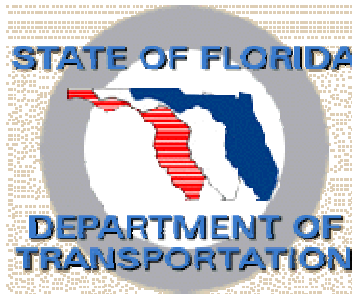# ENHANCING THE FLORIDA STANDARD MODEL USING NEW INFORMATION TECHNOLOGIES
Final Report

Research Center
Florida Department of Transportation
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Submitted by

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16. Abstract

Over the past few decades, the transportation modeling field has seen rapid and significant development in the application and implementation of new state-of-the-art information technologies that make it possible to simulate travel demand in urban areas in a graphical environment. The Florida Statewide Model Task Force is interested in continuously enhancing the Florida Standard Model, called FSUTMS, with state-of-the-practice information technologies, modeling methodologies, and user functionality. With the recent transition of the FSUTMS software engine to Cube/Voyager, there was a need to define new conventions and guidelines for the information management system that would be adopted in the new FSUTMS powered by Cube/Voyager. This report documents the new information technology guidelines and conventions for FSUTMS and the plans for enhancing the FSUTMS user functionality, FSUTMS transit modeling capabilities, and survey data collection and analysis capabilities in the state. It is found that the modeling community in the state benefits greatly from the adoption of standard and consistent modeling procedures and database structures/formats while providing the flexibility needed to customize models in individual local areas. The guidelines and conventions are being implemented in FSUTMS powered by Cube/Voyager with a view to enhance the user-friendliness, robustness, and transparency of the model system. With the new technology guidelines and conventions being implemented in FSUTMS, it is envisioned that the modeling community will save time and resources in planning and modeling studies that utilize FSUTMS.

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EXECUTIVE SUMMARY

PROBLEM STATEMENT

Over the past few decades, the transportation modeling field has seen rapid and significant development in the application and implementation of new state-of-the-art information technologies that make it possible to simulate travel demand in urban areas in a graphical environment. Advances in computer software and hardware capabilities coupled with developments in microsimulation methodologies have contributed to new transportation modeling software and information technologies that merit integration in the Florida Standard Model. The Florida Standard Model, called FSUTMS, has been enhanced significantly over the past two decades and it has served the planning and modeling needs of the state very well. Recent methodological advances in travel demand modeling that have occurred under the umbrella of the federal Travel Model Improvement Program (TMIP) offer a strong basis for conducting research and enhancing the Florida Standard modeling process. In light of these developments, the Florida Statewide Model Task Force felt that there was a need to define new guidelines and conventions for integrating new information technologies and management systems into the Florida Standard Model.

OBJECTIVES

The overall aim of this project was to provide information technology guidelines and conventions to enhance the Florida Standard Model as the transition is made to new modeling software and database formats. Specific objectives of this project are:

a) To design a flexible and user-friendly transportation modeling environment where users can define custom travel demand models that are most appropriate in their respective context

b) To identify methodologies for translating, converting, merging, and integrating existing travel demand modeling databases into the new transportation modeling environment

c) To develop guidelines for a new modeling platform that integrates Geographic Information Systems (GIS) with transportation modeling processes

d) To update and revise the information management systems in the Florida Standard Model so that all data management is consistent with new data structures, formats, and information technologies/software

e) To research the integration of statewide freight and passenger models with the new travel demand modeling systems

f) To develop plans for the enhancement of transit modeling technologies, tools, and methods in FSUTMS

g) To formulate plans for the development of information technology resources for Florida travel survey data collection and analysis

h) To gather information on the information technology enhancements that the Model Task Force and the modeling community in the state would like to have incorporated into FSUTMS in the future.

FINDINGS AND CONCLUSIONS

The research effort has resulted in the development of guidelines and conventions for new information technologies and database formats that will be implemented in the new FSUTMS powered by Cube/Voyager. The various findings and recommendations of the research study are as follows:

1. There is a strong desire to retain consistency and standardization in the terminology, technology, and database/file formats underlying FSUTMS. Consistency and standardization of FSUTMS have provided strong benefits to the state and to various agencies in the state. The modeling community is able to share knowledge and experiences, transfer model files and databases, and move between agencies thanks to consistency and standardization in modeling procedures.

2. There is also the desire to retain the ability to customize models within individual areas so that the models can best represent local conditions. Thus, although there is considerable interest in maintaining consistency and standardization in modeling procedures, the modeling community feels that it is necessary to accommodate custom procedures,

variables, and parameters in individual models. In doing so, the modeling community feels that consistency and standardization can be preserved.

3. In cooperation with the modeling community, the vendor of Cube/Voyager, the new modeling software engine for FSUTMS, developed a series of guidelines and conventions that can be implemented in FSUTMS during the transition to the new platform. These conventions and guidelines are documented in this report. These conventions and guidelines take advantage of the features, enhanced information technologies, and database structures and formats that are inherent to Cube/Voyager. Thus, they represent a quantum step forward in advancing the state of the art and ease of use and understanding of FSUTMS.

4. The modeling community would like to see information technology related improvements made to FSUTMS on a continuous basis. This report documents a comprehensive list of suggestions and desired utilities and technology enhancements that the modeling community in the state would like to see implemented in future versions of FSUTMS. The enhancements are of a dual nature. One set of enhancements deals with the user functionality, user friendliness of the software, automated GIS and reporting capabilities and utilities, and software design. The second set of enhancements deals with the modeling methodologies and procedures incorporated in FSUTMS. These include time of day modeling, trip chaining, junction-based modeling, and dynamic traffic assignment.

5. It is feasible to develop an integrated statewide passenger and freight travel demand model for statewide transportation planning. It is recommended that the statewide models be migrated to the Cube/Voyager platform consistent with the local models. This is because all local models are based on the FSUTMS powered by Cube/Voyager. As the statewide models are essentially aggregated versions of the local models (to ensure consistency of data and networks), the connection between the local models and statewide model would be most seamless if the statewide models were in the FSUTMS – Cube/Voyager format.

6. The modeling community would like to see transit modeling capabilities of FSUTMS enhanced as soon as possible. This report includes a plan and scope of work for enhancing the transit modeling capabilities of FSUTMS. This plan was developed in cooperation with

the Transit Modeling Committee of the Florida Statewide Model Task Force. The plan is consistent with the Federal Transit Administration requirements regarding good model practice for New Starts applications.

7. The models, parameters, and coefficients embedded in FSUTMS should be periodically updated based on the latest available survey data in Florida. The Federal Transit Administration is also placing strong emphasis on the use of locally available survey data for model development and calibration. The Model Task Force would like to have a plan for the establishment of information technology resources for travel survey data collection and analysis in Florida. This report includes a special chapter for the development of such resources. This plan was developed in cooperation with the newly formed Data Committee of the Florida Statewide Model Task Force.

BENEFITS

This research project involved the development of guidelines and conventions for the integration of new information technologies and modern simulation and GIS-based software into the travel demand modeling processes of the state. Travel demand models in the state are used for FIHS planning, MPO planning, transit planning, and many other planning studies in the state. All of these planning studies often involve the analysis of multi-billion dollar transportation improvements and investments. It is critical that state-of-the-practice tools be used in the planning process to help guide transportation investments in the State of Florida. By developing guidelines and conventions for maintaining consistency and uniformity in the integration of the latest and best software, database standards, modeling methodologies, and microsimulation tools into the Florida Standard Modeling Process, this project directly benefits the Department and many other planning agencies in the state that are charged with analyzing alternative transportation projects. These new information technology guidelines and conventions will enhance the ability of the Department and planning agencies in the state to make sound transportation investment decisions by improving the accuracy, transparency, clarity, robustness, and information dissemination capability of the modeling process. Thus, this project was aimed at serving the ultimate goal of enhancing the multimodal transportation modeling methodology in Florida by providing new and improved capabilities for estimating travel demand in urban areas while explicitly

recognizing contemporary planning issues and needs. The results of this research effort will greatly benefit transportation modeling and planning processes in the State of Florida by reducing time and cost involved in transportation modeling studies by a factor of 10-20%.

The results of this research effort are being implemented through a strong technology transfer component. Within the course of this research project, coordination with the modeling community took place via regular interaction and meeting with the Statewide Model Task Force. In addition, the FDOT Systems Planning Office has now developed a complete set of training workshops in cooperation with the vendor of Cube/Voyager that explicitly incorporate the guidelines and conventions documented in this report. The information technologies, plans, and guidelines/conventions documented in this report are being programmed into the Florida Standard Model framework to facilitate a seamless implementation of the new modeling software engine in all planning agencies of the state. Thus, the results of this research effort are being implemented and are having a direct impact on modeling practice.

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CHAPTER 1

INTRODUCTION

BACKGROUND

Over the past few decades, the transportation modeling field has seen rapid and significant development in the application and implementation of new state-of-the-art information technologies that make it possible to simulate travel demand in urban areas in a graphical environment. Advances in computer software and hardware capabilities coupled with developments in microsimulation methodologies have contributed to new transportation modeling software and information technologies that merit integration in the Florida Standard Model. The Florida Standard Model, called FSUTMS, has been enhanced significantly over the past two decades and it has served the planning and modeling needs of the state very well. This research project will serve as an opportunity to further enhance the Florida Standard Model through the integration of state-of-the-art software technologies, information management systems, and microsimulation methodologies.

Recent methodological advances in travel demand modeling that have occurred under the umbrella of the federal Travel Model Improvement Program (TMIP) offer a strong basis for conducting research and enhancing the Florida Standard modeling process. A few of the key new directions in travel demand modeling, both from a methodological and an application standpoint, that have been set forth by the federal TMIP include:

- The integration of time of day modeling procedures that are being introduced in TRANSIMS, the next generation of travel demand models being developed under TMIP by the Los Alamos National Laboratory
- The ability to customize models, coefficients, and explanatory variables for different urban areas depending on socio-economic characteristics, land use patterns, and transportation system characteristics specific to various contexts

- The ability to address new policy issues including freight mobility, economic development, social equity, and non-motorized travel
- The integration of new graphical tools including GIS, real-time microsimulation, and intersection-level displays
- The seamless interface of macroscopic travel demand models, mesoscopic traffic flow models, and microscopic traffic microsimulation models.

During the past few years, the Florida Model Task Force embarked on a major model evaluation study to identify the modeling tools and information technologies that should be integrated into the Florida Standard Model. The Florida Model Task Force completed its first phase of the model evaluation process in Spring 2003 and a second phase in Fall 2004. This research project served as the first phase of a process by which guidelines and conventions for the new tools and technologies identified by the Model Task Force could be integrated into the Florida Standard Model.

This project is aimed at enhancing the multimodal transportation modeling methodology in Florida by providing new and improved capabilities for estimating travel demand in urban areas while explicitly recognizing contemporary planning issues and needs. The results of this research effort will greatly benefit transportation modeling and planning processes in the State of Florida.

STUDY OBJECTIVES

The overall aim of this project was to provide information technology guidelines and conventions to enhance the Florida Standard Model as the transition is made to new modeling software and database formats. Specific objectives of this project are:

a) To design a flexible and user-friendly transportation modeling environment where users can define custom travel demand models that are most appropriate in their respective context

b) To identify methodologies for translating, converting, merging, and integrating existing travel demand modeling databases into the new transportation modeling environment

c) To develop guidelines for a new modeling platform that integrates Geographic Information Systems (GIS) with transportation modeling processes

d) To update and revise the information management systems in the Florida Standard Model so that all data management is consistent with new data structures, formats, and information technologies/software

e) To research the integration of statewide freight and passenger models with the new travel demand modeling systems

f) To develop plans for the enhancement of transit modeling technologies, tools, and methods in FSUTMS

g) To formulate plans for the development of information technology resources for Florida travel survey data collection and analysis

h) To gather information on the information technology enhancements that the Model Task Force and the modeling community in the state would like to have incorporated into FSUTMS in the future.

The chapters in this report and the appendices provide detailed information on the guidelines and conventions for implementing new information technologies in FSUTMS.

CHAPTER 2

SUMMARY OF FLORIDA STATEWIDE MODEL TASK FORCE DIRECTIONS ON MODEL IMPROVEMENTS TO FSUTMS

MTF DISCUSSIONS PRIOR TO 2003

This chapter presents information based on discussions held during the Model Task Force (MTF) meetings from June 2000 to May 2004. In addition, information has been extracted from the Blue Ribbon Panel Report, April 2002 and the Interim Standards and Enhancements report, June 2004. At a tri-chair meeting held in June 2000, the tri-chairs made the request to add a workshop that would focus on the theoretical background of modeling. This additional workshop could perhaps be suggested to be a requirement for some of the other workshops.

At the June 2000 MTF meeting, two items related to model improvements were discussed. These were alternative approaches to modeling the walk access to transit and time-of-day modeling. The MTF requested for Systems Planning Office to report back on the research in order to be able to make a decision as to where to apply the time-of-day factor to the model chain (Generation, Mode Choice, Distribution, or Assignment). This presentation was subsequently made in April 2002, where the suggestion was made to apply time-of-day after Distribution.

During the March 2001 MTF meeting, the MTF members discussed, in a group formation, the most important emerging issues for modeling. The following list was generated:

- Improve the model accuracy by making the trip rates similar to the ITE manual. In particular the attraction model needs to be expanded.
- The transit networks and input data should be operating in a GIS environment.
- The LUCHECK program is outdated; a new validation program should be written.
- The validation standards for the model should be updated.
- The networks need to be refined so that intersection operations can be simulated.

- The model should be expanded to incorporate trip chaining, multi modal and time of day capabilities and other micro simulations such as ITS.
- A switch should be made from ASCII to database format with a GIS application in a Windows environment.
- The model should be able to produce cost-benefit analyses.
- The model should be more sensitive to changes in land use plans, and changes in lane configurations, such as HOV.
- The air quality analysis should be improved.
- The modal choice should be expanded to be able to analyze unusual modes of transit, such as paratransit, etc.
- The model should be able to analyze induced travel (what is the effect of increased capacities on trip generation?)
- The model needs to be linked to an economic development model, to help explain some of the land use issues.
- The planner's ability to answer questions posed by decision makers.
- The planner's ability to provide an equal amount of technical analysis for all modes for the decision makers.
- The lack of technical support for the users.
- The need for smoothing procedures for the model output.

A related topic discussed at the March 2001 meeting was the direction into which modeling should be moving in order to address the above-mentioned issues.

- Feasible to develop a four-step model that is capable of addressing the time-of-day, trip chaining, and land use sensitivity type of issues.
- Taking a more proactive approach in integrating microscopic models, activity trip chain models, economic models, and pursue further integration with GIS allowing real time networks and socioeconomic data.

At the October 2001 MTF meeting, a list of proposed research projects was developed. The list of research projects was developed based on the comprehensive list of important emerging issues for modeling developed during the March 2001 MTF meeting.

- Update trip generation model with recent trip rate surveys in Florida or other areas with relevance to Florida
- Re-examine and improve the trip attraction model considering such factors as area type, employment categories, special trip purposes, etc.
- Restructure highway and transit network data in a GIS environment
- Update the LUCHECK program using a graphic interface (ULAM)
- Fully integrate ULAM and add other relevant land use analysis tools
- Re-examine the model validation standards and update as appropriate
- Transition input files from ASCII to database format
- Examine cost-benefit analysis tools and recommend the ones most suited to transportation planning needs
- Develop an interactive FSUTMS training course based on CD-ROM

The following year, the MTF initiated the creation of a Blue Ribbon Panel to analyze and prioritize Florida's modeling needs. The recommendations from the Blue Ribbon Panel were documented in the Blue Ribbon Panel Report, April 2002. At the MTF meeting in April 2002, the report was discussed. The MTF decided to eliminate further analysis on six items mentioned by the Blue Ribbon Panel. The eliminated items were:

- Maintenance of traffic
- Carpooling strategies
- Flextime
- Technology (telecommuting)
- Incident management
- Construction management
- Language longevity

The key planning issues and contexts identified by the blue ribbon panel were summarized as follows:

1. <u>Capacity Deficiencies and Congestion</u>: Models should be able to identify capacity deficiencies and congestion points in the system and model the potential effects of alternative policy actions and solution strategies that might be considered.

2. <u>Transportation – Land Use Interaction</u>: Models should be able to reflect the feedback relationships between transportation and land use as they might be used to gauge the effects of various land use and smart growth initiatives.

3. <u>Economic Development Impacts of Transportation</u>: It is likely that transportation models will be increasingly asked to address questions of economic impacts in the future.

4. <u>Freight Mobility Strategies</u>: Models will be increasingly expected to help evaluate alternative freight mobility options for safety and economic reasons.

5. <u>Air Quality</u>: The models should be able to adequately address air quality impacts of alternative transportation plans. The EPA guidelines do call for the use of feedback loops in transportation models and the use of time of day models to help better address air quality impacts of transportation. The transportation model incorporated in FSUTMS should be able to provide the information needed by air quality models such as MOBIL6.

6. <u>System Preservation, Maintenance, and Operations</u>: Increasing attention is being paid to system preservation and maintenance including operational enhancements.   Ramp metering, pavement condition monitoring, and other applications that are aimed at system preservation and operations may call for enhanced modeling capabilities including greater GIS functionality and microscopic traffic flow analysis.

7. <u>Equity</u>: The panel felt that various issues related to environmental justice, community impacts, and social considerations may be broadly classified under the term of equity. Planners need to be concerned with who is affected by a transportation action, how many of each demographic or social group are affected, and what might be done to mitigate any adverse impacts.

8. <u>Resource Allocation and Project Selection</u>: Models should be able to adequately evaluate alternative solutions and strategies and help decision makers allocate resources in the best way possible. This is probably one of the most important bottomline-type issues that needs to be considered in model development and application. How can the model be developed and applied such that the information it provides translates into effective resource allocation decisions.

Also listed in the Blue Ribbon Panel report are the deliberations and considerations of the blue ribbon panel with respect to the identification of transportation policies and solution strategies that might be of interest to transportation planners in the state.

1. Highway-Oriented Policies: Highway-oriented policies include those strategies that serve different purposes including bringing about mode, time of day, or route/destination shifts in travel behavior and operational improvements to the highway system. The different strategies that come under this category include:

    a. *Capacity increases*: Adding capacity to the highway system in the form of new highways or new lanes on existing highways continues to be a major strategy for tackling congestion.

    b. *ITS*: Intelligent transportation systems include a range of technology solutions and deployments that are aimed at enhancing traffic flow and providing information to travelers. IDAS is a new planning tool that is aimed at being able to perform planning analysis and evaluation of alternative ITS deployments.

    c. *Signalization*: Signalization enhancements constitute operational improvements that models may be expected to tackle; this calls for more detailed network representation at the level of intersection signalization characteristics.

    d. *Pricing strategies*: There are a range of pricing strategies including parking pricing, congestion pricing, and time of day pricing that are intended to alter behavioral patterns. Models should be able to simulate the effects of pricing policies.

2. Transit-Oriented Policies: Transit-oriented policies include a range of options that bring about changes to transit level of service. Policy actions include:

    a. *Fares/Pricing*: As in the highway context, transit fares and pricing strategies continue to be an important ingredient in transit planning. Such strategies include not only the actual fare paid (dollar cost) by travelers but also fare options (such as multiday passes, unlimited transfer, etc.).

    b. *Service changes*: Transit service changes include hours of service, frequency and headway, route and stop locations, route and stop amenities, on-board amenities (bikes on buses), and other service characteristics that might affect travel patterns.

    c. *HOV changes*: High occupancy vehicle strategies may be considered both a transit and highway strategy. HOV has already been incorporated into many models currently in place; may need to consider further enhancements as HOV strategies become more varied (e.g., HOT lanes).

d. *LRT/BRT initiatives*: Light rail transit and bus rapid transit initiatives are being included in increasing numbers of long range transportation plans. Models should be able to evaluate the performance and impacts of these alternative transit technologies.

3. <u>Demand Spreading Policies</u>: There are several travel demand management strategies and transportation control measures that are aimed at spreading (or even eliminating) travel demand. In addition to pricing strategies (already mentioned under highway-oriented strategies), other demand spreading policy actions include:

   a. *Parking policies*: Many areas are considering parking restrictions, parking pricing strategies, and other parking oriented measures that may affect travel patterns.

   b. *Carpooling strategies*: Carpooling incentives and strategies are aimed at bringing about a mode shift; however, this mode shift may also affect time of day choice, destination choice, route choice, etc. Models should be able to reflect the host of changes to travel patterns that might results from carpool incentives.

   In this context, it is important to note that travel demand or behavioral patterns may be affected in numerous ways as a result of these strategies. Trip chaining patterns may be altered; thus one may conjecture that tour based approaches that attempt to represent travel patterns at the level of the trip chain are more able to respond to behavior-altering policies. Similarly, one might consider the effect of day-shifting (beyond simple time of day shifting which occurs in the same day). In day-shifting, one might move an activity/trip from a weekday to a weekend day as a result of a demand altering policy. The question arises as to how a daily model of demand aimed at capturing the typical weekday can represent day-shifting effects. Such methodological issues, however, may not play a big role from a software platform decision standpoint.

4. <u>Land Use Strategies</u>: There are a host of land use policies and strategies that are of interest to transportation planners in today's context of integrated land use – transportation planning.

   a. *Transit oriented developments*: Transit oriented developments, pedestrian oriented developments, and neo-traditional land developments are new land use patterns that models need to be able to represent.

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b. *Mixed land use strategies*: New land development patterns are emphasizing mixed land development patterns. Models should be able to reflect the effects of such mixed land use strategies where people may begin to walk and conduct more short intra-zonal trips.

c. *Zoning regulations*: Models are expected to be able to assess the impact of zoning regulations on land patterns and travel patterns.

d. *Non-motorized travel initiatives*: Newer land use strategies call for the enhancement of pedestrian and bike facilities and the consideration of pedestrian-friendliness factors in modeling travel demand.

e. *DRI and concurrency*: In Florida, development of regional impacts (DRI) studies and concurrency continue to play a major role in shaping land use and transportation impacts of land development patterns. It should be possible to apply models at the level of individual land development projects and assess projects in the context of concurrency requirements.

5. Other Policies: There are other multimodal policies that may have a bearing on modeling methodology and selection. These include, but are not limited to:

a. *Truck policies*: Many states and urban areas (including Florida) are considering alternative truck mobility options including truck only lanes, truck restrictions by time of day, and other strategies geared towards enhanced truck mobility. Models should be able to assess the impacts of alternative truck mobility strategies.

b. *Intermodal connectivity*: Major emphasis is being placed on enhancing intermodal connectivity at airports, rail terminals, truck terminals, seaports, and other intermodal facilities.

Next the Blue Ribbon Panel concerned itself with the detail-oriented modeling enhancements. Items listed in the report were:

1. Network Details: The ability of the model to incorporate significant network detail is an important consideration in software selection. Some of the items within this category include:

a. *Network completeness*: This refers to the inclusiveness of the network.

b. *Network control*: Intersection control, signal timing patterns, and other intersection penalties are important components of a network as capacity limitations are often associated with nodes (as opposed to links).

c. *Network Shape and GIS Functionality*: The ability of a transportation modeling software to retain the accurate and realistic shape of the network in space is important.

2. External Travel: The current plan in the state to tie all urban and regional models to the new statewide model is a worthwhile effort. Estimation of external trips continues to be a difficult issue for many model applications. The state should continuously strive to enhance the external travel estimation process in FSUTMS.

3. Parameters – Variables – Coefficients: The state should continuously strive to improve the model specification in FSUTMS. Model parameters, explanatory variables, and model coefficients used in FSUTMS need to be updated and enhanced over time.

MTF DISCUSSIONS IN AND AFTER 2003

During 2003 the MTF focused on the selection process of a new software engine to run FSUTMS. Once the software package was selected, a Working Committee was formed to focus on the prioritization of enhancements, updates and standards.

The Working Committee held several meetings prior to documenting their findings in the Interim Standards and Enhancements Working Paper in June 2004 (included in this final report). Non-technical items discussed during the meetings were such items as the need for better version control, particularly on the transit side of the model, as well as the need for a contact person for each model. Following are the applicable excerpts from the Interim Standards and Enhancements report.

1. **User Interface**

   The intent is to provide a standard FSUTMS front-end from which users can access specific geographic models or modeling steps that they wish to run.

2. **File Naming**

   A new file naming convention has been established for FSUTMS. This convention attempts to maintain some of the FSUTMS traditions while taking advantage of long file names. The file name will contain four parts: (1) a data description (2) an alternative description (3) a "U" or "P" designation, and (4) a suffix.

3. **File Directory/Structure**

As an interim standard, it is suggested that a Master Directory be established. This Master Directory will contain a series of directories with one directory for every alternative or scenario run. The Master Directory would have the same name as the model and would contain only input files. Each alternative would have its own directory. The directory name would include the model name and the alternative name. Within each directory, there will be four subdirectories (input, temp, output and report) with each subdirectory having a name that includes the model name, alternative name, and subdirectory name.

4. **Model Structure/Logic**

The most compelling reasons for changing the model structure/logic would be: (1) there may be better procedures, (2) to eliminate the UTPS-based legacy procedures, and (3) the new software makes better procedures available. The ability to analyze different modes of transport such as walk and bike modes, time of day modeling, and so on constitute new methods and applications that would be valuable to the modeling community in the state. At this time, the incorporation of such enhancements into the standard FSUTMS structure is being considered a long-term model development effort.

However, it would seem reasonable to limit FSUTMS to two basic structures:
- Highway only (preferably with the capability of modeling HOVs)
- Generalized nested logit mode choice (for transit modeling)

5. **Parameters**

It is reasonable to recommend that MPOs abandon the use of default parameters originally recommended in Model Update Tasks B and C, as these were based on travel survey data from the 1960s and 1970s. A wealth of household travel surveys conducted in Florida during the late 1980s, 1990s, and more recently provide a more reliable source for such information. Census 2000 data should be encouraged as a source for dwelling unit weight calculations and journey-to-work comparisons. In the long term, it is recommended that all model parameters and coefficients be researched and updated to reflect the latest travel behavior trends and policy considerations.

6. **Input and Output Files**

It is recommended that the erstwhile ZDATA1 and ZDATA2 files be merged into a single ZONEDATA file in a database format. This will provide a single location for all residential and employment data. However, ZDATA3 and ZDATA4, that provide information on special generators and external-internal productions respectively, should continue to remain in separate files due to their unique area-specific structure. In the zone database in the TEMP subdirectory, calculated fields such as zone acreage or density measures could be stored. In addition, area types could be stored here to allow them to be computed based on density or other measures. In the zone database in the OUTPUT subdirectory, the final productions and attractions could be stored. On the other hand, productions and attractions before balancing could be stored in the database in the TEMP subdirectory.

7. **Database Field Names**

The Department's GIS-TM effort, which developed a set of ArcView applications for editing and displaying FSUTMS-Tranplan modeling data, specified a set of field names.

8. **Network Coding Standards**

Existing FSUTMS network coding standards are applicable in the interim for the first wave of model conversions. All existing network coding standards are being maintained at this time. In the long term, however, the network coding standards should be substantially enhanced and updated. It is recommended that an enhanced base map be used for the highway network layer, and that this single layer be used as the basis for all highway and transit networks in the future. It is important to strengthen the tie between the transit and highway networks by using a common base map for these networks. This would facilitate an integrated multimodal analysis using a process equivalent to that in Tranplan for highway/transit speed calculations.

9. **GIS Themes and Templates**

There should be a standard set of themes or templates that are generated with each step or run in FSUTMS. The user would then be able to choose a set of maps and themes that should be displayed/saved with each model step and run.

10. Roadway Geography

The ultimate objective under this item is to incorporate roadway geography and shapes into model networks, thus moving away from the stick-network formats used in FSUTMS-Tranplan. As an interim standard, models with up-to-date networks and base maps should be converted to line layers. The line layers would be maintained in a geographic latitude and longitude coordinate system. Eventually these systems should be changed to use an enhanced base map with shapes for the highway network layer, with this single layer as the basis for all transit networks.

11. Standard Reports

Standard FSUTMS reports should be defaults in FSUTMS and a minimum has been established (see report)

On April 7th and 8th of 2004, a special meeting was held which focused on the transit side of the model. The Federal Transit Administration (FTA) was invited to discuss short-term and long-term improvements which need to be made to the transit modeling practices. The basis for the discussion was the assumption that in the short-run, Florida would stick with the current four step modeling process. Discussion did take place regarding tour-based models; however the implementation of such models was tabled for the long run.

The FTA discussion/recommendations were organized into five topics; these were mode choice model, transit network, transit path building, transit assignment and transit performance evaluation.

MODE CHOICE MODEL

Model Form

The basic decision would be if the model structure is going to be a multinomial or a nested logit structure. This decision would be based on the number of line haul services in the area. If the nested logit structure is chosen, then the decision needs to be made if each mode would get its own nest. This would be directly related on how the modes are handled in the path building structure.

It would be important to set up the software in such a way that the introduction of a new mode would not entail having to change the application code. So as the software is developed, one should add the modes that are going to be tested in the future.

The number of modes in the mode choice model is directly related to path builder. Theoretically, the path builder will choose the best path. The reason the modes are defined in the mode choice model is to aid the path builder in selecting the core mode. In a dense network where the transit path builder does not sort out the mode correctly, the mode choice model will aid in the selection of the correct competitive modes, e.g. urban rail versus light rail.

A discussion took place about the different path building options available, basically to build them sequential versus parallel and how to combine the paths of different modes. In light of the existence of irrational paths, etc., it was decided that it would be important to conduct research on the best path set up.

Travel Choices Considered by the Model

The basic question here would be whether to include non-motorized travel or to model motorized travel only.

Impedance Measures

Currently there are coefficients, which are different for each mode and get applied to the in-vehicle and out-of-vehicle times, wait time less then 7 minutes, and greater than 7 minutes. There is quite a bit of data available on the coefficients.

Socio-economic Variables

The variable of income is represented through automobile ownership. In the mode choice model the trips are stratified by market. On the household side the automobile ownership data is obtained from the Census; however no information is available on the employment side. There are several problems associated with this – people without cars are sent to destinations where people with cars go, there are people in the suburbs without cars that do not work that are being sent to work places, etc. Stratification by attraction would be needed.

Izone-Jzone

These are such variables as the CBD flag, which allows for an adjustment to the number of trips with a CBD destination. The other variables besides time and cost do not capture this travel pattern. It adjusts for the fact that the CBD is pedestrian friendly, and has mixed land uses. Perhaps there are other areas within the urban area that have sidewalks etc. Other trip end measures, scoring of the pedestrian friendly ness of the area have been applied. They seem to work very well, number of local street intersections in the zone. Other measures have been tried and useful.

Non-network Procedures

An automated approach to transit access calculations for walk and auto are needed. These automated procedures need to allow for manual adjustments.

Constants

The calibration of constants needs to mean something; it should not just be a correction factor. There is a need to develop instructions on how to calibrate the mode constants; it involves more than the mechanics of the calculation.

Reporting

Two types of reports are needed - one to report the output of the model runs and one set of reports to analyze the systems, the results of the mode choice application, etc. These reports could be used as a quality control tool.

Development and testing

To develop a new mode choice model, one would have to obtain daily travel surveys. Currently, Florida is interested in implementing the FTA standards in the short run, while in the long run different model structures such as disaggregate tour based models might be considered.

The issue of the implementation of a time of day model would relate to where in the model stream it should be initiated. There is a strong movement to move it up in the model stream; trip distribution and mode choice model run by time-of-day. There are logistical costs associated with this but it appears that the costs outweigh the benefits.

In conclusion, FTA stated that:

- it is imperative that Florida fix the constants in the mode choice model
- FTA can only analyze "new start" projects that are developed using a version of the model that uses a fixed trip table
- it is imperative that Florida develop good reporting routine that will allow for the analysis and quality control necessary to compare the results among the alternatives and to other similar studies.

TRANSIT NETWORK

Several important issues were discussed related to the network. These are not listed in order of importance.

- The selection and use of the line database used for the network.
- The transit travel speed, speed curves based on the highway network versus route times. The use of route time will not allow one to measure the route congestion which is one of the most important issues. It would be important to improve upon the highway travel time, so that there is a relationship between the highway and transit travel times.
- The networks related to the access modes need more detail.
- The coding of stops is an important issue.
- Good network editing tools that automatically update the transit network when changing the highway network.

TRANSIT PATH BUILDING

It is important to have consistency in the path building process and the mode choice model, not only in how the paths are built as far as the combination of modes, but also to ensure consistency with mode choice. Variables used and their weights should be consistent with mode choice utilities.

The non-transit links should have their own path building routine, the highway network should not be used for walk access, and a more detail network is needed.

TRANSIT ASSIGNMENT

The transit assignment result is the product of the previously discussed model elements. A discussion took place on having transit assignments in PA versus OD format. This would imply that the previous model elements would be converted to OD format as well.

The reporting of transit ridership numbers by station, route line, mode, guideway, etc. is currently a time consuming issue. A good reporting system should be developed.

TRANSIT PERFORMANCE EVALUATION

It was pointed out that a good reporting system is needed. The reports would provide information on the performance of the model as well as on the performance of the particular alternative.

Due to SUMMIT, reporting can now take place by market segment. There should be a report indicating whether the transit validation falls within acceptable ranges as it relates to the performance of the transit system

A guideline needs to be developed on how to set up a good on-board survey. It would be a good test to obtain on-board survey data, geocode it, build the trip tables, and assign it to the transit paths, to see if actual travel patterns are being replicated.

FTA made the statement that perhaps in order to force the use of better data, no "new start" project will be allowed to go into preliminary engineering unless an on-board transit survey had been conducted within the past 5 year period.

At the May 2004 MTF meeting, the MTF members were divided into groups and given five topics for discussion. Following is a listing of the topics and the recommendations/ comments, which were made by the different groups:

<u>Roadway geography</u>

Needed layers that were mentioned by the different groups were a TAZ database, TAZ coverage, TAZ geography that includes socioeconomic data, roadway facility, number of lanes, area type and traffic counts, local street network to develop the transit access network (eliminate spider network), railroad alignment, intersection control, turn prohibitors, ITS

components, pavement information, bridge attributes, truck restrictions, bus stop coding, station coding, fixed guideway, and barriers. Compatibility with statewide, FDOT, City and County geography, compatibility with GDTM and EDTM, and ability to overlay aerial overlays are important issues. Other issues brought up were the need for a procedure to maintain the database, who will update the base maps, what will the projection be, and the need for the software to automatically update transit network when the highway network changes.

Standard Reports and Output

Since there is an extensive list in the white paper, most groups focused on those items which were not listed in the white paper. There needs to be a box so the user can select which reports need to be created for a particular run. There is a need for better diagnostics when an error occurs. There needs to be the ability to change the format of the report. There needs to be a mechanism put in place which will allow for the summarization by district, County, market segment, screen line, cut line, off peak vehicle use, emissions, ons & offs by route, % trucks, highway and transit level of service by corridor, environmental justice reporting, transit capacity, summary of flow, trip length frequency data, unbalanced attractions by district or county, station activity, VMT and VHT, HEVAL information, etc. There needs to be a better identification of trip purpose instead of numeric coding of 1, 2 etc. The input and output files need to be time and date stamped. The request was made to allow for the creation of reports by drawing a corridor on a map and obtaining the reports for that specific area. There is a need to develop a reporting system for land use checks, and network checks; a utility for checking data inputs. There is a need to develop reporting for quality control purposes as well as easy debugging procedures. There is a need to compare the assigned data against the survey data.

GIS Themes

The statement was made that the GIS Committee should get involved with development of the GIS Themes. The different groups identified several themes. These were barriers to be used in transit, links by color, volume/capacity, volume/count, population density, level of service with GIS-TM standard imports, environmental justice (selected based on population groups), bridges, maintenance schedules, transit, land use check, facility constraints (environment, historical, etc.), desire line maps, mapping to examine origins and destinations, transfer matrices, bar charts, auto ownership by TAZ, 0-automobile households, mode split by purpose by zone, linkage to census data, and automated volume calculations.

Other issues brought up were the need for defaults for colors and patterns, a default library for GIS, and a central depository to share the themes. A general list of thematic maps should be set up with a pull down menu where the user can select the theme. It was pointed out that when setting up themes, it should be kept in mind that there are several users who are colorblind and/or color challenged.

