FSUTMS NextGen

White Paper

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1. Toward FSUTMS NextGen

This white paper aims to present an approach for developing a new Florida Standard Urban Transportation Model Structure (FSUTMS). FSUTMS has been the fundamental paradigm within which travel demand modeling in Florida has been practiced for the past four decades. The principal aim of FSUTMS has been to achieve a consensus within the Florida modeling community as to the tools, techniques, and datasets that should be employed in travel demand modeling. This approach has contributed greatly to the sense of professional community that Florida's travel demand modelers enjoy.

Although the origins of FSUTMS are in configuring a single piece of software for use on a single mainframe computer in Tallahassee four decades ago, modelers in Florida have continued to acknowledge, by the constant support and development of FSUTMS over the years, that the benefits of FSUTMS extend far beyond that. These benefits have included:

- Making data acquisition for models relatively cheap and easy,
- Streamlining the model development process,
- Availability of a training program that allow modelers to work with any model in the state,
- Increasing knowledge sharing making it easier to apply lessons learned from one model to another, and
- Agreement on model quality standards.

As technological improvements in the field of travel demand modeling have increased significantly over the past two decades, different models in Florida have diverged from previously established standards. This has made it more difficult for modelers to take advantage of the benefits listed above. One example is that much of the material covered in the FSUTMS Comprehensive Modeling Workshop, which at one time was sufficient to allow any modeler to pick up and use any model in the state, is only relevant to certain models still adhering to traditional FSUTMS practices. Materials on more advanced topics that cover methods used in some of the state's more sophisticated models are barely touched upon. It is time to revisit FSUTMS and update it to meet the needs of today's transportation planners.

The following subsections provide more background on the development of FSUTMS and the need for FSUTMS NextGen.

1.1 History of Modeling Standards in Florida

When the practice of travel demand modeling began in Florida in the late 1970s and early 1980s, all models were housed at the Florida Department of Transportation's Central Office. These were Urban Transportation Planning System (UTPS) models that were calculated on mainframe computers. Due to the logistics of developing and executing travel demand models at that time, an effort to coordinate the setup of UTPS was undertaken. This would allow models from around Florida to be run on the mainframe in Tallahassee. This effort led to the establishment of the original Model Task Force (MTF). The MTF established the first set of standards for modeling travel demand in Florida. As a result, models from around the state could be run on the Central Office mainframe without requiring significant retooling of the UTPS software each time a different model needed to be run. This was the beginning of FSUTMS.

As the 1980s progressed, microcomputers became widely available. Also called personal computers (PC), these machines were smaller and easier to maintain and operate than the much larger mainframes. This era also saw the proliferation of a number of different modeling software platforms designed to function on this new kind of computer. As a result, some of the Metropolitan Planning Organizations (MPO) in Florida began to develop travel demand models in-house using the computers and modeling software packages that the MPOs acquired. To avoid a situation in which models in the state would be incompatible with one another, work began to translate the UTPS-based standards to something more appropriate for the microcomputer environment. This led to the creation of FSUTMS – TRANPLAN. The 1990s would see a return of the MTF and a concerted effort to codify FSUTMS for use with the TRANPLAN software.

By the end of 1990s, computing technology had advanced significantly. Data storage requirements and processing speeds were not as limiting as they had been. These advancements meant that work arounds for past limitations, such as scaling and integerizing real numbers or bucket rounding, were no longer necessary. In the early 2000s, the MTF inaugurated a blue-ribbon panel and model evaluation committee with the purpose of identifying a new modeling software platform that could take advantage of the latest computing technology available. Though a number of software products were considered and evaluated, Cube ultimately became the travel demand modeling software package used for FSUTMS modeling. Along with the new modeling software, the Department and MTF began an effort to create a new set of FSUTMS standards along with packaging the models and model related information in a new web-based delivery platform, FSUTMSOnline.net.

Despite having a set of Cube-related FSUTMS standards that were first documented in 2006, many of the models in Florida have made use of Cube's relatively open modeling environment in ways that deviate from these standards. Some of these deviations are relatively minor (slightly different attribute names, for example) while others involve introducing entirely new methodologies for which standards had not been developed.

In a number of cases, the FSUTMS standards for Cube were designed with the intention of being as similar as possible in structure and nomenclature to the older FSUTMS-TRANPLAN standards. This was done to facilitate the transition to Cube for modelers who had significant experience working with TRANPLAN. These TRANPLAN standards, in turn, were originally developed to be similar enough with past UTPS-based standards that when the change from UTPS to TRANPLAN occurred, there would have been minimal disruptions for those modelers who were experienced with the older UTPS system. As a result, some of the current FSUTMS standards are still beholden to addressing the needs of 40-year-old technology that is no longer in use.

As can be seen from this brief history of travel demand modeling in Florida, from the beginning FSUTMS has been tied with specific software products: first UTPS, then TRANPLAN, and finally Cube. With recent changes in Department policy toward platform-agnostic travel demand modeling, this new approach to FSUTMS will focus less on standardizing software setup and implementation, while emphasizing more on methods and data.

1.2 Purpose and Need for New Guidelines

As the state of the practice in travel demand modeling continues to evolve, it is imperative that new modeling guidelines be devised that can contribute to the Department's commitment to maintaining a vibrant and productive community of travel demand modeling professionals while providing for the flexibility required to address the individual needs of each District and MPO. The challenges facing FSUTMS can be summarized in three points:

1. **Increased data availability -** Over the past 15 years, the availability of mobility data has increased dramatically. Traditional mobility data sets like household travel surveys and traffic counts have benefitted from technological enhancements. Web-based survey delivery systems have been launched that can significantly reduce the cost of fielding a travel survey. Traffic counting can now be supplemented with the use of drones to enhance queue analysis. In addition to traditional data sources, passively collected location-based services (LBS) data has improved the ability for transportation analysts to understand existing and emerging traffic patterns by providing speed, routing, and origin-destination data at relatively high fidelity. Data fusion practices aim to combine these different sources to paint a cohesive picture of travel movements at corridor, regional, statewide, and national resolutions. The upcoming NHTS Next Gen data products are an example of combining household travel surveys and LBS data.

