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FINAL

FSUTMS Integrated Transportation / Land Use Modeling

Florida Model Task Force Working Group Findings, Recommendations & Implementation Plan

Whitehouse Group®

EXECUTIVE SUMMARY

In 2009, FDOT conducted a user survey to find out what the most pressing development needs were for agencies in Florida in the coming years. One of the conclusions of the survey was that the need to address the interactions and relationship between transportation investments and land use has a clear need and that need is expected to grow. Many of the policies being explored in Florida have a clear nexus between transportation and land use and the FSUTMS tool box does not include the tools to answer the detailed questions about how land use responds to transportation to affect outcomes.

Later in 2009 and 2010, prompted by the findings from the Florida Model Taskforce (MTF) survey, FDOT initiated a process to explore the issues, and to seek ways to develop an integrated transportation and land use modeling framework that would fit within the FSUTMS framework. The MTF created a working group of local land use planners, DOT staff, MPO planners and consultants to explore the technical and policy aspects revolving around the topic of integrated transportation/land use models. Their goal was to identify issues, opportunities, constraints and recommendations if and how the state should go forward on this topic in the coming years.

The working group concluded:

- FDOT should advance the development of an integrated modeling framework for FSUTMS
- The selected framework should include both rule-based (gaming) methods as well as empirically-based analytical methods as both approaches would add substantial value to local, regional and statewide planning exercises
- No current analytical framework demonstrates a clear advantage over any other
- The diverse nature of Florida mandates that the framework(s) selected will need to be very flexible in methods, data and results and be scalable to address a wide range of possible issues
- A two year Pilot Study should be initiated to fully assess the suitability and utility of rule-based and analytical modeling frameworks in a real-world environment
- Results from the Pilot Study should be used to craft a FSUTMS integrated modeling platform

To advance the working group's recommendations a work plan has been assembled that includes:

- Establishment of an Expert Task Group, designated by the Model Task Force (MTF), that will oversee and provide guidance on the development of the integrated model
- Establishment of a Research Team to perform the analysis and evaluation of various alternative frameworks
- Implementation of a two year Pilot Study to assess both rule-based and analytical models in a Florida-specific case study
- Assessment of findings and opportunity to fine-tune the FSUTMS implementation based on the latest advances
- Three years to develop, test, document and train users on when and how to use the model
- An overall schedule of five years and a cost of between $600k and $900k to conduct all activities necessary to bring a defensible, well-tested and fully documented integrated framework into FSUTMS

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INTRODUCTION

FDOT Central Office conducted a survey of FSUTMS model users to identify the most pressing needs for further development. Amongst the highest priorities identified in the survey results was the need for an integrated FSUTMS/land use modeling framework. There exist many such examples of integrated land use/transportation models in the United States and each has benefits, liabilities and associated cost/schedule implications. Land use and transportation models play an important role in helping decision-makers understand the tradeoffs between policies, alternate infrastructure improvements and the character of a community. The goals of many policies are often to enhance the safety, efficiency and the overall effectiveness of the transportation system and to create an economically sustainable region- land use and transportation investments are inherently intertwined.

To assess the needs and options for developing an integrated modeling framework, the Model Task Force (MTF) created a voluntary working group of professionals with experience in transportation and land use models, policy and analysis. The working group was tasked with developing recommendations on if and how to proceed on the development of an integrated transportation / land use modeling platform for FSUTMS. As shown in the following table, working group participants represented a mix of cities, Metropolitan Planning Organizations (MPOs), FDOT and the consultant community.

Working Group Participants

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To develop a common understanding of the issues involved in the development of an integrated transportation / land use model, the working group undertook an assessment of available literature, experiences and lessons learned from other areas that have undertaken similar endeavors. To frame Florida's current and future needs and opportunities, the working group interviewed policy makers and experts with Florida-specific data.

This report documents the data and process used to inform the working group's decision-making process, their recommendations and a work plan that bring those recommendations to a viable integrated modeling platform that will meet Florida's long-term forecasting needs.

DEVELOPING AN UNDERSTANDING OF INTEGRATED MODELS

The first step of the working group was to assemble relevant documents and to learn from the experiences of agencies in Florida and elsewhere in the United States that have undertaken similar modeling frameworks. Questions to answer from the exercise included:

- What drives the need for an integrated transportation / land use modeling framework?
- What are the different types of land use modeling frameworks that are in use or that have been tried before?
- How are integrated models used, and, what are their limitations?
- How much does it cost and how long does it take to develop an integrated framework?
- What data are commonly available in Florida that can be used to develop an integrated model?
- What are some of the key technical issues to address when developing an integrated framework?
- What are some of the current and upcoming policy needs that should be addressed in such a framework?

To answer the questions it was the consensus of the working group that a combination that included reviews of available literature and "live" presentations and that included questions and answers addressed to experienced technical and policy staff would provide the most information in the briefest amount of time with the least demands on the busy schedules of participants.

Literature Repository

The first step in the assessment was the assembly of a working repository of information about land use models, their issues, and integrated model experiences. The literature repository was stored on a website (http://www.wgianalytics.com/landuse) that could be updated and maintained as new information became available during the exploratory phases of the effort. The website also acted as a repository of webinar materials, presentations and notes that could be used in subsequent discussions.

Literature was organized and labeled by topic. Working group members often asked questions about the contents and completeness of the documentation so that it evolved over time. The complete list of literature available on the website is summarized (and hyperlinked) below with a brief discussion of some of the experiences included in **Appendix A**:

Local Issues

- University of North Carolina: The Role of Employment Sub-centers in Residential Location Decisions
- AMPO: Noteworthy MPO Practices in Transportation-Land Use Planning Integration
- METROPLAN Orlando: Development Pattern Tests: Increased Internal Trip Capture, Multi-Modal Travel, Reverse Commuting, and Community-Oriented Design
- Sacramento, CA: Place Type Menu- Blueprint Transportation/Land Use Study

Climate Change

- US DOT: Integration of Climate Change Considerations in Statewide and Regional Transportation Planning

Sustainability

- Tomasz Zaborowski: Model of Integrated Transport and Land Use Policy Objectives - Comparison of Hannover and Bristol Regions' Policies
- Spiekermann & Wegener: Energy Scarcity and Climate Change: The Challenge for Urban Models

Uncertainty

- University of Texas: Propagation of Uncertainty in Transportation-Land Use Models: An Investigation of DRAM-EMPAL and UTPP Predictions in Austin

Florida Experiences

- Florida Model Task Force: Land Use Survey Findings
- Florida International University/FDOT: A Study of Alternative Land Use Forecasting Models
- Florida's Turnpike Enterprise: Design of Florida's Turnpike's State Integrated Land-Use Travel Demand Model and PowerPoint Presentation
- Florida DOT District 4: FSUTMS ZDATA 2 Development Process Study (24 mb)
- Florida DOT District 7: DELTASIM Working Papers and PowerPoint Presentation
- METROPLAN Orlando: METROPLAN Orlando Future Land Use Allocation Model
- University of Florida: Land Use Survey & Forecasting Model Progress Report
- Van Buskirk, Ryffel and AssociatesVan Buskirk, Ryffel and Associates: Methodologies for: Rule 9J-5.005 General Requirements (Population Forecasting Method) and Rule 9J-5.006 Future Land Use Element (Land Use Needs Analysis)
- West Florida RPC: Urban Land Use Allocation Model Transportation Land Use Alternative Report, Okaloosa-Walton 2004 - 2030 Land Use Allocation Results, and Bay County 2003 - 2030 Projected Change

Other Experiences

- Atlanta (ARC): ARC Land Use Modeling in 5 Minutes
- Dallas (NCTCOG): Description of the Land Use Model, Transportation Model, Data Collection, and Socio-Economic Analysis Efforts at the NCTCOG
- David Simmonds Consultancy: Land-use/Transport Interaction Modeling of the Bathgate-Airdrie Railway Reopening
- Indiana/Purdue: Incorporating a Land Consumption Model with a Statewide Travel Model
- Montgomery, AL MPO: Developing an Integrated LandUse/Transportation Model for Small to Medium-Sized Cities: Case Study of Montgomery, Alabama
- Ohio DOT: Statewide Model Update
- Oregon DOT: Design of a Statewide Land Use Transport Interaction Model for Oregon

Reports Comparing Land Use Models, Functionality, etc.

