

TRAFFIC ANALYSIS ZONES - HOW DO WE MOVE FORWARD?

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ABSTRACT

Traffic Analysis Zones (TAZs) have been a part of CTPP/UTPP tabulation geography for decades. However, over time defining and producing TAZ level tabulations have become costly. This paper reviews census standard geographies and assesses the issues surrounding the continued production of TAZs for CTPP data. The issues include efforts for TAZ delineation, their usefulness, and data quality. The paper also presents the results of a CTPP data user survey that sought experts’ opinions on the usefulness and utility of TAZ geography. The paper concludes that TAZ geography is essential for CTPP data and offers alternatives to address data quality issues.

Key Words: Traffic Analysis Zone, Census Transportation Planning Package, American Community Survey

INTRODUCTION

Traffic Analysis Zones (TAZs) have been a part of Census Transportation Planning Package (CTPP) data product since the inception of the Census commuting special tabulations, dating back to 1980. TAZ is the most commonly used geography unit in travel demand models for transportation planning process. However, in many areas TAZs in CTPP (referred to as Census TAZs hereafter in the paper) are not the same as TAZs used for regional travel demand models (referred to as Model TAZs hereafter), which can be confusing and may lead to problems when referencing the data. In addition, the small geographic units such as Census TAZs impose confidentiality and privacy protection challenges, and data precision might be an issue due to the limited sample sizes of American Community Survey (ACS).

This paper assesses the issues surrounding the continued production of Census TAZs. The assessment is based on literature review, a series of interviews of experts in the field, and an online survey targeting professional staff at metropolitan planning organizations (MPOs) and States Department of Transportation (DOTs). The assessment is primarily from a user perspective. Therefore, the survey aims to understand local agencies' efforts in Census TAZ delineation process, how CTPP data have been used for transportation planning, and how crucial the Census TAZ data structure is with comparison to other geographic units.

The next section describes various geography units for census and CTPP, followed by a discussion on issues surrounding CTPP data and its TAZ geography unit. The user survey results are presented in the following section. The paper concludes with a discussion and recommendations of how to move forward with future TAZ requests.

CENSUS GEOGRAPHY

Standard Census Geographic Entities

At the US Census Bureau, virtually all census data are geographically referenced. Currently, the standard hierarchy of census geographic entities include Census Blocks, Block Groups, Census Tracts, Counties, States, Divisions, Regions, and Nation, with some variations for the island areas and American Indian, Alaska Native, and Native Hawaiian areas. Beyond the standard geographic hierarchy, the Census Bureau uses several other geographic entities including TAZs that help support specific data uses and user groups. The census geographic hierarchy is illustrated in Figure 1.