2. **Diverging modeling practices -** Not only are transportation data sources richer now than ever before, a wider variety of modeling tools and methodologies are also available. Activity-based models (ABM) have now been implemented for the Northeast Regional Planning Model (NERPM-AB), the Southeast Regional Planning Model (SERPM), and the Treasure Coast Regional Planning Model (TCRPM). A supply chain freight model with firm synthesis has been integrated with the Florida Statewide Model (FLSWM). Even the models in Florida that have not implemented these disaggregate modeling methodologies and have held mostly to a traditional FSUTMS framework have implemented customized approaches suitable to the local context. These include the Tampa Bay Regional Planning Model's (TBRPM) lifestyle trip generation model and the Gainesville Urbanized Area Transportation Study Model's (GUATS) non-motorized trip network loading. The Central Florida Regional Planning Model (CFRPM) has transitioned to a geodatabase-based data structure for its network and traffic analysis zone (TAZ) databases. Emerging topics in multi-resolution modeling that seek to better integrate macro-level regional planning models with micro-level traffic simulation models have prompted significant interest in modeling tools that can more easily pass data between these different scales of models.

3. **Platform-Agnostic Modeling Environment -** As Florida's modelers continue to develop techniques and tools to address their specific needs, the ability to maintain a rigid framework of standards applicable across the entire state becomes less feasible. In the past, such standards were enforced through software requirements that made deviating from the standards very difficult, if not impossible. Even "soft" standards like performance targets and coefficient values were still constrained by the software's ability to only report certain metrics or read certain parameters. When Florida migrated from FSUTMS - TRANPLAN to Cube, many of these restrictions began to fall away and more models began to implement procedures that were not addressed by any FSUTMS standard. With the Department's adoption of a platform-agnostic approach to travel demand modeling, any remaining software-imposed restrictions to model structures and methodologies have been removed.

With such a diversity of data, techniques, and modeling platforms available, the modeling community will need to move away from a strict standards approach and adopt a guidelines-based approach. Rather than imposing strict requirements to which all models must adhere, modeling guidelines can be developed that will inform the model development and application process in Florida such that modelers in the state will still be able to effectively communicate with one another. These guidelines should focus on addressing the following:

- Identifying accepted versus unaccepted modeling practices,
- Establishing data expectations, and
- Integrating with the Mobility Data Integration Space (MDIS).

1.3 Establishing FSUTMS NextGen

FSUTMS reflects the state of the practice as understood by Florida's professional modeling community and guides the state in implementing modeling technologies and methodologies. To accomplish this, it has historically fallen to the MTF to shape the development of FSUTMS. Composed of representatives from the Department's District Offices, MPOs, model users' groups, transit agencies, partner agencies (FHWA, EPA, etc.), universities, and consultants, the MTF is Florida's professional modeling community. As the need for a new FSUTMS has become apparent, it should once more fall to the MTF to take the lead. To this end, the following should take place:

- An FSUTMS NextGen working group should be formed made up of members of the MTF.
- Since FSUTMS touches on all aspects of modeling, it is desirable for active members of each the MTF committees to be part of the working group.
- The size of the working group should not be too large to better facilitate discussion and decision-making.
- It is expected that the working group should meet three times over the 2022 calendar year. At these meetings the working group will be presented with recommendations for FSUTMS NextGen developed by a technical team of subject matter experts working on behalf of the Department. The working group will discuss the recommendations and provide feedback to the technical team on how to proceed.
- The goal is to provide an updated set of FSUTMS guidelines and standards for presentation to the full MTF in 2023.

It is not expected that the FSUTMS NextGen working group will continue beyond this initial effort at updating FSUTMS. Once the FSUTMS NextGen standards and guidelines have been developed and adopted by the MTF, the working group will be disbanded and the further development of FSUTMS NextGen will continue under the normal processes of the MTF and its committees.

The first step in developing FSUTMS NextGen is a report laying out the guidelines and standards. This report will inform Florida model development and application going forward. It is expected that FSUTMS NextGen will not only identify methods and data that are to be encouraged or preferred in Florida, but also identify discouraged or unacceptable practices and to note them as such.

It is not expected that the current round of model updates and enhancements need to comply with the FSUTMS NextGen; however, should a model development or update effort begin at a time coinciding with the release of FSUTMS NextGen, model developers are encouraged to refer to the new guidelines.

It is expected that additional supplemental FSUTMS NextGen products will be developed over the next few years. These include additional reports on special topics not addressed in the initial report, appendices designed to incorporate the findings of new research into FSUTMS NextGen, and updated FSUTMS NextGen training.

This white paper is intended to serve as a launching point for the development of FSUTMS NextGen. Though many of the topics discussed in this paper may come across as suggestions or recommendations, they are not intended to dictate the direction that the new standards must take. Rather, these topics are meant to provide points of discussion that can serve as a starting point to identifying what the new standards should be. The main purpose of this white paper is to raise awareness of some of the challenges and possibilities that will come along with developing FSUTMS NextGen.

