Transit Modeling Update

Mode Choice Review and Recommended Model Development Guidance

Contents

Introduction

The purpose of the Transit Modeling Update project is to specify, within FSUTMS and associated support systems, the changes necessary to improve the preparation of transit demand forecasts to a point consistent with federal expectations, and to incorporate state of the practice techniques and tools through a prototype model application. The Tallahassee Capital Region Transportation Planning Agency (CRTPA) model was chosen as the prototype FSUTMS model application.

This memorandum discusses proposed changes to the mode choice model and to the process for building transit level of service matrices. The memorandum builds upon the discussion in the three previous memoranda, which cover proposed transit modeling guidance for the trip generation, time of day choice, and trip distribution steps of FSUTMS. In addition, guidance for calibrating and validating the mode choice model is discussed in a separate, companion document.

The proposed model update recommendations are intended to apply to all regions in the State of Florida that apply trip-based models. The recommendations have been incorporated in the prototype demonstration model.

FSUTMS Mode Choice Model Review

FSUTMS applies a nested logit model to perform mode split. Two model structures are used, depending on the importance of transit in the model area. Regions with relatively small transit systems apply the nesting structure shown at the top of Figure 1. An example of this type of region is the Tallahassee Capital Region. Regions with moderate size transit systems apply the nesting structure shown at the bottom of Figure 1. Examples of this type of regions are the Jacksonville, Orland and Tampa model areas. The Southeast Florida region has the most developed transit system in the state; it uses a mode choice model more advanced than the FSUTMS models and will not be discussed in this guidance.

