



CHAPTER 8

The State of Transportation Statistics

Highlights

- Progress is being made on the availability of transportation statistics, such as the establishment of an annual Port Performance Freight Statistics Program and implementation of the Repository and Open Science Access Portal, but long-standing information gaps remain.
- Extensive data are available on local passenger travel and most long-distance freight movement, but data gaps persist for most forms of long-distance surface passenger travel, domestic movement of international trade, and local freight movement.
- Cost data are available for most forms of passenger travel, but are limited for freight movement.
- Substantial data are available on crashes related to transportation, but the availability of data on causation of safety problems varies by mode of transportation, and the integration of data on motor vehicle crashes, the conditions surrounding each crash, and consequences of the crash remains elusive.
- “Big data” and other alternative data sources may offer ways to update, validate, and improve the detail of traditional statistics. Research is needed to determine the reliability and validity of statistics derived from blended sources, to establish institutional arrangements for access to large proprietary databases, and to integrate these new data sources with traditional forms of data and analysis to provide effective information for decision makers.
- The Bureau of Transportation Statistics (BTS) has achieved significant progress in improving the state of transportation statistics over the last 25 years and will continue to create increasingly robust, timely, credible statistics that support evidence-based decision making and that are useful and used throughout the Nation.

Congress requires that the *Transportation Statistics Annual Report* includes an assessment of the state of transportation statistics and efforts to improve those statistics. Transportation statistics cover the following:

- transportation safety;
- the state of good repair of transportation infrastructure;
- the extent, connectivity, and condition of the transportation system;
- economic efficiency across the entire transportation sector;
- the effects of the transportation system on global and domestic economic competitiveness;
- demographic, economic, and other variables influencing travel behavior;
- transportation-related variables that influence the domestic economy and global competitiveness;
- economic costs and impacts for passenger travel and freight movement;
- intermodal and multimodal passenger movement;
- intermodal and multimodal freight movement; and
- consequences of transportation for the human and natural environment.¹

This chapter reviews the current strengths and weaknesses of transportation statistics, identifies major gaps in those statistics, and

¹ 49 U.S.C. § 6302(b)(3)(B)(vi)

explores new data sources that could be used to fill the gaps. The chapter concludes with transportation perspectives on recent recommendations of the Commission on Evidence-Based Policymaking.

Strengths and Weaknesses of Current Statistics on the Extent, Use, Condition, and Performance of the Transportation System

Table 8-1 summarizes existing statistics on the extent, use, condition, and performance of the transportation system as well as gaps in those statistics. Statistics are generally available to the public for aviation, highways, transit systems, and waterways because the Federal Government operates the aviation and inland waterway systems and provides financial assistance for highways and transit systems. Publicly available statistics on railroads and ports are limited because those entities are either privately owned or privately operated on leased public facilities.

BTS publishes the underlying data on the extent and characteristics of the Nation's transportation network in the National Transportation Atlas Database (NTAD). Until 2016 the NTAD was published once each year, but now BTS has established a system to update the NTAD continuously as new geo-spatial data files are made available. BTS has also added the National Transit Map to the NTAD in 2016, filling a long-standing data gap.

While extensive statistics exist on the extent, use, condition, and performance of the transportation system, some of the underlying data are collected for different reasons and are

TABLE 8-1 Statistics on the Extent, Use, Condition, and Performance of the Transportation System

Topic	Coverage of existing statistics	Major gaps in existing statistics	Why the gaps matter
Extent of and geographic access to the transportation system	<ul style="list-style-type: none"> Multiple versions of the highway and rail networks Detailed representation of the waterway network Intermodal passenger connectivity database National Transit Map 	<ul style="list-style-type: none"> Piecemeal representation of intercity bus networks Little data on availability of social service and non-profit transportation; taxi and taxi-like services 	<ul style="list-style-type: none"> Identify portions of the transportation network that are vulnerable to disruption Identify localities that are isolated from economic opportunities, social services, and upward mobility
Vehicle, aircraft, train, and vessel volumes	<ul style="list-style-type: none"> Number of vehicles on highway segments Number of aircraft by airport; number of car-loadings by rail segment; number of vessels by port and waterway 	<ul style="list-style-type: none"> Inconsistent differentiation among types of highway vehicles (car, bus, truck) Market penetration of motor vehicle automation equipment 	<ul style="list-style-type: none"> Different vehicle types have very different consequences for traffic flow and congestion, pavement and bridge wear, exposure to safety risks, and air quality Motor vehicle automation has major implications for safety
Condition and performance	<ul style="list-style-type: none"> Condition and reliability of highways by segment, transit by property, and inland waterways by facility Reliability of commercial aviation by flight and airport and by causes of delay 	<ul style="list-style-type: none"> Condition and reliability of freight railroads Non-comparable capacity data across ports Condition of urban bus and rail transit maintenance facilities, and rail transit infrastructure Comprehensive metrics for identifying network resiliency 	<ul style="list-style-type: none"> Identify bottlenecks, vulnerabilities to disruption, and other potential losses of efficiency in moving freight and passengers to guide investments in transportation facilities and rolling stock

not comparable across parts of the system. In response to the lack of comparable data on ports, Congress directed BTS, in the *Fixing America’s Surface Transportation (FAST) Act of 2015*, to establish a port performance freight statistics program to annually publish nationally consistent measures of port capacity and throughput.² As required by the FAST Act, BTS convened a working group that recommend measures and methods for obtaining the measures, and published the recommendations and initial statistics in the first annual report [USDOT BTS 2017a].