- ARC (Atlanta MPO): A Review of the Literature on the Application and Development of Land Use Models
- DVRPC (Philadelphia MPO): Review of Land Use Models: Theory and Application
- Fredricksberg VA MPO: 2009 TMA/MPO Modeling Activity Survey
- NCHRP: Predicting Air Quality Effects of Traffic-Flow Improvements (see Chapter 6)
- University of Minnesota: Models of Transportation and Land Use Change: A Guide to the Territory
- US Environmental Protection Agency: Projecting Land-Use Change: A Summary of Models for Assessing the Effects of Community Growth and Change on Land-Use Patterns
- US Department of Agriculture: A Review and Assessment of Land-Use Change Models: Dynamics of Space, Time, and Human Choice

Detailed Technical Papers

- Cambridge Systematics- InfoUSA Data Summary Memorandum- 2007
- David Simmonds: Advances in Integrated Urban/Regional Land Use Transport Modeling using the Delta Package
- Purdue/Indiana: The luci2 Urban Simulation Model and the Central Indiana Implementation
- Terry Partridge: Consumer Surplus Evaluation With and Without Integrated Land Use Models
- University of Texas: Extending the Random-Utility-Based Multiregional Input-Output Model
- Wikipedia's Discussion of Land Use Models
- Google Search Results for Rule-based Models

Commercial Land Use modeling packages in this documentation:

- Community Viz by Placeways
- Cube Land distributed by Citilabs
- Delta by David Simmonds Consultancy
- Interactive Growth Model by VBR&A
- I-PLACE3S by SACOG (Online Demo)
- PECAS distributed by HBA Specto
- ULAM 2008 distributed by Transportation Planning Services
- Urbansim by Paul Waddell
- What If? by What if?/Richard Klosterman

The information in the documentation was intended to be available to working group participants at any time so that they could understand the breadth of the materials available and so that they could find the answer to questions that they may have thought of before or after any of the webinar discussions.

Case Studies

Additionally the working group developed a broad summary of some of the working integrated models in use throughout the United States. The "Case Study Summaries" were intended to highlight information collected from telephone interviews of various states and MPOs. This

summary was not intended to be exhaustive but rather to give an overview of *some* of the experiences. The summaries, presented in **Appendix B**, include a simple description of several integrated transport/land use model efforts either in development or in production in Florida and the United States. The case studies document data requirements, costs, project success, modeling platform used, issues confronted and solutions identified. Each of the land use model frameworks reviewed were broadly classified into one (1) of the following types[1]:

- **Bid Rent-** Analytical models based on real estate pricing and "willingness to pay" theory.
- **Input-Output-** Analytical models based on economic flow theory (production/consumption of goods & services)
- **Gravity/Logit-** Analytical models founded on the concept of spatial separation or accessibility similar to a gravity model used in many four-step transportation models
- **Microsimulation-** Analytical models that use Monte Carlo and other simulation techniques to estimate choices at the individual level agent level (like traffic simulation or activity-based models).
- **Rule-Based-** Those models that use rule-based decision trees. Sometimes referred to as "gaming models" or "what if" models where choice probabilities are asserted using a given set of rules.

In reality, no land use model belongs exclusively to one of these broad classes. Each incorporates concepts from the other; sub-models in each may use elements from the others.

Findings presented to the working group suggested development and implementation costs are the lowest for the rule-based class of models. Analytical models are the most complex and can cost from $100,000 to more than $1,000,000 to develop for complex MPO efforts and from $200,000 to $15,000,000 for statewide efforts depending on the size of the study area, policy sensitivity requirements, data availability/quality and the duration of effort. In recent years, well-staffed agencies typically implement analytical models because of the policy sensitivities they afford. Some, like SACOG, implement both rule-based and analytical models to meet a variety of needs that neither type can fully address. Even within the broad classes there is room for customization to meet a specific need. Data demands, development cost/schedule and total model run-times are therefore unique to each case.

Webinar Series

Supplementing the literature review and case study interviews conducted by telephone was an interactive webinar series. The webinars were intended to afford working group participants the opportunity to learn first-hand from the experiences of academics and practitioners. Each webinar was structured to allow two twenty (20) minute presentations and an additional twenty (20) minutes for questions and answers. Speakers were invited to address the working group on a variety of topics and experiences. The following is a summary of the presenters and presentations provided in the webinars.

[1] There is another "non-model" school of land use forecasting not included in the review- Delphi. Delphi is the process of allocating expected growth based on the experiences and knowledge of professionals in the area. Delphi approaches typically employ information but not in a reproducible way. Some would not consider Delphi a "model" in the true sense of the word. Forecasts are quite often negotiated amongst those involved in the process. For this reason Delphi approaches were not included in the review.

Land Use Modeling Frameworks

Basic Approaches to Land Use Models Employed throughout the US[2] (February 19, 2010) was led by Dr. Zhong-Ren Peng of the University of Florida and Dr. Michael Clay of Auburn University. The discussion was intended to familiarize working group members with the major land use models that have been used or are in development in Florida and the United States. Topics included the differences in theory underpinning various land use models along with known strengths and limitations. The presenters concluded:

- Every model has its strengths and limitations and no model is best suited for every situation.
- The selection of a land use model depends on
    - The purpose of the modeling
    - Sensitivities to land use and transportation policies
    - Data requirements and availability
    - Modeling efforts (time, expertise and budget)

Data Development and Maintenance[3] (March 19, 2010) was led by Mary Stallings of Grimail, Crawford & Associates and Wade White of Whitehouse Group. The discussion included typical base year data sources, typical forecast year data sources, and specific discussions about data development experience and costs for a land use model. Addressed were areas of data availability as well as forecast-ability. The discussion concluded that much of the data needed to develop an integrated model exists for most MPOs in Florida but data quality remains questionable.

Integrated Transport/Land Use Models

Transport Accessibility and Other Measures[4] (March 26, 2010) was led by Wade White of Whitehouse Group who presented some of the different measures of accessibility and how it fits into the integrated model. Observations from his presentation included:

- Accessibility is well-considered in most transport models
- Land use accessibility measures may be VERY different than their transportation counterparts
- Accessibility is almost always
    - A continuous variable
    - A relative measure
- Based on literature/experience, accessibility accounts for about one-third of land use decision-making criterion

Feedback- Concepts & Implications[5] (April 16, 2010) was led by Wade White of Whitehouse Group who highlighted why feedback is considered in most integrated models:

- Tradeoffs are complex
- Tradeoffs occur at different times and at different rates
- Growth itself is incremental

[2] Materials: http://www.wgianalytics.com/landuse/docs/webinars/1/Overview_of_land_use_modeling_review.pdf
[3] Materials- http://www.wgianalytics.com/landuse/docs/webinars/2/Webinar2.zip
[4] Materials- http://www.wgianalytics.com/landuse/docs/webinars/3/WGI_AccessibilityWebinar03.pdf
[5] Materials- http://www.wgianalytics.com/landuse/docs/webinars/4/WGI_FeedbackWebinar04.pdf

- Redevelopment pressures increase as an area reaches "build out"
- Feedback provides the best mechanism to capture the interactions and demands of transport and land use

Mr. White also highlighted some of the more practical issues about feedback including model run time concerns, comparison of alternatives, determining model convergence and how each type of convergence framework provides opportunities and limitations.

