

FSUTMS NEW STANDARDS AND ENHANCEMENTS – A USER ORIENTED APPROACH

A FLORIDA MODEL TASK FORCE WHITE PAPER



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Introduction

For more than two decades, the TRANPLAN based Florida Standard Urban Transportation Model Structure (FSUTMS), or the Florida Standard Model, has played an important role in the transportation engineering and planning activities in the State of Florida. The standardization of the models has established a consistent and uniform modeling practice throughout the state that has benefited both model developers and model users alike. The modeling framework, procedures, and techniques developed over the years have become an integral set of analytical tools for the state and local government agencies to analyze and plan for current and future transportation needs. The Florida Model Task Force (MTF) is committed to the standardization process that continues to improve and enhance the FSUTMS model.

With the advancement of computing technology and increasing demand for travel forecasting models to evaluate new transportation polices and strategies, it has become obvious that the DOS command-line based FSUTMS/TRANPLAN system has fallen behind the state of the art. There is an urgent need to take advantage of the expanded computing power and storage capabilities and build upon past successes to develop a better and more effective transportation modeling system.

In response to the challenges faced by the modeling community, the Florida Model Task Force decided to adopt Cube Voyager as the main modeling engine for FSUTMS. The adoption of Cube Voyager provides an excellent opportunity to review the current modeling system and identify areas where improvements are needed. The new features and algorithms offered by Cube Voyager now make it possible to expand the data handling and modeling capabilities previously limited by computer hardware and DOS program restrictions.

In order to facilitate a smooth transition to the new FSUTMS/CUBE, the Florida Model Task Force wishes to define a series of new standards and enhancements that will help ensure consistency in the transportation modeling process in Florida. This document serves as a white paper to identify the various candidate items for which standards and enhancements may be defined and implemented within a reasonable time frame. The Model Task Force understands that models need to be technically sound to be useful, it is equally important that models need to be user-friendly and results easy to interpret. The development of the new standards will attempt to a balance the technical usability (from a model developer's perspective) with performance usability (from a model users' perspective).

The Model Task Force recognizes that the modeling community is still in the transition period. Many people are just beginning to experiment with or explore the new software system; new findings and recommendations will continually be

brought up. This document will be reviewed on a continuing basis and modified when necessary.

The white paper considers the following items for the development of new standards and enhancements:

- User Interface
- Directory Structure
- File Naming Convention
- Input/Output Files and Database Field Names
- Default Model Parameters/Coefficients
- Updated Network Coding Standards
- Model Structure and Applications
- Standard Mapping Templates
- Standard Report

User Interface

The Model Task Force has decided to develop a user interface within FSUTMS/CUBE that is similar to the FSUTMS/TRANPLAN Launcher. The intent is to provide a standard FSUTMS front-end from which users can access specific geographic models that they wish to run.

The user interface for FSUTMS/CUBE is comprised of two levels. The initial interface (**Figure 1**) is launched through the Microsoft Internet Explorer or other internet browsers. The initial interface contains a map of Florida with all seven district boundaries displayed. A user would be able to click on the map to select the district he or she is interested in. A sub-page will appear that lists all models developed for the district. The user can then select the model he or she wishes to use. The subsequent web page (**Figure 2**) will indicate whether the model has been installed on the user's computer. If the model has not been installed, information will be provided as to where the latest model data can be obtained. If the model has been installed, the web page will display relevant information about the model such as whether the model is an officially adopted model, what the validation year is, and where to get technical support in needed. A link will also be available in the web page to launch the model within CUBE.

In addition to serving as map-based shell over the models contained within a series of Cube catalogs, the initial interface also provides the following functions:

- Selection of the model to be run via buttons
- A button to Support – This would take the user to pages providing access to Frequently Asked Questions (FAQ), reports, user guides and other materials provided by FDOT and the Model Task Force
- A button to Links – A page of helpful links for data and other information
- A button to Citilabs – Provides access to the Citilabs webpage giving information about other resources available to the user. This could also highlight the Citilabs user group if desired.
- A button to Contact – Generates an email to the person assigned to provide assistance with FSUTMS/CUBE.