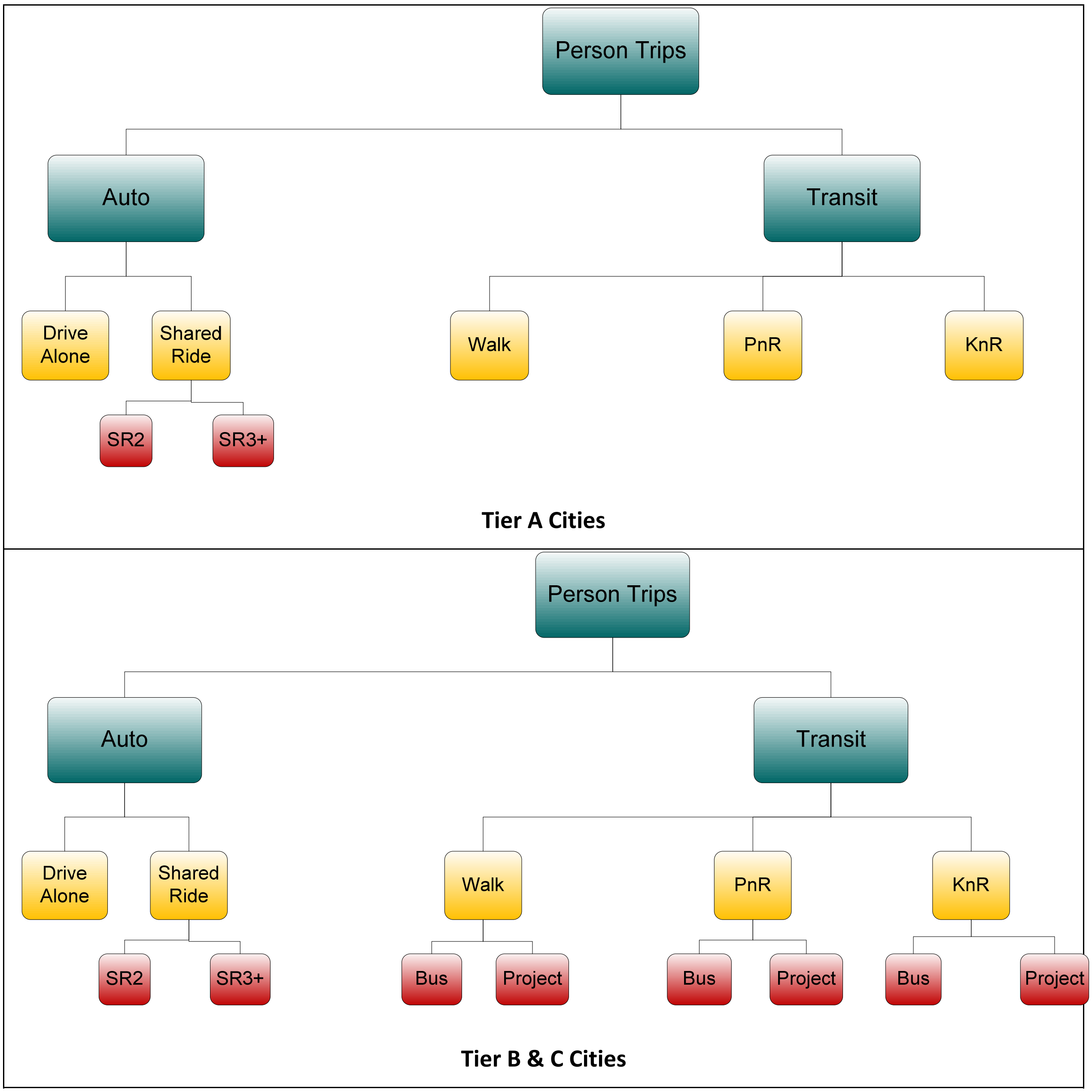

Figure 1: FSUTMS Mode Choice Nesting Structures

The FSUTMS mode choice model templates meet state of the practice, and as such, only relatively minor improvements are proposed as part of this modeling guidance. Similarly, the methods used to code the transit network and to build transit level of service matrices (i.e., “skims”) follow state of the practice and recommended guidelines from the FTA. Some of the good practices already in use in FSUTMS include:

- Actual routing and exact stop location represented as accurately as allowed by the model’s representation of the highway system.
- *Faithful* station coding or station micro-coding-- faithfully represent street-to-station, PNR-to-station, platform-to-platform separation (horizontal & vertical).
- Prevalent fare system(s) implemented as faithfully as possible.
- Allow users to code bus speeds as dependent on stops, in addition to highway speeds
- Automated procedures implemented for coding walk and drive access connectors.
- Reasonable factors used to weight travel time components during path building.
- Reasonable mode choice coefficients applied to travel time and travel cost variables.
- Mode choice constants stratified by auto ownership.

Various improvements to the mode choice model templates are proposed and discussed in the next section. These recommendations stem from the following motivations:

Introduce better representation of transit markets. One of the objectives of travel demand modeling is to understand how travel markets react to changes in levels of service or in the composition of the travel population. As such, it is critical for the model to understand the existing regional transit markets. Many of the changes proposed to FSUTMS throughout the development of this guidance are intended to better differentiate and identify unique transit markets. These changes include the use of additional explanatory variables in trip distribution, the use of car sufficiency and household income to segment the trip distribution and mode choice models, and true time of day segmentation. An additional level of segmentation is the introduction of walk market segmentation, as discussed in the next section.

Consolidate the two templates into a single standard template. While the practical side of using a simpler mode choice model for certain cities is readily acknowledged, care should be taken to avoid over-simplifying the treatment of mode choice. In particular, the current approach of classifying cities into types A, B or C may overlook growth patterns, and/or interest to develop certain types of transit services in the future. Also, the structure proposed for type A cities assumes that the ‘project’ transit service will exhibit the same characteristics as the current transit service, while the structure assumed for type B/C cities assumes the opposite, that is, that the ‘project’ should be treated as a difference transit choice. Both assumptions could be mistaken. The approach proposed here is to adopt a more universal structure that acknowledges that several transit choices (express buses, urban rail, etc.), may not be available in the model region in most analysis scenarios.

Better align certain coefficients and procedures with best practices. A number of modifications are proposed below for various transit path building parameters and mode choice coefficients. Where feasible, a process for establishing appropriate regional values for these parameters or coefficients is discussed.

Proposed Mode Choice Modeling Approach

As indicated above, the overall recommendation is to maintain the current mode choice modeling approach, combined with the changes described below.

Wait Time Computation

As is standard in travel demand modeling, transit wait time is computed as one-half of the headway. This formula is consistent with the assumption that transit users arrive at bus stops at random, that is, as if they didn't know the schedule. It is readily acknowledged that this assumption does not apply to habitual users of routes that have long headways. Since they know the schedule, they arrive a few minutes before the bus is due, regardless of the headway. To represent this behavior FSUTMS caps the contribution of wait time to the utility function at 30 minutes, as shown in Figure 2. That is, if the headway is longer than 60 minutes, the wait time is assumed to be 30 minutes.