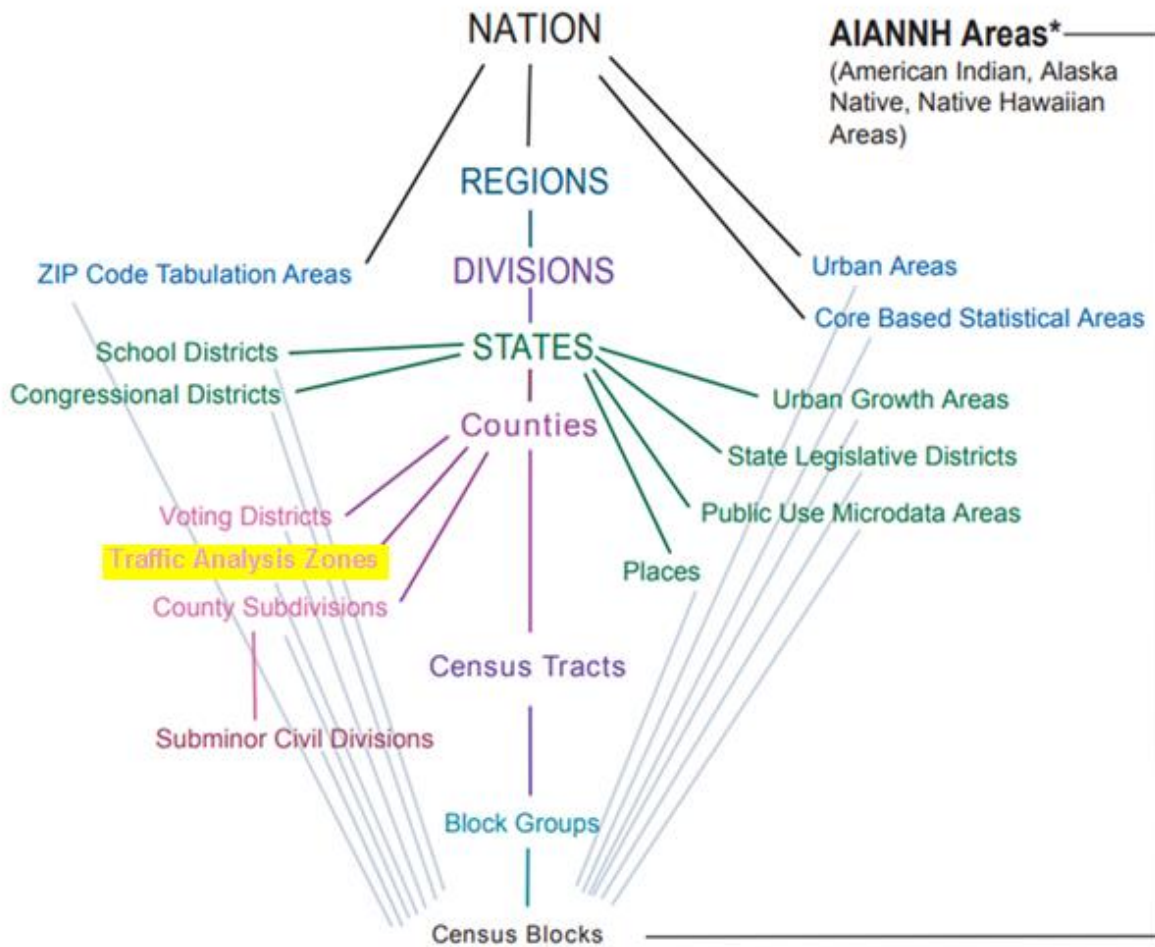


FIGURE 1 Standard Hierarchy of Census Geographic Entities

(Source: U.S. Census Bureau)

The smallest geographic area for which the Census Bureau collects and tabulates decennial census data is census blocks. Block groups are the next level in the geographic hierarchy which are generally defined to contain between 600 and 3,000 people. The block group consists of clusters of blocks and is the smallest geographic entity for which the decennial census tabulated and published sample data when the long form was used, and for which ACS presents data. The next level in the census geographic hierarchy is census tract which is designed to be relatively homogeneous units with respect to population characteristics, economic status, and living conditions. Census tracts are small and relatively permanent statistical subdivisions of a county with an average of 4,000 inhabitants. Although census tracts are designed to be relatively permanent over time, they are updated every 10 years. Since the 1960 census, the Census Bureau has assumed a greater role in promoting and coordinating the delineation, review, and update of census tracts with local involvement.

Model TAZ and Census TAZ

The Census TAZ geographic delineation is not included in the standard hierarchy of census geographic entities. Historically, Census TAZs were created specifically to support CTPP data, with the anticipation that these Census TAZs would be closely associated with Model TAZs in travel demand model and transportation planning process.

The Model TAZ is the unit of geography in conventional four-step travel demand models. In general, Model TAZs are designed to be relatively homogeneous, and the size of Model TAZs varies, with smaller zones in central business district and larger zones in the outer skirt area due to household and employment densities. Model TAZ's socio-economic data, including population, households, and employment, is an input for travel demand models. Usually there is no minimum threshold requirement for Model TAZ population and employment. The total number of Model TAZs in a metropolitan planning area is determined to provide enough level of detail for models that support the regional or statewide transportation planning process. The complexity of the model is another factor that impacts Model TAZs in size. Prior to year 2000, most of travel demand models in the country were conventional four-step model and Model TAZs were similar to census block groups in size with populations between 600 and 3,000. Since then, a new generation of travel demand models and land use models emerged that brought about the ability to provide traffic forecast information in great detail, and with these advances Model TAZs have tended to get smaller in size.

Census TAZs are not the same as Model TAZs. Census TAZ is a geography unit delineated by state and/or local transportation organizations for tabulating transportation-related data (i.e. CTPP data), especially journey-to-work and place-of-work statistics (U.S. Census Bureau, 2002). The creation of Census TAZ as a geographic delineation was aimed to present the data in a way that is more convenient for data users to access and tabulate data. The U.S. Census Bureau requires Census TAZs to follow census designated boundaries (TIGER line boundaries). To ensure data quality, there are other minimum population and/or employment requirements for Census TAZs. These requirements are the main reason that Census TAZs differ from Model TAZs.

The Census Bureau first provided data for TAZs in conjunction with the 1980 census, when it identified them as "traffic zones" (U.S. Census Bureau, 2002). For the 1990 census, Census TAZs were defined as part of CTPP. For 2000 CTPP, the FHWA distributed the TAZ-UP software to MPOs and state DOTs to delineate TAZs. The participation in the TAZ delineation program was not mandatory. MPOs and States who did not participate in the TAZ delineation program were given the option of requesting CTPP 2000 data at either the census tract or block group level of detail.

Different from previous TAZ delineation process, the 2010 TAZ delineation included two geographic structures: census TAZ and census TAD (Traffic Analysis District). The delineation business rules were developed by the Geographic Division of Census Bureau, Federal Highway Administration (FHWA), and American Association of State Highway and Transportation Officials (AASHTO). It was required that all TAZs nest within a county and within a TAD respectively. However, TADs were not required to nest within a county. TADs needed only to nest within the delineation coverage assigned to the MPO/State DOT.