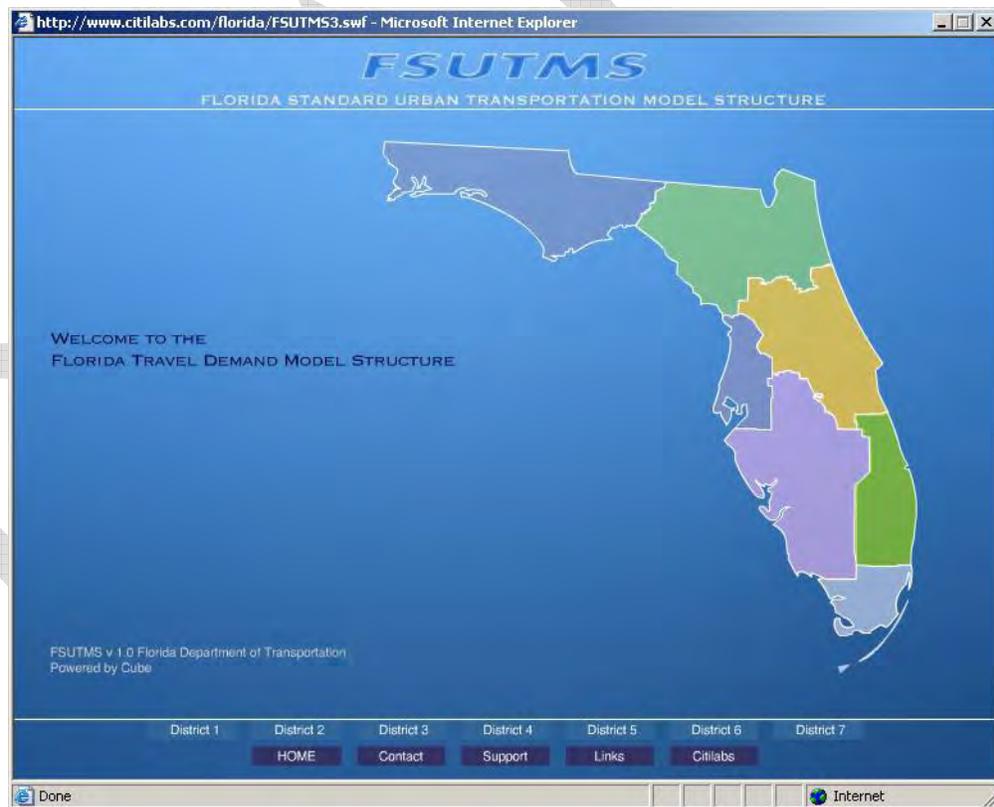


Figure 1 – District Selection Screen

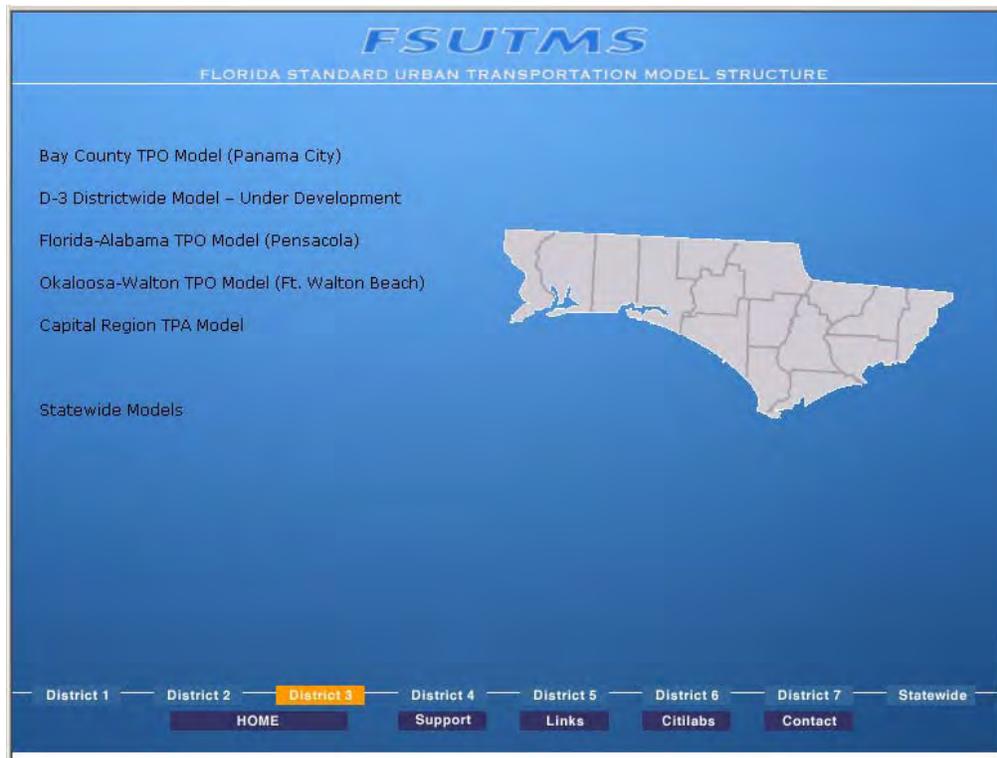


Figure 2 – Model Selection Screen

By clicking on the link for the model, the second level of the user interface, Cube itself, is started. A splash screen (Figure 3) announcing the name “FSUTMS” appears and the appropriate model is opened.