User Interface

Most groups like the map but wanted to have the option to go directly to the model of choice. The version of the model, the data and time need be part of the data. All the current FSUTMS steps should be part of the interface. There is a need to run more than one scenario at the time and/or stack the runs. There should be an initial setup report, and an automatic check for the required files. There should be a checkbox for the users to specify which files the user wants to keep. There is a need for version control. There should be a scenario button interface. There should be buttons for edit, finalize, delete, etc. There should be a way to archive, delete temp files, compress and save a run. There should be an option to name and password protect the run perhaps in an archive library. There should be an option to run Summit and the Mobil air quality program. Before executing a command there should be an "are you sure?" question.

Miscellaneous

Following is a list of items that was brought up by the groups under the miscellaneous topic. The output file should be protected so they cannot be modified (currently binary in TRANPLAN). There is a need to run multiple sessions with one key. The line layers need to be compatible. There should be unlimited undo and redo, save and save as, an audit trail, formal archive, auto save option, an option to update multiple scenarios at the same time, an option to map landmarks and making them polygons. There should be a method to analyze version certifications between networks. The error messages should be improved. A method should be developed to check the speed-cap table. There should be an option to compress files. The output should be easily converted to be used as input to ArcGIS, ETDM, etc.

CHAPTER 3

INFORMATION TECHNOLOGY CONVENTIONS AND ENHANCEMENTS FOR FSUTMS-CUBE

INTRODUCTION

FSUTMS is a complex system of mathematical models used to forecast changes to travel demand in response to proposed changes to transportation policy and infrastructure. Because the process is used by a large number of clients with a wide variety of modeling expertise, it is recommended that the Florida Model Task Force adopt various conventions and standards in order to reduce the complexity in applying the system.

This document serves as a white paper to identify the various candidate items for which conventions and enhancements may be defined and implemented within a reasonable time frame. The objective of this white paper is to provide an initial set of conventions and enhancements for various aspects of FSUTMS-Cube. The white paper considers the following candidate items for the development of conventions and enhancements:

- User interface
- File naming
- File/directory structure
- Model structure/logic
- Cube procedures to be used as standard/default methods
- Default model parameters/coefficients
- Network coding standards
- Standard GIS themes/templates
- Roadway geography
- Standard reports/outputs

The initial section provides some background information about the user interface for Cube, Cube Base.

UNDERSTANDING CUBE

A major difference with Cube from other systems is that 'all' of the model (the models themselves, the graphical workspaces, the scenarios, and the data and results for the scenarios) are all contained within one overall file called the 'Catalog'. A client who wishes to open the model need only 'remember' the name of their catalog.

Once the Catalog is selected and opened in Cube, Cube provides three 'windows' for developing and working with the model. The screen image provided below shows these three windows.
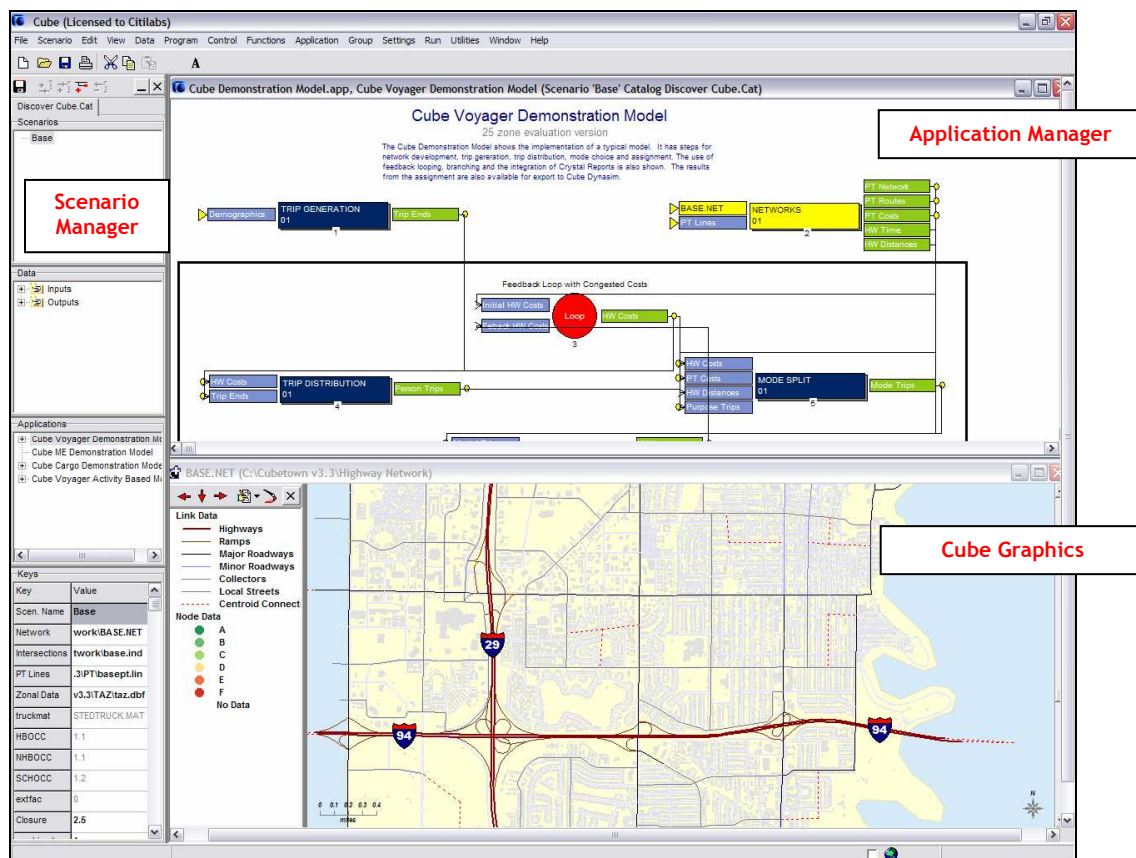

Figure 3.1 The Three Main Windows of Cube

Application Manager

The modeling process is presented in the Application Manager (AM) window in a flow-chart form. This flow chart shows the steps in their order and the linkages between the various inputs and outputs throughout the process.

Information/descriptions are provided in two areas of AM:

1. Descriptive text placed anywhere on the flow chart. This text is useful for describing the processes, or for leaving notes ('post-its').

2. The input and output data:

    ▪   The input and output files are shown on the flow chart and described using 'descriptive text'

    ▪   By clicking once on a file, the physical file name is shown

    ▪   By right clicking on the file and selecting properties further information is displayed
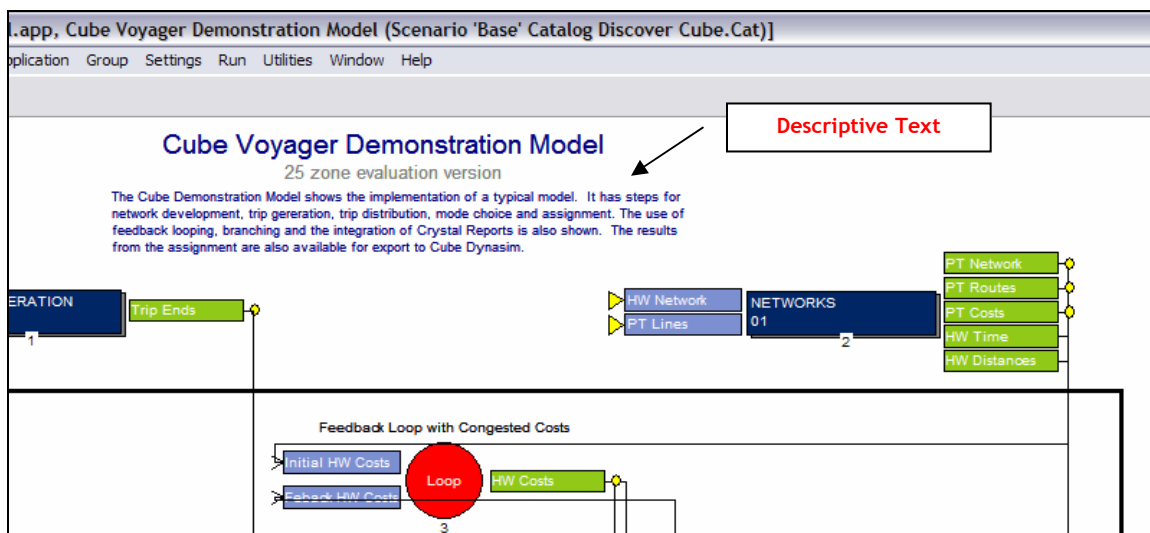

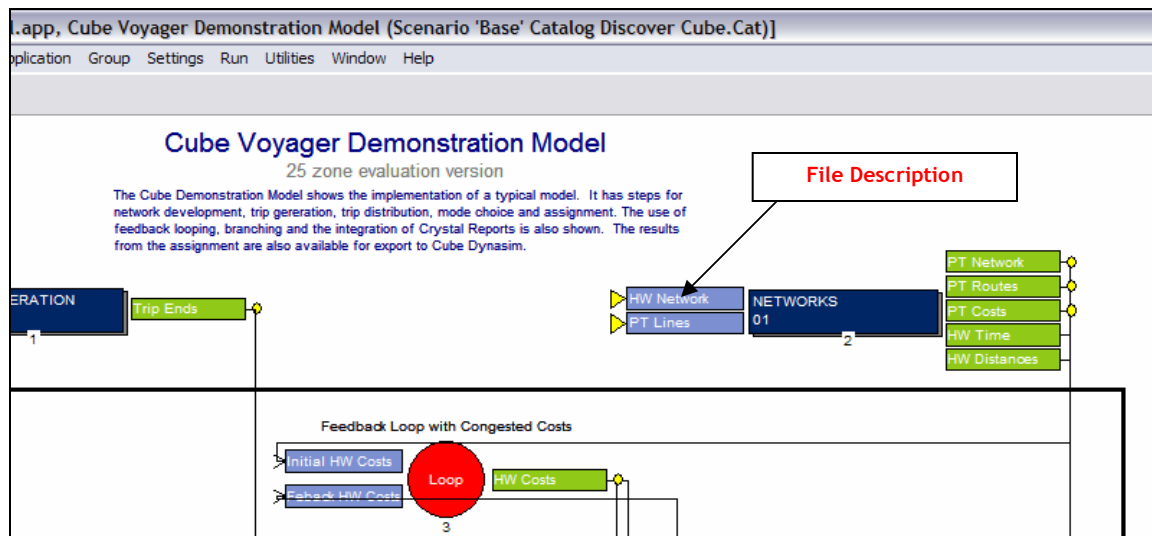**Figure 3.2 Use of Descriptive Text in Application Manager**

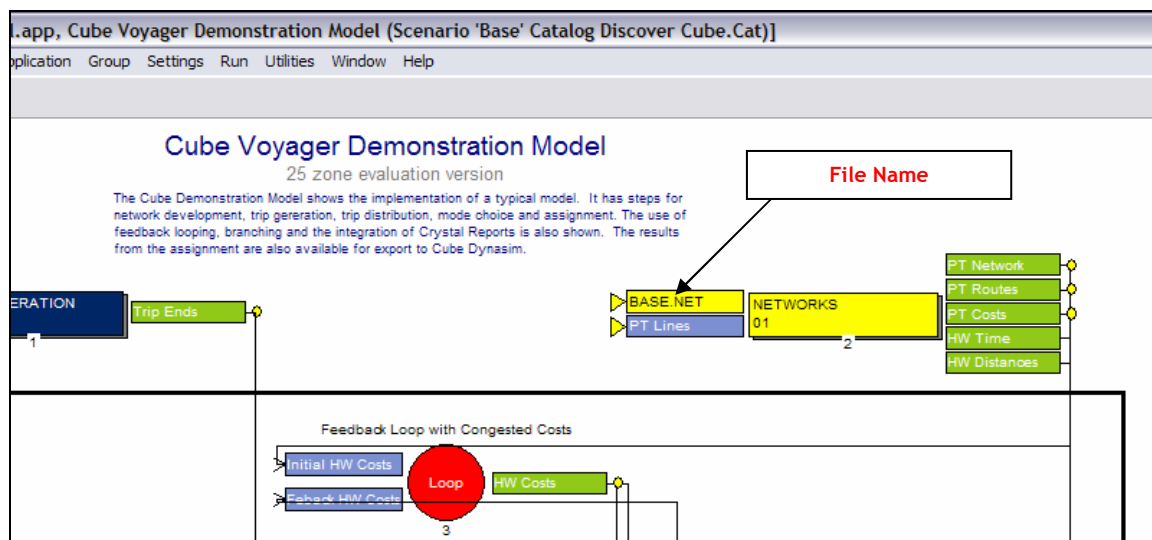**Figure 3.3 File Description in Application Manager**

Figure 3.4 File Name shown by clicking once in Application Manager
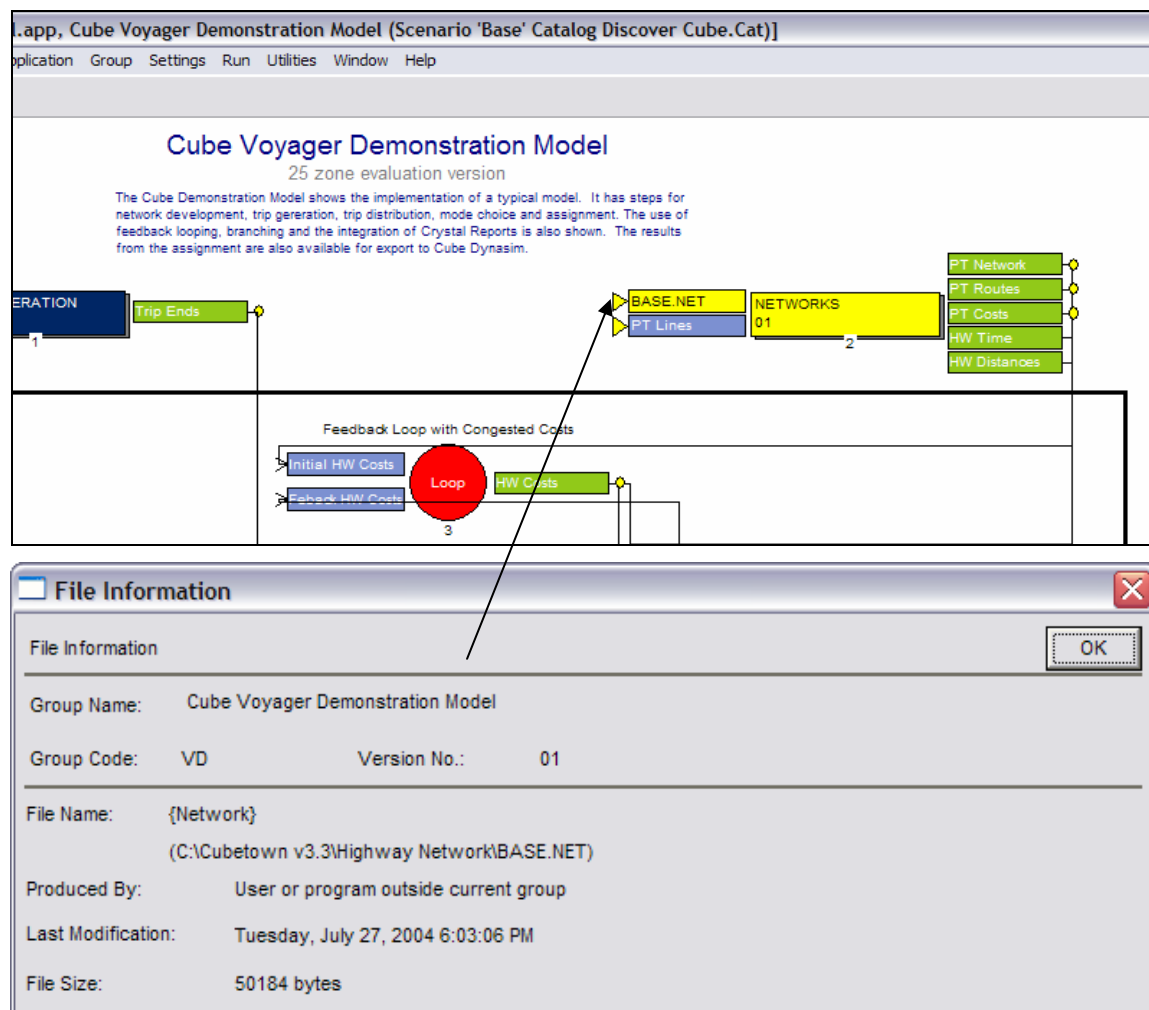
Figure 3.5 File Properties (details) Accessed by Right Clicking on File

Scenario Manager

Scenario Manager is used to develop, run and manage the scenarios.

Figure 3.6 Scenario Manager
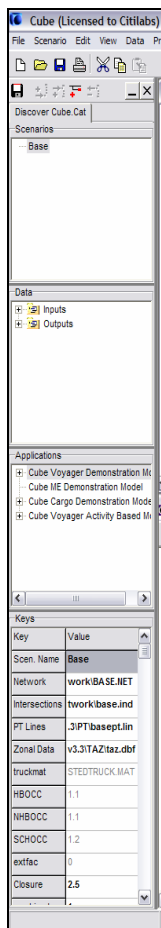
Scenario Manager has 4 sub-windows:

- **Scenarios:** the scenario sub-window is where the user creates and manages the scenarios. Right click here to create a new scenario. Doing so, then fires off the scenario user menu (see below) prompting the user for the model inputs and parameter settings for this scenario. The prompts contained here are controlled by the 'Keys' (See Key section).
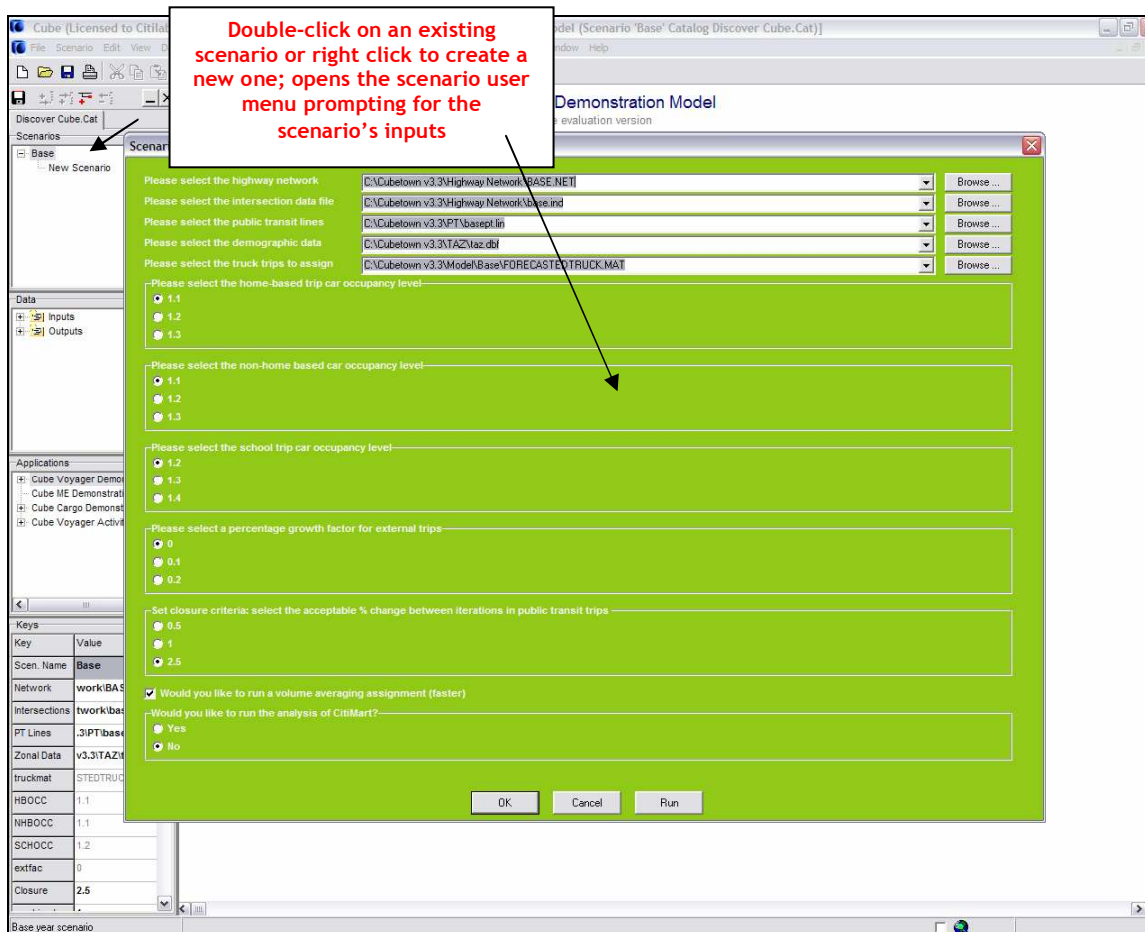
Figure 3.7 Opening the Scenario User Menu

- ▪ **Applications**: the application sub-window is where the 'applications' or models are stored within the catalog. In most cases, one model will be stored here. Double clicking on the application, opens the application in the main window in flow chart form.

- ▪ **Data**: the data sub-window is simply a place to create one-click links to any of the inputs and outputs whether they are data or reports. Double clicking on one of these, opens the information in the main windows.

- ▪ **Keys**: think of 'keys' as the key inputs. A model, like FSUTMS, contains many input files and model and scenario parameters. Examples include: the zonal data, the transit fare, the mode choice coefficients. The model developer can publish these inputs and settings to the scenario user menu prompting the user for scenario-specific

inputs. Normally, model coefficients would not be put here (except perhaps when calibrating the system). It is meant to be used to ask the user of the model to set the inputs for the chosen scenario.

Cube Graphics

The Cube Graphics sub-window is opened when the user opens a highway network, shape file, transit network, or intersection data. Cube Graphics provides comprehensive features for network and data creating and editing as well as GIS functionality. If the user has a license of ArcGIS on their machine, the same data may be exported and opened in ArcGIS.
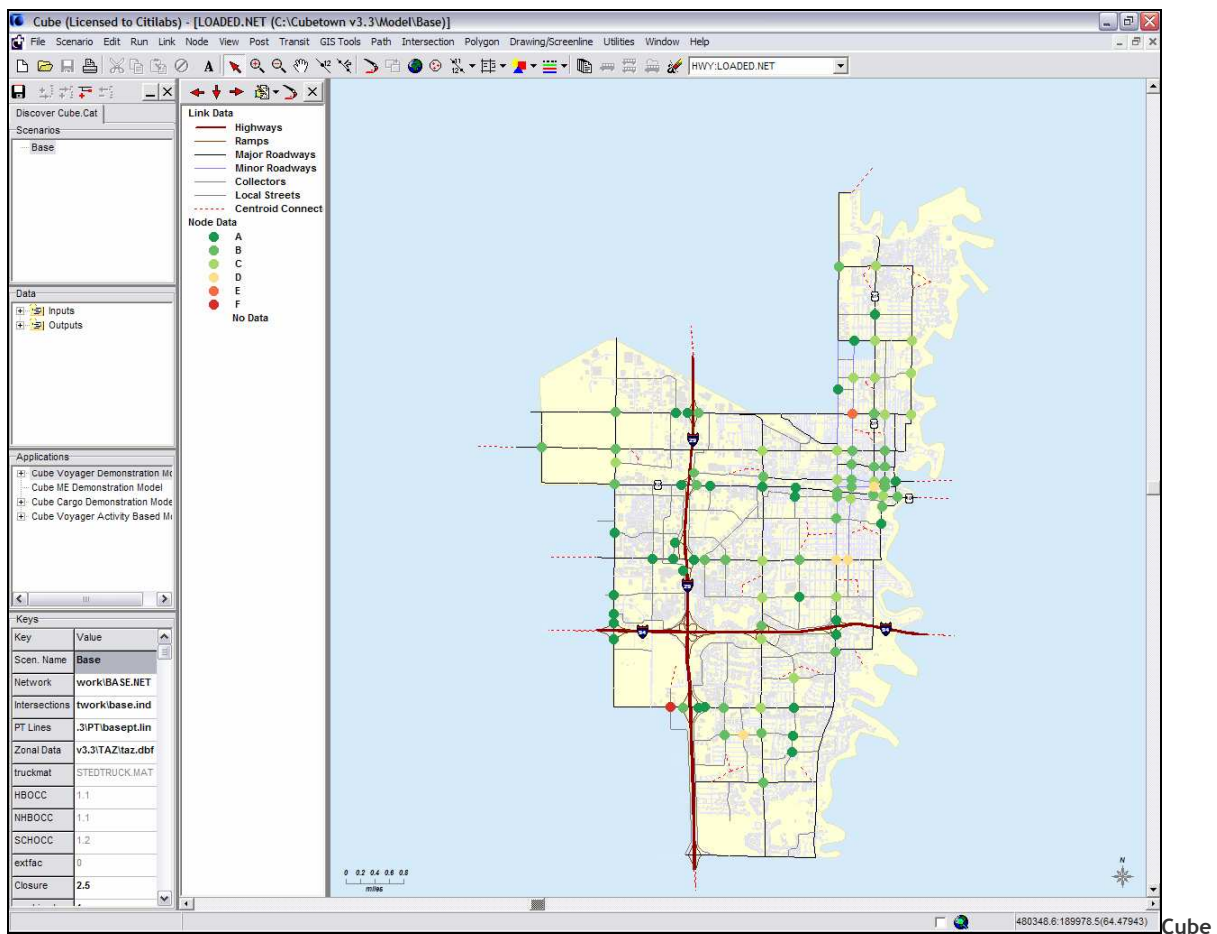

Figure 3.8 Cube Graphics

Cube Graphics provides the capability to create a wide variety of pre-developed and stored graphical commands such as color sets to display volume/capacity ratio, node charting to

display level of service, etc.

USER INTERFACE

The user interface for FSUTMS-Cube is comprised of two levels:

- Level 1: Selection of the area to be modeled: This initial menu provides a map-based view of all of the models available in the state of Florida. The user selected the model that they wish to use via the level 1 interface.
- Level 2: Once the model to be used is selected via the level 1 interface, Cube itself is started and the Cube user interface is then used for the modeling tasks.

The Level 1 Interface: selecting the area to be modeled

The Level 1 interface was developed using HTML and serves as a map-based shell over the models themselves contained within a series of Cube Catalogs. The program is launched in the user's browser and could, over time, be the basis of future FSUTMS that could be run through the internet.

Convention 1: Layout and Function of the Home Page of the Level 1 User Interface

The home page provides the following functions:

- Selection of the model to be run via the map or via buttons
- A button to Support. This would take the user to pages providing access to FAQs, 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.
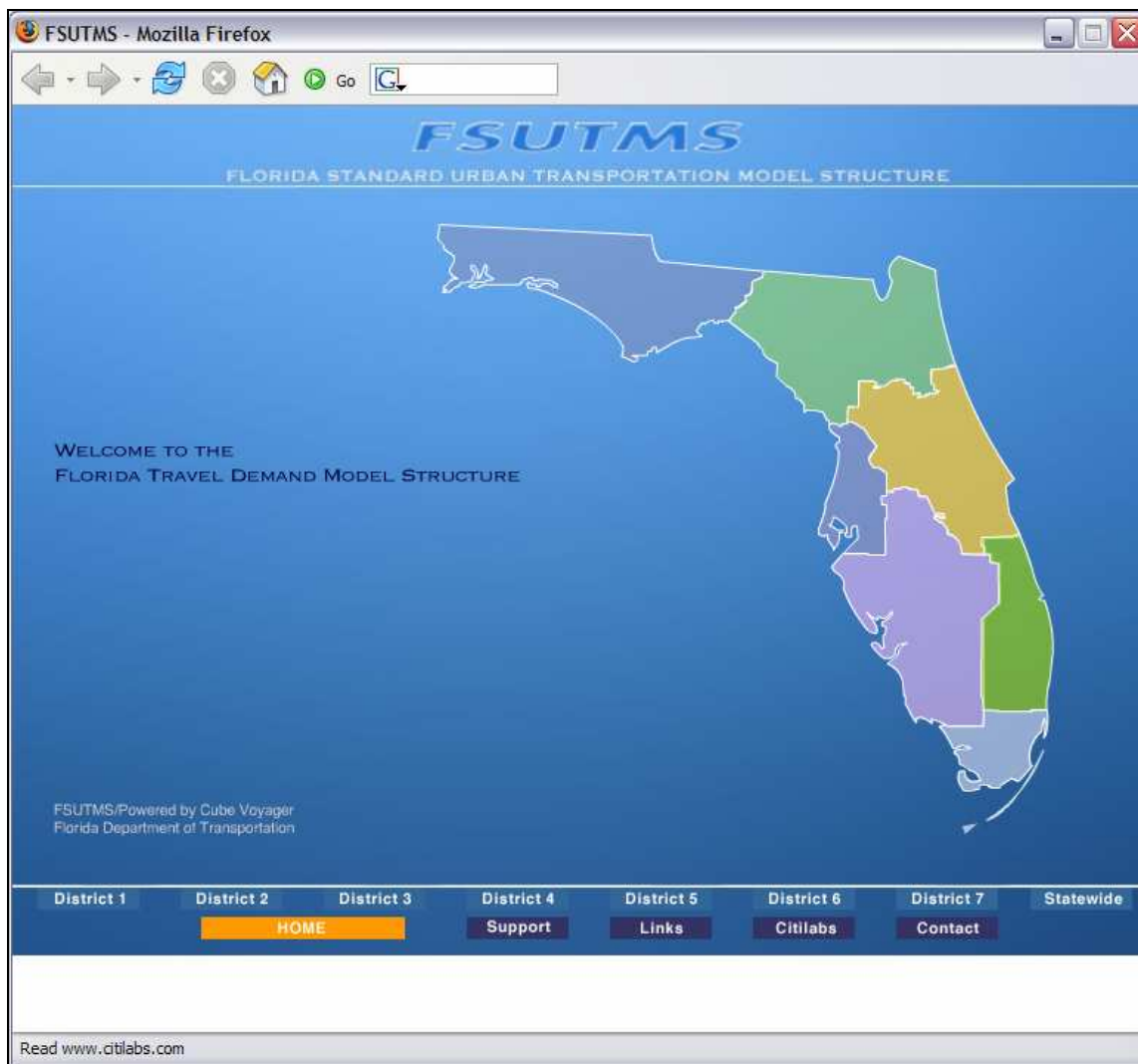
Figure 3.9 Level 1 User Interface Home Page

Selecting a Model, Creating Scenarios and Applying the Model

By selecting one of the districts, a sub-page appears (see below). Regional maps will be added to each of the sub-pages providing the same capabilities as available on the home page.
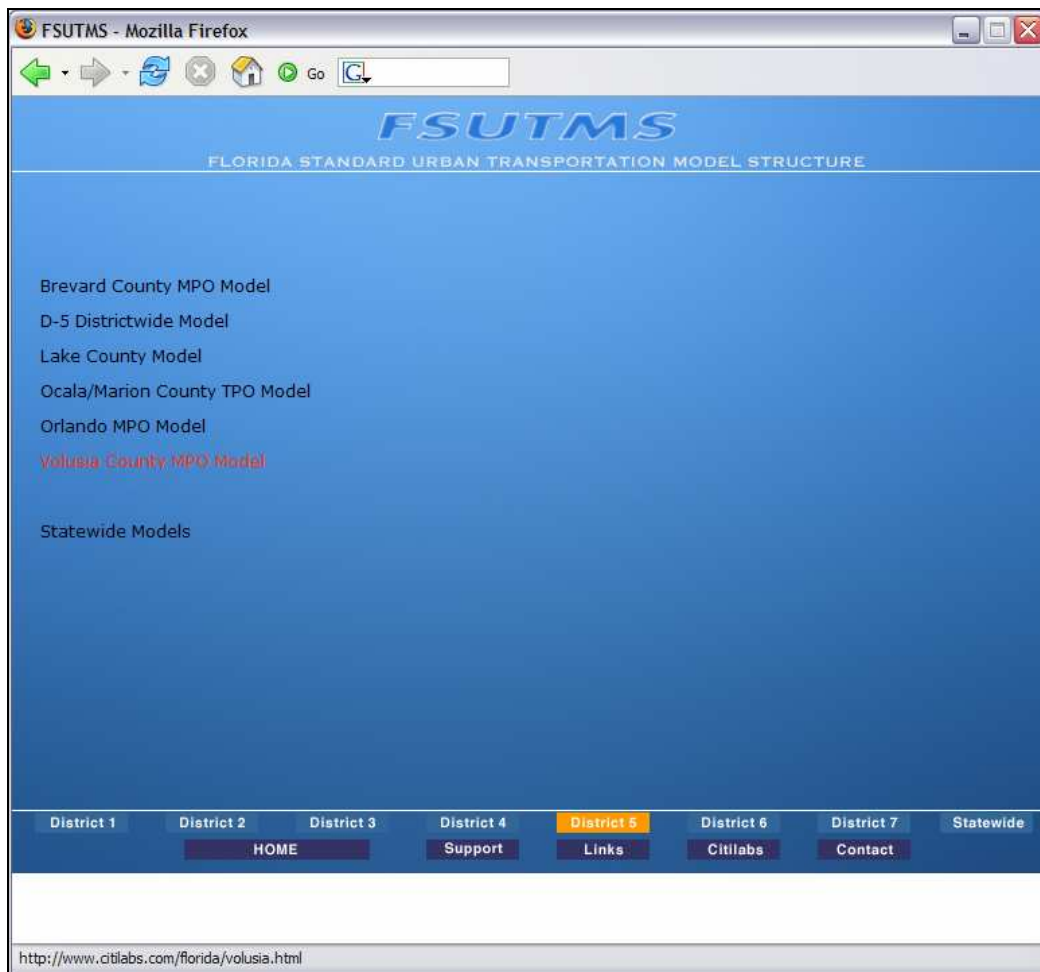
Figure 3.10 User Interface Model Sub-Page

By clicking on one of the models, Cube is started, the splash screen appears as show below and the appropriate model is opened.
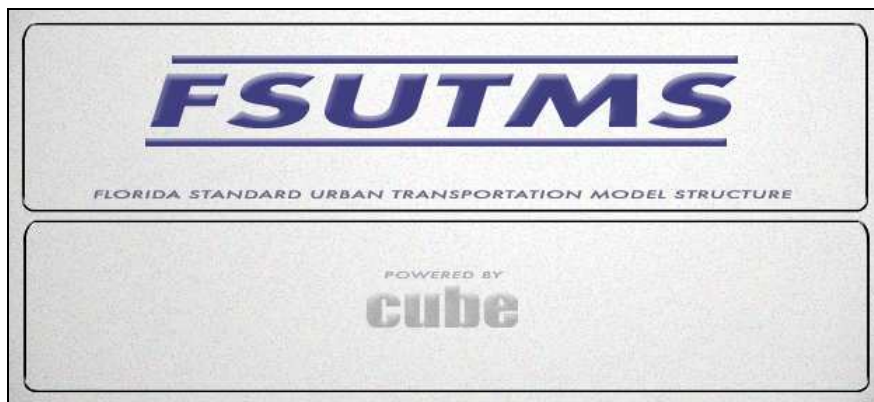
Figure 3.11 Splash Screen

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.
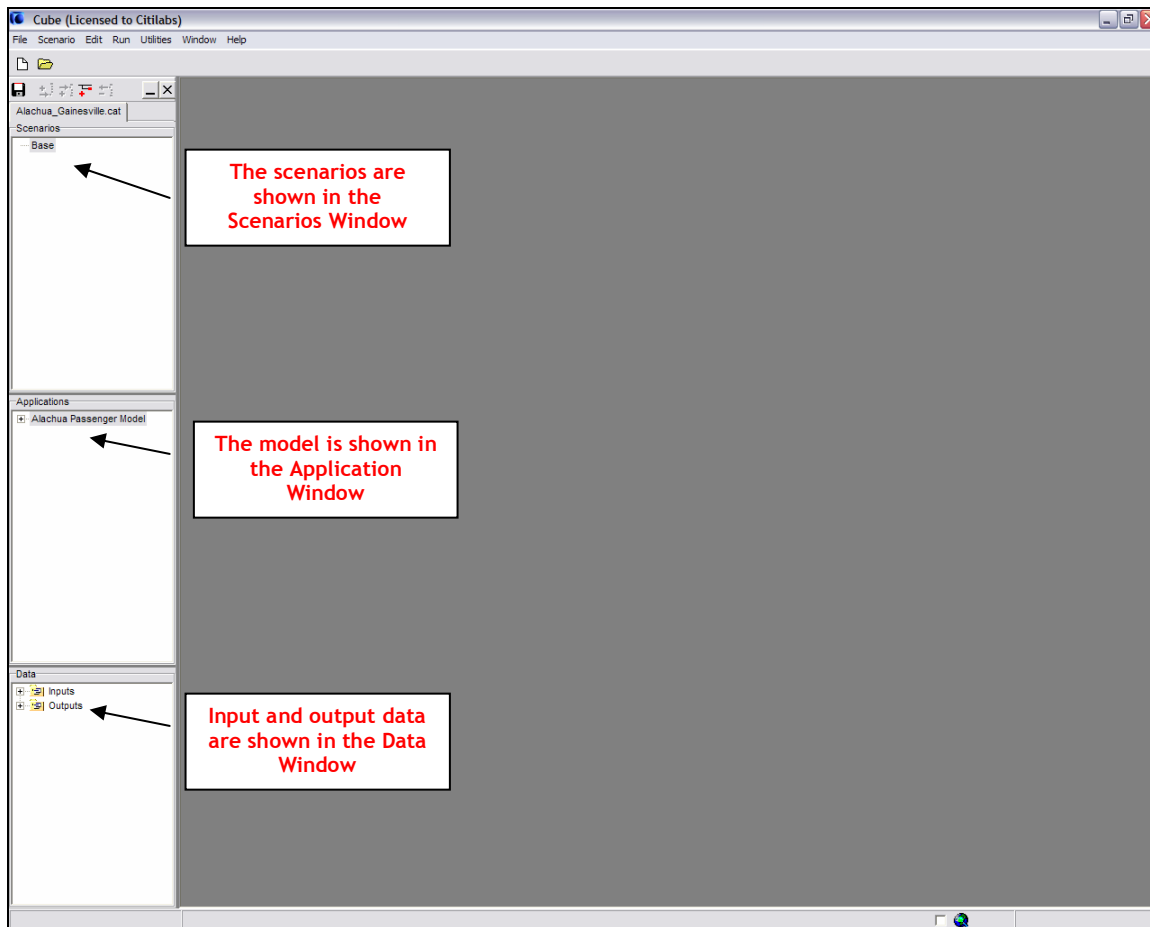
Figure 3.12 Opening of the Catalog of the Selected Model

Convention 2: Naming of the Catalogs and Applications

The name of the Catalog appears at the top of the Scenario Manager column. This file is the 'master' for all of the data, models and scenarios for the area to be modeled. It is suggested to name these using the full, official name of the model (example: Tampa Bay Regional Model.Cat)

Several applications (model processes) can be contained within the Catalog. The names of these application should be standardized to provide clarity and homogeneity. It is suggested to use key words such as 'Passenger' and 'Freight'. Thus, the Tampa Bay regional forecasting model, would be called the: "Tampa Bay Regional Passenger Model.app

The model can be operated in two alternative forms:

Developer Mode Under this mode, the user may modify the model structure and parameters. Although all of the windows are available for use in this mode, the principal window used in this mode is the flow chart view provided by the Application Manager window of Cube. By double-clicking on the Application (in the current example: Alachua Passenger Model), the flow chart view is opened in the main window (see below).

