facilities

#### 2. Transportation Service

- Routes and schedules of fixed-route bus and rail services
- Area and time coverage of paratransit services
- Service operated in compliance with the Americans with Disabilities Act

#### 3. Intelligent Transportation System Infrastructure

- Facility-specific control systems
- Communication networks

#### 4. Linkages Between Transportation Systems and Areal Data

- Data on other systems in surrounding area

#### 5. Vehicle Fleets — Private and Public

- Characteristics and size of vehicle fleets of different modes
- Geographic distribution of vehicle fleets

### IV. Demand and Use Data

#### 1. User Behavior and Characteristics

- Activity by location
- Trip generation by age
- Journey to work by mode and trip length
- Latent demand and induced demand
- Time of day of travel
- Use of time and deferral of trips
- Trip chaining
- Work schedule changes, telecommuting and teleshoping
- Actual versus theoretical trip routing
- External travel distribution
- Local travel of out-of-town visitors
- Travel of people who move to warm climates in winter
- Customer satisfaction
- Network trips
- Transportation disadvantaged
- Changing trip generation characteristics
- Social characteristics of users by mode
- Demand characteristics of the elderly
- Usage characteristics by mode

2. Freight
  - Freight movement by mode: Inter- and intracity
  - Commodity flow
  - Freight demand by time
  - Origin-destination of international freight
  - Border crossing vehicles and their travel pattern
  - Port data
  - Cargo in transit through the United States
3. System Use
  - Vehicle types on different classes of roads
  - Temporal and origin-destination patterns of passengers and goods movement
  - Highway traffic counts and transit ridership
  - Personal trips by alternative modes
  - Occupancy of different types of vehicles
  - Vehicle miles traveled (VMT)
  - Travel time
  - Trip productions and attractions
  - Airport and ground access demand
  - Impact of urban design on travel behavior
  - Traffic impact of special events

## V. System Operation Data

1. System performance
  - Volume versus capacity by time of day
  - Travelers violating transit fare policies
  - Violations of high-occupancy vehicle restrictions
2. Reliability and Congestion
  - Travel time variations by mode and time
  - Characteristics of recurring and nonrecurring congestion
  - Economic impacts of congestion
  - Effects of human factors on traffic flow
  - Systemwide versus localized congestion management measures
  - Vehicle occupancy by hour
  - Responses to scheduled disruptions, special events, and incidents
3. Freight Operations
  - Turn around times at marine and air terminals
  - Factors affecting route choice
  - Delivery by trucks
  - Weight-in-motion systems and truck safety
  - Effect of just-in-time delivery requirements

## VI. Impact and Performance Data

1. Performance Measures
  - Travel times and speeds that the customer considers effective for all modes compared with perceived and actual times and speeds
  - Acceptable delay (for users) by time of day

- User costs
  - Value of user's time
  - User sensitivity to toll charges
  - Quality of trips from customer's perception
  - User mode preferences
  - User versus nonuser benefits
  - Customers' views about traffic calming strategies
2. Communities, Safety, and the Environment
    - Impact of different socioeconomic groups
    - Quality of life
    - Sustainability
    - Social impact of bicycling and walking
    - Negative impacts of transportation improvements
    - Accident rates by mode
    - Accident rates for auto passengers
    - Perceptions of safety and mode choice
    - Correlation of delay and accidents
    - System elements not harmful to the environment
    - Emissions data by mode
    - Acceleration/deceleration of modes
    - Transit ridership
    - User responses to Travel Demand Management and congestion pricing programs
    - System conduciveness to use of alternatives modes — bicycling, walking, ferries
    - Environmental justice
    - Important habitats
  3. Economic Impact
    - Economic impacts of congestion, especially on freight movement
    - Impact on personal and business incomes
    - Economic impacts of transportation programs for reduction of energy consumption and environmental degradation
  4. Freight Movements
    - Access to ports
    - Processing and permitting
    - Cross-border inspections

## A2. NCHRP REPORT 401

A research project sponsored by the National Cooperative Highway Research Program (NCHRP) titled Multimodal Transportation Planning Data, examined the availability of data needed to support statewide and metropolitan multimodal transportation planning along with a few other data related issues. One of the products of this report is NCHRP Report 401, *Guidance Manual for Managing Transportation Planning Data*.<sup>2</sup>