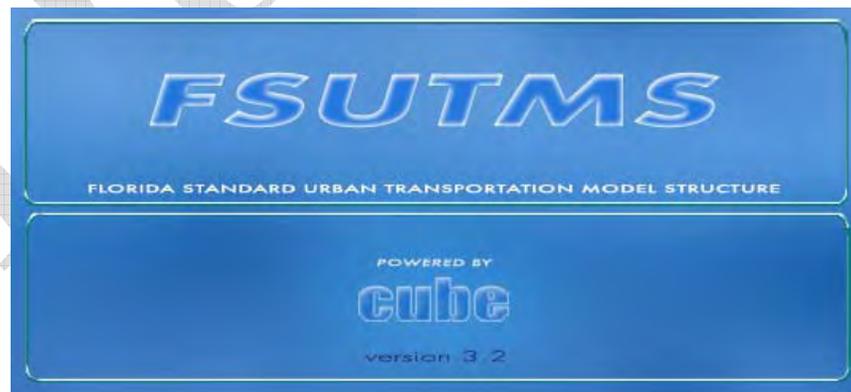


Figure 3 – FSUTMS Splash Screen

The Cube Catalog associated with the selected model is opened and displayed within the Scenario Manager portion of Cube (see below). The selected model, the various scenarios associated with the model and the data input and output of the model are all contained within the Catalog.

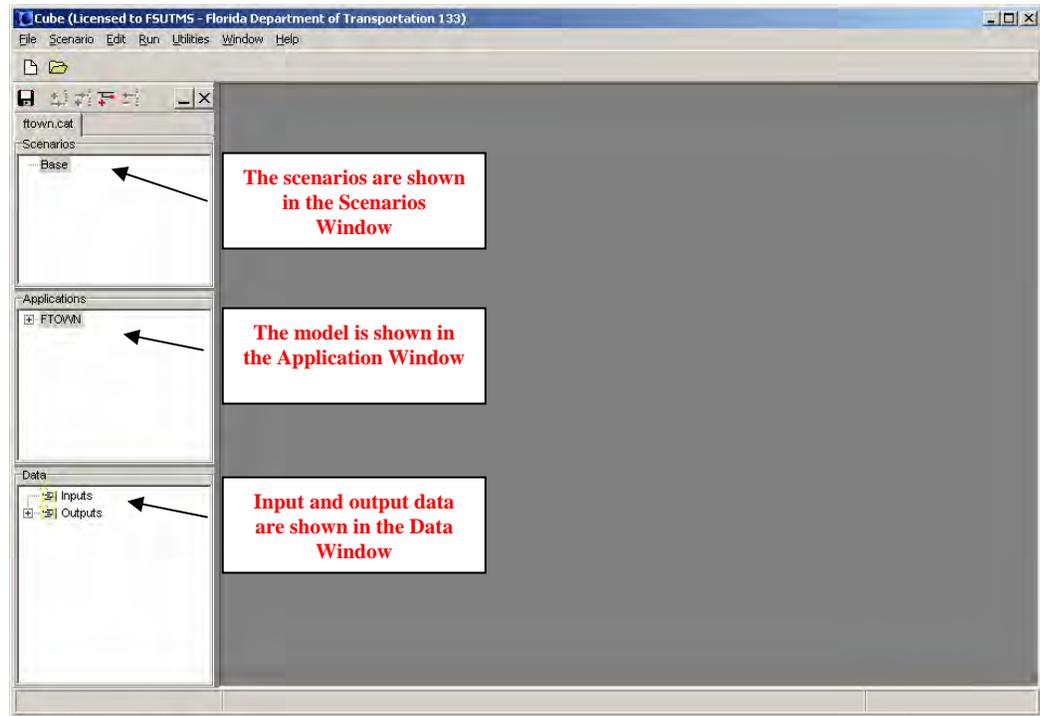


Figure 4 – Opening the Catalog of the Selected Model

File/Directory Structure

One of the advantages of the Cube Applications Manager is that it is not essential for the user to deal explicitly with directories and file locations as clicking on a box in the flow diagram will automatically locate and open the selected file. Standardized procedures for storing and managing files from multiple scenarios of the same model are described below. Also, there are certain key files that should be stored and preserved or backed-up on a permanent basis. Means of permanent storage of key output and input files have also been identified.

Proposed File/Directory Structure

Cube file/directory structures have been developed and implemented in several models including the Northeast Florida Regional Planning Model (NERPM), the Gainesville/Alachua County model, and the Treasure Coast Regional Planning

Model (TCRPM). A recommended directory structure was discussed at the February Model Task Force meeting and modified slightly based on consultation with Citilabs staff. The key recommended folders and files are as follows:

```

\fsutms\d?\modelName – model file folder

\fsutms\d?\modelName\modelname.cat – catalog file

\fsutms\d?\modelName\base – scenario files
    \base\Input – base year input files
    \base\Output – base year output files
    \base\Scenario_1 – specific future year scenario (e.g., E+C)
    \base\Scenario_1\Input – future year scenario input files
    \base\Scenario_1\Output – future year scenario output files

\fsutms\d?\modelName\future – future year input and output scenario files

\fsutms\d?\modelName\applications – applications and user-written programs

\fsutms\d?\modelName\archive – backup files

\fsutms\d?\modelName\doc – procedural guide, validation report, survey info, etc.

\fsutms\d?\modelName\media – GIS files, drawings, photos, etc.

\fsutms\d?\modelName\parameters – model parameters (common to every alt.)
    
```

