Transportation Planning Capacity Building

# Statewide Travel Demand Modeling

## *A TPCB Peer Exchange Event*

**Location:** Columbus, OH (Plus virtual participants)

**Date:** June 15-16, 2022

**Host Agency:** Ohio Department of Transportation (ODOT)

**National Peers:** Kalin Pacheco, California Department of Transportation (Caltrans)
Erik Sabina, Colorado Department of Transportation (CDOT)
Anson Gock, Delaware Department of Transportation (DelDOT)
Terry Corkery, Florida Department of Transportation (FDOT)
Habte Kassa, Georgia Department of Transportation (GDOT)
Sheng Chen, Illinois Department of Transportation (IDOT)
Jeff von Brown, Iowa Department of Transportation (IDOT)
Scott Thomson, Kentucky Transportation Cabinet (KTC)
Jesse Frankovitch, Michigan Department of Transportation (MDOT)
Greg Giaimo, Ohio Department of Transportation (ODOT)
Alex Bettinardi, Oregon Department of Transportation (ODOT)
Janie Temple, Texas Department of Transportation (TxDOT)
Peng Xaio, Virginia Department of Transportation (VDOT)
Chris Chritton, Wisconsin Department of Transportation (WisDOT)

**Sponsoring Agency:** Federal Highway Administration (FHWA)
Transportation Research Board (TRB)

U.S. Department of Transportation
**Federal Highway Administration**

## Notice

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| 13. ABSTRACT (Maximum 200 words)<br>This report summarizes proceedings of a peer exchange sponsored by the Federal Highway Administration (FHWA) and the Transportation Research Board (TRB) and hosted by the Ohio Department of Transportation on June 15-16, 2022. The purpose of the peer exchange was to gather State DOT staff, Federal staff, and representatives of other entities to discuss the current and future status of statewide travel modeling. The peer exchange included robust discussions of statewide travel modeling successes, challenges, and opportunities among State DOTs; modeling and data input improvements happening at the national level, and ideas for future research that can improve how State DOTs develop, implement, and use data in their statewide travel models. The event was sponsored by FHWA through its Transportation Planning Capacity Building Program, led in partnership with the Federal Transit Administration. | | | |
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# Contents

# Peer Exchange Overview

This report highlights the presentations, discussions, and key takeaways from the "Statewide Travel Demand Modeling" peer exchange held on June 15-16, 2022. The event was co-sponsored by the Federal Highway Administration (FHWA) through its Transportation Planning Capacity Building (TPCB) program, led jointly with the Federal Transit Administration (FTA); and the Transportation Research Board (TRB) Statewide Modeling subcommittee (part of AEP50: Committee on Transportation Demand Forecasting). The Ohio Department of Transportation (DOT) hosted the event at the Vern Riffe Center in Columbus, Ohio. The peer exchange brought together peers from across the country to discuss statewide travel demand modeling and to discuss research needs on this topic. Funding for participant and presenter travel was provided by the Federal Highway Administration Offices of Planning (Planning, Environment and Realty), Transportation Management, Freight Management (Operations), and Highway Policy Information (Office of Policy), by the U.S. DOT Intelligent Transportation Systems Joint Program Office, and the U.S. DOT Bureau of Transportation Statistics. It builds on a previous peer exchange on statewide travel demand modeling held in 2004.[1]

About 62 participants attended the event either in-person or virtually, including representatives of State DOTs, FHWA, TRB, and other organizations. The peers included California Department of Transportation (Caltrans), Colorado DOT, Delaware DOT, Florida DOT, Georgia DOT, Illinois DOT, Iowa DOT, Kentucky Transportation Cabinet (KTC), Michigan DOT, Ohio DOT, Oregon DOT, Texas DOT, Virginia DOT, and Wisconsin DOT. During the peer exchange, each peer shared a State report on Statewide Modeling (Appendix C) and presented on their statewide model.

The peer exchange featured five main sessions:

- State DOT presentations on modeling status, data collection, and interactions with national data;
- National presentations from Federal staff and other representatives on Federal activities to support and improve statewide modeling;
- A facilitated discussion of State DOT needs for improving statewide models;
- Breakout groups to discuss and develop needs statements for identified statewide modeling topics; and
- A wrap-up discussion, including next steps.

The appendices in this report include:

- Appendix A: Key Contacts
- Appendix B: Agenda
- Appendix C: Reading List on the Interaction of Statewide and Mega-Regional Travel Demand Models with Emergent National Models and Data
- Appendix D: State Reports on Statewide Modeling

[1] The 2004 peer exchange report  and other foundational resources are listed in Appendix C.

# Session Discussions

## State DOT Presentations on Modeling Status, Data Collection, and Interactions with National Data

State DOT peer participants gave brief presentations, summarized below, about their current statewide modeling practices. Several States are on their second- or third-generation statewide model. Statewide models tended to have large "halo" areas, ranging from parts of neighboring States to all of the U.S. and Canada. The networks and zones in the halo areas were less detailed than those in the State being modeled. Data sources for building, calibrating, and validating the models included national, State and local (e.g., metropolitan planning organization [MPO], county or city) sources, with increasing use of location-based services (LBS) data. Finally, several States reported challenges with employment data, in particular, using actual workplace locations as opposed to using corporate headquarters alone.

### California DOT

Kalin Pacheco noted that the California statewide travel demand model is a hybrid-tour/activity-based model that includes external, short, and long-distance travel. The Caltrans freight model is more of an economic model than a transportation model. It uses both Federal and State data sources, including a 2017 California Vehicle Inventory and Use Survey (VIUS) survey. The base year of the model is 2015, with forecast years going out to 2050. Data gaps in freight include port data, railroad commodity type and trip distribution, supply chain information, electric vehicle (EV) truck data and data for system performance (PM3) reporting. Passenger gaps include transportation network companies (TNC), zero-emission vehicles, and bicycle and pedestrian travel. Caltrans is beginning to use the Cambridge Systematics LOCUS platform for passenger data.