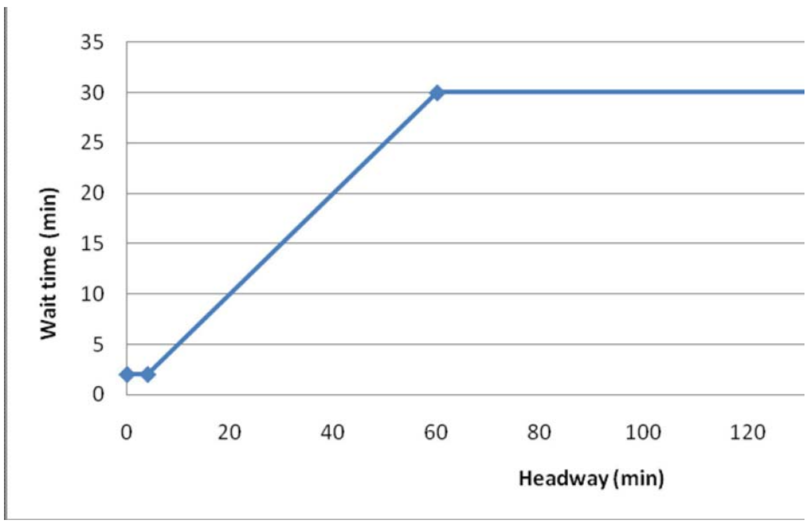

Figure 2: FSUTMS Wait Time Function

This formulation ignores the benefit accrued when long headways are shortened, yet remain longer than 60 minutes. For example, an express bus route may be improved to once every hour during the AM peak period, instead of just once over this entire period. While the wait times may not be different, it is more convenient to have buses run every hour than every other hour.

In order to capture this convenience effect, the utility of wait time can be computed as representing two effects: true wait time at the stop and the convenience of short headways. Mathematically this requires breaking out first wait time into two components, each with its own coefficient, as shown in Equation 1.

$$Utility = \alpha_1 \times max(First\ Wait, W^*) + \alpha_2 \times max(First\ Wait - W^*, 0)$$

In this formulation, W^* is typically a value between 5 minutes and 10 minutes, and it is expected that *abs(*α_2*) < abs(*α_1*)*, since lack of convenience is not as onerous as true wait time.

Bus Speed Computation & Default Values

The FSUTMS mode choice model template does not provide any default formulation for calculating bus speeds. Each region is therefore responsible for defining and validating its own set of transit speed formulas. We propose to include a default template as guidance for well-accepted ways of computing bus speeds. The region will still be responsible for ensuring that the default parameters represent well transit travel times.

The preferred way for computing bus speeds, or more generically, speed for transit vehicles operating in mixed-flow traffic, is a formula that combines highway travel time with a delay per stop, or per mile. Two examples are provided in Table 1 and Table 2.

Table 1 corresponds to the method implemented for the Southeast Florida model, SERPM 6.7[1]. In this example, the transit vehicle speed is highway time plus dwell time per coded stop. As shown, the dwell time varies with the transit agency, the type of service (local, express, shuttle), and marginally with time period. Table 2 corresponds to a method proposed as part of the Phoenix Rapid Bus Alternatives Analysis[2]. In this case, the transit vehicle speed is computed as highway time plus delay per mile. As shown, the delay varies with type of service, facility type, and area type.

We propose to adopt a combination of these two methods for FSUTMS—computing transit travel time as highway time plus delay per coded stop, with the delay expressed as a function of facility type, type of service, and possibly area type, if needed. The dwell times per stop could be computed by combining data from various regions, as available. Each region would still be responsible for validating the default dwell time factors, and to provide backup analysis in case the analysis shows that other dwell time values would better fit the observed travel time data.

Table 1: SERPM 6.7 Dwell Times for Mixed-Flow Transit Vehicles

Transit Agency	**Service**	**Dwell Time per Coded Stop (min)**	
		Peak	Off-Peak
MDT	Local, MAX, KAT & Busway bus service	0.60	0.60
	95X express service	1.20	1.20
BCT	Local bus service	0.70	0.68
	Breeze (limited stop) service	1.20	1.20
Palm Tran	Local bus service	0.46	0.47
MDT & BCT	I-95 Express (inter-county) bus service	1.20	1.20
SFRTA	Tri-Rail shuttles	0.70	0.70

Source: AECOM Consult, Inc.

