Data Inputs Required and Challenges Faced by Metropolitan Planning Organizations in Tennessee for Development of Long Range Travel Demand Models

Introduction

All Metropolitan Planning Organizations (MPOs) in the United States are required by the federal government to develop long range transportation plans as part of their planning process. Each MPO must develop plans for at least a 20-year planning horizon. These plans must incorporate network demands and forecasts for all modes (passenger vehicle, commercial vehicle, public transit, and bicycle/pedestrian), operational analysis, safety and security issues, and air quality considerations, and must involve all groups of stakeholders in the process. Key to development of such plans is the development of a regional travel demand model. These models require an immense and varied set of data in order for reasonably accurate models to be developed and for reasonable predictions to be made with them. Planning agencies/consultants tasked with putting together the data required (which include demographic, socio-economic, and network characteristics of each mode), often face challenges not only in obtaining this information but also in developing high-quality datasets that align with travel-model input requirements.

In order to identify specific data sources used and issues faced by Tennessee MPOs, the Tennessee Model Users Group (TNMUG) undertook a study to review relevant literature, develop instruments to assess data access and quality topics, and obtain input from MPO representatives. This paper outlines the results of this study by first providing a brief literature review, second outlining findings from an initial survey of Tennessee MPOs, third discussing results of follow-up interviews with survey respondents, and finally making recommendations for areas of additional research and continued effort to improve support for Tennessee MPOs in the long range planning process.

Literature Review

The demand for travel as established in consumer theory in economics is a derived demand, which means the need for travel or the "consumption" of travel is driven primarily by the need for people to participate in social and economic activities from which they are separated spatially. Consistent with this theory, the demand for travel in any region is modeled as a function of the socioeconomic, demographic, and transportation system characteristics of that region. Thus MPOs, to develop their long range regional transportation plans, require a tremendous amount of data to determine the characteristics of their residents, their travel patterns, and the network and service characteristics of the modes serving the region. For the travel forecasts and plans developed on the data to be of value, it is essential to ensure that the input-data be of high quality. This can present problems for many agencies, as obtaining such data may require a significant amount of local data collection, processing of available local, regional, or state datasets to suit modeling requirements, and quality control efforts (TRB 2005; TRB 2007; TRB 2012; Urban Transportation Monitor, 2004; Urban Transportation Monitor 2010). These efforts can come at significant costs that arise from amongst others obtaining data from commercial sources as well as staff time required.

Further, MPOs often find that there is no single comprehensive source for a particular type of data, and must instead fuse multiple sources (which may be based on different levels of aggregation, contain different characteristics, and have differing levels of quality) to obtain a sufficient dataset (Battelle, 2004; Venigalla, 2004; TRB 2005; TRB 2012).

In the subsequent sub-sections, the literature on the types of data MPOs use for travel demand model development, their sources, and the primary issues/challenges associated with their use is reviewed. For organization purposes, the review is presented by data-category, with the categories being demographic and socioeconomic, employment, and networks.

Demographic and socioeconomic data

Demographic/socioeconomic data include both population and employment data, with multiple sources available for each. In terms of population data, sources include the following (TRB, 2012):

- Decennial US Census
- American Community Survey (ACS)
- ACS Public Use Microdata Samples (PUMS)
- Local population data.

Each data source listed above provides different types, aggregation, and periodic updates of data. The Decennial US Census is distributed to all addresses, and collects age, gender, and race of household members. The American Community Survey is updated annually, but is distributed to a sample of US residents (approximately 1 in 40 addresses). The information collected by the ACS includes more detail, such as household income, vehicle ownership, education, and employment status (US Census Bureau 1, 2012). However, due to the limited sample size, multiple years of data must be combined to obtain datasets of sufficient size for small area estimates. The PUMS data provide more detail about individual respondents, and typically are more useful for activity-based modeling rather than typical travel demand models. Local population data may also be collected by jurisdictions, and may also help supplement and validate national datasets (US Census Bureau 2, 2012; TRB, 2012). In addition to these publically available sources, private companies such as DemographicsNow (DemographicsNow, 2012) also provide subscription services such that users can download data at multiple levels (including Census tract and block group, zip codes) and have access to several statistical analysis tools for trend analysis and mapping. InfoUSA (InfoUSA, 2012) also allows users to access additional demographic data, but does not offer mapping or analysis capabilities. Woods & Poole provides demographic projections via data pamphlets that can be purchased for a county or metro area (Woods & Poole, 2012).

Employment data

Employment data are also available from a variety of sources that are both public and private. The US Census Bureau provides the Longitudinal Employer-Household Dynamics (LEHD), which employs a set of data-tools to allow users to download economic and workforce data at the county and metro levels. The LEHD data is based on the Quarterly Census of Employment and Wages (QCEW) conducted by the Bureau of Transportation Statistics. The Quarterly Workforce Indicators (QWI) report within LEHD provides employment information by gender, age, and employment type, but does not include self-employed persons. The QWI data can be displayed spatially through the use of the On the Map tool (US Census Bureau 3, 2012; TRB 2012; Ford and Fricker, 2009). Additional commercial sources of employment data can also be obtained through companies such as DemographicsNow (DemographicsNow, 2012), SimplyMap (Geographic Research Inc., 2012), and InfoUSA (InfoUSA, 2012). Both DemographicsNow and SimplyMap provide options for downloading tabular and spatial datasets and utilizing mapping tools to analyze data. InfoUSA allows users to download and append more detailed information to a list of businesses, including type of business, number of employees, and sales volume.

Other sources include Woods & Poole and Dun & Bradstreet. Dun & Bradstreet provides specific employment data services for government agencies (Dun & Bradstreet, 2012).

Network data

The network data needed for development of a region's travel demand models should span all the modes serving the region (e.g., passenger vehicle, commercial vehicle, transit, bicycle/pedestrian). For developing the representation of the road network, possible sources for the digital street files include the U.S. Census Bureau, state departments of transportation, local GIS departments, and commercial vendors (TRB 2012). Bus transit makes use of the road network hence its network representation can be constructed from the digital street files obtained. For a region with rail transit service, information required for representing the rail network should be available at the local/regional transit authority.

For network data pertaining to use, advances in technology provide new opportunities beyond the traditional data collection methods. Traditionally, traffic volume counts have been obtained through permanent stations or periodic counts, with vehicle classification included where possible. New technologies under the umbrella of Intelligent Transportation Systems (ITS), which may include sensors of varying technologies, cellular, GPS, and Bluetooth data provide mechanisms for much larger datasets to be obtained over a wider range of network links for travel time, speed, classification, and origin-destination information. These technologies are constantly improving and increasing in use, although limitations in terms of accuracy and cost do exist with each (Badger, 2012; Ban and Gruteser, 2010; Caceres et. al, 2012; Mobile Probes, 2007; Fraser, 2007). Privacy concerns are also prevalent with these new technologies (Leduc, 2008). These data and systems are offered by a variety of private companies, including INRIX, AirSage, and TrafficCast. INRIX offers a suite of ITS services utilizing a large nationwide network of GPS probes and provides a variety of traffic data services including speed and corridor travel times and both real-time and historical analysis (INRIX, 2012). AirSage uses cellular data to provide both real-time and historical travel data as well as origin-destination trip matrices, with flexibility in terms of data aggregation (AirSage, 2012). TrafficCast offers travel time and speed data collection services via Bluetooth technology (TrafficCast, 2012). Costs associated with Bluetooth are typically much lower than for GPS or cellular technologies (Carroll, et. al, 2012).