Most current and planned statistics on performance are from the perspective of those

who build and operate the transportation system. This perspective is important but incomplete unless it is complemented by performance measures from the user’s perspective. For example, a system designed to spread delay evenly over all travelers may be better tolerated than a system that concentrates the same total delay on only a portion of the travelers, causing missed connections, deliveries, or appointments. Delay also matters more for some purposes than others. Delay is critical for responses to medical emergencies but may only be a minor irritant for leisurely sightseeing. In freight transportation, delay is generally a greater problem for perishable or high-valued goods than for bulk commodities. Statistics on travelers, shippers, and carriers

² Section 6018 of Public Law 114-94, Dec. 4, 2015

who use the transportation system, on the purposes of travel, and on the goods being moved are required to understand whether problems with transportation system performance warrant public action.

Strengths and Weaknesses of Current Statistics on Passenger Travel

Table 8-2 summarizes existing statistics on passenger travel and gaps in those statistics. Existing statistics include total travel on sections of the transportation system and characteristics of the travelers and trips.

National statistics on total travel by portion of the transportation system are drawn from sources, such as the border crossing data from Customs and Border Protection [USDHS CBP OFO 2015], the Federal Transit

Administration’s National Transit Database [USDOT FTA NTD 2014], the BTS monthly passenger enplanement data [USDOT BTS 2012a], and the National Census of Ferry Operators [USDOT BTS 2017c].

Statistics on the characteristics of travelers and trips come from the National Household Travel Survey (NHTS), sponsored mainly by the Federal Highway Administration (FHWA) and several states and metropolitan planning organizations [USDOE ORNL 2015]. The NHTS collects information on individual trips and the demographic and other characteristics of the traveler that influence his or her decision on when, how, and how far to travel. Although the NHTS collects all personal travel taken by all modes of transportation, it mainly captures local travel. The high cost of conducting this type of nationwide survey has limited

TABLE 8-2 Transportation Statistics on Passenger Travel

Topic	Coverage of existing statistics	Major gaps in existing statistics	Why the gaps matter
Intercity and international travel	<ul style="list-style-type: none"> Volumes and origin-destination patterns of commercial aviation passengers Amtrak ridership Volumes of people and number of motor vehicles at border crossings 	<ul style="list-style-type: none"> Origins, destinations, and volumes of travelers by personal vehicles, buses, and general aviation Amount of travel by demographic characteristics of travelers Domestic travel of international visitors by traveler and trip characteristics 	<ul style="list-style-type: none"> Guide investments in airports, intercity rail passenger service, and interregional highways Maximize the economic benefits of travel and tourism Evaluate regulations related to the total contribution of local and long-distance travel to safety risks and environmental problems
Local travel	<ul style="list-style-type: none"> Sporadic national volumes and demographic patterns of travelers by type of place Transit ridership by property Detailed origin-destination patterns of journeys-to-work and demographic characteristics of commuters Geographic and demographic patterns of all resident travelers in metro areas that have conducted local surveys 	<ul style="list-style-type: none"> Pedestrian and bicycle travel Local travel other than commuting in metro areas that have not conducted local surveys Ridership and social and economic benefits of transportation services provided by social service and non-profit organizations Growth of ride-hailing and relationship to transit ridership 	<ul style="list-style-type: none"> Guide investments in streets and public transportation Manage exposure to safety risks Provide physical connections between mobility-challenged citizens and services and employment opportunities

the frequency of this survey to once every 5 to 8 years. Despite these limitations, NHTS remains the only national source that provides the comprehensive data needed to understand travel decisions and predict travel demand. NHTS data collected in 2017 will be released in 2018.

The Census Bureau’s American Community Survey (ACS) is another commonly used source of passenger travel information. The ACS collects commute-to-work data from an annual survey of the population. This survey provides small-area information every

year, unlike the once-per-decade information formerly provided by the decennial census. The ACS also provides statistics for small units of geography aggregated over several years, while metropolitan statistical areas are the most detailed level of geography covered by the NHTS [USDOC ACS 2011].

Strengths and Weaknesses of Current Statistics on Freight Movement

In addition to travelers, the transportation system serves the movement of freight. Table 8-3 summarizes existing statistics on freight

TABLE 8-3 Transportation Statistics on Freight Movement

Topic	Coverage of existing statistics	Major gaps in existing statistics	Why the gaps matter
International freight movement	<ul style="list-style-type: none"> Volumes and value of freight at international gateways Value of trade by country 	<ul style="list-style-type: none"> Domestic transportation of international trade, including domestic leg of imports, exports, and movements between foreign origins and destinations that pass through the United States 	<ul style="list-style-type: none"> Support connections between local and global economies Assess the role international flows play in domestic travel Assess the role of transportation in U.S. international economic competitiveness
Intercity freight movement	<ul style="list-style-type: none"> Tonnage and value of region-to-region flows by commodity and mode 	<ul style="list-style-type: none"> County to county flows of freight by truck Relationships between industry supply chains and region-to-region commodity flows Highway routes used between specific origins and destinations by vehicle type Pipeline volumes by segment 	<ul style="list-style-type: none"> Guide investments in transportation facilities Give local economies access to suppliers and markets Manage exposure to safety risks Understand the consequences of safety and other regulations Expand access to international opportunities of poorly served areas Diagnose and address freight bottlenecks that are barriers to economic development and competitiveness Pipeline volumes affect markets of competing modes and exposure to safety risks
Local freight movement	<ul style="list-style-type: none"> Freight movement only where state and metro area surveys are conducted 	<ul style="list-style-type: none"> County-to-county and intracounty flows of freight Freight passing through the local area to and from distant locations 	<ul style="list-style-type: none"> Guide investments in last-mile transportation facilities Support local supply chains Assess the impacts on local congestion of freight movements Manage exposure to safety risks

movement and gaps in those statistics.