Section 1 of this white paper discusses the history of FSUTMS and addresses the current challenges to FSUTMS and the need for FSUTMS NextGen. **Section 2** discusses how FSUTMS NextGen can approach Florida's modeling practices. It outlines a framework for organizing modeling practices in FSUTMS NextGen and provides example challenges and opportunities for traditional, advanced, and supplemental practices. **Section 3** addresses data expectations and identifies how the use of different modeling software platforms can influence data structure standards. Some examples illustrate how networks, TAZ, and socioeconomic data could be considered under FSUTMS NextGen. **Section 4** briefly discusses the MDIS that is currently under development. This section provides an overview of how FSUTMS NextGen Models can access data from and contribute data to the MDIS. Finally, **Section 5** presents a process of establishing FSUTMS NextGen, the role of an FSUTMS NextGen working group, and a brief conceptual overview of what the FSUTMS NextGen report might look like. These sections of this paper are not meant to be exhaustive treatments of the topics which they discuss but are rather intended as general overviews of key concepts to consider when developing FSUTMS NextGen guidelines and standards.

2. Modeling Practices

Many of the accepted modeling practices in FSUTMS come from a time when modeling methods were enforced by software design. These have evolved over time, often resulting in custom software being written to implement newer modeling methodologies that could not be addressed by the older software. As a result of this, a variety of innovative practices have been brought to Florida models over the years. Some of these innovations were relatively minor, such as restructuring Trip Gen to accommodate different breakdowns of socioeconomic data. Others have been more significant, such as when the generalized nested logit model was first implemented in Florida or when the Toll Facilities Model was first developed. Most recently, the development of activity-based models in Florida have required a fundamental change in how those models are structured.

One of the benefits of the MTF and FSUTMS is the ability to survey these innovations periodically and assess their effectiveness. By taking a “lessons learned” approach, the MTF can assess which innovations work particularly well and which may require further research. Over time, these innovations can be incorporated into FSUTMS for the benefit of the modeling community in the state. This transition from innovative practice to FSUTMS standard typically marks the point at which a method has entered the state of the practice and facilitates the ability to implement the innovation in other models in Florida. This process also benefits the modeling community by identifying unforeseen complications in some implementations, and guiding modelers in such a way as to avoid those issues in the future. This, in turn, reduces the cost and effort of enhancing future models as the need for trial and error in model development is reduced.

In addition to surveying the existing practices in Florida’s models, it is beneficial to compile and review the work the Department has conducted with respect to FSUTMS over the past decade. This includes not only the academic research sponsored by the Department, but also incremental updates to FSUTMS such as the recent assessment of UROAD factors. As significant work has been done by the Department with respect to keeping FSUTMS current, any updates to FSUTMS should try to incorporate as much of this recent work as possible.

An example of incorporating some of this work into the FSUTMS NextGen guidelines and standards is the work recently completed with respect to trip purposes. A memorandum prepared for the Department dated February 20, 2020, discussed standard trip purposes for use in FSUTMS. This memorandum discussed briefly the existing trip purposes used in FSUTMS models and made recommendations as to any changes in trip purposes that should be made. In general, the memorandum adhered to a principle of altering the existing trip purposes as little as possible and only to the extent that they capture meaningful distinctions in travel behavior. To that end, the MTF adopted the recommendation to maintain the following standard purposes common to all FSUTMS models:

- Home-based work (HBW)
- Home-based shopping (HBSh)
- Home-based social-recreational (HBSR)
- Home-based other (HBO)

The MTF also adopted the recommendation that the following trip purposes found in only some FSUTMS models be incorporated into the standard modeling framework:

- Home-based school (HBSc)
- Home-based university (HBU) – as an option where appropriate

The most substantial change recommended in the memorandum and adopted by the MTF was to split the non-home-based trip purpose into two separate purposes:

- Non-home-based work (NHBW)
- Non-home-based other (NHBO)

In addition to these recommendations concerning the standard trip purpose, the memorandum discussed the viability of introducing visitor trip purposes into FSUTMS. Though the discussion did not go much further than recommending that the Department and the MTF look into ways of using existing data to create a visitor trip purpose, it did point out that visitors do make up a significant portion of Florida's traveling population. Though not every part of Florida receives visitors at the same levels of intensity, the consolidation of Florida's models over the past couple of decades into larger regional / districtwide scales of geography means that every model in the state could benefit from a visitor trip purpose.

2.1 Organizing FSUTMS Practices

To better organize FSUTMS NextGen, some framework with respect to the modeling practices under consideration should be developed. This framework will help to guide modelers in better identifying the guidelines and standards relevant to their efforts. This framework would serve a primarily documentary purpose as a way to organize the FSUTMS NextGen report (or series of reports) that is envisioned as a product of this update effort. This framework could be divided into overall topic categories as follows:

- Traditional Practices
- Advanced Practices
- Supplemental Practices

These overall topic categories can then be subdivided into specific subsections for the individual practices that they cover. The practices, in turn, can then be addressed in terms of elements addressing specific methods and applications needed to implement the practices. **Table 2-1** shows an example framework. This example is not comprehensive and could be more fleshed out over the development of the updated FSUTMS standards. For example, transit, mode choice, freight, and commercial vehicles are not mentioned in Table 2-1, but FSUTMS NextGen will need to address each of these topics as well as a number of other topics not included here.

Table 2-1. Example Framework for Addressing Florida Modeling Practices

Category	Practices	Elements
Traditional Practices	Trip Generation	-Cross classification productions -Attraction balancing: regional versus subarea
	Gravity Models	-Friction factor file versus gamma function -Calibration of gamma function parameters -Should NHB trips be dependent on HB trips?
	Trip Purposes	-Traditional purposes (HBW, HBSR, HBSH, HBO) -School trips (HBSc) -When to include university trips (HBU) -Non-home-based work versus non-work -Necessity of a visitor purpose -Sources of visitor data
	Assignment	-CONFAC / UROAD -Alternative volume delay functions -Convergence criteria for equilibrium assignment
Advanced Practices	Activity-based Models	-Considerations for adopting ABMs -Policy sensitivities desired -Identification of outlier behaviors -Sub-TAZ geography needs -When to rerun population synthesizer? -Seed data sources -Control data sources
	Destination Choice Models	-Reasons for adopting destination choice -Sources of data for estimating the model
	Feedback	-All periods versus AM and PM versus AM or PM -Trips versus skims versus link volumes -Closure criteria -Maximum iterations?
	Time-of-Day	-Where to implement (assignment / trip distribution / generation) -Number of periods
Supplemental Practices	Toll Modeling	-Toll choice methodologies -Value-of-Time based assignment classes -ELTOD
	Intersection Modeling	-Source of intersection data -Methods for generalized intersection characteristics
	Connected & Automated Vehicles	-Scenario-based approaches -Assumptions on capacity impacts
	Multi-Resolution Modeling	-Macro, Meso, Micro assignment techniques and integration -Zone Nesting (Parcel, Block, MAZ, MPO TAZ, Statewide TAZ)
	Custom Scripting	-Compiled language versus interpreted language -Promote use of a specific language versus multiple languages