One of the contributions of the report is the presentation of a hierarchical classification system of various data items. The four major components of data identified in the report are:

1. Supply attributes;
2. Demand attributes;
3. System performance; and
4. System impacts.

Further stratifications of data and examples of individual data items for each of these components are presented below:

- I. Supply Attributes of Each Mode — Highway, Rail, Transit Systems, Ports and Inland Waterways, and Airports
  1. Systems Data
    - Guideways, routes, terminals, runways, etc.
    - Capacity
    - Land use for facility expansion
  2. Service Data
    - Access — connections to other modes
    - Intermodal access
    - Areas or cities served
    - Frequency of service
    - Service providers
    - Fare of fee structure
    - Drayage services
  3. Facilities Data
    - Inventory of stops/stations, rest areas, garages, etc.
    - Loading/unloading facilities
    - Vehicles
    - Berth facilities for boats and ships
    - Cargo storage facilities

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<sup>2</sup>Jack Faucett Associates, COMSIS Corp, and Mid-Ohio Regional planning Commission, *Guidance Manual for Managing Transportation Planning Data*, National Cooperative Highway Research Program Report 401. National Academy Press, Washington, D.C., 1997.

4. Condition Data
  - Pavement ratings
  - Bridge structures
  - Tunnel clearance
  - Vehicle age
  - Navigation aids
  - Channel depth and width
  - Lock condition
5. Project Data
  - State projects (proposed)
  - MPO projects (proposed)
  - Major investment data
  - Project evaluation data
  - Project maintenance data
  - Planned expansions and modifications
  - Project history data

## II. Demand Attributes

1. Economic Data
  - Income
  - Employment
  - Vehicle ownership
  - Travel cost
  - Locations of industries, wholesalers, etc.
  - Commodity production and consumption data
  - Export/import data by point of exit/entry
2. Demographic Data
  - Population and labor force
  - Housing characteristics
3. Land Use Data
  - Acreage
  - Housing
  - Employment
  - Zoning
  - Access data
4. Commodity Flow Data
  - Origin-destination
  - Modal split
  - Factors affecting modal split — modal rates, delivery time, etc.
5. Travel Data
  - Trip generation
  - Trip distribution
  - Special generators
  - Traffic volumes by time of day
  - VMT data by vehicle type, road type, time of day, etc.
  - Shipper modal selection factors



6. Travel Behavior Data
  - Mode choice
  - Route choice
  - User preference
  - Time of day of pickup and delivery
  - Carrier behavior

### III. System Performance Attributes

1. Safety Data
  - Incidents and accidents
  - Security
  - Medical services
2. Performance Measures
  - Performance of each mode — highway, transit, etc.
  - Intermodal system performance
  - Efficiency data by mode
  - User cost data
  - Delivery times by mode/intermodal
  - cargo damage
  - Terminal congestion
  - Shipment costs

### IV. System Impact Attributes

1. Air Quality Data
  - Vehicle registration by vehicle class, fuel type, etc.
  - VMT data by road class, time of day, etc.
  - Speed data by road class, vehicle class, time of day, geographic area, etc.
  - Trip data — cold versus hot starts, etc.
  - Emissions contributions by vehicle class, etc.
  - TCM effectiveness estimates
2. Other Environmental Data
  - Visual and aesthetic impacts
  - Noise and vibration impacts
  - Ecosystems
  - Archaeological and cultural impacts
  - Parklands
3. Land Use Data
  - Socioeconomic impacts
  - Neighborhood impacts
4. Energy Data
  - Energy consumption impacts by mode
  - Energy efficiency impacts by mode
  - Energy price impacts
5. Economic Growth Data
  - Local employment impacts
  - Regional employment impacts
  - Access to natural resources

- Access to domestic markets
- Access to ports and foreign markets

### **A3. HPMS REASSESSMENT WORKSHOP**

A national workshop was held in Minneapolis, Minnesota, in July 1997, to examine various aspects and issues involving the Highway performance Monitoring System (HPMS). The participants represented a variety of organizations — transportation agencies at the federal, state, and local levels; universities; research organizations; transportation consulting firms; etc. The three major themes of the workshop were:

1. HPMS mission, goals, and objectives;
2. Improving intergovernmental partnerships and data sharing; and
3. Future scope and scale of HPMS.