The 2010 delineation business rules also provided guidelines that were suggested, but not required. For example, the Census Bureau recommended that the minimum resident worker population and workers by place of work level should be approximately 600 persons, which corresponds to the minimum threshold allowable for 2010 census block groups. It was also recommended that census TADs have an estimated population lower limit of 20,000 residents. Although these rules are recommended but not required, our user survey (see detailed descriptions in user survey section) indicates that many delineation program participants modified their TAZs to meet these suggested requirements.

CTPP AND CENSUS TAZ: HISTORY AND ISSUES

As Census TAZs were created and updated for tabulating CTPP data, it is meaningless to look at the future direction of Census TAZ without understanding the information presented in the CTPP data and how transportation planning professionals use the data, as well as some administrative issues surrounding CTPP.

History of Organizational Cooperation and Cost for CTPP

The CTPP is a historical example of organizational cooperation between the agencies and entities that rely on it (Christopher, 2002). The CTPP data are a set of special tabulations designed by transportation planners using large sample surveys conducted by the Census Bureau. The transportation community assumed the ownership of the program by demonstrating its willingness to pay for a set of special tabulations at the Census TAZ level to meet the transportation planning data needs.

The 1970 Census was the first decennial census to offer the cost-reimbursable Urban Transportation Planning Package (UTPP). There were 112 purchasers, most of which were MPOs. For the 1980 UTPP, there were 152 purchasers. The 1990 CTPP was the first pooled-fund program administrated by AASHTO that allows all the states and MPOs’ access to the data. The 2000 CTPP was also an AASHTO pooled-fund program. The approximate direct costs for CTPP/UTPP are shown in Table 1 (Christopher, 2002)

Table 1. Direct Cost for Transportation Planning Packages

	1970	1980	1990	2000
Buyers/Users	112	152	All States/MPOs	
Cost	\$0.6 M	\$2.0 M	\$2.5 M	\$3.0 M
Tables	43	82	120	203

In addition to the direct charges to the states and MPOs for CTPP tabulation, there have been other costs and contributions from the transportation community to define the local tabulation geography, such as the Census TAZ delineation process. For the development of the 2000 CTPP, state DOT agencies invested three-quarters of million dollars for technical support, coordination and software for Census TAZ delineation (Christopher, 2002). The staff time to develop the Census TAZs was

provided by local agencies for an unknown additional cost. Many agencies hired consultants to help with the TAZ delineation process.

Despite the extra cost of defining Census TAZs for CTPP tabulation, the transportation community has endorsed the Census TAZ delineation process probably because TAZs are an essential geography unit that is associated with transportation planning. For the 2000 CTPP, 282 of the 340 MPOs defined their own TAZs (Christopher, 2002).

On the other hand, the Census Bureau has approached CTPP tabulation as a cost-reimbursable product that was beyond the scope of the Bureau. There is no doubt that the transportation community is the main user of the data. Due to the organizationally cooperative nature of the CTPP program, it is important to have close communication between the transportation community and the Census Bureau in terms of data collection, processing, and tabulation to improve data quality and fulfill transportation planning data needs. The future of the Census TAZ should be guided by this broad conversation on data collection, processing, tabulation, and data usage.

Data Quality

From 1970 to 2000, CTPP and its predecessor, UTPP, used data from the decennial census long form. Now the decennial census long form has been replaced with the continuous ACS, and CTPP uses the ACS sample for the special tabulation. It is worth noting that past decennial census long forms were mailed to one in six households (17% sample size) while the ACS samples the equivalent of 2.5% housing units annually (FHWA/FTA, 2007). The smaller sample size in ACS leads to larger sample errors. The estimated sample error is about 1.33 times of that of the 2000 census (FHWA/FTA, 2007) and therefore, data precision becomes an issue especially for small geography area. Data precision improves for the CTPP data as they are tabulated for larger geography units.

To make sure that users understand that sample errors vary among places and variables, the CTPP tabulations report all the estimates with Margin of Errors (MOEs), and the Census Bureau strongly recommends that users incorporate this uncertainty in their analysis. In our user survey, we asked a question on how MOEs impact transportation planning professionals' decision on data usage/data analysis. The survey found that many transportation professionals did take into account of MOEs when making decisions for data usage/data analysis. At the same time, others found MOEs confusing.

The replacement of the decennial census long form with ACS probably increased the Census Bureau's workload of CTPP tabulation significantly. This is because ACS is conducted on a continuous basis with much smaller sample size. A hierarchical geography system (such as 2010 delineated Census TAZ/TAD) may help to present the data with better quality and still serve for transportation planning data needs.