Figure 5 – Proposed File Directory Structure

Procedures for Storing and Backing-up Key Files

A specific folder has been set aside for storing key input files that will not be modified after validation (\fsutms\d?\modelName\archive). Furthermore, it is recommended that a repository of typical folders such as model validation, existing-plus-committed, Needs Plan, Cost Feasible Plan, and interim years be maintained in each District office and Central Office (the latter for use in maintaining the Statewide Model).

Comments and changes received from the MTF, its committees, and from the broader user community will be addressed in developing the final version of the file/directory structure to be adopted in FSUTMS/CUBE. The development of

the standardized file directory structure will ensure that users can easily find and work with the many files that make up the FSUTMS model. Implementation will be coordinated with staff from Citilabs for incorporation into model conversions.

File Naming Conventions

File naming conventions have been developed for all files used in various steps of the modeling process. The file names should make sense to the users and make it easy to identify a file from its name. File names should be reasonably short (but not necessarily 8.3 in length) and should be such that it is easy to transfer needed input files across scenarios and between users.

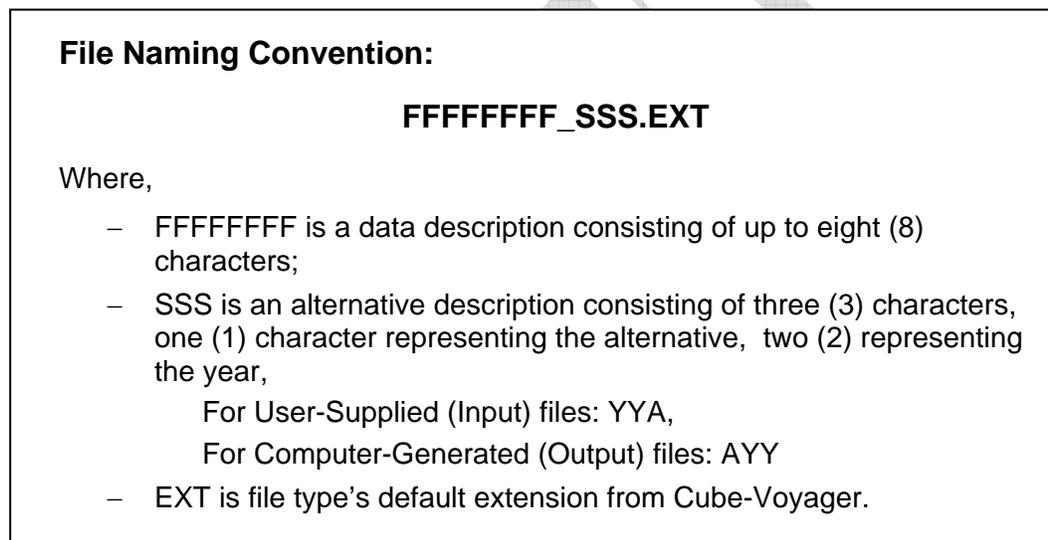


Figure 6 – File Naming Convention

Input and Output Files and Database Field Names

File structures have been identified for the required input and output files for FSUTMS/CUBE. Cube-Voyager compatible file formats are recommended for use wherever applicable. Output file formats are generally exportable to other programs (e.g. Excel) for easy analysis. Field names were also identified for Cube-Voyager dbf and mat files.

Identify All Input/Output File Formats for FSUTMS in Cube-Voyager

Based on the proposed file naming conventions, the input and output data required for each model step were identified and preliminary file name extensions were established. Files can be classified as follows:

- Input files where data are generated external to FSUTMS (e.g. zonal socioeconomic data)
- Input files where data are generated within FSUTMS from a preceding model step
- Output files to be maintained permanently; i.e., where data from the model will be used for other analyses (e.g., assigned traffic volumes and speeds)
- Output files needed for input to other model steps but not needed for permanent maintenance (e.g., travel time skims)
- Output reporting/database files (also discussed in a later section of this document)

There may be overlap between the second and fourth categories (and possibly between the second and third categories), as data outputs from one step may be used as inputs to another.