Freight data are of particular interest to MPOs, since freight must be included in the travel demand modeling process and commercial data are difficult to obtain. Sources such as the Commodity Flow Survey are more appropriate for statewide rather than regional planning models (Horowitz, 2008). The Quick Response Freight Manual (QRFM) outlines existing freight data sources, including Global Insight's Transearch. Transearch provides a comprehensive freight database assembled from a variety of sources, and includes multiple modes (IHS, 2012). However, inaccuracies do exist because of the multiple sources that must be used to develop a local database (FHWA, 2007). The Freight Analysis Framework (FHWA, 2012) provides a dataset assembled from a variety of sources to estimate state and major metropolitan area freight flows by mode. GPS probes are also useful in tracking commercial truck trips, and companies such as NavTeq offer aggregate data (not distinguishable by fleet) to agencies to improve estimates of these trips on the road network (NavTeq, 2012). While traditional surveys (including the National Household Travel Survey as well as local agency surveys) (Edwards, et. al, *in press*; Jones and Buckland, 2007) are still the most frequently used, non-motorized modes (bicycle and pedestrian) can also be estimated using Bluetooth technology,

and several studies have piloted this approach (Leibig, 2012; Liu, et. al, 2012; Malinovskiy, 2012).

Transit data is typically obtained from local transit agencies, and the quality of such data varies. A new resource for national transit data was released in 2005 with Google Transit Feeds, and MPOs now have this option for obtaining such data for travel models (Puchalsky et. al, 2012).

Summary of findings

While many sources of data exist for travel demand models, there are inherent difficulties with each and there are no perfect comprehensive sources for any particular type of data. Demographic and socioeconomic data are available from both public and private sources, but typically multiple sources must be used to assemble a 'best' dataset, and the different levels of aggregation can create difficulties. In terms of employment data, there is again the problem of having to compile data from multiple sources, and some of the commercially available sources can be expensive and restrictive for small/medium size MPOs (Ford and Fricker, 2009). In terms of new technologies to provide network data, cost, sample size, accuracy, and privacy become considerations. For instance, with Bluetooth technologies, individual users can disable this feature on mobile devices, thus reducing the available sample size (Carroll, et. al, 2012). Cellular data accuracy is dependent upon signal strength and tower location for approximating vehicle locations and speeds. GPS technologies provide greater accuracy than cellular, but may be of limited value for low volume roads because of small sample size (Carroll, 2012). Bluetooth data may also be skewed if it records non-motorized traffic on sidewalks or bike paths. Privacy concerns are also a significant consideration, not only with private citizen data where sensitive information may potentially be shared with data users, but also with commercial fleet data, as many carriers do not want proprietary route/travel information shared (Carroll, 2012; Leudec, 2008).

Data used by TN MPOs in Development of Long Range Travel Demand Models

In this section, data used by MPOs in Tennessee in the development or update of their long range travel demand models are presented. Also presented are the challenges the MPOs experience in the use of the data. The information presented in this section was obtained by conducting a survey of Tennessee MPOs via an online survey tool. The online questionnaire contained 24 items focusing on socioeconomic, demographic, and transportation system data used for modeling purposes as well as issues MPOs faced regarding access or quality with each. Participants were also asked to provide contact information if they were willing to participate in follow-up interviews after the survey data was analyzed.

This section is organized into four major parts. The first part reports on the survey findings on the types of data used in model development and challenges experienced by MPOs with their use. The second reports the survey findings on data for constructing the representation of the physical network for each mode. The third part of this section reports the survey findings on count data and characteristics of freight movement needed for model development. Finally, the fourth part of this section reports the survey findings on methods used by MPOs to estimate passenger and freight travel demand.

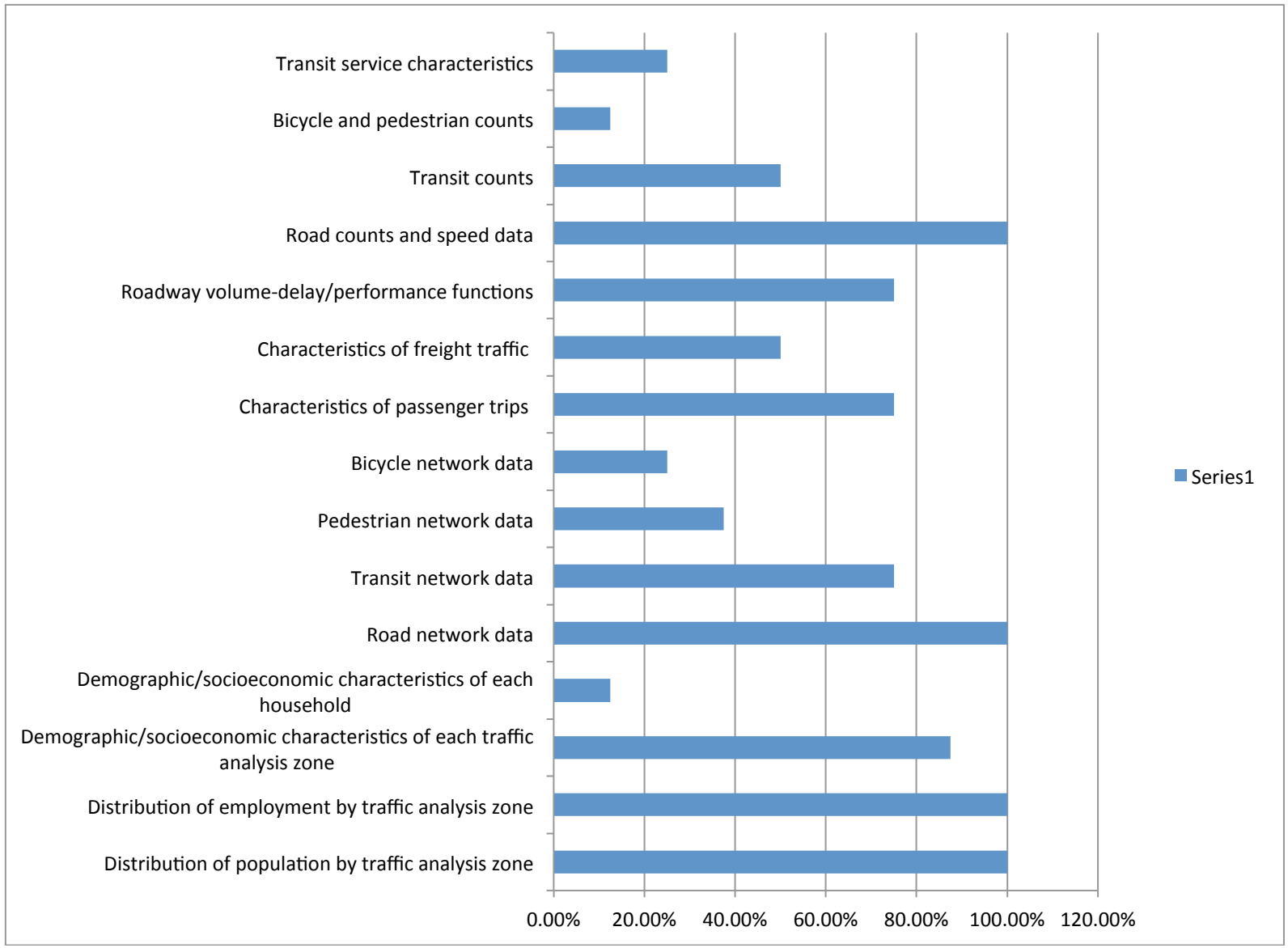
Types, Sources, and Challenges for Data Used in Long Range Models

Eight out of the eleven MPOs in the State responded to the online survey. Table 1 shows the responses the eight MPOs gave to a question on what their data needs were for developing their

long range travel demand models. Figure 1 presents the responses in a chart. All respondents require the distribution of both population and employment by traffic analysis zone (TAZ). Further, seven of the MPOs required more detailed demographic and socioeconomic characteristics of the residents of each TAZ. Six require characteristics of passenger travel such as the distribution by mode, distribution by time of travel, and the spatial distribution of travel. All eight MPOs require road network data including counts and speed data. Six of them require volume-delay/performance functions for model development. Six of the MPOs require transit network data as well. The types of data described above reflect what most, if not all, of the MPOs use in model development. Four of the MPOs though indicated a need for transit counts as well as characteristics of freight traffic. A minority of the responding MPOs, specifically three of them, also require network characteristics and counts relating to non-motorized transportation modes.

