CAMBRIDGE SYSTEMATICS

Southeast Florida Road and Transit User Cost Study

draft

report

prepared for

Florida Department of Transportation District Four

prepared by

Cambridge Systematics, Inc.

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1.0 Introduction

Localized values for travel time and vehicle operating costs for the traveling public in Southeast Florida are critical to understanding and communicating the value of transportation improvements. These two components – travel time values (TTV) and vehicle operating costs (VOC) – together make up the majority of road and transit user costs (RTUC).

The Southeast Florida Road and Transit User Cost (SEFRTUC) Study researched national sources and methodologies for TTV and VOC, and localized the values to best represent conditions in Southeast Florida. The study area included Miami-Dade, Broward, Palm Beach, Martin, St. Lucie, and Indian River Counties.

This study developed travel time values that can be applied to various travel market segments, and vehicle operating costs that can be applied to various vehicle types which can be applied in the evaluation of benefits related to proposed transportation system improvements.

This report summarizes the research findings on TTV and VOC for Automobile, Commercial Vehicle and Transit travel market segments, and provides an overview of a Road and Transit User Cost Calculator Tool developed to bring this information together in one location for the application of these findings in project evaluation. The reader is referred to ten detailed project memoranda included in the Appendix which provide far greater detail on the development of these values.

All values in this report have been benchmarked to year 2004 values, using U.S. Bureau of Labor Statistics employment cost indices. The User Cost Calculator Tool allows estimation of road and transit user cost of any target year later than 1980 by utilizing key variables such as national average/median wage, Consumer Price Index, average gasoline price, automobile price, vehicle fleet composition, and transit user income, etc. The calculator also provides the functionality to project key components such as wage, consumer price index, gasoline price, and vehicle fleet composition, etc., by using historical data.

2.0 Travel Time Values

2.1 AUTOMOBILE AND COMMERCIAL DRIVERS

This section presents a set of proposed travel time values for user transportation cost analyses in Southeast Florida. The derivation of these values for a core set of travel market segments is presented. Additional travel time value estimates are provided for different vehicle class and roadway functional classifications. The findings of a survey of local drivers is discussed in Section 2.2, and the travel time values derived from the literature review presented in this section are then brought together in a proposed set of values in for use in South Florida. Details for this literature review are available in Appendix A.1. Methodologies applied for TTV calculations for auto and commercial drivers are presented in Appendix C.1.

Core Travel Market Segments

A national literature review was conducted to identify prior work on determining the value of travel time to road users in highway user benefit analysis procedures. Based on the review findings, a set of travel time values for four "core" travel market segments was developed. Core travel market segments refer to travel purposes with distinct values of time that are often applied in user benefit analysis, according to the literature review. These market segments are:

1. **Commuter Travel –** Travel to and from the place of work;
2. **On-the-Clock Travel –** Travel undertaken in the conduct of a job;
3. **Personal Travel –** Local, non-work travel conducted by residents; and
4. **Personal Travel –** Visitor, non-work travel conducted by nonresidents.

The derivation of travel time values for these travel market segments is described below. Additionally, travel time values from these core travel market segments can be expanded to other travel market segments by developing a correspondence table of weights that assign the proportion of core travel market segment travel to other travel market segments. The derivation of these weights is presented in the discussion of travel time values by travel demand model trip purposes and in a separate discussion of travel values by vehicle class and functional classification.

Core Market Segment Travel Time Values

The core travel market segment values were derived by 1) obtaining a single median wage across all industries and counties in Southeast Florida; and 2) for each travel market segment, discounting the hourly wage by the appropriate factor from the previous literature review. Table 2.1 presents a median wage of

$22,881 for Southeast Florida based on the Census. To arrive at this figure, two sources of data were used: the national-wide average and median income[1] from the Social Security Administration (SSA) and the U.S. Census. The median annual income for Southeast Florida residents in the six-county region was adjusted by the ratio of the SSA wage to U.S. Census wage, as compared with the median Southeast Florida wage from the U.S. Census.

Table 2.1 Median Income Per Capita by Source

2000 Dollars (Census)

	Median Annual Wage	Source
National Wage	$22,508	Social Security Administration
National Wage	$23,436	U.S. Census
Southeast Florida	$22,881	U.S. Census
Southeast Florida	$21,975	U.S. Census adjusted by SSA median wage

Table 2.2 presents the conversion of the Southeast Florida annual wages into TTVs by travel market segment, excluding on-the-clock travel. After converting the median wage into an hourly wage, values for each travel market segment were obtained by applying a discount factor derived from U.S. Census and Social Security Online. The values also were inflated to 2004 dollars using the U.S. Bureau of Labor Statistics employment cost indices. The percent of wage rate by travel market segment is derived from the American Association of State Highway and Transportation Officials (AASHTO) "red book," the *User Benefit Analysis for Highways* Manual (2003).

- Personal local travel is valued at 50 percent of the wage rate. That proportion is used here.
- Commute travel factors range from 60 percent for carpool drivers to 40 percent for carpool passengers. The 60 percent figure is used here.
- Personal long-distance travel is valued at 70 percent of the wage rate. Long-distance travel is interpreted here to apply to a mix of recreational-oriented visitor travel and other types of personal travel covering distances greater than those traveled by commuters. The 70 percent figure may be interpreted to imply that visitors with a limited amount of vacation time are spending a good deal of money to accomplish recreational objectives and, therefore, value their time at a higher rate compared to personal local travel, and are willing to pay more to avoid congested travel than are local residents.

[1] According to U.S. Social Security Administration, for the most recent 10 years, national median wage level is about 70 percent of national average income level.

The 70 percent figure quoted above may be appropriate for special studies where the number of short-term visitors is known. However, there are a large number of visitors who spend several weeks to several months in Florida as part-time residents. In this case, the value of time for these visitors should be the same as that for full-time residents. The value of time for longer-term visitors is reported below as 50 percent of the U.S. wage rate.

Table 2.2 Travel Time Value for Commuter and Personal Travel

2004 Dollars

	National Median	Southeast Florida	Percent of Wage Rate	Source
Wage-All Industries (2000 Dollars)	$22,508/year	$21,975/year		
Equivalent Year (2004 Dollars)[a]	$24,961/year	$24,370/year		
Commuter	$7.20/hour	$7.02/hour	60%	SE FL wage
Personal (Local)	$6.00/hour	$5.86/hour	50%	SE FL wage
Personal (Visitor)	$6.00/hour	$5.86/hour	50%	U.S. wage

Note: Hourly wages are calculated by dividing the annual compensation by 2,080 hours.

[a] The values were inflated to year 2004 dollars using Median total compensation figures from the Bureau of Labor Statistics, consistent with the approach used by the Highway Economics Requirements System (HERS). See page 86 of the HERS-ST v. 2.0 technical document (2002).

On-the-clock travel is valued at 100 percent of the hourly wage rate, and includes direct wages and all other benefits. The hourly wages for on-the-clock travel shown below correspond to total compensation (including all benefits) for workers in the transportation and service sectors, which are assumed to be the industries with the highest proportion of on-the-clock travelers in their workforce. The median annual wages shown in Table 2.1 are not the same as the ones shown in Table 2.3 because only the wages of workers involved in transporting goods are included in Table 2.3. Based on this information, the median on-the-clock trip in Southeast Florida is valued at $12.08 per hour in year 2004 dollars.

Table 2.3 Per-Person Travel Time Value for On-the-Clock Travel

2004 Dollars

On the Clock TTV Component	Florida Median	Southeast Florida
Wages	$22,980	$24,370
Total Compensation	**$23,704**	**$25,139**
Total (2000 Dollars)	**$10.28 per hour**	**$10.90 per hour**
Total (2004 Dollars)	**$11.39 per hour**	**$12.08 per hour**

Note: For workers in the transportation and service sectors.

Other Market Segment Travel Time Values

The core travel time values shown above have been expanded to other travel market segments, which can be used in travel demand forecasting or for sketch planning analyses. Table 2.4 presents travel time values by the trip purposes cited in the Southeast Florida Regional Travel Characteristics Survey conducted in October 2000. The correspondence to the core travel market segments is developed by estimating the percentage of each trip purpose (e.g., home-based work) that is commute, local, or on-the-clock travel. The percentages were derived by consensus with a group of travel demand forecasters and planners intimately familiar with the survey and travel patterns in Southeast Florida.

Table 2.4 Travel Time Value by Trip Purpose of Demand Forecast Models

2004 Dollars

	Commute	Local Personal	Visitor Personal	On-the-Clock	Average (Per hour)
	$7.03	**$5.86**	**$6.00**	**$12.08**	
Home-Based Work	100%	0%	0%	0%	**$7.03**
Home-Based Shopping	0%	95%	5%	0%	**$5.86**
Home-Based School	0%	100%	0%	0%	**$5.86**
Home-Based Social/ Recreational	0%	95%	5%	0%	**$5.86**
Home-Based Other	0%	90%	0%	10%	**$6.48**
Home-Based Unknown	0%	95%	0%	5%	**$6.17**
Non-Home-Based	0%	90%	0%	10%	**$6.48**

To compute these values, the average values by trip purpose shown in Table 2.4 were weighted by the proportion of travel by trip purpose, which occurs in each time period (Table 2.5). The proportion of travel by each trip purpose and time period was taken from the *Southeast Florida Regional Travel Characteristics Study*.