Figure 3.13 Model View Provided in Developer Mode

Convention 3: Access to Developers Mode

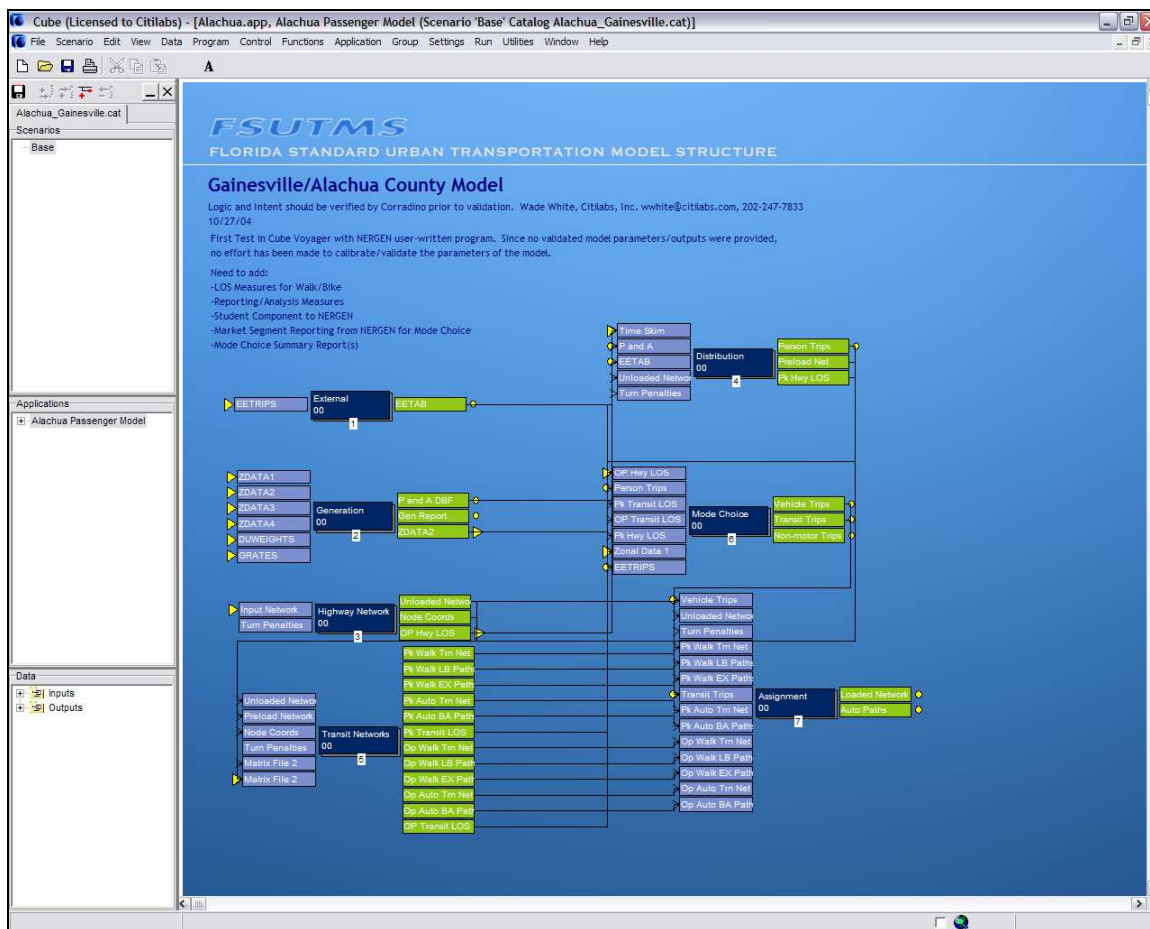When the Catalog is opened in Developers Mode, the user may change the internal structure, parameters and functions. They have the 'rights' to make changes to the model core. Therefore a convention should be decided on access to Developers Mode. Currently, this function is fairly hidden in Cube but is not password protected. It might be useful to consider adding this function.

Convention 4: Use of Free Text on the Flow Chart View

The 'developer' can place text anywhere they desire on the flow chart. This capability can be used to describe the model; to instruct users of the models and to provide information and warnings.

Convention 5: Use of File Descriptors and Colors in the Flow Chart View

The 'developer' can freely choose the text description to place 'over' each of the input and output files in the flow chart view. A convention should be created with standard text for each of the files to make the model easier to use and understand.

Convention 6: Use of Standard Sub-Groups

A model in Cube is normally segmented into several 'layers' of flow chart. The top layer (the 'parent' in Cube) provides an overview of the model. Sub-groups are created in Developer Mode to make the model easier to understand and use. A convention should be created. In the current conversions to date, the following sub-groupings were created:

- External
- Generation

- Highway Network

- Transit Network

- Distribution

- Mode Choice

- Assignment

Appliers Mode If the catalog is stored in Appliers Mode, the principal operating window of Cube is the Scenario Manager window. The user would double click on the scenario they wish to open (see below). This is the mode that would be used by those applying the models.

Figure 3.14 Scenario Manager View in Applier's Mode

Additional scenarios are created by simply right clicking on one of the existing scenarios. All of the parameters and inputs from the 'mother' scenario are propagated down to the 'daughter'. The user simply enters the differences they desire for the new scenario.

Convention 7: Choosing the Prompts to Provide the User

A model contains hundreds of parameters and input files. This convention concerns which of these should be 'keyed' (brought to the user menu). The developer can bring 'everything' to the menu via these keys and it is very useful to do so when adjusting and calibrating the models (in the current example, one can see that many items are on the menu because the models is still to be calibrated). However, it is important to simplify and carefully select which parameters and files will appear on the menu.

Convention 8: Choosing How the Prompts Should Appear

For each of the prompts in the user menu, Cube provides several ways of prompting the user. The options are:

- Text: just open text. Normally used for description
- A Browse button: allows the user to freely search for an input
- A Pull-Down menu: provides a list of options. The user must select one of these options
- A Button Menu: provides a list of options. The user must select one of these options.
- An Open Pull-Down Menu: provides the user with a list of options but allows them to enter other values.

In addition, for parameter values (for example, transit fare), the menus can be constrained with minimum and maximum values. Such constraints should be included in the conventions.

Convention 9: The Naming of Scenarios

The user simply right clicks in the scenarios sub-window of Scenario Manager and may create a scenario. Cube prompts for a name. It may be useful to set a convention for the naming and organization of the scenarios. Scenario names may have very long names and contain text and numbers (but must start with a letter).

A model run is launched by simply clicking the Run button on the user screen. The Task Monitor window appears (see below) providing information on progress. The user may pause or cancel the run if so desired.
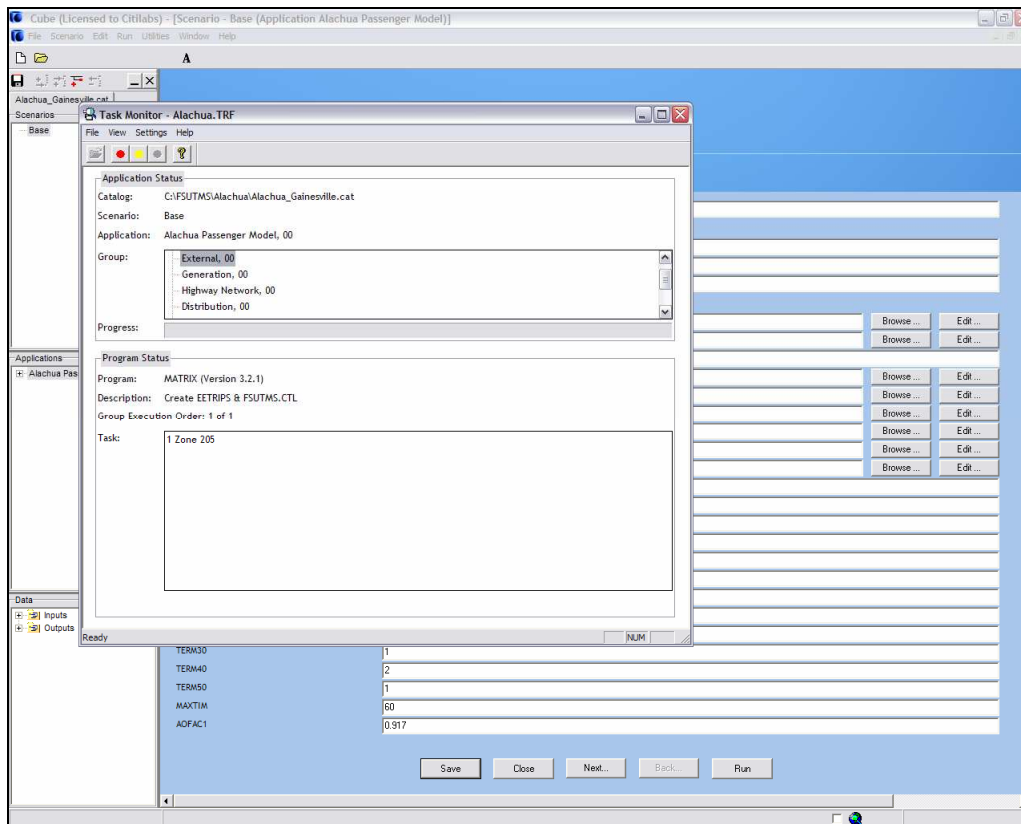
Figure 3.15 Task Monitor Used to Show and Control Run Progress

When completed, the model outputs can be selected and accessed in the Data window of Scenario Monitor. Double clicking opens the file in the main window as shown below.

Figure 3.16 Opening Data via the Data Window of Scenario Manager

Convention 10: Deciding Which Files are to be Saved for Each Scenario

Output files may be deemed 'scenario specific' in Cube. If they are not identified in this way they are treated as intermediate files and are not saved. Those identified as scenario specific are saved and written automatically to the scenario-specific directory. This enables the developer of the model to reduce the number of files and total size of the output generated by a scenario. A convention should be developed to identify the scenario specific files.

Convention 11: Providing access to editing and viewing input files, output files and reports

The data sub-window of Scenario Manager allows the developer to provide 'one-click' access to the input and outputs of the model. In Applier Mode, this menu is where the user will find

and open these files. The model uses and generates many files. This is another opportunity to simplify and highlight the important inputs and outputs from the model.

FILE NAMING

FSUTMS used standard file names to help users manage and locate the various input and output datasets. Since all data are managed by Cube itself, the need to have standard file naming is considerably reduced. The only reason to use such rules is to help users to understand what the file contains when navigating outside of Cube (e.g. looking at a file from Windows Explorer or other file manager).

Cube provides the capability to automate the naming of output files. This would make the implementation of a standard very easy. For the input files, it is simply a question of making a policy.

For the automatically generated output files, Cube uses 8 character names followed by standard file extensions. These extensions should not be modified as some of the modules are developed to search for these extensions. The extensions used in Cube for input and output files are shown below.

Extension	File Contents	Format	Program	I/O
Multiple Programs				
S	Program script file	Text	Multiple	Input
NET	Highway network	Binary	Multiple	Input/Output
MAT	Matrix data	Binary	Multiple	Input/Output
DBF	dBase format dataset	Binary	Multiple	Input/Output
DAT	General text file	Text	Multiple	Input/Output
PRN	Reports and messages	Text	Multiple	Output
Highway				
IND	Input intersection data for junction assignment	Text	Highway	Input
PEN	Input turn penalities for non-junction assignment	Text	Highway	Input
BIN	Output turn volumes for non-junction assignment	Binary or Text	Highway	Output
INT	Output intersection data for junction assignment	Binary	Highway	Output
PTH	Highway path file	Binary	Highway	Output
ICP	Intercept file for use in Cube ME	Binary	Highway	Output
Public Transport				
LIN	Public transit line descriptions for PT	Text	PT	Input
NTL	Public transit non-transit links	Text	PT	Input
PTS	Public transit system file for PT	Text	PT	Input
FAC	Public transit factor file for PT	Text	PT	Input
FAR	Public transit fares for PT	Text	PT	Input
RTE	Public transit routes	Binary	PT	Output
Pilot				
VAR	Variables files for PILOT	Text	Pilot	Input

Figure 3.17 Extensions Used in Cube Voyager

The 8 characters prior to the extensions in Cube are of the following format:

ZZPPPNNA

where:

ZZ is the Application Code. The Application Code is specified in the properties of the layer. This would be the ideal place to use these two characters to represent the model region (example: TB for Tampa Bay, MI for Miami…).

PPP is a short name of the program used to create the file. The short names in Cube Voyager are:

- NET: file is created by NETWORK
- GEN: file is created by GENERATION
- DST: file is created by DISTRIBUTION

- FRA: file is created by FRATAR
- MAT: file is created by MATRIX
- PTR: file is created by PUBLIC TRANSPORT
- HWY: file is created by HIGHWAY
- PIL: file is created by PILOT

This code along with the file extensions, provides a pretty good idea of what is contained in the file. For example, TBHWY00A.NET. The TB would indicate Tampa Bay, the HWY and NET would indicate that it is an output highway network from Highway-the traffic assignment program. Thus, it is probably an assigned highway network.

NN is the Version Number. This code is similar to the Application Code. It is specified in the properties of the layer. A suggestion is to use this to represent the year of the file (2010=10…).

A is a letter that automatically goes from A to Z so that files with the same generated names do not overwrite.

Convention 12: Setting standard file names for inputs

The only constraint placed on this convention by Cube is the three letter suffix. The standard values used by Cube should be maintained. It is possible to have very long, descriptive naming for the portion of the file name prior to the suffix.

For example, it would be possible to have a file named: Year 2020 Tampa Maximum Build.Net

It is hard for us to make a recommendation for the input files as they are very open. Either, the naming should be of the 'long' variety or of the short variety. An 'short' version of the example could be: TP20MBLD.NET.

Convention 13: Setting standard file names for outputs

It would be advantageous to use the automated file naming capabilities of Cube for the generation of the output files. The standard suffixes should also be maintained.

For the output files, Cube currently uses the convention as noted above for the 8 prefix characters:

ZZPPPNN:

ZZ: is the Application Code. It would seem to make sense to assign these two characters a geographic descriptor such as TB for Tampa Bay and MI for Miami.

PPP: is the short name of the program used to generate the output file. This helps to understand the type of information stored within the file.

NN: is the version number. This field could be used to show the date of the data.

An example using this convention:

TBGEN10.DBF

This notes that the file is for Tampa Bay, came from the Generation model and is for 2010. Because it is in DBF format and came from the Generation model, it is highly likely that this file contains the estimated productions and attractions.

Unfortunately, this format and convention does not allow a place to provide information about the scenario (Max Build for example). Cube could be modified to use, for example, a three character scenario descriptor substituting for the name of the program.

FILE/DIRECTORY STRUCTURE

When the user creates a new scenario in Cube (using Scenario Manager), Cube will create a sub-folder in a master scenario directory with the name of that scenario. All scenario specific outputs will be stored in that sub-folder. The inputs would normally come from other directories.

Convention 14: Setting a standard File/Directory Structure

It is recommended to have a Master Directory with the name of the Catalog. For example, it the name of the Catalog is: Broward County Model, then this would be stored in Drive:\Broward County Model

Under the Master Directory a series of directories would be created. These would be:

C:\Master Directory – contains the catalog
    \Model – contains the applications, scripts and other model related info
    \Media – contains GIS layers, photos, films..
    \Inputs
        \Base
            \Highway Networks
            \Transit Networks
            \Land Use Data
            \External Data
            \Zonal Data
        \Y2010
            \No build….(to be named)
                \Highway Networks
                \Transit Networks
                \Land Use Data
                \External Data
                \Zonal Data
        \Y2020…
      \Outputs

```
          \Base
          \Y2010
                    \No build….(to be named)
          \Y2020…
```

A possible directory structure is as follows:
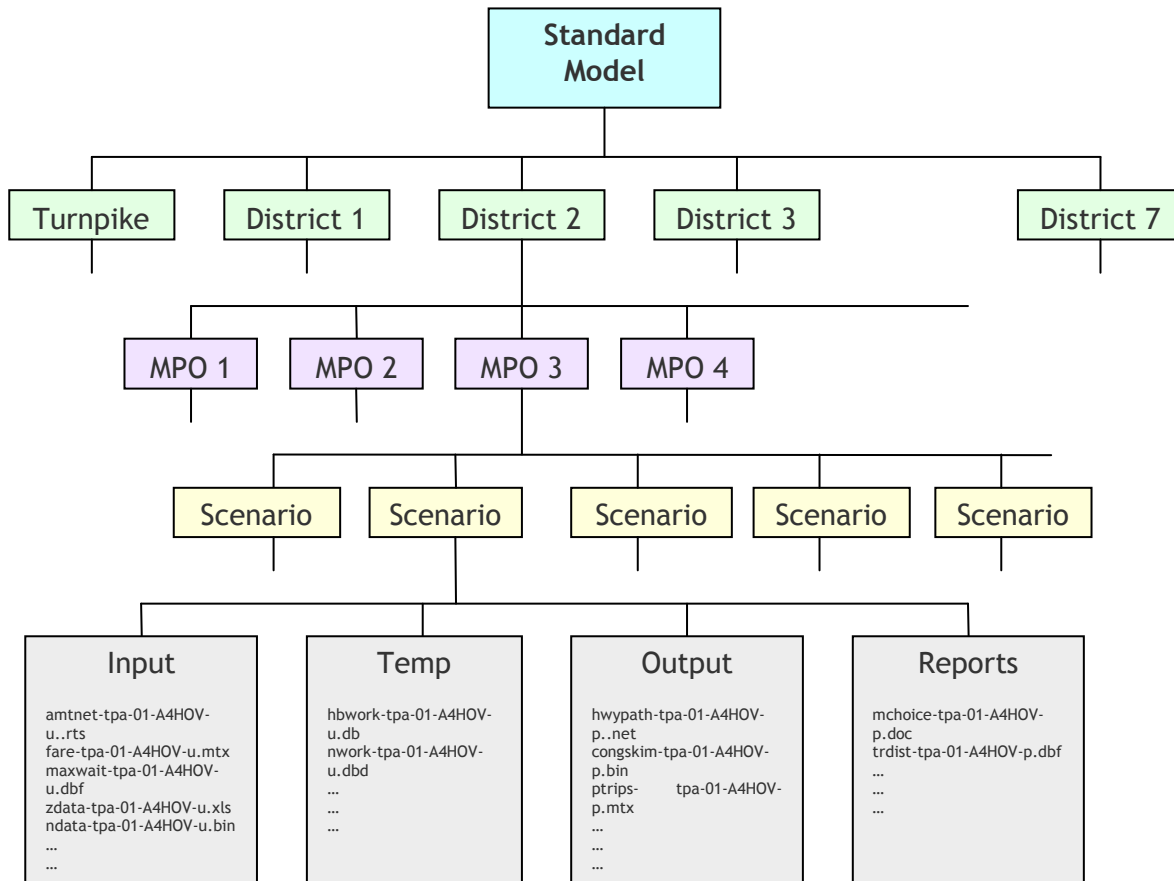
Figure 3.18 Possible Directory Structure

MODEL STRUCTURE/LOGIC

The change of model platform offers an opportunity to modify and enhance the model logic and structure. However, in general, the change in platforms does not necessarily require a change in structure and logic. The most compelling reasons for changing the model structure/logic would be: (1) there may be better procedures, (2) to eliminate the UTPS-based legacy procedures, and (3) Cube makes better procedures available.

The ability to analyze different modes of transport such as walk and bike modes, time of day modeling, and so on constitute new methods and applications that would be valuable to the modeling community in the state. At this time, the incorporation of such enhancements into the standard FSUTMS structure is being considered a long-term model development effort.

Convention 15: Model Structure/Logic

It is suggested that the existing model structure/logic be retained in FSUTMS-Cube.

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 somewhat simplify the modeling process used in Florida and would still enable for variations such as the District 4 and District 7 Lifestyle Models. Various committees of the Model Task Force should continue discussion and research on different methods of trip generation, distribution, and mode choice but for the short term, it is unlikely that all MPOs or FDOT districts are likely to adopt a single Lifestyle Model approach. Since no official MPO or District model has yet to adopt a time-of-day process, this could be considered an issue for evaluation beyond the current FSUTMS-Cube standards phase.

Within this context, it may be useful to examine database structures and formats. For example, zonal data could be kept in separate ZDATA databases or in the TAZ GIS database. Separate ZDATA files can be "joined" to the zonal GIS database file. The zonal database polygons are not likely to be changed very often. It is recommended to have a Master Directory with the name of the Catalog. For example, it the name of the Catalog is: Broward County Model, then this would be stored in Drive:\Broward County Model

DEFAULT FSUTMS-CUBE PROCEDURES

Cube Voyager comes supplied with standard procedures (scripts) stored as 'templates'. It is possible to add to these procedures the standard procedures used in FSUTMS and other useful procedures perhaps done when analyzing and comparing scenarios. In addition, since Voyager has functionality not available in TRANPLAN, certain 'enhanced' functions should be scripted and added.
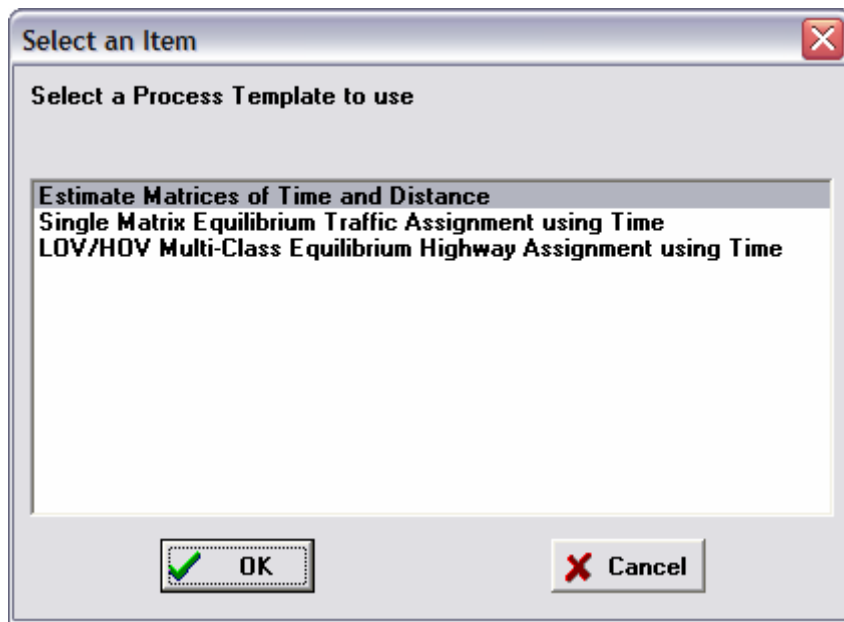
Figure 3.19 Example of Templates in Cube

Convention 16: Standard Procedures

It is recommended that the standard procedures from FSUTMS be stored in the templates. Other useful functions for analysis should be developed and added.

PARAMETERS

The FSUTMS Interactive Users' Library CD includes a complete listing of model parameters and coefficients by module. This electronic document also provides recommendations on sources of typical model parameters used in trip generation such as trip production rates, trip attraction rates, dwelling unit weights, and friction factors. While these recommendations should generally be considered reliable, more recent travel surveys and model validation studies might have resulted in new variations that are worth considering. As we have entered a new century, it is reasonable to recommend that MPOs abandon the use of default parameters originally recommended in Model Update Tasks B and C, as these were based on travel survey data from the 1960s and 1970s. A wealth of household travel surveys conducted in Florida during the late 1980s, 1990s, and more recently provide a more reliable source for such information. Census 2000 data should be encouraged as a source for dwelling unit

weight calculations and journey-to-work comparisons.

Convention 17: Standard Parameters

In general, model parameters are not software specific. Therefore, as an interim measure, it is recommended that existing FSUTMS parameters be retained. In the long term, it is recommended that all model parameters and coefficients be researched and updated to reflect the latest travel behavior trends and policy considerations.

NETWORK CODING STANDARDS

Convention 18: Network Coding Standards

Existing FSUTMS network coding standards are applicable in the for the first wave of model conversions. All existing network coding standards are being maintained at this time. In the long term, however, the network coding standards should be substantially enhanced and updated.   It is recommended that an enhanced base map be used for the highway network layer, and that this single layer be used as the basis for all highway and transit networks in the future. It is important to strengthen the tie between the transit and highway networks by using a common base map for these networks. This would facilitate an integrated multimodal analysis using a process equivalent to that in Tranplan for highway/transit speed calculations.

GIS THEMES AND TEMPLATES

Convention 19: Standard Mapping Templates (sets)

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.

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.

ROADWAY GEOGRAPHY

Convention 20: Highway Networks

The ultimate objective under this item is to incorporate roadway geography and shapes into model networks, thus moving away from the stick-network formats used in FSUTMS-Tranplan. As an intermediate standard, models with up-to-date networks and base maps should be converted to Cube Voyager formats.

Eventually these systems should be changed to use an enhanced base map with shapes for the highway network layer, with this single layer as the basis for all transit networks.

STANDARD REPORTS

Convention 21: Reporting

Standard FSUTMS reports should be defaults in FSUTMS-Cube and should include the following at a minimum (listed by module). Note: It may be possible to combine some of these into single reports.

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, etc.
- 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
- Peak vehicle requirements (based on some TLOS measure?)
- Transit station loading graphical report

CHAPTER 4

INFORMATION TECHNOLOGY ENHANCEMENT PLAN FOR TRANSIT MODELING METHODS IN FSUTMS

INTRODUCTION

The project team has developed a plan for the enhancement of transit modeling methods in FSUTMS-Cube. This plan was developed as an outcome of the April 7-8 transit modeling workshop held in Tampa and the subsequent discussions at the Transit Modeling Committee meeting held in conjunction with the Florida Statewide Model Task Force meeting on May 4-5, 2004 in Daytona Beach. This chapter presents a complete plan for developing enhancements, standards, and guidelines for transit modeling in FSUTMS.

BACKGROUND

Increasing levels of congestion and use of the private automobile in Florida coupled with tightening funding, land use, and environmental constraints on roadway expansion have motivated urban areas around the state to consider substantial investment in expanding or building new transit systems that would make transit a more viable modal option for the traveling public. The growing interest in planning and building multimodal transportation systems in various areas of the state has focused attention on the planning models, tools, and methods that are used in the state for analyzing and evaluating transit systems. Moreover, in an era of tightening budgets and competing demands for scarce resources, it is widely recognized that the best tools are needed to evaluate and forecast the potential benefits that would arise from the investment. The Federal Transit Administration (FTA) New Starts program is an example of a process that demands rigorous analytical and modeling procedures for transit systems evaluation.

The Florida Department of Transportation Central Office is committed to the development, implementation, and application of best practice in transit systems modeling in the state.

The Systems Planning Office and the Public Transit Office have developed a series of methods, tools, and models in the recent past to help agencies plan and evaluate transit systems in a variety of urban contexts. The recent transition to the Cube modeling software as the engine for the Florida Standard Urban Transportation Model Structure (FSUTMS) offers a key opportunity for further enhancing transit modeling methods used in the state and to develop guidelines for best practice that are consistent with the expectations and requirements of the FTA. Moreover, transit systems modeling has often been regarded as a tedious and resource-intensive process; the transition in FSUTMS to the Cube modeling software engine provides an opportunity to make the process more user-friendly, transparent, and integrated with the highway modeling process. The Transit Modeling Committee of the Florida Statewide Model Task Force is leading the effort to implement best practice in transit modeling in the state and will play a pivotal oversight role in the execution of this plan.

The Blue Ribbon Panel Report commissioned by the Florida Statewide Model Task Force in April 2003 provided broad suggestions for enhancing the state of the practice in multimodal transportation modeling in Florida. The Blue Ribbon Panel suggested that the state would be well served by enhancing the transit modeling capabilities in FSUTMS and by ensuring that the procedures were consistent with best practice as articulated by the FTA. These suggestions were further cemented at a recent Transit Modeling Workshop held in Tampa (April 7-8, 2004), where various presentations highlighting the state of the practice in transit modeling, transit modeling needs and requirements from an FTA perspective, transit modeling experiences and pitfalls, and transit modeling issues were made by a variety of transit modeling and planning experts. These presentations and discussions provide an excellent starting point for developing and enhancing transit modeling methods and capabilities in FSUTMS and for developing guidelines for best practice in transit modeling that can help guide planners and modelers in the analysis and evaluation of transit investments.

OBJECTIVES

This plan is aimed at enhancing and standardizing the transit modeling procedures in FSUTMS-Cube. In particular, the following are the specific objectives of the proposed plan:

- To review best practices in transit systems modeling around the country in the context of the expectations, guidelines, and requirements articulated by the FTA

- To identify best practices in transit systems modeling that should be adopted and incorporated in FSUTMS-Cube as standard procedures

- To provide guidance on the development, specification, and application of transit systems modeling procedures in the state

- To develop a long term plan and strategy for integrating new and enhanced transit systems modeling procedures in FSUTMS-Cube.

As part of this plan, it is likely that a series of transit model improvements will be identified for potential implementation in FSUTMS. However, within the scope of this plan and the 12-month time schedule in which the enhancements need to be identified (as per the request of the Statewide Model Task Force), it is not going to be possible to implement and program every proposed improvement/enhancement into FSUTMS-Cube. Moreover, it is critical that the Transit Modeling Committee of the Florida Statewide Model Task Force have sufficient opportunity to deliberate the merits associated with various enhancements prior to taking the effort and committing the resources to implementing them. As such, while a few enhancements may be incorporated into FSUTMS-Cube within the scope of this plan, it is envisioned that the vast majority of the enhancements will be programmed into FSUTMS through a series of subsequent follow-up plans. The enhancements implemented in FSUTMS within the scope of this plan are likely to be those whose benefits are obvious and which can be programmed and implemented easily and quickly within the budget and time constraints of this plan.

WORK PLAN

This section provides a description of the various tasks that will be undertaken as part of the plan. The work plan has been formulated so that there is ample opportunity for the Transit Committee of the Florida Statewide Model Task Force to review progress and provide feedback during the course of the plan. This plan may be considered the first phase in a

series of plans aimed at enhancing and standardizing best practice in transit modeling in Florida.

Task 1: Development of Detailed Plan and Methodology

The proposed plan is aimed at enhancing and standardizing transit modeling procedures in FSUTMS-Cube and providing guidance on best practice in transit modeling for Florida's transportation modeling community.   Although these objectives are well defined, the methodology and strategy by which these objectives can be accomplished are not well defined. The team will meet with the Transit Committee of the Florida Statewide Model Task Force and present a detailed plan and methodology for accomplishing the objectives of the effort. The team will work with the transit committee to refine the plan, come to agreement on the issues and priorities related to transit model enhancements, and develop a clear plan of action and task assignments for the effort. The results of the deliberations from the April 7-8 Transit Modeling Workshop will be used as a starting point for developing the detailed plan and methodology. Within this task, the specific types of improvements that can be programmed into FSUTMS-Cube as part of this plan will be identified. Also, the scope and nature of the deliverables (for example, the nature of the best practice guidelines to be developed in this plan) will be defined in this task and during the first meeting with the Transit Modeling Committee of the Florida Statewide Model Task Force.

Tasks 2 through 6 constitute the core of the proposed plan. In these tasks, various modeling steps or procedures most relevant to transit modeling need to be addressed in a comprehensive manner. Each task will have an identical set of subtasks aimed at clarifying the issues, identifying enhancements and standards, and developing guidelines for best practice.

Task 2: Transit Network Coding and Attributes

FSUTMS-Cube offers enhanced GIS and transit network editing, coding, and building tools that can be used to code accurate transit networks.   Transit network coding and attribute definition includes, at a minimum, the following aspects:

- Route segment or line attributes
- Node/stop attributes
- Route network by time of day/time period

- Coding and defining auto connectors (auto access)
- Coding and defining walk connectors (walk access)
- Consistency and integration with highway network and highway speeds

The accuracy of the transit network is closely tied to the choice of the network basemap that is chosen for building the highway and transit networks. Using a detailed street map (as opposed to the typical model highway network) will provide a basis for developing an accurate transit network with auto and walk connectors that are consistent with the underlying street network. Another critical aspect related to the integration of the highway and transit networks is the ability to reflect changes (say, increasing levels of congestion) in the highway network on the transit network performance. Through an integrated system, changes made to the highway network can be automatically reflected in the transit network. Such a process would greatly enhance the consistency between the highway and transit network edits. However, it is also possible to use published schedules as a basis for determining transit speeds and travel times. While this method reflects transit travel times, it may be difficult to tie changes that would occur in the schedules to changes in the highway system.

The coding and definition of auto and walk access connectors should potentially be automated to the extent possible. Again, this can be made possible by having an accurate and detailed underlying street network upon which the auto access and walk access connectors can be defined for each stop. Several new tools being developed by the FDOT Central Public Transit Office such as FTIS, TLOS, and TBEST also call for more accurate and detailed transit networks. This task will focus on developing and designing enhanced methodologies, tools, and standards for transit network coding.