Data Contents

The CTPP tabulations include three geographies:

1. Residence-based tabulations summarizing worker and household characteristics
2. Workplace-based tabulations summarizing worker characteristics
3. Worker flows between home and work, include travel mode

The residence-based tabulations are much like regular census products except that they have more two-way, three-way, and even four-way tables that depict population and household characteristics. This is specifically tailored for use by MPO travel demand models.

The workplace-based tabulations are the only census product that contains summary data on workers at their place of work. It is also known that workplace geocoding has been a problem since 1970s due to reporting errors. The problem is especially troublesome when tabulating workplace data at a small geography unit such as Census TAZ. It directly leads to the loss of data when the workplace address contains errors and cannot be assigned to the corresponding TAZ. Tabulating the workplace data at standard census geographic level such as block groups does not solve the problem because Census TAZs and census block groups are comparable in size. Tabulating the workplace data at a larger geographic unit such as Census TADs or census tracts, or even County level, can prevent the loss of survey records. However, doing so cannot prevent the loss of information as the worker flow information (such as trip length and travel time) between home and work relies on the accuracy of workplace location.

We believe the geocoding issue of workplace location can be tackled much more efficiently in the data collection process rather than by altering the geographic unit in the data tabulating process. Collecting and geoprocessing location data used to be a hassle. But with advances in sensor technology and the widespread use of blue tooth devices in transportation data collection, location information can be collected more easily and accurately. Furthermore, the digital form of the location data makes geoprocessing more straightforward.

Data collection requires careful planning and is beyond the scope of this paper. Due to the organizational cooperation nature of CTPP program, close communication between agencies is a first step to improve data quality.

Data Usage

Transportation planning professionals use CTPP data to:

1. Evaluate the existing conditions;
2. Develop or update travel demand models; and
3. Analyze demographic and travel trends.

When evaluating the existing conditions or analyzing demographic and travel trends, we usually refer to a larger scale geography such as a planning corridor, a city, a county, or at a regional level. It is rare to see a travel trend analysis tailored specifically to one TAZ. In this sense, data tabulated at a larger geographic unit such as TAD may be sufficient if the trade-off must be made.

To use the CTPP data for travel demand model development and update, it is essential to have the data at TAZ level. The residence-based and workplace-based demographic tabulations can be used as demographic inputs for a base year model. The work flow data between home and work can be used for the calibration and validation of trip distribution models for home-based work trips. The calibration of trip distribution models is to reproduce the trip length distribution (not simply to replicate the current flows between zones). A valid trip length distribution of work flow relies on accurate home and work locations, presented at TAZ level.

CENSUS TAZ ONLINE SURVEY

Overview

As part of this study, an online survey was conducted to gauge state DOTs, MPOs, RPOs, and other planning organizations' experience and preferences of Census TAZ data. The results of this survey will help us to understand the current usage of Census TAZ data and provide some insights for future improvements.

Survey Development and Methodology

With inputs from the AASHTO oversight board, the research team utilized Google Form to develop a 15-question online survey regarding Census TAZ data use and preferences. An email with the survey link was sent out to everyone on the CTPP TAZ Delineation Contact List from the AASHTO website:

(http://ctpp.transportation.org/Documents/CTPP_TAZ_Delineation_Contact_List_Database_Master_to_Census_Bureau_March42011.xls).

After removing duplicated records, about 400 emails were sent on July 11th, 2017. About 100 emails failed to deliver due to personnel changes or other reasons. Also, about 20 automatic replies were received due to the recipients' out of office or vacation status. Follow-up emails with reminders were sent out on July 17th, 21st, and 28th respectively. A PDF copy of survey questionnaires was attached with reminder emails so that the potential survey participants could share the survey with colleagues within their agencies. The survey asked one entry per agency. The survey was closed on August 3rd, 2017.

We received a total of 99 survey responses, of which 96 were online, and 3 via marked survey PDF files.