Medium- and heavy-duty trucks are typically not used for personal use. Therefore their travel time should be measured as 100 percent on-the-clock travel ($12.08). Light-duty trucks are used both for personal and commercial use. HERS (FHWA) assumes that 25 percent of light-duty truck VMTs are on-the-clock travel, and that 75 percent of VMTs are for personal use, using the same assumption results in an average hourly value of $7.42for light-duty trucks.[2]

[2] Insufficient information was available to develop separate TTVs for light-duty truck travel by travel purpose/vehicle type (Table 2.6), and by roadway functional classification/ vehicle type (Table 2.7) below.

Table 2.5 Travel Time Value by Time Period

2004 Dollars

	6:30 a.m.-9:00 a.m.	9:00 a.m.-11:30 a.m.	11:30 a.m.-1:30 p.m.	1:30 p.m.-4:30 p.m.	4:30 p.m.-6:30 p.m.	Other	Value/Hour by Trip Purpose
Home-Based Work	40%	16%	11%	20%	32%	25%	$7.03
Home-Based Shopping	3%	16%	14%	11%	11%	13%	$5.86
Home-Based School	16%	3%	3%	10%	5%	3%	$5.86
Home-Based Social/ Recreational	3%	7%	5%	6%	8%	16%	$5.86
Home-Based Other	20%	25%	20%	21%	21%	25%	$6.48
Home-Based Unknown	0%	1%	1%	1%	1%	1%	$6.17
Non-Home-Based	16%	32%	46%	32%	22%	16%	$6.48
Average	**$6.56**	**$6.40**	**$6.40**	**$6.42**	**$6.50**	**$6.42**	

Note: Percentages may not add to 100 due to rounding.

In

Table 2.6, per-person values and per-vehicle values by core travel market segment and vehicle type are shown. These are the values that would be used for benefit calculations, in which vehicle hours, instead of person hours, are the unit of measurement calculations. A discounted inventory value is added to the single-unit and combination-unit truck values. These values are calculated from the 2002 Commodity Flow survey tabulations and the 1997 Vehicle Inventory and Use tabulations for the State of Florida, and are based on the value of goods shipped by ton per mile. Occupancies used to calculate the per-vehicle values for personal vehicles were derived from the 2001 National Household Travel Survey. Occupancies for trucks were derived from HERS. For buses, the average occupancy (10.15) was calculated from 2003 National Transit Database for the Miami-Dade Transit Agency.

Table 2.6 Travel Time Value by Travel Purpose and Vehicle Type

2004 Dollars

	Personal Vehicles	Buses	Single Unit Trucks	Combination Unit Trucks
Commute	25%	15%		
Local/Personal	55%	70%		
Visitor/Personal	10%	10%		
On-the-Clock	10%	5%	100%	100%
TTV Per-Person Per Hour	**$6.79**	**$6.36**	**$12.08**	**$12.08**
Average Occupancy	**1.57**	**10.15**	**1.2**	**1.2**
Inventory Cost			**$0.14**	**$0.22**
TTV Per Vehicle Per Hour	**$10.65**	**$64.53**	**$14.64**	**$14.72**

Table 2.7 presents travel time values by roadway functional classification and by vehicle type. To compute these values, travel by core TTV category was distributed over four vehicle types (auto/motorcycle, bus, single-unit truck, and combination unit truck). The TTVs in

Table 2.6 were then weighted by the proportion of travel by vehicle type and functional class, which was derived from an analysis of Florida Department of Transportation (FDOT) District 4's traffic monitoring system.

Table 2.7 Travel Time Value by Roadway Functional Classification and Vehicle Type
2004 Dollars

	Personal Vehicles	Buses	Single-Unit Trucks	Combination-Unit Trucks	Per-Vehicle TTVs
Rural Principal Arterial – Interstate	80.1%	0.6%	2.8%	16.6%	$11.77
Rural Principal Arterial – Other	89.7%	0.4%	2.9%	7.0%	$11.27
Rural Minor Arterial	93.2%	0.2%	2.9%	3.6%	$11.01
Rural Major Collector	88.9%	0.3%	3.7%	7.1%	$11.25
Principal Arterial – Interstate	92.2%	0.6%	2.4%	4.8%	$11.26
Urban Principal Arterial – Other Freeways/Expressways	94.7%	0.5%	2.2%	2.7%	$11.13
Urban Other Principal Arterial	97.1%	0.2%	1.7%	1.0%	$10.87
Urban Minor Arterial	97.8%	0.2%	1.2%	0.8%	$10.84
Urban Collector	95.9%	0.4%	1.6%	2.1%	$11.01
Occupancy	**1.57**	**10.15**	**1.2**	**1.2**	

2.2 TRANSIT USERS

An extensive national and international literature review was conducted to determine the value of travel time to transit users relative to that of automobile and commercial vehicle users. Findings of the literature review are presented in the Appendix A.2.

Existing literature was reviewed to determine TTVs for transit users within the United States and throughout the world. Factors influencing TTVs were identified, and proposed values were established for such factors based on the research conducted. Three geographic levels were used for the purpose of comparison: Southeast Florida, Florida, and United States.

The methodology applied by the accompanying travel time value calculator for application in Southeast Florida transit user benefit analysis is as follows:

- Determine application;
- Determine travel market segments; and
- Determine transit user TTVs.

Full details on the methodology are provided in Appendix C.2.

Table 2.8 below presents travel time value for transit users.

Table 2.8 Travel Time Value for Transit User Cost Analysis (value expressed in 2004$/hr)

	SEFL	FL	US	Bus	Tri-Rail	Metro-Rail
1-Market Segment Travel Time Values						
All Travel Segments	$3.26	$3.08	$3.33	$3.41	$7.92	$3.28
2-Market Segment Travel Time Values						
Personal	$3.17	$2.99	$3.24	$3.37	$7.82	$3.24
On the Clock	$7.57	$7.14	$7.76	$5.48	$12.94	$5.26
3-Market Segment Travel Time Values						
Commuter	$3.78	$3.57	$3.88	$4.04	$9.53	$3.87
All Personal	$2.52	$2.39	$2.58	$2.68	$6.03	$2.58
On the Clock	$7.57	$7.14	$7.76	$5.48	$12.94	$5.26
4-Market Segment Travel Time Values						
Commuter	$3.78	$3.57	$3.88	$4.04	$9.53	$3.87
Personal (Local)	$2.52	$2.38	$2.58	$2.69	$6.35	$2.58
Personal (Visitor)	$2.58	$2.58	$2.58	$2.58	$2.58	$2.58
On the Clock	$7.57	$7.14	$7.76	$5.48	$12.94	$5.26
7-Market Segment Travel Time Values						
Commute Peak Hour	$4.37	$4.12	$4.48	$4.66	$11.00	$4.47
Commute Off-Peak	$3.34	$3.15	$3.42	$3.57	$8.41	$3.42
Local Personal Peak Hour	$2.93	$2.76	$3.00	$3.13	$7.38	$3.00
Local Personal Off-Peak	$2.21	$2.08	$2.26	$2.36	$5.57	$2.26
Local Visitor Peak Hour	$3.00	$3.00	$3.00	$3.00	$3.00	$3.00
Local Visitor Off-Peak	$2.26	$2.26	$2.26	$2.26	$2.26	$2.26
On the Clock (Business)	$7.57	$7.14	$7.76	$5.48	$12.94	$5.26
Waiting/Transfer Time Values						
	$7.57	$7.14	$7.76	$5.48	$12.94	$5.26

2.3 TRAVEL TIME VALUE SURVEY FINDINGS

Survey Purpose

The purpose of the survey was to verify TTVs reflecting local conditions. The principal utility of the survey was to adjust travel time values the consultant team obtains from the literature review and other sources to local conditions, reflecting the input of local travelers. Appendix B presents the survey in details.

Survey Design

The survey encompassed a subset of the stratifications such as different time periods; different types of roadways (arterials, toll ways, freeways); and by mode (highway, transit, non-motorized) for a region covering Miami-Dade, Broward, Palm Beach, Martin, St. Lucie and Indian River counties, and included a limited

number of demographic and travel market segment stratifications depending on the sample size allowed. First, the Southeast Florida value of time telephone survey was administered to a random sampling of 5,000 households in the six-county SEFRTUC region. This pool of households was drawn upon until the target of 200 completed surveys was achieved. To ensure that as large a proportion of the working population as possible was contacted, calls were only made only during the early evening during the week and all day and evening during the weekends. Only 10 percent of all households contacted were not able to complete the survey once the survey got underway. The survey was administered during the time period between December 1, 2004 to December 13, 2004, and January 8, 2005 to January 30, 2005.

