Incorporating active transport into the regional planning process to support first and last mile travel

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October 2019

A publication of the USDOT Tier 1 Center:
Cooperative Mobility for Competitive Megaregions
At The University of Texas at Austin

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Technical Report Documentation Page

1. Report No. CM2-31	2. Government Accession No.	3. Recipient's Catalog No. ORCID: 0000-0002-8558-1013
4. Title and Subtitle Incorporating active transport into the regional planning process to support first and last mile travel		5. Report Date October 2019 6. Performing Organization Code
7. Author(s) Rydell Walthall, C Michael Walton		8. Performing Organization Report No. CM2-#31
9. Performing Organization Name and Address School of Architecture The University of Texas at Austin 310 Inner Campus Drive, B7500 Austin, TX 78712		10. Work Unit No. (TRAIS) 11. Contract or Grant No. USDOT 69A3551747135
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Transit Administration Office of the Assistant Secretary for Research and Technology, UTC Program 1200 New Jersey Avenue, SE Washington, DC 20590		13. Type of Report and Period Covered Technical Report conducted September 2018 - October 2019 14. Sponsoring Agency Code
15. Supplementary Notes Project performed under a grant from the U.S. Department of Transportation's University Transportation Center's Program.		
16. Abstract This report details the creation and proper use of a comprehensive MPO database. The database details each MPO's governance structure, committees, and travel demand modeling capabilities with an emphasis on non-automotive transportation modes. The report also outlines a resource to group MPOs by megaregion, which could aid with the comparison of planning practices across metropolitan areas throughout a megaregion.		
17. Key Words active transportation, MPO database, megaregion planning, alternative transportation planning	18. Distribution Statement No restrictions.	

19. Security Classif. (of report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of pages 39	22. Price

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Acknowledgements (if desired)

The authors would first like to thank the following people who collaborated on the creation of the MPO database: Dr. Gian-Claudia Sciara, Mashrur Rahman, Paulina Urbanowicz, Nikhil Tangirala, and Dr. Megan Ryerson. Without the collaborative environment fostered by the Cooperative Mobility for Competitive Megaregions University Consortium, which brought these researchers together, a comprehensive MPO database would not have been possible. The authors would also like to thank Maureen Kelly and Vicki Simpson for their invaluable assistance in bringing together this final report.

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1. Motivation

There is broad interest in providing mobility to megaregions through multiple modes: air, rail, and highways. The optimum balance between these three modes at the megaregion level is influenced by the type of infrastructure supported in the megaregion's urban areas. Improving the automobile infrastructure in cities shifts the balance toward highways. Improving transit would help travelers move between air or rail terminals and their end destinations, shifting the balance towards those systems. Improving active transport infrastructure—infrastructure that increases a city's walkability and bikeability—will shift the balance towards rail terminals located at the city center.

This research is influenced by the role active transport infrastructure plays in modal choice for long-distance inter-metro travel trips. It is important to identify the extent to which active transport provision can make high-speed mobility options, such as high-speed rail, feasible for megaregions.

Low-quality infrastructure or low perceptions of safety in active transport could convince a traveler to drive rather than use another mode; for example, they may choose to take their car rather than the train for long-distance trips in order to ensure a reliable means of transportation at the destination. Before examining active transportation and other non-automotive modes at the megaregional level, it is first necessary to examine how they are currently handled at the regional level in metropolitan planning organizations (MPOs).

To that end, the Cooperative Mobility for Competitive Megaregions (CM^2) University Consortium developed a database to provide a framework for examining how MPOs currently handle planning for non-automotive modes. This report describes the construction of that database and gives an overview of current statistics regarding MPO planning practices across the country for non-automotive modes.

2. MPO Database Developed by CM^2

This research contributed to an effort to create a comprehensive database on MPO governance and planning practices for freight, active transportation, and airports. While this section will focus on the information in that database as it pertains to active transportation, there are CM2 projects exploring the other aspects of the database.[1] [2]

2.1. Data Dictionary

The variables in the database can broadly be split into four categories: descriptive variables, governance variables, committee variables, and modeling variables. The following sections detail the categories and the variables within each category.

For all Boolean variables in the short form of the database, if the variable is "unknown" for an observation, the variable is encoded as "-1". Otherwise, TRUE values are encoded as "1" and FALSE values are encoded as "0".

Each observation in the database is an individual MPO. The database has two forms: a long form that includes long strings for some of the variables and a short form in which each variable is either a short string or a number.

Appendix A of this report contains R code to load the short form of the database with the proper categories, data types, and data labels.

2.1.1. Descriptive Variables

The descriptive variables contain information about each MPO's population, major city, state or states, and other information available from the Federal Highway Administration (FHWA) for MPOs. Although this information was readily available, it was included in the database for convenience.

The descriptive variables in the database are:

[1] Sciara, Gian-Claudia. "Transit Operators in Metropolitan Transportation Decision Making." Cooperative Mobility for Competitive Megaregions. To be published.
[2] Sciara, Gian-Claudia; Ryerson, Megan. "Airport Governance in U.S. Metro Regions: Institutional Models and their Implications for Megaregion Transport." Cooperative Mobility for Competitive Megaregions. To be published.

- ***MPO ID (MPO_ID):*** the unique identification number assigned by FHWA for each MPO. The first two digits correspond to the FIPS code (a federally created code that identifies geographic areas) of the MPO's state—or its primary state, if the MPO's area crosses state boundaries.
- ***Name (NAME):*** the MPO's official name.
- ***Abbreviation (ABRV):*** the MPO's commonly used abbreviation if one is in use.
- ***Major City (MAJOR_CITY):*** a major city within the MPO, as listed by FHWA. This is not always the city the MPO is based in.
- ***Multistate (MULTISTATE):*** a Boolean variable to denote whether the MPO crosses state boundaries. This category can be useful for examining MPOs that have already had to deal with the sort of cross-state planning issues that can be common in megaregions.
- ***State (STATE1):*** the state the MPO lies within, or the primary state for an MPO whose area crosses a state boundary.
- ***State2 (STATE2):*** a second state for an MPO whose area crosses a state boundary. This field is blank for single-state MPOs.
- ***State3 (STATE3):*** a third state an MPO whose area crosses multiple state boundaries. This field is blank for single-state and two-state MPOs. No MPO crosses into four states.
- ***Website (MAIN_URL):*** the URL for the MPO's official website, or the official website of the agency that hosts the MPO.
- ***Designation Year (DES_YR):*** the year the MPO was designated as the region's planning organization.
- **2010 Population (POP10):** the population of the MPO as of the 2010 census.

2.1.2. Governance Variables

The governance variables predominantly describe the composition of the MPO's policy board—the body responsible for approving the MPO's long-range transportation plans. This information primarily comes from the bylaws of each individual MPO.

Following are the governance variables in the database:

- ***Not in CoG or other Regional Agency (INDEPENDENT):*** this Boolean variable denotes whether the MPO is independent or not. For example, FALSE in this field would denote that the MPO may be part of a council of governments (COG) or housed within the transportation department of the MPO's largest city.

- ***Link to the bylaws (BYLAW_URL):*** this field contains the URL of the MPO's bylaws. If different parts of the MPO's operations are governed by different documents, this URL will link to the document that outlines the structure of the MPO's policy board. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

- ***MPO Board Name (BOARD):*** the official name of the MPO's policy board, the body responsible for approving the MPO's long-range transportation plan. This is the board used for the rest of the governance variables. This body was chosen for analysis because all MPOs are required to have such a board; this board shapes the MPO's official planning policy and is responsible for approving MPO transportation projects. Using this variable should also prevent confusion with the governing board of certain COGs. For example, the Southern California Association of Governments, the largest MPO in the Southern California Megaregion, has a General Assembly ahead of the entire COG and a Transportation Committee responsible for crafting the long-range transportation plan, but its Regional Council is the body responsible for approving the long-range transportation plan. Many MPOs have a technical committee responsible for drafting large portions of the MPO's long-range transportation plan, but that committee normally does not have the authority to adopt the plan for the region.

- ***Size of Board (BRD_SZ):*** this is the number of seats on the MPO's policy board, including ex officio seats. MPOs use different definitions for what comprises non-voting seats, and information about non-voting seats was not always available. Therefore, this variable was collected when available to help put the variable *TRN*_SEAT into context because many transit seats are ex officio, but this figure should not be used for analysis. If it is used for analysis, only MPOs for which the variable is included (326 out of 404) should be analyzed and the analysis should correct for any biases in the type of MPO for which the variable was readily variable, such as MPO size.