The discussions and deliberations of the workshop were organized under these three themes. The first two themes did not examine individual data items in detail. The third theme's scope included some individual data items although it also included many other issues of HPMS. The report titled *HPMS Reassessment Workshop/Steering Committee Meeting — Summary*,<sup>3</sup> captures the highlights of discussions at various general sessions and breakout groups. The report is published by the Federal Highway Administration, of the U.S. Department of Transportation. The major categories of data and some of the individual data items mentioned in this report are presented below.

The major categories of data that were mentioned included:

1. Vehicle miles traveled (VMT);
2. Pavement condition;
3. Congestion data; and
4. Safety data.

Several issues involving the use of HPMS generated VMT data for meeting the requirements of the Clean Air Act Amendments of 1990 were discussed at the workshop. The United States Environmental Protection Agency (USEPA) and the Federal Highway Administration (FHWA) have an agreement regarding the appropriate uses of HPMS VMT for air quality analyses. In some cases additional data, such as local traffic counts outside of HPMS sample counts may be used with the consent of FHWA and USEPA. VMT growth rates and the spatial and temporal allocation of VMT may be obtained from other methods such as travel demand models.

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<sup>3</sup>*HPMS Reassessment Workshop/Steering Committee Meeting — Summary*, Publication No. FHWA-PL-98-012. Office of Highway Information Management, Federal Highway Administration, U.S. Department of Transportation.

For pavement condition data, there are opportunities for improving current procedures used. The protocols developed by the American Association of State Highway and Transportation Officials may be useful for this purpose.

With regard to congestion data, it was mentioned that FHWA is moving away from using volume/capacity ratio as a measure of congestion. Alternative measures that are being considered include:

1. Travel time;
2. Travel speed; and
3. Delay.

The above listed data usually are available from an Intelligent Transportation System (ITS) on a real time basis. However, currently there are no protocols for retaining, managing, and sharing data generated by ITS. Procedures to incorporate ITS real time data into HPMS static data base should be examined/investigated.

There are different data bases for safety related data that are maintained by various agencies, including the National Highway Traffic Safety Administration. FHWA may be examining opportunities for reporting existing safety data through the HPMS.

#### **A.4. "ITS AS A DATA RESOURCE" WORKSHOP**

ITS America, in association with the Federal Highway Administration, Federal Transit Administration, and the Association of Metropolitan Planning Organizations, sponsored a Workshop entitled: *ITS As a Data Resource* on January 9 and 10, 1998. The Workshop identified opportunities for tapping data produced by Intelligent Transportation Systems for use in:

- ! Transportation Planning Applications (covering both highway and transit).
- ! Transportation Operations (including state and local traffic engineering).
- ! Commercial Vehicle and Intermodal Freight Planning.

The objectives of the Workshop were to:

- ! Bring transportation planners and operators together with representatives of the ITS community to discuss common data needs and concerns.
- ! Identify currently available ITS-generated data that can meet the data needs of transportation planners and operators.
- ! Identify opportunities for expanding ITS-generated data collection to meet additional data needs of planners and operators.

Workshop participants dealt with a variety of issues including:

- ! The nature of ITS-generated data that are now available, with particular emphasis on the data structures in the ITS National ITS Architecture.
- ! A discussion of the general data needs of transportation planners and operators.
- ! Matching available ITS-generated data with data needs.
- ! Discussing how additional data needs can be met by expanding ITS-generated data services.
- ! Levels of summarization that would have to be made to raw ITS-generated data to meet data needs.
- ! Computer resource requirements.

As preparatory information for the participants, three White Papers were developed: (1) *ITS Data for Freight Planning*, (2) *Using ITS-derived Data for Transportation Planning, Programming, and Operations*, and (3) *Use of ITS Data for Transit Planning*. In the first and third papers, a list of data needs were developed; these appear in the following tables.