### Colorado DOT

Erik Sabina noted that Colorado has a statewide activity-based model based on DaySim, which combines local and long-distance trips. Externals use a trip-based structure borrowed from the Denver Regional Council of Governments (DRCOG). A household travel survey on the front range (north-south corridor that includes Denver) was conducted in 2009-2010. CDOT synthesized the in-State population using Census data. StreetLight data is used for externals. StreetLight provides frequency data and needs to be scaled using other sources to derive volumes. For employment data, CDOT found the Quarterly Census of Employment and Wages (QCEW) provided by the Bureau of Labor Statistics to be superior to data available through private vendors. Speed calibration uses INRIX data, with considerable effort to conflate the INRIX network with the CDOT model network.

### Delaware DOT

Anson Gock noted that the Delaware statewide model includes a transit component which accounts for Delaware's statewide transit agency. The model extends into Maryland. Required applications of the model include metropolitan transportation plans (MTP), transportation improvement programs (TIP), and MPO/Delaware DOT air quality conformity analysis. Delaware DOT is working on validation due to the many travel changes resulting from the COVID-19 pandemic. Delaware DOT would like to start incorporating bicycle and pedestrian planning (e.g., the results of adding a new path) and exploring use of the National Renewable Energy Laboratory (NREL) Mobility Energy Productivity metric.

## Florida DOT

Terry Corkery explained that several decades ago, Florida DOT developed the Florida Standard Urban Transportation Model Structure (FSUTMS), in partnership with FDOT district offices and 27 MPOs in the State. Models include the Statewide model, eight regional models, and models of the Florida Turnpike. Data development includes a master highway network with lanes, area type, facility type, speeds, and annual average daily traffic (AADT). The statewide model has 8,588 internal zones, external zones for North American freight, and passenger zones for external trips. Socioeconomic data for the statewide model include Census 2015 ACS estimates by block group and 2014 Infogroup (DataAxle) employment data, and is supplemented by county business patterns, Longitudinal Employer-Household Dynamics (LEHD), and Florida Bureau of Economic and Business Research county forecasts. The base year is 2015 and future year is 2045. Features of the newest version of the statewide model include destination choice, long distance mode choice, toll income stratification, and, on the freight side, a model of firm synthesis.

## Georgia DOT

Habte Kassa noted that since 2006, Georgia's statewide model has been through several revisions, with peer reviews in 2012 and 2019. The current version updates the base year to 2020 (using 2020 Census information and 2019 pre-COVID employment information and traffic counts), with a horizon year of 2050. The model includes passenger, freight, and non-freight truck modules. The freight module is based on freight generators, development sites, TRANSEARCH data, and waybill data. The non-freight truck module uses FHWA Quick Response Freight methods. Georgia DOT based growth assumptions partially on a workshop with stakeholders. There is an interest in equity and resiliency to better support performance-based planning.

## Illinois DOT

Sheng Chen noted that the Illinois three-year model development effort began in 2018 and will result in an advanced trip-based hybrid model. It is focused on highway modes with short- and long-distance passenger and freight travel. It includes close to 5,000 zones (internal and external). Location-based service (LBS) data includes rMerge (from RSG) and American Transportation Research Institute (ATRI) truck Global Positioning System (GPS) data. Passenger data is from the Census, 2017 National Household Travel Survey (NHTS) and the national long-distance model. Illinois DOT did not have a household survey for residents. Freight data is from the Freight Analysis Framework Version 4 (FAF4), the 2002 VIUS, Environmental Protection Agency (EPA) data on underground storage tanks (used to infer truck fueling locations), and Quick Response Freight Methods III. Network data came from the All Road Network of Linear Referenced Data (ARNOLD), and socio-economic data included American Community Survey (ACS) five-year estimates and LEHD Origin-Destination Employment Statistics (LODES).  Planned updates include using FAF5, the new VIUS, big data and the new NHTS, and 2020 Census data.

## Iowa DOT

Jeff von Brown noted that the Iowa Traffic Analysis Model (iTRAM) includes a buffer of several hundred miles into neighboring States, as well as a national truck model based on FAF4. Population data comes from ACS and Woods & Poole, with employment data from IMPLAN and EBP. MPO employment data includes county parcel data for trips per 1,000 square feet (ksf). Travel surveys and StreetLight are used for personal travel (with limited trip-chaining ability). Jeff noted that the commodify flow survey may not identify true commodity origins; Quetica/WISERTrade was used to supplement the Commodity Flow Survey (CFS). The freight model is based on FAF and includes a rail model.

## Kentucky Transportation Cabinet

Scott Thomson noted that Kentucky has a three-step statewide model that has evolved over the years. Although the network does not include transit, it does include freight with a halo area that includes Interstates in 48 States and other major roads in neighboring States. Today, the zone system includes some 6,000 zones in Kentucky, plus external zones across the U.S. A multi-resolution network is used, with 162,000 roadway links "open," but a total of 446,000 roadway links (including what appear to be local roads). Speed and capacity use Highway Capacity Manual (HCM) methods, modified to add delay for challenging road geometries (e.g., sharp curves). For calibration, they have some 15,000 count stations, with 10,000 of them on roads with less than 5,000 average daily traffic (ADT).

## Michigan DOT

Jesse Frankovitch noted that the current Michigan statewide model was completed in 2019. It has 2015 as the base year and 2045 as the horizon year. It includes four time periods during the day, plus three seasonal timeframes. The model has approximately 4,000 zones within Michigan, 200 zones in a nearby halo area (bordering regions in Wisconsin, Indiana, Ohio and Ontario), and large zones elsewhere in the U.S., Canada and Mexico. Data sources include the ACS, DataAxle for base employment, Regional Economic Models, Inc. (REMI), 2014 Transearch for freight, a statewide household travel survey, and traffic counts. Passive origin-destination (OD) data sources include AirSage and ATRI for trucks. For future development, Michigan DOT is looking at NHTS or other alternatives to a large household survey, plus updates to their freight data. Michigan DOT would like to update its OD big data for a post-pandemic base year.