Identify the File Type for Each Input/Output File

Before determining the file format, the type of file was identified. File types include zone level data, highway link level data, highway node level data, matrices (i.e. trip tables or skim files), and transit route level data. The files that can include data inputs for more than one particular model input/output have been identified. It is recognized that some of these file types might evolve over time as most trip generation programs are still using ASCII input data, for example. File types, listed by extension, would include the following:

- dbf – Database format
- dat – ASCII data format
- mat – Cube-Voyager matrix
- prn – Model output summary (*.OUT from FSUTMS-TRANPLAN)
- net – Cube-Voyager highway network
- lin – Cube-Voyager transit line (route) inputs
- rte – Cube-Voyager transit access paths

Identify Field Names for Typical Input and Output Files

For each non-ASCII file, preliminary fields or data items have been determined. For each Cube database file, preliminary field names have been identified. Information necessary to know how scenarios will be managed will aid in determining whether specific fields need to have the scenario identifiers as part of

the field names. For example, if the zonal socioeconomic data for 2000 and 2030 are to be stored in the same file, the fields need to have the year identified in the field names. Some of these fields will vary due to different trip generation and trip purpose structures used in models throughout Florida.

Network Coding Standards

Updated standard highway and transit network coding conventions and standards have been identified. Highway and transit network coding approaches will be oriented toward using the Highway and PT programs for Cube-Voyager.

Define Draft Network Coding Standards

Florida's original highway network coding standards were established in the early 1980s based on UTPS mainframe capabilities. In 1998, FDOT and the Florida Model Task Force completed the HNET Procedural Enhancements Study, which incorporated more recent FSUTMS techniques such as toll facilities modeling, implementation of Viper, and established standard two-digit area types and facility types, speeds, capacities, and variable factors (VFACTORS) for BPR curves, peak-to-daily ratios (CONFAC), and relationships between practical and actual capacities (UROAD). With the advent of FSUTMS/CUBE, new network procedures must be established that reflect a movement away from ASCII files to Voyager network formats for data storage and editing, and yet build upon methods documented in the 1998 HNET Study.

Review coding of highway and transit networks in existing Cube-Voyager models

Much like the HNET Study, FSUTMS/CUBE network development processes are being tested on actual models to ensure the methodologies are sound, easily replicated, and effective. With the advent of FSUTMS/CUBE, the editing of highway and transit networks will be of a more integrated nature. Network coding will therefore, incorporate capabilities for both highway and transit network development, including enhanced capabilities for use of GIS technologies and databases.

Revise Standards based on Review of Existing Cube-Voyager Models

A review of alternative coding techniques, standards, and methodologies will inevitably result in revisions. Network coding standards and procedures for both highway and transit modes will be revised, where necessary. It is anticipated that this will be an ongoing effort. MTF HNET and Transit Committees might wish to work towards further refinement of these procedures through commissioning of a task work order to develop refined recommendations on issues such as toll facilities modeling, modeling of special use lanes (HOV, HOT, TOT), additional network data fields, additional area types and facility types (some of which have

been used already in specific Florida models), speed and capacity lookup vs. coded data, network and zonal detail, and transit access coding.

Standard Model Parameters and Coefficients

A set of default parameters is being developed for all FSUTMS model components. In the 1980s, FDOT issued a series of reports known as “Model Update Phases I through V”. Each report in this series addressed a different component of the four-step modeling process, with the goal of establishing standard procedures, later to be known as FSUTMS, along with recommendations on default model parameters and coefficients. These reports were supplemented during the 1990s with the release of the FSUTMS Users Library CD, which provided a document for each step in the FSUTMS process, along with updated default model parameters and sources. These default model parameters and coefficients can be used in the absence of locally available data such as trip rates, friction factors, mode choice coefficients, etc. It is recommended that a task work order be issued to study this topic and make recommendations to the Model Task Force in 2006 as it will take considerable effort to review all existing model parameters and sources for default values.

Review Existing FSUTMS Default Parameters to Determine Use

Based on the structure of FSUTMS/CUBE, a review of existing default parameters should be conducted to determine which parameters are relevant to the new model structure and which existing defaults should be updated.

The FSUTMS Interactive Users Library CD provides a comprehensive listing of all model parameters presently required in the TRANPLAN version of FSUTMS and should be used to review each parameter presently required and identify its relevance to the new structure of FSUTMS. Documentation for specialized urban and regional planning models for areas such as Tampa Bay, Southeast Florida, Northeast Florida, District 5, and Treasure Coast should also be reviewed to identify any additional model parameters required for FSUTMS.

Recommend New Default Parameters Where Needed

A review of current default parameter settings, where available, should be conducted to determine:

- If existing defaults are still valid
- If more recent surveys and model research provide for consideration of other defaults
- If additional research or surveys should be considered to update standard defaults

- Identify instances where standard default settings are either not desirable or if they are, where defaults should be borrowed from.

Examples of existing model default parameters include the SPDCAP and VFACTORS files (which were recently updated for the year 2000 Statewide Model), trip generation rates and dwelling unit weights (most recent recommendations are found in the FSUTMS Interactive Users Library CD), mode choice coefficients, PROFILE.MAS settings (e.g., terminal times, auto occupancy factors, and equilibrium closure criteria), and settings that are currently hard-coded into the TRANPLAN scripts (e.g., number of adjacent zones averaged to calculate intra-zonal times) .