Policy Evaluation

Real-world Experiences in Policy Evaluation[6] (April 30, 2010) was presented by Gordon Garry of the Sacramento Area Council of Governments (SACOG) and Becky Knudson of the Oregon DOT. The webinar included a candid discussion from veterans of integrated land use models; from concept to implementation and assessment. Mr. Garry discussed the impetus behind the development of the integrated model. In his presentation he posited that:

- Policy drives data and models
- Incremental improvement = continuity
- Model development is "pushed" by research advancements and "pulled" by policy needs
- Integrated cross-discipline planning and decision-making can be improved with good analysis

Mr. Garry continued to show how SACOG uses both rule-based and analytical models in their day-to-day operations and how information from the models is used to answer policy questions ranging from environmental to economic impact.

Ms. Knudson presented the ODOT website and her observations on the development of the 2nd generation Oregon Integrated Model. She summarized lessons learned from the 1st generation development and how those lessons informed the 2nd generation model. She also demonstrated live visualization tools and discussed applications of the model, outputs and how those outputs were used to inform policy decisions.

Policy Sensitivities[7] (May 7, 2010) was led by Kathleen Neill of the FDOT Office of Policy Planning with representatives from the Florida Department of Environmental Protection and Department of Community Affairs in attendance. Ms. Neil highlighted policy considerations that will become more prominent in coming years from both a federal and state perspective. Topics she raised included:

- The evolution of "Mega-Regions" and their implication for statewide planning and economic forecasting
- The challenge of meeting environmental policy and physical demands in several areas including natural habitat, water and air quality
- Delay of the transportation bill reauthorization and its implications for planning
- Discretionary and earmark spending changes
- The implications of the high-speed rail program on Florida's transportation and land use
- Performance-based planning standards
- Livability and urban mobility

[6] Materials- http://www.wgianalytics.com/landuse/docs/webinars/5/SACOGmodelFLwebinarApr2010.ppt and http://www.oregon.gov/ODOT/TD/TPAU/

[7] Materials- http://www.wgianalytics.com/landuse/docs/webinars/6/PolicyWebinar06.zip

Rule-based Models

The roles, data and applicability of rule-based land use models in practice[8] (May 14, 2010) was led by Dr. Richard Klosterman of "What if" Inc. and Dr. Paul VanBuskirk of VanBuskirk, Ryffel and Associates, Inc. Dr. Klosterman highlighted applications of the "What If" model and the strengths and weaknesses of rule-based models. Among the strengths he highlighted included:

- Low cost
- Tied directly to GIS
- Smaller data requirements
- Easy to understand and implement
- Policy-oriented
- Can be linked with transportation models
- Appropriate for public hearings

Dr. Klosterman also acknowledged their limitations:

- Do not consider spatial interaction and markets
- Do not consider land use-transportation interaction
- Not widely adopted for transportation applications
- Cannot be calibrated

Dr. VanBuskirk highlighted an application of the Interactive Growth Model (IGM) in Collier County and the steps necessary to develop the model:

1. Accurate Population Forecast
2. Disaggregate Community into Zones
3 Current Inventory of Development and Demographics by Zones
4. Build out Inventory of Development and Forecast of Demographics by Zones
5. Develop Sub Models
6. Criteria and Formulas for Spatial Distribution of Development over Time
7. Data Output for 5 Year Increments
8. Graphic Interpretation of Results

Dr. VanBuskirk also presented results and how the results were used to develop accurate assessments of the mix of land uses necessary to support the community's vision and how the ability to test scenarios in a prompt fashion allowed planners to "make the case" for compact development.

[8] Materials- http://www.wgianalytics.com/landuse/docs/webinars/7/Webinar07RuleBased.zip

WORKING GROUP RECOMMENDATIONS & FINDINGS

Shortly after the first meeting of the working group, members where posed with a set of "practical" questions to keep in mind while reviewing information and presentations:

- What are the desirable characteristics for a FSUTMS-based land use modeling process?
- What are the "least common denominator" data requirements?
    - Are the data available everywhere?
    - If not, will they be?
- What is the appropriate level of geographic resolution,
    - Parcel?
    - Grid?
    - Zone?
    - District?
- Must the land use model(s) be compatible with newer "activity-based" methods?
- What resources can/are agencies willing to commit to land use modeling?
- What sort of "talent pool" is out there to estimate and calibrate such tools?
- What are the potential roles of the university researchers in the process?
- What are the local, state and federal policies that the integrated model should be sensitive to?
- What is acceptable error in a land use model or in an integrated model?
- What are realistic validation and sensitivity criteria?
- What is a realistic implementation schedule?
- How would the effort to develop integrated models compete with other agency priorities?
- Ultimately, how do you determine "success"?

After the initial series of webinars and the identification of issues that were relevant to Florida's modeling future, working group members participated in two additional webinars intended to summarize what was learned over the three months and to develop a series of recommendations that would lead toward a decision by the full MTF on if and how to proceed. What follows are the recommendations of the working group and the weight assigned to each conclusion. The recommendations effectively constitute a scope and the weight of individual items within the scope for a FSUTMS integrated modeling platform.

Demonstrated Need and Benefit

The working group had 100% concurrence in their recommendation that an integrated modeling platform should be a part of FSUTMS. In fact, some labeled it a "no brainer". Needs driving the decision included the amount of resources spent on developing demographic forecasts today, the relative insensitivity of those forecasts to changes in the transportation system and the likely increases in the demands of policy makers to answer questions ranging from economic impact to mobility and environmental consequences of local and statewide policies.

Full Integration with FSUTMS

Perhaps the working group by its very nature has a bias towards the concept of a fully-integrated model but the consensus was overwhelming that any model should be fully integrated. Whether it should just share common data between the land use and transportation forecasts or whether the process should be fully automated was about equally split. It was felt that any process evaluated should be adaptable to either approach.

Theoretical Framework

The working group rated a sound theoretical framework as a critical item in the overall specification of the integrated model. It was felt that defensibility of the model would be a key to its success and a very important consideration in the model's use. The group did not find the case of one theoretical framework vs. any other convincing in and of itself- i.e. that one was inherently better than another. However any framework would need to be able to answer the policy questions that are anticipated and even those that are not.

The group suggested that the theoretical framework(s) should be sensitive to local differences and therefore should be supported empirically on a case-by-case basis until the case was made that a single theoretical framework would be appropriate for all areas in Florida.

Policy Adherence

All members of the group ranked policy adherence as a critical element of the framework. The consensus was that flexibility in how strictly the model assesses policies should be adjustable so that it could be adjusted to meet different needs. The ability to strictly apply policies was not viewed as important in the long-term as how well those policies are known today is not clear. At a minimum, any selected framework should be able to evaluate:

- Transport
  - Automobile / Road
  - Transit
  - Freight
- Land Use
  - Households
  - Economic Development
  - Job Locations
- Impact Assessment

A comprehensive framework should be able to address small or large scale public visioning evaluations.

Relative Ease of Use

The working group identified three areas that should be addressed in any framework that would prove important to its overall success- calibration, testing and visioning. Easy use for charrettes is viewed as highly important for MPOs.

GIS Integration

All working group members viewed GIS integration as a critical element in the integrated framework. Larger agencies such as large MPOs and FDOT say that building the framework to

work with enterprise GIS data is critical and that any proposed platform should support enterprise GIS data for both input and for output analyses.

Adaptability

Given changes in methodologies and modeling processes, all working group members ranked adaptability as a critical feature of any proposed integrated modeling platform. The group noted that a single method may not be appropriate given the diversity of Florida's development pressures throughout the state.

Comprehensibility

The working group identified 6 areas of comprehensibility and ability that would be important to assess an integrated model on:

- Zonal Data
- Other Inputs and Outputs
- Good Error Reporting and Diagnostics
- Ability to Communicate Results to the Public and Elected Officials
- 3-D Animation
- Ability to compare different alternatives

Of the desirable features, only the ability to produce 3-D animations was ranked as "low" importance. It was felt by the group that this feature could be managed through post-processing and future add-on modules.

Available Support

All working group members rated available support in six different areas:

- In-house
- Consultant
- Developer
- Platform
- User Community
- Long-term vs. contract-to-contract

The working group concluded that having formal software developer support would be a critical aspect of the land use model part of the platform. An "open source"-styled user community supported was ranked as relatively unattractive. The group recommended that support not be "contract-to-contract" but be managed at a statewide level.