Due to the magnitude and complexity of freight transportation, no single data collection provides a comprehensive picture of annual freight movement from origin to destination by all modes of transportation and by all commodity types. Among the various data sources, the Commodity Flow Survey (CFS), cosponsored by BTS and the Census Bureau, provides the most comprehensive coverage of U.S. freight flows. The CFS is the only source of nationwide data on domestic freight shipments by manufacturing, mining, wholesale, and selected retail industries covering all modes of transportation. It also provides comprehensive data on domestic hazardous material shipments. The CFS is conducted every 5 years as part of the Economic Census.

The Freight Analysis Framework (FAF) builds on the CFS to provide national estimates of total freight movement by mode of transportation and type of commodity for over 130 regions based on states and metropolitan areas. The CFS covers roughly two-thirds of the tonnage and value measured in the FAF. The remaining freight is measured from multiple, publicly available data sources, such as the data on freight flows across U.S. land borders and data on the international movement of air cargo collected by BTS [USDOT BTS 2012b].

The FAF is based on observed data wherever possible, but must turn to models and assumptions to fill the remaining data gaps in the 5-year benchmarks and to make annual updates and forecasts. Among the data gaps in the 5-year benchmarks requiring significant

modeling are shipments from farms, the movement of municipal solid waste, and the domestic transportation of foreign trade. While movements of goods between U.S. international gateways and foreign countries are tracked continuously, movements of international trade between gateways and domestic origins for exports and domestic destinations for imports have not been observed directly since the 1970s. The FAF includes benchmarks every 5 years based on the CFS, annual estimates, and 30-year forecasts.

The freight system is undergoing significant changes as online shopping becomes more prevalent and new delivery technologies are deployed. New forms of data collection may be required to capture potential changes in freight flows caused by e-commerce, shifts in supply chains, and other developments in the economy.

Strengths and Weaknesses of Current Statistics on Transportation's Role in the Economy

Table 8-4 summarizes existing statistics on the role of transportation in the economy and gaps in those statistics. Statistics cover how much the Nation spends on transportation, how transportation costs have changed, how many people are employed in transportation companies and occupations, and how transportation contributes to economic output.

Transportation's role in the economy is derived from statistics on expenditures by households and businesses for transportation services, employment in transportation industries and occupations, and the value of transportation

TABLE 8-4 Statistics on Transportation’s Role in the Economy

Topic	Coverage of existing statistics	Major gaps in existing statistics	Why the gaps matter
Transportation capital stocks	<ul style="list-style-type: none"> National estimates of the value of transportation capital stocks State inventories of public capital stocks for asset management systems 	<ul style="list-style-type: none"> National economic return on future capital stock investment by mode Economic return to states on facility specific investments 	<ul style="list-style-type: none"> Fiscally constrained public investment is hampered by inability to match transportation investments to economic returns.
Transportation expenditures and investments	<ul style="list-style-type: none"> Total transportation expenditures and investments by households, businesses, and government 	<ul style="list-style-type: none"> Borrowing by public and private entities to support transportation investment 	<ul style="list-style-type: none"> Capacity of financial system to support public and private investments in transportation
Transportation costs and prices	<ul style="list-style-type: none"> Gasoline and diesel prices Costs of automobile ownership Air carrier costs for selected categories For-hire carrier price indices Cost to maintain highway, transit and waterway condition 	<ul style="list-style-type: none"> Trucking costs by type of cost Rail costs based on actual operating expenses rather than regulatory formula Comprehensive costs for bus, general aviation, pipeline Cargo damage and loss Comprehensive estimates of cost savings from congestion reduction. 	<ul style="list-style-type: none"> Cost data are used by businesses and consumers to make transportation choices and by government to identify the economic consequences of transportation investments and regulations
Transportation’s contribution to the economy	<ul style="list-style-type: none"> Transportation as a share of Gross Domestic Product by sector of the economy Transportation embedded in other industries (the Transportation Satellite Account) Transportation employment 	<ul style="list-style-type: none"> Economic and social activity enabled by transportation Value travel time by households using the transportation system 	<ul style="list-style-type: none"> Input to establishing the appropriate size of investment programs and levels of revenue collection

to the economy. These statistics come from the Census Bureau, the Bureau of Economic Analysis (BEA), and the Bureau of Labor Statistics, each of which treats transportation as a significant sector of the economy.

For-hire transportation is one of the many sectors covered in the Economic Census, conducted every 5 years. This sector is also covered in the Census Bureau’s Services Annual Survey, which collects operating revenue and other industry-specific data. BEA uses these data to estimate the flow of expenditures among sectors of the economy in order to understand how changes in the costs in a specific sector affect the rest of the

economy. BTS expands on this accounting in its Transportation Satellite Account to include the sizable contribution to the economy made by in-house transportation services within non-transportation industries, such as truck fleets operated by large retail companies. BTS also estimates the economic contribution of personal transportation that falls outside the standard accounting of gross domestic product.

Transportation is not often highlighted in monthly national economic statistics. To provide a perspective on transportation’s role in a dynamic economy, BTS developed the monthly Transportation Services Index (TSI) [USDOT BTS 2012c]. This index is based on

activity in all modes of for-hire passenger and freight transportation services, and affords a better understanding of the relationship between transportation and the current and future course of the economy.

Strengths and Weaknesses of Current Statistics on the Unintended Consequences of Transportation

In addition to the intended economic activity that transportation creates, transportation has unintended impacts on safety, energy consumption, the environment, and

communities. Table 8-5 summarizes existing statistics and gaps in those statistics.