[1] SERPM 6.7 Transit Model Development Results. Draft Technical Memorandum. Prepared for the Florida Department of Transportation District 4 by AECOM Consult, Inc. 2012.
[2] Phoenix Rapid Bus Calibration Technical Memorandum. Prepared for the Maricopa Association of Governments by AECOM Consult, Inc. 2008.

Table 2: Phoenix Dwell Times for Mixed-Flow Transit Vehicles

Service & Area Type	Dwell Time per mile by Facility Type (min.)								
	Freeway	Express-way	Collectors	6-Leg Arterial	Major Arterial	Metered Ramps	Other Ramps	C/D Road	HOV Lanes
Local Bus									
CBD	0.00	0.00	2.45	1.50	2.45	1.50	1.50	1.50	0.00
Outlying CBD	0.00	0.00	3.50	1.50	2.45	1.50	1.50	1.50	0.00
Mixed Urban	0.00	0.00	1.50	1.50	1.95	1.50	1.50	1.50	0.00
Suburban	0.00	0.00	1.50	1.50	1.60	1.50	1.50	1.50	0.00
Rural	0.00	0.00	1.50	1.50	1.80	1.50	1.50	1.50	0.00
Express Bus									
CBD	0.00	0.00	2.50	0.00	2.50	1.50	1.50	1.50	0.00
Outlying CBD	0.00	0.00	3.50	1.50	2.50	1.50	1.50	1.50	0.00
Mixed Urban	0.00	0.00	1.50	1.50	2.00	1.50	1.50	1.50	0.00
Suburban	0.00	0.00	1.50	1.50	1.70	1.50	1.50	1.50	0.00
Rural	0.00	0.00	1.50	1.50	1.80	1.50	1.50	1.50	0.00
Shuttle Bus									
CBD	0.00	0.00	1.50	1.50	2.70	1.50	1.50	1.50	0.00
Outlying CBD	0.00	0.00	1.50	1.50	2.70	1.50	1.50	1.50	0.00
Mixed Urban	0.00	0.00	1.50	1.50	2.70	1.50	1.50	1.50	0.00
Suburban	0.00	0.00	1.50	1.50	2.70	1.50	1.50	1.50	0.00
Rural	0.00	0.00	1.50	1.50	2.70	1.50	1.50	1.50	0.00

Source: AECOM Consult, Inc.

Walk & Drive Access Connectors

Walk and drive access connectors are automatically generated in FSUTMS using standard Cube script commands and the implementation of the AUTOCON functionality in Cube 6.0. We propose to maintain the current functionality but possibly allowing for longer walk access connectors. Currently, walk access connectors cannot be longer than 0.6 miles, which may not be long enough to connect large zones that have some portion accessible to transit. The recommended approach for establishing the appropriate maximum length of walk connectors is to assign trips from an on-board survey under different connector length assumptions, and examine at which lengths a significant portion of trips is unassigned due to the absence of long enough connectors.

No changes are proposed to the methodology used to build drive access connectors, other than the use of Cube 6.0 to replace the functionality of the AUTOCON program directly with Cube script. An example implementation is provided with the transit guidance demonstration model.

Walk Market Segmentation

The goal of walk market segmentation is to improve the representation of walk times. Without walk segmentation, the model can do no better than assume that all trips produced or attracted to a zone experience a walk distance equivalent to the length of the centroid connector. This assumption is incorrect in most model regions and for the majority of zones that are at least partially within walking distance of transit.

FSUTMS uses percent walks combined with the REWALK program to identify the portion of a zone that is within walking distance of a transit stop. We propose to expand upon this methodology by further segmenting walk access into 'short' walk and 'long' walk. The exact definition of the breakpoint between short and long is typically between one-quarter to one-third of a mile; the best approach is to establish it based on analysis of on-board survey data. In the mode choice model, the walk time that applies to a trip within short walk is typically capped at 5 minutes (0.25 miles at 3 mph), while the long walk time is capped at 10 minutes. Including drive access, this results in seven possible access segments for production/attraction zone pair, as shown in Table 3.