Model Structure and Applications

Retain Existing Model Structure and Logic

The current FSUTMS/TRANPLAN model structure follows the conventional four-step modeling process that has been widely used in the United States over the past few decades. The four-step travel demand models have served as a valuable tool in forecasting future traffic conditions and are the basis for the determination of the need for new road capacities, transit service changes and changes in land use policies and patterns. The four-step models have served reasonably well for the purposes they are designed for. However, with the capital funding for new roadways ever decreasing, attention has been shifted to improve the efficiency of existing transportation facilities. Models are increasingly called upon to address a much broader range of transportation policy issues and project alternatives including transportation demand management (TDM) policies, transportation system management (TSM) projects, and air quality analysis. The ability to analyze non-motorized transportation modes such as pedestrian and bicycle travel and to simulate traffic conditions in different time periods of a day is often required to properly address these issues.

The change of model platform offers a good opportunity to review and modify the model structure and logic. In the long term, the model structure will be modified and enhanced to meet the needs of the modeling and planning community in the State. However, it is also important to maintain continuity in the interim period. The current model structure still provides adequate information for the development of long-range transportation plans and identification of required improvements on transportation facilities for small MPOs and rural areas where traffic congestion has not become a serious problem. For large MPOs and urban areas, new features can be added and improvements can be made within the existing modeling framework to address some of the most urgent policy issues in the short term. Therefore, it is suggested that the existing model structure and logic be retained in FSUTMS/CUBE.

Use Default FSUTMS Highway Only and Nested Logit Model Structure

In terms of FSUTMS modeling processes, it is generally agreed that the single-path FSUTMS option could be eliminated as this option provides only for the modeling of one network mode (e.g., local bus) with no variations in service by time-of-day (i.e., no peak-period express bus service). If a community has no plans for premium transit service in the future, it might be best that the highway only option be considered, along with enhancements to model high occupancy vehicles as is found in the current Lee County model. On the other hand, if a community plans for any fixed guideway transit, even the multi-path (single-period) option would be insufficient as this process assumes multiple modes only during the peak (AM) period. This option is only useful if the community's transit plans are limited to peak-period express bus service. The next FSUTMS option is multi-path/multi-period; however, most models in Florida have abandoned this process for some form of nested logit model. The generalized nested logit model, implemented as part of the Northeast Regional Planning Model, might provide the single best transit option for FSUTMS users due to its flexibility.

It is reasonable to assume that part of the rationale in having multiple transit processes in FSUTMS was borne out of the limitations of software and hardware in the mid-1980s, when TRANPLAN came into use. With these limitations now largely overcome, it would seem reasonable to limit FSUTMS/CUBE to two basic structures:

- Highway only (preferably with the capability of modeling HOVs)
- Generalized nested logit mode choice (for transit modeling)

At this point in time, as there are a number of unique model structures in use throughout Florida for various reasons (socioeconomic, behavioral, policy, etc.), it would not seem feasible to expect all models to coalesce on one unified structure. However, if FSUTMS/CUBE could be limited to two standard structures, this would simplify the modeling process used in Florida and would still allow for variations such as the District 4 and District 7 lifestyle trip generation models.

Identify Main Model Groups and Develop Standard Flowchart

CUBE uses groups and sub-groups to represent model components and flowchart to graphically represent relationships between the model components. This unique feature makes the model structure transparent and the model flow easy to understand. To take advantage of this unique feature and help organize the model in a logical fashion, it is suggested that main model groups be identified and standardized. Individual districts and MPOs will have the flexibility to define their own sub-groups to satisfy their particular needs and requirements. To be

consistent with the FSUTMS model structure, it is recommended that the following main groups be included:

- Trip Generation
- Highway Network
- Trip Distribution
- Transit Network
- Mode Choice
- Trip Assignment
- Reporting

Figure 7 – FSUTMS Main Model Groups

The following is an example of sub-groups included in each main group:

- Trip Generation
 - *External Trips*
 - *Internal Trips*
- Highway Network
- Trip Distribution
 - *Gravity Model*
 - *Pre-Assignment*
- Transit Network
- Mode Choice
- Trip Assignment
 - *Highway Assignment*
 - *Transit Assignment*
- Reporting
 - *Air Quality Analysis*
 - *Environmental Justice*
 - *HEVAL, RMSE, etc.*

Figure 8 – FSUTMS Main Model Sub-Groups

When developing the model flowchart, it is required to include metadata on every level of application that should provide the following information:

Metadata for model applications:

- Created on: 01-01-2005
- Created by: John Creator of ABC, Inc.
- Brief Description of the Application
- Modified on: 10-01-2006
- Modified by: Jane Modifier of XYZ Group
- Brief Description of what is changed

Figure 9 – Metadata for Model Applications**Identify Default CUBE VOYAGER Procedures**

CUBE VOYAGER comes supplied with many standard procedures (scripts) stored as “templates”. Some of the procedures function very similarly to their TRANPLAN counterparts, such as trip distribution, network building, and trip assignment; others behave very differently compared to the corresponding TRANPLAN modules, such as transit modeling and mode choice model. Ideally, all TRANPLAN modules should be replaced with VOYAGER procedures in the model conversion process, and it is even possible to do so using CUBE’s powerful scripting language. However, based on the model conversion experience so far and in the interests of efficiency and expediency in model conversion, the conversion of all processes to native CUBE VOYAGER procedures is being considered a longer term development and enhancement effort.