## Ohio DOT

Greg Giaimo noted that the Ohio statewide model includes short- and long-distance person travel, visitor travel, and freight models. Although the zone structure reaches out to include 48 States in the U.S., and Canada, a lack of key national data sources requires some models to stop at the cordon (extending a short distance into neighboring States), while others continue to the full zone system. External-external passenger car trips come from StreetLight, and the visitor model was based on a tourism survey. Greg noted that a national source of data on hotels, campgrounds and the like would be useful for visitor modeling. The other passenger models rely upon Census and a combination of QCEW, Data Axle, LEHD and Tredis forecasts. The model also requires land use data which is difficult to assemble in-State and impossible out of State. The freight model is based on FAF4 and VIUS but gaps in FAF require a separate service and delivery model based on an ODOT establishment survey. The network uses an Ohio DOT centerline inventory (which is not routable) and Tiger outside Ohio. A single routable, up-to-date highway network with key attributes (e.g., facility type, lanes, traffic control, speed, traffic counts) would be useful. Rail freight network data had to be obtained directly from rail carriers which is difficult.

## Oregon DOT

Alex Bettinardi noted that Oregon's Statewide Integrated Model (SWIM) models travel demand along with land use and economic activity. Network data includes State GIS data, freight routes (including weight restrictions) and generalized transit data. Forecast population data makes use of the Portland

State University Population Research Center. Employment data comes from the QCEW and State forecasts. Oregon DOT is also using IMPLAN and IHSMarkt. For land use, Oregon DOT has a nearly complete zoning layer, with local zoning mapped into 55 uniform zoning categories.

## Texas DOT

Janie Temple noted that Version 4 of the Texas DOT Statewide Analysis Model (SAM-V4) uses a base year of 2015 and a horizon year of 2050. It includes multi-modal (e.g., highway, rail, air, but not urban transit) forecasts of passengers and freight. The socio-economic data uses national sources (e.g., Census, LEHD, CFS, FAF, etc.), as well as State data. Texas also purchased 20,000 add-ons for the 2017 NHTS and added a few questions on long distance travel. Private data sources include INRIX, DataAxle, Woods and Poole and Transearch. They are beginning to look at StreetLight and Wejo data, to refine the Statewide Analysis Model (SAM) trip table. Having a routable national network would be nice. They noted an interest in using the model for bicycle and pedestrian planning, and in adding urban transit to the model.

## Virginia DOT

Peng Xaio explained that like other statewide models, the Virginia DOT model has a substantial halo area, reaching into neighboring States plus a portion of Pennsylvania. It includes the District of Columbia and Baltimore. In addition to the usual data sources (e.g., Census, NHTS, MPO data), Virginia has a contract with StreetLight data accessible to everyone in the State. Virginia DOT is using the StreetLight data to obtain rest area activities and external travel data, including external-external trip distributions, which are significant in Virginia. Peng noted that it may be difficult to identify a long continuous trip with the StreetLight data, as brief stops may cause the trip to be broken up. The statewide model is being used to see how speeds change in peak periods, and thus, it needs to be validated for speeds, in addition to volumes.

## Wisconsin DOT

Chris Chritton noted that Wisconsin DOT is now on its third generation (2021) statewide model, with a base year of 2017 and future year of 2050. The first two generations had base years of 2006 and 2016. Components of the model include a passenger model, a long-distance passenger model, a freight truck model, and a non-freight truck model. In-State sources for the network include the Wisconsin Information System for Local Roads (WISLR) and 20 network geodatabases of regional networks, interchangeable with regional travel demand models. Out-of-State network data comes from FAF3.4 and the National Highway Planning Network. The halo area includes Interstate highways throughout the U.S., plus more detail in neighboring States. Data come from Federal data sources, such as the 2010 Census, 2012-2016 ACS, QCEW, LEHD, other State government departments and MPOs in Wisconsin and neighboring States. Private data sources include Woods & Poole, Infogroup/Data Axle, and Transearch. Data sources for calibration and validation include NHTS, the National Performance Management Research Data Set (NPMRDS), FAF, and traffic counts. Wisconsin DOT is using the model for conducting corridor studies, developing the statewide freight plan, studying tolling feasibility, and for conformity analysis and the EPA National Emissions Inventory.

# National Presentations

Following the presentations from State DOT participants, representatives of FHWA, the Bureau of Transportation Statistics (BTS), and RSG gave presentations on national and other efforts to provide resources to State DOTs to improve statewide modeling capabilities. The presentations addressed the following topics:

- The present and future of the Freight Analysis Framework (FAF);
- Updates on the Commodity Flow Survey (CFS);
- The return of the Vehicle Inventory and Use Survey;
- Future BTS research on long-distance travel;
- The use of passive OD data in the National Household Travel Survey (NHTS); and
- National Performance Management Research Data Set (NPMRDS) applications and freight microsimulation; and
- Efforts to develop a national long-distance passenger travel model.

## Freight Analysis Framework, Present and Future

Birat Pandey (FHWA) explained that the Freight Analysis Framework (FAF) is updated every five years in conjunction with the economic Census. The FAF provides information on weight and value of freight transported, types of commodities and transport mode, and freight truck routings. It is a national model with 130 domestic zones and eight international regions. Domestic zones may be a metropolitan area, a part of a State, or an entire State (see Figure 1).

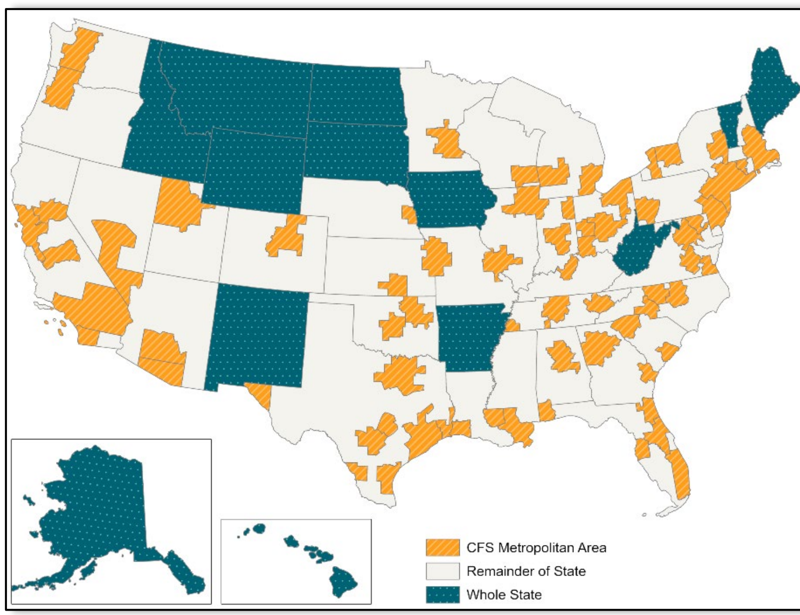

*Figure 1 Domestic FAF Zones (Source: FHWA)*

In the current iteration, FAF5, data sources are for a 2017 base year. Data is from the CFS, imports and exports, and other Federal data sources (e.g., crude petroleum from the Energy Information Administration).