It is important to note that the group saw a more complicated framework as less useful and less viable in the long-run.

Data Reliance

Data reliance was evaluated from three different perspectives- reliance on locally collected data, reliance on proprietary data; and, reliance on public (free) data sources. The group recommended that the selected platform be built on publically available data but be able to be tailored based on locally collected data to reflect local anomalies.

The group also recognized that coordinating development of the model with other statewide data development efforts would be important. Given the likely reliance on parcel-based data for both input and output, the group recommended that FDOT coordinate with the Department of Revenue (DOR) to develop a consistent set of standards for data and formats that could be applied to existing and future land use data.

Time and Costs

"Reasonable" run times and cost was viewed as a critical element of the integrated model while the time and costs associated with developing and implementing the model was viewed as less important. The rationale is based on the assertion that if the model runs quickly, it will be more usable. Development and implementation occur only during model validation exercises and should be less important than the "day-to-day" applications.

Staff Time

The conclusion of the working group was that the amount of time to build and implement an integrated model was not as important as the time necessary to train staff and maintain the model. The rationale behind this recommendation was that agencies bear the recurring costs of training and model maintenance while the time to build and implement the model would be a "one-time" cost.

Price

All members of the working group-MPOs, DOT and consultants- expressed a clear sensitivity to the price of entry and maintenance of an integrated platform. Some members asserted that the cost of development could likely be minimized through the FSUTMS process of "borrowing" model platform. However the purchase price, the cost of data development and the cost of ongoing maintenance will be an important aspect when evaluating a proposed platform.

Implementation Schedule

The working group addressed the timing of the integrated model's implementation. The group did not feel that having a process fully implemented by the next round of long-range plans was critical for an analytical-based model but having a model suitable to visioning would be very helpful.

Other Considerations

Pilot Study

The working group recommended a "try it before you buy it" approach to implementation. This would allow for the ability to document data requirements, data deficiencies, evaluate alternative frameworks and to fine-tune the specific elements of the integrated model (input, process & output) to meet Florida's need. The group recommended that the MTF work to find a willing and capable area to undertake the study and that the MTF search for sources of funding (federal, state & local) that would support the pilot.

Incorporate Rule-Based and Analytical Modeling Approaches

The working group observed that rule-based (gaming) and analytical models each offers desirable functionality depending on the particular need. Ideally the integrated platform could employ both approaches that share a common database and similar data requirements.

Integration with Management Systems

The integrated platform should work with other management systems available in MPOs and counties. In particular, concurrency management systems and congestion management systems were identified as key systems where an integrated platform could add value. The ability to evaluate proposed development and its impacts was viewed as a natural extension of the abilities of an integrated platform.

Work with Impact Assessment

Like management systems, impact assessment analysis could benefit greatly from an integrated model. The integrated model should work with standard methods and procedures used in Florida to assess and fine-tune development proposals to optimally meet stated goals in areas of policy and economic development. The integrated platform should be extended to provide tools to tailor development proposals to meet stated goals. This will require the ability to visualize inputs and outputs in a way that clearly communicates results and validates them against other experiences.

Coordination with Department of Revenue Specifications

There are some efforts to standardize DOR codes used in property appraiser-based parcel data. The DOR currently does not have the ability to enforce a consistent set of methodologies used to develop and document what local property appraisers do to develop their databases including the frequency of updates. A consistent approach to parcel data development will make the cost to develop and implement a statewide integrated model lower and will help assure quality. The group recommended that the MTF coordinate with FDOT and the DOR to develop standards parcel-based data and meta-data.

Run with or Without Land Use Model

The ability to run the integrated model with or without the land use forecasting component is a desirable feature for the FSUTMS design. Some land use models can add substantial run-time to the overall transportation model and the ability to turn off the land use model for certain alternatives was viewed as a desirable feature.

Schedule Coordination

The working group recommended that the final implementation of the integrated platform not be tied to the next round of long-range plans as that would not afford sufficient time to fully test, document and train staff. Experience in other states suggests that the full implementation of the integrated platform is a longer-term development effort. However, beginning a thoughtful process of assessment and fine-tuning sooner than later is viewed as important to the overall success of the model.

IMPLEMENTATION PLAN

The working group, appointed by the Florida Model Task Force (MTF), investigated land use models in Florida and integrated transport/land use models in the United States. The goal of this process was to assess the need and suitability of such models and to develop an implementation plan to provide FSUTMS users an integrated FSUTMS land use/transport model framework. The working group did not recommend a specific platform or approach but rather recommended that process be put in place that would assess the options to see how well they fit the recommendations of the working group.

The working group outlined the need, key issues and the importance of the various elements of the proposed integrated platform. From the working group recommendations an implementation plan has been assembled that meets the immediate and long-term recommendations.

Conduct Pilot Study

Based on the working group's recommendations, an initial outline of tasks necessary to carry the integrated model forward have been developed. Those steps are outlined below.

Establish MTF Expert Task Group

The pilot study would benefit from the experiences and knowledge of an expert task group that can provide guidance and direction to the overall pilot study effort. The Expert Task Group would be responsible for reviewing the proposed scope, platform, process and results to suitability around the various agencies in Florida. The Expert Task Group should be appointed by the MTF and include approximately 6 to 8 members from a variety of agencies including MPOs, city/county government land use planning, FDOT districts, academic and the consultant community.

Identify Potential Pilot Study Candidate(s)

The first step in the implementation plan will be for the Expert Task Group to identify candidate MPOs and/or FDOT Districts that are willing to participate in a pilot study. The pilot study will be intended to assess the performance, cost and functionality of various possible combinations of methods, data and platforms upon which to build the FSUTMS integrated transportation/land use model. The ideal candidate for the pilot study should have sufficient staff resources and familiarity with the range of data used to develop land use models.

Depending on the size of the area, the scope of work and associated budget necessary to implement the pilot study may vary. The schedule for this effort should afford two (2) years for the implementation and assessment of the pilot study.

Identify Research Team

The Research Team would serve as the labor to screen and assess the various land use modeling platforms. Their role would be to develop an example of the integrated model, document how available data are used, what policy sensitivities can be demonstrated, and to perform a qualitative assessment of the user experience. The Research Team should be consist of staff and university researchers familiar with the study area, FSUTMS standards and transportation and land use policy evaluation.

Screen Suitable Land Use Models

The working group identified two distinct needs which seem to not be fully satisfied by rule-based or analytical models alone. Given the working group's criteria and importance, a questionnaire on how various land use models might satisfy the recommendations of the working group should be directed to the larger community of transportation and land use planners via website, electronic bulletin boards and similar list-serves. Responses to the questionnaire will be reviewed by the Expert Task Group and Research Team to evaluate how well various packages could possibly meet Florida's needs.

Based on this screening the Expert Task Group should recommend two or more land use model packages that include both analytical and rule-based capabilities for subsequent testing in the Pilot Study. The number of land use models evaluated should be at least one in each of the categories and no more than three. Since rule-based models are easier to implement and are less data intensive, it may be possible to test more than one of them in the Pilot Study.

Implement Pilot Study

The Pilot Study will assess each land use model recommended from the initial screening. The screening process will use the Research Team to evaluate ease of implementation, suitability, ease of use, analytical framework, data requirements, model specification, adaptability, run time, error reporting, error handling and other critical elements identified by the working group. The Research Team will integrate the land use model(s) into the Pilot Study area's FSUTMS transportation model, build appropriate feedback mechanisms and evaluate a range of possible operational scenarios ranging from no automated feedback to fully automated convergent feedback.

An important aspect of the Pilot Study will be the assessment of the integrated platform for a series of "real world" policy tests. Such tests should explore the range of geographic scale suitability (transit oriented development, developments of regional impact, subarea plans, long-range transportation plans, investment grade facility forecasts, etc.) and document which tool(s) should be used and under what conditions.