Table 3: Enumeration of Proposed Access/Egress Markets

Access	Egress	
	Short Walk	Long Walk
Short Walk	1	2
Long Walk	3	4
Drive	5	6
No Transit	7	7

Household & Time Period Segmentation

As discussed in the trip generation and time of day choice modeling guidance memoranda, the proposed segmentation of the mode choice model combines "true" time of day segmentation with household stratification by household income and car sufficiency. True time of day segmentation implies that trips for each purpose are split into peak and off-peak period trips, and exposed to the levels of service corresponding to their time period. Currently FSUTMS exposes HBW trips to peak level of service, and all other trips to off-peak (free-flow) levels of service.

The proposed household market segments are:

i. Zero Car Households – All Income
ii. Cars less than Workers – Low Income
iii. Cars less than Workers - Medium Income
iv. Cars less than Workers – High Income
v. Cars equal to or greater than Workers - Low Income
vi. Cars equal to or greater than Workers - Medium Income
vii. Cars equal to or greater than Workers – High Income

Model Structure & Coefficients

As discussed above, the current FSUTMS mode choice model nesting structure does not distinguish between different types of transit service, other than offering the option of modeling new service as a mode different from local bus in regions that use the Tier B/C model. Cities like Orlando, Tampa and Jacksonville already exhibit transit services with distinct characteristics from local bus. Examples include the LYMMO BRT in Orlando, the TECO line streetcar system in Tampa, and express bus services in all three cities. Moreover, studies are underway or completed in these regions to introduce commuter rail service (Jacksonville and Orlando), and to expand LYMMO (Orlando). As some of the current Tier A regions grow, they may find too that the Tier A mode choice model does not adequately represent the range of transit options that they may wish to plan for.

The definition of the transit choice set for any given region hinges on two main considerations: understanding of competition between the various transit services, and representation of un-included mode attributes.

Transit Competition. Competition among transit routes exists when riders traveling between an origin and destination (OD) have a choice of different routes and/or different services (for example, a one-seat ride on express bus or a path that includes multiple local bus routes). A travel demand model can represent this competition in two ways—in the path builder or in mode choice.

- The *path builder* can be configured to find only one path for each OD pair, or to proportionally allocate the OD trips to various likely paths. Paths are built and compared on the basis of generalized cost, which typically includes travel time and fare characteristics. The generalized cost function includes factors to weigh the contribution of out-of-vehicle time and fare to in-vehicle time. These factors are typically constant for all transit markets.
- The *mode choice model* allocates the OD trips among the various available modes on the basis of their utility. Utility includes similar level of service attributes and weights as the generalized cost function, but with two important differences: it includes also a constant that measures un-included attributes (such as seat availability, reliability, etc.), and the level of service weights or coefficients can vary by transit market, such as trip purpose and household income/car sufficiency groups. As such, the mode choice model understands better the attributes of the different path choices and how they related to the various types of transit users.

Currently FSUTMS relies primarily on the path builder to represent competition. While this is appropriate for the majority of OD pairs, it limits the representation of competition where it does exist. This can be particularly critical when examining future year alternatives. The extent to which analyses of future transit alternatives may be affected is unknown, but it is a distinct possibility that the structure of the model may negatively impact certain analyses. Allowing the FSUTMS mode choice model to represent transit competition more comprehensively that it does today would address this concern. The only real disadvantage is the extra time required to build additional transit skim matrices.

Un-Included Attributes. The transit mode-specific constant measures the contribution to the utility function of attributes not otherwise explicitly included, such as comfort, travel time reliability, and safety, among others. These un-included attributes are not constant across all transit modes. For example, transit operating on a dedicated guideway is more reliable than bus transit operating in mixed-flow traffic. Similarly, long distance commuter rail vehicles that offer a wide seat with amenities such as a table, wi-fi, and electricity are far more comfortable than light rail vehicles designed for large loads of standees. A way to capture these differences in un-included attributes is to represent these various modes as separate choices in the mode choice model, by specifying each mode-specific constant to represent the relative contribution (in minutes of travel time) of that mode's un-included attributes *relative* to a reference mode, which often times is local bus. FTA has provided guidance on appropriate values for mode-specific constants for modes that are new to the region[3]. Hence, agencies that intend to use FSUTMS for analyses of transit options that exhibit different un-included attributes than local bus would benefit from a mode choice model that treats these services as different modes.