Of the unintended consequences, safety is the main focus for several of the largest statistical programs in the U.S. Department of Transportation (USDOT). The National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration (FMCSA) account for 40 percent of the expenditures on major statistical programs in the Department [EOP OMB 2015]. The Pipeline and Hazardous

TABLE 8-5 Statistics on the Unintended Consequences of Transportation

Topic	Coverage of existing statistics	Major gaps in existing statistics	Why the gaps matter
Safety	<ul style="list-style-type: none"> • Transportation fatalities and injuries for all modes • Safety incidents involving hazardous materials; precursor events (close calls) for aviation, selected transit, and off-shore oil extraction and transport 	<ul style="list-style-type: none"> • Risk factors • Exposure by type of safety risk • Precursor events (close calls) for most forms of surface transportation • Disabilities and medical costs related to transportation injuries 	<ul style="list-style-type: none"> • Effective reduction of transportation-related casualties and property loss depends on detailed understanding of safety risks and causes of safety incidents • Measures of safety program effectiveness guide public investments and regulations
Energy consumption, green house gasses, air quality	<ul style="list-style-type: none"> • Air quality by type of pollutant and airshed • Relationship of vehicle emissions to type of vehicle and vehicle speed 	<ul style="list-style-type: none"> • In-use fuel economy and emissions • Amount of vehicle travel by type of vehicle and vehicle speed in each airshed 	<ul style="list-style-type: none"> • Estimates of air quality issues are based primarily on laboratory conditions and assumed operating patterns and should be tested against actual operating conditions
Noise, water quality, habitat dislocation	<ul style="list-style-type: none"> • Noise footprints around airports • National Transportation Noise Map • Environmental disruptions related to individual transportation projects 	<ul style="list-style-type: none"> • Impacts of new street lighting technology • Natural habitat disruption 	<ul style="list-style-type: none"> • Deployment of LED street lights raises community concerns with environmental quality and health issues • Geographic distributions of habitat disruption identify mitigation investment needs and target mitigation measures
Community disruption	<ul style="list-style-type: none"> • Social and economic characteristics of populations adjacent to transportation facilities 	<ul style="list-style-type: none"> • Social and economic connections among urban neighborhoods and among rural locations 	<ul style="list-style-type: none"> • Improve planning to avoid or mitigate community disruption from transportation facilities and to provide physical connections between mobility-challenged citizens and services and employment opportunities

Materials Safety Administration (PHMSA) and FHWA also have large-scale safety programs in place. Altogether, the Department's annual expenditures on safety data exceed \$50 million.

In addition to its long-standing safety data programs, USDOT is exploring new sources of information and new analytical strategies to better understand safety risks. The Safety Data Initiative includes pilot efforts to integrate and analyze large databases, including real-time data sets that have not been previously tapped for risk analysis. The initiative focuses primarily on highway safety, which accounts for the preponderance of transportation fatalities.

In comparison to highway fatalities, the relatively low fatality rates of commercial aviation, railroads, transit, and pipelines do not reduce the need for data to understand risks and maintain or improve the safety of these modes. The focus of data programs for these modes goes beyond determining causes of infrequent crashes to understanding circumstances surrounding near misses or other mishaps that could have resulted in a serious incident. To identify safety problems and develop information for mitigating those problems, BTS provides a close calls reporting system that allows individuals and companies to report problems without fear of retaliation. Anonymity of respondents is assured under the *Confidential Information Protection and Statistical Efficiency Act*.³ The Metrorail and bus operations of the Washington Metropolitan Area Transit Authority and the off-shore oil extraction industry currently use this BTS authority and service.

³ Title V of Public Law 107-347, Dec. 17, 2002

The areas of energy consumption and related environmental emissions are another focus of statistics on unintended consequences of transportation. The transportation sector accounts for more than two-thirds of the petroleum consumed in the country and produces between one-quarter and one-third of all of the carbon dioxide (CO₂) emitted by the Nation's energy consumption. The U.S. Department of Energy has a major data program that tracks energy consumption by transportation sector [USDOE EIA 2015], and transportation's contributions to greenhouse gases and other emissions are tracked by the Environmental Protection Agency [USEPA OTAQ 2015]. While individual agencies compile information to meet specific needs, integrating these data and developing analytical techniques from many disciplines are the keys to effectively using these data sources to reduce transportation-related energy consumption and emissions. For example, the relationships between vehicle usage patterns and energy usage intensity are crucial to measuring and assessing the effectiveness of different energy and emission reduction opportunities and policies. Unfortunately, with the discontinuation of the Vehicle Inventory and Use Survey (VIUS) in 2002, much of the data necessary to help make these assessments are now at least 15 years out of date [USDOC CB VIUS 2002]. A plan by BTS and its partners to revive the VIUS is currently under consideration. An influx of new VIUS data might prove invaluable for tracking the deployment of driver assistance technology for collision avoidance, lane tracking, and other steps toward full vehicle automation. The VIUS is also essential for measuring

the economic activities performed by motor vehicles.

Energy and safety concerns converge in the transportation of crude petroleum, ethanol, and other hazardous cargos by railroad. In response to the FAST Act,⁴ BTS worked with the Association of American Railroads to measure the use of tank cars for carrying these cargos—distinguishing tank cars that meet new standards from those that have not yet been brought up to standard. BTS published summary statistics in its first annual report [USDOT BTS 2017b]. BTS is also collecting data that tracks the construction of new tank cars and the conversion of old tank cars to the new standards.

Statistical Information Gaps and Challenges

Considering the wide range of transportation data sources and information needs for public decisions, key gaps in statistical information are apparent:

- Long-distance, intercity travel remains poorly measured for surface modes of transportation.
- Understanding the domestic movement of international trade is based on models and assumptions more than on data from observations.
- Basic performance measures for public use are much improved for some modes, such as trucking and commercial aviation, but are lacking for other modes, such as freight railroads.
- Cost data are available for most forms of

passenger travel but are limited for freight movement.

- The value of transportation to the economy and society is poorly articulated.
- Availability of data on causation of safety problems varies by mode of transportation.
- Integration of data on motor vehicle crashes, the conditions surrounding each crash, and consequences of the crash remains elusive.
- Data on highway vehicle use by vehicle characteristics, type of user, energy consumed, and economic activity have not been collected since 2002.