Table 1: Tennessee MPO data needs for developing long range travel demand models

Question: What data does your agency use to develop/update its long range transportation plans (please select all that apply)?		
Data Type	**Response Percent**	**Response Count**
Distribution of population by traffic analysis zone	100.0%	8
Distribution of employment by traffic analysis zone	100.0%	8
Demographic/socioeconomic characteristics of each traffic analysis zone	87.5%	7
Demographic/socioeconomic characteristics of each household	12.5%	1
Road network data	100.0%	8
Transit network data	75.0%	6
Pedestrian network data	37.5%	3
Bicycle network data	25.0%	2
Characteristics of passenger trips (distribution by mode, distribution by time of travel, spatial distribution/pattern of travel, etc)	75.0%	6
Characteristics of freight traffic (volumes by commodity, volumes by vehicle type, spatial distribution of freight traffic, etc)	50.0%	4
Roadway volume-delay/performance functions	75.0%	6
Road counts and speed data	100.0%	8
Transit counts	50.0%	4
Bicycle and pedestrian counts	12.5%	1
Transit service characteristics	25.0%	2
Other (please specify)	0.0%	0


Transit service characteristics
Bicycle and pedestrian counts
Transit counts
Road counts and speed data
Roadway volume-delay/performance functions
Characteristics of freight traffic
Characteristics of passenger trips
Bicycle network data
Pedestrian network data
Transit network data
Road network data
Demographic/socioeconomic characteristics of each household
Demographic/socioeconomic characteristics of each traffic analysis zone
Distribution of employment by traffic analysis zone
Distribution of population by traffic analysis zone
0.00%
20.00%
40.00%
60.00%
80.00%
100.00%
120.00%
Series1

Sources of Demographic and Employment Data used by TN MPOs

Table 2 and Figure 2 show the responses given by the eight responding MPOs to a question about the sources of the demographic and socioeconomic characteristics of the household and population data they used in model development. The responses given indicate the agencies use data from multiple sources to knit the datasets that they require for model development. Six of the MPOs indicated they use the data from the decennial census, the American Community Survey (ACS), as well as data collected in a household travel behavior survey undertaken in their respective regions. Five of them also indicated that they make use of data collected in the National Household Travel Survey (NHTS). Three MPOs also cited other data sources namely, that compiled by Woods and Poole, data from the U.S. Bureau of Labor Statistics (BLS), and data from the U.S. Bureau of Economic Analysis (BEA).

Table 2: Sources of demographic characteristics of an MPO region's population

Question: What are the sources of your household and population demographic/socioeconomic data?		
Answer Options	**Response Percent**	**Response Count**
National Household Travel Survey (NHTS)	62.5%	5
Decennial census	75.0%	6
American Community Survey (ACS)	75.0%	6
Regional Household Travel Survey	75.0%	6
Other (please specify)		3
answered question		**8**
skipped question		**0**

Number	**Other (please specify)**
1	Woods & Poole
2	BLS and BEA data in general
3	Woods and Poole

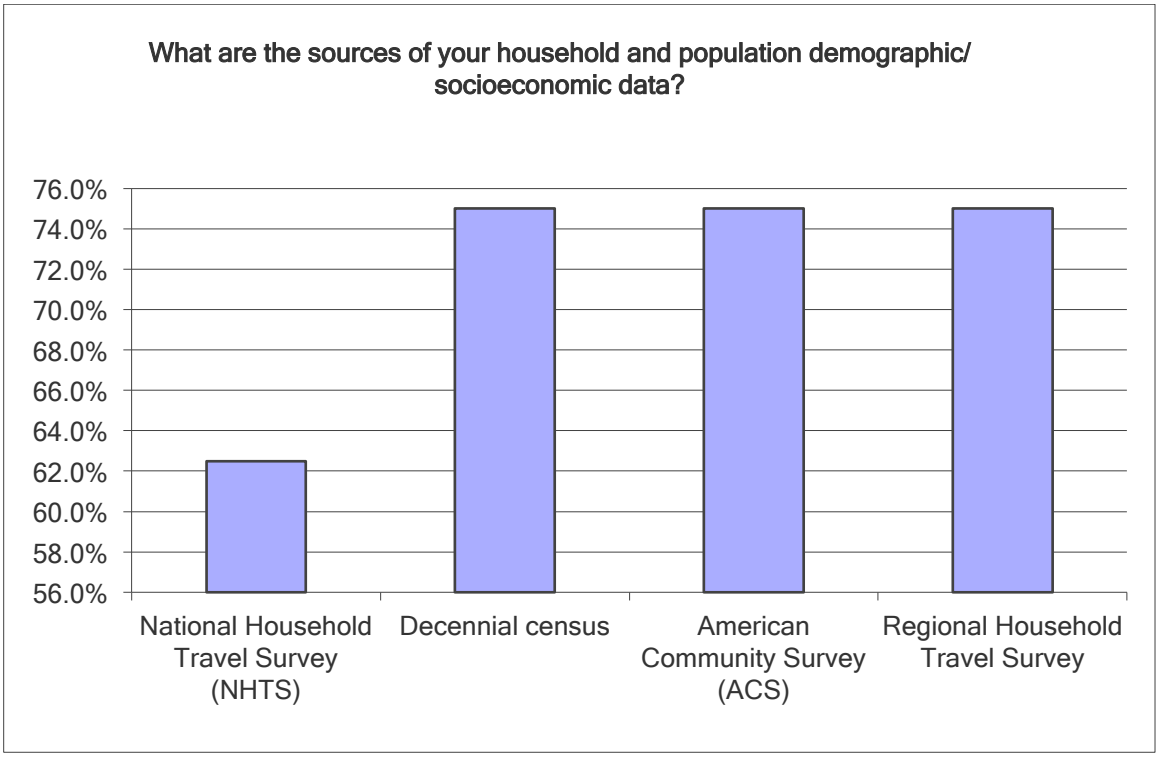


Figure 2: Sources of demographic characteristics of an MPO region's population

Table 3 and Figure 3 show the responses to the question about the sources of the employment data used in long range travel demand model development. The majority of the responding MPOs (five of them) use the Quarterly Census of Employment and Wages. Three MPOs indicate using Market Research Listings and three indicate using data collected in Regional Household Travel Surveys. The U.S. Bureau of Labor Statistics (BLS), the U.S. Bureau of Economic Analysis (BEA) and InfoUSA were specifically cited by two MPOs as sources of employment data. There is very little use by the MPOs of the data collected by State Employment Commissions and by the Current Population Survey.

Issues/Challenges encountered by TN MPOs in the use of Data

Table 4 includes a summary of the responses to the question pertaining to difficulties encountered in obtaining the data MPOs need to develop their long range travel demand models. The data item the majority of MPOs (four out of eight) indicated they had difficulty obtaining is the distribution of employment by traffic analysis zone. The next data items of equal response count are the spatial distribution of population by TAZ and the demographic characteristics of the resident population of each zone. One or two MPOs also indicated difficulty with obtaining road and pedestrian network data, volume-delay functions and characteristics of freight traffic. An MPO region that spans two states mentioned challenges in obtaining data from the different states without being specific about the particular data items. Another MPO cited difficulty obtaining data on external-external travel by visitors and also on school enrolment.