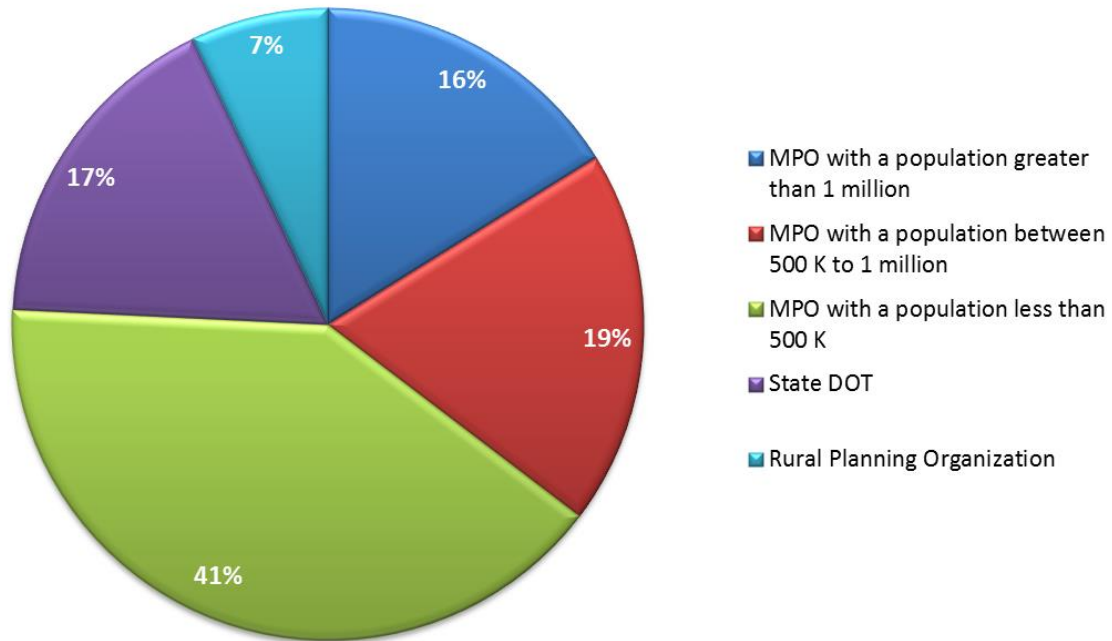
Summary of Survey Results

There was a total of 15 questions in this survey, grouped into three categories. The first category was about the planning agency and its transportation planning data sources, including two questions. The second category is about AASHTO's TAZ delineation program, including five questions. And the third category is about CTPP-TAZ data usage, including eight questions. Besides the 15 questions, there were three additional information-collection questions regarding extra comments, contact information for follow-up questions. The survey results are summarized below.

Survey Question Category One: Agency and its Transportation Planning Data Sources

Question 1	Which of the followings describe your agency	
Choices	Response Options	Count
a	MPO with a population greater than 1 million	16
b	MPO with a population between 500 K to 1 million	19
c	MPO with a population less than 500 K	40
d	State DOT	17
RPO	Rural Planning Organization	7
Total		99

Which of the followings describe your agency



Among the 99 respondents, 17% are from state DOTs, and the remaining 83% are from various regional planning organizations, including 76% from MPOs and 7% from Rural Planning Organizations (RPOs). Among the MPOs, 41% are small MPOs (population less than 500k), 19% are medium size MPOs, and 16% are large MPOs with population greater than 1 million. With 40 participating agencies as small MPOs, it seems that small MPOs are quite interested in CTPP data, perhaps indicating greater importance of CTPP data to them. CTPP data are probably their main/sole data sources for transportation planning.

FIGURE 2 provides an overview of the geographic distribution of the survey respondent agencies. Please note that about 5 DOTs, 10 MPOs, and 4 RPOs did not provide the specific name of their agencies. So about 19 survey respondents are not marked in FIGURE 2.