Forecast data is based on macroeconomic models for domestic and international freight. FAF goes out to a 2050 forecast year, with several intermediate forecast years.

FAF also includes a network model for highways based on a disaggregation of the FAF zones, which is only used for highway routing and is not publicly available. FAF includes visualization tools, considers 42 commodity group types, and accounts for national and international multi-modal trade. However, as it is a national model with large zones and a limited road network, a local analysis will likely require supplemental data. Furthermore, some analyses may require more details on the commodities. For example, FAF does not include a breakout of hazardous commodities.

## Commodity Flow Survey (CFS)

Joe McGill (BTS) noted that CFS data is accessible via the Census data platform, Center for Enterprise Dissemination Services and Consumer Innovation (CEDSCI). A granular public use data file is also available. Although the file has individual trips, it uses an aggregated travel mode, use of CFS area for geographies, and top-level coding for commodities. Subarea estimates are also available in subareas that have at least 10,000 shipments. For example, while Ohio has five CFS areas (the same as FAF), it has 16 subareas. The most recent CFS data is from 2017.

Researchers with a demonstrated need can obtain direct access to data collected from the respondents (Title 13). There is a lengthy approval process that holds users to the same standards as those applied to employees at the U.S. Census Bureau.

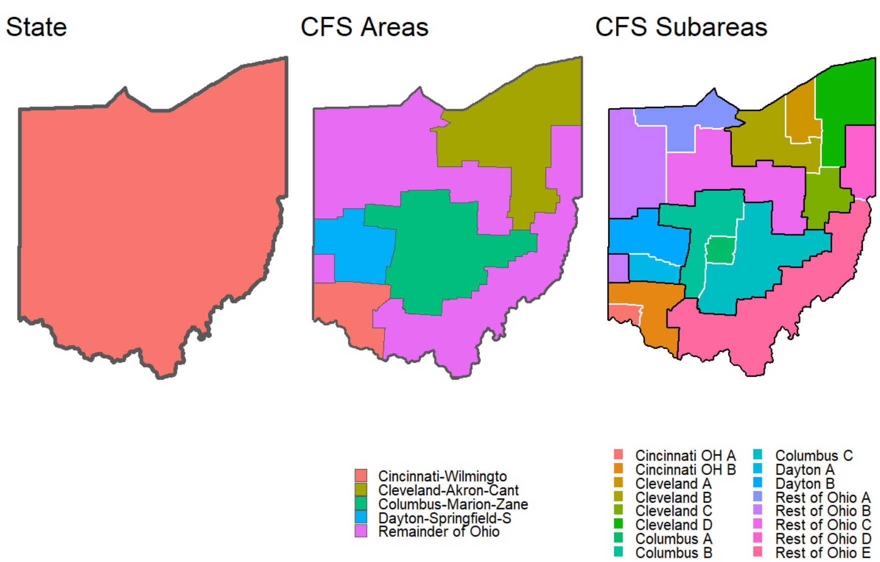


*Figure 2: A comparison of geographies among State, CFS areas, and CFS subareas (Source: FHWA)*

## Vehicle Inventory and Use Survey (VIUS)

Joe McGill (BTS) noted that the Vehicle Inventory and Use Survey (VIUS) is returning after a 20-year gap. In the past, several surveys were conducted between 1962 and 2002. The VIUS is a survey 150,000 of registered commercial and/or personal vehicles, including pickup trucks, sport utility vehicles, vans, straight trucks, and tractor trailers. It does not include buses and passenger cars. Questions address the vehicle and how it is used, including mileage, weight, idle time, and type of business, among others. There are also questions on safety technologies (e.g., driver assistance) and vehicle maintenance, including costs.

Data collection is occurring between February and October 2022, with an initial public use file release planned for December 2023.

## Future BTS Research on Long-Distance Travel

Ed Strocko (BTS) summarized new BTS projects related to long-distance U.S. travel, including:

- Location-based service (LBS) cell phone data
- GPS-based probe data from freight trucks
- Inter-city passenger connectivity metrics
- Intercity Bus Atlas
- National Transit Map (NTM) inter-city routes

In an ongoing project, LBS data with 270 million daily users is being used to construct mobility patterns from mobile phone sightings. BTS has developed a daily mobility project that counts the long-distance trips (50+ miles from "home") made by Americans during the pandemic. Ongoing work includes dwell times for trucks at the Port of Baltimore and determining the origins and destinations of travelers at hub airports and rental car facilities.

Data from ATRI, collected since October 2018, is being used to derive OD patterns for trucks. Geofences around terminals and border crossing are used to assess delay and border crossing activity.

BTS is developing a statistical product that quantifies equity in intercity travel, looking at accessibility measures between cities (e.g., major cities connected only by a single mode). Next steps include collecting data on reliability, frequency, and safety of intercity transportation.