- ***Number of Voting Seats (BRD_VOTE):*** the number of voting seats on the MPO's policy board. For MPOs with weighted voting, this variable reflects the total number of seats, and not the number of votes.

- ***MPO uses weighted voting (WEIGHTED):*** a Boolean variable to denote whether the MPO uses a weighted voting system. This variable was included because weighted voting can affect the representation of each seat. For example, an MPO with weighted voting could assign one out of ten voting seats to the head of a transit agency, but that seat might have less than ten percent of the voting power.

- ***Transit Seats (TRN_SEAT):*** the number of seats on the policy board held by transit agencies or having direct transit focus. This variable includes ex officio seats but excludes representatives from the Federal Transit Administration.

- ***Voting Transit Seats (TRN_VOTE):*** the number of seats out of the previous variable, *TRN_SEAT*, able to vote on the MPO's policy board.

- ***Transit Representation (TRN_REP):*** this Boolean variable simply shows whether the MPO's policy board has voting transit representation. TRUE denotes that the variable *TRN_VOTE* is nonzero.

- ***Transit Representation is Direct (TRN_DIRECT):*** this Boolean variable denotes whether the MPO's transit representation comes directly from a transit agency. Some MPOs have voting seats on their policy boards that might include public officials who happen to also

have stakes in regional transit agencies, but who are not on the board in their capacity as a transit agency leader.

- ***Airport Seats (AIR_SEAT):*** this variable denotes the number of seats on the MPO's policy board that come from airports or aviation agencies within the MPO. This variable includes ex officio seats.

- ***Voting Airport Seats (AIR_VOTE):*** the number of seats out of the previous variable, *AIR_SEAT*, able to vote on the MPO's policy board.

- ***Transit Representation (TRN_REP_PRCT):*** this variable represents the voting power of the transit seats on the MPO's policy board as a percentage. If an MPO's policy board has ten voting seats and one of those seats comes from a transit agency, the *TRN_REP_PRCT* record for that MPO would be ten percent.

- ***Airport Representation (AIR_REP_PRCT):*** this variable represents the voting power of the airport seats on the MPO's policy board as a percentage. If an MPO's policy board has ten voting seats and one of those seats comes from an airport or aviation agency, the *AIR_REP_PRCT* record for that MPO would be ten percent.

- ***Notes on Governance (GOV_NOTES):*** this variable allows for storage of notes on unusual practices in the MPO pertaining to the MPO's governance variables, providing a valuable source of clarification if a variable is difficult to classify for the MPO or if the source for the governance variables was unusual. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

2.1.3. Committee Variables

While the governance variables identify whether the MPO has direct influence to make transportation decisions for non-automobile modes, the committee variables help track non-automotive soft power in the MPO. The existence of a committee implies that the MPO might be more likely to consider the committee's issues. These variables also include fields for the URLs of relevant committees to assist researchers who may need to find specific information about these committees' structures. The URL fields are excluded from the shortened form of the database.

The power MPOs delegate to these committees varies considerably. In some MPOs, committees may only serve in advisory roles, while other MPOs give committees leeway to craft the MPO's plan for transportation mode.

Following are the committee variables in the database:

- ***Airport Committee (AIR_COMM):*** this Boolean variable signifies whether the MPO has a committee dedicated to transportation issues related to a regional airport or general aviation issues.
- ***Airport Committee Link (AIR_COMM_URL):*** this variable provides the URL for the committee referred to in the variable AIR_COMM. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.
- ***Ped/Bike Committee (ACTIVE_COMM):*** this Boolean variable signifies whether the MPO has a committee dedicated to active transportation issues. This variable does not imply that the MPO has either a bicycle committee or pedestrian committee. Rather, this variable indicates that a committee within the MPO handles both pedestrian and bicycling issues.
- ***Ped/Bike Committee Link (ACTIVE_COMM_URL):*** this variable provides the URL for the committee referred to in the variable *ACTIVE_COMM*. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.
- ***Dedicated Bicycle Committee (BIK_COMM):*** this Boolean variable signifies whether the MPO has a committee dedicated specifically to bicycle transport issues. For an MPO with a committee that handles active transportation issues, including both pedestrian and bicycling issues, this variable would not be TRUE in the database unless the MPO also has a separate committee that handles only bicycling issues.
- ***Bicycle Committee Link (BIK_COMM_URL):*** this variable provides the URL for the committee referred to in the variable *BIK_COMM*. If the database is exported in a format

that does not allow for long string variables, this variable might be excluded from that version of the database.

- ***Dedicated Pedestrian Committee (PED_COMM):*** this Boolean variable signifies whether the MPO has a committee dedicated to pedestrian transportation issues. For an MPO with a committee that handles active transportation issues, including both pedestrian and bicycling issues, this variable would not be TRUE in the database unless the MPO also has a separate committee that only handles bicycling issues.

- ***Pedestrian Committee Link (PED_COMM_URL):*** this variable provides the URL for the committee referred to in the variable *PED_COMM*. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

- ***Transit Committee (TRN_COMM):*** this Boolean variable indicates whether the MPO has a committee dedicated to handling transportation issues related to transit. Some MPOs have general transportation committees that are assigned to consider a wide variety of transportation issues including transit. For those MPOs, this variable would be FALSE unless there is a committee in the MPO that specifically handles transit issues.

- ***Transit Committee Link (TRN_COMM_URL):*** this variable provides the URL for the committee referred to in the variable *TRN_COMM*. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

- ***Notes on Committees (COMM_NOTES):*** this variable provides annotations of situations where committee classification might be subjective. In some cases, researchers have also attempted to provide information about committee structure in this field. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

2.1.4. Modeling Variables

In developing this database, the researchers examined MPOs' travel demand modeling practices because modeling forecasts help form the basis of MPOs' long-range transportation plans. If an

MPO is not modeling some modes, such as walking or bicycling, it would be difficult for the MPO to estimate whether a transportation project will benefit those modes.

Following are the modeling variables in the database:

- ***Produced/Maintained in-house (TDM_INT):*** this variable tracks whether the MPO produces its own travel demand model or uses a model developed by an external agency. This allows researchers to track whether the MPO has influence over how the model is set up. For the purpose of the database, MPOs that contract with consulting firms to develop a model are still considered to have developed their own model because the MPO will have power to instruct the consulting firm during the model's creation. For some MPOs, there is not enough information available about the model to determine whether the MPO developed its model. For those MPOs, this field is marked 'Unknown' in the database.

- ***Link to model documentation (TDM_DOC_URL):*** this variable provides the URL for documentation about the MPO's travel demand model where available. For some MPOs, model documentation might be unavailable but published results based on the model provide information about the type of model used. For those MPOs, the URL shows the location where the model results were published. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

- ***Model Type (TDM_TYPE):*** this variable shows the type of model used by the MPO. Researchers classified travel demand models into the following categories (numbers signify how the variable is coded in the short form of the database):

    - *Simple Growth Model (0):* the MPO does not have a full travel demand model, but rather forecasts future travel demand by applying a growth factor to all links in the MPO's transportation network. For example, an MPO might simply assume that a roadway's directional design hour volume will grow at the same rate as the MPO's population.

    - *Four Step Model (1):* the MPO uses a travel demand model based on the classic four-step model of trip generation, trip distribution, mode choice, and network

assignment. If the MPO's model excludes the mode choice step, its model is still classified as a four-step model for the purpose of this database.

- *4-step but developing ABM (2):* the MPO still uses a classic four-step model, as described above, but it is in the process of developing an activity-based model.
- *Activity Based Model (3):* the MPO uses an activity-based model to forecast travel demand.
- *Unknown (-1):* there was not enough information available to classify the MPO's travel demand model.