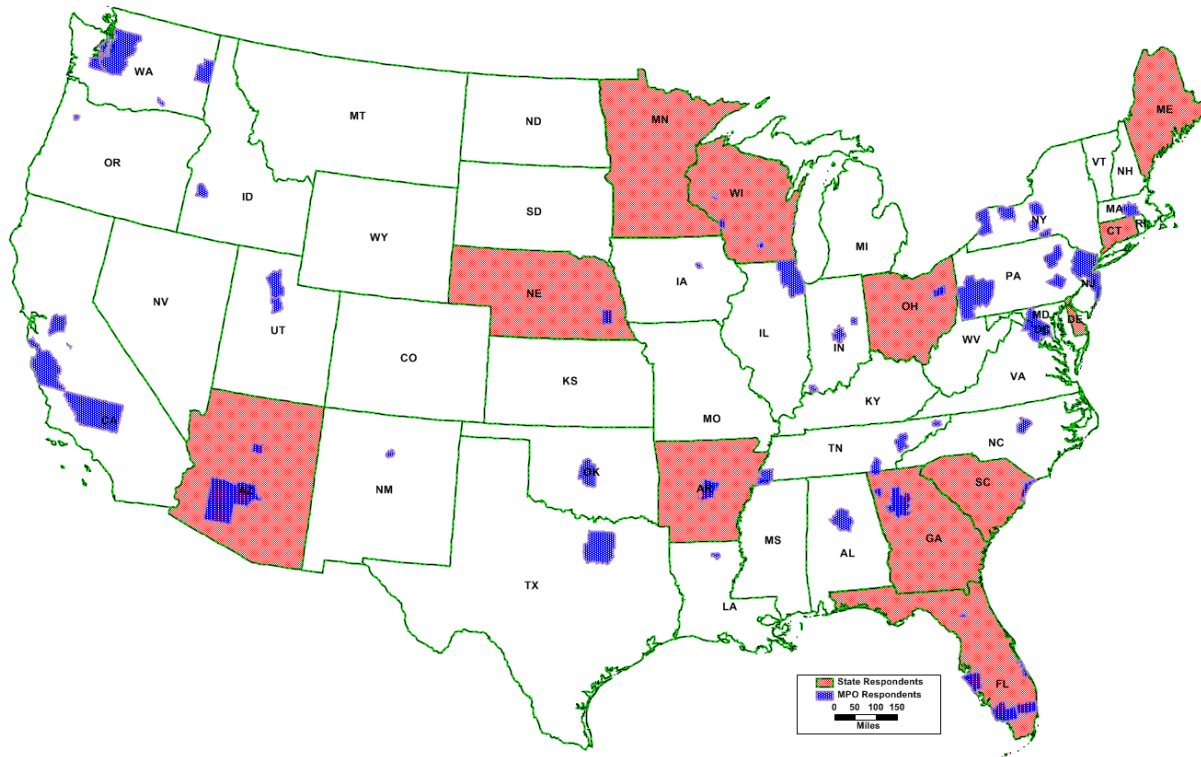


FIGURE 2 CENSUS TAZ SURVEY RESPONDENT DISTRIBUTION

Question 2	Which of the following statements describe your agency's TAZ-related transportation planning data needs and data acquisition practice? (Please check all that apply)	
Choice	Response Options	Count
a	The agency solely relies on CTPP data package, State's add-on data when available, and other publicly available sources for its transportation planning data needs	19
b	The agency supplements regional household travel surveys and/or other locally collected demographic/employment data with CTPP data package/State's add-on data/other publicly available data sources for its transportation planning data needs	45
c	The agency purchases data to supplement CTPP data package/State's add-on data/other publicly available data sources for its transportation planning data needs	16
d	The agency mainly relies regional household travel surveys and/or locally collected demographic/employment data for its transportation planning needs and CTPP data package/State's add-on data/other publicly available data sources are used for reference	18
e	Other	5
Total		103

Question 2 asks about the agency's general data acquisition practice and CTPP data usage. About 19% agencies solely rely on CTPP data package and state add-on data. About 45% conducted their own regional household travel survey to supplement CTPP data. Another 16% agencies purchased

additional data to supplement CTPP data. Only 18% of agencies mainly use household survey data for planning purposes.

Survey Question Category Two: TAZ Delineation Program

Question 3	Did your agency participate in the TAZ delineation program (2010/2011)?
Response Options	Count
Yes	82
No	7
Not Sure	10
Total	99

For most of the survey respondents (83%), their agencies participated in the TAZ delineation program in 2010/2011. This confirms the transportation community’s support for Census TAZ geography.

Question 4	If No in Q3, what was the reason not to participate the TAZ delineation program? (Please check all that apply)	
Choice	Response Options	Count
a	Agency staff shortage/budget constraint	4
Other	State DOT did on our behalf	3
Total		7

Among the seven agencies who did not directly participate in the TAZ delineation program, four did not participate due to staff availability while for three agencies, the state DOT participated on their behalf.

Question 5	If Yes in Q3, does the TAZ system for your regional travel model is the same as the CTPP TAZ geography for your region?
Response Options	Count
Yes	29
No	43
Not Sure	10
Total	82

For the 82 agencies who participated in the CTPP TAZ delineation program, 35% of them do have their regional travel demand model’s TAZ system identical to the CTPP TAZ geography.

Question 6	What was the reason to use different TAZ systems for regional model and CTPP data?	
Choice	Response Options	Count
a	TAZs for regional model are small and can't fulfill the recommended minimum	25
b	There are TAZs in regional model that cross County lines	1
c	TAZs for regional model do not nest perfectly with census tract/block group	17
Others	Others	9
Total		52

For the 52 agencies who participated in the CTPP TAZ delineation program but did not use the CTPP TAZ system for regional model, about 48% of them attributed the reason to the fact that TAZs for their regional models are small and cannot fulfill the recommended minimum population and employment thresholds; about 33% of the agencies said that it was because the TAZs for regional model do not nest perfectly with census tract/block group.

Question 7	How different are the TAZs for regional model and CTPP-TAZ geography?	
Choice	Response Options	Count
a	Less than 5% of the TAZs are in different shape for the regional model and CTPP	8
b	5% - 25% of the TAZs are in different shape for the regional model and CTPP	11
c	25%-50% of the TAZs are in different shape for the regional model and CTPP	11
d	More than 50% of the TAZs are in different shape for the regional model and CTPP	7
e	The CTPP-TAZ is completely different from the regional model TAZs	6
Total		43

When the 52 agencies above were asked how different the TAZs for the regional model and CTPP-TAZ geography were, 43 of them provided responses. The difference is spread across the response options: 19% for 5% or less difference; 25% for 5%-25% difference; 26% for 25%-50% difference; 16% for more than 50% difference; and 14% are completely different.