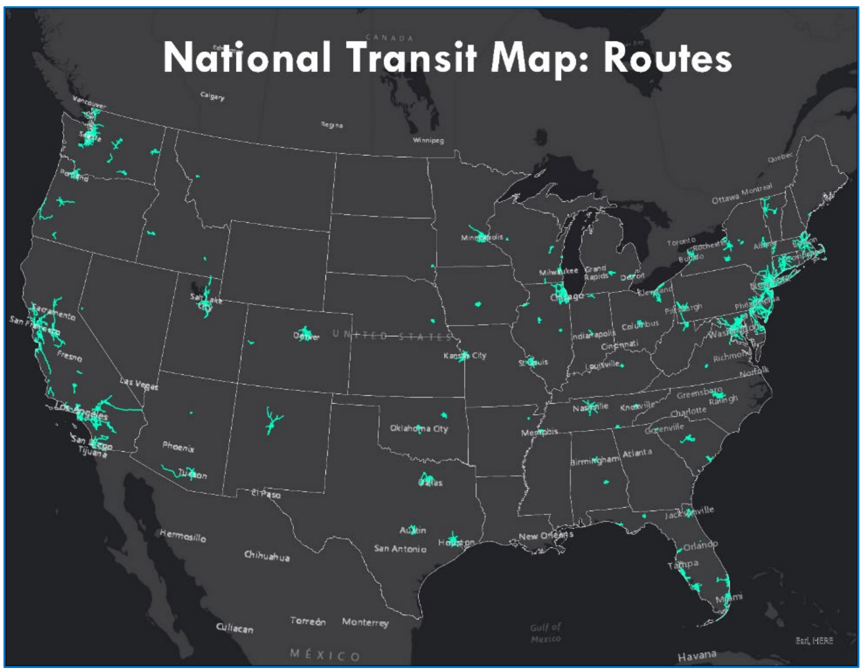


*Figure 3: National Transit Map: Routes (Source: BTS)*

Participating North American bus companies are providing General Transit Feed Specification (GTFS) data to build an intercity bus atlas. Similarly, a national transit map is also being built to include both intracity and intercity networks.

Additional long-distance concepts include the substitution of communications for transportation, use of imagery data to identify vehicles (e.g., rail cars), and multimodal freight network assignment.

## National Household Travel Survey (NHTS), "Big Data OD (Origin/Destination)," Highway Performance Monitoring System (HPMS)

Danny Jenkins (FHWA) noted that the NHTS started in 1969, with its most recent iterations in 2001, 2009, and 2017. An every eight-year pace for conducting the NHTS is no longer sustainable. The next generation NHTS will be a biennial household survey that uses new data sources, including passive origin/destination (OD) data. It will collect both trip rates and OD data. National OD data for both truck and passenger travel will be collected annually for the entire calendar year, from 2020 to 2024, using an FHWA-created 583-zone system. Add-on partners have the option of obtaining sub-national passenger data at a more detailed spatial and temporal resolution. Passenger travel modes include air, rail, vehicle, and other (e.g., active transportation, ferry). The data resides at Oak Ridge National Laboratory.

The Highway Performance Monitoring System (HPMS) was initially developed in 1978 and is now on version 9. It is a national highway information system that contains designation and extent information on all public roads and traffic volume information on the National Highway System. It also includes sample panel data, which provides more detailed statistical data on a randomly selected set of arterial and collector roadways. HPMS 9 supports incremental data submissions to FHWA and is intended to support national spatial roadway networks such as the National Road Network.

Finally, the Vehicle Identification Number (VIN) and licensed driver data pilot project is collecting aggregate data on registered motor vehicles and licensed drivers from States, as required by 23 CFR parts 1.5, 420.105(b).

## NPMRDS and Applications; Freight Microsimulation

Jeff Purdy (FHWA) noted that the National Performance Management Research Data Set (NPMRDS) uses probe data to provide average travel times, every five minutes, on the National Highway System. Its uses include addressing reliability and congestion performance measures, identifying transportation improvements, and monitoring the effectiveness of projects. Two dimensions are considered: congestion and reliability. A recurring delay at a bottleneck is congested but reliable, while at the other extreme, frequent crashes or other incidents on an otherwise uncongested road would be an example of uncongested but unreliable. He noted that non-recurring congestion (e.g., incidents, weather, work zones) causes as much delay as recurring congestion (e.g., bottlenecks, signals).

Performance measures include the Truck Travel Time Reliability (TTTR) index, which is the 95th percentile travel time divided by the median travel time. He noted that freight bottlenecks may be due to both general delays that affect everyone, and truck-specific delays (e.g., weight and height restrictions).

The Strategic Highway Research Program 2 (SHRP2) Freight Demand Modeling and Data Improvement (C20) project set a goal to foster new approaches to freight demand modeling and led to the [Freight Demand Modeling and Data Improvement Program](). FHWA is supporting several projects that include behavior-based freight modeling and innovations in local freight data. The freight modeling projects demonstrate models of the economic behavior of supply-chain actors (Maricopa Association of Governments), integration of State and regional models (Maryland DOT and Baltimore Regional Commission), and the uses of various types of surveys (Portland Metro).

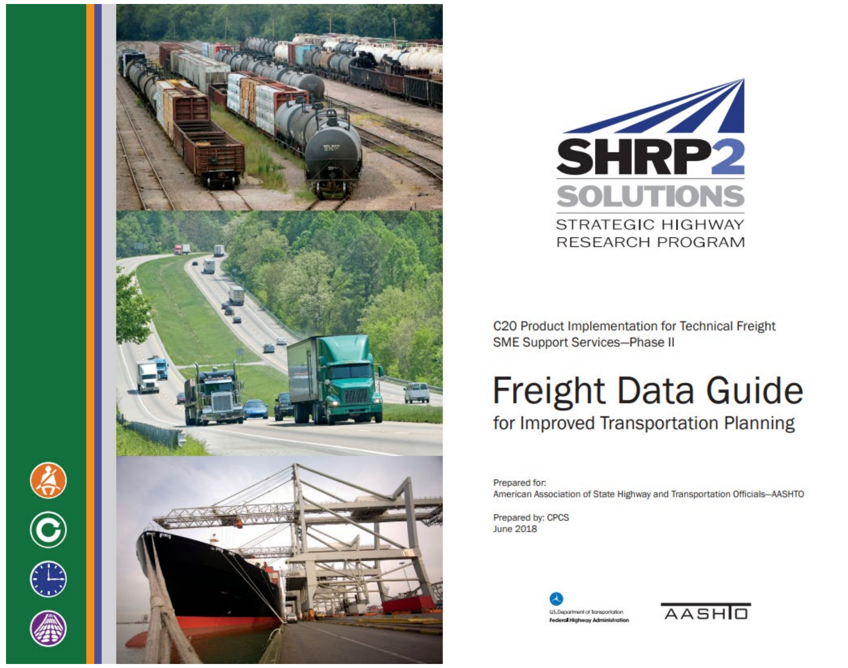


*Figure 4: SHRP2 C20 Document Cover and Title (Source: FHWA)*

Finally, he showed the Truck Parking Estimation Tool, which estimates demand for truck parking based on the North American Industrial Classification System (NAICS) code and number of employees.