Table 3: Sources of data on employment in an MPO region

What are the sources of your employment data?		
Answer Options	**Response Percent**	**Response Count**
Quarterly Census of Employment and Wages	71.4%	5
State Employment Commissions	14.3%	1
Current Population Survey	14.3%	1
Market Research Listings	42.9%	3
Longitudinal Employer–Household Dynamics	28.6%	2
Regional Household Travel Survey	42.9%	3
Other (please specify)		3
answered question		**7**
skipped question		**1**

Number	**Other (please specify)**
1	BLS and BEA data in general; proprietary data sources
2	Purchase employment data from InfoUSA
3	INFOUSA

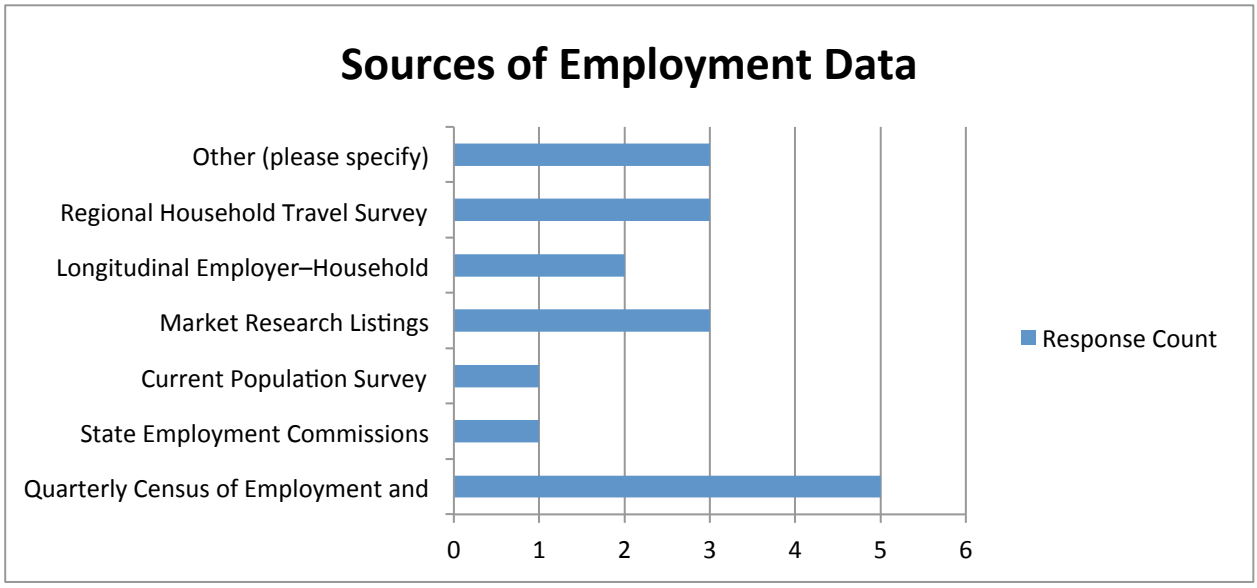


Figure 3: Sources of data on employment in an MPO region

Table 4: Description of data items MPOs have difficulty obtaining for developing regional travel forecasting models

What data do you have difficulty obtaining to develop/update your long range transportation plans (please select all that apply)?		
Answer Options	**Response Percent**	**Response Count**
Distribution of population by traffic analysis zone	60.0%	3
Distribution of employment by traffic analysis zone	80.0%	4
Demographic/socioeconomic characteristics of each traffic analysis zone	60.0%	3
Demographic/socioeconomic characteristics of each household	60.0%	3
Road network data	20.0%	1
Transit network data	0.0%	0
Pedestrian network data	40.0%	2
Bicycle network data	20.0%	1
Characteristics of passenger trips (distribution by mode, distribution by time of travel, spatial distribution/pattern of travel, etc)	20.0%	1
Characteristics of freight traffic (volumes by commodity, volumes by vehicle type, spatial distribution of freight traffic, etc)	40.0%	2
Roadway volume-delay/performance functions	40.0%	2
Road counts and speed data	0.0%	0
Transit counts	20.0%	1
Bicycle and pedestrian counts	20.0%	1
Transit service characteristics	0.0%	0
Other (please specify)		2
	answered question	**5**
	skipped question	**3**

Number	**Other (please specify)**
1	Since we are bi-state. The difficulties are various by state.
2	School enrollment Visitor E-E

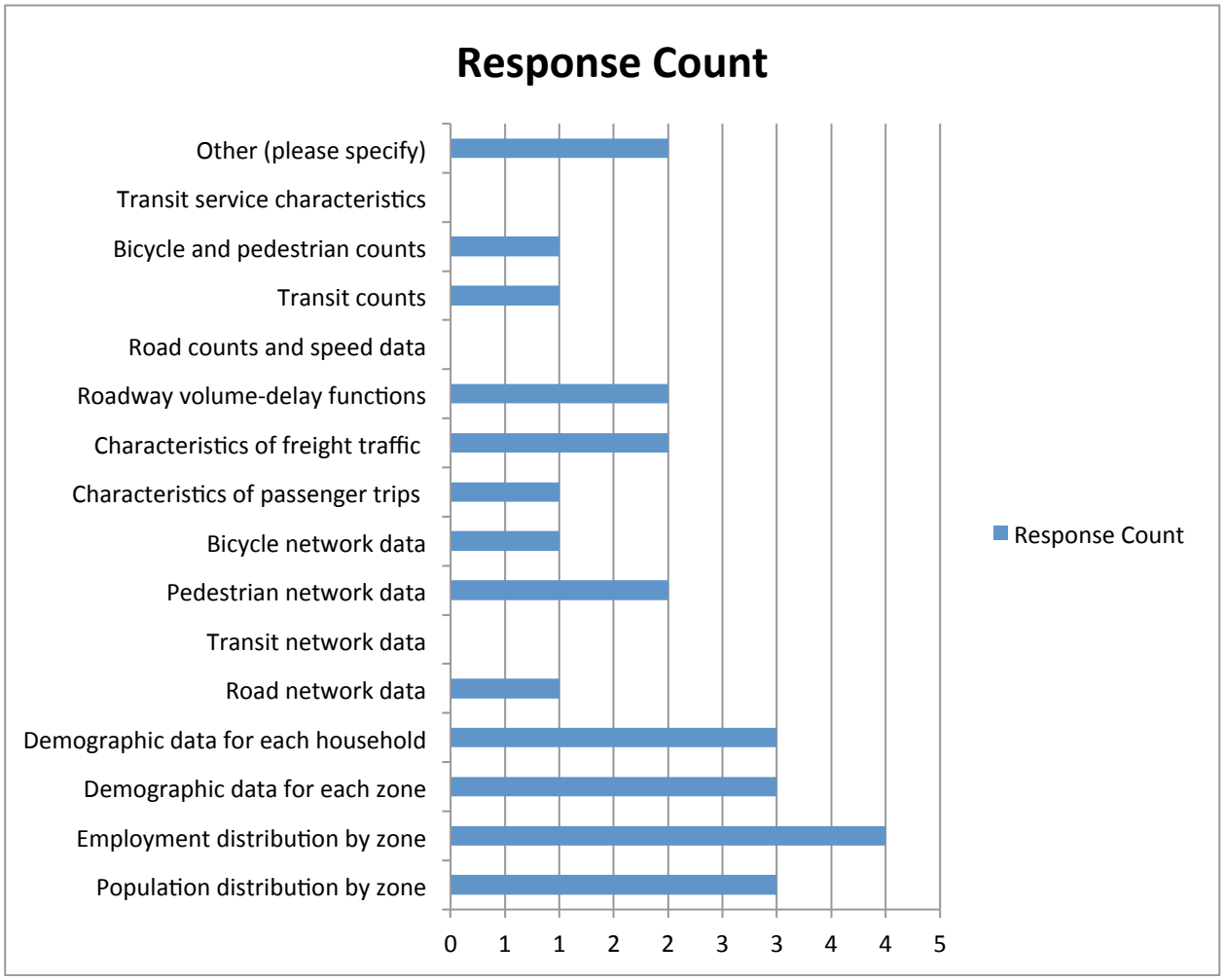


Figure 4: Description of data items MPOs have had difficulty obtaining for developing regional travel forecasting models