2.2 Traditional Practices

Traditional practices in FSUTMS are those that have a long history of use in Florida. These are generally consistent with the following model characteristics that were at one time common to nearly all FSUTMS models even if today some of these characteristics are less common or even absent altogether:

- Aggregate TAZ-level modeling from trip generation through trip assignment
- One single daily time-period
- Trip productions calculated using cross-classification tables
- Trip attractions calculated using linear models
- Highway networks containing the "Big Three": Facility Type, Area Type, Number of Lanes
- Calculating network capacities and speeds from the Big Three
- Use of gravity models with friction factor files
- Mode choice for areas modeling transit (originally multinomial logit, but then transitioning to nested logit)
- Static highway assignment with user equilibrium using the Bureau of Public Roads (BPR) volume delay function (VDF)
- Variable VDF parameters by facility type
- Hourly capacity conversion factors to daily capacities
- Modeling PSWADT instead of AADT and using model output conversion factors (MOCF) to convert model outputs to AADT

Though there have been other characteristics of FSUTMS models that have not been included in this list, these are the ones that should be most recognizable to those who have had extensive experience working with FSUTMS.

The treatment of these traditional practices in FSUTMS NextGen should address the following:

- Practices that should be retained either as an exclusive practice or as an option in addition to other practices
- Practices that should be modified to make use of recent enhancements
- Practices that should be discontinued

While identifying which specific practices should be retained, modified, or discontinued is beyond the scope of this white paper, this paper envisions the stratification of traditional practices into these three categories as one of the first outcomes of updating FSUTMS.

An example of this is how trip distribution is handled with respect to the use of the gravity model. Trip distribution models in Florida have traditionally been gravity models. These models are relatively straight forward to build and maintain. Though destination choice models have now been implemented in several instances in Florida, it seems likely that at least some planning areas would prefer to maintain a gravity model. A decision would need to be made concerning whether the FSUTMS gravity model should be retained (as an option along with destination choice models), modified so that it is still a gravity model but uses updated methodologies, or be discontinued entirely in favor of transitioning all trip distribution models to destination choice.

A modification to the gravity model might consider the following. A gravity model only requires that the following information be known:

- The number of productions in each zone.
- The number of attractions in each zone.
- The impedance from each zone to each zone.
- A socioeconomic adjustment factor (typically discouraged in Florida).

The long standing FSUTMS method for calculating impedance has been to use calibrated friction factor curves. These curves are stored in a file where each time mark (typically given in 1-minute intervals) is assigned a specific friction factor. These friction factors can be adjusted manually at each time interval giving the modeler a high degree of customization of the model's OD patterns at the risk of over-fitting the model. If the model is over-fit, then there is a good chance that the model will be unable to respond reasonably to changes in land use patterns or transportation network characteristics.

This risk of over-fitting the friction factors can be overcome by relying more on function-derived friction factors. The most common of these functions is the gamma function:

$$F_{ij} = \alpha {t_{ij}}^{\beta} e^{\gamma t_{ij}}$$

Where:

α is a coefficient.
β is an exponent.
γ is a coefficient.
t_{ij} is the impedance between zones i and j.
F_{ij} is the friction factor between zones i and j.

There are two approaches to consider for a function-based approach to friction factors. The first is to maintain the use of a friction factor file (assuming one is working with software that permits the use of friction factor files) but insist that the friction factors be calculated from a function. If the gravity model needs to be calibrated, it would be done by adjusting the parameters of the function and recalculating the friction factors rather than by directly adjusting the friction factors in the file. This could be verified by publishing the function parameters in the model documentation so that the reviewer could recalculate the friction factors and compare those to the values in the file. The second approach would be to discard the friction factor file and instead work directly with a function in the gravity model such that friction factors are calculated by the model on the fly. Again, calibration would be done by adjusting the function parameters. Furthermore, impedances may be calculated using generalized cost functions as opposed to relying solely on travel times as has been the case in many past FSUTMS models.

Another consideration in whether to modify the trip distribution process in the model is to assess how non-home-based (NHB) trips are handled. NHB trips in trip-based four step models typically suffer from trip end mismatch. This mismatch occurs as a result of NHB trip generation being performed independent of the home-based trip ends. In standard FSUTMS models, NHB trips are generated based primarily on employment characteristics similar to how home-based attraction ends are calculated. While on the surface this may seem to result in a logical allocation of NHB trip ends, the models do not contain any constraints to ensure that the trip ends the model generates for NHB trips have any relationship to the trip ends that the model selected for home-based trip ends. It is completely possible that the model will identify a NHBW trip where neither end is the destination of an earlier HBW trip.

One way to address this is to sequence the trip generation and trip distribution in a trip-based four-step model as shown in **Figure 2-1**.

Figure 2-1. Sequencing NHB Trip Generation and Distribution

The goal is to ensure that NHB trip generation only considers those locations where HB attractions exist. Additionally, the number of possible NHB productions at a given TAZ would be limited to the number of HB attractions at that TAZ. This will make it possible to constrain the NHB trip ends based on the locations the model has selected for home-based trip ends. The result should allow for better continuity between HB and NHB trips and yield a pseudo-tour phenomenon in a trip-based model. This technique has been employed nationally with models such as the Salt Lake City model and the North Carolina Statewide Travel Model.