- ***Non-motorized modeling (ACTIVE_MODEL):*** this variable categorizes how the MPO's travel demand model handles active transportation modes. Because it was very rare for an MPO's travel demand model to assign pedestrian or bicycle trips to a network, researchers tracked only how active transportation modes were handled in mode choice. This variable uses the following categories (numbers signify how the variable is encoded in the short form of the database):
  - *Combined non-motorized mode choice (0):* the model combines pedestrian and walking trips as a single mode choice.
  - *Separate bike/ped mode choice (1):* the model has separate mode choice categories for pedestrian and bicycle trips.
  - *Non-motorized modes not modeled (2):* the model does not include active transportation modes in mode choice.
  - *Unknown (-1):* there was not enough information about the model to determine how active transportation modes are handled.
- ***Notes on non-motorized implementation (ACTIVE_MODEL_NOTES):*** this variable provides additional information about the MPO's modeling of active transportation modes. For example, some MPOs do not model pedestrian and bicycle trips but do model walking and bicycle access to transit. Additionally, researchers have attempted to annotate whether the model assigns active transportation trips to a pedestrian or bicycle network. If the

database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

- ***Transit Mode (TRN_MODEL):*** this variable categorizes how the MPO's travel demand model handles transit trips. Because it is much more common relative to active transportation trips for MPOs to assign transit trips to a network, the categorizations used are different from *ACTIVE_MODEL* (numbers signify how the variable was encoded in the short form of the database):
    - *In assignment and mode choice (0):* the model has a mode choice category for transit trips and then assigns those trips to a network.
    - *In mode choice (1):* the model has a mode choice category for transit trips and then drops those trips from assignment.
    - *Not modeled (2):* transit is included in neither the model's assignment nor mode choice stages.
    - *Unknown (-1):* there was not enough information available about the model to determine how transit trips are handled.
- ***Freight Mode (FRT_MODEL):*** this variable categorizes how the MPO's travel demand model handles freight. Specifically, MPOs were found to include freight in their base travel demand models only if trucking trips accounted for significant amounts of congestion on the automotive network. Because freight trips are generated separately from passenger trips, the categorizations in the database do not consider mode choice. The categories in the database are the following:
    - *Assigned (0):* the model assigns trucking trips to the transportation network.
    - *Not modeled (1):* the model does not consider freight trips.
    - *Unknown (-1):* there was not enough information about the model to determine whether the model includes freight trips.

- ***Notes on Modeling (TDM_NOTES):*** this variable provides space to annotate unusual circumstances regarding the MPO's travel demand model. Researchers also attempted to note the database's source for the modeling information when model documentation was unavailable. If the MPO has separate models to provide information for specific modes, such as freight rail, researchers also attempted to note that in this field. If the database is exported in a format that does not allow for long string variables, this variable might be excluded from that version of the database.

2.2. Data Collection

The database is based on FHWA's listing of all 404 MPOs across the country. Researchers examined each individual MPO to populate the database. The primary sources of information for each MPO are their bylaws and travel demand model documentation. For many MPOs, those documents are published on their websites, but the format of the data is nearly unique to each MPO. This uniqueness made collating the data into a standardized database non-trivial. Additionally, many MPOs do not have all the desired data readily available, necessitating close examination of the documentation that is provided. For example, it is sometimes possible to determine the values for several of the database's governance structure variables by examining the minutes from a policy board meeting

For some of the modeling variables, the proper values might be apparent from planning documents using data from the travel demand model. For example, if an MPO's long-range transportation plan has forecast transit ridership, it is likely that that the travel demand model incorporates transit.

If meeting minutes or planning documents did not provide enough details, it was sometimes necessary to contact MPOs directly. If the MPO did not respond, researchers left the MPO in the database with the relevant variables recorded as "unknown." Of the four variable categories, the modeling variables were the most likely to be missing data. In all, 242 MPOs in the database, roughly sixty percent of the total, have at least one modeling variable recorded as "unknown."

3. Database Statistics & Observations

3.1. Overall Statistics

3.1.1. Governance

Number of Voting Seats on the Policy Board

Figure 1 shows the distribution of the number of voting seats on MPO policy boards. Most MPOs have fifteen or fewer voting seats, but the distribution has a long right tail.

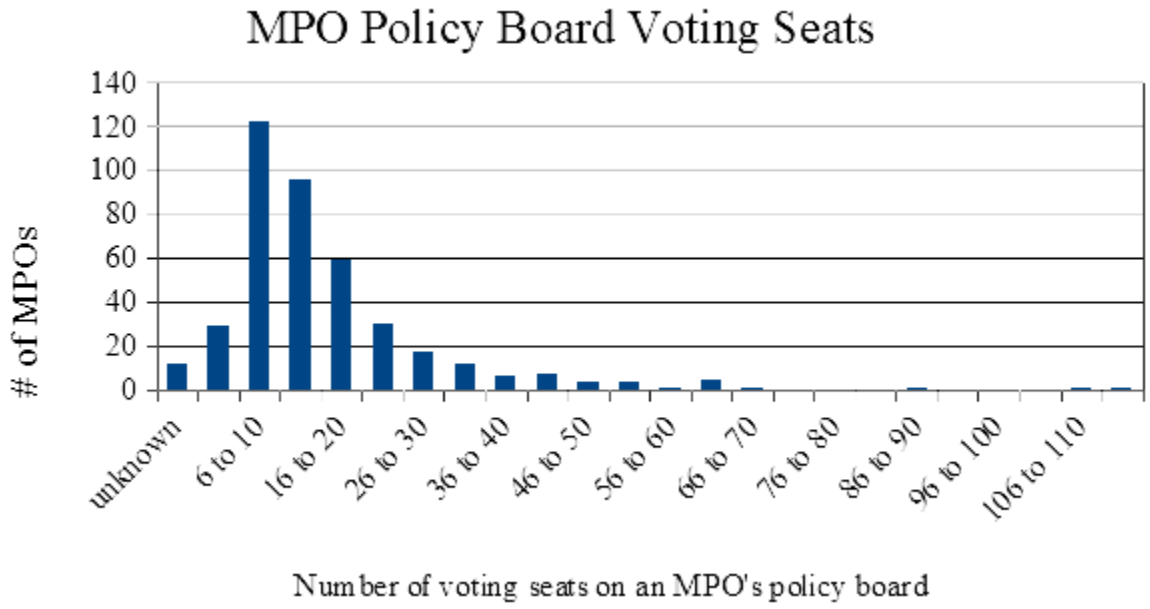

Figure 1: Distribution of voting seats on MPO policy boards. 151 MPOs have ten or fewer voting seats, but the distribution has a long right tail.

Transit Representation

Figure 2 shows the distribution of transit representation among MPOs based on the percentage of voting seats. Transit has the most representation amongst alternative transportation modes, but nearly half of MPOs provide no voting transit representation. The distribution of voting transit representation peaks at five to ten percent, but it has a long right tail. The Indianapolis MPO provides the most representation, with two out of five voting seats coming from transit agencies.