Attention should also be paid to the definition of alternatives and scenarios. Standards should be established to define what constitutes a baseline alternative, alternative build scenarios, and ways of quantifying the differences among them. In comparing alternatives and the benefits that accrue to travelers from various build alternatives, defining and quantifying differences among alternatives is key to the FTA's New Starts plan analysis process. In this context, various software and network-related questions will need to be answered. For example, should all scenarios operate off the same base network or should

different scenarios/alternatives have different base networks? Standards and guidelines are needed to clarify the development of alternatives and the transit networks that define them.

Subtask 2.1: Review Best Practice and Clarify Issues
In the first subtask, a detailed review of best practice, tools available and used for transit network coding, and issues related to transit network coding will be conducted.

Subtask 2.2: Identify Enhancements and Standards to FSUTMS-Cube
The team will identify enhancements to transit network coding procedures for FSUTMS with particular emphasis on those enhancements that take advantage of the GIS and transit coding capabilities of Cube. In addition, the team will define a set of standards that should define all transit networks in FSUTMS models in the state.

Subtask 2.3: Develop Guidelines and Guidance on Transit Network Coding/Attributes
Based on the results of Subtask 2.2, the team will develop a series of guidelines and provide guidance on the development, definition, coding, and attributes of transit networks. These guidelines will be consistent with the enhancements and standards defined in the previous subtask to ensure that the modeling community in the state has the tools needed to meet the standards and follow the guidelines.

Subtask 2.4: Implement/Program Selected Enhancements in FSUTMS-Cube
The team will identify a selected set of enhancements or procedures for transit network coding that can be implemented and programmed into FSUTMS-Cube within the scope, resources, and time frame of this plan. These enhancements and procedures are those that provide clear and present benefits, are easy and quick to program in FSUTMS-Cube, and have well defined methods, tools, procedures, and standards that define them.

Subtask 2.5: Develop Plan/Strategy for Implementing Enhancements and Standards
As it is unlikely that all potential enhancements and standards can be implemented within the scope of this plan, the team will develop a longer-term strategy and plan for implementing the enhancements and standards identified in this task into FSUTMS-Cube.

Task 3: Transit Path Building

The primary objectives of transit path building are to develop and compute transit skims for mode choice modeling (and possibly for trip distribution modeling as well) and to build paths for transit assignment. There is a need for consistency in transit path building throughout the modeling process. There are several path building algorithms and options in Cube that have important implications for transit assignment. Different options include:

- Shortest path (all-or-nothing)
- Optimal strategies
- Pathfinder
- User equilibrium (assignment)
- Stochastic user equilibrium (assignment)

It is important to understand the advantages and disadvantages of the different methods and algorithms in different transit contexts and to develop standards for their use and application in practice in Florida. Best practice methods should be incorporated into FSUTMS as standard transit path building tools.

The computation of impedance is a critical component to building transit paths. There are various components of impedance in a transit context, including, but not necessarily limited to:

- In-vehicle time
- Initial wait time
- Transfer wait time
- Access time
- Egress time
- Dwell time
- Number of transfers
- Costs

It is important to ensure that variables used in the computation of impedance and their weights are consistent with the mode choice utility equations.

In building the access links associated with transit paths, one should consider using a detailed street network as an underlying basis for developing walk access links and connectors. On the other hand, one may be able to use the highway model network and centroid connectors to develop the auto access links and connectors. Enhancements to the access/egress components of the transit paths will be considered as part of this plan.

Within the context of transit path building, one should also give consideration to time of day modeling issues. In general, it is critical to ensure that there is consistency between mode choice and assignment. Thus, if mode choice and transit assignment are to be performed on the same time periods, time of day modeling procedures should be introduced prior to mode choice (either between trip distribution and mode choice or between trip generation and trip distribution). Appropriate time of day modeling enhancements and standards will be identified as part of this plan.

At the transit modeling workshop held on April 7-8, 2004, the use of weights on links used by certain modes was discussed to ensure that the path builder is building the "correct" path. Currently, a weight is applied to the preferred mode in the path builder routine. The need to eliminate limits on different variables in the path building routine was also noted at the meeting. Most of the built-in limits on variables such as wait times, walk and auto access/egress times, transfer times, and number of transfers may lead to inaccuracies when alternatives are compared against one another. The use of non-linear functions or piecewise linear functions (as is used in the 1st wait versus 2nd wait time) to avoid the use of artificial limits was discussed at the MTF meeting. This plan will explore these methods and determine those enhancements that should be incorporated as standard best practice in FSUTMS.

Subtask 3.1: Review Best Practice and Clarify Issues
In the first subtask, a detailed review of best practice, methods and tools available and used for transit path building, and issues related to transit path building will be conducted.

Subtask 3.2: Identify Enhancements and Standards to FSUTMS-Cube
The team will identify enhancements to transit path building procedures for FSUTMS with particular emphasis on those enhancements that take advantage of the methods, tools, and capabilities available in Cube. In addition, the team will define a set of standards for transit path building in FSUTMS models in the state.

Subtask 3.3: Develop Guidelines and Guidance on Transit Path Building

Based on the results of Subtask 3.2, the team will develop a series of guidelines and provide guidance on transit path building procedures in different contexts. These guidelines will be consistent with the enhancements and standards defined in the previous subtask to ensure that the modeling community in the state has the tools needed to meet the standards and follow the guidelines.

Subtask 3.4: Implement/Program Selected Enhancements in FSUTMS-Cube

The team will identify a selected set of enhancements or procedures for transit path building that can be implemented and programmed into FSUTMS-Cube within the scope, resources, and time frame of this plan. These enhancements and procedures are those that provide clear and present benefits, are easy and quick to program in FSUTMS-Cube, and have well defined methods, tools, procedures, and standards that define them.

Subtask 3.5: Develop Plan/Strategy for Implementing Enhancements and Standards

As it is unlikely that all potential enhancements and standards can be implemented within the scope of this plan, the team will develop a longer-term strategy and plan for implementing the enhancements and standards identified in this task into FSUTMS-Cube.

Task 4: Mode Choice Model and Modal Utility Equations

Transit models produce travel forecasts for proposed transit facilities or investments, and these forecasts are often used to determine how favorably the benefits of the plans compare to their costs. To ensure the accuracy of the ridership forecasts, FTA has begun evaluating the mode choice equations to determine whether the model coefficients and alternative specific constants are reasonable and justifiable. With the wide variety of transit modeling procedures used throughout the country, the new strategy is designed to establish a level playing field for all New Starts plan applicants. The new approach is intended to ensure that ridership forecasts — and the resulting predicted benefits — are not unfairly inflated for some plans compared to others. An analysis of 19 recently completed New Starts projects revealed that only about one-half of the projects' actual ridership was within acceptable range of the original travel forecasts. FTA is currently determining whether these discrepancies can be traced to overestimated socio-economic data or to inappropriate mode choice equations.

It is clear that the mode choice model structure, specification, utility equations, coefficients, and variables play a substantial role in transit modeling and ridership estimation. Considerable emphasis will be placed on the enhancement of and development of standards for mode choice models in FSUTMS within the scope of this plan. At a minimum, the plan will address the range of issues and aspects identified at the transit modeling workshop held on April 7-8, 2004. The issues identified at that workshop include:

- model form/structure
- mode choice set
- impedance measures
- socio-economic variables
- Izone Jzone adjustments
- coding access modes
- constants and coefficients
- type of reporting
- time of day modeling
- computing user benefits
- software issues.

The discussion below is largely drawn from the proceedings of that workshop.

Model Form

There are two basic model forms, the multinomial logit and the nested logit structure, that are used widely in practice. The decision to use the multinomial versus the nested logit structure should be based on the number of line haul services operating in the area. Once the decision is made to use the nested logit structure, a determination needs to be made as to how many nests are necessary to obtain an accurate forecast. This decision is in turn directly related to the methodology and basis by which transit paths are built. Theoretically, the path builder chooses the best path. The reason the modes are defined in the mode choice model is to aid the path builder in selecting the correct mode. In a dense network where the transit path builder does not sort out the mode correctly, the mode choice model will aid in the selection of the correct mode, e.g. urban rail versus light rail. However, it is important to realize that there are trade-offs when the path builder is used to select the mode instead of the mode choice model. For example, in Florida, the express bus service is typically a peak

hour service serving park and ride lots. However, in the mode choice model utility equation, excluded (omitted) attributes of relevance include: span of service and absence of midday service. In this instance, having a single constant for rail and express bus is not advisable as the constant needs to capture the effects of omitted variables of relevance. Simplicity and transparency in the definition of the mode choice model structure are of critical importance to the FTA. It is felt that a large number of nests will complicate the ability to accurately develop coefficients associated with the nests.

When developing the "standard mode choice model" it would be important to develop it in such a way that the introduction of a new mode would not entail having to change the application code. Also, within the context of the different path building options available, more research and testing is needed to develop the best path building routine for FSUTMS. For example, paths may be built sequentially or in parallel and paths may be combined across different modes in different ways.

Mode Choice Set

The mode choice set needs to be clearly defined. A determination needs to be made as to how various transit modes would be treated. While some transit modes may merit being treated as separate and distinct entities, others may be combined into composite modes. Treatment of access mode options is also critical in this regard for developing a robust and reasonable nesting structure. Similarly, the treatment of HOV modes and toll modes needs to be defined and standards have to be established so that robust criteria are applied in developing the mode choice options in the choice set. In addition to distinguishing among the motorized modes, consideration should also be given to the potential inclusion of non-motorized modes such as walking and biking in the choice set depending on the particular model development and application context.

Impedance Measures

The impedance measures used currently in FSUTMS appear to be typical of those used around the country. Each mode has a coefficient that is applied to the various impedance measures to compute modal utilities. As part of their updated guidelines, the FTA has established a range into which the modal utility coefficients associated with various impedance measures need to fall. If the coefficient is outside the defined range, documentation will be required explaining the development and rationale for the value of the coefficient. This plan will

scrutinize the components of impedance and the coefficients associated with them to ensure that they are consistent with best practice.

Socio-economic Variables

Modal utility equations used in FSUTMS and many areas around the country do not include socio-economic variables as explanatory factors. In some instances, separate modal utility equations are estimated for different market segments that are defined by employment status, household lifestyle, and/or household auto availability/ownership. In this plan, research will be done to see if benefits can be derived from enhanced market segmentation based mode choice model development and application. The team will explore both options, i.e., including socio-economic variables as explanatory factors and/or developing modal utility equations for different socio-economic market segments.

Izone-Jzone Adjustments

Zonal adjustments are introduced to adjust the number of trips attracted at a certain destination. The most typical adjustment that one often encounters is that of the CBD flag. The CBD flag allows for an adjustment to the number of trips attracted at a CBD destination. The adjustment is made to reflect the pedestrian friendly setting and the attractiveness of mixed land uses, that are typically associated with CBD destinations. It may be important to include such destination-specific adjustment in the mode choice model and there may be other areas within the modeling region that have sidewalks and transit-oriented developments that warrant special adjustment flags. In some urban models other trip end measures have been implemented. These include such approaches as the scoring of the pedestrian friendliness of an area and introducing such factors or scores into modal utility equations. In general, the variety of measures that have been tried and introduced into various mode choice models have proven to be useful. In this plan, research will be undertaken to develop guidelines for the formulation and introduction of such measures in mode choice models.

Coding Access Modes

Care should be exercised and enhanced procedures may assist transit modelers in the coding of access modes. The coding of the walk access code is generally regarded as cumbersome, while the more automated process is not considered to be very accurate. A more accurate automated approach to transit access calculations for walk and auto is desirable. However, it is important to have the ability to perform manual adjustments to the automated process.

This plan will examine the feasibility of developing enhanced procedures for accurately coding and calculating attributes associated with access modes.

Constants and Coefficients

At the heart of mode choice model utility equations are the alternative specific constants, explanatory variables, and model coefficients. The alternative specific constant should be a reflection of those characteristics of the mode that cannot be expressed through other observable attributes such as time or cost. The calibration of constants should not be done in a manner that reduces it to a correction factor for inaccuracies caused by other elements within the model. Clear guidance, standards, and procedures are needed for the calibration of alternative specific constants and nesting coefficients. In addition, special attention should be paid to the development of alternative specific constants for new modes that are not in the choice set. There are different ways in which one can deal with the "new mode" problem and these alternative approaches will be evaluated in this research plan.

In addition to alternative specific constants, the research team will pay considerable attention to the explanatory variables included in the modal utility equations and their coefficients. The FTA has provided some guidelines with respect to the values of certain coefficients associated with travel time and cost. The team will develop standards, enhancements, and procedures for specifying modal utility equations, identifying explanatory variables, and checking the reasonableness of model coefficient values. The research team will also identify any circumstances where departures from the ranges suggested by the FTA may be justified or warranted.

In this context, the team will also develop guidance on how on-board transit surveys can be used to estimate and calibrate model constants and coefficients. The FTA is encouraging agencies to conduct on-board transit surveys to obtain data that can be used to check the reasonableness and accuracy of mode choice models. Many on-board transit surveys are conducted in Florida in conjunction with the development of Transit Development Plans (TDPs). These survey databases offer a rich source of information for mode choice model development, calibration, and validation.

Reporting

The FTA is placing emphasis on the transparency of the model form, structure, and application. Therefore, at least two types of reports are needed to conduct two different types of analyses. One set of output reports should provide the user insight into the logic, structure, form, specification, and reasonableness of the model constants and coefficients. Another set of reports should provide the user with the ridership forecasts at different levels of spatial and temporal aggregation to facilitate analyses of transit investment alternatives. Both sets of reports should also be used in quality control.

As part of the reporting process, various statistics should be provided so that quick logic and reasonableness checks can be conducted. The distribution of trips by purpose and market segment (defined by car ownership, income, or other similar socio-economic variables) and travel time distributions are examples of such useful statistics. Even though some of these outputs and measures are not necessarily derived from the mode choice model (but may come from the trip generation or trip distribution steps), it would be useful to see these statistics in conjunction with the mode choice model reports.

Time of Day Modeling

Transit modeling would greatly benefit from time of day modeling. As mentioned earlier, it is important to introduce time of day modeling procedures at the right point in the modeling process so as to ensure consistency between the mode choice and transit assignment steps. The research plan will result in the development of guidelines, enhancements, and standard procedures for introducing time of day modeling elements into the modeling process while maintaining consistency and integrity in the mode choice modeling step.

Computing User benefits

There is a great deal of interest in being able to obtain outputs from the mode choice model that can be used to calculate user benefits, particularly in the context of New Starts plans, where the SUMMIT program is used to calculate user benefits associated with transit investments. The calculation of user benefits is directly tied to the outputs of the mode choice model. This research plan will involve the development of enhancements, procedures, and standards for ensuring that the outputs of the mode choice modeling step in FSUTMS are consistent with the SUMMIT program and the procedures for calculation of user benefits.

<u>Software Issues</u>

In the transition of FSUTMS to the Cube-based engine, questions have been raised regarding the migration of the mode choice models into the new FSUTMS. The team is well aware of the challenges, time constraints, resource constraints, and computational complexity associated with attempting a full migration of the mode choice model codes into the new FSUTMS-Cube environment. In collaboration with the user community, the team will develop guidelines and standards for the implementation of mode choice models in FSUTMS-Cube. The team will consider different options and explore the advantages and disadvantages associated with the different options in different modeling contexts.

Subtask 4.1: Review Best Practice and Clarify Issues

In the first subtask, a detailed review of best practice, methods, specification, structure, coefficients, explanatory variables, and issues related to mode choice models and modal utility equations will be conducted.

Subtask 4.2: Identify Enhancements and Standards to FSUTMS-Cube

The team will identify enhancements to mode choice modeling procedures and modal utility equation specification for FSUTMS with particular emphasis on those enhancements that take advantage of the mode choice modeling capabilities of Cube. In addition, the team will define a set of standards for mode choice models and modal utility equations in FSUTMS models in the state.

Subtask 4.3: Develop Guidelines and Guidance on Mode Choice Utility Equations

Based on the results of Subtask 4.2, the team will develop a series of guidelines and provide guidance on the development, definition, nesting structure, specification, coefficients, and explanatory variables in mode choice models for the state. These guidelines will be consistent with the enhancements and standards defined in the previous subtask to ensure that the modeling community in the state has the tools needed to meet the standards and follow the guidelines.

Subtask 4.4: Implement/Program Selected Enhancements in FSUTMS-Cube

The team will identify a selected set of enhancements, procedures, or standards for mode choice models that can be implemented and programmed into FSUTMS-Cube within the scope, resources, and time frame of this plan. These enhancements and procedures are those that

provide clear and present benefits, are easy and quick to program in FSUTMS-Cube, and have well defined methods, tools, procedures, and standards that define them.

Subtask 4.5: Develop Plan/Strategy for Implementing Enhancements and Standards

As it is unlikely that all potential enhancements and standards can be implemented within the scope of this plan, the team will develop a longer-term strategy and plan for implementing the enhancements and standards identified in this task into FSUTMS-Cube.

Task 5: Transit Assignment

This task involves the development of guidance, enhancements, and standards for transit assignment procedures in FSUTMS-Cube. Cube offers a host of transit assignment procedures that may be brought to bear in FSUTMS. The team will examine the alternative methods available, review best practice in the country, and provide guidelines for transit assignment procedures that should be adopted as standards in FSUTMS.

One of the aspects related to transit assignment is that of having transit trips in production-attraction format as opposed to origin-destination format. Transit person trips are reported in production-attraction format. The assumption is made that the reverse of the AM peak trip is made in the PM peak. In Florida, transit trips are typically modeled in the AM peak and midday periods. Changing the current method to one in which transit trips in origin-destination format are assigned would require changes to the path building routine. At this time, no real benefits are perceived by making such a potential change. However, the team will explore this further and determine the implications associated with assigning P-A format transit trips as opposed to O-D format transit trips.

Another issue related to transit assignment is that of trip purpose. Currently, the Florida models are set up to assign the work trips to the AM peak and the non-work trips to the midday period. This structure was originally used to overcome limited computer resources and in the interest of efficiency. As such considerations are no longer of major concern, it may be feasible to develop a more advanced assignment process that more accurately stratifies and splits trips by purpose across the transit service periods provided. On-board transit survey data may be able to provide valuable information regarding trip purpose distributions by time of day.

Transit assignment is the step where the ridership by stop and/or route is predicted. Simple and easy-to-interpret reports that provide detailed information about boardings by station, link loadings, ridership by line, direction, and time of day, etc. should be developed and standardized.

One of the challenges associated with transit assignment is that it has traditionally been very difficult to validate transit models at the individual stop-level or within specific time periods. Most transit calibration and validation has been done at the route level for total daily ridership. As enhancements are made to the various transit modeling modules, new standards, guidelines, and procedures may need to be developed for transit model calibration and validation. The team will investigate the feasibility of updating or developing transit model calibration and validation standards for use in Florida in different contexts.

Subtask 5.1: Review Best Practice and Clarify Issues
In the first subtask, a detailed review of best practice, methods and tools available and used for transit assignment, and issues related to transit assignment will be conducted.

Subtask 5.2: Identify Enhancements and Standards to FSUTMS-Cube
The team will identify enhancements to transit assignment procedures for FSUTMS with particular emphasis on those enhancements that take advantage of the transit assignment procedures and capabilities built into Cube. In addition, the team will develop a set of standards that should characterize transit assignments in FSUTMS models in the state.

Subtask 5.3: Develop Guidelines and Guidance on Transit Assignment
Based on the results of Subtask 5.2, the team will develop a series of guidelines and provide guidance on the development, implementation, and application of transit assignment procedures. These guidelines will be consistent with the enhancements and standards defined in the previous subtask to ensure that the modeling community in the state has the tools needed to meet the standards and follow the guidelines.

Subtask 5.4: Implement/Program Selected Enhancements in FSUTMS-Cube
The team will identify a selected set of enhancements, procedures, and/or standards for transit assignment that can be implemented and programmed into FSUTMS-Cube within the scope, resources, and time frame of this plan. These enhancements and procedures are those

that provide clear and present benefits, are easy and quick to program in FSUTMS-Cube, and have well defined methods, tools, procedures, and standards that define them.

Subtask 5.5: Develop Plan/Strategy for Implementing Enhancements and Standards

As it is unlikely that all potential enhancements and standards can be implemented within the scope of this plan, the team will develop a longer-term strategy and plan for implementing the enhancements and standards identified in this task into FSUTMS-Cube.

Task 6: Transit Performance Evaluation

Transit performance evaluation reports should be informative and easy to understand and interpret. They should provide information that would enable easy comparison across transit alternatives. The reports should provide information on the performance of the model as well as the performance of the particular transit alternative. For example, to obtain information on the performance of the model, there should be reports indicating whether the transit validation falls within acceptable ranges. With respect to the performance of the particular alternative, the report should include information on various supply measures such as route miles, system miles, passenger trips per service mile, passenger trips per service hour, number of transfers, and so on. These diagnostic measures provide key information in the analysis of alternative transit investments and in checking the reasonableness of the transit model.

Checking the reasonableness of the transit model output and judging whether different transit validation criteria have been met may warrant the collection and assembly of different types of transit data. The research plan will identify transit databases that should be made available in the modeling process to facilitate transit model performance evaluation and reasonableness checks. In summary, a good reporting system needs to be developed when setting up transit modeling standards for FSUTMS-Cube.

In this regard, one can not ignore the issues related to the lack of reliable transit data and the difficulties associated with obtaining such data. The conduct of a robust on-board transit survey is a challenge. One of the greatest difficulties is in geocoding the correct origin and destination of transit trips reported in the survey. Guidelines are needed on how to set up a good on-board survey that would yield reliable data regarding transit ridership that can be used for transit model calibration, validation, and performance evaluation. For example, a

good test of the transit model would involve obtaining on-board survey data, geocoding the data, building trip tables, assigning trips to the transit paths, and analyzing the output to see if actual travel patterns are being replicated.

Finally, it would be desirable to have transit performance evaluation reports that can be used in conjunction with the SUMMIT user benefits calculation. Reports that provide information on the model outputs that are used by SUMMIT for calculating user benefits would be useful. In this way, the SUMMIT calculations can be easily assessed for their reasonableness and any errors or unreasonable numbers can be traced back to their source in the model. If an interface between FSUTMS-Cube and SUMMIT is being developed, then this report may include the information from that interface as a standard output.

Subtask 6.1: Review Best Practice and Clarify Output Measures of Transit Performance
In the first subtask, a detailed review of best practice and output measures of transit performance used around the country will be conducted. In addition, output performance measures related to transit that would be of interest to the modeling community in the state will be identified and defined.

Subtask 6.2: Identify Enhancements and Standards to FSUTMS-Cube
The team will identify enhancements to transit performance evaluation module in FSUTMS with particular emphasis on those enhancements that take advantage of the GIS and transit output reporting capabilities built into Cube. In addition, the team will develop a set of standard measures, outputs, and reports that should define all transit performance evaluation routines in FSUTMS models in the state.

Subtask 6.3: Develop Guidelines and Guidance on Transit Performance Evaluation
Based on the results of Subtask 6.2, the team will develop a series of guidelines and provide guidance on the definition, specification, and reporting of transit performance evaluation measures and outputs. These guidelines will be consistent with the enhancements and standards defined in the previous subtask to ensure that the modeling community in the state has the tools needed to meet the standards and follow the guidelines.

Subtask 6.4: Implement/Program Selected Enhancements in FSUTMS-Cube

The team will identify a selected set of enhancements, evaluation reports, and/or procedures for transit performance evaluation that can be implemented and programmed into FSUTMS-Cube within the scope, resources, and time frame of this plan. These enhancements and procedures are those that provide clear and present benefits, are easy and quick to program in FSUTMS-Cube, and have well defined methods, tools, procedures, and standards that define them.

Subtask 6.5: Develop Plan/Strategy for Implementing Enhancements and Standards

As it is unlikely that all potential enhancements and standards can be implemented within the scope of this plan, the team will develop a longer-term strategy and plan for implementing the enhancements, output reports, performance evaluation measures, and standards identified in this task into FSUTMS-Cube.

Task 7: Preparation and Submission of Midterm Report with Review and Feedback

The team will prepare and submit a mid-term report about half-way through the plan. It is envisioned that this mid-term report will cover the first two subtasks in each of the Tasks 2 through 6. Thus the midterm report will contain a review of best practice, clarify issues, and identify enhancements and standards for each of the transit modeling modules covered in this scope of work. An interim meeting with the Transit Modeling Committee of the Florida Statewide Model Task Force will be held to present, review, and obtain feedback on the interim report. The end of the second subtask constitutes an important juncture where the enhancements and standards should be defined and agreed upon. Only after there is broad agreement regarding the enhancements and standards on each of the modules should guidelines be developed and enhancements to FSUTMS-Cube planned and programmed.

Task 8: Preliminary Plan for Identification of Improvements in Other FSUTMS Modules

While this plan will clearly focus on the modeling procedures and modules most relevant and directly affecting transit model forecasts, the importance of other modeling steps and their potential impacts on transit ridership estimates can not be ignored. This effort will include a specific task to develop a plan for identification of improvements in other FSUTMS modules and steps that would have a bearing on the accuracy and reliability of transit ridership forecasts. In particular, focus will be placed on the trip generation, trip distribution, and highway network/speeds procedures. The estimation of the total trip productions and

attractions by purpose, O-D trip tables by purpose and time of day, and the representation of the highway network have important implications for transit modeling. Without accurate trip tables, one is not going to be able to accurately estimate transit ridership. Similarly, if it is desired to have the transit network integrated with and related to the highway network (to extract speeds and travel times), the highway network representation and speed-volume relationships used play a critical role in transit network accuracy, mode choice, and path building. The team will develop a plan for identifying enhancements and standards that should be made to other modules of FSUTMS for further ensuring that transit forecasts in Florida are as accurate and reliable as possible.

It is envisioned that the plan will lead to the development of research projects aimed at enhancing the other modules of FSUTMS under the guidance and oversight of the respective committees of the Florida Statewide Model Task Force. For example, potential enhancements to the trip distribution model are already being explored in a research plan under the oversight of the Trip Distribution committee. Similarly, enhancements to the trip generation module and the highway network procedures would be undertaken with guidance from the Trip Generation and Highway Network committees of the Florida Statewide Model Task Force. As these modules have a bearing on the accuracy and reliability of transit forecasts, it is envisioned that the Transit Modeling committee would also be involved in providing feedback on any enhancements made to those modules.

Task 9: Preparation and Submission of Final Deliverables with Review and Feedback
The team will prepare and submit a final report documenting the suggested enhancements, standards, guidelines, and procedures for transit modeling in the state. The draft final report will be presented and reviewed at a full meeting of the Transit Committee of the Florida Statewide Model Task Force to obtain feedback prior to the preparation of the revised final report. The team will deliver the final deliverables both in hard copy and in electronic format.

There will be three deliverables on this plan. They include:

- A technical memorandum at the end of Task 1 detailing the plan and methodology and outlining the roles and task allocations among team members

- An interim report about halfway through the plan containing information on the review of best practice and potential enhancements and standards for the various transit modeling procedures/modules considered in this plan
- A final report at the end of the plan containing the results of the entire plan.

Each deliverable will be presented to the Transit Committee of the Statewide Model Task Force for review and feedback.

BUDGET AND TIME

It is envisaged that the effort will take 18 months to complete and require about $175,000 in budget.

Task No.	Task Name	Amount	Completed by Month
Task 1	Detailed Plan Plan and Methodology + Technical Memo	$ 15,000	2
Task 2	Transit Network Procedures	$ 20,000	4
Task 3	Transit Path Building Procedures	$ 20,000	6
Task 4	Model Choice Modeling Procedures	$ 20,000	8
Task 5	Transit Assignment Procedures	$ 20,000	10
Task 6	Transit Evaluation Reports and Outputs	$ 20,000	12
Task 7	Preparation and Submission of Interim Report	$ 20,000	12
Task 8	Plan for Enhancement of Other FSUTMS Modules	$ 20,000	14
Task 9	Preparation and Submission of Final Report and Deliverables	$ 20,000	16, 18 (incl. review)
TOTAL	Total Cost for Plan	$ 175,000	

CHAPTER 5

INFORMATION RESOURCES DEVELOPMENT PLAN FOR FLORIDA TRAVEL DATA COLLECTION AND ANALYSIS

BACKGROUND

The transportation modeling and planning community in the State of Florida relies heavily on travel survey data for developing, calibrating, and validating travel demand forecasting models, evaluating alternatives, assessing impacts of policies and multimodal plans, and quantifying travel demand by purpose, time, location, and mode. Various metropolitan areas and FDOT Districts have spent considerable resources over the past 10-15 years to collect detailed travel survey data with a view that such data would provide a basis for developing accurate travel demand forecasting models within a FSUTMS context. Indeed, in the absence of reliable travel survey data, local areas would not be able to develop and estimate trip rates, model coefficients, and other model parameters that are relevant and applicable in their local context.

More recently, there has been widespread interest in the development and validation of transit models that require reliable and accurate on-board transit survey data for calibrating mode choice models and checking ridership forecasts. The Federal Transit Administration (FTA) expects that states and metropolitan areas will use up-to-date household travel survey data and on-board transit survey data to estimate mode choice models that are applicable in a local context. Thus, there is an increasing level of expectation regarding the use of local travel survey data for developing, calibrating, and validating travel demand forecasting models.

Despite the widespread interest and the explicit recognition of the importance of collecting travel survey data (of different types), many areas are simply not able to afford such data collection efforts. Travel surveys are expensive, labor intensive, complex, and time consuming efforts that many small and medium metropolitan areas can not afford. In this context, the Florida Department of Transportation Central Office can play a pivotal role in

providing data and travel survey statistics for a range of area types and in establishing a set of state-of-the-art survey procedures and guidelines that areas can adopt if they would like to proceed with a local travel survey effort.

The Statewide Model Task Force established the Travel Survey and Data Committee at its meeting in May 2004 with a view towards facilitating the advancement of survey procedures and survey data collection and analysis in the state. This plan is intended to serve as a first effort in the travel survey data collection and analysis arena.

There are many different types of data and surveys that are useful and important to the transportation planning profession. Within the scope of this plan, focus will be placed on passenger travel demand (as opposed to freight transportation). Thus, this plan will focus on urban and long distance passenger travel data for all modes of transportation including travel characteristics in non-urban areas. Also, the scope will place particular emphasis on on-board transit surveys and external (roadside) surveys. There has been considerable sensitivity related to the stopping of motorists on major roadways for conducting travel surveys. As a result, it would be prudent to develop one or more alternative methodologies for conducting roadside surveys.

OBJECTIVES

This plan is aimed at developing state-of-the-art and up-to-date travel survey data collection procedures, databases, and statistics for transportation planning and model development in Florida. Specifically, the objectives are as follows:

- To develop state-of-the-art data collection instruments and procedures for three types of surveys:
    o Household travel surveys
    o On-board transit surveys
    o External roadside surveys

- To develop an online archive of travel survey databases for these three types of surveys for use in Florida

- To provide an online and offline resource book containing detailed statistics on household and passenger socio-economic and travel characteristics by geographic location and area type

- To provide guidance on the collection and use of travel survey data for travel demand modeling and forecasting

Within the scope of this plan, census databases such as SF1, SF3, ACS, and CTPP will not be analyzed, archived, or summarized. These databases are already widely available in multiple formats from a wide variety of online and offline sources. As such, this plan will focus exclusively on data collected and assembled in Florida. On the other hand, national travel survey data such as the National Household Travel Survey (NHTS) will be included in this scope.

WORK PLAN

This section provides a description of the various tasks that will be undertaken as part of the plan. The work plan has been formulated so that there is ample opportunity for the Survey and Data Committee of the Florida Statewide Model Task Force to review progress and provide feedback to the plan team during the course of the study. This study may be considered the first phase in a series of plans aimed at enhancing and standardizing best practice in travel survey data collection and analysis in Florida.

Task 1: Development of Detailed Study Plan and Methodology

The proposed study is aimed at enhancing and standardizing travel survey data collection and analysis for transportation planning and modeling in Florida. Although the plan objectives are well defined, the methodology, strategy, and exact work plan by which these objectives will be accomplished can only be defined through a close working partnership with the Survey and Data Committee of the Statewide Model Task Force. The study team will meet with the Survey and Data Committee of the Florida Statewide Model Task Force and present a detailed study plan and methodology for accomplishing the objectives of the plan. The study team

will work with the Survey and Data committee to refine the study plan, come to agreement on the issues and priorities related to travel survey data collection and analysis, and develop a clear plan of action and task assignments for the plan. Also, the scope and nature of the deliverables (for example, the nature of the online archive of survey databases, best practice guidelines, and the resource book to be developed in this plan) will be defined in this task and during the meeting with the Survey and Data Committee of the Florida Statewide Model Task Force.

Task 2: Review of Travel Survey Methodologies, Standards, and Procedures

The research team will conduct a thorough review of work that has been done in the areas of travel survey methodologies, standards, and procedures. There have been several initiatives at the federal and local levels regarding the refinement, enhancement, and standardization of travel survey methodologies. Recently, there was an NCHRP Synthesis report on Standardization of Household Travel Surveys. At this time, there is an ongoing NCHRP study on the development of standards for household travel surveys. There is another ongoing study funded by the Bureau of Transportation Statistics for the establishment of a national travel survey archive at the University of Minnesota. The principal investigator has intimate knowledge of the research that has been undertaken and is currently being undertaken on these and other survey-related projects around the country. All of the information and resources from these efforts will be reviewed and synthesized by the research team for potential application and use within the context of this plan. The review will cover the three primary types of travel surveys included in the scope of this plan: household travel surveys, on-board transit surveys, and external roadside surveys.

Task 3: Collection of Florida Surveys – Data and Documentation

As part of this plan, no new survey is proposed to be conducted. Instead, the team will collect, compile, archive and document, and analyze existing travel survey data sets in Florida. Several metropolitan areas and FDOT Districts have spent considerable resources to collect large amounts of survey data over the past decade or so. The research team will contact each District, MPO, transit agency, and their respective consultants to try and gather/compile all of the survey data sets collected within the past 15 years. Data sets from before 1990 will not be included in the scope of this work unless it is reasonably clean, formatted in a readily readable form, and well-documented. The research team will not only get the databases and related documentation, but will also collect all reports, survey

instruments, and documentation that describes the methodology by which the data was collected. The research team will collect detailed information on three types of surveys conducted in Florida in the past 10-15 years: household travel surveys, on-board transit surveys, and external roadside surveys.

Task 4: Compilation of Travel Survey Data Archive for Florida

The research team will compile the travel survey data along with all available documentation and data descriptions in a consistent and uniform format. The survey data will be organized by type of survey and area type. For example, household travel surveys from large, medium, and small areas will be grouped or identified separately. Similarly, transit survey data from large, medium, and small transit properties will be grouped and identified separately. This will allow the transportation planning community to easily identify a data set that might be most applicable to a specific situation or context. Data sets will be compiled and saved in standard DBF format in various levels of aggregation – trip level, person-level, and household-level. Where possible, network level of service data will be appended to the trip data sets so that the data sets can potentially be used for mode choice model estimation and calibration. The standardized format of databases will allow users to easily import the data into different software and analyze them for understanding trip rates, trip length distributions, mode distributions, time of day distributions, and other travel characteristics.

In addition to providing the data sets and the descriptions of the data sets and variables contained in them, the survey archive will provide information about the survey implementation itself. Wherever available, the survey archive will provide information about response rates, sample sizes, recruitment rates, biases, percent missing data, percent incomplete responses, and so on with a view to providing potential users information that is needed for understanding results that might come out of the use of the data in the archive. Also, to the extent possible, weights and expansion factors will be included with the data sets so that unbiased and population level measures can be obtained from a statistical analysis of the data.

There is a significant move in the professional to standardize the format and documentation of survey data for archiving purposes using the XML technology consistent with the Data Documentation Initiative (DDI) that has been presented in the survey data literature. Although it would be ideal to archive the data according to these definitions and standards,

such an effort is beyond the scope of this plan. Therefore, in this plan, all data and documentation will be first compiled in a standard and consistent format such DBF and Acrobat PDF so that the conversion to XML can be done in a subsequent effort.

The entire travel survey archive will be made available via the internet using appropriate login and security/registration procedures where necessary. All data sets will be stripped of any and all information that might reveal the identities of the responding individuals. Thus, all procedures and guidelines related to the protection of human subjects participating in surveys will be strictly followed in this plan.