2.3 Advanced Practices

Advanced practices are those that have been developed and introduced to Florida over the past decade. Though these practices are becoming more common in the state, they are by no means ubiquitous. Furthermore, many of these practices require specialized skills that many modelers accustomed to working within a traditional FSUTMS paradigm may not possess. This itself is changing as, over time, the profession continues to encourage familiarity with these practices and the skills required to develop and apply these types of models.

2.3.1 ABMs as an Example of Advanced Practice in Florida

With the relative newness of activity-based models, different model custodians in the state have implemented them in somewhat different ways. Traditional trip-based models are aggregate models and calculate all relevant trip making characteristics at the TAZ level. The simplest such models apply a trip rate to the number of households in a TAZ to calculate the total trips in the TAZ. These are then distributed to other TAZs such that a certain percentage of trips in one TAZ are allocated to a second TAZ while another percentage is allocated to a third TAZ and so on. ABMs, on the other hand are disaggregate models. This means that trip making characteristics are calculated for the individual trip maker. Each individual represented in the model calculates an activity chain. The activity chain determines each trip that individual makes each day and how those trips are related to each other. For example, the model may calculate that a specific individual in the model drives to work in the morning, stays at work for 8 hours, drives to the grocery store to do some shopping, and returns home 30 minutes later. ABMs have now been implemented for the NERPM-AB, SERPM, and TCRPM models.

ABMs are more computationally intensive than traditional trip-based models, but they provide a more precise understanding of travel demand in a given region and allow for greater policy analysis than older aggregate models. Given these advantages, it is understandable why some regions would prefer to implement these models. Assessing the extent to which ABMs in Florida can be standardized can be problematic as the extant ABMs in the state use different software. NERPM-AB uses PopulationSim for population synthesis and DaySim for activity calculations while SERPM and TCRPM both use PopSyn for population synthesis and CT-RAMP for activity calculations. The Department is currently considering joining the ActivitySim development consortium. This would bring ABM practice in Florida in line with a number of Departments of Transportation and MPOs around the nation. With this in mind, there are several avenues to explore for possible guidelines for ABMs.

The decision to convert a model to an ABM is not one that should be taken lightly. Not only are these models more complex to develop and maintain, they can also be more difficult to apply in everyday planning and engineering situations. The benefits gained as a result of these models include more precise representations of travel behavior, a greater sensitivity to policy-based scenarios, and the ability to analyze population segments in greater detail. As such, considerations on when it would be appropriate to convert a model to an ABM should be explored. Planning areas that are still primarily focused on congestion-based metrics and with ample opportunity to address local transportation issues with enhancements to the transportation network's available capacity may not be as interested in ABMs. Those areas where building additional capacity is less feasible, whether due to cost prohibition or lack of political will, might consider implementing an ABM to see if non-construction-based solutions such as congestion pricing or alternative work from home schedules could potentially address their transportation concerns. Another consideration is that some ABMs can be developed that do not require a full implementation, such as TCRPM's ABM Lite approach. This could significantly reduce development and maintenance costs of the model while still providing many of the same benefits of a full ABM.

Thought also needs to be given to the delineation of new geographies. For example, some ABMs make use of microzones, also called micro-analysis zones (MAZ), along with TAZs. These MAZs are a level of geography between parcels and TAZs. This allows for more precise modeling of the population than using TAZs but with less computational overhead than using parcels. NERPM-AB had been using parcels, but these were aggregated to MAZs in the most recent update to the model. Guidance on the need to use MAZs over either parcels or TAZs, how to define MAZs, and the data used to develop MAZs could be beneficial to planning areas considering adopting ABMs. This also has a direct bearing on population synthesis.

Population synthesis is the process by which person characteristics for each individual living in a planning area are modeled. These characteristics include membership in a household, employment status, relationship to other members in the household, and other characteristics as appropriate. These data are synthesized from a seed sample of representative individuals and households. These are in turn controlled by totals for the various household and person characteristics. Seed sample data are typically acquired from the Public Use Microdata Sample (PUMS) data for the area being modeled; though it is also possible to use some other source of sample data such as a regional household travel survey (which may suffer from much smaller sample sizes). The control totals are controlled at multiple levels of geography within the model. These include MAZs, TAZs, and county or super-county geographies if appropriate. The control data may come from the Census or local demographer estimates as appropriate. While traditional FSUTMS models make use of TAZ-level demographic data that are similar to the control totals used for population synthesis, population synthesis requires additional categorization of the data beyond the simple population and dwelling units by dwelling unit type used in the traditional models. For example, households may be broken down by size, income, and number of workers, while population may be broken down by sex and age. Different characteristics may be used for controls at different levels of geography in the same model.

Given the complex interactions between data types and geographies used for population synthesis and the fact that this application of the data is beyond the realm of experience of most FSUTMS modelers, the tendency with Florida's existing ABMs has been to recommend running the population synthesizer only when absolutely needed. The guidance provided with SERPM 8 indicates that population synthesis should only be run "if the control totals are changed from the base scenario."[1] The guidance for running population synthesis for NERPM-AB likewise indicates that population synthesis should only be run if there have been significant changes to the land use data, with guidance from earlier versions of the model indicating that population synthesis be run only by a select group of organizations authorized to do so. Clear guidance should be developed indicating when it is appropriate to run a population synthesis model for areas seeking to adopt an ABM.