There were just two MPOs out of the eight that responded to the survey that indicated encountering some challenges with the use of the demographic and socioeconomic data they obtained from their sources (see Table 5). The main challenge experienced by the first MPO was in developing the base-year data for a base-year that is between census years, and also the mismatch between the spatial units used by census, that is block groups, versus the traffic analysis zones used in travel demand analysis. An additional complicating and related challenge cited was with the possible changes that could occur with the definition of census geography every 10 years. The second MPO mentioned "known" errors that sometimes exist in the data, such as population allocated to cemeteries.

Three out of the eight MPOs indicated encountering some challenges with the use of the employment data they obtained from their respective sources. The challenges experienced by one MPO related to data quality issues, namely incorrect geocoding of employers or in some cases no information on the employers at all. Also mentioned were issues with the Quarterly Census of Employment and Wages (QCEW) and Longitudinal Employer-Household Dynamics (LEHD) relating to incorrect geographic location to which employees were assigned.

Table 5: Challenges with the use of demographic data in transportation planning applications

For each data source selected or listed in question (3), provide a brief description of any challenges you have had with the use of the data in planning applications. [Question 3: What are the sources of your household and population demographic/socioeconomic data?]	
Answer Options	**Response Count**
	2
answered question	**2**
skipped question	**6**
Number	**Response Text**
1	I can't personally speak much to the challenges related to the survey data as noted under #4. In terms of the census data, the main challenge is developing base year data for an inter-censal year, i.e. 2006 and also the mis-match in geographic scale, i.e. block groups vs. TAZs. The fact that census geography can change every 10 years is also a challenge.
2	Sometimes known errors appear (i.e., population in cemeteries)

Data for Constructing the Representation of the Physical Network of each Mode

The primary sources of data on the road network for the seven MPOs that responded to the related survey question were TDOT's TRIMS database, and by direct collection and field visits undertaken by the MPO (Table 6). One MPO also indicated Tel-Atlas to be a source of road network data.

Table 6: Sources of road network data

What are the sources for your road network data?	
Answer Options	**Response Count**
	6
answered question	**6**
skipped question	**2**
Number	**Response Text**
1	Primarily TDOT TRIMS database
2	Own collection, DOT
3	The highway network database was collected directly or derived from field visits and available data from TDOT, including TRIMS photography data.
4	local government agencies
5	Data collection by self
6	TRIMS Tel-Atlas

The link performance functions used by MPOs for traffic assignment purposes were obtained from a variety of sources (see Table 7). The consultant for one of the responding MPOs

developed the functions after collecting the necessary data using the floating car method. This same MPO indicated it obtained traffic counts from existing sources at state, county, and local levels. Another MPO indicated the functions were developed by the consultant through calibration but without providing specific details. One MPO cited local government agencies as the source for their functions, while another MPO indicated their staff collected the necessary data for development of the functions. Finally, an MPO indicated the use of existing functions from a previous model and the functions presented in NCHRP 365.

Table 7: Source of link performance functions

What is the source of your roadway performance functions?		
Answer Options	**Response Count**	
	5	
answered question	**5**	
skipped question	**3**	
Number	**Response Text**	**Categories**
1	Handled by model development consultant through calibration	
2	Travel time runs (using the floating car method) were conducted by the MPO's consultants in a previous study and with the last TDM update. Traffic counts were obtained from existing sources at state, county, and local levels.	
3	local government agencies	
4	Data collection by self	
5	Previous Model/NCHRP 365	

The five MPOs that responded to the survey question on the source of transit network data all cited the transit authority in their respective jurisdiction (see Table 8). One MPO also cited the census and the State as additional sources.

Table 9, which has the responses to the survey question on the source of transit service characteristics, shows all the responding MPOs cite their respective regional transit authority as the data-source. One MPO indicates the census and the State as additional sources.

Table 8: Sources of transit network data

What are the sources for your transit network data?	
Answer Options	**Response Count**
	6
answered question	**6**
skipped question	**2**
Number	**Response Text**
1	We have GIS files of the KAT transit routes
2	CARTA
3	Transit network data is obtained directly from the Memphis Area Transit Authority (MATA).
4	ethra, census, state
5	Does not apply
6	Transit Authority

Table 9: Sources of transit service characteristics

What are the sources for your transit service characteristics?	
Answer Options	**Response Count**
	6
answered question	**6**
skipped question	**2**
Number	**Response Text**
1	Knoxville Area Transit (KAT)
2	CARTA, On-board survey
3	Transit network data is obtained directly from the Memphis Area Transit Authority (MATA).
4	ethra, census, state
5	Does not apply
6	OnBoard Survey

The responses to the question on the sources for a region's pedestrian network were varied (see Table 10). One MPO specifically cited TDOT's TRIMS data. Another MPO indicated it currently did not have a source for sidewalk/pedestrian network data, walking connectors were developed by the consultants within the CBD and most of the urban zones for their model. These connectors enhanced transit accessibility and serve to represent cross-block pedestrian movements which cannot be accommodated by the highway centroid connectors. Another MPO cited State and local governments as the source of their pedestrian network data. Finally, one MPO indicated a field study was undertaken to construct the network of interest.

Table 10: Sources of pedestrian network data

What are the sources for your pedestrian network data?	
Answer Options	**Response Count**
	5
answered question	**5**
skipped question	**3**
Number	**Response Text**
1	TDOT TRIMS data
2	As there was currently no source for sidewalk/ped network data, walking connectors were developed by the consultants within the CBD and most of the urban zones for the model. These connectors enhanced transit accessibility and serve to represent cross-block pedestrian movements which cannot be accommodated by the highway centroid connectors.
3	state, local governments
4	Does not apply
5	Study

Six MPOs provided responses to the survey question on the sources of their bicycle network data (see Table 11). The first MPO indicated it had no sources, with the implication that it had no information on the network or on bicycle use. The second MPO cited a "Bike Plan" as the source. The third MPO indicated that local jurisdictions provide their respective bicycle network and use data and these are assembled to create a regional network and database. The fourth MPO cited as source the State and local governments without providing any specific details. The fifth MPO has its staff collect the necessary data on the bike mode. Finally, the sixth MPO also indicated it undertakes field studies to provide the necessary data for travel demand analysis.

Count Data and Characteristics of Freight Movement

Count data are very important in the development of models of travel demand. Their uses include providing a description of the spatial pattern of travel demand by mode, travel demand model estimation, and travel demand model validation.

Table 12 presents the responses to counts undertaken at external stations to capture external travel. The first MPO obtained the data on external travel through a video license plate survey. For its next survey, the MPO planned to look at alternative methods such as cell phone tracking. The second MPO cited TDOT as the source of its external travel data. The third MPO indicated that it obtained percent splits from the TN Statewide Travel Demand Model which was applied to traffic counts to determine external travel in the base year. The Freight Analysis Framework data was also used to develop a base year EE truck trip table. The fourth MPO obtained the data through traffic counts undertaken at the external cordon. Finally, the fifth MPO cited the TN Statewide Model as its source for external-external travel.