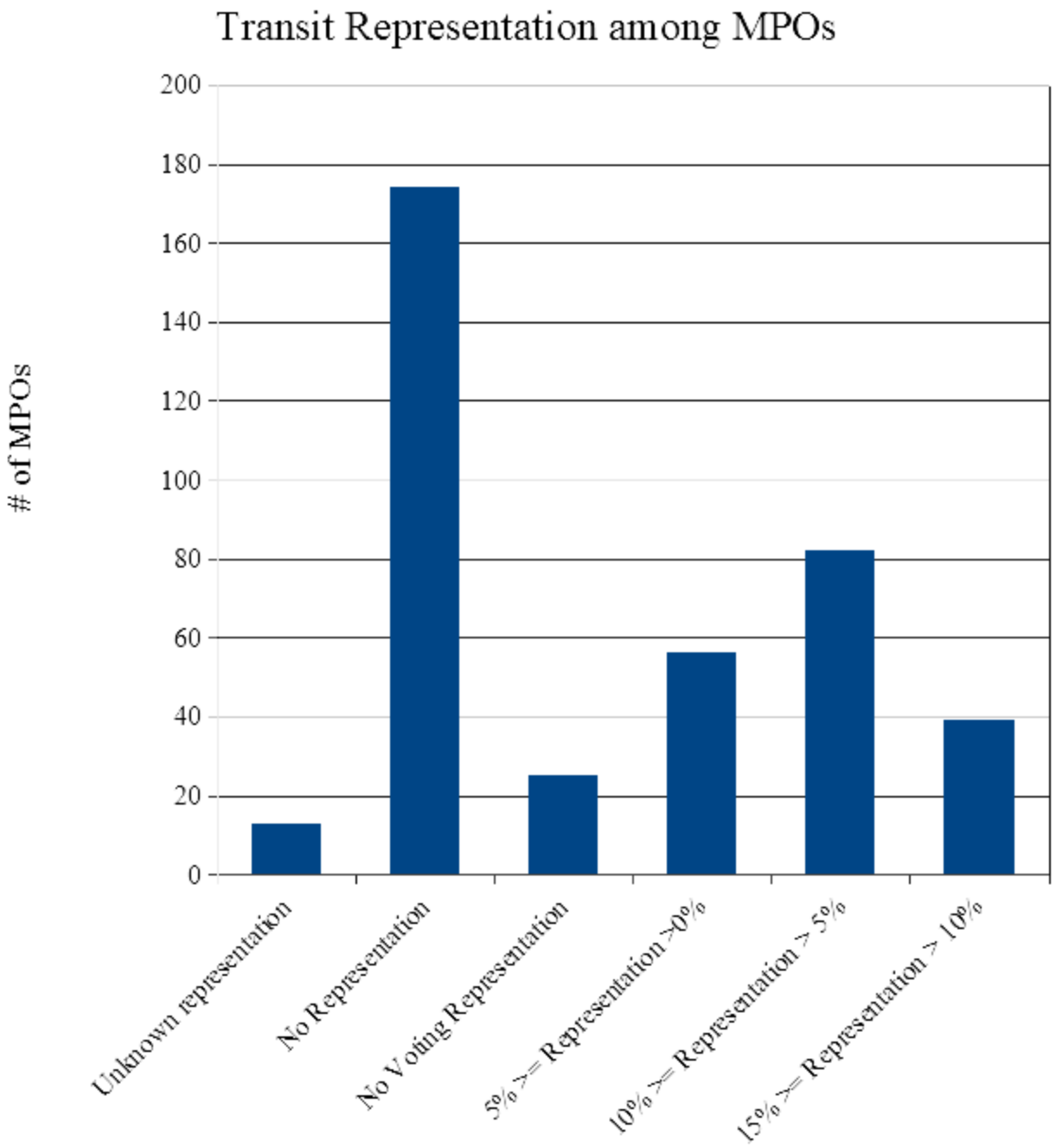

Figure 2: Counts of the number of MPOs in each transit representation category.

3.1.2. Committees

The existence of a committee could at least tacitly indicate that the MPO is considering planning issues under that committee's purview. Roughly a quarter of MPOs have active transport committees, roughly an eighth have transit committees, and only about one in forty have airport

committees. This means little committee infrastructure is currently in place to begin megaregional planning between MPOs.

Table 1: Number of MPOs with each type of alternative transportation committee.

	Has Committee	**Does Not Have Committee**
Airport	10	394
Active Transport	106	298
Dedicated Bicycle	7	397
Dedicated Pedestrian	2	402
Transit	54	350

3.1.3. Modeling

If an MPO does not have the capacity to model a mode, it might be more difficult for the MPO to plan projects for that mode. This section looks at the modeling variables in the database and provides the number of MPOs with various modeling capabilities. As noted before, the modeling variables in the database were the most difficult to find, and many had to be recorded as "unknown" in the database.

Type of Travel Demand Model

Figure 3 shows the counts of MPOs with different types of travel demand models. Unsurprisingly, the vast majority of MPOs use the classic four-step model. A growing number of MPOs are developing or already using more advanced activity-based models, however.

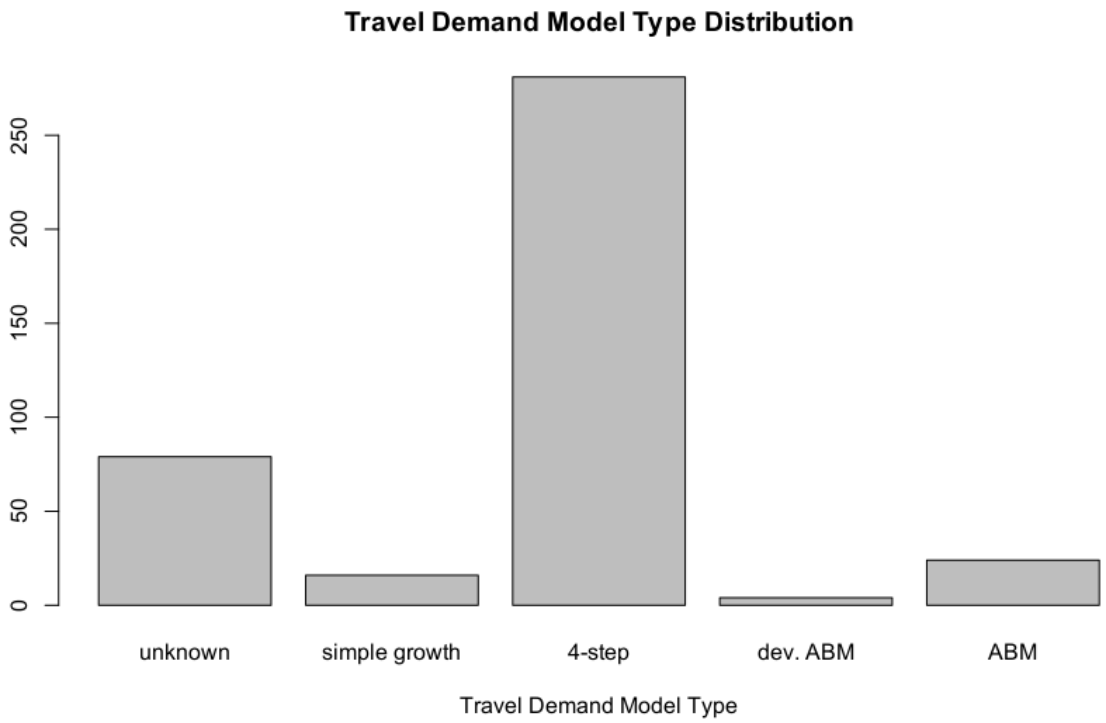

Figure 3: The number of MPOs using different types of travel demand model. "dev. ABM" here means the MPO is using a four-step model but is in the process of developing an activity-based model.

Active Transport Modeling

Most MPOs either do not model active transportation modes or do not provide enough information to determine whether they model those modes. When active transport is modeled, it is usually only included in the mode choice step of a four-step model—most models drop active transport trips from assignment. The number of MPOs that assign active transport trips to a network is small enough that researchers dropped an assignment category from the database, but this practice is typically discussed in the notes field for each MPO. Figure 4 shows the counts of MPOs that include active transport modes in the mode choice step (or as available modes for tours in activity-based models), either as a single combined mode or as separate modes for walking and bicycling. In total, eighty-six MPOs (less than a quarter) at least partially model active transport trips.

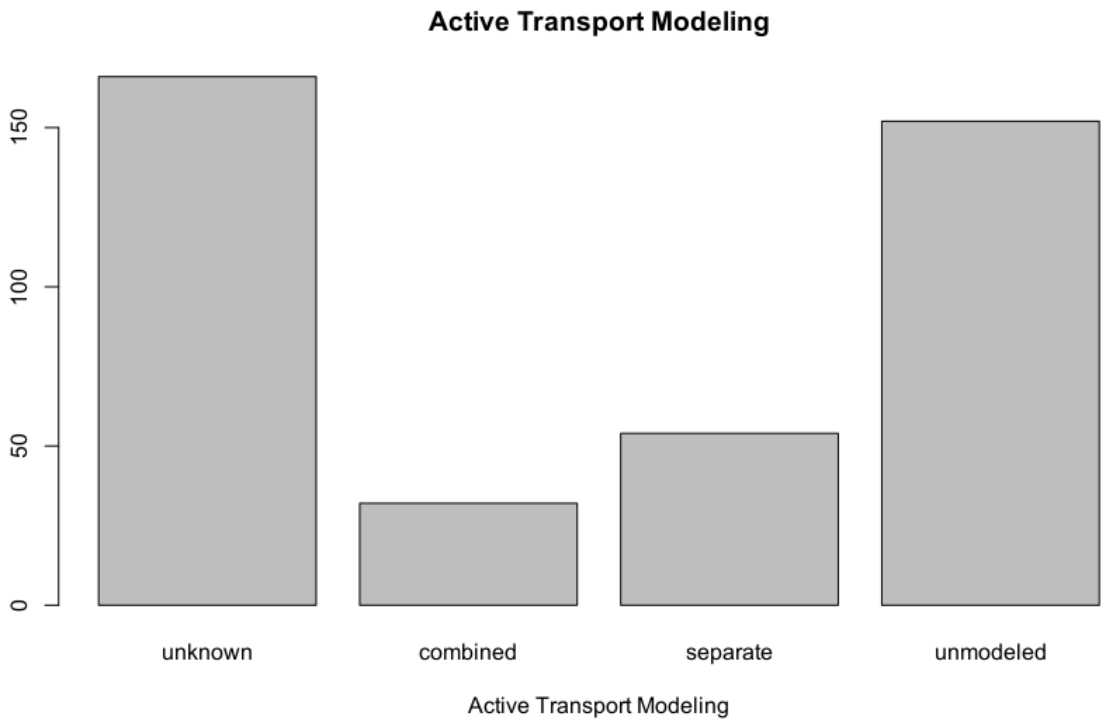

Figure 4: The number of MPOs modeling active transport modes. "Combined" signifies that walking and biking are combined as a single mode choice, while "separate" means there are separate mode choices in the model for walking or biking. A small subset of the MPOs including active transport modes in the mode choice step also assign them to a network.