The survey instrument consisted of a set of questions on socioeconomic and current trip-making characteristics and a set of stated-preference questions from which the values of time were to be derived. Employed respondents were asked to report the travel time of their latest work trip and to indicate whether, as employees, they had flexibility in the time they reported to work. Both employed and nonworking individuals also were asked to report the travel time of their most recent non-work trip. Using these most recent work and non-work trips as points of reference, the stated-preference survey questions asked respondents whether they would, if they had the choice, continue to make their trip as they do now, or would be willing to pay a toll or tax to save varying amounts of time as given in the survey. The work and non-work sections each presented respondents with four choice experiments. In all, there were 308 usable work trip choice experiments and 762 non-work choice experiments.

Survey Findings

The main findings from the survey are the following:

1. Travel time values for all trips fall in the range of $8.00 to $12.00, which is quite consistent with previous findings from national sources that have been adjusted for use in Southeast Florida.
2. Respondents attach a higher value to work trips than non-work trips ($12.00 versus $8.00, when unweighted or $7.40 and $10.30 when weighted by age distribution in the population).
3. Higher-income respondents have a higher value of time than lower-income residents ($16.70 versus $7.80 unweighted by age distribution, and $11.20 versus $8.70 when weighted by age distribution in the population).
4. These results can be applied to the SEFRTUC study to develop TTV factors that could be used for analyses using high-/low-income travel market segments, or travel market segment stratifications, based on age, trip length, or possibly other stratifications.

Validation of TTVs with Survey Results

To determine whether the travel time values extracted from the literature review were consistent with the values of Southeast Florida travelers, a household interview survey of 200 Southeast Florida residents was conducted in January 2005. The methods, analyses, and findings derived from the survey are described in detail in this section. Using standard market research techniques, travel time values were derived from the survey for the work and non-work travel market segments. Values for travel market segments based on income and age also were estimated, and are shown in Table 2.9. Overall, older individuals were overrepresented in the survey response pool and younger individuals were underrepresented. To compensate for this, the survey responses were weighted by population age group quintile. The weighted and unweighted TTVs are presented in Table 2.9. The weighting produces significant changes in the TTV for households with incomes greater than $40,000. This is because of the disproportionate number of older households with higher incomes who responded to the survey, as compared with the actual proportion of these households that exists in the population. It is expected that the weighted TTVs for respondents 50 years of age or older would drop for the same reason as well.

Table 2.9 Selected Travel Time Values from Analysis of SEFTRUC Survey

	Unweighted	Weighted	TTV4 Per HR From Lit. Review (2004 $)	Adjusted Values
Travel Market Segment 1-Purpose				
Work	$11.92	$10.32	$12.69	N/A
Non-work	$8.32	$7.37	$10.58	N/A
Travel Market Segment 2 – Income				
$40k or greater	$16.67	$11.17	N/A	$11.27
Under $40k	$7.78	$8.72	N/A	$8.79
Travel Market Segment 3 – Age				
50 years old or more	$10.17	N/A	N/A	$11.08
Under 50 years old	$8.33	N/A	N/A.	$9.03

The literature review and the survey-derived TTVs (whether weighted or unweighted) for work trips corresponded very well. All values fall within the $10.00 to $13.00 per hour range. The non-work values from the survey were lower than the ones derived from the literature review, however, amounting to about 40 percent of the wage rate. This is in contrast to the AASHTO "*red book*," which suggests that non-work trips should be valued at 50 percent of the wage rate.

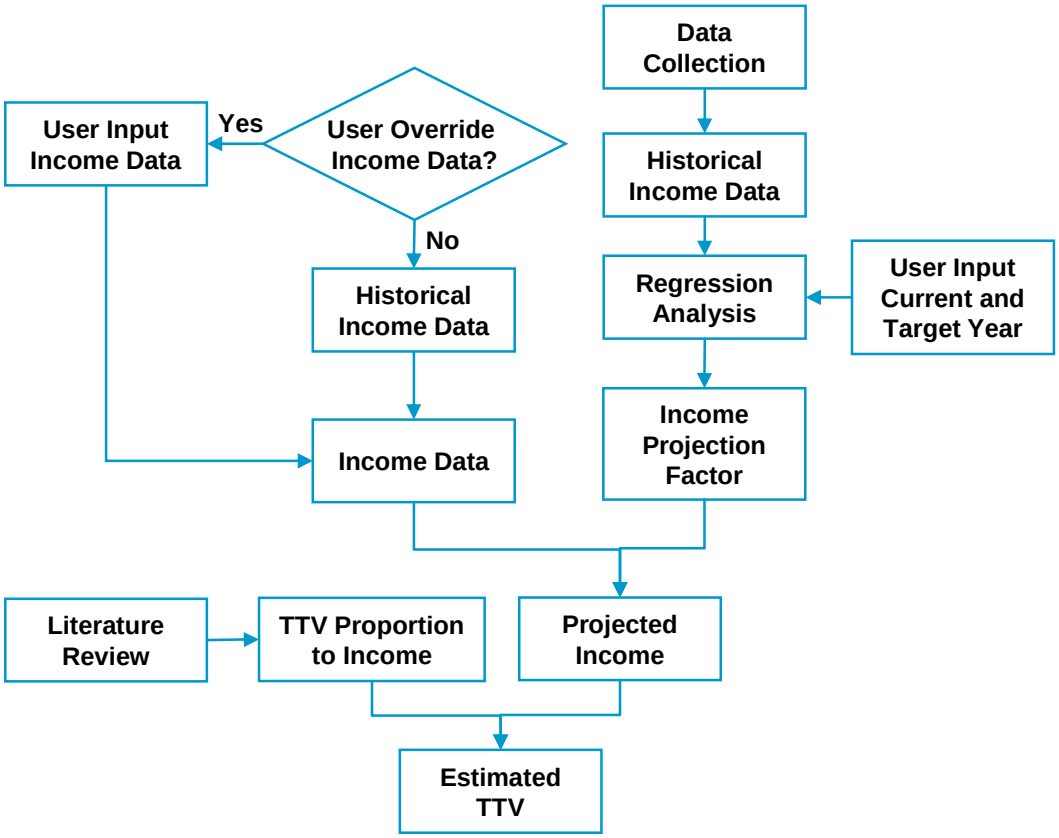
It was recommended retaining the AASHTO "*red book*" values for work and non-work travel. The two sets of results were close enough for planning purposes to leave them as they are from the red book. The income and age-based TTVs were adjusted so that they would produce the same total user costs as the work and non-work trips, since the trip purpose, income, and age-based TTVs all characterize travelers from the same population. To determine this adjustment, the estimated TTVs were simply factored upwards to match the weighted average TTV for workers and non-workers in each subcategory.

2.4 TRAVEL TIME VALUE METHODOLOGY FLOW CHART AND ASSUMPTIONS

The key methodologies applied in the development of Travel Time Value of road users and transit users are similar. Median income of road users and transit users are established based on existing database from agents such as Florida Department of Transportation, U.S. Social Security Administration, and U.S. Census Bureau. An extensive review of literature identified that travel time value is proportional to traveler's income depending on trip time, trip purpose, trip mode, etc. Travel time values were then developed by applying such proportions to median income level.

Historical income data was applied to develop a regression equation to project income level of future years. The regression analysis produced a strong fit of historical income data; therefore it is believed that the projection of future income level is reliable. Users can change target year into any future year and the calculator is able to compute future year income level and apply such income to TTV proportion identified by literature review to estimate future year travel time value. Considering inconsistency and uncertainty of historical income data, as well as unknown economic situation of future years, the calculator allows users to override income data and income projection by providing input boxes and setting up priority rules so that travel time value is estimated based on user input rather than historical data if requested. All default inputs can be easily retracted. Figure 2.1 illustrates the methodology applied for TTV development.

Figure 2.1 Travel Time Value Methodology Flow Chart



Due to limited data availability, assumptions are made to accommodate project needs. Key assumptions of developing travel time values are summarized as below:

- Assume the ratio of median transit user wage to overall median wage does not change among different geographic level (regional, state-wide, and national-wide);
- Assume the ratio of median income to average income is constant throughout years;
- Assume travel market segmentations are the same for different geographic level;
- Assume travel time value market segmentations are the same for different geographic level;
- Assume travel time value proportion to income level does not change throughout years; and
- Assume transit user proportion to income level does not change among different modes.

3.0 Vehicle Operating Costs

3.1 AUTOMOBILES

Introduction

Based on the review of highway user benefit analysis procedures presented in the literature review, a set of vehicle operating costs was developed. These costs are built up from the essential components of Vehicle Operating Costs (VOC) that are relevant for Southeast Florida and are stratified by classes of vehicles. The study area included Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties in FDOT District 4 and Miami-Dade County in District 6.

Eight major VOC components were estimated for the State of Florida and the Southeast Florida region. Additionally, four cost factors were identified as relevant to the study area. VOC components and cost factors (in brackets) include the following:

- Fuel (function of speed, and stop-and-go conditions);
- Fuel taxes;
- Maintenance and repairs (function of mileage, and stop-and-go conditions);
- Tires (function of mileage, and stop-and-go conditions);
- Depreciation (function of mileage and vehicle age);
- Finance charges;
- Insurance; and
- Licensing and registration.