Survey Question Category Three: CTPP-TAZ Data Usage

Question 8	Have you used CTPP tables or are you familiar with CTPP tables?
Response Options	Count
Yes	91
No	8
Not Sure	0
Total	99

Most (92%) survey respondents have used CTPP tables or are familiar with CTPP tables.

Question 9	For which of the following transportation analysis do you use CTPP tables? (Please check all that apply)	
Choice	Response Options	Count
a	Travel demand modeling	83
b	Major corridor planning	37
c	Environmental justice analysis	45
d	Transit planning	31
e	Public involvement	25
Others	Others	10
Total		231

Question 9 is about the usage of CTPP tables. Among 99 survey respondents, 83 use the data for travel demand modeling, far more than any other transportation analysis listed. Besides these transportation analysis, survey respondents also used CTPP tables for population forecasting, origin/destination analysis, commuting flows for long range planning, general travel pattern analysis, community impact analysis, and many other ad hoc requests.

Question 10	Which of the following CTPP tables are most useful to serve for your agency's transportation data needs?	
Choice	Response Options	Count
a	Residence-based tables	28
b	Workplace-based tables	16
c	Home-to-work flows tables	54
Total		98

Question 10 is about data contents. According to the survey respondents, the home-to-work flow tables are the most useful to serve their agencies' transportation data needs. This is probably because there are other data sources for population and employment data, but home-to-work flow tables are only available through CTPP.

Question 11	How crucial is the CTPP data at TAZ geographic level for your use?	
Choice	Response Options	Count
a	The data must be at CTPP-TAZ level	23
b	The data can be at census tract/block group level, but it's more convenient to have data at CTPP-TAZ level	48
c	It is more convenient to have data at census tract/block group level	18
d	I did not use CTPP data at TAZ geographic level	5
Others	Others	4
Total		98

On whether it's crucial to have the CTPP data at TAZ geographic level for their use, 49% of survey respondents think that the CTPP data can be at census track/block group level, but it's more convenient to have data at CTPP-TAZ level. While 24% think the data must be at CTPP-TAZ level.

18% think it is more convenient at census tract/block group level. There are four responses in “others” group. Among the responses, one thinks that the smallest level of geography is the most beneficial; and another respondent stated that they normally use CTPP data at census tract and block group level, but for model development they have used the TAZ level data. In summary, the responses to this question confirmed the transportation community’s preference of CTPP data at the TAZ level.

Question 12	Have you ever used margin of error information provided by CTPP data?
Response Options	Count
Yes	48
No	50
Not Sure	0
Total	98

In terms of data quality measures, about half of the respondents have used MOE information provided by CTPP while the other half have not.

Question 13	Which of the following statements closely describe your view on margin of error field? (please check all that apply)	
Choice	Response Options	Count
a	Margin of error information is completely ignored while using the data	12
b	Margin of error provides some insights on data quality but it does not influence the way the data was used	53
c	Margin of error provides insights on data quality and it is significant enough to alter the way the data was used	38
d	Margin of error provides information that leads to confusion in data usage	9
Others	Others	6
Total		118

For the view on MOE, 54% of survey respondents think the MOE fields provide some insights on data quality but do not influence the way the data were used. 12% completely ignored the information. About 38% think MOE is significant enough to alter the way the data were used. About 9% think this information causes confusion.

Question 14	On residence-based CTPP tables, which of the following statements closely describe your view? (Please check all that apply)	
Choice	Response Options	Count
a	It is the most important to provide CTPP tables at TAZ geographic level with current household/person demographic variables	60
b	It is more important to provide multi-dimensional joint distribution of household/person demographic variables with a certain level of accuracy. The data does not need to be presented at TAZ geographic level	37
Others	Others	7
Total		104

For residence-based CTPP tables, 61% of survey respondents think it is the most important to provide the tables at TAZ geographic level with current household/person demographic variables. About 37% think it is more important to have a multi-dimensional joint distribution of household/person demographic variables and the data does not need to be presented at TAZ level.

Question 15	On workplace-based and flow-based CTPP tables, which of the following statements closely describe your view and/or data acquisition practice at your agency? (Please check all that apply)	
Choice	Response Options	Count
a	We do not use CTPP workplace-based tables to develop employment demographics for the region	35
b	We heavily rely on CTPP workplace-based tables to develop employment demographics for the region	21
c	The workplace demographic information does not need to be presented at TAZ geographic level for our use	16
d	The workplace demographic information need to be presented at TAZ geographic level for our use	37
e	The workplace mode of transportation and travel time data does not need to be presented at TAZ geographic level for our use	14
f	The workplace mode of transportation and travel time data need to be presented at TAZ geographic level for our use	38
Others	Others	11
Total		172

Question 15 is a multiple choice question with a list of statements. It was intended to understand how transportation agencies use workplace-based and flow-based CTPP tables and what is their preferred geography unit for data presentation.