Given these two considerations, we propose the transit structure shown in Figure 3 for the FSUTMS mode choice model. In this structure, transit choices are explicitly identified as specific types of services, and would be represented with mode-specific constants that follow FTA guidance. Each MPO would be responsible for ensuring that modes that already exist in a region, such as express bus, or LYMMO, for example, exhibit constants that are reasonable from the perspective of un-included attributes and yield mode shares consistent with observed shares. In essence, this structure extends the Type B/C mode choice model to enumerate likely types of potential “project” or premium transit modes that may be of interest in Florida over the next few years. The mode choice model source code should be modified so that it knows when transit modes do not exist in the analysis scenario, and therefore avoids building unnecessary skim matrices.

A second modification to the FSUTMS mode choice model is the addition of non-motorized options—walk and bike, as explicit choices. Certain types of transit services that exist in Florida, such as streetcars and downtown people movers, are competitive with walk and bike markets. For this reason, short distance markets should be exposed to the full set of options available to them. Consistent with this recommendation, the trip production rates should be estimated to forecast all trips, and not just motorized trips, and similarly the trip distribution model should be calibrated to match the trip length distribution of all trips combined.

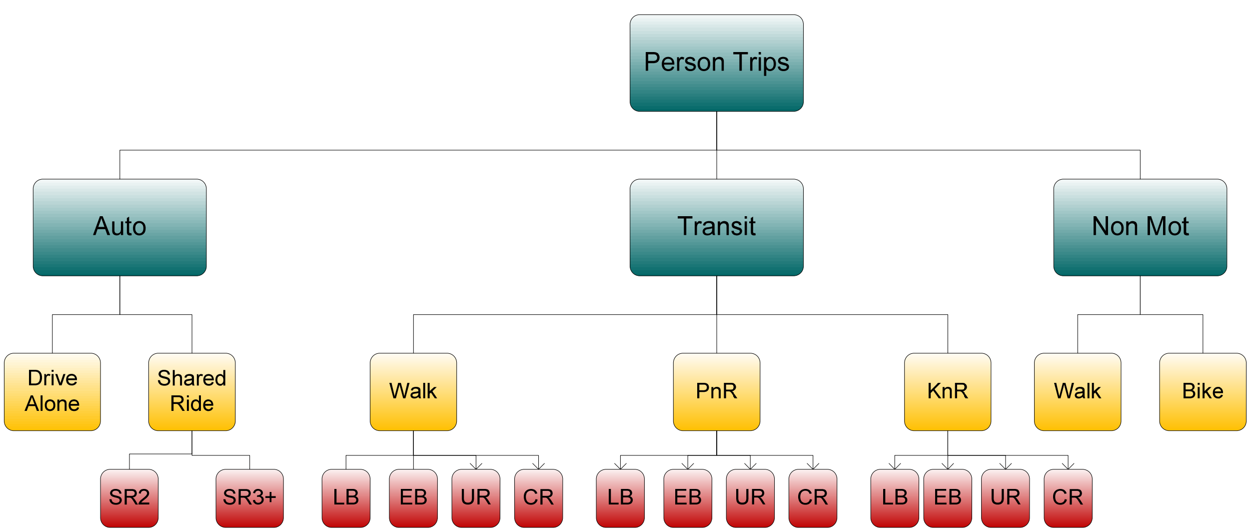

Figure 3: Proposed FSUTMS Mode Choice Model

[3] Federal Transit Administration. Proposed Guidance on New Starts / Small Starts Policies and Procedures. Report No. FTA-2007-27172-1. Washington, D.C.: 2007.

The last set of recommended modifications to the FSUTMS mode choice model concerns the values of the level of service coefficients, nesting coefficients, and default mode-specific constants. Table 4 shows the current set of parameter values, while Table 5 shows the proposed default values. This recommendation is substantiated as follows:

NHB Travel Time Coefficients. The in-vehicle time coefficient for NHB trips is typically somewhat less negative than the HBW coefficient. A value of -0.017, or 2/3 of the HBW coefficient, is proposed for FSUTMS. All other NHB coefficients have been scaled accordingly to preserve the value of time and out-of-vehicle to in-vehicle travel time ratios.