In the interim, it is suggested a wrap-around program that can execute the TRANPLAN GEN programs be used to accommodate the several variations of GEN that exist in the state. Similarly, the mode choice step will call up the existing external TRANPLAN/FORTRAN mode choice programs. Even though CUBE VOYAGER has a CHOICE (MATRIX) function that allows nested logit mode choice analysis, most of the Florida models has extensive pre- and post-processing which is time consuming to replicate in CUBE. Thus, in the short term, FSUTM/CUBE will wrap around the TRANPLAN/FORTAN nested logit model codes/scripts. The air quality analysis routine EMIS can be done in the same fashion. All other program in other modeling steps will use native CUBE VOYAGER procedures and routines. This includes using the gravity model and CUBE’s trip assignment procedures. Users should note that the results from the FSUTMS/CUBE model will be slightly different from results obtained from the FSUTMS/TRANPLAN model. Users will need to re-calibrate and validate the FSUTMS/CUBE models as part of the conversion process.

CUBE’s PUBLIC TRANSPORT (PT) Module offers a different approach to model the transit systems than FSUTMS/TRANPLAN, particularly in terms of transit access representation and transit path building. The Model Task Force

should evaluate the pros and cons of the PT module within the FSUTMS framework and decide whether or not to adopt the CUBE PT procedure.

Integrate Common Applications into Model Streams

CUBE has built-in controls that allow users to run individual model groups or sub-groups separately, start the model run from any point in the model stream, or run the entire model with only selected modules. However, these controls are not obvious to average model users, and some operations require changes (e.g., setting the execution order to zero (0)) to the model stream by the user. To provide users with an easy way of choosing the model groups they wish to run without them making changes to the model, it is recommended that a “Run Setting Section” be built into the Model Scenario Manager that includes a list of model groups with a check box next to each group.

Select Link Analysis and Select Zone Analysis are two of the most common applications of travel demand models. Both types of analysis can be conducted easily with the interactive analysis tool built in CUBE if a network path file is created. Creating a path file requires modification of trip assignment script file, and if a Select Link Analysis or Select Zone Analysis is required for each model run, it is a good idea to either create separate applications or to include a “Special Application Section” in the Model Scenario Manager and have the CUBE script handle these types of analysis. **Figure 10** shows an example of “Run Setting Section” and “Special Application Section” in Model Scenario Manager.