Data were obtained from public agencies such as AASHTO, the U.S. Environmental Protection Agency, and the U.S. Census Bureau, and private agencies such as the American Automobile Association, Runzheimer International, the Black Book, the Kelly Blue Book, and Intellichoice. Details of data and literature are shown in Appendix D.1.

Results

VOC estimates in Florida in general and in the southeast region in particular are presented in this section (Table 3.1 and Table 3.2). A comparison of difference between statewide and local costs also is presented (Table 3.3).

Table 3.1 Generalized Vehicle Operating Cost – Southeast Florida

2004 Dollars

Vehicle Class	Vehicle Size		
	Small	Medium	Large
Attributes			
Vehicle Lifespan (Years)	9	9	9
Speed (mph)	38	38	38
City/Highway Condition	City	City	City
Mileage per Year	12,000	12,000	12,000
Cost Per Year			
Fuel Cost	$888	$1,160	$1,336
Fuel Tax	$211	$275	$317
Maintenance and Repairs	$259	$259	$324
Tires	$117	$119	$151
Insurance	$1,236	$1,078	$1,038
Depreciation	$1,534	$1,632	$2,515
Finance Charges	$450	$479	$739
License and Registration	$46	$51	$61
Annual Total Vehicle Operating Cost	**$4,741**	**$5,054**	**$6,481**

Table 3.2 Generalized Vehicle Operating Cost – Florida Statewide

2004 Dollars

Vehicle Class	Vehicle Size		
	Small	Medium	Large
Attributes			
Vehicle Lifespan (Years)	9	9	9
Speed (mph)	38	38	38
City/Highway Condition	City	City	City
Mileage per Year	12,000	12,000	12,000
Cost Per Year			
Fuel Cost	$888	$1,160	$1,160
Fuel Tax	$198	$275	$259
Maintenance and Repairs	$259	$259	$259
Tires	$117	$119	$119
Insurance	$1,172	$1,078	$1,020
Depreciation	$1,534	$1,632	$1,632
Finance Charges	$452	$479	$481
License and Registration	$46	$51	$51
Annual Total Vehicle Operating Cost	**$4,666**	**$4,981**	**$6,412**

Source: Cambridge Systematics, Inc.

Table 3.3 Regional to Statewide VOC Ratios

Percent

Vehicle Class	Vehicle Size		
	Small	Medium	Large
Fuel Cost	0.00%	0.00%	0.00%
Fuel Tax	6.26%	6.26%	6.26%
Maintenance and Repairs	0.00%	0.00%	0.00%
Tires	0.00%	0.00%	0.00%
Insurance	5.42%	5.67%	5.34%
Depreciation	0.00%	0.00%	0.00%
Finance Charges	-0.30%	-0.30%	-0.30%
License and Registration	0.00%	0.00%	0.00%
Total Vehicle Operating Cost	1.60%	1.46%	1.08%

Source: Cambridge Systematics, Inc.

Generalized vehicle operating cost estimates for District 4 and Miami-Dade County and Florida in general also were developed. These costs were developed by weighting vehicle operating costs for small-, medium-, and large-size vehicles by their respective market shares in Southeast Florida. As noted in Section 3.0, information on vehicle shares for small, medium, and large vehicles is based on input from the Florida Department of Motor Vehicles and the FDOT District 4 Office of Systems Planning. Ratios of vehicle operating costs by vehicle type to generalized vehicle operating costs for small-, medium-, and large-size vehicles were then computed to compare average costs to costs by vehicle type (Table 3.4 and Table 3.5). These ratios are particularly useful in applications where only generalized vehicle operating cost estimates are available, and there is a need for vehicle operating costs by vehicle type.

Table 3.4 Ratio of Vehicle Operating Costs by Vehicle Type to Average Vehicle Operating Costs for All Personal Vehicle Types in Southeast Florida

Cost Components	Southeast Florida (2004 Dollars Per Mile)	Ratio		
		Compact Car	Midsize Car	Large Car
Fuel Cost	$0.10	0.07	0.10	0.11
Fuel Tax	$0.02	0.02	0.02	0.03
Maintenance and Repairs	$0.02	0.02	0.02	0.03
Tires	$0.01	0.01	0.01	0.01
Insurance	$0.09	0.10	0.09	0.09
Depreciation	$0.16	0.13	0.14	0.21
Finance Charges	$0.05	0.04	0.04	0.06
License and Registration	$0.00	0.00	0.00	0.01
Totals Vehicle Operating Cost	**$0.46**	**0.40**	**0.42**	**0.54**
Annual Vehicle Operating Cost (dollars per year)	**$5,497**	**$4,741**	**$5,054**	**$6,481**

Source: Cambridge Systematics, Inc.

Table 3.5 Ratio of Vehicle Operating Costs by Vehicle Type to Average Vehicle Operating Costs for All Personal Vehicle Types in Florida

Cost Components	Florida (2004 Dollars Per Mile)	Ratio		
		Compact Car	Midsize Car	Large Car
Fuel Cost	$0.10	0.07	0.10	0.11
Fuel Tax	$0.02	0.02	0.02	0.02
Maintenance and Repairs	$0.02	0.02	0.02	0.03
Tires	$0.01	0.01	0.01	0.01
Insurance	$0.09	0.10	0.08	0.08
Depreciation	$0.16	0.13	0.14	0.21
Finance Charges	$0.05	0.04	0.04	0.06
License and Registration	$0.00	0.00	0.00	0.01
Totals Vehicle Operating Cost	**$0.46**	**0.39**	**0.42**	**0.53**
Annual Vehicle Operating Cost (dollars per year)	**$5,509**	**$4,666**	**$4,981**	**$6,412**

Source: Cambridge Systematics, Inc.

Discussion

Overall, vehicle operating costs in Southeast Florida are marginally lower ($5,497 per year) than average statewide figures ($5,509 per year), as indicated in

Table 3.4 and Table 3.5. Finance charges and depreciation are the leading causes of the difference. This is primarily due to the larger share of large vehicles (37.0 percent) statewide compared to a 30.8 percent share of large vehicles only in Southeast Florida, where depreciations costs and finance charges are usually the highest.

Nonetheless, a comparison by vehicle type at the state and regional level indicates that vehicle operating costs are slightly higher in the six Southeast Florida counties. As shown in Table 3.3, vehicle operating costs for small-, medium-, and large-size vehicles in Florida's District 4 and Miami Dade County are leading the State by 1.60 percent, 1.46 percent, and 1.08 percent, respectively. Fuel tax and insurance costs are the cause of the difference with District 4 and Miami-Dade County leading Florida by 5.56 percent for medium-sized vehicles, 7.69 percent for small-sized vehicles, and 10.00 percent for large-sized vehicles for insurance cost; and by 5.15 percent for small-sized vehicles and 5.95 percent and 6.17 percent for medium-sized and large-sized vehicles, respectively, for fuel tax costs. Results for the remaining components are approximately identical in both regions.

The findings also indicate that total vehicle costs are size-dependent as initially expected. The overall cost of operating and maintaining are:

- Small-sized vehicles are 14 percent below average vehicle operating costs in Southeast Florida and 15 percent below vehicle operating costs throughout the State;
- Medium-sized vehicles are 8 percent below average vehicle operating costs in Southeast Florida and 10 percent below vehicle operating costs throughout the State; and
- Large-sized vehicles are 18 percent above average vehicle operating costs in Southeast Florida and 16 percent above vehicle operating costs throughout Florida.

Insurance costs are the highest for small-sized vehicles and the lowest for large-sized vehicles. Fuel costs and finance charges are the highest for large-sized vehicles and the lowest for small-sized cars.

Vehicle depreciations accounted for the largest portion of vehicle operating costs, ranging from 32.4 percent for small-sized cars to roughly 38.8 percent for large-sized vehicles in Southeast Florida, and from 32.9percent for small-sized cars to 39.2 percent for large-sized vehicles across the State. Insurance, another major cost factor, accounted for about 16.0 percent of total costs for large-sized cars and 26.1 percent for small-sized cars in Southeast Florida. On average, tire change and maintenance and repair costs accounted for 7.4 percent of overall costs for large-sized cars and up to 7.6 percent for small-sized vehicles throughout the State.

3.2 COMMERCIAL VEHICLES

VOCs for Generalized Traveling Conditions

Generalized travel conditions, in terms of vehicle mix, vehicle age, vehicle-miles traveled, stop-and-go conditions, and speed were developed to generate VOCs. A spreadsheet calculator was developed separately to estimate generalized VOCs for various scenarios based on the following factors:

- Annual average mileage;
- Average vehicle lifespan;
- Stop-and-go scenarios: city or highway conditions;
- Average speed scenarios; and
- Tire change frequency scenarios.

These data were collection from public agencies such as AASHTO, FHWA, and MNDOT. Details are available in Appendix D.2.