Commuter Rail In-Vehicle Time Coefficient. FSUTMS allows using a different in-vehicle time coefficient for commuter rail than for other modes. FTA allows the use of less negative coefficients for commuter rail, provided the type of service justifies. The rationale is that the comfort associated with commuter rail services is proportional to the duration of the trip. The recommended practice is the status quo, that is, assume the same in-vehicle time coefficient for commuter rail unless otherwise justified by the project.

Table 4: FSUTMS Default Mode Choice Parameters

Utility Term	Trip Purpose					
	HBW		**HBNW**		**NHB**	
	Coef.	Ratio(1)	Coef.	Ratio(1)	Coef.	Ratio(1)
Level of Service Coefficients						
In-vehicle time	-0.0250		-0.0125		-0.025	
In-vehicle time, commuter rail	-0.0250	1.0	-0.0125	1.0	-0.025	1.0
Out-of-vehicle time	-0.0500	2.0	-0.0250	2.0	-0.0500	2.0
Drive access time	-0.0375	1.5	-0.0187	1.5	-0.0375	1.5
Cost	-0.0025	$6(2)	-0.0025	$3(2)	-0.0050	$3(2)
Number of Transfers	-0.2500	10	-0.1250	10	-0.2500	10
Nesting Coefficients						
Transit access	0.5		0.5		0.5	
Transit mode	0.5		0.5		0.5	
Auto mode	0.8		0.8		0.8	
Auto occupancy	0.2		0.2		0.2	
Constants(default values)						
CBD, walk to transit	1.00	-40	1.00	-80	1.00	-40
CBD, pnr to transit	1.00	-40	1.00	-80	1.00	-40
CBD, knr to transit	1.00	-40	1.00	-80	1.00	-40
Mode-specific (3)	-1.00	40	-1.00	80	-1.00	40

(1) Relative to in-vehicle time coefficient.

(2) Implicit value of time ($/hr)

(3) Stratified by mode and household auto availability

Cost Coefficient. Given that the person trip tables are stratified by household markets, it is desirable to stratify the cost coefficient by household market too. The cost coefficient should be representative of the average value of time within each market; in this case, income and car sufficiency levels. The average value of time in turn is expected to be approximately between one-quarter to one-half of the average hourly wage. The proposed cost coefficients assume that HBW value of time is one-third of the average wage rate, and HBNW and NHB value of time is approximately ½ of the HBW value of time. Average wage rates calculated for the entire state are shown in Table 6. Car sufficiency for HBW trips is computed relative to number of workers in the household, while car sufficiency for HBNW trips is computed relative to the number of adults in the household (approximately). Nonetheless, as shown in Table 6, the average household income varies very little across car sufficiency group. The cost coefficients may be customized to better fit regional population profiles.

Nesting Coefficients. The FSUTMS default nesting coefficients violate the assumptions underpinning the logit mode choice model, in particular that the scale of utility at each level of the nest should be constant. In addition, the auto side of the nest exhibits a nesting coefficient product of 0.16 (0.8 X 0.2), which makes the choice between SR2 and SR3+ overly sensitive to differences in travel time and cost. In general , the product of the nesting coefficients should not be lower than 0.25-0.30.

CBD Constants. As indicated in the Transit Model Development Guide[4], the constants provided in the transit model template are default values that *must* be modified by the user. That is, appropriate values for these constants must be established via model calibration. Nevertheless, a more appropriate default value for the CBD constant is zero. A CBD constant, if used, should be positive and no larger than approximately 20 minutes of in-vehicle travel time. Further, stratifying the CBD constant by access market requires careful justification based on observed travel patterns and differences between walk and drive access markets. The default condition should be to assume the same constant for all access markets.

Mode-Specific Constants. As discussed above, the mode-specific constant captures the effect of un-included attributes. Some of these attributes are related to the trip-maker, while others are related to the mode. It then follows that the constant for a transit mode can be represented as consisting of two parts, one part that varies with the household market, and one part that varies with the mode. We recommend making this representation explicit to avoid over-specification issues during model calibration. Operationally, this requires specifying a transit constant that is common to all transit modes and that varies with household market, a 'drive access' constant that also varies with household market and applies to PNR and KNR access choices, and a KNR access constant, also stratified by household market. Each transit mode utility would also include a mode-specific constant that does not vary with household market or access market.