Task 5: Development of Standard Survey Instruments and Procedures for Florida

This task involves the development of state-of-the-art survey instruments and procedures/methodologies for Florida. Over the years, different metropolitan areas, FDOT Districts, transit agencies, and consultants have used a variety of survey procedures, instruments, and methods for collecting data. It is certainly recognized that each survey effort is a unique undertaking that warrants the formulation of specific instruments and methodologies pertinent to the specific situation, context, and objectives of the survey. However, for general purpose travel surveys such as household travel surveys, on-board transit surveys, and external roadside surveys, it may be possible to develop a generic standardized set of survey instruments and procedures that can be used as a starting point for any such survey data collection effort. Agencies and consultants can then modify the procedures and instruments depending on the specific context or objectives of the survey. Having some uniformity in instruments and procedures will provide some consistency in data formats, variables included in data sets, and data reliability. This will also allow comparisons across geographic areas and over time while controlling for survey methodology effects. These standard survey instruments and procedures will also be developed with a view towards ensuring consistency with federal NCHRP plans and recognized survey methodologies. For example, in three recent large-scale household travel surveys conducted in Florida, information regarding the respondent gender was not collected. However, it is very well documented in the literature that respondent gender is a key variable that explains travel characteristics and should be included in all travel surveys. Such omissions will be avoided through the development of standard state-of-the-art procedures and instruments. The research team will develop instruments, procedures, and methodologies for household travel surveys, on-board transit surveys, and external roadside surveys. The instruments and

procedures will be developed for the most common forms of survey administration such as mail and telephone.

Once again, it should be emphasized that this task is not intended to prescribe how all surveys should be conducted in Florida. The results of this task will simply provide a starting point for agencies considering a survey effort in their respective areas. It is hoped that the availability of such standardized procedures and instruments will greatly reduce the cost of survey development and implementation while ensuring consistency with all federal guidelines and recommendations regarding good travel survey practice. The USDOT Travel Survey Manual is another useful reference that will be used in the accomplishment of this task.

A special note is due here regarding external or any other type of roadside survey. There is considerable sensitivity about stopping motorists on major corridors to administer a survey. As a result, many areas shy away from conducting such surveys. The development of a methodology that can be used to collect data typically collected in a roadside survey is a specific task that will be undertaken in this plan. Different techniques will be considered for potentially collecting roadside survey data.   Besides minimally invasive/intrusive roadside surveys, the research team will explore the use of intelligent transportation systems (ITS) and other advanced technologies for potentially obtaining the same type of data without having to trouble motorists. These technologies include license plate recognition technology, GPS based travel surveys, variable message signs, and web-based surveys. However, there may be instances where motorists have to be intercepted in the field. The research team will design a protocol where such surveys can be conducted with minimal disruption and trouble to motorists while maximizing the safety of field workers.

Task 6: Analysis and Compilation of Travel Characteristics for Florida
The third major component of this research plan is to compile a comprehensive guidebook or resource book containing detailed travel characteristics for Florida. The many different travel surveys collected and compiled in the previous tasks will be analyzed using standard, rigorous,   and   well-established   statistical   and   econometric   methods   to   provide   a comprehensive resource of trip rates, trip length distributions, time of day distributions, trip purpose distributions, modal distributions, etc. for travel demand modeling in Florida. The comprehensive statistics and compilation of travel measures/characteristics will be made

available both online and in hard copy format. This guidebook will be similar to the NCHRP Report 365, but will be customized and applicable to Florida because it is completely based on Florida survey data. Such a guidebook will serve as a quick reference for Florida agencies that are interested in obtaining trip rates and other likely travel characteristics for their area without having to undertake a detailed statistical analysis of survey data on their own. Similar to the NCHRP report, this compilation can be periodically (say, once in 5-10 years) updated to reflect the latest survey data and travel characteristics in Florida. The research team will also analyze the transit on-board survey data and the external roadside survey data to provide detailed statistics and travel characteristics pertinent to those surveys. Such data will prove valuable in transit modeling and in assessing external travel.

In addition to pure descriptive statistical analysis consisting of distributions, averages, medians, and so on, the research team will also extend the analysis to include statistical and econometric modeling of various travel characteristics. For example, the research team will estimate linear and non-linear regression models of trip generation (by purpose and time of day), fit statistical distributions to trip length distributions and time of day distributions of travel, estimate friction factors for different trip types based on trip length distributions, and estimate discrete choice models of mode choice for different trip purposes using the multinomial and nested logit modeling methodologies. The MTF does not feel that a comprehensive model development, calibration, and testing effort can be undertaken within this research plan. However, it is felt that a first-cut effort at providing model estimation results can be provided within the scope of this research plan. The research team will provide model specifications, coefficients, and goodness-of-fit test statistics that planners and modelers can use as a reference within their own model development plans. Thus, the guidebook will contain two distinct parts – one part that contains statistical descriptions of travel characteristics and a second part that contains results of econometric model estimation and statistical probability distribution fitting.

Task 7: Preparation and Submission of Deliverables
The team will prepare and submit a series of deliverables during and at the end of the plan. During the plan, the research team will prepare and submit the following midterm deliverables:

- A technical memorandum describing the detailed work plan and study approach

- An interim report at the 10-month mark to describe the work accomplished at about the half-way point in the plan
- Brief quarterly progress reports with invoices

At the end of the plan, the research team will prepare and submit the following final deliverables:

- A website containing the travel survey data archive with all documentation – all contents of the website will also be submitted on CD-ROM
- A set of survey instruments and procedures for each survey type considered in the plan – all instruments and procedures will be documented and presented both in hard copy and in electronic format (both CD and website)
- A resource book containing the statistical analysis and models of the travel survey data – the resource book will be available both in electronic (web and CD-ROM) and paper format

These deliverables will be submitted to the Survey and Data Committee of the Model Task Force in draft form so that committee members can provide comments and feedback. Deliverables will then be finalized and submitted to the Department.

BUDGET AND SCHEDULE

It is envisaged that this effort can be undertaken in an 18-month period and will require a budget of $100,000. The table on the next page shows the approximate budget required for each task and the time-schedule.

Task No.	Task Name	Amount	Completed by Month
Task 1	Detailed Study Plan and Methodology + Technical Memo	$ 5,000	2
Task 2	Review of Survey Methodologies	$ 5,000	4
Task 3	Collection of Florida Travel Survey Data	$ 20,000	8
Task 4	Compilation of Florida Travel Survey Data Archive	$ 20,000	10
Task 5	Development of Survey Instruments and Procedures	$ 10,000	12
Task 6	Resource Book on Travel Characteristics and Model Parameters	$ 20,000	14
Task 7	Preparation and Submission of Deliverables	$ 20,000	16, 18 (incl. review & feedback)
TOTAL	Total Cost for Plan	$ 100,000	

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

Over the past few years, the Florida Model Task Force has identified new modeling tools and information technologies that should be integrated into the Florida Standard Model (FSUTMS). Effective Fall 2004, the Model Task Force adopted Cube/Voyager as the modeling software engine for FSUTMS. This research project served as the first phase of a process by which guidelines and conventions for the new tools and technologies identified by the Model Task Force could be integrated into the Florida Standard Model.

The overall aim of this project was to provide information technology guidelines and conventions to enhance the Florida Standard Model as the transition is made to the new Cube/Voyager modeling software and database formats. Specific objectives of this project were:

a) To design a flexible and user-friendly transportation modeling environment where users can define custom travel demand models that are most appropriate in their respective context

b) To identify methodologies for translating, converting, merging, and integrating existing travel demand modeling databases into the new transportation modeling environment

c) To develop guidelines for a new modeling platform that integrates Geographic Information Systems (GIS) with transportation modeling processes

d) To update and revise the information management systems in the Florida Standard Model so that all data management is consistent with new data structures, formats, and information technologies/software

e) To research the integration of statewide freight and passenger models with the new travel demand modeling systems

f) To develop plans for the enhancement of transit modeling technologies, tools, and methods in FSUTMS

g) To formulate plans for the development of information technology resources for Florida travel survey data collection and analysis

h) To gather information on the information technology enhancements that the Model Task Force and the modeling community in the state would like to have incorporated into FSUTMS in the future.

The chapters in this report and the appendices provide detailed information on the guidelines and conventions for implementing new information technologies in FSUTMS powered by Cube/Voyager.

FINDINGS AND RECOMMENDATIONS

The research effort has resulted in the development of guidelines and conventions for new information technologies and database formats that will be implemented in the new FSUTMS powered by Cube/Voyager. The various findings and recommendations of the research study are as follows:

a) There is a strong desire to retain consistency and standardization in the terminology, technology, and database/file formats underlying FSUTMS. Consistency and standardization of FSUTMS have provided strong benefits to the state and to various agencies in the state. The modeling community is able to share knowledge and

experiences, transfer model files and databases, and move between agencies thanks to consistency and standardization in modeling procedures.

b) There is also the desire to retain the ability to customize models within individual areas so that the models can best represent local conditions. Thus, although there is considerable interest in maintaining consistency and standardization in modeling procedures, the modeling community feels that it is necessary to accommodate custom procedures, variables, and parameters in individual models. In doing so, the modeling community feels that consistency and standardization can be preserved.

c) In cooperation with the modeling community, the vendor of Cube/Voyager, the new modeling software engine for FSUTMS, developed a series of guidelines and conventions that can be implemented in FSUTMS during the transition to the new platform. These conventions and guidelines are documented in this report. These conventions and guidelines take advantage of the features, enhanced information technologies, and database structures and formats that are inherent to Cube/Voyager. Thus, they represent a quantum step forward in advancing the state of the art and ease of use and understanding of FSUTMS.

d) The modeling community would like to see information technology related improvements made to FSUTMS on a continuous basis. This report documents a comprehensive list of suggestions and desired utilities and technology enhancements that the modeling community in the state would like to see implemented in future versions of FSUTMS. The enhancements are of a dual nature. One set of enhancements deals with the user functionality, user friendliness of the software, automated GIS and reporting capabilities and utilities, and software design. The second set of enhancements deals with the modeling methodologies and procedures incorporated in FSUTMS. These include time of day modeling, trip chaining, junction-based modeling, and dynamic traffic assignment.

e) It is feasible to develop an integrated statewide passenger and freight travel demand model for statewide transportation planning. It is recommended that the statewide models be migrated to the Cube/Voyager platform consistent with the local models. This is because all local models are based on the FSUTMS powered by Cube/Voyager.

As the statewide models are essentially aggregated versions of the local models (to ensure consistency of data and networks), the connection between the local models and statewide model would be most seamless if the statewide models were in the FSUTMS – Cube/Voyager format.

f) The modeling community would like to see transit modeling capabilities of FSUTMS enhanced as soon as possible. This report includes a plan and scope of work for enhancing the transit modeling capabilities of FSUTMS. This plan was developed in cooperation with the Transit Modeling Committee of the Florida Statewide Model Task Force. The plan is consistent with the Federal Transit Administration requirements regarding good model practice for New Starts applications.

g) The models, parameters, and coefficients embedded in FSUTMS should be periodically updated based on the latest available survey data in Florida. The Federal Transit Administration is also placing strong emphasis on the use of locally available survey data for model development and calibration. The Model Task Force would like to have a plan for the establishment of information technology resources for travel survey data collection and analysis in Florida. This report includes a special chapter for the development of such resources. This plan was developed in cooperation with the newly formed Data Committee of the Florida Statewide Model Task Force.

SIMILAR EFFORTS

Although considerable research is being undertaken around the world to enhance travel demand modeling processes, there is no similar research project that would be applicable in the Florida context. While results of some other ongoing research may prove useful in the course of this research effort, this research effort is unique and particularly valuable and timely as travel demand models are being asked to address a wider range of planning issues. The integration of new information technologies and software architecture as outlined in this report will transform the Florida Standard Model into a 21st century marvel of technology and power.

AFFECTED FUNCTIONAL AREAS

The functional areas that are directly affected by this research effort include:

- FDOT District Planning Offices (in charge of model development and application)
- Metropolitan Planning Organizations

In addition, it is anticipated that other planning agencies such as transit agencies, regional planning councils, and city/county planning departments would greatly benefit from an enhanced Florida Standard Model process that addresses a wide range of planning issues and needs and incorporates state-of-the-art information technologies.
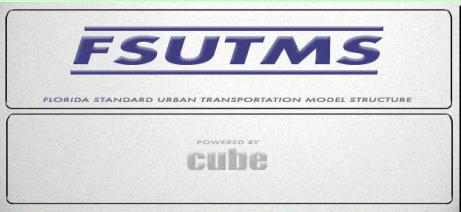
BENEFITS TO THE DEPARTMENT

This research project involved the development of guidelines and conventions for the integration of new information technologies and modern simulation and GIS-based software into the travel demand modeling processes of the state. Travel demand models in the state are used for FIHS planning, MPO planning, transit planning, and many other planning studies in the state. All of these planning studies often involve the analysis of multi-billion dollar transportation improvements and investments. It is critical that state-of-the-practice tools be used in the planning process to help guide transportation investments in the State of Florida. By developing guidelines and conventions for maintaining consistency and uniformity in the integration of the latest and best software, database standards, modeling methodologies, and microsimulation tools into the Florida Standard Modeling Process, this project directly benefits the Department and many other planning agencies in the state that are charged with analyzing alternative transportation projects. These new information technology guidelines and conventions will enhance the ability of the Department and planning agencies in the state to make sound transportation investment decisions by improving the accuracy, transparency, clarity, robustness, and information dissemination capability of the modeling process. Thus, this project was aimed at serving the ultimate goal of enhancing the multimodal transportation modeling methodology in Florida by providing new and improved capabilities for estimating travel demand in urban areas while explicitly recognizing contemporary planning issues and needs. The results of this research effort will

greatly benefit transportation modeling and planning processes in the State of Florida by reducing time and cost involved in transportation modeling studies by a factor of 10-20%.

IMPLEMENTATION PLAN

The results of this research effort are being implemented through a strong technology transfer component. Within the course of this research project, coordination with the modeling community took place via regular interaction and meeting with the Statewide Model Task Force. In addition, the FDOT Systems Planning Office has now developed a complete set of training workshops in cooperation with the vendor of Cube/Voyager that explicitly incorporate the guidelines and conventions documented in this report. The information technologies, plans, and guidelines/conventions documented in this report are already being programmed in the Florida Standard Model framework to facilitate a seamless implementation of the new modeling software engine in all planning agencies of the state. Thus, the results of this research effort are being implemented and will have a direct impact on modeling practice.

Appendix A

Standards for FSUTMS

**Florida Statewide Model Task Force
Working Group Meeting**

February 10-11, 2005
Tampa, FL

Developing Interim Standards and Enhancements

➢ Transition to CUBE/Voyager offers opportunity to:
  ❖ Revise standards in FSUTMS
  ❖ Identify enhancements to FSUTMS
➢ Flexibility in new travel demand modeling software:
  ❖ Flexibility in methods and procedures
  ❖ Flexibility in database structures and formats

Objective

> Develop standards for FSUTMS that:
  - ❖ Retains spirit of standardization
  - ❖ Takes advantage of flexibility offered by new software
> Not necessarily conflicting aims

Spirit of FSUTMS

> Florida **Standard** Urban Transportation Model Structure
> Standards apply to structure of model components:
  - ❖ Data
  - ❖ Files
  - ❖ Procedures
  - ❖ Basic Methods
  - ❖ Outputs/Reports/Displays

Motivation for Standards

- Exchange information, data, model procedures
- Easy and fast to understand and explain
- Consistency in model development and application
- Workforce mobility
- Easy and fast to apply different models for different projects

User Interface

- Standard scheme for launching FSUTMS and choosing a model
- Accessing a model easy and intuitive
- Considerations:
  - Visually appealing
  - Click-and-select based operation
  - Automatic recognition of installed model systems
  - Nested relationship between regional models and MPO models

File Names/Variable Names

- File names and variable names restrictive and not intuitive in past
- Take advantage of flexibility offered by new software and operating systems
  - Longer file and variable names, but not too long
  - Incorporate critical redundancy in names
  - **Consistency** in naming convention remains a key
- Strategic decisions
  - Example: merge/integrate zonal data files

File/Directory Structure

- Logical file/directory structure
  - Easy to locate, copy, view, and transfer files
  - Easy to differentiate across scenarios, alternatives, years, etc.
- **Consistency** in file locations and directory structure
  - Minimize errors in file usage
  - Facilitate model application by novice users
- Distinguish between input, temporary, and output files

Model Structure/Logic

- Basic four-step process to continue as foundation for FSUTMS
- Several variations of the four-step process possible:
  - Feedback loops
  - Introduction of time of day component → transit modeling implications
- Introduction of other modules or components – how, where, and why?
  - Land use models (UrbanSim, Land, ULAM)
  - Synthetic population generation programs
  - Activity-based models (CUBE activity-based model, FAMOS, etc.)
  - Dynamic traffic microsimulation models

Modeling Methodologies

- Consistency in modeling methodologies
  - Easy and fast to explain and understand
  - Compare results across areas/runs
  - Maintain standard methodologies for model components
- Accommodate alternative methods
  - Regression vs cross-classification trip generation
  - Singly vs doubly constrained gravity model
  - Transit skimming and path generation
  - Time of day split factors vs peak spreading models (time of day choice models)

Networks and Geography

➢ New modeling software, GIS, and spatial data allow fine resolution and accurate representation:

  ❖ Zonal/parcel/census geography

  ❖ Highway and transit networks – integration of networks through relational database structures

FSUTMS

Reports and Output Displays

➢ Standard series of templates and maps

  ❖ Standard menu of output choices

  ❖ Reports that summarize/describe:

    ▪ Inputs

    ▪ Outputs

    ▪ Distributions/statistics

  ❖ Facilitate model reasonableness checks and report preparation
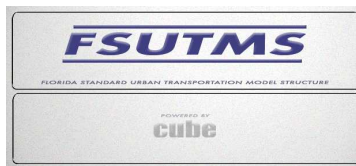
FSUTMS

Retaining the FSUTMS Concept

➤ All standards and enhancements done in the spirit of keeping benefits of FSUTMS

- ❖ High level of standardization
- ❖ Consistency in modeling methods/procedures
- ❖ High level of technical support from Central Office and Citilabs
- ❖ Ongoing training workshops
- ❖ Sharing of technical expertise through MTF
- ❖ Continuous improvement process
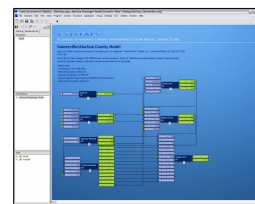
APPENDIX B

FSUTMS Standardization Process
Design Concepts, Considerations and Recommendations


Overview

- Review of FSUTMS-TRANPLAN Data Management
- An Overview of Cube Voyager's Data Management
  - Input Data Management
  - Scenario-specific Output Data Management
  - Application Management
  - Graphics and Other Subsystems
- Considerations
- Recommendations
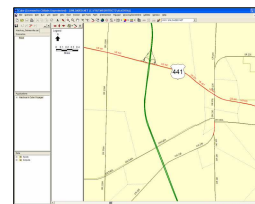
Review

Current FSUTMS-TRANPLAN Data Management

- Core TRANPLAN Programs in \urbansys or \fsutms.v55 Directories
- FSUTMS-specific programs/scripts in \fsutms.v55
- All Input and Output Data in one Directory*
- All Script Files in one Directory*
- User-written programs not in standard locations model to model

*there are exceptions

Intermodal Systems Development
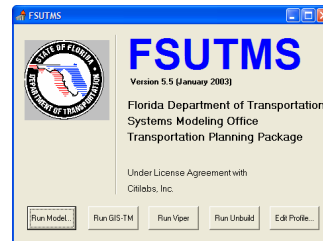
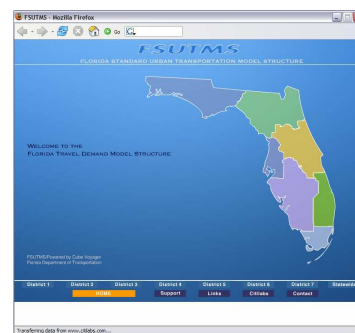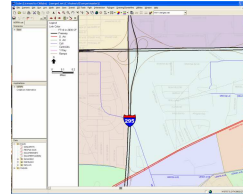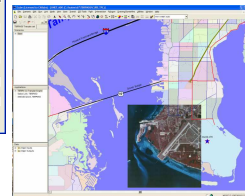**Review**

FSUTMS-Cube Voyager Data Management

- Core Voyager Programs in:
  - \program files\citilabs\Cube
  - \program files\citilabs\CubeVoyager
- FSUTMS Launcher in c:\fsutms
- Input Data Files can be Anywhere
- Input Script Files can be Anywhere
- Cube Base Manages all File Handling
  - Application Manager
  - Scenario Manager

Intermodal Systems Development

cube

Review
Cube Graphics

- Includes VIPER Plus:
  - Advanced GIS Tools
  - Interactive Reporting
  - Mapping & Presentation of Results
  - Export of Networks
  - Display & Manipulation of Database Files
  - Display of Citilabs' Binary Matrices
  - Converters for Summit
  - Converters for CTPP Data
  - Execution Capability of Script Files
  - Logging of Network Revisions

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cube

Review
Application Manager

- Builds Models and Other User Applications
- Runs Models
- Documents Model Process
- Manages Program Flow, Branching & Looping
- Provides a Common Interface for all of Citilabs' Forecasting Engines
- Controls Passing of Data to ArcGIS
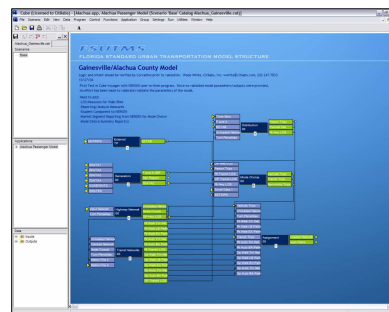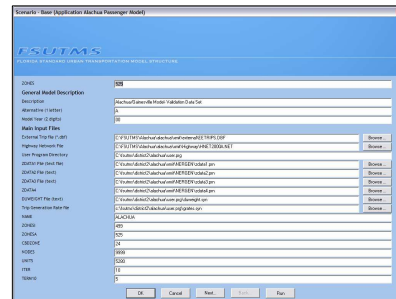
Review

Scenario Manager

- Manages and Stores Key Scenario-specific Inputs and Outputs
- Builds Directory Structure to Store Scenario-specific Outputs
- Keeps Track of Scenario-specific Model Parameters

Demo
FSUTMS-Cube Voyager Interface

Considerations
Cube Preferred Data Formats

- Inputs:
  - Socio-economic Data – dBase
  - Highway Network Files- Voyager Binary
  - Transit Route Files – Text
  - Lookup Files – Text
  - Script Files – Text
- Outputs
  - Productions & Attractions, matrices and Vector data – dBase
  - Assigned networks, Path File - Voyager Binary
  - Reports and messages – Text

Considerations
FSUTMS Concept

- Standard Process / Interface
- Standard Reports & Custom Reporting
- Flexibility to Incorporate New Processes
- Management of:
  - Model Process
  - Alternative Specific Data
  - Model Validation Specific Data
- Exchange of User Knowledge Base

- What Should & Shouldn't be in UI
- FSUTMS "Branding"

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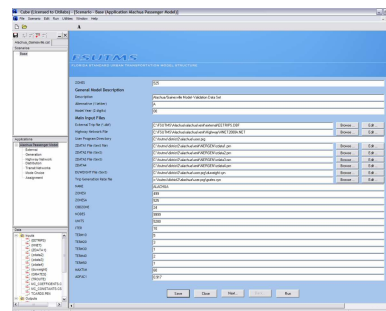
Recommendations
Directory Structure

- Catalog File
  - \fsutms\d?\ModelName\Model Name.cat
- Model Process
  - \fsutms\d?\ModelName\Applications (including user written programs)
- Model Input Files
  - \fsutms\d?\ModelName\Input
  - \fsutms\d?\ModelName\Input\AltYr1
  - \fsutms\d?\ModelName\Input\AltYr1\ZDATA
  - \fsutms\d?\ModelName\Input\AltYr1\Network
  - \fsutms\d?\ModelName\Input\AltYr1\parameters
  - \fsutms\d?\ModelName\Input\AltYr2
- Model Output Files
  - \fsutms\d?\ModelName\Output\Base
  - \fsutms\d?\ModelName\Output\Base\AltYr1
  - \fsutms\d?\ModelName\Output\Base\AltYr2
- Media Data (other GIS Files ,Drawings, etc.)
  - \fsutms\d?\ModelName\Media
- Common Data Files
  - \fsutms\d?\ModelName\Parametric

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cube

Recommendations
File Naming

- Scenario Manager's Automated Process is available for use
- Stick with 8+3 Convention for all I/O (until Win95/98/2000/ME support is no longer required)
  - Insures compatibility across platforms (WIN98/2000/XP)
  - Insures Backup Systems work Properly (CD/DVD Archiving)
- File Names Should Contain PPPPPXXX.EXT where:
  - PPPPP is a data description consisting of up to 5 characters.
  - XXX is an alternative description consisting of 3 characters, 1 character representing the alternative, 2 representing the year.
    - For Input files: YYA
    - For Output files: AYY
  - EXT is the file type's default extension

Recommendations

File Naming - Examples

– ZDATA1.00A:	ZDATA00A.DBF
– EETRIPS.00A:	EETRP00A.DBF
– PRODS.A00	PRODSA00.DBF
– EETAB.A00	EETABA00.MAT
– PTRIPS.00A:	PTRPSA00.MAT
– TCARDS.00A:	TCRDS00A.PEN
– HNET.A00	HNETA00.NET
– HRLDXY.A00	HWYLDA00.NET
– HEVAL.OUT	HEVALA00.TXT

Intermodal Systems Development

Discussion
Directory Structure and
File Naming Convention

Intermodal Systems Development

❖ Directory Structure and File Naming Convention

❖ **Zonal Data and Network Files**

❖ Model Structure and Application Issues

❖ Standard Parameters, Mapping and Reports

Recommendations
Zonal Characteristics (ZDATA)

- In SHP/DBF Format
- Different files for different scenarios located in the input directory
- Same Attribute Names
- Key Fields
  - METADATA
  - TAZ
  - DISTRICT
  - SUPERDISTRICT
  - TOTALPOP, TOTALDUS,TOTALEMP
  - After that, each model can use their own, including FSUTMS default fields

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Recommendations
Highway Network (HNET, HRLDXY)

- Voyager Binary Format
- Commonly named "Core" Attributes
  - INPUT
    - FACILITY_TYPE
    - AREA_TYPE
    - NUM_LANES
    - SPEED
    - COUNT
    - SCREENLINE
    - TOLL_ID (Plaza Number with Relational DBF)
    - TOLL_DSC (Toll Plaza Description)
    - GROUP1 (User defined stratification variable used for reporting purposes)
    - GROUP2
    - GROUP3
  - OUTPUT
    - CGSPEED and CGTIME
    - TOTALVOL
    - LTRKVOL, HTRKVOL, SOVVOL, HOVVOL,WALKVOL, BIKEVOL
    - VMT, VHT
- Consider Using Core System Variables where Possible

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Recommendations
Other Network Attributes

- Sidewalk/bikeways (Binary variable, 1/0 indicating if a link is/not a sidewalk or bike path)
- Railroads, FT=101-109
- Busway, FT=49 or FT=111-119
- RCI Key
- County ID
- Traffic Count Station ID, Year & Owner
- Construction Code
- Signals & Other Intersection Characteristics such as TCARDS

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Recommendations
Highway Network Geography

- Incorporate Roadway Geography and Shapes into Model Networks
- Use of GDT or NAVTEQ Street Network Database for Modeling Network
- Highway Network Layer with Shapes as Basis for Transit Networks

Recommendations
Transit Networks

- Maintain Networks in Cube Voyager LIN format
- One Network / Alternative (i.e. Alternative Specific)
- Use HEADWAY[1], etc.
- Use ROUTE NAME vs. LINE=
- Re-think the whole PCWALK concept
- Consider Using User-class Based Path Building vs. Mode-based Path Building

Discussion
Zonal Data and Network Files

❖ Directory Structure & File Naming Convention

❖ Zonal Data and Network Files

❖ **Model Structure and Application Issues**

❖ Standard Parameters, Mapping and Reports

Recommendations
Model Structure/Logic

- Existing Model Structure/Logic to be Retained
- Default FSUTMS Highway Only and Nested Logit Model Flowchart
- Continue Research on Default Methods for Trip Generation, Distribution, Mode Choice, and Time-of-Day Modeling to be Incorporated in the Near Future

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Recommendations
Model Application

- Include Metadata on Top Level of Application/Model
- Identify List of "Scenario-specific" Outputs
- Organize Outputs in Data Management System
- Consider Having All Models Include Same Groups
  - Generation
  - Network
  - Distribution
  - Mode Choice
  - Transit Network (optional)
  - Assignment
  - Reporting
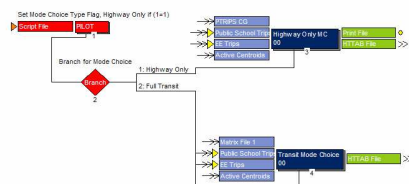
Recommendations
Other Common Applications

- Make them Available to all FSUTMS Users
- Stored on Website Link for download to \fsutms\special.app
  - SUMMIT-style Checking
  - Link-based Traffic Smoothing
  - Sub-area models
  - File Export/Import from Other Software
  - FSUTMS Data Merger/Transformer
  - Land Use Checker
  - Customized Reporting
  - Standard Templates
- Can be updated frequently- even by users who come up with their own applications

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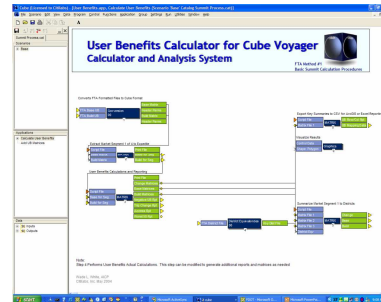
Recommendations
Native Cube Voyager Procedures

- Short-Term
  - Trip Distribution
  - Traffic Assignment?
- Long-Term
  - Trip Generation
  - Time-of-day
  - Mode Choice
  - Assignment
    - Signalization & HCM LOS Reporting
    - Dynamic Traffic Assignment
  - Geo-database Networks
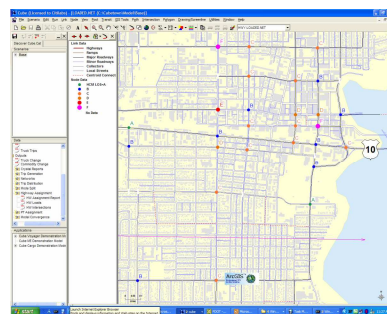
Discussion
Model Structure/Logic and Application Issues

❖ Directory Structure and File Naming Convention

❖ Zonal Data and Network Files

❖ Model Structure and Application Issues

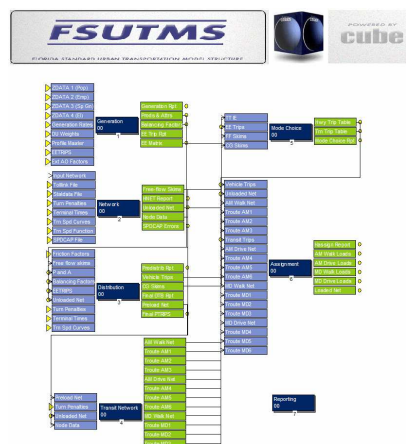❖ **Standard Parameters, Mapping and Reports**

Recommendations
Standard Parameters

- Model Parameters are not Software Specific
- FSUTMS Parameters and Coefficients be Retained for the Interim
- FSUTMS Profile.mas Parameters Should be Brought to the User Menu as PARAMETR.DBF

Recommendations
Standard Mapping Templates

- Citilabs and Systems Planning Created Standard Sets of Maps for FSUTMS Users
- Standard Sets of Maps Display Zonal Geography and Network Attributes
- May be Enhanced for Each Release
- Demo of Mapping Templates

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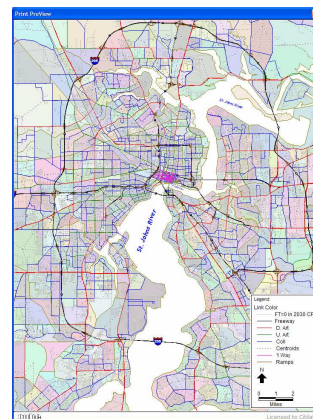
Recommendations
Reporting – Trip Generation

- Total Number and Percent of Trips by Purpose
- Aggregate Trips by Purpose Per Person, Per Household, and Per Employee
- Socioeconomic Ratios and Totals Currently Calculated by LUCHECK
- Environmental Justice Statistics

Recommendations
Reporting – Trip Distribution

- Trip Length Frequency Distributions
- Difference Between Input and Output Attractions By Zone
- Average Trip Lengths by Purpose Compared To Observed Values
- Number and Percentage of Intrazonal Trips By Purpose Compared to Observed Values
- Additional for Validation
  - Average Trip Lengths by Purpose Compared To Observed Values
  - Number and Percentage of Intrazonal Trips By Purpose Compared to Observed Values

Recommendations
Reporting – Mode Choice

- Formatted Listing of Model Coefficients and Constants
- Diagram of Nesting Structure
- Number and Percent of Trips by Mode, Sub-Mode, and Purpose
- Mode Share for Major Activity Centers
- Estimated Auto Occupancy by Purpose

Recommendations
Reporting – Highway Assignment

- VDT, VHT and Delay
- Number of Trips Loaded and Counted
- Volume/Capacity Ratios by VDT, VHT, and PSWADT:
  - By Screenline, Cut Line, Cordon Line and Significant Corridors
  - By Area Type, Facility Type, and Number of Lanes
  - By Volume Group
- Input and Congested Speeds and Percent Difference
- Additional for Validation
  - RMSE By Volume Group
  - Volume/Count Ratios like Volume/Capacity Ratios

Recommendations
Reporting – Transit Assignment

- Boardings and Alightings by Stop and Direction
- Estimated Number of Transfers By Mode and Route
- Peak Vehicle Requirements
- Transit Station Loading Graphical Report
- Additional for Validation
  - Estimated and Observed Ridership by Mode and Route
  - Ratio of Estimated Over Observed Ridership by Mode and Route

Discussion
Standard Parameters, Mapping Templates, and Reports

Summary

- Cube Voyager is an Open System
- FSUTMS Benefits from Structure & Flexibility
  - Reporting is greatly simplified
  - Training is greatly simplified
  - Experience is readily transferable
- Cube Base & Cube Voyager Provide a ready-made way to Manage Data, Models and Processes
- Consider using Core System Variables where possible to Minimize Re-work and Scripting
- Consider platform limitations when implementing file naming/management systems.

Wish List

- Improve Documentation
- Model Setup Program
- Interactive Scripting
- Citilabs Office in Florida
- Cube Voyager Tie or Scarf
  - How about a mouse pad?

APPENDIX C

FUTURE ENHANCEMENTS TO FSUTMS-CUBE

SUMMARY OF GROUP DISCUSSIONS AT
MODEL TASK FORCE MEETING, MAY 4-5, 2004

Roadway Geography

- Needed GIS layers include a TAZ database, TAZ coverage, model roadway/network geography, and a local street network to develop the transit access network (eliminate spider network).

- Information that should be included in these database layers include socioeconomic data, roadway facility type, number of lanes, area type and traffic counts, railroad alignment, intersection control, turn prohibitors, ITS components, pavement information, bridge attributes, truck restrictions, bus stop coding, station coding, fixed guideway, and barriers.

- The roadway geography should be compatible with statewide, FDOT, city and county geography, GDL (Geographic Data Library) and ETDM procedures, and should provide the ability to overlay aerial photos.

- There is a need to develop a procedure to maintain the databases over time, including the Citilabs-provided base maps.

- The projection system needs to be established for each network in the state.

- FSUTMS should automatically update the transit network when changes are made to the highway network.

Generation of Standard Reports and Output

- There needs to be a checkbox so that the user can select the specific reports that should be generated in a particular run.

- Better diagnostic messages should be provided when an error occurs.

- Users should be able to change the format of the report.

- There should be an interface that will allow for the production of summary reports by district, county, market segment, screen line, and cut line.

- Reports should be provided to display off peak vehicle use, emissions, ons and offs by transit route, percent trucks, highway and transit level of service by corridor, environmental justice, transit capacity, trip length frequency data, unbalanced attractions by district or county, transit station activity, VMT and VHT, and other useful HEVAL information.

- There needs to be a better identification of trip purpose instead of the previous numeric coding scheme of 1, 2 etc.