2.3.2 Destination Choice as an Example of Advanced Practice in Florida

Another practice to consider is the use of destination choice models. Destination choice models are generalized trip distribution models that can account for a wide variety of explanatory variables in describing why travelers choose to go to some locations rather than others. The gravity model, which is really a special case of the destination choice model, can only account for productions, attractions, and impedances (most gravity models also allow for "socioeconomic adjustment" factors, which allow for a brute force way to enforce the number of trips traveling between specific zones). Destination choice models can have any number of explanatory variables so long as the data exists to support the significance of those variables and the number of variables selected aligns with good statistical practices with respect to the number of observations available. This flexibility allows destination choice models to account for physical and psychological barriers (such as rivers, county boundaries, etc.), income / wage dynamics, parking availability, and lifestyle characteristics. These are in addition to the traditional variables of productions, attractions, and impedance found in gravity models.

Conversion of existing gravity models to destination choice models is viable. This needs to be carefully considered. Currently, the ABMs in the state as well as the FLSWM have destination choice models implemented. It is not necessarily the case that smaller or more rural planning areas should avoid destination choice models. The key factor for consideration should be whether or not the planning area contains features that are known to local transportation professionals to influence destination choice and are not adequately captured by just looking at productions, attractions, and impedance. The presence of rivers or intracoastal waterways, for example, could be a sufficient reason for wanting to adopt a destination choice model.

2.4 Supplemental Practices

Whereas both traditional practices and advanced practices deal with core travel demand model functions, supplemental practices are those that address specific applications and have not been a required component of FSUTMS models. As the situations the supplemental practices are meant to address become more common, it may become the case that they will see more frequent use in the models. If so, incorporating guidelines for these supplemental practices into FSUTMS should also be undertaken. In some cases, as with toll modeling, this is already true with respect to the toll facilities model.

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[1] https://sites.google.com/site/serpm8reference/application/model-setup-and-run#h.p_Bch-hQCiAA3O – accessed on January 11, 2022.

2.4.1 Toll Facilities Model as an Example of Existing Supplemental Practice

FSUTMS has had the toll facilities model (Toll FM) since the late 1990s. This model captures the impedance incurred at toll plazas as a result of a number of contributing factors involved in paying a toll:

- Deceleration time approaching the toll plaza,
- Transaction time at the toll plaza,
- Price of the toll generalized into a travel time, and
- Acceleration time leaving the toll plaza.

The development of the toll facilities model resulted not only in the development of specific model parameters used to convert price to travel time, but also set guidelines on the proper coding of toll plazas in the model network, including the number of links to use, the length of these links, and the attributes required to represent the plaza. Since the toll facilities model was first created, transponder-based toll payment technologies have made open-road tolling the norm in Florida, especially along the Florida Turnpike system. Initially, mixed-technology toll collection plazas where some gates were open-road and some gates used traditional cash transactions prompted the MTF to assess toll modeling approaches that could handle this reality. Since open-road toll collection does not require deceleration, acceleration, or transaction time, it stands to reason that such plazas should be modeled without the additional time impedances; however, if the same plaza contains cash gates, the desire to model the plaza precisely would result in no one using the cash gates since the impedance by definition would be worse for the cash gates than the open-road gates.

This prompted an approach for discrete choice modeling of toll users with transponders versus other travelers. While having the benefit of being able to isolate open-road eligible toll users from their non-transponder using counterparts makes the assignment of these trips more precise, it does present a question as to whether to exclude travelers from toll roads altogether prior to traffic assignment. Usually, such models are incorporated as part of a mode choice model and may distinguish auto travelers between toll using with transponder, toll using without transponder, and non-toll using. This segmentation assumes that some travelers will never pay a toll no matter what conditions they encounter in traffic. There is also the question as to whether discrete toll choice modeling should occur during mode choice or embedded within highway assignment itself.

An alternative to transponder choice modeling is to use path-based choice during assignment where the model incorporates the toll cost as part of the path-building process and diverts trips toward or away from toll facilities based on congestion. The simplest implementation of this uses a single value-of-time (VOT) market segment for all trips. With only one VOT market segment, these models lack a refined sensitivity to a region's socioeconomic diversity. This makes it difficult to assess whether the location of a toll facility relative to certain residences and activity centers has any bearing on the use of the facility. This can be addressed by disaggregating the trip table into multiple VOT market segments and assigning these as separate assignment classes. Various methods exist for doing this including using average income and a disaggregation curve to segment the trip matrix at a TAZ-level similar to how household disaggregation models use average persons per household to segment households into 1-person households, 2-person households, and so on. A trip table disaggregated by VOT market segment will allow for a more reasonable response to tolls during highway assignment.

2.4.2 CAV Modeling as Emerging Supplemental Practice

In contrast to toll modeling, which has been well established in Florida and continues to evolve, modeling for connected & automated vehicles (CAV) is an emerging practice. With relatively little information available from which to reliably model technology that is still in its early stages of development, the primary emphasis has been to establish scenario-based modeling approaches that use a range of assumptions from the research literature. Scenarios created around these assumptions then give modelers an opportunity to analyze the potential outcomes of increased usage of CAVs in the transportation fleet. The scenario-based approach can be challenging with respect to CAVs as there is still little known about how these vehicles will impact the transportation system. In many cases, the assumptions are speculative, though the use of exploratory modeling could mitigate these uncertainties.

Recent research has focused on trying to narrow down the range of reasonable assumptions, and a consensus is starting to form. One field in which this consensus has entered the state of the practice is with respect to the capacity impacts of CAVs. The recently released 7th edition of the Highway Capacity Manual (HCM 7) has included a methodology for adjusting available capacity based on the market penetration of CAVs in the transportation fleet.[2] The new methodology can be found in Chapters 26, 31, and 33 for freeways, signalized intersections, and roundabouts, respectively. By inputting a user-provided market penetration of CAVs, the methodology returns planning-level service volumes. This methodology could serve as the foundation of FSUTMS-specific roadway capacity adjustments for CAVs. As a result, capacity impacts due to CAVs can be made consistent throughout the state. Given Florida's leadership role in planning for CAVs, introducing higher levels of consistency between Florida models in this field leads to increased credibility and defensibility of these analyses. For other aspects concerning potential CAV impacts, a set of guidelines based on a review of existing methodologies in Florida models as well as the research literature can be fleshed out during the process of developing FSUTMS NextGen guidelines and standards.