For the purpose of this effort, average vehicle operating cost estimates were developed based on the following generalized traveling conditions:

- **Vehicle Mix –** According to findings from the Florida Department of Highway Safety and Motor Vehicles the automobile (including Sports Utility Vehicles)/ commercial vehicle mix in the State consists of small- (15.2 percent), medium- (45.5 percent), large-sized vehicles (27.0 percent); single-unit trucks (3.8 percent); and combination-unit trucks (8.5 percent). Findings from Florida's District 4 traffic monitoring system indicate that small-, medium-, and large-sized vehicles account for 16.8 percent, 42.0 percent, and 34.5 percent of the total numbers of automobiles and commercial vehicles in Southeast Florida, respectively (District 4 and Miami-Dade County), leaving single- and combination-unit vehicles with 2.2 percent and 4.5 percent of total shares, respectively.
- **Vehicle Lifespan –** The average vehicle lifespan is five years for single- and combination-unit trucks. This average is based on findings from Mark Berwick's Truck Costs for Owner/Operators study.
- **Vehicle Miles Traveled –** Also according to findings from the Truck Costs for Owner/Operators study, the average yearly travel distance for single- and combination-unit trucks is 100,000 miles. This yearly travel distance was used to compute commercial vehicles operating costs per mile driven.
- **Stop-and-Go Conditions –** South Florida is in a predominantly urban setting; it was therefore assumed that commercial VOC estimates should reflect city traveling conditions majority of times. The U.S. Environmental Protection Agency (EPA) sources suggest that driving under stop-and-go conditions (also known as city conditions, where level of service (LOS) E and

F are usually observed) leads to about 35 percent more fuel consumption. Under such conditions, yearly fuel costs and taxes were adjusted by a factor of 1.35.

- **Speed –** The average speed was set to 45 mph according to findings from the Truck Costs for Owner/Operators Study.

Operating costs for single-and combination-unit trucks for Florida and the southeast region of the State are presented in Table 3.6 and Table 3.7.

Results indicate that single- and combination-unit trucks operating costs are slightly higher in southeast Florida compared to the rest of the State. Vehicle operating costs are leading the State by 0.73 percent for single-unit trucks and 0.56 percent for combination-unit trucks. This is primarily due to higher fuel taxes (6.26 percent) for both types of commercial vehicles and insurance cost for single-unit trucks (Table 3.8).

Table 3.6 Generalized Vehicle Operating Cost – Southeast Florida

2004 Dollars

	Truck	
Vehicle Class	**Single-Unit**	**Combination-Unit**
Attributes		
Vehicle Lifespan (years)	5	5
Speed (mph)	45	45
City/Highway Condition	City	City
Mileage per Year	100,000	100,000
Cost Per Year		
Fuel Cost*	$0.227	$0.305
Fuel Tax	$0.054	$0.072
Maintenance and Repairs*	$0.064	$0.085
Tires*	$0.031	$0.040
Insurance	$0.013	$0.065
Depreciation	$0.086	$0.107
Finance Charges	$0.013	$0.036
License and Registration	$0.001	$0.001
Total Vehicle Operating Cost	**$0.488**	**$0.710**
User Benefit Recommended Value	**$0.341**	**$0.467**
Annual Total Vehicle Operating Cost	**$48,789**	**$71,047**

Source: Cambridge Systematics, Inc.
Items marked with "*" included in "User Benefit Recommended Value."
Note: Percentages may not add to 100 due to rounding.

Table 3.7 Generalized Vehicle Operating Cost – Florida

2004 Dollars

Vehicle Class	Truck	
	Single-Unit	Combination-Unit
Attributes		
Vehicle Lifespan (years)	5	5
Speed (mph)	45	45
City/Highway Condition	City	City
Mileage Per Year	100,000	100,000
Cost Per Mile		
Fuel Cost*	$0.227	$0.305
Fuel Tax	$0.051	$0.068
Maintenance and Repairs*	$0.064	$0.085
Tires*	$0.031	$0.040
Insurance	$0.012	$0.065
Depreciation	$0.086	$0.107
Finance Charges	$0.013	$0.036
License and Registration	$0.001	$0.001
Total Vehicle Operating Cost	**$0.484**	**$0.707**
User Benefit Recommended Value	**$0.341**	**$0.467**
Annual Total Vehicle Operating Cost	**$48,435**	**$70,652**

Source: Cambridge Systematics, Inc.
Items marked with "*" included in "User Benefit Recommended Value."
Note: Percentages may not add to 100 due to rounding.

Table 3.8 SE Florida Region to Statewide VOC Ratios

Percent Difference

Vehicle Class	Truck	
	Single-Unit	Combination-Unit
Fuel Cost	0.00%	0.00%
Fuel Tax	6.26%	6.26%
Maintenance and Repairs	0.00%	0.00%
Tires	0.00%	0.00%
Insurance	3.21%	-0.30%
Depreciation	0.00%	0.00%
Finance Charges	-0.30%	-0.30%
License and Registration	0.00%	0.00%
Total Vehicle Operating Cost	0.73%	0.56%

Source: Cambridge Systematics, Inc.

3.3 TRANSIT VEHICLES

Transit vehicle operating costs were determined from National Transit Database (NTD) data. Each year, transit agencies of the nation report to NTD their data such as operating costs, service provided, and funding. Such data can be utilized directly toward estimating transit vehicle operating costs. Therefore, literature review is not necessary for this study purpose.

Research was undertaken to ascertain specific figures for operational expenses of public transit across various technologies in use for Southeast Florida, the State of Florida, and the United States, as a whole. The National Transit Database (NTD) was the primary source of data for this work. Individual costs associated with operating public transit are provided for the study area of Southeast Florida, the State, as well as the nation.

The research shows that, while South Florida spends more on Motorized Bus than Florida does on the statewide level, the operational expenses are relatively low in most categories, as compared to the national average. Operational expenses for Demand Response services are typically lower than the national average.

Ratios for cost values of different technologies for the local, state, and national areas are shown in Table 3.9. Differences in cost per trip values are frequently due to the density of the area and the propensity to use public transit. Differences in cost per mile values are a partial result of the cost of doing business in a particular area, taking into account fuel costs and distances traveled.

Table 3.9 Transit Cost Metrics Converted to Ratios

	Motorized Bus	Commuter Rail	Demand Response
Cost/Passenger Trip			
National	1.00	2.79	8.70
State	1.14	4.21	7.13
Local	1.14	4.21	8.14
Cost/Revenue Mile			
National	2.97	3.75	1.35
State	2.14	4.21	1.25
Local	2.56	4.21	1.00
Cost/Revenue Hour			
National	2.47	7.83	1.34
State	1.99	9.86	1.19
Local	2.27	9.86	1.00

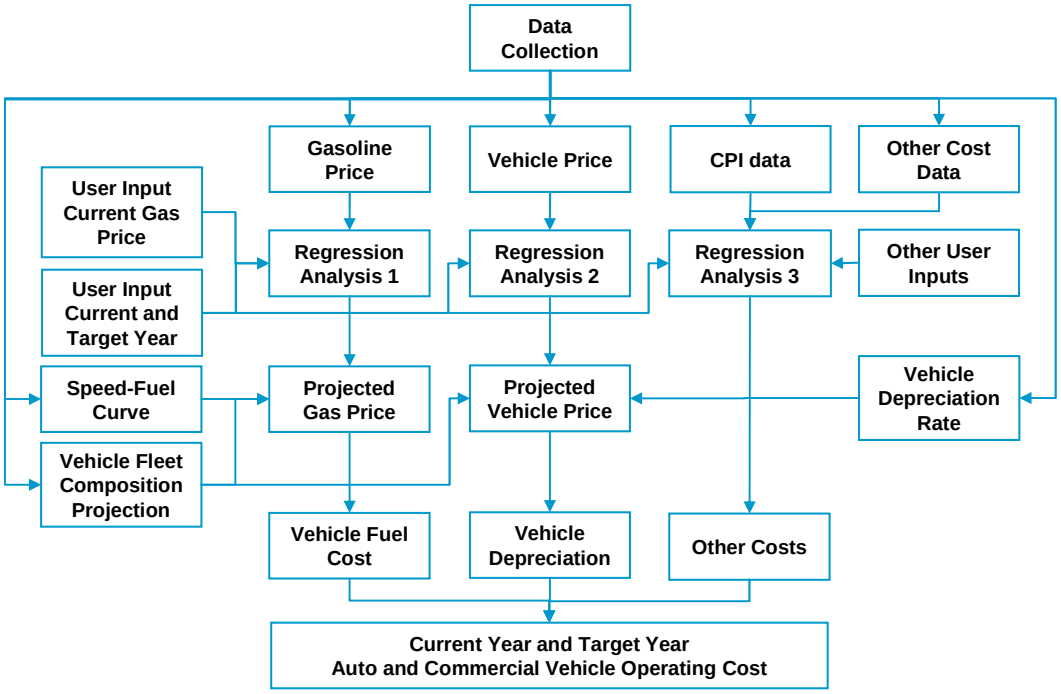
Average operational expenses across all technologies in the study area are higher than the averages for the State of Florida, as well as for that of the nation. A partial explanation for the study area's higher costs may include the following:

- Southeast Florida, while highly urbanized, is also a large geographic area with relatively dispersed population and employment centers, requiring a larger network of transit facilities to serve the activity centers.
- The Study Area's population includes a large proportion of seniors and lower-income residents. This service population characteristic influences system configuration and vehicle technology. Local systems are bus-oriented and costlier than the more efficient commuter and light-rail technologies.