## National Long-Distance Model

Maren Outwater (RSG) noted that unlike short trips, long-distance trips occur less frequently, may take advantage of air, rail, ferry or bus modes, are scheduled far in advance, and often include leisure travel. The destination and mode are likely to be chosen together. These factors make long-distance travel more difficult to model. With support from the FHWA Exploratory Advanced Research Program, RSG developed a prototype national long-distance passenger travel model. Its steps are:

1. Schedule the travel, by deciding to make a long-distance tour, within time and cost constraints. Time is allocated by activity. The size of the group is also determined in this initial step.
2. Choose both the destination and mode for the tour.
3. Choose the route for each long-distance tour.

The modeling system synthesizes travel for 117 million households (309 million people) on a zone system of 470 National Use Model Areas (NUMAs). Networks were developed for roads (including toll roads), bus, passenger rail, and airport connections.

Output metrics include person-tours, person-miles traveled, average cost per mile, average time per tour, average tours per household, and travel time. They may be subdivided by model, purpose, geographic region, and region pair. They may also be subdivided by demographic information (household size, income and model, tour party size, state) to help us understand equity implications.

# Discussions and Breakouts

On day 2 of the peer exchange, the participants discussed topics to consider discussing in breakouts in order to develop needs statements for future research consideration. The topics came from participant discussions from the prior day and the research needs identified in the 2004 statewide modeling peer exchange. The topics are listed in Table 1 by category. The Breakout column indicates which topics were addressed in each of the five breakouts ("None" indicates that the topic was not discussed in a breakout.

| Category | Topic | Breakout |
|---|---|---|
| Data | Assumptions in freight movements (e.g., will supply chains be modeled?) | Freight data |
| Data | Improved freight data (e.g., better resolution, more comprehensive and timely) | Freight data |
| Data | How to best select private passive data (national and otherwise) | Passive data |
| Data | How to best use passive data (national and otherwise) | Passive data |
| Data | Long-distance passenger travel data | Passive data |
| Data | Trip generation challenges (e.g., employment data, other generators [e.g., hotels, parks]) | Trip generation |
| Data | Central data hub of public sources and practices (e.g., Census, networks) | Trip generation |
| Data | Data fusion, integrating data sets (e.g., national, State, local, private, public) | Trip generation |
| Data | Research on the future of data | None |
| Modeling | Modeling strategies (e.g., trip, tour-based, complexity) | Modeling strategies |
| Modeling | Consistency in zone and networks across States to facilitate cross-border modeling | Modeling strategies |
| Modeling | National models (i.e., forecasts and scenarios at national level) | National models |
| Modeling | How to develop forecasts and scenarios for statewide models | National models |
| Model use | Managing expectations about what the models tell us | Modeling strategies |
| Model use | Congestion, reliability impacts of long-distance travel | None |
| Model use | Equity and accessibility assessment | None |
| Model use | Planning for resilience | None |
| Model use | Economic impacts of transportation investments | None |

*Table 1: List of Possible Breakout Discussion Topics*

A discussion and voting process led to the assignment of most of these topics to one of five breakout discussions. The five breakout discussion topics were:

- Breakout 1: Freight Data

- Breakout 2: Passive Data
- Breakout 3: Trip Generation
- Breakout 4: Modeling Strategies
- Breakout 5: National Models

Participants assigned themselves to the breakout discussions of their choice. The discussions and research needs for each topic are described in this section of the report.

## Breakout 1 – Freight Data

The group discussed assumptions in freight movements (e.g., will supply chains be modeled?), more comprehensive and timely freight data with improved resolution, and commercial travel patterns.

One of the unique aspects of statewide modeling is the ability to model freight movements, which typically traverse beyond the boundaries of a traditional MPO model. While there are several data sources available to estimate freight flows, much of these data are only available at large geographies not suited to modeling trucks at the Traffic Analysis Zone (TAZ) level. This breakout group focused on data enhancements and areas of additional research related to modeling freight and truck flows. It was noted that some combination of research and guidance is needed in any study of freight modeling topics.

Disaggregation of available data sources was a key focus of the discussion. FAF5 includes a disaggregation process focused on achieving acceptable truck flows on the model highway network. According to FHWA staff, this FAF5 truck commodity disaggregation was a "top down" analysis with minimal local data and travel insights. FHWA is hesitant to provide an official FAF5 modal disaggregation under the assumption that local, regional, and statewide agencies are best equipped to provide data needed for disaggregation. FHWA is willing to provide a technical memorandum on the present FAF5 disaggregation and validation process. Nonetheless, there is a strong desire to have an improved or standardized disaggregation process that minimizes conflict and duplication of effort. Future research can potentially include a user survey of methods for freight data disaggregation.

Another discussion topic was on the aspects of freight logistics that could be addressed in statewide models. Additional research could potentially look at sources of data on empty or less than truckload (LTL) trucks. FHWA does not have any data on last mile deliveries; however, this is becoming a significant factor in road use and congestion. It would also be useful to know the share of truck drivers that operate according to preselected routes vs. options for route choice by drivers.

The group was also interested in discussing truck/freight survey data. There was a resounding desire to continue with VIUS on a more regular basis. Intercept surveys were discussed, including the potential for interviewing truck drivers at rest areas. Expansion to 300 CFS subareas was acknowledged. It was noted that there are legal limitations on questions we can ask in U.S. and thus, intercept surveys might not address commodity groups, as an example. There was also discussion on guidance for less frequent, larger samples versus annual surveys with smaller samples. Guidance is also needed on the limitations of using passive data on truck flows.