[2] National Academies of Sciences, Engineering, and Medicine. 2022. *Highway Capacity Manual 7th Edition: A Guide for Multimodal Mobility Analysis.* Washington, DC: The National Academies Press.

3 Data Expectations

In an environment where FSUTMS models are no longer constrained to the expectations of a single modeling platform, dictating standards on the basis of file specifications is difficult at best. Some effort could be made at requiring the use of universal file types (CSV, DBF, etc.) that can be converted into the preferred proprietary data format used by a given software. This would allow for greater standardization across all models; however, this would not address specific data requirements that could differ between platforms. For example, one software platform may require that each travel direction on a single segment of a highway network be stored as two separate records in a database while another platform may allow or even prefer that both travel directions be stored in a single record. This would significantly impact which attributes the network should contain (e.g., a single number of lanes attribute since each direction is a separate record, or two number of lanes attributes, one for the AB direction and the other for the BA direction, since both directions are on the same record). Attempting to standardize this over multiple platforms could prove to be very difficult.

Rather than focusing on standardizing file types and attribute structures, a better approach would be to focus on data expectations and guidelines. For the above example concerning number of lanes on a highway network, FSUTMS NextGen could specify that it is an expectation that the highway network will have an attribute for number of lanes and even suggest appropriate attribute names such as LANES (for software where each direction is a separate record) and LANES_AB / LANES_BA (for software where both directions are on a single record). Focusing on expectations and guidelines would allow for flexibility in how models are developed throughout Florida while still providing modelers a basis for understanding and using a model with which they are not yet familiar.

Data considerations for FSUTMS NextGen could also be organized according to a framework. **Table 3-1** shows an example framework for data similar to the one showed in Table 2-1 for modeling practices.

Table 3-1. Example Framework for FSUTMS NextGen Data

Practice	Elements
Demographics	-Continue dwelling unit by type? Greater differentiation in type? -Auto ownership versus income? -Greater differentiation in population (age, employment status, sex)?
Employment	-General categories (Industrial, Commercial, etc.) versus 2-digit NAICS? -School and university employment? -Include average salaries?
TAZs	-Numbering practices (incorporate county FIPS?) -Nesting practices -Delineation standards
Costs	-Travel times -Tolls -Operating Costs
Capacities	-Include HCM characteristics (lane width, shoulders, median, parking)? -Intersection locations, control types, cycle length, green time, etc.?
Master Network	-Project ID numbers -Specific flags for which links belong to which scenarios -Separate database for project characteristics?

The discussion in the rest of this section highlights some of the challenges in standardizing data in FSUTMS NexGen.

3.1 Networks

Transportation networks in FSUTMS have been one of the main elements of Florida models constrained by software requirements. Despite being more flexible than the earlier TRANPLAN version of FSUTMS with respect to the number of attributes and their nomenclature, Cube still had fundamental assumptions built into its data architecture that influenced how FSUTMS highway networks were standardized. An example of this is the node / link structure and the primacy that nodes take in that structure. Cube networks are defined as a set of nodes and links where the node reference is primary. Cube links have attributes identifying the A and B node pertaining to that link while the nodes possess cartesian coordinates identifying the location of the nodes in space. Links themselves have no apparent identifier and are merely referenced based on their A and B node. While not immediately obvious, this does influence a number of other data elements related to the highway network such as turn penalties (defined in terms of A, B, and C nodes in a turn movement), turning volume files (same use of A, B, and C nodes), intersection approaches (intersection node and corresponding approaches identified by node number), and transit lines (defined as a sequence of stop and non-stop nodes).

Not all modeling software make the same assumptions. Some, for example, use the link as the primary reference, with turn movements, penalties, and intersection approaches all defined in terms of link-to-link relationships instead of node-to-node-to-node relationships. This, in turn, influences file formats, data contents, and other aspects of the highway network. In a platform-agnostic environment, it is not then possible to standardize the highway network in terms of specifying the proper formatting of network files and their associated files. Instead, FSUTMS NextGen will need to focus on guidelines concerning the appropriate network-related methodologies to be used in Florida. This could include which data types to include as attributes (number of lanes, area type, etc.) along with general naming conventions (recognizing that specific naming may be dependent on the software used for a specific model). For example, area types should be reexamined to determine how they are defined, whether to establish them on a quantitative basis such as by analyzing land use densities, or even if area types should be removed from FSUTMS altogether. Some other example considerations are as follows.

- Capacities are primarily calculated in FSUTMS by comparing a link’s facility type, area type, and number of lanes to a lookup table typically called SPDCAP. This method provides an easily maintained data structure (three attributes and a lookup table) that allows for some level of detail with respect to different roadway characteristics while not requiring that a large amount of data be kept for each link. An alternative method could be to use HCM-based equations to calculate link capacities. This results in being able to account for more precise impacts to capacities at the expense of requiring a larger number of attributes to be maintained (such as lane width or on-street parking).

- Current FSUTMS practice handles capacities at the link-level; however, many travel demand modeling software packages can handle some amount of intersection capacity using junction modeling. One of the benefits of using junction modeling is that there is greater consistency between the travel demand model turning characteristics and those used by traffic simulation models. The greatest hinderance to the use of junction modeling is the need to identify and maintain all of the characteristics for each intersection covered in the model. This can include control device, phasing, and cycle time among other characteristics for each signalized intersection. It might be possible to incorporate these in a central data framework such as the MDIS discussed later in this paper. It is also possible to develop a generalized junction methodology. The Ohio Department of Transportation uses junction modeling and has developed a set of tools based on a generalized methodology that takes assumptions about the network at the link-level and creates intersection data.