- The input and output files need to be time and date stamped.

- The system should allow for the creation of reports by drawing a corridor on a map and obtaining reports for a specified area.

- There is a need to develop a reporting system for land use checks and network checks, i.e., there should be a utility for checking data inputs.

- There is a need to develop reports for quality control purposes and user-friendly debugging procedures.

- The reports should include a comparison between the model outputs and observed patterns in travel survey data.

GIS Themes

- The GIS Committee should be involved in the development and specification of GIS Themes.

- Several themes of interest include:
    o barriers to be used in transit
    o links by color
    o volume/capacity
    o volume/count
    o population density
    o level of service with GIS-TM standard imports
    o environmental justice (selected based on population groups)
    o bridges
    o maintenance schedules
    o transit routes
    o land use checks
    o facility constraints (environmental, historical, etc.)
    o desire line maps
    o mapping to examine origins and destinations
    o transfer matrices
    o bar charts showing various shares and trends
    o auto ownership by TAZ
    o zero-automobile households
    o mode split by purpose by zone
    o linkage to census data

- FSUTMS should include defaults for colors and patterns, a default library for GIS layers, and a central depository to share themes.

- A general list of thematic maps should be set up with a pull down menu where the user can select the desired theme.

- Care should be taken to ensure that the colors can be easily discerned by those who may be colorblind and/or color challenged.

User Interface

- The proposed user interface is good.

- The flash screen should be optional.

- The map-based model selection interface is quite good, but there should also be an option to go directly to the model of choice.

- The version number of the model should be clearly identified.

- All current FSUTMS steps should be a part of the standard interface.

- There is a need to be able to run more than one scenario at a time and/or stack runs sequentially in a batch job.

- There should be an initial setup report and an automatic check for the required files.

- There should be a checkbox for the users to specify the files that should be kept at the end of the run.

- There is a need for model version control.

- There should be a scenario button interface.

- There should be buttons to edit, finalize, delete, etc.

- There should be a way to archive, delete temporary files, compress files, and save a run.

- There should be an option to name and password protect a model run, perhaps in an archive library.

- There should be an option to run Summit (for Transit New Starts Projects) and air quality emissions program.

- Before executing a command there should be an "are you sure?" question.

Miscellaneous

- The output file should be protected so that it cannot be modified (e.g., current binary format in TRANPLAN).

- There is a need to run multiple sessions with one key.

- The line layers need to be compatible across modal networks.

- There should be
  - unlimited undo and redo capabilities
  - save and save as capabilities
  - an audit trail of user actions
  - a formal archiving ability
  - auto save option
  - an option to update multiple scenarios at the same time
  - an option to map landmarks and make them polygons.

- There should be a method to analyze version certifications between networks.

- The error and debugging messages should be improved.

- A method should be developed to check the speed-cap table.

- There should be an option to compress files.

- It should be easy to convert CUBE output to a format compatible for input to ArcGIS, ETDM, etc.

- The CUBE training should be more focused on FSUTMS (travel demand modeling) and less on GIS functionality.

SUMMARY OF GROUP DISCUSSIONS AT
MODEL TASK FORCE MEETING, NOVEMBER 12-13, 2003

INTRODUCTION

The Florida Model Task Force (MTF) met on November 12 and 13, 2003 in Orlando, Florida. On Thursday November 13, 2003 the MTF requested input from the members on five different topics. These were trip generation, trip distribution and mode choice, highway network, transit network, and traffic assignment (highway and transit). The members were divided into groups and were asked to take a "brainstorm" approach to the group interaction and develop a list of items that they felt were important in the short-term/interim migration of FSUTMS-Tranplan to FSUTMS-CUBE. The group sessions were held from 10:30 AM until 11:30 AM and from 1:00 PM until 2:30 PM. The lists are documented in this appendix. The items are organized by topic and the lists generated by each group are reproduced below verbatim.

DELIBERATIONS OF THE TRAFFIC ASSIGNMENT GROUP

Moderator: Frank Baron, MTF Freight Committee Chair, Miami MPO

Time-of-day related

- Automated All-or-nothing followed by a regular assignment with a follow-up comparison & analysis techniques (compounded impedance versus congestion)
- Time of Day analysis
- Design hour traffic (peak hour)
- Default user equilibrium for the State (with options for local areas
- Transit access by Time-of-Day implications
- Methods of assignment (non-equilibrium for off-peak, e.g. All-or-nothing or stochastic
- Period/peak spread
- Analyze different assignment techniques, such as time-of-day, incremental time-slice assignment maintaining a feedback to the network.

Generalized Users Cost related

- Toll modeling – vehicle class and user class with single occupancy vehicles versus multi occupancy vehicles
- Generalized Cost Assignment
- Generalized user costs versus use of time

Revising Volume-Delay Function (BPR) related

- Variable "BPR" curve / volume capacity constraint assignment techniques *x* vehicle classification.
- Assignment by area (long term)
- Intersection delay
- Highway versus Transit congestion interactions
- Addressing instability in equilibrium assignment
- Transit speed curve updates
- Replace BPR curves, develop volume delay functions (especially time dependent functions)
- A check for volume delay curves

Truck Assignment

- Trucks – vehicle classification
- Truck assignments in model
- Truck assignment on a truck network

Transit Assignment & Skim Procedures

- Update transit assignment of skim processes
- Transit externals
- *Non motorized travelers (long term)*
- Additional modes for assignment?
- Users cost
- Capacity restrained procedures for transit

Miscellaneous

- Mobile 6 interface
- Automated way to perform turn-prohibitors or time penalties movements and view them

Needed Reporting Features

- User selected menu of different reports
- Observed versus estimates for transit ridership (place to put it in DBF)
- Transit select link analysis
- Transit select line/route analysis
- Station-to-Station matrix & GIS maps
- Capacity restrained for transit
- Standard package for restrained transit with feedback assistance
- Automated calibration, validated, techniques
- Program or Users/input or output file name convention to sort report names and files
- Choices for reports and options
- Reporting in tables, files and maps
- Maps with descriptions and capability to display the changes from one scenario to another.
- Observed versus estimated speeds

- Input and Output comparison reports for alternative series
- Automate the ability to join linked data for temporary comparisons
- Select zone, link analyses should be automated process
- Standardized output in standard format for later analysis and comparisons
- Populated crystal or excel reports with standard output
- FTA summit and FTA indices reports
- Scatter grams
- Reports by subarea
- Environmental justice reports
- Development of output reports for validation, analysis and presentations
- LOS-oriented and T-LOS reports and other scatter grams

Items that can be Eliminated
- Single Path, Single Period

DELIBERATIONS OF THE TRIP DISTRIBUTION AND MODE CHOICE GROUP
Moderator: Mike Neidhart, MTF Trip Distribution Committee Chair, Volusia County MPO

File Structure Ideas
- Lookup tables or gamma functions or matrix format (FF, KF)
- Create a folder structure with input files, output files and report files

Needed Capabilities in CUBE
- Use cube programming language versus existing Fortran
- Ability to use Fortran program if replication of existing results is important or if maintaining custom-features is important
- Integrate percent walk code into CUBE/cube programming language
- Trip length frequency distributions by purpose
- Regional trip distribution
- Distribution of long trips
- Generalized nested logit
- Treat Toll as a separate mode

- Develop an automated calibration process for the Generalized Nested Logit structure
- Option for using different types for models by study area (destination choice, gravity)
- Ability to add additional trip purposes
- Ability to use FTA user benefit program

Needed Reporting Features

- Desire Line button
- Streamline reports (suppression, don't report zones with 0 trips)
- Average trip lengths
- Intrazonal by purpose (including % intrazonal)
- Trip length frequency distribution curves (graphed)
- Input versus output attractions/convergences
- % Mode split by mode (in addition to # of trips by mode)
- Reduce reporting to necessary output
- Plot report of trip length for comparison
- Standardized reports for calibration/validation
- Matrix aggregation
- Reports that alert the user such as numbers out of range, etc.

Outstanding/Long Term Issues

- Single path versus multi-path versus nested logit
- Composite impedance
- Choice of procedures to implement Friction Factors
- Citilabs needs to write an accessibility file from the GM
- Special generator are non-standard and are handled differently by each area (airport trips)
- Research project needed to investigate airport trips as a separate trip purpose
- Additional research is need to test doubly-constrained gravity model
- Include socio economic and demographic variables in the mode choice
- Develop nesting structures.
- Market segmentation and consistency through Mode
- Use logit destination choice by market segment

- Trip tours bad for distribution
- FTA process might require legacy code

DELIBERATIONS OF THE HIGHWAY NETWORK (HNET) GROUP

Moderator: Glen Ahlert, MTF GIS Committee Chair, Lee County MPO

File Structure Ideas

- Links, xy, spdcap, Tcards, tollink, (vfactors)
- Future networks – database should contain all alternatives
- Make fieldname dBase compatible
- Perhaps need a routine to export to dBase
- Mechanism to backup databases
- Add the ability to add jurisdictional codes, road names, project names, count stations (permanent) that apply to the link. Include look-up tables for seasonal factors, k-factors, etc.
- Have summary tables and multiple tables rather than one huge table of data

Needed Capabilities in CUBE

- Geographically accurate network
- Standard name for fields
- Standard line layers
- Standard projections
- Speed and capacity by facility type/area type/number of lanes need to be in a lookup table with automatic linkage. Along with possible user overrides (protection system)
- Speed-cap table needs to be reformatted to be more easily readable (simplified)
- Intersection delay
- Toll facilities modeling- coordinate with turnpike enterprise (open road tolling/automated vehicles identification/hot lanes)
- CUBE needs to use "Vine-builder"
- Create TT and Auto occupancy factor look-up tables to replace profile.mas
- Separated productions and attractions loadings for each zone

- Facility designations for truck routes and truck prohibitors
- Universal turn prohibitors (e.g. all left turns)
- Link characteristics by time of day (reversible lanes, no on-street parking at rush hour)
- Turn prohibitors by time of day.
- Code nodes by milepost (dynamically –conflate)
- Node based delay
- FIHS/SIS code (option to code with higher speed)

Needed Reporting Features
- Penalties and prohibitors need to be visual
- Intrazonal & terminal times
- Toll plaza information
- Visualization of speeds and capacities (graphs & plots)
- Create standard & required tables for validation reports, etc.
- Flag differences between networks
- Flag speed-cap hierarchy
- Flag area types changes or abnormalities
- Report additional link information (e.g. access management)
- LOS reports associated with count stations

Outstanding/Long Term Issues
- Intrazonal and terminal times, where do we update them?
- Turn penalty coding in CUBE should be simplified.
- Ability to specify percent loading to each connector of a zone
- Develop alternatives to facility and area type coding. Code specific characteristics used by Highway Capacity Manual rather than facility type coded.
- Automated area type factor based on ZDATA of adjoining zones, etc.

DELIBERATIONS OF THE TRANSIT MODELING GROUP

Moderator: Kevin Feldt, MTF Transit Committee Chair, Jacksonville Transportation Authority

File Structure Ideas

- Placeholder for observed data in database file
- Investigate route databases (definition) for Route importing

Needed Capabilities in CUBE

- Added modes (non-motorized) for assignment
- Automation to assist in validation/calibration process
- Integrate the summit software and reporting from FTA
- For single period, single path and multi-period single path include single occupancy and multi occupancy vehicle assignments
- Coding transit routes by directions
- Highway network changes are automatically made in the transit network
- Pull transit speeds from congested hwy speeds (consistency)
- Eliminate separate auto access links, use roadway network
- Standardize stop attributes
- Transit path building should include standard parameters
- Model different mode (ferry)
- Coding of fares (generalized cost pathing)
- Geo referenced transit stops
- Walk links separate from highway network
- Improve park and ride coding
- Add "kiss offs"
- High-speed rail parameters
- Mechanism to handle interline routes
- Accommodate more than one transit operator
- Code walk buffer by stop or route in cube programming language script
- Import optimized route networks
- Keep observed ridership data
- Improved transit assignment by time-of-day

- Ability to analyze land use impacts for transit investment studies
- Integrate best O&M estimating procedures
- Code walk access barriers
- Speed delay functions
- Transit assignment with schedule integration

Needed Reporting Features
- Station to station matrix
- Select link and zonal analysis
- Access mode
- Offer crystal reports and spreadsheet for output
- Incorporate TLOS measurements in report
- Reports by route and mode, transfers, boardings, alighting by stop and direction, link volumes, performance measures, etc.
- Travel time by link by mode
- TLOS reporting
- Automatic population of tables and spreadsheets
- Menu driven reports
- Trace path algorithms for accessibility for zone pairs
- Reporting by Transit Company
- Include standard display features

Items that can be Eliminated
- Optional links coding
- TNET attributes
- Auto connector program

Outstanding/Long Term Issues
- Standardized modes with parameters
- On demand transit – demand responsive transit
- Pathing rather than buffering if available
- Transit simulator
- Develop a coding guidelines manual

DELIBERATIONS OF THE TRIP GENERATION GROUP

Moderator: Gary Kramer, MTF Transportation Land Use Committee Chair, West Florida Regional Planning Council

File Structure Ideas

- Single Zonal Data file as a database
    - Inputs
    - Outputs – permanent or temporary
    - Use 1 file for multiple alternatives
    - Maintain portability – compact set of information
    - Use of filed comments for added detail

- ZD1, ZD2, ZD4 should be one file
- Special generators kept separate
- Alternative and year separate files
- Trip rate database
- Standard inclusive ZDATA format (Some models might not use all L.U. variables)
- Use separate directories for different alternatives

Needed Capabilities in CUBE

- Automation with Cube programming language to be able to export from CUBE to our exiting Fortran code & then bring back in CUBE
- Using Cube programming language to create or duplicate our existing Fortran programs (more long term)
- Parking information and Zdata
- Standard variables and additional detail as needed
- Track changes on DBF files
- Auto ownership versus income break out auto ownership into 0,1,2,3+
- Total dwelling units (DU), occupied DUs, seasonal DUs
- School – separate
- Hotel/motel – separate
- Land use cross-class variables

- Internal/external routine with trips occupancy rates, etc.
- Combine P's and A's
- Use of different rates by geography, tourism and income
- Treat airports, universities, schools, and trucks as different purposes
- Table format (GRATES, DUWEIGHTS)
- Profile.mas, via launcher
- Special generator trip rates
- Subarea balancing

Externals

- Adopt a process for internal & external trips
- Integrate IE & EE processes (% splits)
- External trips by:
  - Auto occupancy (DA 2p and 3p)
  - Truck Classification (LD, MD, HD)
- DBF table of EE trips
- Station descriptions

Needed Reporting Features

- Portable to spreadsheets, etc
- Standard edits feature like LUCheck
- Aggregate trips rates
- Trips % by purpose
- Port to metadata
- Ps & As exported to DBF
- Import/export to ASCII for comparison between datasets
- Ability to note changes in inputs/rates
- Output report of model parameters

Items that can be Eliminated

- ASCII Zdata files

Outstanding/Long Term Issues

- Lifestyles versus standard model
- Truck generation
- Airport/other major generators – standard methodology
- Generation by time of day
- What variables are needed statewide for other reasons?
- Fortran vs. Cube programming language scripts
- Generalized Gen (later) to handle multiple structures
- Eliminate balancing of As and Ps (shift to Distribution)
- Add more detail into the existing data (5 employee categories)
- Use Citilabs trip generation (more long term)

APPENDIX D
DOCUMENTATION OF THE FLORIDA STATEWIDE FREIGHT MODEL

BACKGROUND

Following the adoption of TransCAD as the modeling software engine for FSUTMS in Spring 2003, the Systems Planning Office embarked on an ambitious Statewide Freight Model Development effort. This effort was undertaken in 2003-2004 with a view towards implementing a comprehensive and detailed statewide freight travel demand modeling system within the TransCAD environment.

Following the completion of that first phase effort, Cambridge Systematics, Inc. was awarded a subcontract to further enhance the Statewide Freight Travel Model by performing various calibration and validation tests. In addition, Cambridge Systematics, Inc. was to explore the feasibility to integrate the statewide freight travel demand model with the statewide passenger travel demand model. Following the award of this contract, the Model Task Force voted to adopt Cube/Voyager as the modeling software engine for FSUTMS.

After the switch to Cube/Voyager, the Systems Planning Office and the Model Task Force devoted time and resources to the implementation of Cube/Voyager in the state and the development of training workshops for planners and modelers in the state. Cambridge Systematics, Inc. developed a routine to combine the passenger travel demand forecasts and the freight travel demand forecasts from the two statewide travel demand models so that the statewide models developed earlier in TransCAD would continue to be useful while the transition to Cube/Voyager took place. Caliper Corporation provided the detailed documentation on the Statewide Freight Travel Model that was used by Cambridge Systematics, Inc. for executing its subcontract on the integration of the statewide passenger and freight models. This documentation, provided by Caliper Corporation in Acrobat PDF format, is provided in this chapter.

1

Documentation for the Florida Statewide Freight Model (STFM)

Prepared for Reynolds, Smith and Hill
and
The Systems Planning Division of the
Florida Department of Transportation

February 25, 2004

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Documentation for the Florida Statewide Freight Model (STFM)

This documentation outlines the general procedures and assumptions used to implement the Florida Statewide Freight Model (STFM) in TransCAD Version 4.7. This model builds upon and expands the STFM model developed by Cambridge Systematics in 2002.

The earlier STFM model was developed for a 508-zone system, used a less accurate and less complete road network, and modeled long haul trucking based upon estimates of commodity flows at the county to county geographic level. The current model uses a 3903-zone system and a significantly enhanced road and also includes local and intermediate haul truck trips by medium trucks and tractor trailer combinations.

A User's Guide for the STFM appears as an Appendix to this report. It explains how to run the model, add additional scenarios, and view the model outputs. All of TransCAD's extensive GIS and modeling capabilities can be used to further modify and analyze the STFM results.

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APPENDIX

1   Introduction and Overview

The Florida Statewide Freight Model (STFM) was first developed by Cambridge Systematics (CS) using FSUTMS (i.e., TRANPLAN) as the modeling platform. This model used estimates of commodity flows from Reebie Associates to generate truck volumes between county pairs to, from, and within Florida. Because of the nature of the model, its focus was on predicting long haul trucking including interstate movements. The model was based on a 508-zone structure with a road network that was fairly detailed within Florida and used major roads to connect to other states.

Previously under subcontract to CS, Caliper implemented the model in TransCAD and substituted a more accurate road network in place of the one used previously. In the first implementation, the 508 zone system was retained as were all model components including FORTRAN code used for mode choice. Subsequently, Caliper assisted USF in working on a 4000 zone framework for both passenger and freight models as well as substituting an even more detailed and refined highway network that contains virtually all of the links found in the MPO level models used in Florida.

While the original model was never calibrated to the 4000 zone system, it became clear to the Systems Planning Office that the model would not predict truck flows that were close to reported counts without additional modification, expansion of scope, and calibration. Also, after the Florida Model Task Force adopted a resolution to replace TRANPLAN with TransCAD, Caliper was then tasked under subcontract to Reynolds, Smith, and Hill to review the statewide passenger and freight models and to make short-term enhancements to the models in TransCAD. Recommendations were also sought for future enhancement of both models.

The model enhancements to the STFM included full conversion of the CS long haul truck model, numerical improvements to the accuracy of the model resulting from limitations of integer arithmetic, bucket rounding and trip distance limits imposed by TRANPLAN, refinement of network centroid connectors and expansion of the model to include shorter intrastate trips made by medium and large (i.e. tractor trailer combinations) trucks.

Extensive data processing was performed to examine additional datasets that could be used in future versions of the STFM and to make use of classified vehicle counts that could be used for calibration and validation of the model. The counts for mobile and permanent counting stations were found to differ from the counts on the Traffic Statistics CD and there were difficulties in accurately placing the counts on the much more geographically accurate road network that Caliper had provided with TransCAD.

The model zones were rebuilt from equivalency tables and demographics were recomputed from Census data and from the firm database that FDOT had licensed. Various errors associated with zone geography were identified and corrected which also lead to improvements in the socio-economic measures utilized in the STFM and STPM.

Various data sources were reviewed in order to identify data that could be used to model intrastate truck trips. While some useful data were identified, it became clear that the best approach would be to estimate these trip tables from counts. The trip table estimation procedure works best with an initial starting or seed matrix. For the large trucks, the estimates from the long haul model were used as a starting point. For medium intrastate trucks, the seed matrix was obtained by implementing a model previously developed by Howard Slavin for urban truck trip generation and distribution. Then the trip table estimation process was performed for large and medium trucks.

In the current implementation of the model, these additional matrices are added to the truck trip matrix from the long haul model for large trucks and a two-class truck trip assignment is performed. This yields estimates of large and medium trucks on each link of the Florida statewide network.

Using these procedures, the model fits the base year data exceedingly well. RMSE percentages on the order of 47% for large trucks and 21% for medium trucks were obtained. For major roads, these percentages are 28% and 9% respectively. This result is far more accurate than is typically achieved in statewide modeling.

Due to the very small budget for this effort, an elaborate forecasting model for intrastate truck trips was not developed. In the current implementation, these additional trip matrices can be scaled up using growth factor percentages or any of the other methods provided in TransCAD. In future work, additional forecasting procedures should be implemented.

2   STFM Model Framework and Data Inputs

In this section, we describe the model framework and data inputs. The portion of the model that is derived from the Cambridge Systematics work is described only briefly as it is more fully documented in another report. A flow chart indicating the structure of the model follows. This is followed by a discussion of the data inputs and subsequent sections of this report document the model components.
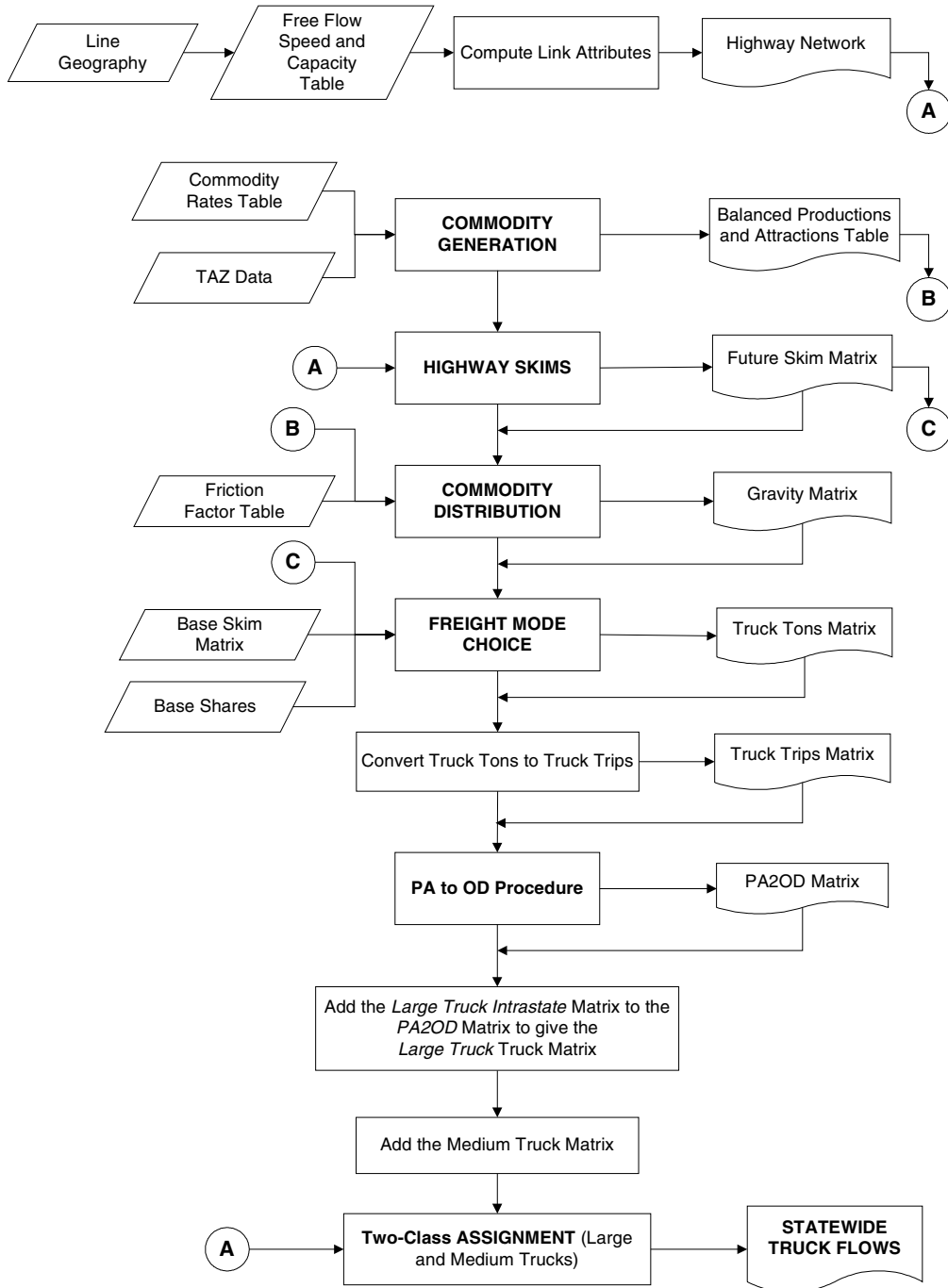
Figure 2.1: STFM Model Framework

2.1 Network Enhancements

Significant work was carried out to prepare the TransCAD Florida road database for use in the STFM.

- Additional links for the rest of the United States were incorporated using tools in TransCAD and an extract of the national road network that comes with TransCAD.

- A thorough revision of the functional class type (FTYPE2) and the area type (ATYPE2) values was undertaken. These fields are critical from a modeling perspective as they influence the speeds and the capacities of individual links and thus have a significant bearing on the model results. On a network wide basis, inconsistencies in the FTYPE2 and ATYPE2 values were removed from the network. Recommendations to these values by suggested by Cambridge Systematics and others were incorporated.

- Speeds and capacities were allocated to the links based on the Highway Procedural Enhancements Study, performed by the Florida DOT. Further, adjustments to these speeds were performed in certain localized areas.

- Counts from shape files containing truck volumes for the years 2001 and 2002 were transferred appropriately to links in the network. Since the geography of the shape files did not correspond exactly with the statewide network, special procedures had to be employed to transfer the counts to the database. In particular, some in-house tools were used to transfer the counts with minimal errors.

- Further, Counts from the Freight Analysis Framework (FAF) (source FHWA) were incorporated into the network in a manner similar to above.

- Classified Counts from the 2002 Florida Traffic Information database were added to the network. The classified counts were used to construct medium and heavy truck counts and these were transferred from the relevant PTMS or TTMS station to the network links using appropriate GIS techniques.

- A new set of centroid connectors was developed. Connectors were made to mid-block and constrained to be to connect to ramps instead of the midpoints of highway links.

Also, under this task we endeavored to initiate a review of the network by local transportation professionals. We made early versions of the network available on the internet, in TransCAD format on a CD, and also generated paper maps for District Office review. We also compared several MPO model networks with the statewide network as it is desirable that the statewide network include all the MPO model network links. The following sections describe the network in more detail with focus on the link and the node attributes. A brief description of the TAZ layer is also presented.

2.2 Detailed Network Description

The following tables present link and node fields that were added by Caliper and those that are of importance to the STFM model. Some fields from the original database (the RCI fields) were untouched in any of the network edits and hence are not described.

2.2.1 Link Attributes

Field	Description
ID	The internal link ID automatically generated by TransCAD
Length	GIS Length determined by TransCAD
Dir	0 = Two Way Street, 1 or -1 = One way street
FTYPE2	The functional class of the link. The major functional classes are: 10 - 19: Freeways and Expressways 20 - 29: Divided Arterials 30 - 39: Undivided Arterials 40 - 49: Collectors 50 - 59: Centroid Connectors 60 - 69: One-Way Facilities 70 - 79: Ramps 80 - 89: HOV Facilities 90 - 99: Freeways with Toll Facilities
ATYPE2	The area type classification of the link. The major area types are: 10 - 14: CBD Areas 20 - 21: All CBD Fringe Areas 30 - 34: Residential Areas 40 - 43: OBD Areas 50 - 52: Rural Areas
[Road Name 1] to [Road Name 4]	Street name of the link. Road Name 1 represents the primary road name. Road Names 2 to 4 represent alternative names, if any.
TYPE	Text description of Functional Class
TOLL	1 = Toll Link, null otherwise
ABLane/BALane	The number of lanes in each direction
DISABLE	1 = Future network links that are not to be included for the STFM model, null otherwise
[Speed (mi/hr)]	The speed for all the links outside Florida. Source Caliper.

ODTollLinks	1 = Link belongs to the selection set of the OD based tolls, null otherwise
FixedTollLinks	1 = Link has a toll value, null otherwise
[2-AXLE] to [6-AXLE] *	The Toll values for the links depending on Axle load
AB_01_AADT/ BA_01_AADT	The Average Annual Daily Traffic from the Florida Traffic CD for the year 2001. Similar fields exits for the year 2002 as well (AB_02_AADT/BA_02_AADT)
AB_01_TruckAADT/ BA_01_TruckAADT	The Average Annual Daily Truck Traffic from the Florida Traffic CD for the year 2001. Similar fields exists for the year 2002 (AB_02_TruckAADT/BA_02_TruckAADT)
AB_01_AutoAADT/ BA_01_AutoAADT	The Average Annual Daily Auto Traffic from the Florida Traffic CD for the year 2001. Similar fields exists for the year 2002 (AB_02_AutoAADT/BA_02_AutoAADT)
AB_01_HvyTruckAA DT/BA_01_HvyTruck AADT	The Average Annual Daily Heavy Truck Traffic from the Florida Traffic CD. Similar fields exists for the year 2002 (AB_02_HvyTruckAADT/BA_02_HvyTruckAADT)
AB_01_MedTruckAA DT/BA_01_MedTruck AADT	The Average Annual Daily Medium Truck Traffic from the Florida Traffic CD. Similar fields exists for the year 2002(AB_02_MedTruckAADT/BA_02_MedTruckAADT)
TR_01_TFCTR	The truck factor used to derive truck AADT from total AADT. e.g. AB_01_TruckAADT = TR_01_TFCTR*AB_01_AADT/100 A similar fields exists for the year 2002 (TR_02_TFCTR)
TR_01_HvyTrkPct	The heavy truck factor used to derive heavy truck AADT from total AADT. e.g. AB_01_HvyTruckAADT = TR_01_HvyTrkPct*AB_01_AADT/100 A similar field exists for the year 2002 (TR_02_HvyTrkPct)
TR_01_MedTrkPct	The heavy truck factor used to derive heavy truck AADT from total AADT. e.g. AB_01_MedTruckAADT = TR_01_MedTrkPct*AB_01_AADT/100 A similar field exists for the year 2002 (TR_02_MedTrkPct). Note that the medium and the heavy truck percent add up to the TFCTR value.
AB_FAF_AADT98/ BA_FAF_AADT98	The AADT from the Freight Analysis Framework (1998)
AB_FAF_AADTT98/ BA_FAF_AADTT98	The Average Annual Daily Truck Traffic from the freight analysis framework (1998)
AB_FAF_FAF98/ BA_FAF_FAF98	The truck flow corresponding to the Freight Flow Analysis Movement from the freight analysis framework (1998)

Notes	An integer coded field with notes on particular links. In particular, Notes = 2 represent disabled links and Notes = 16 represent links outside Florida
[AB_Hr_Cap]/ [BA_Hr_Cap]	The hourly capacity values for the links.
[AB_Daily Capacity]/ [BA_Daily Capacity] *	The daily capacity values for the links. Note that the daily capacity is 10 times the hourly capacity.
AB_Speed/BA_Speed	The free flow speeds on the links
AB_Time/BA_Time *	The calculated free flow times on the links corresponding to free flow speeds: (Length*60/*_Speed)
AB_CTime_PAX/ BA_Ctime_PAX	The congested times on the links from the passenger model
Alpha *	The alpha parameter of the BPR function for the links
Beta *	The beta parameter of the BPR function for the links
ConnectFlag	A Flag that indicates which links are eligible to be connected by the centroid connectors. 1 = Split Link, 2 = Connect, 3 = Do Not Connect
CentroidConnector	1 = Link is a centroid connector, null otherwise
RealCount	1 = The counts from the Traffic CD Data that are actually measured rather than computed indirectly
PTMS_ID	The ID of the Portable counting station (used in the classifier count data)
TTMS_ID	The ID of the Telemetric counting station (used in the classifier count data)
AB_P_T_Med/ BA_P_T_Med **	The medium truck counts obtained at either a Portable or a Telemetric Counting Station (classifier count data, classes 5, 6 and 7 as per the Florida Annual Vehicle Classification)
AB_P_T_Hvy/ BA_P_T_Hvy **	The heavy truck counts obtained at either a Portable or a Telemetric Counting Station (classifier count data, classes 8 to 13 as per the Florida Annual Vehicle Classification)
AB_P_T_Pax/ BA_P_T_Pax **	The passenger counts obtained at either a Portable or a Telemetric Counting Station (classifier count data)
AB_P_T_Total/ BA_P_T_Total	The total counts obtained at either a Portable or a Telemetric Counting Station (classifier count data).
ab_overridespeed/ ba_overridespeed	The field that contains the local adjustments of the AB_Speed/BA_Speed fields

Table 2.1: Link Attributes

Please note that all the fields indicated with an asterisk (*) are required by the model, while building the network (the .net) file in TransCAD. One or more of the fields marked by two asterisks (**) were required in the .net file for running the trip table estimation process.

2.2.2 Computation of Critical Network Fields

The critical fields that have a significant bearing on the model results are the speeds and capacities of the links (i.e. the fields AB_Speed/BA_Speed, Hourly Capacity ([AB_Hr_Cap]/BA_Hr_Cap]), Alpha and Beta in the network). These values were obtained from the Highway Network (HNET) Procedural Enhancement study for Florida. This study allocates free flow speeds and hourly lane capacities (LOS E Capacities) based on values of FTYPE2, ATYPE2 and number of lanes. However, the speeds of ramps from the HNET study were considerably high (50 mi/hr) and these were reduced to a maximum of 35 mi/hr. A speed capacity rates file was constructed based on the above and was used to compute the network attributes (SpeedsAndCapacities1017.bin in the model Extras folder). Further during the process of model conversion, speeds on some of the frontage roads have been adjusted so that appropriate paths are chosen that use the freeways rather than getting off the freeway, on to the frontage road and back on to the freeway. It is to be noted that these attributes are computed as a preprocessing operation and the network fields are filled before the STFM model is run.

2.2.3 Node Attributes

Field	Description
ID	The internal Node ID provided by TransCAD
Longitude	The Longitude of the node provided by TransCAD
Latitude	The Latitude of the node provided by TransCAD
TAZ	The TAZ ID's of the centroid nodes. This field links the centroids in the network to TAZ's.
Ext_3914	Contains the TAZ ID's of the external stations.
Ext_508	Contains the TAZ ID's of the original 508 zone system
PORT	1 = Nodes that are ports, null otherwise
Description	The name of the port, if PORT = 1
[Toll Plaza]	1 = Node is a toll plaza, null otherwise
[Toll Plaza Type]	The type of the toll plaza (MAINLINE, INTERCHANGE or BRIDGE)
[Toll Plaza Name]	The street name where the toll plaza is located.
Centroid	1 = Node is a centroid node, null otherwise

Table 2.2: Node Attributes

2.3 TAZ Layer Improvements

A review of the TAZ system was performed at Caliper and certain problematic zones were eliminated. Some of these problematic zones include sliver zones with very small areas and of no practical significance and a few tiny zones present only in the water. The sliver zones and the tiny island zones were combined with other zones. The boundaries of the TAZ layer were rebuilt from Caliper block geography which has a nicer coastline.

Population estimates for the TAZ were checked and some errors were found, including deviations of about 50% from the Census 2000 data (for a few zones). Fresh estimates of the population and employment data by two digit SIC code type were computed.

The resulting TAZ has 3903 zones within Florida, to which 34 external stations were added. The internal zones are identified by zone ID's less than or equal to 3926, whereas the external zones are identified by zone ID's greater than 3959.

2.4 Network and Matrix Initialization

The initialization routine for the STFM model builds the highway network (.NET) file from the line layer. The network file is used in TransCAD to build shortest paths and run assignments. The fields that are included in the network are AB_Time/BA_Time, [AB_Daily Capacity]/[BA_Daily Capacity], Alpha, Beta, [3-Axle] and [4-Axle].