The original Quick Response Freight Manual (QRFM) included truck trip generation rates from two studies; however, subsequent QRFM reports have excluded such material over transferability concerns.

Despite these limitations, with a general lack of truck survey data, some range of acceptable standard truck trip rates by truck type and key land use categories would be desirable. Limitations on use of standard truck trip rates should be documented along with any new guidance. Guidance is also needed on truck to rail flows to better simulate intermodal operations. A range of acceptable truck trip lengths would also be helpful for model validation.

# Breakout 2 – Passive Data

The group discussed how to best select and use private passive data (national and otherwise). Topics include data hubs and fusion (linking unrelated but overlapping data sources), issues with licensing of private data sources, and understanding how the data was developed.

Passive data is a moving target, with new providers, new products, and new data sources being used in existing products. Therefore, it is difficult to conduct time series analyses, as the base shifts over time.

It is important to understand the process by which passive data was collected and processed. Passive data is likely to be biased (e.g., where the provider's service is sparse or dense). It is unclear how passive data imputes demographic data. Non-passive data sets (e.g., Census) may be used to validate the passive data set. Passive data may not permit cross-tabulation. It is important to continue conducting standard data collection.

Passive data can be expensive, especially for a statewide collection. Therefore, it would be desirable to have a pooled fund study or organization vet passive data sources on behalf of many agencies. The Eastern Transportation Coalition has tried to identify vendors through its Transportation Data Marketplace.

Some State DOTs have used passive data in place of the standard household travel survey. The group expressed interest in the lessons learned by those agencies.

# Breakout 3 – Trip Generation

The group discussed challenges with trip generation (e.g., employment data, other generators such as hotels and parks), having a central data hub of public sources and practices, and data fusion and integration (e.g., national, State, local, private, public). More specifically, identified challenges include employment reported at the wrong location, the geography of NHTS data, Census privacy blurring, and alternative methods for privacy protection in the data development process.

Data on the spatial distribution of activity (often called socio-economic and land use data) is vital to the process of generating traffic levels in statewide models. State DOTs can usually obtain this data within their State boundaries. However, the scope of freight and long-distance travel that is the focus of such models and that impact that State is much broader than the State boundaries.

For demographic data, the decennial Census is a definitive nationwide data source. The primary concern is the unknown impact that differential privacy procedures will have on travel forecasts. Nationwide procedures and recommended best practice to evaluate and adjust the Census data for the specific purpose of providing adequate travel modeling should be a high priority.

Sources of employment data are much more varied. While LEHD provides nationwide coverage by sector, the aggregation and privacy adjustments inherent to the data mean that many States use disaggregate employment data within their own State as the basis of employment estimates. There are two primary sources, either QCEW with its attendant restricted scope (firms covered by unemployment insurance laws) and strict confidentiality requirements or purchased data such as Data Axle, which are assembled somewhat ad hoc for marketing purposes and have poorly defined gaps and duplications. Additionally, FHWA-sponsored research such as National Cooperative Freight Research Program (NCFRP) Project 25, titled Freight Trip Generation and Land Use, indicates the strong correlation of freight generation not just to employees but also establishment size points and the need for either fully disaggregate employment data or at least the aggregate employment data by both industry and establishment size.

Statewide models with their emphasis on freight modeling also present some unique challenges regarding employment data. The differentiation between office/headquarters employment, production employment and warehousing/distribution employment is vital to freight generation modeling. However, is often impossible to discern from the broad industry classification applied to a business. Further research into teleworking propensity by employment classification and providing national data respecting that categorization would also provide benefits for all travel modeling to respond to that changing dynamic. Research into methods and then providing national employment data by establishment size and by office/production/warehousing with guidance on telework propensity is a high priority for statewide and freight modeling.

Additional economic data sources are also of particular use to statewide models. Because of the focus on freight, economic production/consumption factors are often used link economic activity and freight production, these data can be purchased from the private sector. However, aligning it with typical statewide travel model categories can be challenging. Additional data that could be useful to resolve some of the issues might be obtainable from image recognition of satellite imagery include building floor space (including residential floor space by residence type to adjust for differential privacy issues in Census), parking spaces, venue seating, cargo bay doors, and land use/coverage. The availability of this last item on a national level would have profound implications on the ability to employ integrated land use-transport models on a much broader basis (not just extending to urban travel models but to many other fields as well).

In addition, the rural/recreational focus found in statewide models makes data on hotel rooms and parks/campsites useful. This data is very difficult to obtain and no known national source exists. Seasonal effects of agricultural uses, construction, and recreation also tend to be more important in statewide models. Providing employment and other economic data by quarter at a national level would benefit statewide modeling.

Finally, integration and fusion of data sets and guidance on availability and use would be key to leveraging the usefulness of the various data discussed here.

## Breakout 4 – Modeling Strategies

The group discussed model formulation, consistency in zones and networks, managing expectations for what the model can and can’t do, multi-resolution modeling, time of day, and networks.

In terms of model formulation, it is important at the beginning of the model development process to tell a cohesive story that incorporates analytics, addresses customer requirements, and uses state of the practice statewide modeling tools and data. Remember that one size does not fit all!

It is important to manage expectations of what the model can and can't tell us. It is critical to formulate the model structure (e.g., four-step, hybrid, tour-based), the questions being asked, the customer's needs, and existing requirements (e.g., Federal, State, other). An architecture or blueprint step can be useful. It is very important to discuss the uncertainty of modeling, forecasting, and societal change to manage expectations of what the model can and can't do.

In terms of analysis and model structure, the purpose is to develop a tool that has the appropriate level of complexity and the ability to meet expectations. Examples of possible structuring decisions include considering multi-resolution (e.g., use by MPOs, subarea studies and simulation studies), the density of networks, and newly available data and modeling tools.

To tell the story of the model, State DOTs need to know who the audience is and to use graphics, documentation and story boards to communicate effectively.