Of the major data gaps, intercity passenger travel is particularly significant. While data are available on the number of trips on commercial aircraft and intercity rail, long-distance travel in personal vehicles, intercity bus, and general aviation are poorly understood. The demographic characteristics of the long-distance traveler by any mode have not been measured for almost two decades. The last survey of intercity travel was conducted in 1995. As a consequence, current discussions about trends in passenger travel and the consequences of travel are dominated by measures of local travel. This limitation may result in misguided conclusions because long-distance travel involves different trip purposes and conditions than local travel, and one long-distance trip can generate as many miles of travel as dozens or even hundreds of local trips. Without information on long-distance travel, decision makers do not know how local congestion affects long-distance travel, how long-distance travel contributes to

⁴ Section 7308 of of Public Law 114-94, Dec. 4, 2015

local congestion and the local economy, and how the total of local and long-distance travel contributes to safety risks and environmental problems.

The tables in this chapter include many areas of improved statistical information in recent years. The FAF, built primarily on data collected by BTS, provides a comprehensive picture of goods movement throughout the United States. The Transportation Satellite Account, featured in chapter 6, provides a more complete accounting of transportation's role in supporting other sectors of the national economy. The safety tables in *National Transportation Statistics* enumerate fatalities and injuries across all modes of transportation with double counting removed.

Other BTS contributions in 2017 to improved statistical information include:

- Publication in January of the first *Port Performance Freight Statistics Program Annual Report* [USDOT BTS 2017a].
- Release in March of the first edition of the National Transportation Noise Map and Database.
- Publication in September of the first annual report on *Fleet Composition of Rail Tank Cars that Transport Flammable Liquids* [USDOT BTS 2017b].
- Implementation in October of the Repository and Open Science Access Portal (ROSA-P), providing access to full-text electronic publications, datasets, and other resources for the transportation community, including all USDOT-funded research under the USDOT Public Access Plan.

- Release in November of the biennial National Census of Ferry Operators [USDOT BTS 2017c].
- Innovative use of vessel tracking data from the U.S. Coast Guard's Automatic Identification System (AIS) for measuring ship dwell times in the second edition of the *Port Performance Freight Statistics Program Annual Report* and for measuring route miles in the National Census of Ferry Operators.
- Enhancement throughout the year of the BTS website for improved access to transportation statistics.

Efforts to improve statistical information are underway throughout USDOT. For example, FHWA completed data collection for a new NHTS and has launched a major content review of its Highway Performance Monitoring System. Efforts to improve data management in support of statistical information are also underway, such as NHTSA's implementation of an Electronic Data Transfer Pilot to establish direct links between State and NHTSA databases for improved quality, reduced costs, and improved timeliness.

BTS and its partners are exploring data sources beyond traditional surveys to fill information gaps. These sources include:

- Administrative records, such as vehicle registration files and police reports from highway crashes.
- Sensors, such as the rubber hoses stretched across highways to count traffic, engine monitors to estimate fuel economy, and the

positions reported by cell phones to track travel and by transponders to track ships and aircraft.

- Imagery, such as traffic monitoring cameras and satellite photos.
- Crowd sourcing, such as Open Street Map for tracking changes in the highway network and Waze for tracking highway disruptions.
- Web scraping, such as the Billion Prices Project, to track the prices of consumer goods.

While these data sources show great promise, the availability of data alone does not assure that robust statistics exist to help answer the questions of decision makers. Significant quality issues, inadequate methods for analyzing data to create useful information, and confidentiality concerns can undermine the effectiveness of these data for credible, public statistics.

Statistical agencies have extensive, well-established methods identifying and controlling for error in data from sample surveys, but not for dealing with error in data from sources other than surveys. Some sources of error in alternative data sources are analogous to those found in surveys; for example, sensor failure can be treated like survey non-response. Other sources of error may require very different approaches to identification and correction. The challenge is compounded when data are blended from many sources for an estimate: might the individual sources of error cancel each other out or compound one another? The Federal Committee on Statistical Methodology is working to establish a framework in

2018 for identifying and measuring error in alternative and blended data.

BTS and its partners are also exploring new analytical methods for creating useful information from the new data sources. Frequently labeled “big data analytics,” these methods were originally developed to make short-term forecasts from very large datasets. These methods are being adapted by private shippers to monitor and manage supply chains, and are now being explored by public agencies as early indicators of changing social and economic conditions and of emerging safety problems. The potential for adapting these forecasting methods to prediction and understanding of complex, uncontrolled transportation phenomena remains unproven. In any case, traditional statistical methods are still needed to avoid confusing correlation with causation and misleading public decisions.

All data sources and estimation methods have quality issues, and understanding whether the quality problems are large or small is central to appropriate uses and to credibility of the resulting statistics. Credibility also depends on the perception that the information is free of political influence. To assure objectivity, the Office of Management and Budget exempts the products of BTS and all other principle federal statistical agencies from political review through Statistical Policy Directive No. 1 [EOP OMB 2014].

Evidence-Based Policy Making

Congress directed BTS to ensure that the Bureau’s statistics support transportation

decision making.⁵ This mandate is consistent with the current emphasis of the Congress and the Executive Branch on evidence-based decision making throughout the Federal Government. “Agencies are encouraged to allocate resources to programs and practices backed by strong evidence of effectiveness while trimming activities that evidence shows are not effective” [EOP OMB 2013a]. Congress established a Commission on Evidence-Based Policymaking in 2016 to recommend approaches for integrating administrative, survey, and other data into evidence of the effectiveness of public programs.⁶

The Commission’s final report, issued in 2017, recommends:

- establishment of an annual “learning agenda” and a chief evaluation officer in each executive department to develop evidence on the effectiveness of the department’s programs;
- establishment of a National Secure Data Service to facilitate access to confidential data for developing evidence while protecting confidentiality and assuring transparency of evidence-building methods;
- adoption of state-of-the-art database, cryptography, and privacy-preserving, and privacy-enhancing technologies for confidential data used in decision making;
- use of administrative data collected from states for statistical purposes; and

- improvements to administrative processes and changes to statutes to further the development of evidence.