Table A.1. Public Sector Freight Planning Data Needs

Function	Data Needs	Planning Application
Congestion management	Truck-hours of travel Average speed or travel rate (hours per kilometer) for truck Added truck-hours or truck-hours per kilometer due to congestion Truck transport cost (total, or per truck-kilometer, metric ton-kilometer, or dollar value of freight carried) Added cost due to congestion Transport time reliability Types of trucks and commodities caught in congestion Energy consumption for trucks: total or per truck-kilometer or metric ton-kilometer Emissions rates for trucks: total or per truck-kilometer or metric ton-kilometer	Understand impact of congestion on goods movement Understand contribution of trucks on urban congestion and air quality problems
Intermodal access	Volumes of trucks entering or exiting an intermodal facility Congestion-related delays on access roads to the facility Queuing counts related to the capacity of the facility Accident rates on access roads to the facility Travel time contours around the facility (e.g., driving distance within 30 minutes) Number of people living or working within x kilometers of the facility	Identify landside access improvement needs
Truck route designation and maintenance	Truck traffic volumes Origin/destination patterns Truck size and weight data	Identify high-volume truck routes and corridors Assess pavement damage and replacement needs
Safety mitigation	Accident rates Rail-grade crossings Low-clearance bridges Steep grades	Identify safety hazards and develop mitigation strategies
Economic development	Truck volumes Commodity movements Origin/destination patterns Shipping costs	Assess economic benefits and costs of freight transportation investment projects

**Table A.2. Data Needs of Transit Operators**

<b>Transit Planning Function</b>	<b>Data Elements/Messages</b>
Corridor Analysis planning	strategic transportation planning data (see Strategic/Business planning, below)
	travelers per vehicle data
	vehicle emissions data
	emissions impact data
	multimodal construction cost data
	multimodal construction cost projections
	multimodal operating cost data
	multimodal operating cost projections
	multimodal replacement/renewal cost data
	multimodal replacement/renewal cost projections
	multimodal performance data (reliability, performance, variation)
	multimodal performance projections
	multimodal travel/shipping cost data
	multimodal travel/shipping cost projections
	multimodal mobility impact data
	multimodal mobility impact projections
	multimodal land development impact data
	multimodal land development impact projections
	multimodal economic impact data
	multimodal economic impact projections
multimodal customer satisfaction projections	
Maintenance planning	system reliability data
	time-to-repair data
Market Research	strategic transportation planning data
	Corridor analysis planning data
	demographic data
	customer expectation data
	customer expectation projections
	highway performance data (O-D travel time, reliability)
	highway performance projections
	highway travel cost data
	highway travel cost projections
	airline performance data
	airline performance projections
	airline travel cost data
	airline travel cost projections
	competing transit carrier performance data
	competing transit carrier performance projections
	competing transit carrier travel cost data
	competing transit carrier travel cost projections
	transit performance data
	transit performance projections
	transit travel cost data
fare elasticity data	
fare elasticity projections	
transit travel cost projections	

**Table A.2. Data Needs of Transit Operators**

<b>Transit Planning Function</b>	<b>Data Elements/Messages</b>
New Project planning (including Major Investment Studies and environmental impact reports)	zoning data
	hardware/software maintenance data
	hardware/software reliability data
	construction cost data
	construction cost projections
	operating cost data
	operating cost projections
	replacement/renewal cost data
Operations planning (including day-to-day scheduling and headways)	replacement/renewal cost projections
	Ridership
	Accident data
	Claims data
	Maps
	Weather
	Demographics
	Passenger Travel Times
	Running Time
	Signal Timing
	Roadway Conditions
Service Disruptions	
Research and development planning	Time-to-market data
	Implementation time variance data (planned versus actual)
	capital cost variance data (planned versus actual)
	operating cost variance data (planned versus actual)
	performance variance data (planned versus actual)
	reliability variance data (planned versus actual)
Service planning (including route locations, scheduling and runcutting)	usage/utility variance data (planned versus actual)
	strategic transportation planning data
	corridor analysis planning data (above)
	transit market research/business planning data (above)
	crime statistics
	modal performance data
	modal performance projections
	modal operating cost data
	modal operating cost projections
	highway performance data
highway performance projections	



**Table A.2. Data Needs of Transit Operators**

Transit Planning Function	Data Elements/Messages
Strategic/Business planning	map data
	current demographics
	journey-to-work data
	journey-to-school data
	movement-of-goods data
	recreational travel data
	current travel demand
	current travel constraints
	land development strategy
	mobility management strategy
	zoning data
	forecast demographics
	forecast travel constraints