## Breakout 5 – National Models

The group discussed national models (e.g., forecasts and scenarios at national level) and how to develop forecasts and scenarios for statewide models.

The group observed that a national travel model doesn't do much by itself but can be helpful in providing consistent data for use by State DOTs in their statewide models. State DOTs are seeking tools to make national models more useful, to improve multi-level modeling, and the ability to build scenarios from the models. For example, in the current national long-distance travel model prototype, it is not easy to deal with changes to air travel. The Federal government could support State DOTs in trying to tie into these models, because that is how we will know that the model is usable. A tool and/or process to assist in multi-level modeling is needed, particularly to understand how to re-factor and re-weight the model to local conditions.

More specific gaps that could be filled include:

- A passenger equivalent to FAF,
- A standard short-distance model, perhaps using ActivitySimple, and
- A cross-border model.

# Conclusion and Next Steps

The peer exchange gathered State DOT staff, Federal staff, and representatives of other entities to discuss the current and future status of statewide travel modeling. The peer exchange included robust discussions of statewide travel modeling successes, challenges, and opportunities among State DOTs; modeling and data input improvements happening at the national level, and ideas for future research that can improve how State DOTs develop, implement, and use data in their statewide travel models.

The peer exchange resulted in needs statements for future research consideration on the topics of freight data, passive data, trip generation, modeling strategies, and national models. FHWA and the TRB Statewide Modeling subcommittee (part of AEP50: Committee on Transportation Demand Forecasting) will work together to develop the breakout group discussion findings into research needs statements to advance research on these important topics.

# Appendices

## Appendix A: Key Contacts

### Peer Exchange Planning Team

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### Peer Presenters

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## Federal and Other Presenters

Danny Jenkins, P.E., Office of Highway Policy Information
Federal Highway Administration

Joe McGill, Office of Data Development and Standards
Bureau of Transportation Statistics

Maren Outwater, P.E., Principal
RSG

Birat Pandey, Office of Freight Management and Operations
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Jeff Purdy, Freight Management and Operations, Office of Operations
Federal Highway Administration

Ed Strocko, Office of Spatial Analysis and Visualization
Bureau of Transportation Statistics

# Appendix B: Agenda

Agenda
Statewide Travel Demand Modeling Peer Exchange
June 15-16, 2022
Vern Riffe Center, Columbus, Ohio

Wednesday, June 15

9:00 Welcome, Jeremy Raw, FHWA Office of Planning

9:15 What to Expect and Logistics, Greg Giaimo, Modeling & Forecasting, Ohio DOT

9:25 Participant Introductions and Brief Perspective on the Peer Exchange (1-2 minutes each)

9:45 Presentations by State DOT Participants on Modeling Status, Data Collection, and Interactions with National Data (5-10 minutes each)

10:30 Break

10:45 Presentations by State DOT Participants Continued

12:00 Lunch

1:00 Freight Analysis Framework, Present and Future, Birat Pandey, FHWA

1:30 Commodity Flow Survey (CFS), VIUS, Joe McGill

1:50 Future BTS Research on Long-Distance Travel (Virtual Presentation), Ed Strocko BTS

2:15 Break

2:45 NHTS, "Big Data OD", HPMS, Danny Jenkins, FHWA

3:15 NPMRDS and Applications; Freight Microsimulation (Virtual Presentation), Jeff Purdy, FHWA

3:45 National Long-Distance Model (Virtual Presentation), Maren Outwater, RSG

4:00 Adjourn

Thursday, June 16

8:00 Facilitated Discussion of Needs

9:00 Facilitated Prioritization Exercise & Development of and Assignment to Breakout Groups

9:30 Break

9:45 Breakout Group Discussions, Development of Needs Statements

10:45 Breakout Groups Report Back on Needs Statements

11:30 Wrap up and Next Steps

12:00 Adjourn

# Appendix C: Reading List on the Interaction of Statewide and Mega-Regional Travel Demand Models with Emergent National Models and Data

U.S. Department of Transportation, Federal Highway Administration 2018. *Foundational Knowledge to Support a Long-Distance Passenger Travel Demand Modeling Framework: Model Documentation*. Washington, DC: https://www.fhwa.dot.gov/policyinformation/analysisframework/docs/fundamental_knowledge_to_support_ld_passenger_model.pdf.

National Academies of Sciences, Engineering, and Medicine 2017. *Statewide and Megaregional Travel Forecasting Models: Freight and Passenger*. Washington, DC: The National Academies Press. https://doi.org/10.17226/24927.

U.S. Department of Transportation, Federal Highway Administration 2013. *Traffic Analysis Framework Part IIA --Establishing Multimodal Interregional Passenger Travel Origin Destination Data*. Washington, DC: https://www.fhwa.dot.gov/policyinformation/analysisframework/docs/taf_final_report.pdf.

National Academies of Sciences, Engineering, and Medicine 2012. *NCHRP REPORT 735: Long-Distance and Rural Travel Transferable Parameters for Statewide Travel Forecasting Models*. Washington, DC: The National Academies Press. http://nap.edu/22661.

National Academies of Sciences, Engineering, and Medicine 2010. *NCHRP Project 836-B Task 91: Validation and Sensitivity Considerations for Statewide Models*. Washington, DC: The National Academies Press. http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36(91)_FR.pdf.

National Academies of Sciences, Engineering, and Medicine 2008. *NCHRP Project 836-B Task 70: National Travel Demand Forecasting Model Phase I Final Scope*. Washington, DC: The National Academies Press. http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP08-36(70)_FR.pdf.

National Academies of Sciences, Engineering, and Medicine 2005. *TRANSPORTATION RESEARCH CIRCULAR E-C075: Statewide Travel Demand Modeling – A Peer Exchange.* Washington, DC: The National Academies Press. http://www.trb.org/Publications/Blurbs/156191.aspx.

National Academies of Sciences, Engineering and Medicine 2022, Travel Forecasting Resource Section on Statewide Models. https://tfresource.org/topics/Statewide_models.html.

# Appendix D: State Reports on Statewide Modeling