This will be the most intensive element of the pilot process but should serve to identify which of the evaluated products best meets the short and long-term goals of the integrated model.

Assess Pilot Study

After the integrated models have been built and tested, the Research Team and Expert Task Group will meet to assess how well each evaluated platform satisfied the working group requirements and to evaluate the usefulness of the products. If deficiencies in products or approaches are found, they should be fully documented during the assessment. The Expert Task Group and Research Team should include in the assessment the likelihood of success of implementing such systems elsewhere in Florida, the approximate time necessary to develop and implement the integrated model and the likely cost to implement such a model for small, medium and large urban area.

Present Pilot Study Findings to MTF, MPO-AC and FDOT Leadership

After the Pilot Study has been completed, the Expert Task Group and Research Team will present findings to the full MTF. The MTF should discuss findings and implications and recommend a course of action that will lead to the development and implementation of the integrated platform. It is at this point that initial and recurring costs should be identified for the various alternative solutions.

An important aspect of the presentation will be to demonstrate the value of the integrated system and to provide leadership with a clear case as to what additional capabilities the integrated model brings to their agency and areas where the implementation of the integrated model will result in cost savings, consistency and appropriate policy sensitivities.

Refine Implementation Plan & Budget

After the results and findings of the Pilot Study are endorsed by the MTF, FDOT should work to finalize the implementation plan taking into consideration available funding, expected development and training costs and any advances in methods, data, platforms and presentation capacity that have evolved since Pilot Study was initiated.

Develop FSUTMS Add-on Package

The development of the FSUTMS add on package will include adding of the land use model to the Cube Voyager interface, data management protocols and reporting tools. FDOT will work with developers to identify ways to optimize model run time, enterprise database integration and coordinate data standards and requirements with other state agencies such as the Department of Revenue. This phase of the work program will focus on finalizing standards and protocols for the integrated modeling platform as well as comprehensive testing of the integrated platform to make sure it is robust to the demands of agencies.

Develop Training Materials

After the land use model and integrated platform(s) have been developed, FDOT will develop training materials and a statewide training program to familiarize the user community with the new tools and their proper use. Recent experience suggests that the training materials will include a combination of documentation, web casts and on-site training in regions around the state.

Part of the training materials will include guidance for when to use (or not use) the integrated platform(s). Training materials will build on the case studies and leverage standard FSUTMS training data sets and training programs.

Roll Out FSUTMS Update

After training has been delivered to the modeling community, FDOT will roll out the updated FSUTMS to the modeling community. Coordination with vendors will be necessary to make sure the integrated system is concurrently available to the consultant community.

Schedule

As shown in **Figure 1**, the overall schedule for the Pilot Study, integrated model development, testing, training and roll out would be approximately five years from start to finish. The Pilot Study will take approximately two years to complete with approximately three years to complete additional development, testing, documentation, user training and FSUTMS roll out.

The rule-based (gaming) model element may be advanced more quickly than the analytical (empirical) model as the need for data development, model estimation, testing, training and documentation is much more limited.

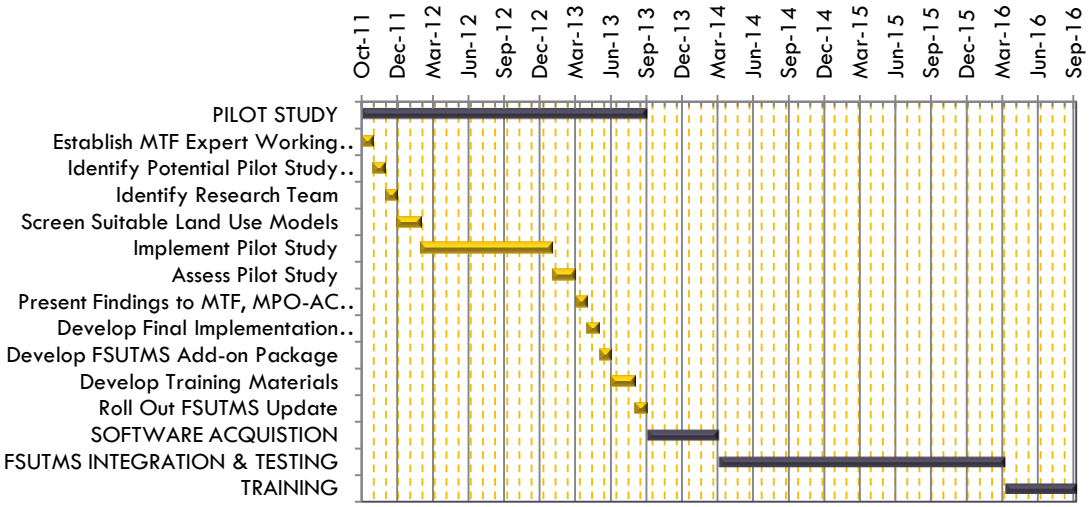

Figure 1 Integrated Model Development and Implementation Schedule

Budget

The budget to complete the initial two year Pilot Study will likely be in the range of $300k-$600k depending on the size of the study area, the amount and quality of available data and the number of land use model platforms evaluated. The Pilot Study should be seen as a "proof of concept" for the platforms and approaches and should not focus on the very detailed assessment that would be necessary for a "real world" full development effort as experience from applications around the US indicates the costs of full development and testing of a fully integrated model are somewhat larger than they are for a traditional transportation model alone.

Beyond the Pilot Study the necessary budget is much less clear as the budget will be a function of the number of land use model "engines" selected, the cost of commercial software (or "home-grown" software), maintenance costs, development and training. A place holder value of approximately $100k per year for the three years of development beyond the Pilot Study should be sufficient to bring the integrated model to FSUTMS. This amount would include software development/acquisition costs and the staff time necessary to develop and test the platform, develop training materials, and coordinate with MTF leadership. Therefore the total budget to bring the integrated model tool set from Pilot Study to availability should be in the $600k-$900k range for the five year effort.

Funding Opportunities

The initial cost of the Pilot study could be funded through standard FDOT appropriations and research funding channels with sufficient notice to FDOT management. Federal funding that can be used to evaluate transportation and land use sustainability has been available recently but may not be available over the full life of the project. Ongoing coordination with FHWA, EPA and HUD may help to identify additional funding opportunities that become available in future years.

Long-term testing and implementation of the integrated model will become a standard part of the long-range plan development process and various visioning exercises conducted by cities, MPOs and FDOT in coming years.

APPENDIX A- OVERVIEW OF EXPERIENCES

Florida Experiences

FDOT-District 4

Florida's FSUTMS ZDATA2 Development Process Study assessed the socioeconomic data sources used to generate trip attractions. This data assessment was used to create a standardized approach to developing base year and future year trip attraction based on the data sources.

Phase I of the study identified and evaluated data sources while conducting research on modeling and data development procedures used in other areas. This information was obtained by mailing surveys to Florida Metropolitan Planning Organizations (MPOs). Phase II detailed the evaluations and recommendations of three alternative processes for validating employment data and preparing base year trip attraction data.

The study concluded that the following standards were needed:

1) Functioning street network maps
2) Standardized naming conventions to address-match efficiently
3) And compatibility between the street network and the TAZ polygon coverage. [9]

FDOT-District 7

The DELTASIM model forecasted income and automobile ownership. This micro-simulation model was designed to work with the current Tampa Bay Regional Planning Model (TBRPM) framework. The TBRPM integrates these forecasting components to better meet the policy analysis needs of the Tampa Bay region.

DELTASIM uses many household characteristics to forecast income and automobile ownership, including:

- Age
- Education
- Employment status
- Employment industry[10]

Florida Turnpike Enterprise

The Turnpike State Model (TSM) is being used by the FDOT Turnpike Enterprise to study the feasibility of potential intercity highway projects that do not fall within the jurisdiction of available urban and regional travel models. Current households, employment densities, developable land, and zone-to-zone accessibility would be taken into account to enhance intercity analyses.