For workplace-based CTPP tables, more agencies do not use CTPP tables to develop employment demographics than those who do (35 vs. 21). It is also noted that close to 40% of the survey respondents, (37 and 38 responses respectively), indicated that the workplace demographic information, as well as home-to-work mode of transportation and travel time information, need to be presented at TAZ geographic level for their use. On the other hand, about 15% of the survey respondents indicated that workplace demographics and home-to-work flow information do not need to be presented at TAZ level for them to use.

Besides answering survey questions, survey participants also provided valuable comments on the CTPP data. There are two comments especially worth mentioning. One is related to the expansion of MPO coverage area. Several survey participants indicated that their agencies do not use CTPP tabulation because of the recent expansion of their MPO coverage area. As MPOs are required to update their long range transportation plan every five years, the update cycle of TAZs may be something to consider in the future.

Another participant indicated that the base year for his/her agency's current travel demand model is 2015. The CTPP tabulations based on 2006-2010 ACS are outdated for their travel model update. Processing data takes time and effort. The next CTPP data set will be based on the 2012-2016 ACS, to be available in late 2018 or early 2019. By then many MPOs will still be updating their travel demand model with a base year between 2012 and 2016.

MOVING FORWARD WITH TAZ

TAZ is an essential geographic unit in travel demand models for transportation planning. The CTPP tabulations at TAZ level have widespread support within the transportation community, as confirmed by our online TAZ user survey. In addition, small-sized MPOs rely more on CTPP data to fulfill their transportation data needs due to their limited resources.

Though tabulating CTPP data at TAZ level is the transportation community's preferred platform for data presentation, there are issues surrounding CTPP data tabulated at TAZ level. First, the CTPP tabulations are a cost-reimbursable product of the Census Bureau. TAZ geography is not a part of standard hierarchy of census geography, so the Census Bureau is less supportive of this delineation. Second, CTPP tabulations are based on ACS. The small sample size of ACS leads to data precision concerns when the data are tabulated for small geographic areas such as TAZs. Additionally, the geocoding of workplace location has been a problem in the past due to reporting error. The workplace addresses with reporting errors cannot be assigned to a TAZ geography and will lead to loss of survey records and raise data quality concerns. Finally, Census TAZ definitions differ from Model TAZ definitions in many areas because of the recommended minimum population/employment requirement, the need to maintain linkages with Census Tract and Block Group definitions, and changes in MPO area definitions. The alternative TAZ definitions may cause confusion and limit the value of Census TAZ tabulations.

Our online TAZ user survey shows that more than 70% of the survey respondents prefer CTPP tabulations at TAZ level. About a quarter of survey respondents think that CTPP data at TAZ geography is a must for their use. As many small- and medium-sized MPOs with limited resources rely heavily or completely on CTPP to fulfill their transportation data needs, it is essential to maintain the TAZ geography for CTPP tabulation. Tabulating CTPP data at standard census geography unit will not necessarily solve some of the data quality issues. For example, TAZs are comparable with census block groups in size. If CTPP data were tabulated at block group level, all the geocoding and MOE issues would have remained with block group geography.

It is a practical solution to have a hierarchical geography system based on TAZs for CTPP's geocoding and data precision problems. The 2010 TAZ delineation included a new geography TAD which is an aggregation of TAZs. The data tabulated at TAD level will help to mitigate some of the data quality problems. This is a less ideal scenario especially for home-to-work flow data, as trip

distribution models aim to replicate trip length distribution. With larger geography, the trip length distribution estimates become less accurate.

There are a few immediate CTPP-TAZ issues that deserve our attention. One is about the data cycle. Unlike previous CTPP tabulations based on census long form in a ten-year cycle, CTPP now is based on ACS and is released every three to five years. As MPOs are required to update their long range transportation plan every five years, the more frequent CTPP data release is very helpful to fulfill the transportation planning data needs. However, in the process of updating the long range transportation plan, MPOs may have expanded their coverage area due to growth. They may update their Model TAZ system. Therefore, the question is whether Census TAZ delineation process should be conducted in a more frequent basis, say, updated every five years, to keep up with the updates at local agencies. We believe it will be beneficial for the transportation community to have TAZ delineated every five years, or paired with CTPP new release. On the other hand, more frequent delineation processes require staff work hours and administrative coordination. We are also unclear about the funding resources.

Our long-term goal is to have CTPP tabulations at TAZ level with improved accuracy. Past research has shown that the most effective way to improve data quality is in the data collection process. For example, if ACS data were collected digitally, workplace location can be instantly verified to a point on the map. The point layer can then be easily tagged to any geography entities which will significantly reduce reporting errors and reduce the workload for geocoding and geoprocessing. On the other hand, CTPP is a product of cooperation among multiple agencies. The survey and data processing are administrated by the Census Bureau. It is not clear how progressive the Census Bureau is in adopting technologies in data collection process. Nonetheless, it is a key to keep close communication with the Census Bureau on issues of data collection, data processing, and data usage to achieve the long-term goal.

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