Transit Modeling

Nearly twice as many MPOs model transit trips as active transport trips (153 versus 86). This might be in part due to data availability: most bus systems use the same networks as automobiles so the data collection necessary for an MPO to model transit trips might be less than the data collection for active transport. Figure 5 shows the number of MPOs including transit trips in mode choice only and the number of MPOs including transit trips in mode choice and assignment (if transit is included in assignment, it must also be included in mode choice).

Figure 5: Counts of the number of MPOs modeling transit trips. Unlike active transportation, most MPOs that model transit trips at all also carry the trips into the assignment step.

Freight Modeling

For some MPOs trucking trips passing through the region represent a significant portion of road network usage. The database recorded whether MPOs model freight. Freight trips are generated separately from passenger trips; thus, it would not make sense to include freight trips in the mode choice step (it is possible to have freight mode choice, but that is outside the scope of the database structure). Figure 6 shows the number of MPOs assigning freight trips to their travel demand models' networks.

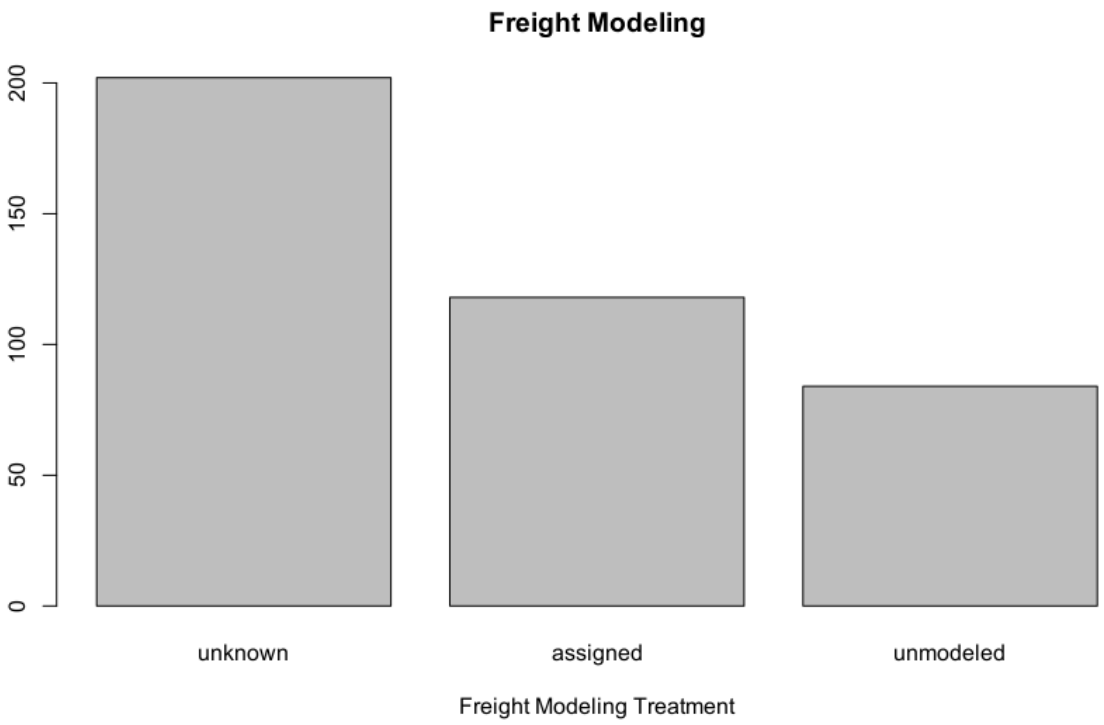

Figure 6: The number of MPOs modeling freight.

3.2. Differentiating by Population

One variable that should directly influence the resources an MPO has for planning is the MPO's size. Larger MPOs might have more resources and more needs for planning, and this section examines the extent to which this is true by comparing the variables to the MPO populations.

3.2.1. Discrete Variables

For discrete variables such as many of the database's governance variables, simple correlations help illustrate the variable's relationship to the MPO population. The correlation between board size and log-population is 0.44 and the correlation between voting seats and log-population is 0.49. Thus, MPOs with larger populations tend to have larger boards, both in terms of overall board size and the number of voting seats on the board. Figure 7 plots each MPO's policy board seats against the natural logarithm of the MPO's population, and Figure 8 does the same with transit seats on the MPO policy boards.

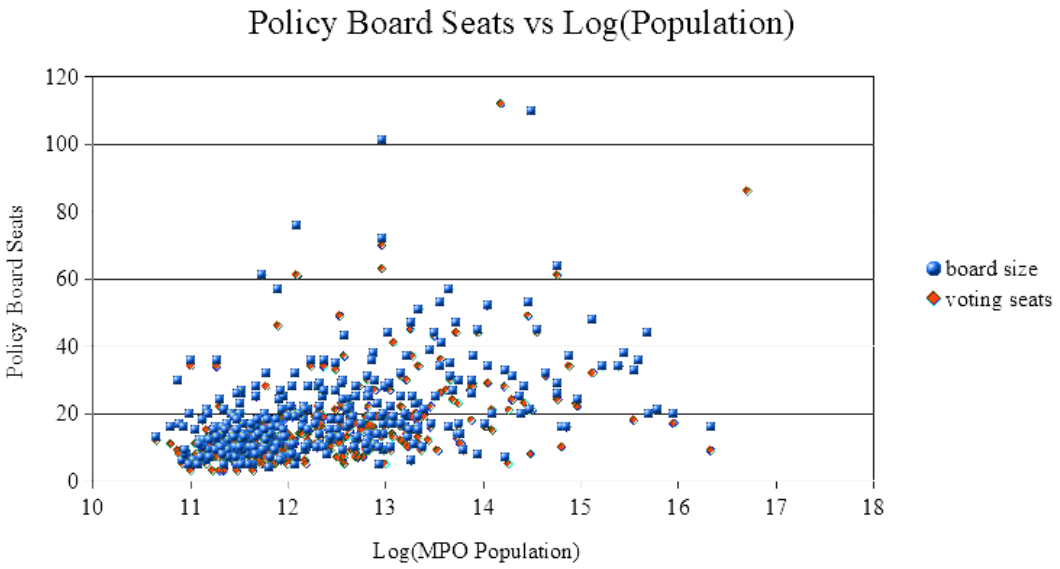

Figure 7: MPO policy board size versus the natural logarithm of the MPO's population.

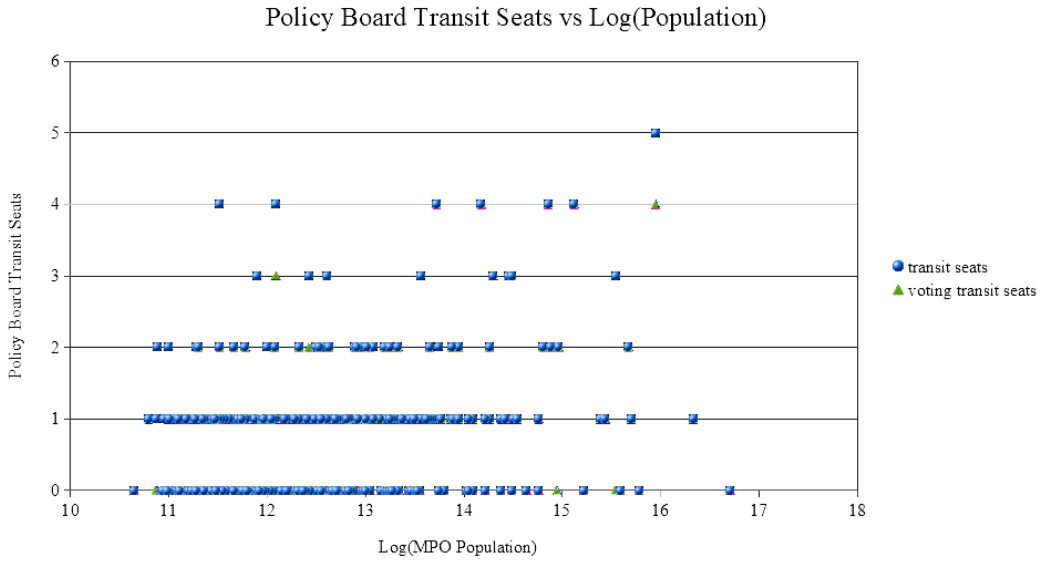

Figure 8: MPO policy board transit seats versus the natural logarithm of the MPO's population.