3.4 VEHICLE OPERATING COST METHODOLOGY FLOW CHARTS AND ASSUMPTIONS

Methodologies applied in the development of the two vehicle operating cost calculators are quite different. For auto and commercial, vehicle operating cost was broken down into finite cost components. Data collection efforts were taken for each component. These components were then combined to obtain total annual vehicle operating costs, and per mile costs by dividing total cost by annual mileages. Major cost components that vary throughout years include gas price and vehicle depreciation. Historical gasoline price data was collected and a regression analysis was performed in order to project future gasoline price. In addition, a speed vs. fuel efficiency curve from California Life-Cycle Benefit/Cost Analysis Model (Cal B/C model) was used to vehicle fuel cost with average travel speed. Vehicle depreciation is simplified into a linear rate. Historical vehicle price data was collected and a regression for vehicle price was developed to project future vehicle price, which was combined with vehicle depreciation rate to obtain vehicle depreciation costs. Other cost components, such as tire, insurance, maintenance, and repair, were developed by applying historical or projected Consumer Price Index (CPI) growth rate into real-world data collected for this study. Figure 3-1 shows the methodology flow chart of auto and commercial vehicle operating costs.

Figure 3.1 Auto and Commercial Vehicle Operating Costs Methodology Flow Chart



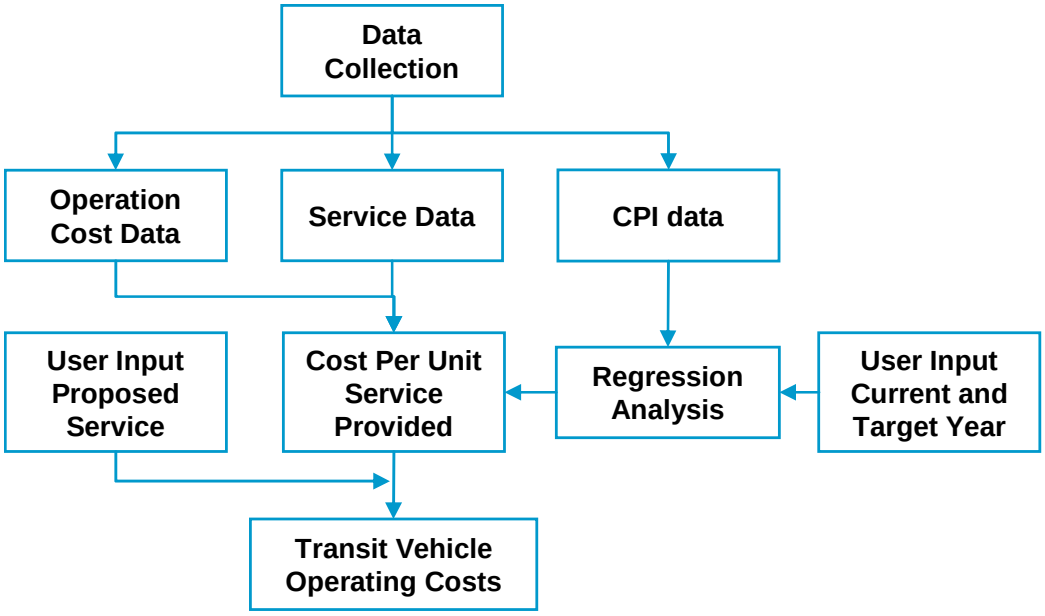
The methodology for developing transit VOC is quite straight-forward. Every year, more than 600 transit agencies across the U.S. report their operation statistics to the National Transit Database (NTD). Such information includes[3]:

- Operational characteristics - vehicle revenue hours and miles, unlinked passenger trips and passenger miles, etc.
- Service characteristics - service reliability and safety, etc.
- Capital revenues and assets - sources and uses of capital, fleet size and age, and fixed guideways, etc.
- Financial operating statistics - Revenues, Federal, state and local funding, costs, etc.

In recent years the NTD has grown to include safety, security, and rural transportation data. These data together with inflation rates developed from CPI were used to obtain average unit transit operating cost (cost per passenger, cost per revenue mile, and cost per revenue hour). Figure 3.2 presents the methodology flow chart of transit vehicle operating costs.

[3] http://www.ntdprogram.gov

Figure 3.2 Transit Vehicle Operating Costs Methodology Flow Chart



Due to limited data availability, assumptions are made to accommodate project needs. Key assumptions of developing vehicle operating costs include:

- Assume vehicle depreciation is linear to its mileage; and
- Assume the life span of personal vehicles is 150,000 miles, 500,000 miles for commercial vehicles.

4.0 Road and Transit User Cost Calculator

As part of the effort to develop localized road user costs in Southeast Florida, Cambridge Systematics developed a consolidated road and transit user cost calculator to estimate VOCs and TTVs for various scenarios based on a range of factors. This section describes and provides guidance and direction on how to use the RTUC calculator.

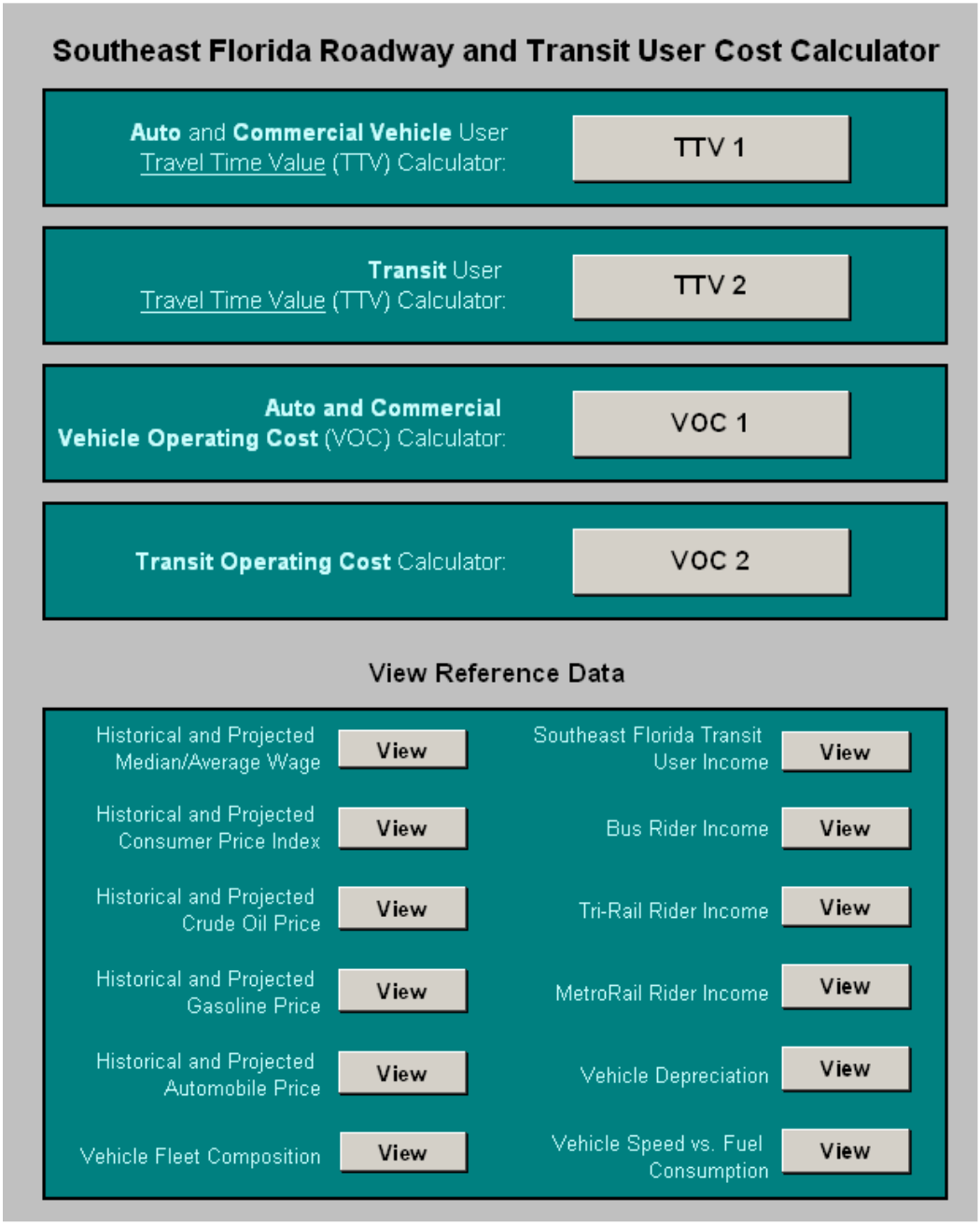
As indicated in the Appendices A through E, both the methodology and cost factors were based on an extensive review of academic and practitioner literature on user benefit analysis, from consideration of the data needed for developing localized values, as well as input from FDOT District 4 Systems Planning staff.