[4] Florida Department of Transportation. FSUTMS Transit Model Development Guide. Technical Report. Prepared by AECOM Consult, Inc. Tallahassee, FL: 2008.

Table 5: Recommended Mode Choice Model Parameters

Utility Term	Trip Purpose					
	HBW		HBNW		NHB	
	Coef.	Ratio(1)	Coef.	Ratio(1)	Coef.	Ratio(1)
Level of Service Coefficients						
In-vehicle time	-0.0250		-0.0125		-0.017	
In-vehicle time, commuter rail	-0.0250	1.0	-0.0125	1.0	-0.017	1.0
Out-of-vehicle time	-0.0500	2.0	-0.0250	2.0	-0.034	2.0
Drive access time	-0.0375	1.5	-0.0187	1.5	-0.0255	1.5
Cost					-0.00340	$3(2)
Zero cars, all income	-0.00375	$4(2)	-0.0025	$2(2)		
Insufficient cars						
Income < $25K(4)	-0.00600	$2.5	-0.00600	$1.5		
Income $25K-$50K	-0.00250	$6.0	-0.00250	$3.0		
Income > $50K	-0.00095	$15.7	-0.00095	$7.9		
Sufficient cars						
Income < $25K	-0.00600	$2.5	-0.00600	$1.5		
Income $25K-$50K	-0.00250	$6.0	-0.00250	$3.0		
Income > $50K	-0.00080	$18.7	-0.00080	$9.4		
Number of Transfers	-0.2500	10	-0.1250	10	-0.1700	10
Nesting Coefficients						
Transit access	0.5		0.5		0.5	
Transit mode	0.7		0.7		0.7	
Auto mode	0.7		0.7		0.7	
Auto occupancy	0.5		0.5		0.5	
Constants(default values)						
CBD, all transit	0.00	0	0.00	0	0.00	0
Drive alone (3)	0.00	0	0.00	0	0.00	0
Shared ride (2 & 3+)(3)	-1.00	-	-1.00	-	-1.00	-
Shared ride 3+(3)	-1.00	-	-1.00	-	-1.00	-
Transit (all ride modes) (3)	-1.00	-	-1.00	-	-1.00	-
Drive-transit (all ride modes) (3)	-1.00	-	-1.00	-	-1.00	-
KNR-transit (all ride modes) (3)	-1.00	-	-1.00	-	-1.00	-
Express bus	0.125	5	0.000	0	0.000	0
Urban rail	0.250	10	0.125	10	0.170	10
Commuter rail	0.250	10	0.062	5	0.085	5

(1) Relative to in-vehicle time coefficient.

(2) Implicit value of time ($/hr)

(3) Stratified by household income and car sufficiency

(4) Income and cost values expressed in $2009

Table 6: Average Florida Statewide Household Income ($2009)

Household Market	HBW			HBNW		
	Average Annual Income	Implied Hourly Wage	Hhld. Pct.	Average Annual Income	Implied Hourly Wage	Hhld. Pct.
Zero Cars, All Income	$24,900	$12.0	8.7%	$24,900	$12.0	8.7%
Car Insufficient						
Income < $25K	$18,300	$8.8	0.6%	$14,800	$6.8	6.9%
Income $25K-$50K	$37,400	$18.0	2.1%	$35,800	$17.2	7.0%
Income > $50K	$97,000	$46.6	3.8%	$96,200	$46.2	6.1%
Car Sufficient						
Income < $25K	$14,100	$6.8	19.9%	$13,900	$6.7	13.6%
Income $25K-$50K	$36,400	$17.5	22.3%	$36,800	$17.7	17.5%
Income > $50K	$116,300	$55.9	42.5%	$117,500	$56.5	40.2%

Source: American Community Survey Public Use Micro Sample, 2005-2009 Release.

Model Calibration

The calibration of the mode choice model requires careful analysis of observed data and of the performance of the entire model system. Methods and guidelines for mode choice model calibration are discussed in a separate document[5].

[5] Florida Department of Transportation. Principles of Mode Choice Model Calibration and Validation. Prepared by Parsons Brinckerhoff, Inc. Tallahassee, FL: 2010.