3.2.2. Categorical and Boolean Variables

For the categorical and Boolean variables, the following figures show the counts of MPOs in each decile for each variable. Each decile has roughly forty MPOs (the second, fourth, seventh, and ninth have forty-one).

Committees

Figure 9 shows the number of MPOs in each decile with the different types of committees compiled in the database, collectively referred to as *alternative transport committees*. For this figure, an MPO is considered to have an active transport committee if it has a general active transport committee, a dedicated bicycling committee, or a dedicated pedestrian committee. Any airport, active transport, or transit committee in the MPO means the MPO counts as having an alternative transport committee.

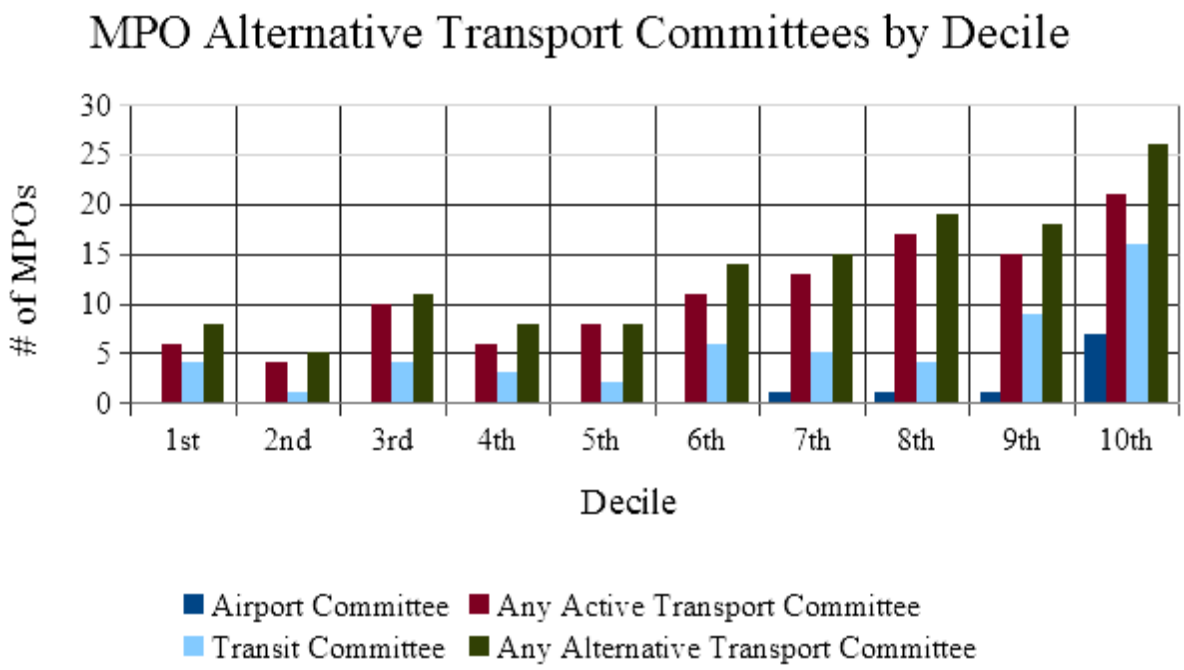

Figure 9: The number of MPOs in each decile with different types of alternative transport committees. Larger MPOs tend to have more alternative transport committees. No MPO smaller than the seventh decile has an airport committee.

Modeling

Figure 10 shows the number of MPOs within each decile using each type of travel demand model. There is not too much variance across the smaller MPOs, although more of the very small MPOs use simple growth models. Very large MPOs are much more likely to use activity-based models, and they are also more likely to have modeling information available. One surprising finding is that a few very small MPOs also use activity-based models.

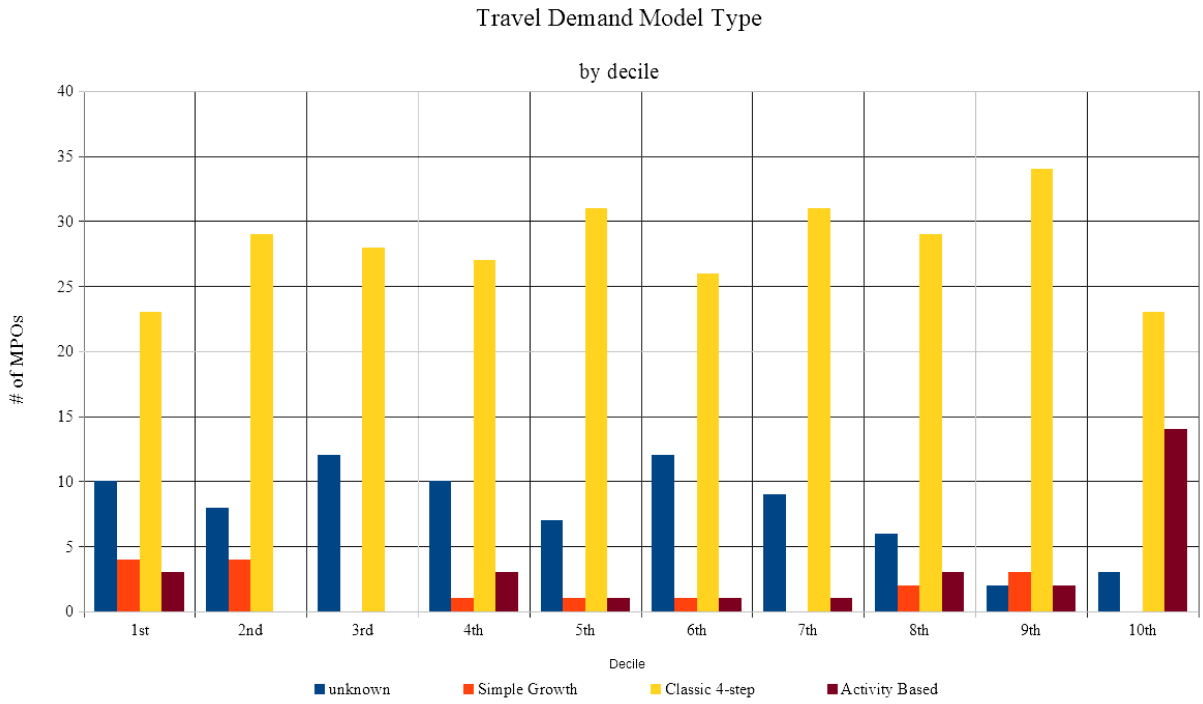

Figure 10: The number of MPOs in each decile with each type of travel demand model.

There is a clear trend for larger MPOs to include more non-automotive modes in their travel demand models. Figure 11 shows the number of MPOs in each decile including each non-automotive mode in the database in their models. Nearly all the MPOs in the last decile model transit, and almost half the MPOs in that decile model active transport modes.