Model projections would be based on available databases that could be updated. For example, land use data (population, employment, etc.) would be obtained from the US Census and InfoUSA

[9] District 4 Planning Office. (1998). *FSUTMS ZDATA2 Development Process Study*. Tallahassee, FL.: Florida Department of Transportation.
[10] White, W. (2009). *DELTASIM Auto Ownership and Income Sub-Models*. Arnold, MD: Whitehouse Group Inc.

databases and updated by Florida's Bureau of Economic and Business Research (BEBR), the US Department of Commerce, and the Bureau of Economic Analysis (BEA).

Trip distribution and toll mode choice modeling will evaluate behaviorally-based travel demand modeling procedures. This modeling, based on survey data, will improve the Turnpike State Model and the feasibility assessments of future Turnpike projects and initiatives.[11]

Metroplan Orlando

Metroplan Orlando uses its Future Land Use Allocation Model (FLUAM) to predict future development in vacant parcels. Predictions rely on data including:

- Population growth
- Employment per acre forecasts
- Historical development trends
- Residential capacity
- Environmental constraints

County and local data are annually reviewed and updated to calculate current year socioeconomic data and more accurately predict future development. [12]

West Florida RPC

The Florida-Alabama Transportation Planning Organization (TPO) uses the Urban Land Use Allocation Model (ULAM) to create a long-term transportation and land use plan. The goal of the ULAM model is to provide an automated process to predict regional or county-wide population and employment control totals at the TAZ level.[13]

The Bay County Urban Area has a version of the ULAM model that uses the standard ULAM model input files and ULAM documentation. Population and employment projections for the year 2030 were forecasted by TAZs using this ULAM model. [14]

The Okaloosa-Walton area used the ULAM to forecast, evaluate, and compare the traffic impacts of each land use alternative. Based on the results of the land use and transportation analysis, it was concluded that a "Hybrid" land use alternative would be the best method of development for the 2030 Long Range Transportation Plan for the Okaloosa-Walton area. The Hybrid land use setup expanded agricultural areas while compacting developed urban areas. [15]

Florida International University

To predict future travel demand, socioeconomic and demographic data are needed, and these data are acquired by using future land use forecasts. UrbanSim, a land use forecasting model developed at the University of Washington, uses this crucial data to simulate land use changes by considering important information, such as local markets and structural constraints. By using these

[11] Adler, T., Dehghani, Y., Doherty, M. (2004). *Design of Florida's Turnpike State Integrated Land-Use Travel Demand Model*. Tallahassee, FL: Florida Department of Transportation Turnpike Enterprise.
[12] Data Transfer Solution, LCC. (2006). *Future Land Use Allocation Model*. Orlando, FL: Metroplan Orlando.
[13] Transportation Planning Services, Inc. (2010). *Urban Land Use Allocation Model: Transportation Land Use Alternative Report*. Pensacola, FL: Florida-Alabama Transportation Planning Organization.
[14] Transportation Planning Services, Inc. (2006). *Okaloosa-Walton 2004-2030 Land Use Allocation Results*. Pensacola, FL: Okaloosa-Walton Transportation Planning Organization.
[15] Transportation Planning Services, Inc. (2005). *Bay County 2003-2030 Projected Change*. Panama City, FL: The Bay County Transportation Planning Organization.

data, UrbanSim is more economically accurate and realistic because it considers a greater variety of variables. And because it spatially disaggregates small grid cells and parcel data, it can be integrated with a travel demand model.

Volusia County, Florida used UrbanSim to assess the model's accuracy and investigate any shortcomings of the model. When tested, UrbanSim was found to simulate land use changes well. However, "consensus building" in urban areas is not modeled, which limits its accuracy. Consultation with local agencies and more concrete community visions can help mitigate the shortcomings of the model.

Data imputation and data quality also played a significant role in the shortcomings of the UrbanSim model. To fix this, a TAZ-based UrbanSim model is being developed at the University of Washington to reduce the amount of data processing that would need to be involved in its implementation. [16]

Van Buskirk, Ryffel & Associates

Van Buskirk, Ryffel and Associates Inc. used algorithms to develop population growth models that optimized land use allocation. Their population forecasting model used algorithms based on typical Sigmoid (s-shaped) curves. Their "Interactive Growth Model™" forecasted the disaggregated and spatial distribution of population. Possible variables considered in the model include:

- Location of the development
- Timing of the development
- Proximity of existing development
- Propensity to aggregate land parcels
- The transportation network[17]

Other Experiences

Ohio Department of Transportation

The Ohio Department of Transportation used a statewide model to forecast land use. The model modules were:

1) Interregional economic models reflecting national forecasts
2) Demographic models reflecting migration activity, changes in population, and household composition
3) Activity allocation models that used forecasts of related flows of goods and labor among zones
4) Land development models that simulated developer behavior, taking demand and costs into account
5) Personal and household travel models that forecasted personal characteristics
6) Aggregate models of goods and services, forecasting economic and demographic activity
7) Disaggregate model of business-related travel, forecasting management and sales activities and services
8) A visitor travel model that forecasted non-resident activity

[16] Zhao, F., Chung, S. (2006). *A Study of Alternative Land Use Forecasting Models*. Tallahassee, FL: Florida Department of Transportation.

[17] Van Buskirk, Ryffel and Associates Inc. (2010). *Response to Florida Department of Community Affairs Rulemaking Workshop*. Fort Myers Beach, FL: Van Buskirk, Ryffel and Associates Inc.

9) And a transport system supply model, incorporating other models of transportation (such as bus and rail.)

The model forecasted:

1) Traffic volume
2) Traffic flow
3) Traffic congestion
4) Employment
5) And commodity production.[18]

Oregon Department of Transportation

The Oregon DOT uses a 2nd generation integrated land use transport interaction model. The model covers the entire state of Oregon and a "ring" around the perimeter of the state for about 50 miles beyond the state boundaries.

The model used micro-simulation in some of the modules. The modules considered:

1) Regional economies and demographics
2) Household allocations
3) Land development
4) Production allocations and interactions
5) Household travel
6) Commercial movements
7) Transport supply
8) And support and general utilities.[19]

Atlanta Regional Council

The Atlanta Regional Council used an open source forecasting model that was developed in San Diego in the 1970s. The IPEF Interactive Population and Econometric Forecasting Model was a regional forecasting model, and it had a few noticeable problems:

1) It consumed substantial staff time
2) The model offered few output variables
3) There was little ability for scenario testing
4) And it still required the purchase of a national forecast.

The Small-Area Land Allocation model, DRAM/EMPAL (D/E), also had some problems:

1) There was difficulty calibrating the model
2) The model produced irregular quality results
3) And support was "disappearing." [20]

North Central Texas Council of Governments

After using the DRAM/EMPAL land use model, the North Central Texas Council of Governments found two major problems:

[18] Giaimo, G. (2007). *Statewide Model Update*. Columbus, OH: Ohio Department of Transportation.
[19] Hunt, J.D., Donnelly, R., Abraham, J.E., Batten, C., Freedman, J., Hicks, J., Costinett, P.J., Upton, W.J. *Design of a Statewide Land Use Transport Interaction Model for Oregon*. Portland, OR: Oregon Department of Transportation.
[20] Alexander, M. (2010). *ACR Land Use Modeling in 5 Minutes*. Atlanta, GA: Atlanta Regional Commission.

1) There was no real forecast cycle for real estate markets, such as housing supply, demand, and prices
2) And the current model does not have micro-simulation modeling for residential location, business location choices, real estate development and prices, and overall annual evolution of cities over time. [21]

Montgomery Metropolitan Planning Organization

The Montgomery Metropolitan Planning Organization (MPO) was interested in developing a land use and transport model for the Montgomery/Autauga/Elmore region. Typically, land use and transport modeling is not used in rural areas because of staffing and budgetary constraints at the MPO level. The case study by the Montgomery MPO investigated to see which model, if any, would be the best for small-to-medium sized MPOs interested in developing a modeling system.