Table 11: Sources of bicycle network data

What are the sources for your bicycle network data?	
Answer Options	**Response Count**
	6
answered question	**6**
skipped question	**2**
Number	**Response Text**
1	Don't have any
2	BIke Plan, TPO
3	Local jurisdictions provide data on the regional bicycle network to the MPO, which maintains a regional database of the facilities.
4	state, local governments
5	Data collection by self
6	Study

Table 12: Sources for data on external travel

What are the sources for data on external travel in your region?		
Answer Options	**Response Count**	
	5	
answered question	**5**	
skipped question	**3**	
Number	**Response Text**	
1	We performed a video license plate survey a few years ago - I believe it was 2007. This probably needs to be updated in near future and we will look at other methodologies such as cell phone tracking.	
2	DOT	
3	External station data. Percent splits from the TN Statewide Travel Demand Model were applied to traffic counts to determine external travel for the base year. Freight Analysis Framework data was also used to develop a base year EE truck trip table.	
4	Traffic counts along cordon line	
5	TN State wide Model	

The primary source of count data on various road facilities in each MPO region is TDOT (Table 13). The first MPO supplements the TDOT counts with counts it undertakes using a contractor. The second MPO also supplements the TDOT counts with counts it also undertakes. The third MPO obtains additional count information from the county and local sources. Finally, the fifth MPO, whose region lies in both Tennessee and Virginia, also obtains road traffic count data from VaDOT in addition to undertaking counts by in-house staff.

Table 13: Sources for road count data

What are the sources of your roadway count data?		
Answer Options	**Response Count**	
	6	
answered question	**6**	
skipped question	**2**	
Number	**Response Text**	
1	TDOT coverage counts supplemented by some counts our agency conducts using a contractor	
2	TPO, DOT, own survey	
3	TDOT, county, and local sources.	
4	state	
5	TDOT, VaDOT, traffic counts by self or staff	
6	TDOT	

The primary source of transit count data is primarily the regional transit authority for the jurisdiction (see Table 14). In addition, one other MPO cites the State as a source of transit count data.

Table 14: Sources for transit count data

What are the sources of your transit count data?	
Answer Options	**Response Count**
	6
answered question	**6**
skipped question	**2**
Number	**Response Text**
1	From KAT
2	CARTA
3	MATA.
4	state, ethra
5	Does not apply
6	Transit Authority

Data on freight/truck traffic characteristics and their movements were obtained from a variety of sources (Table 15, Figure 5). Three of the responding MPOs cited as a source the commodity flow survey (CFS) data. Five of the MPOs cited the freight analysis framework as a data source. Two MPOs undertook interviews of sampled specific carriers to provide them with information on their tours and schedules. One MPO obtained information on freight through a mail-back survey of carriers. Three MPOs cited use of Transearch data for their analysis of freight

movements. However, one of them indicated that for model development, the Transearch data was not used. Rather, they made use of generic quick-response freight modeling techniques.

Table 15: Sources of freight/truck traffic characteristics and their movements

What are the sources of freight/truck traffic characteristics and their movements?		
Answer Options	**Response Percent**	**Response Count**
Commodity Flow Survey (CFS)	42.9%	3
Freight Analysis Framework	71.4%	5
Interview of specific carriers to determine tours and schedules	28.6%	2
Mail-back surveys of carriers	14.3%	1
Other (please specify)		3
	answered question	**7**
	skipped question	**1**

Number	**Other (please specify)**
1	Transearch Data also, however in terms of the model itself it is based mostly on generic quick-response freight modeling techniques.
2	Regional Freight Profile Transearch TDOT
3	Tran search

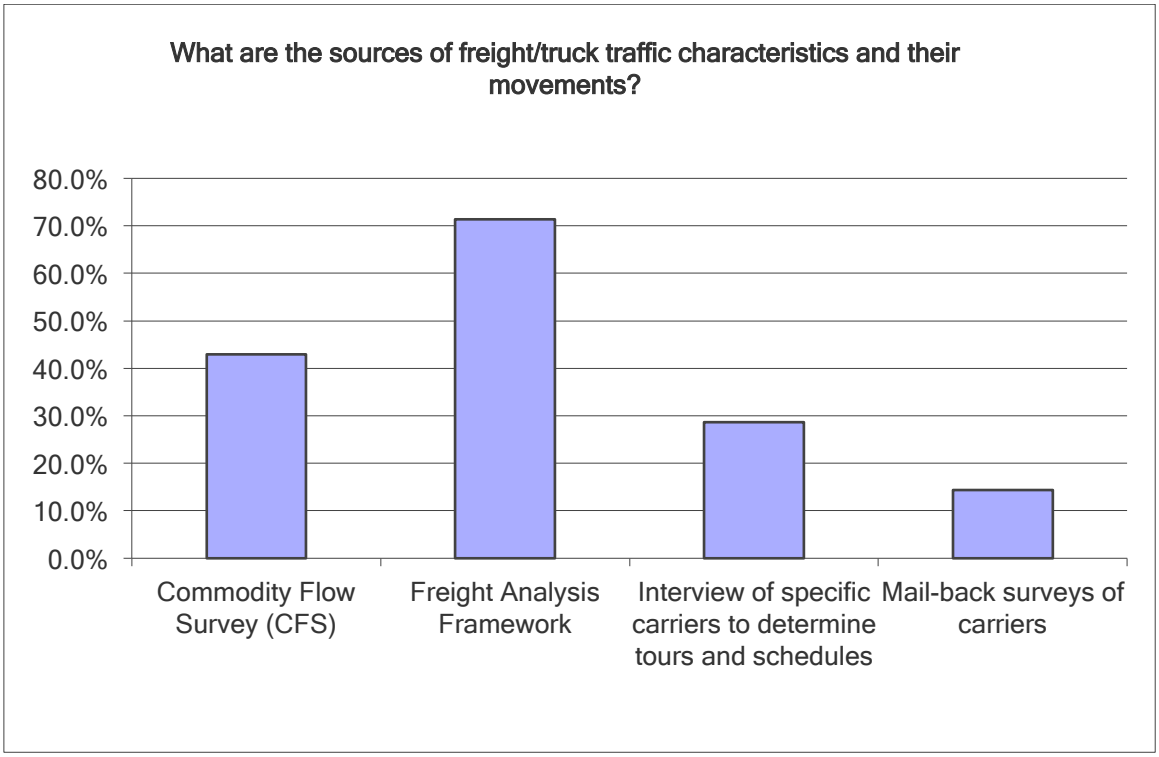


Figure 5: Sources of freight/truck traffic characteristics and their movements

Estimation of Passenger and Freight Travel Demand

The process of obtaining estimates of passenger travel demand for the majority of the responding MPOs (six out of the eight MPOs) was done through the conduct of a regional household travel behavior survey (Table 16, Figure 6). Four MPOs also indicated making use of NCHRP 365. Notwithstanding that at the time the survey of MPOs was conducted, NCHRP 716 had not been out that long, one MPO indicated making use of it in the analysis of passenger travel demand. One MPO mentioned the use of equations based on employment type (employment types are defined according to the North American Industry Classification System (NAICS)) developed by their consultant for obtaining estimates of passenger travel demand.