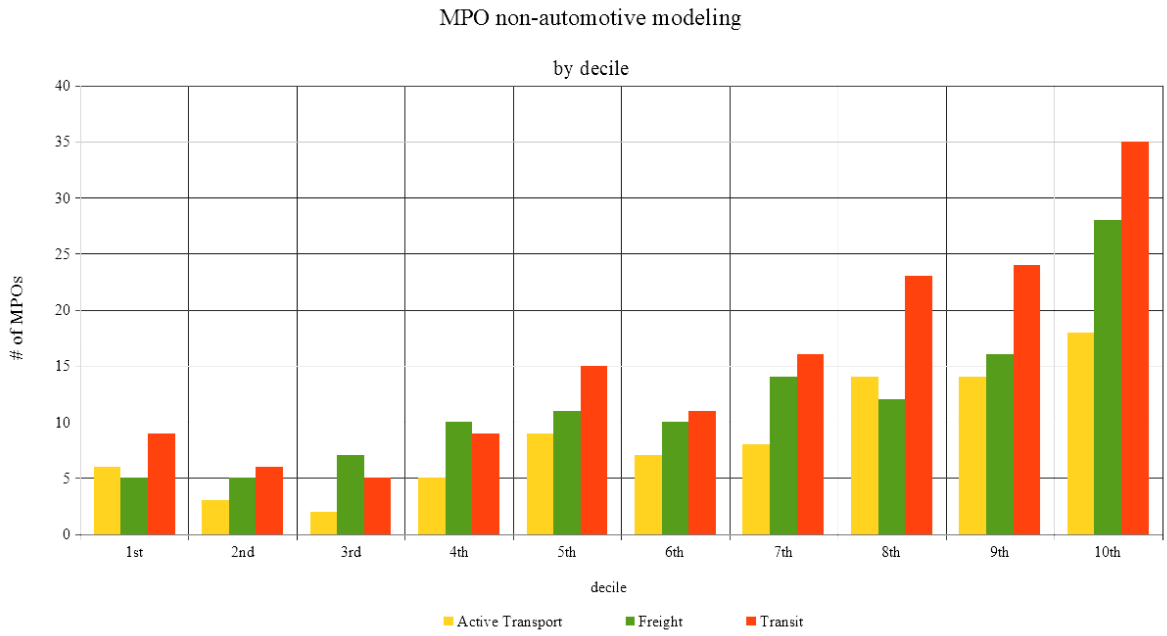

Figure 11: The number of MPOs in each decile modeling each non-automotive transportation mode. The counts include MPOs if they include the mode in their model in either mode choice or assignment.

3.3. Other Observations from the Database

This section provides discussion of findings from the database that are not apparent from the variables themselves. These observations come from the researchers' notes while researchers were compiling the database.

The governance structure for many MPOs appears to be determined in whole or in part by the MPO's state department of transportation (DOT) or state legislature. State governments could thus play a large role in reforming MPOs if there is a desire to include more representation for alternative transportation modes in the MPO governance structure.

Active transportation assignment appears to be limited to large planning organizations that are also using or developing activity-based models. While it is not too rare for MPOs to model active transportation in the mode choice step, only a few MPOs have included active transportation networks for assignment. Two that do are the Southern California Association of Governments and the nearby San Diego Association of Governments, both relatively large planning organizations in the same megaregion. In both of those cases, the MPO is a part of a COG and is in the process of developing an activity-based model for transportation planning.

Some MPOs are developing models that employ dynamic traffic assignment, a way to more accurately model the development of congestion throughout a transportation network that can also more accurately reflect link interactions.[3] The Florida DOT is in the process of developing both activity based and dynamic traffic assignment models. Because the Florida DOT creates the models used by regions within the state, the Florida Megaregion might become the first megaregion as a whole to widely employ these newer modeling techniques.

[3] Chiu, Yi-Chang; Bottom, Jon; Mahut, Michael; Paz, Alex; Balakrishna, Ramachandran; Waller, Travis; Hicks, Jim. "Dynamic Traffic Assignment: A Primer." Transportation Network Modeling Committee, Transportation Research Board. June 2011. link

4. MPOs in Megaregions

In determining the presence of MPOs in megaregions, the researchers used the megaregion definitions from America 2050, which identifies the following eleven megaregions across the country:[4]

- Arizona Sun Corridor Megaregion
- Cascadia Megaregion
- Florida Megaregion
- Front Range Megaregion
- Great Lakes Megaregion
- Gulf Coast Megaregion
- Northeast Megaregion
- Northern California Megaregion
- Piedmont Atlantic Megaregion
- Southern California Megaregion
- Texas Triangle Megaregion

Figure 12 shows the extent of the eleven megaregions.[5] Based on those boundaries, researchers categorized each MPO as being within, adjacent to, or outside of each megaregion. Overall, 241 MPOs are within at least one megaregion, 56 are adjacent to at least one megaregion, and 294 are either within or adjacent to a megaregion. That represents seventy-three percent of all MPOs, demonstrating the clear relevance of MPO planning to megaregion planning.

[4] Regional Plan Association. "America 2050: Megaregions." 2016. link
[5] Regional Plan Association. "America 2050: assets." 2014. link

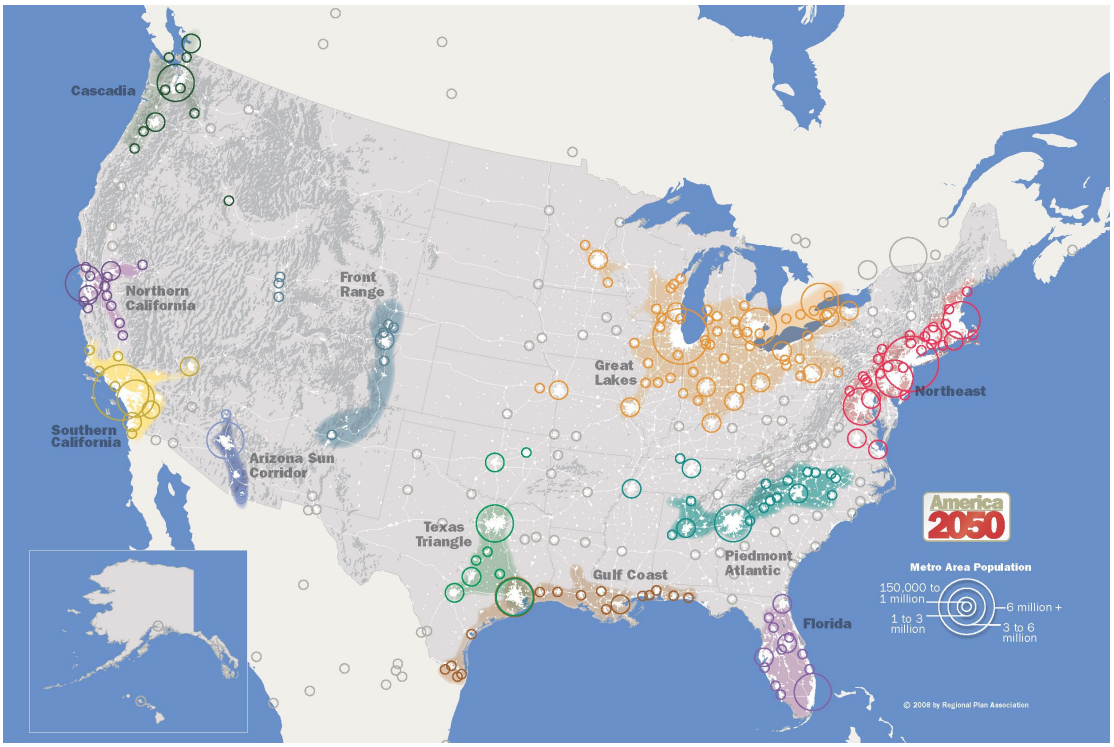

Figure 12: Megaregions in the United States as defined by America 2050 [5].

Table 2 shows the breakdown of MPOs by megaregion. The megaregions in the eastern half of the country tend to have many more MPOs. In fact, the four megaregions with the most MPOs—the Great Lakes, the Northeast, the Piedmont Atlantic, and the Florida megaregions—all include East Coast states. This could be in part due to the presence of older urban areas in the eastern half of the country—older areas with distinct histories might be less likely to have formed united planning agencies once the USDOT started requiring MPOs—or it might just be a reflection of the greater urbanization in that half, as shown in Figure 13.[6] Regardless of the cause, the greater numbers of MPOs in eastern megaregions might make megaregional planning there more difficult.

[6] United States Census Bureau. "History: Maps." 21 October 2019. link

Table 2: Number of MPOs within and adjacent to each megaregion.