After comparing different models used in other areas, the Montgomery MPO chose PECAS because its structure is complex while still being able to be adapted to the needs of a smaller region. Labor and fiscal issues were solved by employing staff and students from Auburn University. [22]

Purdue University

The Indiana Department of Transportation (INDOT) integrated its statewide travel demand model with the simple "luci2" land use model to create the Integrated Transportation Land-Use Demand Estimation (INTRLUDE) model. The "luci2" model forecasted population density by considering:

1) County population forecasts
2) Minimum/maximum density values
3) Sewer service expansion
4) Preservation of agricultural land
5) Urban growth boundaries
6) Development dispersal
7) Importance of employment accessibility for residential development
8) And unanticipated changes in employment in specific TAZs (e.g. the creation of a Honda assembly plant or job losses in an area where a plant closes down) [23]

David Simmonds Consultancy

David Simmons Consultancy used land use/transport model forecasts when the Bathgate-Airdrie railway was reopening in Central Scotland. The Transport Model for Scotland was developed using the Citilabs CUBE software suite. The model analyzed benefits of employment growth and found that the reopening scheme would have positive impacts on the number of resident and jobs in the rail's corridors. Although there was some forecasted redistribution of activity, there was general growth. [24]

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[21] http://www.wgianalytics.com/landuse/docs/other/NCTCOG_modeling_activities_6_26_09.pdf

[22] Clay, M., Andersen, K., Abraham, J., Hunt, J.D., White, W. *Developing an Integrated Land-Use/Transportation Model for Small to Medium-Sized Cities*. Montgomery, AL: Auburn University.

[23] Ottensmann, J., Brown, L., Fricker, J., Jin, L. *Incorporating a Land Consumption Model with a Statewide Travel Model*. Indianapolis, IN: Purdue University.

[24] Nicoll, J., Aramu, A., Simmonds, D. *Land-Use/Transport Interaction Modeling of the Bathgate-Airdrie Railway Reopening*. Edinburg, Scotland: David Simmonds Consultancy.

APPENDIX B: CASE STUDY SUMMARY FINDINGS

Florida Case Studies

Bay County Long Range Plan Land Use Model	
Study Area	Bay County, FL
Project Budget or Cost	~20,000 per application
Project Status/Schedule	Application (3rd time)
Modeling Platform(s)	ULAM/Cube TRANPLAN
Land Use Model Type	Rule-based
Geographic Analysis Unit	TAZ
Transport Model Type	Traditional Three Step
Data Requirements	Zoning, Future land use, TAZ, Parcel (property appraiser), DRIs
Project Successes	Visualize where land use is by TAZ, reproducible, air quality analyses
Issues Confronted	Data review, projections, growth centers, employment centers
Solutions Identified	Land use subcommittee of TCC
DELTASIM Land Use Model Development	
Study Area	Tampa Bay Region (FDOT District 7), FL
Project Budget or Cost	Approximately $200,000
Project Status/Schedule	Final Development &Validation / (2004-2010)
Modeling Platform(s)	Custom Application / Cube Voyager
Land Use Model Type	Microsimulation
Geographic Analysis Unit	Parcel & TAZ
Transport Model Type	Enhanced Four-step
Data Requirements	InfoUSA databases, GIS-based parcel base map with attributes, PUMS, Census STF3, FL Department of Health birth and death cohort tables by sex and age, demographic literature, Permit Data
Project Successes	Full disaggregate model, micro-simulation of choices, life events, developer choices, lifestyle characteristics, vacancy, seasonality, births, deaths, net migration, designed for 100% compatibility with activity-based or zone-based model framework, land use policies (future land use and existing land use/zoning), redevelopment, composite impedance-based accessibility measures, transit and highway-based accessibility measures, auto ownership sub-model.
Issues Confronted	No off-the-shelf product would meet forecasting needs, incompatibility of parcel data attributes across counties, parcel polygon features missing in some counties, employer transition data difficult to acquire, disaggregate sub-model specification, parcel database size, run-time constraints
Solutions Identified	Extensive research into appropriate methods from a range of 50+ land use forecasting models, development of a custom application, extensive processing and reprocessing of parcel base map, master land use code equivalency, synthetic household generation process for disaggregate household/person information, Department of Commerce data for macro-economic employer trends, "warm-start" processing

Florida's Turnpike	
Study Area	Florida (statewide)
Project Budget or Cost	~$200,000
Project Status/Schedule	Application & Updates
Modeling Platform(s)	Custom Application/TRANPLAN
Land Use Model Type	Gravity/Logit
Geographic Analysis Unit	Parcel & TAZ
Transport Model Type	Enhanced Four-step
Data Requirements	Parcel data with attributes, control totals by land use, permit data
Project Successes	Quick run time, understandable framework, consistent parcel data processing, GIS data management
Issues Confronted	Data consistency between counties
Solutions Identified	Custom GIS process to integrate and reconcile data inconsistencies
Metroplan Orlando Land Use Forecasting Model	
Study Area	Florida (statewide)
Project Budget or Cost	~$1,000,000 (first version, updates since)
Project Status/Schedule	Application & Updates
Modeling Platform(s)	Custom Application (ESRI/ARCGIS)/TRANPLAN
Land Use Model Type	Rule-based
Geographic Analysis Unit	Parcel & TAZ
Transport Model Type	Enhanced Four-step
Data Requirements	Parcel data with attributes, control totals by land use,
Project Successes	Good land use forecasting model, took historic parcel data and grew it instead of taking target number and allocate, came within BEBR projections at parcel level, identified undevelopable lands, land value
Issues Confronted	Getting local government coordination
Solutions Identified	Set up local subcommittee that is still in use.
University of Florida	
Study Area	Florida (statewide)
Project Budget or Cost	Pending
Project Status/Schedule	Model Estimation
Modeling Platform(s)	Custom Application/TRANPLAN
Land Use Model Type	Gravity/Logit
Geographic Analysis Unit	Grid Cell & TAZ
Transport Model Type	Four-step
Data Requirements	Parcel data with attributes, control totals by land use,
Project Successes	Pending
Issues Confronted	Pending (work in progress)
Solutions Identified	Pending

Other Case Studies

Atlanta Regional Commission Land Use Model #1	
Study Area	Greater Atlanta Region (17 counties), GA
Project Budget or Cost	~500,000 (maintenance)
Project Status/Schedule	Completed-Abandoned/ 1990- 2008
Modeling Platform(s)	DRAM-EMPAL/TPPLUS-TRANPLAN (predecessor)
Geographic Analysis Unit	Census Tract (manual disaggregation to TAZs)
Land Use Model Type	Gravity
Transport Model Type	Enhanced Four-step
Data Requirements	Permit data, construction data, etc.
Project Successes	Simple to use, user-friendly, good interface with transportation model, and provided answers needed at the time, worked with GIS, only used for conformity
Issues Confronted	Support system retired, no longer maintained and looking for forecasts that could handle smaller geography
Solutions Identified	Switch systems to PECAS
Atlanta Regional Commission Land Use Model #2	
Study Area	Greater Atlanta Region (20 counties), GA
Project Budget or Cost	~$140,000 committed so far ($200,000 expected)
Project Status/Schedule	Calibration / 2008 – 2010 (target completion for conformity by end of 2011), funding is annual
Modeling Platform(s)	PECAS/TPPLUS
Geographic Analysis Unit	Parcel & TAZ
Land Use Model Type	Input-Output
Transport Model Type	Enhanced Four-step
Data Requirements	Parcel data, regional REMI data,
Project Successes	Full 20 county run of AA module, SD for one county (Fulton)
Issues Confronted	Data collection (on-going challenge), maintaining data over time
Solutions Identified	Periodic update, institutional data/contacts,