The calculator was developed using Microsoft Excel 2002, SP3 and is provided as a separate stand-alone file to this document. It is recommended that users set screen resolution into 1280x1024, so that horizontal page extents are fully visible without the requirement of zooming in or out. In addition, users should keep these worksheets protected since pages contain macros and formulas. **It is very important that users should keep a backup copy of the calculator so that default inputs and formulas are retractable.** Figure 4.1 shows a screenshot of the calculator's main operation panel. The calculator elements are as follows:

- Travel time values – automobiles and commercial vehicle users
- Travel time values – transit users
- Vehicle operating costs – automobiles and commercial vehicles
- Vehicle operating costs – transit vehicles
- Reference Data
    - Historical and projected median/average wage
    - Historical and projected Consumer Price Index
    - Historical and projected crude oil price
    - Historical and projected gasoline price
    - Historical and projected automobile price
    - Vehicle fleet composition
    - Southeast Florida transit user income
    - Bus rider income
    - Tri-Rail rider income

- MetroRail rider income
- Vehicle depreciation
- Vehicle speed vs. fuel consumption

Figure 4.1 SEFTRUC Calculator Main Panel



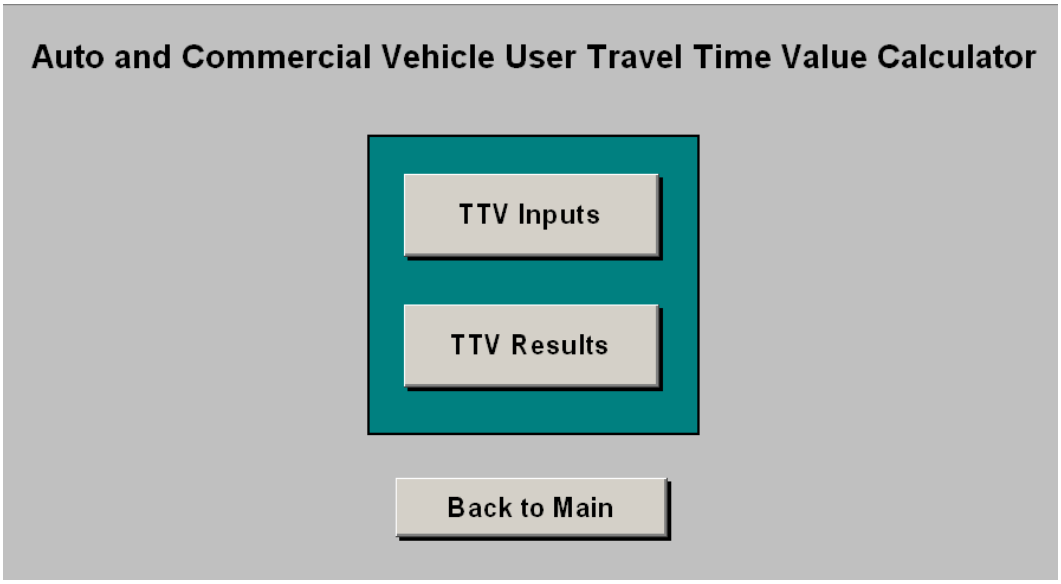
The following describes these four modules and the reference data of the calculator.

4.1 TRAVEL TIME VALUES

Automobile and Commercial Vehicle Users

The auto and commercial vehicle user travel time value calculator includes two components: "TTV Inputs" and "TTV Results", as shown in Figure 4.2. Methodologies applied in the development of this calculator are described in Appendix C.1.

Figure 4.2 Auto and Commercial Vehicle User TTV Calculator Panel



The "TTV Inputs" allows users to determine the application; travel market segment (commuter, local personal, local visitor, and on the clock); distribution by vehicle type (personal vehicles, buses, single-unit trucks, and combination-unit trucks); wages by travel market segment; travel time values by trip purpose; vehicle type; time period; and inflation factors. Cells hatched by light blue color are unlocked and left changeable. The currently recommended input data are based on extensive research conducted in the first two phases of this ongoing road user costs effort, as specified in Appendix A.1. Users may elect to update these input data to calculate more current and hence accurate travel time values. Users are allowed to change the target year of TTV. The calculator will automatically update the TTV into the selected year by applying a relative wage factor.

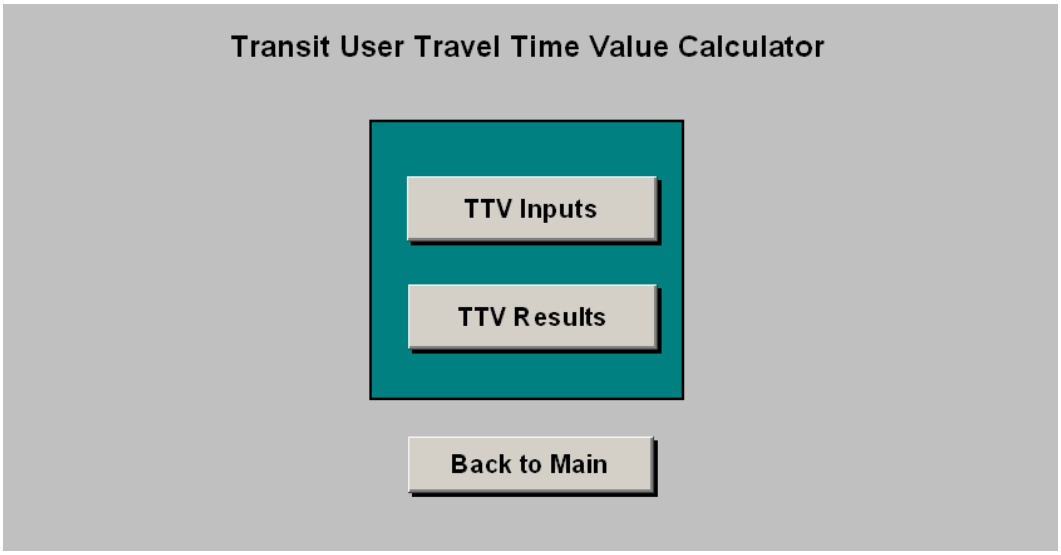
The other component, namely "TTV Results", should ideally be password-protected to ensure that formulas and other fixed assumptions are not erased or altered by accident. Travel time values in Florida and the southeast region for year 2004 and 2030 are computed and presented in this output worksheet.

A "Back To…" button is provided on each of the worksheet, which allows users to go back to the previous level of the calculator tool.

Transit Users

Similarly, as shown in Figure 4.3, the transit user travel time value calculator also includes two components: "TTV Inputs" and "TTV Results". "TTV Inputs", directs users to detail inputs. The format and style of this worksheet is the same as the one for auto and commercial vehicle users. Blue cells are editable. The currently recommended input data are based on extensive research conducted in the first two phases of this ongoing transit user costs effort, and are provided in Appendix A.2. Sources of default input applied in the calculator are provided by the end of each input table. Users may elect to update these input data to calculate more current and hence accurate travel time values of transit users.

Figure 4.3 Transit User TTV Calculator Panel



"TTV Results" provides side by side comparison of these travel time values for Southeast Florida, Florida, and national-wide level. In addition, by using survey results conducted for Southeast Florida, the calculator provides TTV for bus, Tri-Rail, and MetroRail riders. This output page also is protected for its formulas and is automatically updated. Users can unprotect the sheet if trying to copy the outputs. Methodologies applied in this calculator are described in Appendix C.2.

4.2 VEHICLE OPERATING COSTS

Automobile and Commercial Vehicle Users

The calculator estimates generalized vehicle operating costs for various scenarios based on the following input factors whose default values and their sources are available from a number of public and private agencies, and are provided in the calculator:

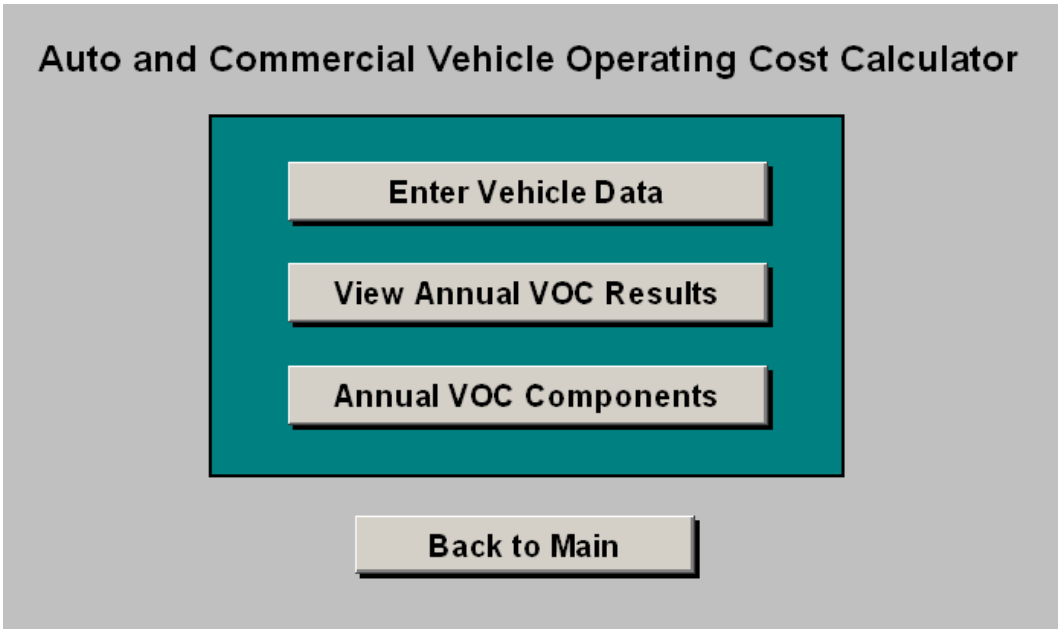
- Vehicle mix consisting of small, medium, and large cars; single-unit trucks; and combination unity-trucks.
- Annual average mileage.
- Average vehicle lifespan.
- Stop-and-go scenarios: city or highway conditions.
- Average speed scenarios.
- Tires change frequency scenarios.
- Tires change costs per job.
- Oil change frequency scenarios.
- Oil change costs per job.
- Maintenance and repairs frequency scenarios.
- Maintenance and repairs costs per job.
- Fuel costs.
- Fuel taxes.
- Fuel economy.
- License and registration costs.
- Sales taxes.
- Finance rates and charges.
- Vehicle life span.
- Annual insurance costs.

The existing proposed input values are based on extensive research conducted in 2004, as indicated in Appendix D.1 and Appendix D.2. However, users are recommended to review and update the 'Input Vehicle Data' worksheet to account for inflation, technological advancements that may affect vehicle performance, and other potential changes to highway travel costs.

Figure 4.4 shows a screenshot of the calculator's operation panel. Changes to the "Input Vehicle Data" spreadsheet will affect the 'output' vehicle operating costs worksheets, "View Annual VOC Results", where 2004 per mile vehicle operating costs by vehicle type, for Southeast Florida and the State of Florida, are presented. It is recommended that the result worksheet remain password-

protected to ensure that output data, which are tied to specific formulas, are not accidentally deleted or changed.

Figure 4.4 Auto and Commercial VOC Calculator Panel



The "Annual VOC Components" page includes the following components:

- Fuel Costs – To compute fuel costs per mile and by vehicle type;
- Fuel Tax – To compute combined per mile Federal, State, and local fuel taxes by vehicle type.
- Tires – To compute per mile costs of replacing four tires.
- Maintenance and Repairs – To compute the combined per mile costs of an oil and filter job every 5,000 miles; an overall vehicle tune-up at 30,000 miles; and an overall 60,000 miles vehicle check-up.
- Depreciation – To compute the per mile cost of age and mileage based depreciation by vehicle type.
- Finance Charge– To compute the per mile cost of owing a vehicle.
- Insurance – To compute per mile cost of insurance by vehicle type.
- License and Registration – To compute the per mile cost of vehicle registration and new license issuance by vehicle type.

Ideally, the eight worksheets should also be protected, to ensure that formulas are not changed or deleted by error. All necessary changes to more accurately reflect inflation, other transportation cost increases (or decreases in the case of technological advancements that may positively affect fuel efficiency for example), and other traveling conditions such as speed variation and miles

driven per year, should be limited to "Enter Vehicle Data". Detail methodologies applied in building the calculator are documented in Appendix E.1 and Appendix E.2.

Transit Vehicles

The fourth module estimates generalized transit vehicle operating costs for various scenarios as shown in Figure 4.5. Button "Enter Transit Scenario Data" leads users to data input pages for different transit modes, as shown in Figure 4.6, bus, demand response, commuter rail, and light rail. Click the corresponding button to go to the input page. In the four input pages, blue cells are for users to input data that may be more up to date than default numbers. Each transit input page is divided into two blocks.

Figure 4.5 Transit VOC Calculator Operation Panel

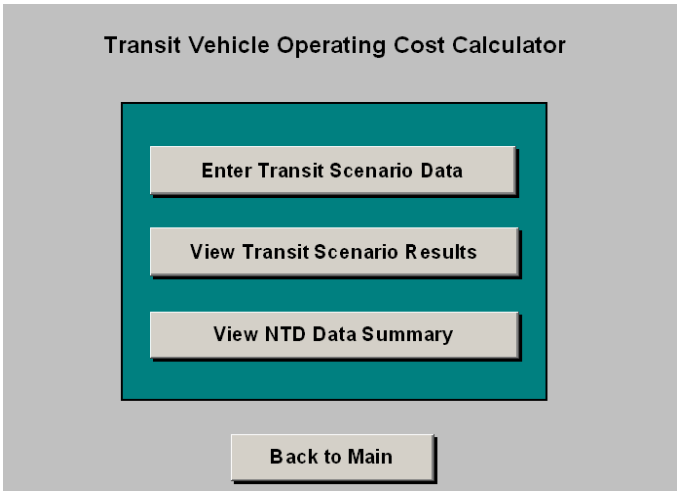
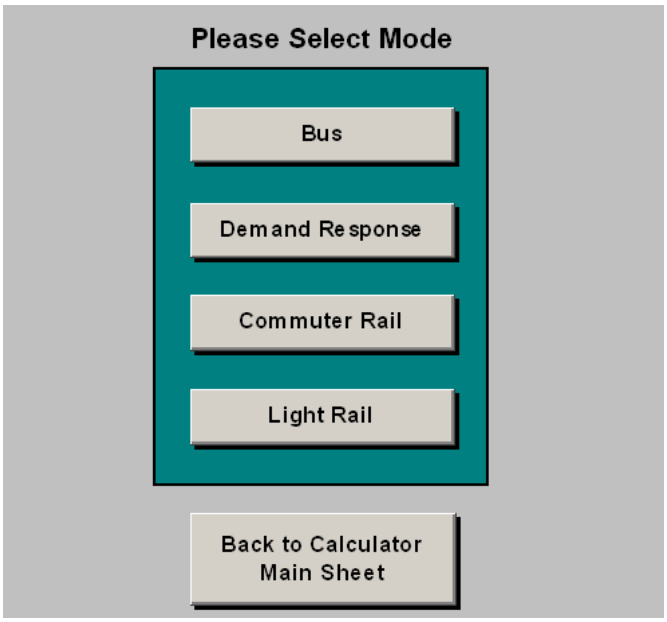


Figure 4.6 Mode Selection Window of Transit VOC Calculator



In the first block, users are asked to enter service data for each proposed transit route. Total annual revenue miles are then calculated according to service input. In the second block, users will enter transit expense data. There are three entering options: estimated expense per revenue mile, estimated percent change, and estimated annual expense. Users will enter the best available data for each of the expense item or category. If data is not available for an expense item or category, the calculator will use the default number indicated in the dark grey cell.

The default values are based on 2006 expenses reported by transit agencies throughout the country to the National Transit Database (NTD), and were deflated into 2004 dollars. However, users are recommended to review and update worksheets of "Bus," "Demand Response," "Commuter Rail," and "Light Rail" to account for inflation; technological advancements that may affect vehicle performance; and other potential changes to travel costs. In some instances, users may have two or more data entries for an expense item or category. The calculator prioritizes these inputs in the following manner: "NEW ESTIMATED EXPENSE" is higher than "ESTIMATED PERCENT CHANGE," which is in turn higher than "TOTAL ROUTE ANNUAL EXPENSE." Users can reset the current input page by clicking the clear input button. After finishing one transit mode, click "Back" button to continue inputting other interested transit modes. After finishing all the inputs, click "Back to Calculator Main Sheet" in worksheet "SelectMode" to navigate to the transit VOC calculator main page for further actions.

Button "View Transit Scenario Results" directs users to the output page. Total annual revenue miles, estimated total annual operating cost, and unit operating cost (in dollars per revenue mile) for all four transit modes are provided in this

worksheet. Again, cells in this worksheet contain formulas. Therefore, users are not recommended to change cell contents. Click "Back to Main" to return to sheet "Main."

Button "View NTD Data Summary" brings users to the page that summarizes transit VOC data based on the following input variables from 2006 National Transit Database (NTD):

- Operators' wage;
- Other salaries and wages;
- Fringe benefits;
- Services;
- Fuel and lube;
- Tires and other;
- Others materials and supplies;
- Utilities;
- Casualty and liability;
- Tax;
- In report purchased transportation;
- Separate report purchased transportation;
- Miscellaneous expense;
- Expense transfer; and
- ADA-related expense.

The procedures and tools used during the extraction of data and building of this calculator have been introduced in Appendix E.3. Default values used for input sheets came from the NTD summary. It is recommended that the NTD summary sheet to be updated annually, upon the release of the new year's NTD. Appendix E.4 introduces and summarizes operating costs of existing transit technologies in Southeast Florida region. Appendix E.5 further reviews the national-wide operation cost of the region's proposed transit technologies.