The initialization routine also creates empty matrices required for the trip distribution and the assignment stage.

3 Commodity Generation

The Productions and Attractions for the STFM model are expressed as tonnages of commodities from and to each TAZ and external station in the rest of the US. There are separate models for each of 14 sectors and their associated commodities as below. This generation model was developed by Cambridge Systematics and primarily estimates tonnage associated with long haul transportation.

- Agriculture

- Non-Metallic Minerals

- Coal

- Food

- Non-Durable Manufacturing Goods

- Lumber

- Chemicals

- Paper

- Petroleum Products

- Other Durable Manufacturing Goods

- Clay, Concrete and Glass

- Waste

- Miscellaneous Freight

- Warehouse

3.1 Cross Classification

The commodity generation rates for both productions and attractions are based on employment by 2 digit SIC (Standard Industrial Classification) codes, specified by the Census Bureau. The 2 Digit SIC code employments used in the commodity generation are provided in Table 3.1.

SIC Code	Description
07	Agricultural Services
10	Metal, Mining
20	Food and Kindred Products
21	Tobacco Products
22	Textile Mill Products
23	Apparel and Other Textile Products
24	Lumber and Wood Products
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing and Publishing
28	Chemical and Allied Products
29	Petroleum and Coal Products
30	Rubber and Misc. Plastic Products
31	Leather and Leather Products
32	Stone, Clay and Glass Products
33	Primary Metal Industries
34	Fabricated Metal Products
35	Industrial Machinery and Equipment
36	Electronic and Other Electric Equipment
37	Transportation Equipment
38	Instruments and Related Products
39	Misc. Manufacturing Industries
42	Trucking and Warehousing
44	Water Transportation
45	Air Transportation
49	Electric, Gas and Sanitary Services
50	Wholesale Trade - Durable Goods
51	Wholesale Trade - Non-Durable Goods

Table 3.1: SIC Employment Categories

The commodity generation is based on regression equations to estimate zonal productions and attractions using the SIC employment data. In addition to the above SIC employments, the Total SIC Employment and Population are used for some of the commodities.

The equations to determine productions and attractions for each of the purposes are presented in Tables 3.2 and 3.3.

Production Equations

Purpose	Equation to Determine Tons of Commodities (Productions)
Agriculture	35.99 * SIC7
Non-Metallic Minerals	5593.11 * SIC10
Coal	Determined only from Special Generator and External data
Food	353.40 * SIC20
Non-Durable Manufacturing Goods	26.75*(SIC21+SIC22+SIC23+SIC25+SIC27)
Lumber	316.24 * SIC24
Chemicals	900.49 * SIC28
Paper	199.50 * SIC26
Petroleum Products	570.61 * SIC29
Other Durable Manufacturing Goods	23.58 * (SIC30 + SIC31 + SIC33 + SIC34 + SIC35 + SIC36 + SIC37 + SIC38 + SIC39)
Clay, Concrete and Glass	3453.99 * SIC32
Waste	0.69 * Total SIC Employment
Miscellaneous Freight	1.74 * (SIC42 + SIC44 + SIC45)
Warehouse	157.43 * (SIC50 + SIC51)

Table 3.2: Commodity Production Equations

Attraction Equations

Purpose	Equation to Determine Tons of Commodities (Attractions)
Agriculture	34.37 * SIC20
Non-Metallic Minerals	1349.69 * SIC28
Coal	149.27 * SIC49
Food	211.29 * SIC51
Non-Durable Manufacturing Goods	45.09 * SIC51
Lumber	(303.38 * SIC25) + (0.38 * Population)
Chemicals	169.45 * SIC51
Paper	45.48 * SIC51
Petroleum Products	0.20 * Population
Other Durable Manufacturing Goods	32.33 * SIC50
Clay, Concrete and Glass	2.56 * Population
Waste	64.61 * SIC33
Miscellaneous Freight	3.56 * (SIC42 + SIC44 + SIC45)
Warehouse	2.49 * Population

Table 3.3: Commodity Attraction Equations

The model uses a rates table (grates.bin located in the model input directory), which contains the above equations represented in a tabular format. The file containing SIC employment data on a zonal basis can be located in the Input directory of the model (Zdata.bin). The cross classificiation produces an unbalanced Productions and Attractions table.

3.2 Special Generator and External Zones Data

The file containing special generator data and data for the external zones is located in the Model directory (TEI.bin). The special generator data is added to the respective zones after zonal productions and attractions have been estimated.

3.3 Commodity Flow Balancing

Commodity flow balancing is performed by using the weighted sum method, with equal weights for the productions and attractions. The resulting output is multiplied by 0.001 to yield flows in thousands of tons. The output file after the flow generation stage can be located in the model output directory (BalancedPandA.bin). The following flowchart (Figure 3.1) illustrates the entire trip generation process.
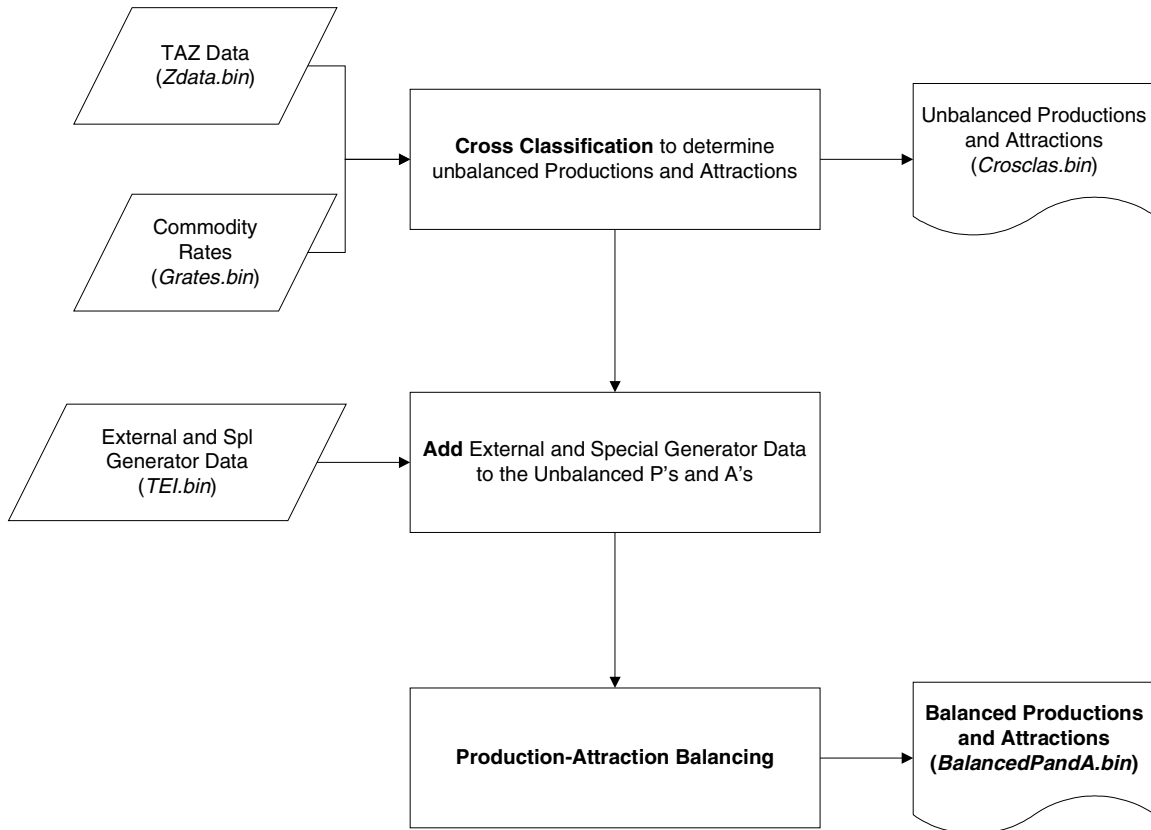
Figure 3.1: The Commodity Flow Generation Process

3.4   Flow Generation Results

The trip generation results after balancing are summarized for all the zones by commodity and are presented in Table 3.4. The values are represented in thousands of tons.

Purpose	Total Commodity (Thousands of Tons)
Agriculture	10,450
Non-Metallic Minerals	42,665
Coal	41,998
Food	33,288
Non-Durable Manufacturing Goods	6,204
Lumber	15,508
Chemicals	42,641
Paper	25,208
Petroleum Products	40,914
Other Durable Manufacturing Goods	24,482
Clay, Concrete and Glass	92,698
Waste	12,796
Miscellaneous Freight	10,939
Warehouse	102,982

Table 3.4: Commodity Flow Generation Summary Statistics

4   Shortest Path Travel Time and Distance Matrices

The next stage of the model produces estimates of shortest path times and shortest path distances. These matrices are used for commodity distribution and the freight mode choice model.

This stage uses the highway network created in the Initialization stage as an input. Further, since the trip distribution model is based on Free Flow Times or the Distance depending on the commodity, two matrices need to be produced. The first matrix is obtained by running the shortest path routine from centroid to centroid by minimizing the AB_Time/BA_Time field (These fields contain the Free Flow Travel Times). The second matrix is obtained by running the same procedure but minimizing the LENGTH field instead. Note that the centroid are identified either by the condition "Centroid = 1" or by the condition "TAZ <> null" in the node layer. The number of centroids in the network is 3937 (including the external zones).

After the matrices are calculated, intrazonal times are calculated for both the matrices using the closest neighbor approach. For each row origin, the travel time (or distance) of its three closest neighbors is found from the matrix. The intrazonal time (or distance) is computed as the average of the three numbers.

After both the matrices are computed separately, they are merged to a single matrix file (fhskim.mtx located in the model output directory). In requirements with the mode choice procedure however, the resulting matrix needs to have three cores (or three matrices). The first core should contain a dummy or an empty matrix, the second should contain the shortest path distances and the third should contain the shortest path Free Flow Travel Times. This matrix is also referred to as the future skim matrix, although it is not really a skim matrix at all.

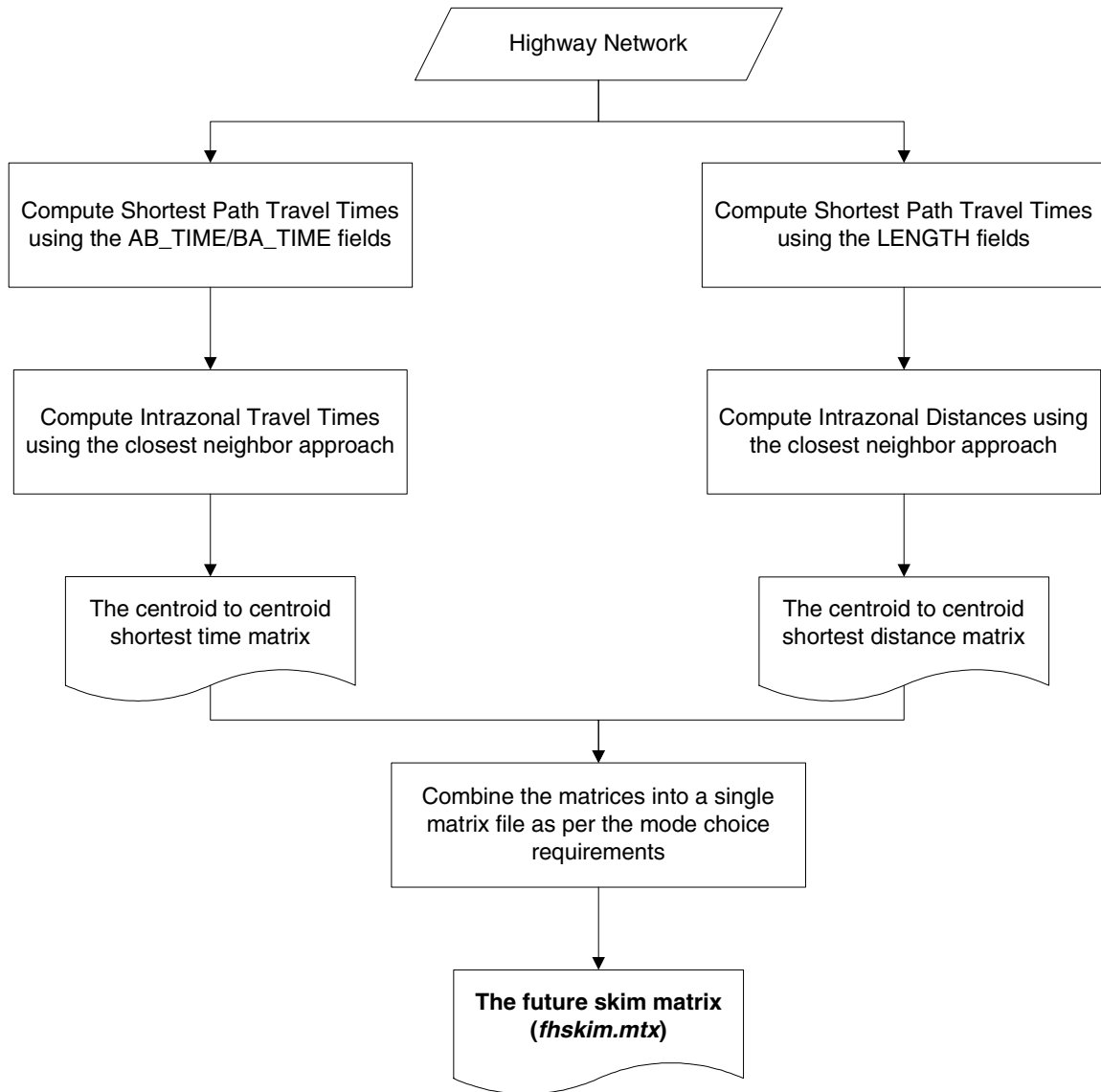Figure 4.1 shows the steps involved in the shortest pathfinding process.

```
                            ┌─────────────────────┐
                           ╱  Highway Network      ╱
                          └─────────────────────┘
```


Figure 4.1: The Highway Skim Process

5   Commodity Flow Distribution

The trip distribution for the STFM model is based on the Singly Constrained Gravity Method (SC Gravity or the TRANPLAN method), with constraints on the productions. The model uses the shortest path distance matrix for all the commodities except for Coal and Warehouse. The Coal and Warehouse trip distributions are based on the shortest path Free Flow Times.

Before the trip distribution the skim matrices are factored by 10 to convert the impedances into tenths of miles and minutes, respectively. This is required since the friction factor curves are based on the factored impedance variables.

The friction factor curves for the STFM model are based on a simple exponential function of the form $Exp(-c*T)$, where c is a commodity-specific constant and T is the value of the skim variable expressed in tenths of miles or minutes. Table 5.1 presents the value of the constant and the skim variable for each of the commodities.

No	Purpose	Skim Variable	Constant c
1	Agriculture	Distance	0.000797
2	Non-Metallic Minerals	Distance	0.003215
3	Coal	Distance	0.001223
4	Food	Distance	0.001517
5	Non-Durable Manufacturing	Distance	0.001803
6	Lumber	Distance	0.001720
7	Chemicals	Distance	0.001542
8	Paper	Distance	0.001327
9	Petroleum Products	Distance	0.000928
10	Other-Durable Manufacturing	Distance	0.001090
11	Clay, Concrete and Glass	Time	0.003801
12	Waste	Distance	0.001043
13	Miscellaneous Freight	Distance	0.001078
14	Warehouse	Time	0.002434

Table 5.1: Value of c in the Friction Factor Equation

The above file containing the coefficient values can be found in the Extras directory (Deterrence. bin). For convenience, the model uses a friction factor table rather than computing the friction factors on the fly (Friction.bin in the model input directory).

The friction factor table contains the value of the friction factor for values ranging from 0 to 2000 in increments of 1. Thus the value of the friction factor is pre-computed for skim values from 0 to 200 (miles or minutes). For values greater than 2000 (i.e. 200 miles or minutes), the friction factor computed at the value 2000 is used. The friction factor table contains a field or a column for each of the commodities. Depending on the actual skim value for a particular Origin-Destination pair, the value of the friction factor is read from the table (with interpolation if necessary).

The number of iterations used in the procedure is 20 with a convergence value of 5. The resulting gravity matrix file (CGRAV.mtx in the model output directory) has 14 matrices or cores, one for each commodity.

After the commodity flow distribution is complete, the impedances are converted back to their original scale. Figure 5.1 illustrates the steps in the trip distribution procedure.
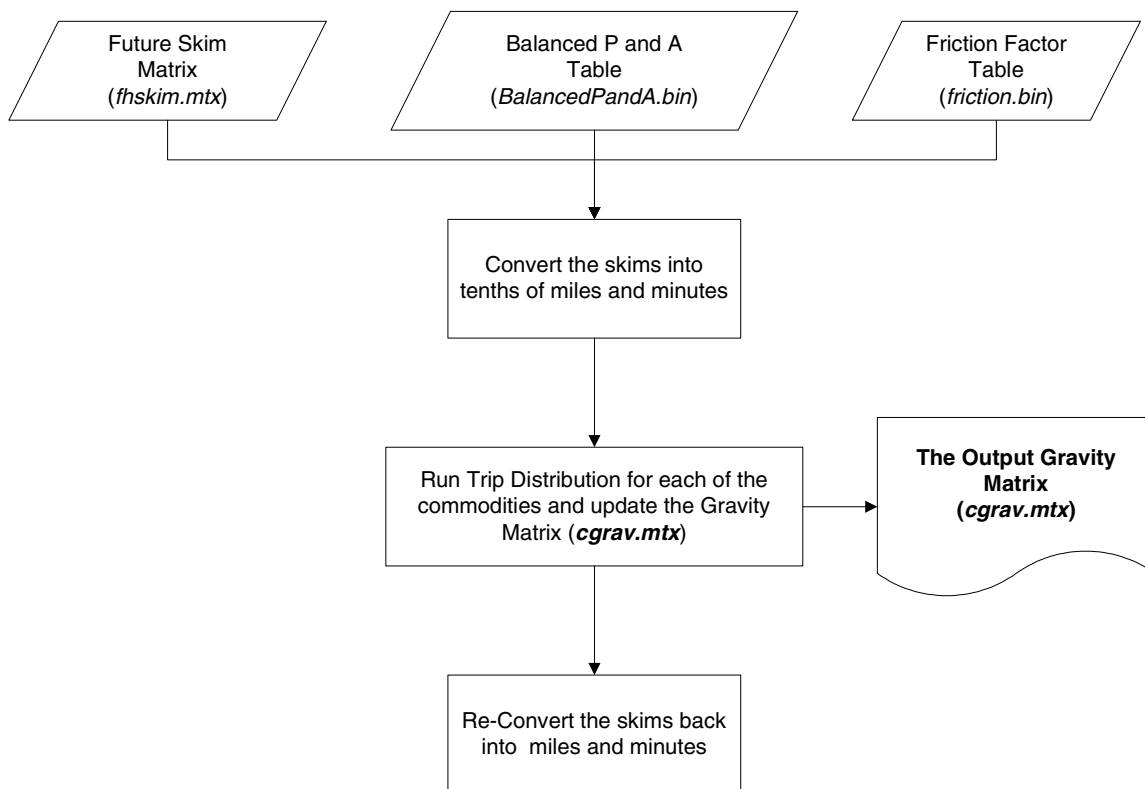

Figure 5.1: The Commodity Flow Distribution Process

6 Freight Mode Choice

The output from the gravity model provides tons of commodity flow, irrespective of mode. The purpose of the mode choice model is to allocate the tonnage for each of the commodities into the following modes:

- Truck
- Intermodal Rail (IR)
- Carload Rail (CR)
- Air
- Water.

The mode choice program for the STFM model is either an incremental Multinomial Logit Model (MNL) or a regular MNL model for each Origin-Destination pair, depending on the availability of observed base shares for the particular Origin-Destination pair. In the case where observed base for the particular pair of zones are available; new shares are estimated using an Incremental Logit Model. The observed base shares are inputs to the model and are obtained from Reebie data. If base shares are absent for the particular pair of zones, a full MNL model is applied.

Finally, the truck tons matrix obtained from the mode choice model is converted to truck trips using a set of factors based on truck distance and commodity type. A PA to OD procedure is applied on the truck trips matrix.

The actual mode choice computation in the model is performed by a C program developed at Caliper that mimicks the CS FORTRAN program provided earlier. This program is called by TransCAD after the appropriate parameters and matrices have been provided.

6.1 Logit Model Specification

The mode choice model deals with 14 commodity groups and 5 modes. Some of the commodity groups are all allocated to only one mode:

- Non-Metallic Minerals and Coal commodities are allocated only to Carload Rail,
- Waste and Warehousing commodities are allocated only to Truck;
- Miscellaneous Freight is allocated only to Intermodal Rail.

On account of the above, the MNL models have to be applied only to 9 commodities. Further, mode splits for the remaining commodities are performed only on the truck and the two rail modes. Specifically in the presence of base shares for all the modes, only the shares of the truck and the two rail modes are adjusted. The shares for the water and air modes remain the same as before. In the absence of base shares, shares are allocated only to the truck and the rail modes.

6.1.1 Utility Equations

The form of the utility equation was taken from a stated preference survey for a freight study in New York. The explanatory variables identified in model specification were the natural log of travel time multiplied by commodity value per ton and the travel cost.

The utility equation is of the form:

$$U_{ij} = CTMP_{ij} * Ln(TT_i) * Bvalue_j + CCMP_{ij} * TC_i + KMP_{ij}$$

where:

i = the mode (Truck, Carload Rail or Intermodal Rail)

j = the commodity (any of the 9 commodities for which the mode choice is applied)

U_{ij} = Utility for mode i and commodity j

$CTMP_{ij}$ = Travel Time Coefficient for mode i and commodity j

TT_i = Travel Time for mode i

$CCMP_{ij}$ = Travel Cost Coefficient for mode i and commodity j

TC_i = Travel Cost for mode i

$Bvalue_j$ = the commodity value per ton for commodity j

KMP_{ij} = The Modal Constant for mode i and commodity j (Note that KMP_{ij} is zero for the truck mode) and

$Ln()$ = The natural logarithm function

The calculation of the variables in the above equation is described next followed by a description of the constants and the calibrated coefficients required for the model.

The travel cost in the above equations is comprised of two components; the fixed cost for the mode and the cost per mile for the mode.

The travel time is calculated based on the following equations. Note that the Truck Travel Time in the above equation is calculated in accordance with the Hours of Service regulations, which represents travel time and an 8 hour rest period after every 10 hours of travel.

Truck Travel Time (TT_{Truck}) =

        Integer((Network Travel Time+8) /18)*8 + Network Travel Time

CR Travel Time (TT_{CR}) = CR Constant Time + (Distance/CR Speed)

IR Travel Time (TT_{IR}) = IR Constant Time + (Distance/IR Speed)

6.1.2   Constants used in the Model Specification

The constants required to compute the variables are shown in Table 6.1.

Constant	Description	Value
Bcarldk	Carload Constant Cost ($)	12
Bcarldcpm	Carload Cost Per Mile ($)	0.025
Bimodk	Intermodal Constant Cost ($)	26
Bimodcpm	Intermodal Cost Per Mile ($)	0.028
Btcpm	Truck Cost Per Mile ($)	0.08
Btspd	Truck Speed (mph): Not used in the model	50
Bcarlspd	Carload Speed (mph)	20
Bimodspd	Intermodal Speed (mph)	22.75
Bcarldkt	Carload Constant Time (hrs)	60
Bimodkt	Intermodal Constant Time (hrs)	24

Table 6.1: Constants Used in the Mode Choice Model

In the current implementation of the model, the constants are the same for the base and the scenario year.

Table 6.2 shows the commodity value per ton for the base year as well as the future year.

Commodity	Bvalue: Value Per Ton ($)
Agriculture	171.49
Non-Metallic Minerals	24.33
Coal	27.01
Food	684.14
Non-Durable Manufacturing	7175.17
Lumber	276.15
Chemicals	865.91
Paper	1041.00
Petroleum Products	175.93
Other-Durable Manufacturing	5143.68
Clay, Concrete and Glass	103.62
Waste	4612.67
Miscellaneous Freight	7264.31
Warehouse	1618.00

Table 6.2: Value Per Ton for Each of the Commodities

6.1.3   Calibrated Coefficients Required for the Model

The parameters to be calibrated for the model are the alternate specific constants, the travel time coefficients and the travel cost coefficients. These coefficients are commodity specific and are listed below:

- KMP: Utility constants for each mode and purpose. Constants are expected for the Carload and Intermodal rail modes (No constants are needed for the Truck mode as it is chosen as the base).

- CTMP: Travel time coefficients for each mode and purpose. Modes for which the coefficients are required are 1, truck, and 2, both Carload and Intermodal rail (In the current implementation all modes have the same co-efficient values).

- CCMP: Travel cost coefficients for each mode and purpose. Modes for which the coefficients are required are 1, truck, and 2, both Carload and Intermodal rail (In the current implementation all modes have the same co-efficient values).

The above coefficients are expected only for the 9 commodities for which the mode split is required. Tables 6.3 and 6.4 present the co-efficient used in the model for the Carload Rail and the Intermodal Rail respectively.

Commodity	KMP	CTMP	CCMP
Agriculture	-0.69	-0.00757	-0.00417
Food	-0.15	-0.00194	-0.00189
Non-Durable Manufacturing	3.92	-0.00069	0
Lumber	-2.47	-0.00473	-0.00388
Chemicals	-0.96	-0.00092	-0.00861
Paper	-1.75	-0.00126	-0.00240
Petroleum Products	9.16	0	0
Other-Durable Manufacturing	1.88	-0.00048	0
Clay, Concrete & Glass	1.72	-0.0275	0

Table 6.3: Coefficients for the Carload Rail Mode

Commodity	KMP	CTMP	CCMP
Agriculture	-2.05	-0.00757	-0.00417
Food	-1.85	-0.00194	-0.00189
NonDurable Manufacturing	2.86	-0.00069	0
Lumber	-0.68	-0.00473	-0.00388
Chemicals	-3.37	-0.00092	-0.00861
Paper	-0.45	-0.00126	-0.00240
Petroleum Products	3.00	0	0
Other-Durable Manufacturing	-0.48	-0.00048	0
Clay, Concrete & Glass	-1.57	-0.0275	0

Table 6.4: Coefficients for the Intermodal Rail Mode

For the truck mode, the CTMP and the CCMP values are the same as that for the Carload Rail and the Intermodal Rail modes.

6.2   Calculation of Modal Shares

Once the utilities are determined, the shares for the three modes are calculated using the utility equations as below. The shares for the three modes are calculated for each commodity type and each zone pair.

- For a full MNL model, the shares are given by

$$S_{ij} = Exp(U_{ij}) / \sum_i Exp(U_{ij})$$

  Where,
  S_{ij} = Share of mode i and commodity j
  U_{ij} = Utilities for mode i and commodity j
  Exp() = The exponential function

- For an incremental MNL model, the revised shares are given by

$$RS_{ij} = Exp(BS_{ij} * \Delta U_{ij}) / \sum_i Exp(BS_{ij} * \Delta U_{ij})$$

  Where
  RS_{ij} = Revised Share of mode i and commodity j
  BS_{ij} = Base Share of mode i and commodity j
  ΔU_{ij} = Changes in the utilities for each mode i and commodity j
  Exp() = The exponential function

For the intazonal trips, if base shares exist they are unchanged for the intrazonals. If base shares do not exist, but the distribution model produces intrazonal goods movement, they are assigned entirely to trucks.

6.3   Converting Truck Tons to Truck Trips

The mode choice splits the commodities into five matrix files, one file for each mode (truckt.mtx, carloadt.mtx, intermodalt.mtx, watert.mtx and airt.mtx located in the model Ouput directory). Further, each matrix file has 14 matrices, one for every commodity.

Since the model is concerned with truck flows, the truck tons matrix file needs to be converted to provide truck trips. The conversion of truck tons to truck trips is performed based on the distance and the commodity being transported. Distances are categorized into 5 groups as below:

- Category 1: Less then 50 miles.
- Category 2: At least 50, but less than 100 miles.
- Category 3: At least 100, but less than 200 miles.
- Category 4: At least 200, but less than 500 miles.
- Category 5: Greater than 500 miles.

The conversion of truck tons to truck trips is achieved by means of a *tload* parameter defined for each distance group and commodity. The calibrated values used in the model are presented in Table 6.5.

The formula used for the conversion is given by:

Truck Trips = Truck Tons * tload / Wdays,
where tload = Load Parameter by Commodity and Distance Group (Table 12)
          Wdays = Number of working days in a year (306 for the current model)

After applying the above factors to the truck matrix file, the number of trucks obtained for each commodity are added up to provide a zone to zone matrix containing the number of *Large Interstate* trucks (Trucktrp.mtx in the model Output directory)

Commodity	Tload 1	Tload 2	Tload 3	Tload 4	Tload 5
Agriculture	0.0620	0.0556	0.0499	0.0448	0.0402
Non-Metallic Minerals	0.0520	0.0500	0.0481	0.0462	0.0445
Coal	0.0549	0.0494	0.0445	0.0401	0.0361
Food	0.0665	0.0582	0.0510	0.0446	0.0391
Non-Durable Manufacturing	0.0603	0.0559	0.0519	0.0482	0.0447
Lumber	0.0568	0.0505	0.0448	0.0398	0.0353
Chemicals	0.0490	0.0462	0.0435	0.0409	0.0385
Paper	0.0678	0.0601	0.0533	0.0472	0.0418
Petroleum Products	0.0482	0.0452	0.0425	0.0399	0.0374
Other-Durable Manufacturing	0.0603	0.0558	0.0516	0.0477	0.0440
Clay, Concrete and Glass	0.0445	0.0430	0.0416	0.0403	0.0390
Waste	0.0572	0.0528	0.0487	0.0450	0.0415
Miscellaneous Freight	0.0575	0.0534	0.0497	0.0462	0.0430
Warehouse	0.0572	0.0528	0.0487	0.0450	0.0415

Table 6.5: Values of the tload Parameter by Distance Category

6.4   PA to OD Conversion

Finally, the truck trips from the mode choice are transformed from a Production-Attraction (PA) to an Origin-Destination (OD) matrix by a simple PA to OD conversion procedure. Since this is a daily model, the conversion is done using the formula:

PA2ODMatrix = 0.5 * TruckTripsMatrix + 0.5 * Transpose of the TruckTripsMatrix

This procedure results in a symmetric PA2OD.mtx (located in the model output directory). Figure 6.1 at the end of this section shows the mode choice process.

6.5   Freight Mode Choice Results

The shares obtained from the mode choice model are presented in Table 6.6 for all the commodities.

Commodity	% Truck	% CR	% IR	% Air	% Water
Agriculture	73.4	8.4	15.1	0.6	2.5
Non-Metallic Minerals	0.0	100.0	0.0	0.0	0.0
Coal	0.0	100.0	0.0	0.0	0.0
Food	95.1	0.6	3.1	0.2	1.0
Non-Durable Manufacturing	91.5	3.5	1.8	2.1	1.1
Lumber	97.8	1.5	0.6	0.1	0.0
Chemicals	81.6	16.5	0.8	0.1	1.0
Paper	96.2	2.0	1.7	0.1	0.0
Petroleum Products	20.3	20.4	0.1	0.3	58.9
Other-Durable Manufacturing	82.2	12.8	1.6	0.5	2.9
Clay, Concrete and Glass	95.8	3.7	0.1	0.0	0.4
Waste	100.0	0.0	0.0	0.0	0.0
Miscellaneous Freight	0.0	0.0	100.0	0.0	0.0
Warehouse	100.0	0.0	0.0	0.0	0.0

Table 6.6: Freight Mode Choice Shares

The summary of truck tons and truck trips is shown in Table 6.7.

Commodity	Truck Tons (in Thousands)	Truck Trips
Agriculture	7,670	1,014
Non-Metallic Minerals	0	0
Coal	0	0
Food	31,643	5,157
Non-Durable Manufacturing	5,679	1,015
Lumber	15,169	2,058
Chemicals	34,797	4,815
Paper	24,249	4,523
Petroleum Products	8,291	1,078
Other-Durable Manufacturing	20,113	3,182
Clay, Concrete and Glass	88,815	12,699
Waste	12,796	1,768
Miscellaneous Freight	0	0
Warehouse	102,982	17,963

Table 6.7: Truck Tons and Truck Trips by Commodity

The total long haul truck shipments in thousands of tons is 352,204 and the total long haul truck trips is 55,272. Obviously, this is many fewer trips than are observed on Florida roadways.
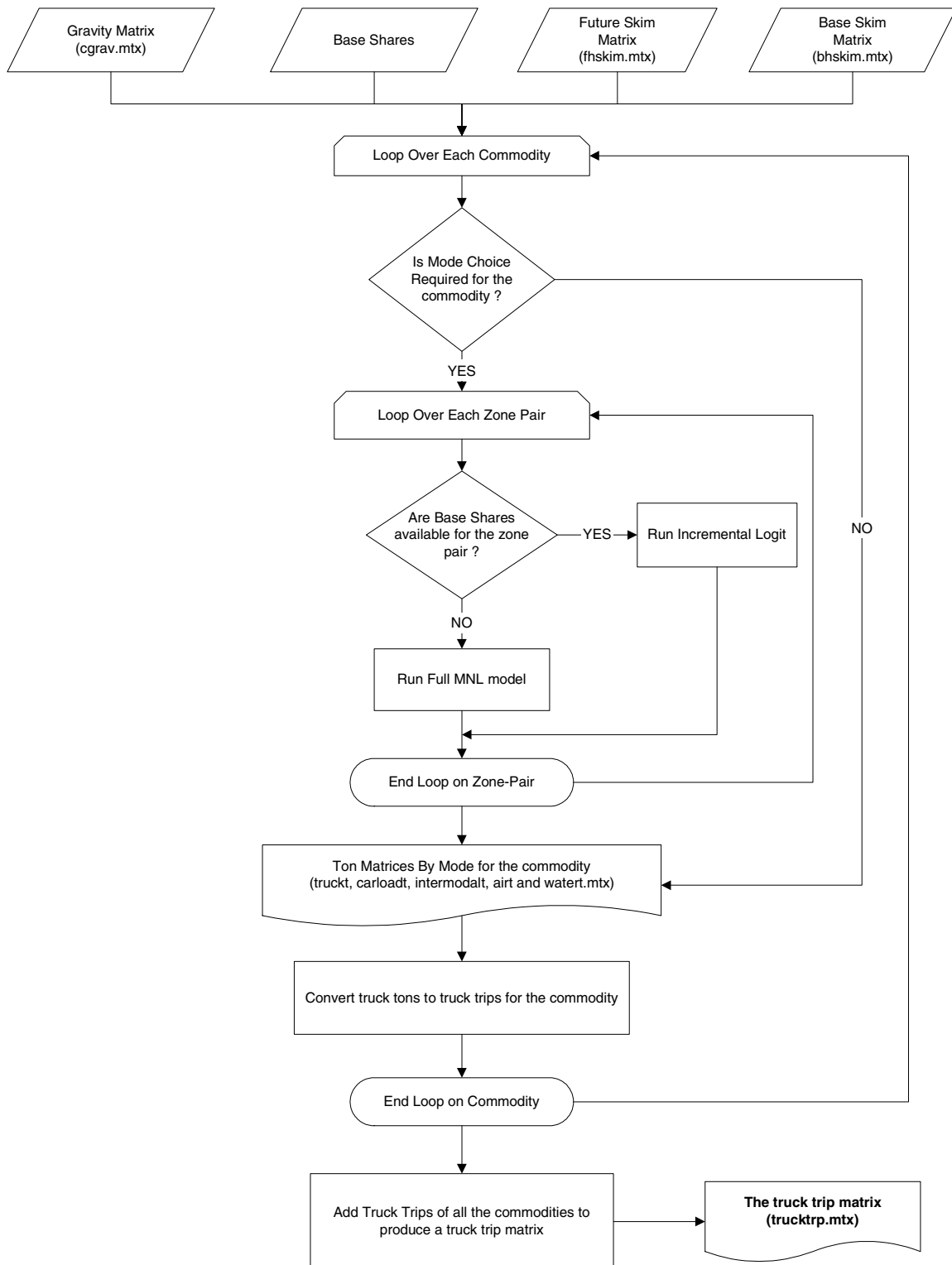
Figure 6.1: The Freight Mode Choice Process

7 The Origin-Destination Matrix Estimation Procedure for Additional Large and Medium Truck Trips

The PA2OD.mtx obtained after application of the mode choice and the PA2OD procedure results in a truck trip matrix that primarily represents large trucks engaged in long haul transportation. Trip tables were estimated to calculate the additional large and medium truck trips that are present on the Florida road network. The objective of the ODME process was to use classified traffic count sources to estimate these trips. The final matrix after adding the additional trips should provide a matrix that when assigned matches the observed truck counts satisfactorily.