The survey results concerning the development of estimates of freight demand were a bit more mixed than that for passenger travel demand (Table 17, Figure 7). Three MPOs indicated use of data collected in regional household travel surveys for model development and subsequent forecasting. Two MPOs indicated use of NCHRP 365 while one MPO indicated use of NCHRP 716. Other mentioned sources for generating estimates of truck movements were the quick response freight model, the use of consultant-developed equations that are based on employment type data from NAICS, and information from INRIX a software company that collects information anonymously from tens of millions of mobile phones, trucks, delivery vans, and other fleet vehicles equipped with GPS locator devices.

Table 16: Developing estimates of passenger travel demand

What are your MPO's sources for developing estimates of passenger travel demand?			
Answer Options		**Response Percent**	**Response Count**
NCHRP 365		57.1%	4
NCHRP 716		14.3%	1
Regional Household Travel Survey		85.7%	6
Other (please specify)			1
		answered question	**7**
		skipped question	**1**
Number	**Response Date**	**Other (please specify)**	**Categories**
1	**Aug 6, 2012 11:29 AM**	Equations developed by consultant based on employment type (NAICS)	

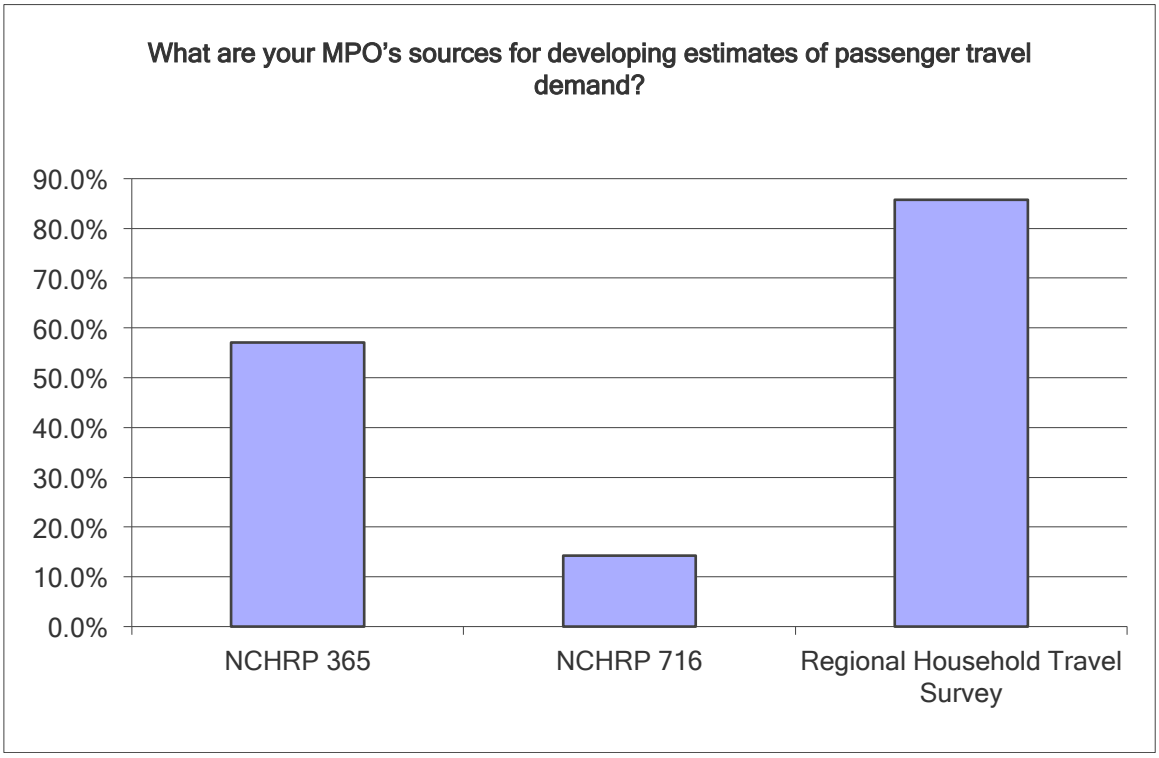


Figure 6: Sources for developing estimates of passenger travel demand

Table 17: Developing estimates of freight/truck demand

What are your MPO's sources for developing estimates of freight/truck demand?		
Answer Options	**Response Percent**	**Response Count**
NCHRP 365	66.7%	2
NCHRP 716	33.3%	1
Regional Household Travel Survey	100.0%	3
Other (please specify)		4
	answered question	**3**
	skipped question	**5**
Number	**Other (please specify)**	
1	QRFM	
2	INRIX	
3	Equations developed by consultant based on employment type (NAICS)	
4	QRFM	

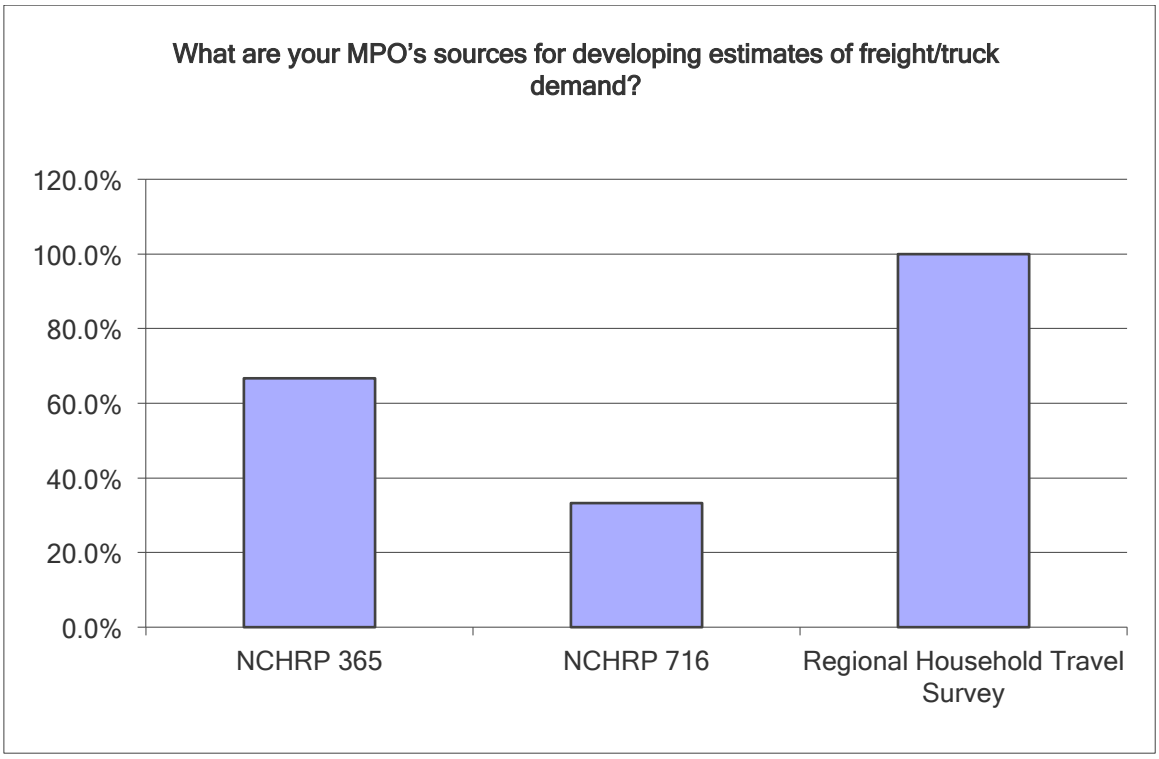


Figure 7: MPO sources for developing estimates of freight demand

TNMUG Travel Data Follow-Up Interview

After data was compiled and analyzed from the initial online survey, a follow-up questionnaire was constructed to obtain greater detail regarding new data sources and applications, difficulties encountered in obtaining employment data, and suggestions from Tennessee MPOs regarding additional support that TDOT could provide. The questionnaire contained 7 items, and was conducted by telephone interview. Eight agencies responding to the initial survey indicated they would be willing to provide additional insight and supplied contact information. All eight agencies were contacted by email with a request to participate in the follow-up survey, and a copy of the survey questions were provided to each agency at this time. Of the eight agencies contacted, six actually participated in the follow up interviews. The results of these interviews are outlined in the following sections, with new travel data sources described first, issues with employment data described second, and MPO suggestions for TDOT described last.