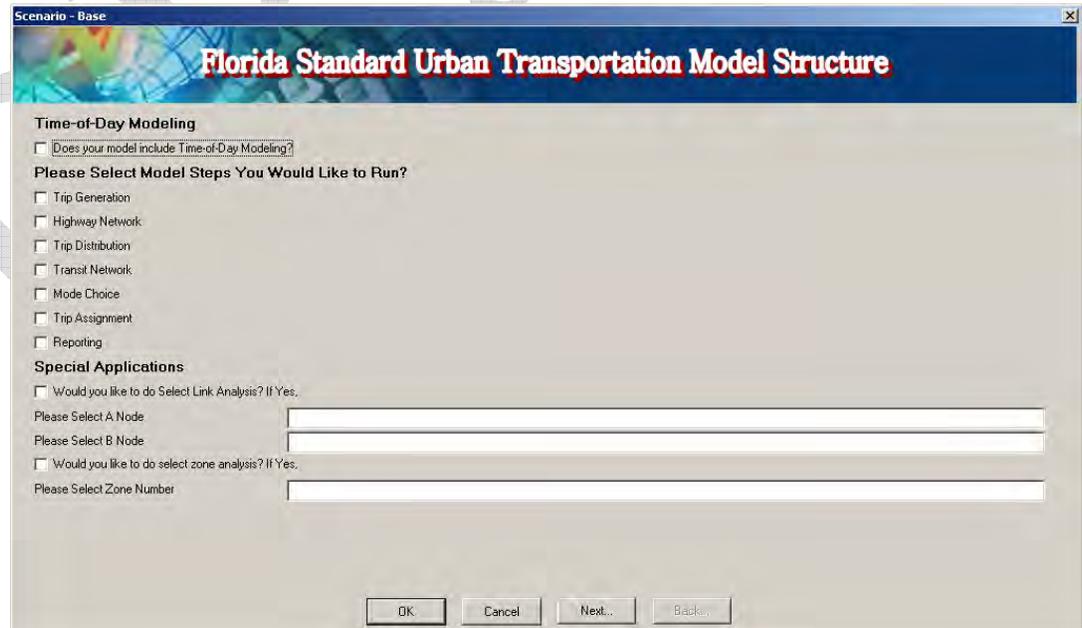


Figure 10 - “Run Setting” and “Special Application” Sections in Scenario Manger

There are many other applications that are commonly used in planning and engineering projects that can be potentially integrated into the FSUTMS model system. The Department and Model Task Force will provide continuing support and necessary resources to conduct research and implement research findings where appropriate. The ultimate goal is to provide a set of easy-to-use tools within the FSUTMS/CUBE framework that meet the needs and requirements of transportation engineering and planning community in the State. The following is a list of applications that can be integrated into the model system:

- FTA SUMMIT program and error-checking logic
- Link-based design traffic smoothing and estimation
- Sub-area modeling
- IDAS integration for ITS analysis
- Land use data reasonableness checking utility
- File import and export from/to other modeling software packages

Figure 11 – Common Model Applications

Incorporate Time-of -Day Modeling Into the Model Structure

With the current model structure, future travel forecasts are made on a daily basis for a typical peak season weekday. The daily models seem to be able to address capacity related issues and evaluate the impacts of new developments, but are inadequate in handling some of the emerging issues that require estimation of traffic variations during different time periods of a day. Examples of such new requirements include:

- Transportation Demand Management (TDM) measures,
- Transportation System Management (TSM) measures,
- Transit (e.g. New Starts Analysis) Analysis,
- Intelligent Transportation System (ITS) Analysis,
- Vehicle Emissions and Air Quality Analysis, and
- Traffic Congestion Management Programs

It is becoming increasingly clear that a time-of-day (TOD) modeling component is needed in the FSUTMS model structure, particularly for MPOs and urban areas that experience significant traffic congestion problems. It is suggested that all MPOs and transportation planning areas start to evaluate the needs to include TOD component in their modeling system. When assessing the needs and possible implementation of TOD modeling, the following questions should be carefully examined:

- Existing travel conditions and projected future growth in your area,
- Type of TOD model suitable for your area, e.g., a simple TOD factor model vs. a full-fledged TOD model that simulates people's choice of starting time.
- Location of the TOD model in the FSUTMS model chain,
- Number of time periods required,
- Data requirement for model calibration and validation, and
- Available technical and financial resources.

The Model Task Force and the Department will conduct studies and provide guidance to districts and MPOs so that they can make the best-informed decision with regard to these issues.

Standard Mapping Templates

The CUBE software package offers an extensive list of map templates from which the user can choose a display or theme. In addition, CUBE allows the user to create a custom map or theme for display purposes. There should be a standard set of themes or templates that are generated with each step or run in FSUTMS/CUBE. The user would then be able to choose a set of maps and themes that should be displayed/saved with each model step and model run.

As part of the model conversion process, Citilabs has created a standard set of maps for users. This standard set of maps and themes will be used as standard and point of departure pending additional input from the Model Task Force. The standard set of maps includes those for displaying zonal geography (by selected socio-economic variables such as household size and car ownership) and networks by facility type, area type, and so on.

Standard Reports

A set of standard FSUTMS/CUBE reports needs to be developed to serve as study documentation. At a minimum, the following information should be included in the reports. The information should be represented in both tabular and graphic format for easy interpretation.

Trip Generation

- Total number and percent of trips by purpose
- Aggregate trips by purpose per person, per household, and per employee
- Socioeconomic ratios such as persons per household, employees per population
- Socioeconomic totals and other ratios presently found in the LUCHECK program

- Environmental justice statistics such as the percentage of zero auto households

Trip Distribution

- Average (mean) trip lengths by purpose, compared to observed values
- Trip length frequency distributions (tabular and graphed) by purpose, compared to observed distributions
- Difference between input and output attractions by zone
- Number and percentage of intrazonal trips by purpose, compared to observed values

Mode Choice

- Formatted listing of model coefficients and constants
- Diagram of nesting structure
- Number and percent of trips by mode, sub-mode, and purpose
- Estimated auto occupancy factors by purpose

Highway Assignment

- Vehicle-miles traveled (VMT)
- Vehicle-hours traveled (VHT)
- Number of trips loaded and counted
- Volume/count ratios by VMT, VHT, and PSWADT:
 - By screenline, cutline, and cordon line
 - By area type, facility type, and number of lanes
 - By volume group
- Root Mean Squared Error (RMSE) by volume group
- Input and congested speeds (and percent differences)

Transit Assignment

- Estimated and observed ridership by mode and route
- Boardings and alightings by stop and direction
- Ratio of estimated over observed ridership by mode and route
- Estimated number of transfers by mode and route
- Transit station loading graphical report



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