7.1 Framework for the Matrix Estimation Process

To determine a feasible strategy to estimate the truck matrices, several experiments were carried out and some observations on the results are briefly mentioned below:

- Truck counts for the Florida state were obtained from various sources (For the relevant network fields corresponding to the counts, please refer Table 1):
1. Counts from the Florida Traffic CD.
2. Flows from the Freight Analysis Framework carried out by FHWA.
3. Classification Counts from a classifier database.

- Truck counts from different sources described above were compared and significant differences were observed between these count sources.

- The output matrix (PA2OD.mtx) from the Florida Statewide Freight Model (STFM) was used in an initial set of experiments as an input along with counts from the truck volume shape files. A large set of experiments involving various trip table estimation techniques and different assignment settings were performed. However, in each of these cases differences were found between the estimated volumes and the counts from the truck volume counts.

- Alternative zonal systems were employed in a new set of experiments with the objective that this might reduce noise on local roads leading to better match on the major roads. However, again the closeness between the assigned volumes and traffic counts was not satisfactory. Various other network configurations such as a more detailed network for links outside the state of Florida were also employed.

- Preload volumes from the passenger model input to the trip table estimator procedure only marginally affected the results.

- Given that the original STFM model focused primarily on long-haul trucking, it seemed that it, by itself, would not provide a suitable seed for the trip table estimation process. This makes sense when it is considered that the counts from the traffic CD do not distinguish trucks by size. There are truck percentages, but it was felt that these would not be reliable unless they came from a classification station. The fact

that the counts from the alternative classified count data had separate values for medium and heavy trucks, presented the opportunity to obtain two new trip matrices. One matrix would be for intra-state movements of medium trucks and the other would add additional heavy truck movements. This was decided upon as the final approach to estimate truck matrices.

7.2 Large Truck Trip Matrix Estimation

The large truck trip matrix was estimated by using TransCAD's MMA ODME procedure. This procedure was run separately at Caliper. In order to run an ODME process, it is essential to use an appropriate seed matrix that is "expanded" to provide the *large truck* matrix. Since, the Cambridge Systematics model dealt with long haul flow patterns for large trucks, the PA2OD matrix from the Planning model was used as the seed matrix. The count fields used were the AB_P_T_Hvy/BA_P_T_Hvy fields. The single-path method was used and approximately 300 iterations were performed.

The resulting trip matrix represented the Large Truck Matrix (containing both Intrastate as well as Interstate trucks). Thus, we obtained a *Large truck Intrastate* trip table by subtracting the PA2OD matrix (representing the Interstate flow) from the result of the trip table estimation process. This matrix is used as an input to the STFM model and is added to PA2OD.mtx from the Planning model to yield the Large Truck trip table, HvyTruckAdditions.mtx (located in the model input directory). Note that during the process of subtraction any negative values in the resulting matrix were set to 0.

7.3 Medium Truck Trip Matrix Estimation

The Medium Truck trip table comprises primarily of trucks that make intrastate movements many of which might be rather short. To obtain a seed matrix for the ODME process, zonal attributes that consisted of employment data were used in conjunction with truck trip generation and trip distribution models estimated by Howard Slavin for Boston many years ago. In particular, the trip tables obtained from the trip generation process were used in conjunction with the shortest path matrix and exponential friction factor curves to generate PA matrices representing the distribution of Medium Truck trips. These PA matrices were transformed using a PA to OD matrix conversion to yield the Medium Truck seed matrix.

The count fields used during the ODME process were the AB_P_T_Med/BA_P_T_Med fields. The single-path method was used and approximately 300 iterations were performed.

The *Large Truck Intrastate* trip table from the ODME process is added to the PA2OD matrix from the STFM model to yield the *Large Truck* Matrix. Using this matrix and the *Medium Truck* trip table, a matrix file with two matrices is created, one for the heavy trucks and the other for the medium trucks (MMA_OD.mtx in the model output directory). This matrix is used for the assignment in the next stage of the STFM model.

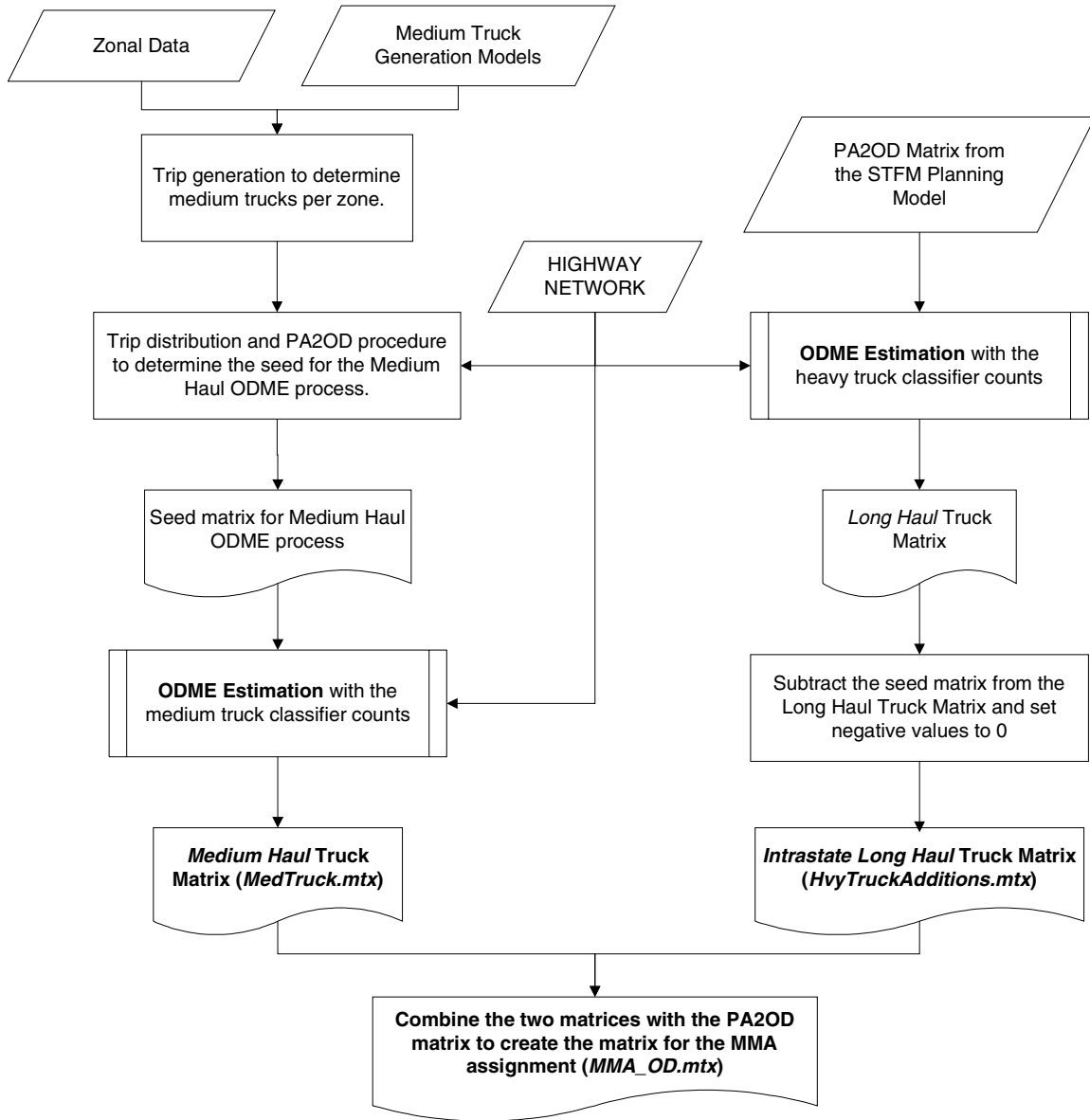Figure 7.1 illustrates the ODME process.

Figure 7.1: The ODME process

8 Two-Class Medium and Large Truck Trip (MMA) Assignment

The inputs required to run the assignment are the Line Geography layer and the network file (.net file), the medium and long haul trip table and data regarding the tolls.

8.1 Assignment Settings

The settings for the assignment are presented below:

- The two classes of traffic for the MMA assignment are the Medium Haul Trucks and the Long Haul Trucks.

- Further, the assignment is toll based and it includes both fixed tolls as well as OD based tolls. The set of links for which the tolls are applicable are chosen in the network and are given by the selection sets "FixedTollLink = 1" and "ODTollLink = 1" respectively. The network field [3-AXLE] is used for the fixed toll values for the Medium class and the field [4-AXLE] is used for the fixed toll values for the heavy class. The matrix ODTolls.mtx located in the input directory contains the ODToll values from node to node for both the medium and the heavy trucks.

- The Value of Time used in the assignment is 0.45 $/minute.

- The Bureau of Public Roads (BPR) function is used to compute congested travel times. The Alpha and Beta parameters to be used for the links are read from the network (.net) file.

- The number of iterations is set to 20 with convergence criteria of 0.01.

- The model reports flows by class and the results of the assignment is contained in the file ASSGFLW.bin in the model output directory. This table can be joined to the line geography and viewed in TransCAD.

- An option to perform critical zone analysis for the nodes depicting the ports is included in the model. This query file can be updated to yield critical zone results. The mechanism to update the query file can be obtained in the Planning User's guide that accompanies TransCAD 4.7. One of the port nodes is currently used in the query file.

8.2   Assignment Results

In order to determine the closeness of assignment flows with the observed classifier counts, the percentage RMSE was used as a measure of effectiveness. The percentage RMSE is defined as follows:

$$\%RMSE = 100 * \sqrt{(\sum_i (Model_i - Count_i)^2 / (Numberofcounts - 1)} / (\sum_i (Count_i / NumberofCounts))$$

This %RMSE is determined for medium as well as heavy trucks. The value for the medium trucks was 21% and that of heavy trucks was 47%. The match of the medium counts versus medium truck flow is excellent.

However, the value of %RMSE for heavy trucks seems higher, though it a significant improvement from the earlier model. On further analysis, the match of heavy truck counts versus heavy truck flow directly from the ODME process was excellent with a percentage RMSE of 22. The increase in %RMSE in the STFM model is attributed to the fact that there were a few values in the estimated OD matrix that were lesser than the seed matrix (PA2OD.mtx). On subtracting the PA2OD matrix from the Long Haul estimated matrix, some negative values are obtained (which were set to 0). An analysis indicated that though the maximum negative value in the difference matrix was not high (around 80), a significant number of the small negative values in the affected the results. It is possible to reduce the margin of the error by performing more iterations in the ODME process.

A breakdown of results by link types for the medium and the heavy trucks is shown in Tables 8.1 and 8.2. For the freeways and arterials the %RMSE is excellent for both the heavy and the medium trucks.

Link Classification (FTYPE2)	# Obs	Total Model Flows	Total Counts	%RMSE
Freeways and Expressways(10-19)	305	401,611	398,371	9.1
Divided Arterials (20-29)	2,496	1,160,307	1,127,562	19.4
Undivided Arterials (30-39)	1,467	304,953	283,074	31.9
Collectors (40-49)	289	50,617	45,848	42.7
One-Way Facilities (60-69)	94	36,640	32,438	33.2
Ramps (70-79)	5	3,063	1,705	37.6
Toll Facilities (90-99)	103	61,035	56,255	28.4
All Links	**4,760**	**2,018,807**	**1,945,835**	**20.9**

Table 8.1: Counts versus Flows for the Medium Truck Trips

Link Classification (FTYPE2)	# Obs	Total Model Flows	Total Counts	%RMSE
Freeways and Expressways(10-19)	305	697,266	831,823	27.9
Divided Arterials (20-29)	2,496	774,672	781,466	26.9
Undivided Arterials (30-39)	1,467	260,135	253,522	34.5
Collectors (40-49)	289	33,533	30,688	38.7
One-Way Facilities (60-69)	94	20,814	20,851	68.8
Ramps (70-79)	5	1,676	894	41.8
Toll Facilities (90-99)	103	66,698	75,445	52.1
All Links	**4,760**	**1,856,524**	**1,986,450**	**47.0**

Table 8.2: Counts versus Flows for the Heavy Truck Trips

APPENDIX A

User's Guide

for

Florida Statewide Freight Model (STFM) with TransCAD 4.7

This User's Guide is designed to help you learn and use the STFM custom add-in for TransCAD. In this document you will learn how to install and launch the add-in and work with the Base Scenario. You will learn how to set up and run a model and view the results. You will also learn how to set up and run additional scenarios.

In This User's Guide

Introduction

The STFM custom application performs the following transportation planning procedures:

- Initialization
- Trip Generation
- Highway Network Skimming (or Preprocess Skims)
- Trip Distribution
- PA to OD Transformation
- Trip Assignment
- Aggregate Matrices

The add-in allows you to store any number of scenarios. You can think of a scenario as a transportation plan horizon year. For example, you may want to have a scenario for years 2000, 2005, 2010, and 2020. Scenarios are defined by a name, a set of input and output files, and a set of model parameters. There are special features in the add-in to assist you in setting up scenarios. Once you have setup a scenario, the model steps for a scenario can be run separately or run as a group.

There are three dialog boxes that are used to manage and run the model. These are shown below:

1   The first is the main dialog box (called the Florida Statewide Freight Model dialog box), which appears when the add-in is launched. From this dialog box, a scenario is selected and the corresponding models are run.

2   The second dialog box is the Scenario Manager dialog box. This dialog box is activated by clicking on the Setup button in the main dialog box. From this dialog box, you have access to all of the scenario management tools. You can add, delete, sort, describe, and rename scenarios from this dialog box.

3   The third dialog box provides access to detailed information regarding the scenario. This dialog box is activated by clicking on the Contents button in the Project Scenarios dialog box, or by double-clicking on an item in the Steps scroll list. From this dialog box you can open input or output files, change input or output files, and view and/or change model parameters.

The remainder of this User Guide explains how to work with these dialog boxes to set up and run the Florida Statewide Freight Model.

Main Dialog Box   Scenario Manager   Input/Output
                                                       File and   Parameter
                                                       Managers
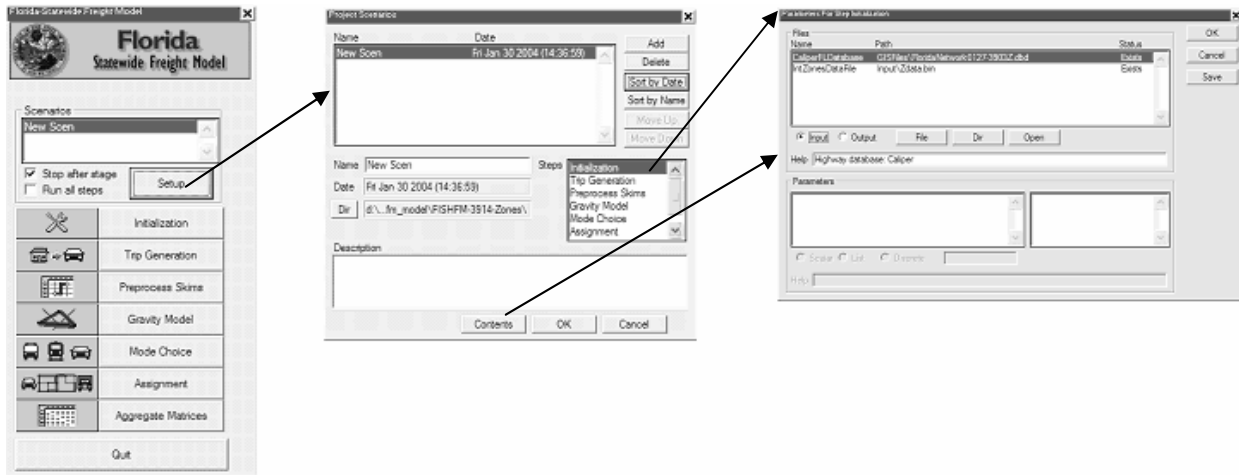
Installing the Add-in

The custom add-in is packaged in an easy-to-install setup program. Before installing the add-in, be sure to un-install all previous versions of it. The setup program, named setup.exe, is located on the CD provided and should be executed from within Windows. When installing, you will be prompted for your TransCAD installation directory as well as a directory to copy the data files to.

This step needs to be run only once (per computer). After installation, running the add-in is as simple as running TransCAD. First, start TransCAD, then go to Tools-Add-ins and choose the add-in entitled FLORIDA-Statewide Model.   Click on the OK button to activate the custom interface.

Computer Requirements
The STFM Model requires a reasonably powerful PC in order to run efficiently. We recommend the following as minimum standards:

* Pentium 400Mhz.
* 512MB of RAM memory.
* Approximately 5 GB of free hard drive space to accommodate all input and output files.

Launching the Add-in

Once the add-in is installed using the steps described above, the main dialog box is launched through the Tools-Add-Ins menu item in TransCAD.

- **To Launch the Add-in**

1. If TransCAD is not running, start TransCAD.

2. Go to *Tools-Add-Ins*.

3. Choose FLORIDA-Statewide Model and click OK to display the dialog box. (If you do not see FLORIDA-Statewide Planning Model in the Add-ins window, click Cancel and install the add-in by following the directions above.)

All other functionality for the add-in is accessed through the main dialog box.

Working with the Base Scenario

In this section you will learn how to setup, run, and view outputs for the Base Scenario.

Setting up the Base Scenario

Before you can run the model, you must first define the scenario. This means providing TransCAD with the name of the scenario along with the set of input files, output files, and parameters that define the scenario. This information is entered and viewed using the Project Scenarios and Parameter Manager dialog boxes. You can store any number of scenarios in the custom add-in.

The Base Scenario is particularly straightforward to setup, because it is the default scenario provided with the custom add-in (as defined in the florida_mod.bin file installed with the add-in).
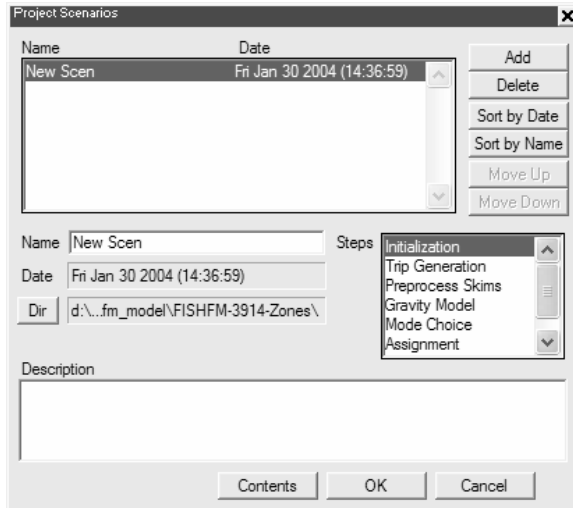
- **To Setup the Base Scenario**

1. If the add-in is not running, activate it by following the instructions above to open the FLORIDA-Statewide Freight Model dialog box.

2. From the FLORIDA-Statewide Freight Model dialog box, click on the Setup button to open the Project Scenarios dialog box. If there are no existing scenario files, the Custom add-in will ask if you want to create a new one; click Yes.

3. Click the Add button to add a new scenario.

   A scenario named New Scen is automatically created and added to the list of scenarios in the text box at the top of the Project Scenarios dialog box, and the current time is also listed. By default, New Scen is the Base Scenario. The input and output files as well as the parameters are automatically entered, and the model is ready to

run. Note that if you are setting up any scenario other than the base year, you will have to modify at least some of the input files and parameters to match the scenario of interest. This is described later in the section on Working with Additional Scenarios.

4. Rename the scenario by entering the new name in the Name text box (for example, Year 2000 Base Scenario) and, if desired, provide a longer description of the scenario in the Description text box.

5. Click OK to save the settings of the scenario and close the Project Scenarios dialog box.

The base scenario is now set up and ready to run. Note that the model steps are listed in the Steps text box and the directory listed for the scenario is set to the location to which the installation program installed the input and output files. If you want to view or modify any of the scenario settings (input/output files or parameters), you can do so by clicking on the Contents button (described under Viewing Outputs... and Modifying Scenarios).

Running the Base Scenario

Models are run from the FLORIDA-Statewide Freight Model dialog box. Make sure you have exited the Project Scenarios dialog box (by clicking OK) so that the settings for the scenario are updated and saved.

•   **To Run all of the Model Steps for the Base Scenario**

1. From the FLORIDA-Statewide Freight Model dialog box choose the Base Scenario from the Scenarios selection box.

2. Uncheck the Stop After Stage checkbox.

3. Make sure that the Run all steps checkbox is checked.

4. Click the Initialization button.

The custom add-in will run all model stages.

- **To Run a Single Model Step of the Base Scenario**

1. From the FLORIDA-Statewide Freight Model dialog box choose the Base Scenario from the Scenarios selection box.

2. Make sure that the Stop After Stage checkbox is checked.

3. Make sure that the Run All Steps checkbox is checked.

4. Make sure that the input files are available. (The easiest way to do this for the base scenario is to run each of the prior stages of the model by following these steps.)

5. Click the button that identifies the step you want to run (for example, Trip Generation).

The custom add-in will run the selected stage and stop.

Viewing and Analyzing Outputs for the Base Scenario

The full functionality of TransCAD is available to analyze the outputs of a model run. There are innumerable ways to perform the analysis. Below are a few suggestions to get started viewing the output results. For more information, see the TransCAD User's Guide and the Travel Demand Modeling with TransCAD manual.

- **To Open the Output (or Input) Files for any Model Step**

If you know the name and location of the output file, you can always choose File-Open in the TransCAD menu, choose the file type you wish to view (Geographic File, Dbase table, Fixed Format Binary Table, Matrix, etc.) and choose the file you wish to open. Alternately, you can open the files from the Parameter manager dialog box of the add-in. To do this:

1. Click the Setup button in the FLORIDA-Statewide Freight Model main dialog box to open the Project Scenarios dialog box.

2. Select the scenario and model step of Interest.
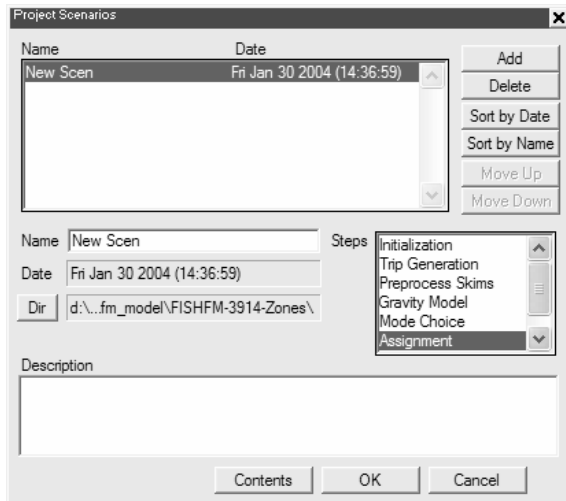
3. Click the Contents button to open the Parameter Manager dialog box.

4. Click the Output radio button to get the list of output files.
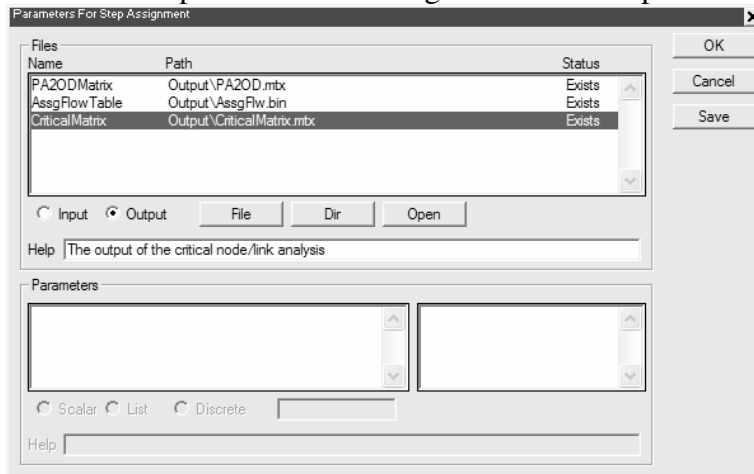
5. Select the files that you want to open (use Shift-click or Ctrl-click to select multiple files).

6. Click the Open button and the add-in will open the files.

Note that when the Parameter manager dialog box is open, you can change the step or the scenario that is displayed in the dialog box by making the selection in the Project Scenario dialog box.

There are many files that play a role in several of the model steps. For example, Network Skimming creates a shortest path matrix as an output, which is an input to Trip Distribution. However, note that each file appears **only once** in the entire set of Parameter Manager dialog boxes, usually in the first model step for which it is used.

- **To View Traffic Assignment Outputs for the Daily Period and Modify the Critical Query Table**

Open the highway geography and daily flow table:

1. Use the steps described above to open the Highway DB file, which is an input to the Create Network model step, and the ASSGFLW.bin, which is an output of the Assignment step.

Join the highway geography to the flow table:

2. From the TransCAD menu, choose Dataview-Join and join the Highway/Streets layer's ID field to the filed ID1 in the ASSGFLW.bin table. Click OK to view the join.

Generate a flow map:

3. Choose Planning-Planning Utilities-Create Flow Map to create a scaled symbol theme on the links over volume flow and a color theme over VOC ratio.

Use the utilities in TransCAD to pan around the map, add labels, etc.

4. To modify the Critical Link/Node Query File, you need to open the highway geography file and choose the menu *Planning-Planning Utilities-Select Link/Zone Queries*. Click on the load button and browse to the model input directory and choose the CriticalPortNode.qry file. You can edit this file to include more nodes and links. Please refer to the Planning User guide on how to update the query file.

- **To View the Running Log and Report Files**

Every time a model is run, the add-in will save information in two text files, the log file and the report file. The log file lists every procedure that you run and any problems that were encountered. The report file lists every procedure that you run and a summary of input and output. To view these files:

1. Choose Edit-Preferences from the TransCAD menu to open the Preferences dialog box.

2. Choose the Logging tab.

3. Click on the Display button to display either the log file or the report file.

Information on the most recent model run will be appended to these files.

Working with Additional Scenarios

Any number of scenarios beyond the Year 2000 Base Scenario can be setup, stored, and run using the add-in.

Adding a Scenario

- **To Create an Additional Scenario**

1. From the Florida Statewide Freight Model dialog box, click on the Setup button to open the Project Scenarios dialog box.

2. Click the Add button to add a new scenario. The add-in will create a scenario named New Scen and add it (along with the current date and time) to the end of the list of scenarios in the dialog box.

3. Rename the scenario by typing in the Name text box.

4. Enter a description for the scenario in the Description text box.

By default, the added scenario is created using the settings for the default Base Scenario, so you will need to re-specify at least some of these settings to generate the scenario of interest. The next step describes how to do this.
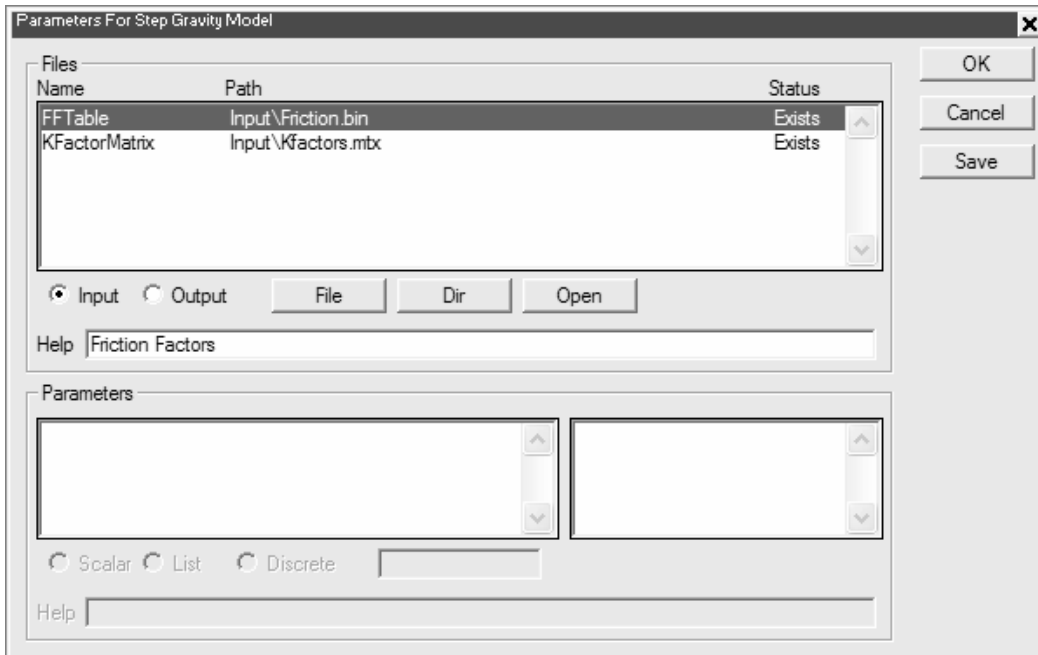
Modifying Scenarios

A scenario is defined by a set of input files, output files, and parameters. Each step of the model has a different set of files and parameters. These settings are managed using the Scenario Manager dialog box, for which there are different dialog boxes for each model step.

An important point in selecting the input files to use for a given scenario is that these files must match the input files provided for the default Base Scenario. This means that all table inputs (Demographics table, trip rates table, etc.) must contain the same field names as the base year default files and must have the same number of records.

If any of these restrictions are violated, the add-in will give you error messages if you attempt to run the model.

- **To Modify the Input Files, Output Files, or Parameters Used for a Scenario.**

1. From the Project Scenarios dialog box, select the scenario of interest from the list of scenarios and the model step of interest from the Steps selection box.

2. Click the Contents button to open the Scenario Manager dialog box for the chosen scenario and model step. This dialog box will automatically update to reflect the selections in the main dialog box. Only one Parameter manager dialog box can be viewed at a time.

3. Use this dialog box to manage the input and output files as follows

To do this…	Do this…
View the list of input files	Click the Input radio button, and all input files for the model step will be displayed in the Files scroll list.
View the list of output files	Click the Output radio button, and all output files for the step will be displayed in the Files scroll list.
Obtain a description of the file	Select the file of interest from the Files scroll list, and a description will be provided in the Help text box.
Check the status of a file	The Status column in the Files scroll list states whether a file Exists, is In Use, or Missing. In Use files will be automatically closed when a model is run. All of the input files must Exist in order for a model to be run. Any output files that Exist will be overwritten when a model is run.
Open a file	Double-click on the file in the Files scroll list, or select the file in the Files scroll list and click the Open button. Networks (.NET) cannot be opened, but their geographic counterparts (.DBD line geographic files) can. Query Files (.QRY) cannot be opened this way as well.
Change the file that is used	Select the file you want to change from the Files scroll list. Click on File and select the file that you want to use.
	All input files must match the structure of the input files provided with the Base Scenario
Change the directory of a file	To change the directory of a file, select it from the Files scroll list, click on Dir and select the directory. To change the directory for multiple files, use Shift-click or Ctrl-click to select multiple files from the Files scroll list.

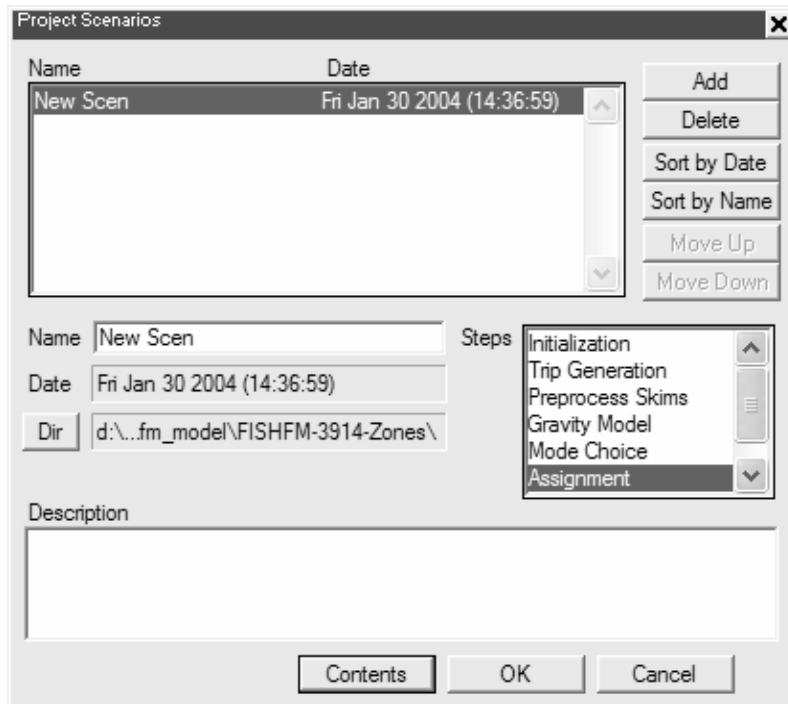4. Use this dialog box to manage the parameters as follows

To do this…	Do this…
View (Scalar) parameters	Click the Scalar radio button and the scalar parameters will be listed in the Parameters scroll list.
Obtain a description of the Parameter	Select a parameter from the Parameters scroll list, and a description will be provided in the Help text box.
Change the parameter	Select the parameter from the Parameters scroll list and enter

Managing Scenarios

Any number of scenarios can be stored in the add-in. Scenarios can be added, deleted, and modified.

- **To Manage the Scenarios**

1. From the Florida Statewide Freight Model dialog box, click the Setup button to open the Project Scenarios dialog box.

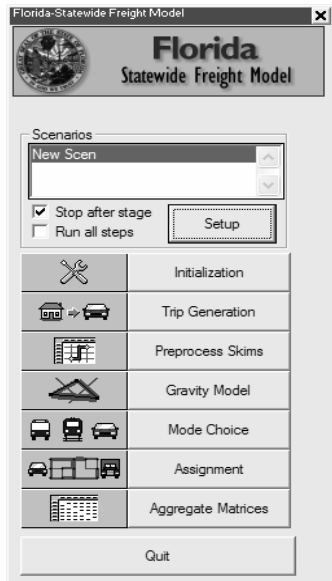2. Use this dialog box to manage the scenarios as follows

To do this…	Do this…
Add a new scenario	Click the Add button and a scenario named New Scen will be added to the bottom of the list of scenarios along with a time stamp. This scenario will be setup with the Base Scenario settings.
Delete a scenario	Select the scenario you want to delete from the Scenario scroll list, and click the Delete button.
Sort the scenarios by date	Click the Sort by Date button.
Sort the scenarios by name	Click the Sort by Name button.
Move a scenario up or down	Select the scenario you want to move up in the scenario list and click the Move Up or Move Down button.
Rename a scenario	Select the scenario you want to rename and enter the new name in the Name text box.
Change the default directory	Select the scenario for which you want to change the default directory for the input and output files, click the Dir button and select the directory. The directory for all input and output files for the scenario will be changed to this default directory.
Provide a description	Select the scenario for which you want to provide a description, and enter the description in the Description text box.
Save scenario settings	Click OK.

Running a Scenario

Running a future year scenario is no different than running the Base Scenario. However, the key to running a scenario that is not the default is to verify that the inputs are setup correctly. This means that all input files must exist, and they must have the same format as the default input files, as described above in Modifying Scenarios. Another important point is that all existing Output files will be overwritten when the model is run.

- **To Run a Scenario**

1. Scenarios are run from the Florida Statewide Freight Model Demand dialog box:

2. Select the scenario you want to run from the list of scenarios, and use this dialog box to run models as follows:

To do this…	Do this…
Run a model continuously	Uncheck Stop after stage, check Run all steps, click the Create Network button.
Run one model step	Verify that all inputs for the model step exist. Check Stop after stage, check Run all steps, and click the button that states the model step you want to run.
Skip a model step	Click on the picture button next to the step you want to skip to open the Stage Step Settings dialog box. Uncheck any step you do not want to run and click OK. The Run all steps checkbox will automatically be unchecked.
View/modify scenario settings	Click Setup to open the Project Scenarios dialog box, and follow instructions above regarding setting up scenarios.
Exit the Add-in	Click Quit