New Travel Data Sources

Three items on the follow-up questionnaire focused on identification of new data sources that would be useful to Tennessee MPOs for travel demand studies, applications for the new data, and anticipated costs for obtaining the data. In terms of identifying new sources of travel data, four of the responding agencies identified cellular data as an emerging data source with promise for travel demand modeling. These agencies indicated key applications for this data would include traffic volume assignment, average travel speed and travel time for urban roads (not freeways), and freight modeling. One agency reported experience in using cellular data, but indicated accuracy problems related to traffic assignment with vehicles assigned inappropriately to parallel streets in local traffic because of proximity. In such cases, parallel streets were too close together for the vehicle data to be properly assigned, and discrepancies were discovered because of unusually high traffic volumes reported on local roads in the dataset. In addition, the agency had issues with small sample sizes for some of the data.

Another responding agency indicated that while cellular data looks interesting, particularly for obtaining average travel speeds and travel times along urban corridors, there are so many providers that it is difficult to know which provides the best data and service from the standpoint of an MPO. Another agency expressed concern that the cellular data available does not typically contain trip purpose, and thus conducting household travel surveys using a GPS component may provide more useful information. All agencies that reported interest in cellular data expressed significant concerns regarding data quality and the resulting quality control effort that would be required for the data to be useful. Another agency expressed concerns regarding privacy issues of cellular data. In addition to cellular data, one agency also reported that the ability to obtain data from ITS systems in place across the state also looks promising, and another indicated GPS data for trucks is also of interest, particularly for improving freight modeling. A concern raised also included the difficulty in obtaining freight data from private carriers.

Finally, costs of obtaining data are always a challenge for MPOs in the transportation planning process. Several agencies indicated they would like for TDOT to enter into an agreement with one of the cellular providers to provide data for the entire state. One agency also reported that the cost for obtaining the cellular data itself is not that high, but that the quality control costs are significant, and that this is another area where the MPOs could use help from TDOT.

Employment Data Issues

Difficulty in obtaining employment data at the traffic analysis zone level was found to be one of the major challenges TN MPOs face in developing or updating their travel demand models in the

initial survey. In the follow-up interviews, participants were asked to identify any proprietary employment data sources that would be helpful for travel demand model development/update. The participating agencies listed the following sources for employment data that are currently in use or under consideration by the MPOs:

- InfoUSA
- Longitudinal Employer-Household Dynamics (US Census Bureau)
- TN Department of Economic and Community Development
- Local Chamber of Commerce
- Woods & Poole Economics, Inc.
- Dun & Bradstreet
- Quarterly Census of Employment and Wages (US Department of Labor)
- Census Transportation Planning Package (TAZ level employment data due in 2013)
- Public library

Quality of employment data from all sources was a primary concern for all responding agencies, with InfoUSA cited by one agency as having a particularly high number of incorrect entries. Most responding agencies indicated that rather than a single data source for employment data, they instead used multiple sources to develop a hybrid 'best' dataset. The development of this hybrid dataset takes considerable staff time, particularly because of the quality control and verification required. Problems with employment data occur due to large employers having all employees assigned to the headquarter location rather than locations of individual sites or franchises (particularly QCEW and LEHD). Another issue identified is that some categories of employees are overrepresented because combined locations (i.e. professional medical office buildings) are all categorized separately in terms of the number of employees, rather than taking into account that many of the staff in such locations are shared by the employing group. Another aspect of the available data that presents problems is the lack of consistency, even within a single dataset, in terms of spelling and name assignments, which can make it difficult to identify duplicate entries. Other MPOs face issues because their boundaries cross into multiple states, leading to even greater data consistency and availability problems because of discrepancies between state data sets and access policies (particularly regarding level of detail available due to privacy restrictions).

Agencies using Dun & Bradstreet reported that this data had less headquartering issues, but did present problems with large employers in incorrect locations or appearing multiple times in the dataset. The Dun & Bradstreet data was reasonably priced, with the cost approximately $1,000 for online data access for one year. Data available from the Census Bureau was reported to have some quality control issues, however, the Census Bureau does work to address inaccuracies, and updates the information each year. Currently, data is only available coded to the block level, but the Census Transportation Planning Package will be released next year with employment data coded to the TAZ level, and may provide a better resource for MPOs. For agencies using public libraries to download employment data, limited download of records available at a time resulted in this source being infeasible for complete coverage. All agencies using employment data available from the State of Tennessee reported that this resource was of good quality, and because it was also free was widely used. In order to obtain a complete dataset for each MPO area, however, multiple sources were still required, even if just to serve as a basis for quality control checks.

MPO Suggestions for TDOT

When asked how TDOT could further support the MPOs in the planning effort as it pertains to data collection, several suggestions were provided by participants. All agencies responded that the summer workshops and TNMUG meetings are very helpful and provide significant support in modeling efforts. One MPO suggested that TDOT should acquire cellular data from INRIX (or another provider) for the entire state, and help MPOs with processing and use of the data. Also suggested was that TDOT review their existing data collection procedures with the MPOs and solicit feedback regarding where additional count stations should be located to avoid duplication with local efforts and achieve maximum impact. Also suggested is that TDOT help the MPOs identify mechanisms to deal with data quality issues, as this consumes a significant amount of MPO staff time.

One MPO suggested that TDOT could provide additional training on the employment data available through the US Census Bureau, and particularly focus on data processing and reliability. Another would like to see more rigorous review of MOVES model data input requirements to determine how best to meet these data needs. More local opportunities for training were also seen as desirable for MPOs, rather than having to travel to receive training. Specific TDOT contacts for the various elements of the planning process were also suggested as something that would be beneficial to MPOs in terms of streamlining the support process. Finally, multiple respondents indicated that help from TDOT in obtaining freight data to incorporate into modeling efforts would be very helpful, as this is an area where very little data is available, and access is a significant issue.

Conclusions/Recommendations

The analysis of both survey and interview data highlights several areas of research and communication that should be pursued in order to support Tennessee MPOs as they move forward with long range planning efforts. These findings reflect the need to investigate new sources of data that may be useful not only in obtaining estimates of travel times and speeds to apply to network corridors but also in gathering data to support inclusion of freight in modeling efforts. The results of this study are summarized as follows:

1. A nationwide survey of MPOs should be conducted to identify sources of cellular/gps/bluetooth data currently in use, quality of data from these sources, and applications in which the data is used (with benefits/limitations clearly outlined).
2. A nationwide survey of MPOs should be conducted to identify sources of freight/commercial vehicle data in use by other agencies, quality of these sources, and applications in which the data is used.
3. Consideration should be given to entering into a collaborative agreement statewide (or multi-state) to obtain and share advanced technology data because of the potential cost savings through high volume contracts with commercial vendors.
4. TDOT should convene a meeting with MPO staff across the state to specifically discuss TDOT's current and planned data collection efforts (particularly to maximize impact of both state and local effort) and opportunities to provide additional support.
5. The Tennessee Model Users Group (TNMUG) continues to provide a valuable resource for MPOs across the state to support modeling efforts, a venue for communication and collaboration amongst planning professionals, and a forum for identifying best practices as well as areas where further research is required.

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