Megaregion	**MPOs within megaregion**	**MPOs adjacent to megaregion**
Arizona Sun Corridor	4	1
Cascadia	11	3
Florida	23	3
Front Range	7	1
Great Lakes	71	20
Gulf Coast	19	2
Northeast	46	11
Northern California	12	3
Piedmont Atlantic	34	6
Southern California	6	3
Texas Triangle	9	7

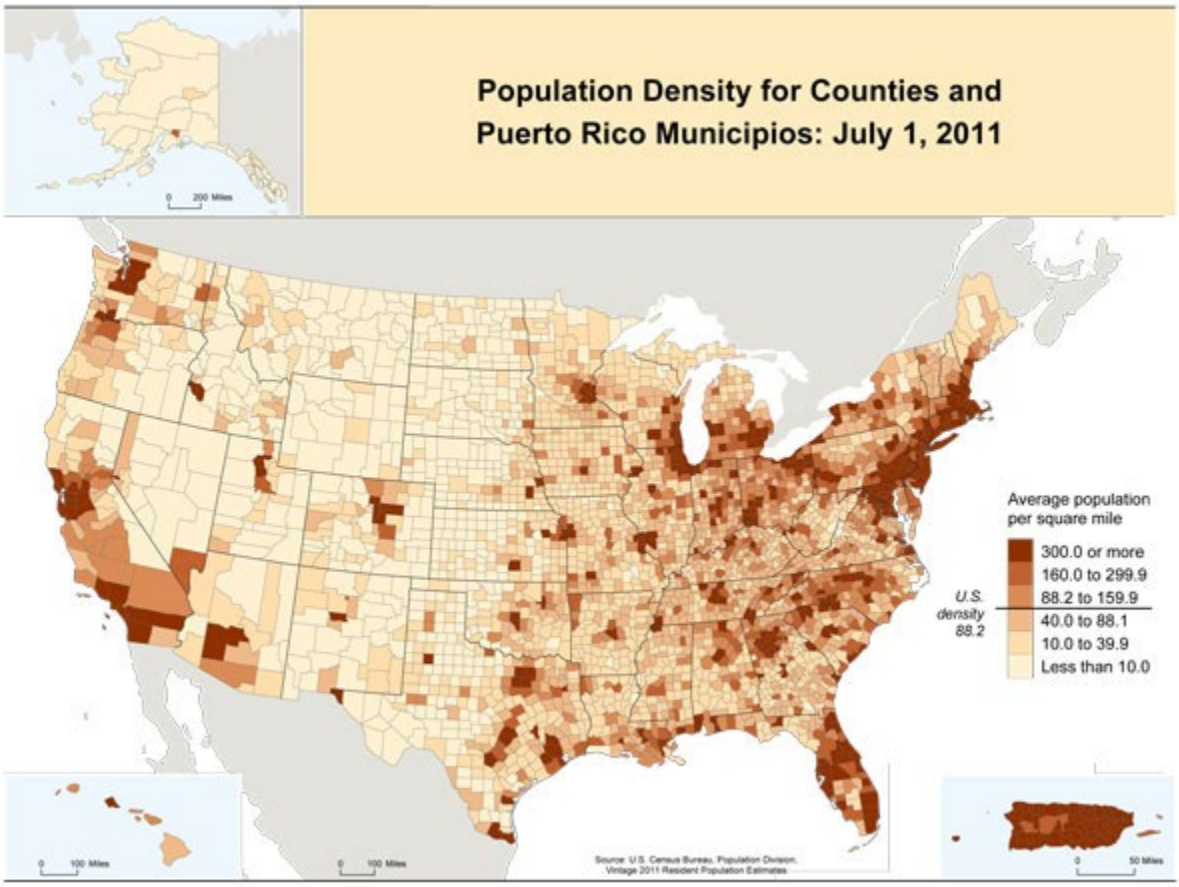

Figure 13: US population density by county according to the US Census Bureau. [6]

5. Conclusion and Recommendations

Based on the comprehensive database developed through CM^2, it is clear MPOs handle planning for alternative transportation modes in a myriad of different ways. Larger MPOs tend to use more complex travel demand models and are also more likely to have committees that address alternative transportation needs. MPOs within the same megaregion typically do not have similar modeling practices, although the Florida Megaregion is one exception to this: all the MPOs in the megaregion are in the same state and the state DOT ensures they all have similar travel demand models. The Florida Megaregion might provide a paradigm for other megaregions to follow for ensuring consistent non-automotive transportation planning.

For future uses of the database, researchers should examine whether multistate-MPOs have appreciably different modeling practices from single-state MPOs. Additionally, if the database is updated in the future as MPOs change, researchers might consider adding fields to examine how MPOs handle ride sharing and autonomous vehicles. Several MPOs already have autonomous vehicle committees.

Appendix A: R Code to Load Database

The following R code will allow loading the short form of the database into a dataframe called "MPOs". If the version of R being used does not contain the Hmisc library, line 2 and lines 54 through 84 may be excluded, but the final dataframe will not have descriptions for each variable.

```
library(readr)
library(Hmisc)
MPOs <- read_csv("MPO_database_shortform.csv",
                 col_types = cols(ACT_COMM = col_logical(),
                 ACT_MODEL = col_integer(),
                 AIR_COMM = col_logical(),
                 AIR_SEAT = col_integer(),
                 AIR_VOTE = col_integer(),
                 BIK_COMM = col_logical(),
                 BRD_SZ = col_integer(),
                 DES_YR = col_integer(),
                 FRT_MODEL = col_integer(),
                 INDEPENDENT = col_logical(),
                 MPO_ID = col_integer(),
                 MULTISTATE = col_logical(),
                 PED_COMM = col_logical(),
                 POP10 = col_integer(),
                 STATE3 = col_character(),
                 TDM_INT = col_logical(),
                 TDM_TYPE = col_integer(),
                 TRN_COMM = col_logical(),
                 TRN_DIRECT = col_logical(),
                 TRN_MODEL = col_integer(),
```

```
                TRN_REP = col_logical(),
                TRN_SEAT = col_integer(),
                TRN_VOTE = col_integer(),
                WEIGHTED = col_logical()))

MPOs$TDM_TYPE <- factor(MPOs$TDM_TYPE,
            levels = c(-1, 0, 1, 2, 3),
            labels = c('unknown',
               'simpleGrowth',
               '4-step',
               'devABM',
               'ABM'))
MPOs$ACT_MODEL <- factor(MPOs$ACT_MODEL,
            levels = c(-1, 0, 1, 2),
            labels = c('unknown',
                 'combined',
                 'separate',
                 'unmodeled'))
MPOs$TRN_MODEL <- factor(MPOs$TRN_MODEL,
           levels = c(-1, 0, 1, 2),
           labels = c('unknown',
                      'assigned',
                      'modeChoice',
                      'unmodeled'))
MPOs$FRT_MODEL <- factor(MPOs$FRT_MODEL,
            levels = c(-1,0,1),
            labels = c('unknown',
                      'assigned',
                      'unmodeled'))
```

```
var.labels = c(MPO_ID = "ID number",
          MULTISTATE = "Multistate",
          STATE1 = "MPO's state",
          STATE2 = "2nd state if applicable",
          STATE3 = "3rd state if applicable",
          DES_YR = "Year the MPO was designated",
          POP10 = "Population from the 2010 Census",
          INDEPENDENT = "Not a part of a CoG or City",
          BRD_SZ = "Seats on the Policy Board",
          BRD_VOTE = "Voting seats on the Policy Board",
          WEIGHTED = "Weighted voting",
          TRN_SEAT = "Transit seats on the Policy Board",
          TRN_VOTE = "Voting transit seats on the Policy Board",
          TRN_REP = "Transit representation",
          TRN_DIRECT = "Direct transit representation",
          AIR_SEAT = "Airport seats on the Policy Board",
          AIR_VOTE = "Voting airport seats on the Policy Board",
          TRN_REP_PRCT = "% transit representation by vote",
          AIR_REP_PRCT = "% air representation by vote",
          AIR_COMM = "Airport committee",
          ACT_COMM = "Active transport committee",
          BIK_COMM = "Dedicated bicycling committee",
          PED_COMM = "Dedicated pedestrian committee",
          TRN_COMM = "Transit committee",
          TDM_INT = "Internal travel demand model",
          TDM_TYPE = "Travel demand model type",
          ACT_MODEL = "Active transport modeling",
          TRN_MODEL = "Transit modeling",
```

```
          FRT_MODEL = "Freight modeling")

label(MPOs) = as.list(var.labels[match(names(MPOs),
names(var.labels))])
```

References

Chiu, Yi-Chang; Bottom, Jon; Mahut, Michael; Paz, Alex; Balakrishna, Ramachandran; Waller, Travis; Hicks, Jim. "Dynamic Traffic Assignment: A Primer." Transportation Network Modeling Committee, Transportation Research Board. June 2011. https://onlinepubs.trb.org/onlinepubs/circulars/ec153.pdf

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Sciara, Gian-Claudia. "Transit Operators in Metropolitan Transportation Decision Making." Cooperative Mobility for Competitive Megaregions. To be published.

Sciara, Gian-Claudia; Ryerson, Megan. "Airport Governance in U.S. Metro Regions: Institutional Models and their Implications for Megaregion Transport." Cooperative Mobility for Competitive Megaregions. To be published.

United States Census Bureau. "History: Maps." 21 October 2019. https://www.census.gov/history/www/reference/maps/