The Commission also recommends that each department assign a Principal Statistical Agency head or other appropriately qualified senior official to coordinate access to and stewardship of the department’s data resources for evidence building in collaboration with senior department information technology, privacy, and other leaders [CEP 2017]. The Service and Methods Demonstration Program for transit in the 1970s is one approach that USDOT could use for establishing a multimodal learning agenda for transportation [USDOT UMTA 1979].

Looking Ahead

The transportation community must juggle the demands of evidence-based decision making and the development and interpretation of new data sources with the maintenance and improvement of traditional statistics on which decision makers and planners are dependent. BTS has direct control over a small portion of the data sources highlighted in this chapter, but it has a leadership role in many external data sources as the principal Federal statistical agency for transportation [EOP OMB 2014].

While other prominent data programs exist in USDOT:

- BTS is the Department’s only source of statistics that covers all modes of transportation.
- BTS is the Federal Government’s primary source of original information on commercial aviation.

⁵ 49 U.S.C. § 6302(b)(3)(B)(i)

⁶ Public Law 114-140, Mar. 30, 2016

- BTS is the only part of USDOT that is designated by the Office of Management and Budget (OMB) as a Principal Federal Statistical Agency and covered by all Statistical Policy Directives.

BTS recognizes that it must evolve its statistical products, data collection methods, and expertise to provide effective services to the transportation community in a rapidly changing world. As a 21st Century statistical agency, BTS must:

- Provide fresh, recent information in small bytes.
- Be flexible and nimble to address emerging issues.
- Focus on new technology for collection and delivery of information, especially through mobile devices and apps.
- Adhere to Statistical Policy Directives of the Office of Management and Budget to assure that statistics are objective, accurate, timely, and credible.

Toward these ends, BTS will expand its statistical products, publish to the web immediately rather than wait for printed reports, continue to streamline its data processing procedures, and implement new ways for the transportation community to find and use information on the BTS website. BTS will also continue to operate and improve the National Transportation Library, which is making transportation information, statistics, databases, and research findings from throughout USDOT transparent and accessible to the public under the government-wide Open Data Policy [EOP OMB 2013b]. All BTS

products and the collections of the National Transportation Library are available on the internet at www.bts.gov.

As resources permit, BTS is undertaking research to explore alternative data sources and new methods of estimating statistics on the extent and use of the transportation system and on the consequences of transportation. New data sources are critical for replacing surveys that suffer from declining response rates and increasing costs. BTS is looking at new approaches to measure phenomena, such as passenger travel and freight movement, for which traditional surveys are decreasingly effective. BTS is working with the other principal Federal statistical agencies to explore the use of administrative records, data from sensors, and advanced data mining analytics. BTS has initiated a major research program to develop methods for supplementing and enhancing portions of the FAF and reducing respondent burden for the CFS in 2022. In addition to research, BTS is continuing to work with its partners in USDOT and the principal Federal statistical agencies to identify and resolve significant problems with comparability and quality of transportation statistics.

BTS recognizes the need to take a more active role with its partners to assist with performance measurement and evidence-based decision making. BTS provides statistical expertise to advise the design of performance measures and program evaluations, portals to data that can be used in performance measurement and program evaluations, and public access to statistics created by performance measurement and program evaluations.

BTS has achieved significant progress in improving the state of transportation statistics over the last 25 years. The Bureau will continue to strive in the years ahead to create increasingly robust, timely, credible products in each of the topic areas identified in legislative mandates and departmental goals. BTS will continue to enhance timeliness, improve the quality of its products, and produce statistics that are useful, relevant, and used throughout the Nation.

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GLOSSARY

Air carrier: Certificated provider of scheduled and nonscheduled services.

Alternative fuel (vehicle): Nonconventional or advanced fuels or any materials or substances, such as biodiesel, electric charging, ethanol, natural gas, and hydrogen, that can be used in place of conventional fuels, such as gasoline and diesel.

Arterial: A class of roads serving major traffic movements (high-speed, high volume) for travel between major points.

Block hours: The time elapsed from the moment an aircraft pushes back from the departure gate until the moment of engine shutoff at the arrival gate following its landing.

Bus: Large motor vehicle used to carry more than 10 passengers, including school buses, intercity buses, and transit buses.

Capital stock (transportation): Includes structures owned by either the public or private sectors, such as bridges, stations, highways, streets, and ports; and equipment, such as automobiles, aircraft, and ships.

Chained dollars: A method of inflation adjustment that allows for comparing in dollar values changes between years.

Class I railroad: Railroads earning adjusted annual operating revenues for three consecutive years of \$250,000,000 or more, based on 1991 dollars with an adjustment factor applied to subsequent years.

Commercial air carrier: An air carrier certificated in accordance with Federal

Aviation Regulations Part 121 or Part 127 to conduct scheduled services on specified routes.

Commuter rail: Urban/suburban passenger train service for short-distance travel between a central city and adjacent suburbs run on tracks of a traditional railroad system. Does not include heavy or light rail transit service.

Consumer Price Index (CPI): Measures changes in the prices paid by urban consumers for a representative basket of goods and services.

Current dollars: Represents the dollar value of a good or service in terms of prices current at the time the good or service is sold.

Deadweight tons: The number of tons of 2,240 pounds that a vessel can transport of cargo, stores, and bunker fuel. It is the difference between the number of tons of water a vessel displaces “light” and the number of tons it displaces when submerged to the “load line.”

Demand-response: A transit mode comprised of passenger cars, vans, or small buses operating in response to calls from passengers or their agents to the transit operator, who then dispatches a vehicle to pick up the passengers and transport them to their destinations.