Baltimore Metropolitan Commission (BMC)	
Study Area	Baltimore MPO Study Area (5 counties & 2 cities)
Project Budget or Cost	~ $100,000 (plus staff time/resources)
Project Status/Schedule	Final Calibration / 2005-2010
Modeling Platform(s)	PECAS/TPPLUS
Land Use Model Type	Input-Output
Geographic Analysis Unit	Parcel & TAZ & Regional Planning Districts
Transport Model Type	Enhanced Four-step
Data Requirements	Parcel, Zoning, FLU, ELU, economic flow data, 2002 Economic Input / Output model, land development costs, economic sectors, FAR, layer of environmental constraints, other limits on development by parcel
Project Successes	Full transport model integration, market considerations, identify infrastructure needs and prices
Issues Confronted	State parcel data refinement, zoning, current use, economic flow data, land development costs, densities, economic sectors, FAR, layer of environmental constraints by zoning, other limits on development by parcel, activities reflective of SIC
Solutions Identified	Strong GIS staff, synthetic parcel data for prices, long-term development
Blueprint Model	
Study Area	St. Louis, MO MPO Region
Project Budget or Cost	~$2,000,000-$3,000,000
Project Status/Schedule	Complete-Abandoned /2002-2006
Modeling Platform(s)	LEAM/MINUTP
Land Use Model Type	Gravity/Logit
Geographic Analysis Unit	Parcel &TAZ
Transport Model Type	Traditional Four-step
Data Requirements	Parcel data, Census data, Employer Surveys, Household Surveys, Permit Data, Missouri Economic Research and Information Center Database (geo-referenced), topographical data, literature research
Project Successes	Able to check effects of light-rail stations on TOD development, integration of transport model, mixed use
Issues Confronted	Too cumbersome and time consuming to validate for entire region, political will and concerns regarding growth policies, could never determine development and transport order of operations, staff turnover
Solutions Identified	Use for subareas only, correction factors

CalPECAS	
Study Area	California (Statewide)
Project Budget or Cost	~$5,000,000-$10,000,000 (plus ~$5,000,000 for data collection)
Project Status/Schedule	Model Development /2007-2012
Modeling Platform(s)	Input-Output
Land Use Model Type	Input-Output
Geographic Analysis Unit	Grid Cell or Parcel / TAZ
Transport Model Type	Enhanced Four-step
Data Requirements	Typical PECAS and others (pending)
Project Successes	Pending, satisfaction of California legal mandates
Issues Confronted	Pending, data, high-speed rail support, travel model integration and improvements, network updates, GIS data edits
Solutions Identified	Caltrans is developing a household survey that, in coordination with the state's MPOs, will be used to support the development of the integrated model and other modeling efforts.
Houston-Galveston Area Council (H-GAC)	
Study Area	8 counties of the Houston-Galveston MPO
Project Budget or Cost	~400k/year total (not all 100% is model-related) It is of a continuous modeling program (started in about 2000—the agency used DRAM/EMPAL before) rather than a fixed-term project.
Project Status/Schedule	2 forecasts completed; 3rd one in development / 2000 – present
Modeling Platform(s)	URBANSIM/EMME2
Land Use Model Type	Input-Output
Geographic Analysis Unit	Grid Cell & TAZ
Transport Model Type	Traditional 4-step
Data Requirements	Appraisal data, extensive research
Project Successes	No major grief from anybody about the forecast
Issues Confronted	Data quality, complex modeling issues
Solutions Identified	Invest in data development, be creative

Montgomery MPO #1	
Study Area	Montgomery MPO Boundary(3 counties)
Project Budget or Cost	~$600,000
Project Status/Schedule	Calibration Abandoned
Modeling Platform(s)	PECAS/Cube TRANPLAN
Land Use Model Type	Input-Output
Geographic Analysis Unit	Parcel & TAZ
Transport Model Type	Traditional Three-step
Data Requirements	Parcel base map with attributes, economic flows
Project Successes	Assembly of a consistent regional base map, preliminary model
Issues Confronted	Data development & consistency, validation not complete
Solutions Identified	Student labor to work with parcel data to reduce costs, close coordination with planning director for policies, switched to Cube Land platform
Montgomery MPO #2	
Study Area	Montgomery MPO Boundary(3 counties)
Project Budget or Cost	~$250,000
Project Status/Schedule	Model Validation / 2009-2010
Modeling Platform(s)	Cube Land/Cube Voyager
Land Use Model Type	Bid-Rent
Geographic Analysis Unit	Parcel & TAZ
Transport Model Type	Traditional Four-step
Data Requirements	Parcel data, disaggregate household and employer data, Census SF3 data
Project Successes	Low-cost data development for estimation, completed in less than 1 year, integration of sidewalks, new urbanism, density policies, bid-rent functions, transferability of process to other MPOs
Issues Confronted	Lack of segmented market data, parcel data issues, lack of disaggregate demand-side datasets for model estimation
Solutions Identified	Disaggregate low-cost commercial databases for households and firms,
Potential Effects of the Trans-Texas Corridor on Land Use Patterns	
Study Area	Texas (statewide)
Project Budget or Cost	~200,000
Project Status/Schedule	Application & Updates / 2003-2005
Modeling Platform(s)	RUMBRIO/TransCAD
Land Use Model Type	Input-Output
Geographic Analysis Unit	County-based due to movement of entire industries and firms
Transport Model Type	Traditional Three-step
Data Requirements	Economic flow, available land, others
Project Successes	Looked at VIUS stats by sector, making sure that code was simple and elegant, uses actual data without any synthetic data
Issues Confronted	TXDOT, adding transport infrastructure, mode shift of freight, road pricing, self-financing of facilities
Solutions Identified	Keeping it straight-forward and reasonable with respect to data availability

Puget Sound Regional Commission (PSRC)	
Study Area	Seattle WA MPO area
Project Budget or Cost	~ $1,500,000 consultants data & model development
Project Status/Schedule	Application / 2004-2009
Modeling Platform(s)	URBANSIM/EMME
Land Use Model Type	Microsimulation
Geographic Analysis Unit	Parcel & TAZ
Transport Model Type	Hybrid Activity/Enhanced Four-step
Data Requirements	Parcel data, household survey (validation only), synthesized population, DOLES with local surveys on data and education
Project Successes	Ability to look at development changes based on transportation investment, additional performance measures (energy consumption, greenhouse gas, buildings, etc.),
Issues Confronted	One of the first to use URBANSIM so development costs were higher than would otherwise be, grid cell-based difficult to interpret and translating policies to grids difficult, took a year to convert mid-stream from grid-cell to parcel-based, quality of parcel data
Solutions Identified	Move to parcel-based, clean up base map, achieve consistency
Sacramento Area Council of Governments (SACOG)	
Study Area	SACOG MPO Area
Project Budget or Cost	~ $1,000,000 model development + data development costs
Project Status/Schedule	Production- IPLACE3s & PECAS
Modeling Platform(s)	PECAS/DAYSIM & TPPLUS (assignment)
Land Use Model Type	Rule-based (IPLACE3s); Input-Output (PECAS)
Geographic Analysis Unit	Places=parcel & subparcel, PECAS-space development=parcel & subparcel, activity allocaton=Districts (groups of TAZs)
Transport Model Type	Activity-based (DAYSIM)
Data Requirements	Parcel, Zoning, Current use, Economic Flow data, Land development costs, place type (single use/multi-use), densities, economic sectors, design characteristics, FAR, parking requirements & cost, layer of environmental constraints, stream, habitat conservation & other limits on development by parcel
Project Successes	Nancy Hanson, IPLACE3s' program manager at the California Energy Commission, feels that the project has been a resounding success. "It's a comprehensive application," she said of SACOG's use of the software. "They've also managed to build a huge amount of goodwill [amongst the local citizens] by listening to what people want.", public involvement, policy evaluation, Places reinforces activity-based process due to disaggregate nature of both so a better connection to elected officials, cause & effect of choices (congestion, GHG, etc.) to better match what people what to know.
Issues Confronted	A lot of work, rising workload, rising expectations, communication , more technical skills, computing power
Solutions Identified	Efficiency, IPLACE3s is now web-based, leveraging of computer power for analytics, data management and communication, good GIS and database programming capabilities, clear performance measures tied to mapping for communication, ongoing partnerships on data programs