Directional route-miles: The sum of the mileage in each direction over which transit vehicles travel while in revenue service.

Directly operated service: Transportation service provided directly by a transit agency, using their employees to supply the necessary labor to operate the revenue vehicles.

Distribution pipeline: Delivers natural gas to individual homes and businesses.

E85: A gasoline-ethanol mixture that may contain anywhere from 51 to 85 percent ethanol. Because fuel ethanol is denatured with approximately 2 to 3 percent gasoline, E85 is typically no more than 83 percent ethanol.

Energy intensity: The amount of energy used to produce a given level of output or activity, e.g., energy use per passenger-mile of travel. A decline in energy intensity indicates an improvement in energy efficiency, while an increase in energy intensity indicates a drop in energy efficiency.

Enplanements: Total number of revenue passengers boarding aircraft.

Expressway: A controlled access, divided arterial highway for through traffic, the intersections of which are usually separated from other roadways by differing grades.

Ferry boat: A vessel that provides fixed-route service across a body of water and is primarily engaged in transporting passengers or vehicles.

Flex fuel vehicle: A type of alternative fuel vehicle that can use conventional gasoline or gasoline-ethanol mixtures of up to 85 percent ethanol (E85).

Footprint (vehicle): The size of a vehicle defined as the rectangular “footprint” formed by its four tires. A vehicle’s footprint is its track (width) multiplied by its wheelbase (length).

For-hire (transportation): Refers to a vehicle operated on behalf of or by a company

that provides services to external customers for a fee. It is distinguished from private transportation services in which a firm transports its own freight and does not offer its transportation services to other shippers.

Freeway: All urban principal arterial roads with limited control of access not on the interstate system.

Functionally obsolete bridge: does not meet current design standards (for criteria such as lane width), either because the volume of traffic carried by the bridge exceeds the level anticipated when the bridge was constructed and/or the relevant design standards have been revised.

GDP (gross domestic product): The total value of goods and services produced by labor and property located in the United States. As long as the labor and property are located in the United States, the suppliers may be either U.S. residents or residents of foreign countries.

General aviation: Civil aviation operations other than those air carriers holding a Certificate of Public Convenience and Necessity. Types of aircraft used in general aviation range from corporate, multiengine jets piloted by a professional crew to amateur-built, single-engine, piston-driven, acrobatic planes.

Heavy rail: High-speed transit rail operated on rights-of-way that exclude all other vehicles and pedestrians.

Hybrid vehicle: Hybrid electric vehicles combine features of internal combustion engines and electric motors. Unlike 100% electric vehicles, hybrid vehicles do not need to be plugged into an external source

of electricity to be recharged. Most hybrid vehicles operate on gasoline.

In-house (transportation): Includes transportation services provided within a firm whose main business is not transportation, such as grocery stores that use their own truck fleets to move goods from warehouses to retail outlets.

Interstate: Limited access divided facility of at least four lanes designated by the Federal Highway Administration as part of the Interstate System.

International Roughness Index (IRI): A scale for roughness based on the simulated response of a generic motor vehicle to the roughness in a single wheel path of the road surface.

Lane-mile: Equals one mile of one-lane road, thus three miles of a three-lane road would equal nine lane-miles.

Large certificated air carrier: Carriers operating aircraft with a maximum passenger capacity of more than 60 seats or a maximum payload of more than 18,000 pounds. These carriers are also grouped by annual operating revenues: majors—more than \$1 billion; nationals—between \$100 million and \$1 billion; large regionals—between \$20 million and \$99,999,999; and medium regionals—less than \$20 million.

Light-duty vehicle: Passenger cars, light trucks, vans, pickup trucks, and sport/utility vehicles regardless of wheelbase.

Light-duty vehicle, long wheelbase: Passenger cars, light trucks, vans, pickup

trucks, and sport/utility vehicles with wheelbases longer than 121 inches.

Light-duty vehicle, short wheelbase: Passenger cars, light trucks, vans, pickup trucks, and sport/utility vehicles with wheelbases equal to or less than 121 inches and typically with a gross weight of less than 10,000 lb.

Light rail: Urban transit rail operated on a reserved right-of-way that may be crossed by roads used by motor vehicles and pedestrians.

Linked trip: A trip from the origin to the destination on the transit system. Even if a passenger must make several transfers during a journey, the trip is counted as one linked trip on the system.

Local road: All roads not defined as arterials or collectors; primarily provides access to land with little or no through movement.

Long-distance travel: As used in this report, trips of more than 50 miles. Such trips are primarily served by air carriers and privately owned vehicles.

Major collector: Collector roads that tend to serve higher traffic volumes than other collector roads. Major collector roads typically link arterials. Traffic volumes and speeds are typically lower than those of arterials.

Minor arterial: Roads linking cities and larger towns in rural areas. In urban areas, they are roads that link, but do not enter neighborhoods within a community.

Minor collector: Collector roads that tend to serve lower traffic volumes than other collector roads. Traffic volumes and speeds are typically lower than those of major collector roads.

Motorcoach: A vehicle designed for long-distance transportation of passengers, characterized by integral construction with an elevated passenger deck located over a baggage compartment. It is at least 35 feet in length with a capacity of more than 30 passengers.

Motorcycle: A two- or three-wheeled vehicle designed to transport one or two people, including motorscooters, minibikes, and mopeds.

Multiple Modes and Mail: the Freight Analysis Framework (FAF) and the Commodity Flow Survey (CFS) use “Multiple Modes and Mail” rather than “Intermodal” to represent commodities that move by more than one mode. Intermodal typically refers to containerized cargo that moves between ship and surface modes or between truck and rail, and repeated efforts to identify containerized cargo in the CFS have proved unsuccessful. Multiple mode shipments can include anything from containerized cargo to bulk goods such as coal moving from a mine to a railhead by truck and then by rail to a seaport. Mail shipments include parcel delivery services where shippers typically do not know what modes were involved after the shipment was picked up.

National Highway System (NHS): This system of highways designated and approved in accordance with the provisions of 23 United States Code 103b Federal-aid systems.

Nominal dollars: A market value that does not take inflation into account and reflects prices and quantities that were current at the time the measure was taken.

Nonself-propelled vessels: Includes dry cargo, tank barges, and railroad car floats that operate in U.S. ports and waterways.

Oceangoing vessels: Includes U.S. flag, privately owned merchant fleet of oceangoing, self-propelled, cargo-carrying vessels of 1,000 gross tons or greater.

Offshore gathering line: A pipeline that collects oil and natural gas from an offshore source, such as the Gulf of Mexico. Natural gas is collected by gathering lines that convey the resource to transmission lines, which in turn carry it to treatment plants that remove impurities from the gas. On the petroleum side, gathering pipelines collect crude oil from onshore and offshore wells. The oil is transported from the gathering lines to a trunk-line system that connects with processing facilities in regional markets.

Offshore transmission line (gas): A pipeline other than a gathering line that is located offshore for the purpose of transporting gas from a gathering line or storage facility to a distribution center, storage facility, or large volume customer that is not downstream from a distribution center.

Onshore gathering line: A pipeline that collects oil and natural gas from an onshore source, such as an oil field. Natural gas is collected by gathering lines that convey the resource to transmission lines, which in turn carry it to treatment plants that remove impurities from the gas. On the petroleum side, gathering pipelines collect crude oil from onshore and offshore wells. The oil is transported from the gathering lines to a trunk-line system that connects with processing facilities in regional markets.

Onshore transmission line (gas): A pipeline other than a gathering line that is located onshore for the purpose of transporting gas from a gathering line or storage facility to a distribution center, storage facility, or large volume customer that is not downstream from a distribution center.

Particulates: Carbon particles formed by partial oxidation and reduction of hydrocarbon fuel. Also included are trace quantities of metal oxides and nitrides originating from engine wear, component degradation, and inorganic fuel additives.

Passenger-mile: One passenger transported one mile. For example, one vehicle traveling 3 miles carrying 5 passengers generates 15 passenger-miles.

Person-miles: An estimate of the aggregate distances traveled by all persons on a given trip based on the estimated transportation-network-miles traveled on that trip. For instance, four persons traveling 25 miles would accumulate 100 person-miles. They include the driver and passenger in personal vehicles, but do not include the operator or crew for air, rail, and transit modes.

Person trip: A trip taken by an individual. For example, if three persons from the same household travel together, the trip is counted as one household trip and three person trips.

Personal vehicle: A motorized vehicle that is privately owned, leased, rented or company-owned and available to be used regularly by a household, which may include vehicles used solely for business purposes or business-owned vehicles, so long as they are driven home and can be used for the home to work trip (e.g., taxicabs, police cars, etc.).

Planning Time Index (PTI): The ratio of travel time on the worst day of the month compared to the time required to make the same trip at free-flow speeds.

Post Panamax vessel: Vessels exceeding the length or width of the lock chambers in the Panama Canal. The Panama Canal expansion project, slated for completion in 2015, is intended to double the canal's capacity by creating a new lane of traffic for more and larger ships.

Real dollars: Value adjusted for changes in prices over time due to inflation.

Self-propelled vessels: Includes dry cargo vessels, tankers, and offshore supply vessels, tugboats, pushboats, and passenger vessels, such as excursion/sightseeing boats, combination passenger and dry cargo vessels, and ferries.

Short ton: A unit of weight equal to 2,000 pounds.

Structurally deficient (bridge): Characterized by deteriorated conditions of significant bridge elements and potentially reduced load-carrying capacity. A "structurally deficient" designation does not imply that a bridge is unsafe, but such bridges typically require significant maintenance and repair to remain in service, and would eventually require major rehabilitation or replacement to address the underlying deficiency.

TEU (twenty-foot equivalent unit): A TEU is a nominal unit of measure equivalent to a 20' x 8' x 8' shipping container. For example, a 50 ft. container equals 2.5 TEU.

Tg CO₂ Eq.: Teragrams of carbon dioxide equivalent, a metric measure used to compare

the emissions from various greenhouse gases based on their global warming potential.

Ton-mile: A unit of measure equal to movement of 1 ton over 1 mile.

Trainset: One or more powered cars mated with a number of passenger or freight cars that operate as one entity.

Transit bus: A bus designed for frequent stop service with front and center doors, normally with a rear-mounted diesel engine, low-back seating, and without luggage storage compartments or rest room facilities. Includes motor and trolley bus.

Transmission line: A pipeline used to transport natural gas from a gathering, processing, or storage facility to a processing or storage facility, large volume customer, or distribution system.

Transportation Services Index (TSI): A monthly measure indicating the relative change in the volume of services over time performed by the for-hire transportation sector. Change is shown relative to a base year, which is given a value of 100. The TSI covers the activities of for-hire freight carriers, for-hire passenger carriers, and a combination of the two. See www.rita.dot.gov for a detailed explanation.

Travel Time Index (TTI): The ratio of the travel time during the peak traffic period to the time required to make the same trip at free-flow speeds.

Trip-chaining: The practice of adding daily errands and other activities, such as shopping or going to a fitness center, to commutes to and from work.

Trolley bus: See transit bus.

Unlinked trips: The number of passengers who board public transportation vehicles. Passengers are counted each time they board vehicles no matter how many vehicles they use to travel from their origin to their destination.

Vehicle-mile: Measures the distance traveled by a private vehicle, such as an automobile, van, pickup truck, or motorcycle. Each mile traveled is counted as one vehicle-mile regardless of number of passengers.