- A comprehensive statewide highway network database could be developed that would allow for a central source of transportation network data. This database could contain multiple levels of resolution that could account for statewide, regional, and local modeling needs. Consistency in network characteristics and attribute nomenclature would be crucial to this.

3.2 Traffic Analysis Zone Numbering

TAZ numbering practices in Florida have typically been constrained by modeling software requirements that enforced a 1+ zone numbering scheme. This numbering scheme required that all TAZs be numbered consecutively starting at 1. If there were gaps in the numbering sequence, then the software would create “empty” zones in the resulting model matrices. For example, if the first TAZ was numbered 1 and the next was numbered 1000, then the resulting matrices would contain a row and column containing the relevant data for TAZ 1, 998 rows and columns numbered 2 through 999 containing empty or dummy data, and then a row and column containing the relevant data for TAZ 1000. Besides causing confusion for someone attempting to analyze such a matrix, the resulting size of the matrix file would dramatically increase data storage requirements to accommodate a mostly empty matrix. This then creates a balancing act wherein the modeler needs to consider maintaining some number of empty or “dummy” zones to accommodate TAZ splits while simultaneously not creating an unnecessarily large matrix file.

This enforced 1+ number scheme would also limit the amount of data conveyed by the zone number itself. At best, the modeler could set aside zone ranges to associate with specific locations in the model such as counties. This then would require that the modeler document or recall these specific zone ranges. Other than the use of such ranges, a modeler would not be able to deduce any meaningful information from the zone number itself.

With the move away from a uniform software platform, models become more likely to use modeling software that does not enforce this 1+ numbering scheme. As a result, the dimensions of a matrix can be dictated by the total number of TAZs present in the model as opposed to being dictated by the highest zone number in the model. This also allows more flexibility in the numbers used to identify TAZs.

It would be possible to integrate the county FIPS code into the TAZ number so that the location of the TAZ is more readily identifiable. For example, TAZ 950001 could correspond to TAZ 1 in Orange County (FIPS 095) while TAZ 1170001 could correspond to TAZ 1 in Seminole County (FIPS 117). The TAZ numbering within each county of the same model could start at 1 because the presence of the county FIPS code would serve to distinguish these TAZs from each other. In cases where it would be necessary to include TAZs from outside of Florida, the numbering scheme could be expanded to include the state FIPS code as well.

Including the FIPS code into the TAZ numbering convention is just one example of how to number TAZs in the absence of a strict requirement to use a 1+ numbering scheme. A number of other schemes are possible as well, including using Census geography ID numbers, zip codes, or locally significant geographies such as planning districts. The important thing is that Florida's modeling community should not feel constrained by the traditional 1+ system if using software that does not enforce such a system.

3.3 Socioeconomic Data

Socioeconomic data for travel demand models are typically composed of two primary components: production-related and attraction-related. These two primary components are further broken down into categories appropriate for the trip generation methodologies used in a particular model. Florida has traditionally used population, households, auto ownership, and seasonal occupancy for production-related data. These are further broken down by single family and multi-family dwelling units and supplemented with data on hotel and motel units. Attraction-related data has typically been based on employment broken down into industrial, commercial, and service employment and supplemented with school enrollment data.

Over the years, as Florida models have become more sophisticated, certain models in the state introduced additional population and employment data breakdowns. These include lifestyle characteristics describing age and/or employment status of the population and distinguishing between manufacturing and other types of industrial employment. Most recently, the development and adoption of a number of activity-based models (ABM) in the state has resulted in the use of population synthesizers that rely on models to calculate the characteristics of individual households. These dramatically alter the data requirements for the model. The rise of ecommerce also has the potential to change the relationship of retail-based trips with households becoming both production and attraction with a warehouse origin and a home destination.

In such an environment with a wide array of trip generation methodologies, standardizing a full suite of socioeconomic data across the state is no longer viable. The socioeconomic data requirements can vary significantly from one model to the next. It is therefore necessary to focus any new guidance on socioeconomic data to certain key aggregate characteristics that can be universal between all of the models. This could make some aspects of reporting and analysis more comparable between models. At a minimum, this should include dwelling units, population, and total employment. These could then be further disaggregated into the subcategories required by each model or, as in the case of ABMs, used to derive the number of households.

3.4 Travel Behavior Data

Florida participated in the 2009 NHTS and despite its flaws this data set is the only dataset that provides detailed travel behavior information across the state. Efforts in District 4 and District 7 have been made to collect travel survey data since the 2009 NHTS and have been hampered by low response rates. The FSUTMS community should develop guidelines for travel behavior data collection. This can involve guidelines for integrating passive data with a small sample HTS. The passive data would provide the where and when about travel while the HTS would provide context to the travel with whom, why, and how travel happened. Guidelines should be developed for minimally acceptable standards for data collection. Furthermore, the benefits and challenges of using passive data sources to understand travel behavior should be explored.

4 Mobility Data Integration Space

The MDIS is an initiative of the Forecasting and Trends Office (FTO). Its purpose is to serve as an integrated data environment meant to bring together existing transportation data sources. These existing sources are currently siloed from one another, often residing with the separate programs and modal offices that generate and consume these data. This data integration is expected to facilitate data analysis and distribution by creating a central nexus where all these data come together and can be accessed by data generators and data consumers alike. The development of MDIS is ongoing and is expected to be concurrent with the development of FSUTMS NextGen. As such, it is not possible to give a comprehensive treatment of the potential interactions between the two in this white paper. What follows is a high-level overview of how MDIS and FSUTMS NextGen could interact.

Florida's travel demand models not only make use of a variety of datasets identified for incorporation into the MDIS, but the models also generate data that are intended to be brought into the MDIS. Examples of data used by the model intended to be housed within the MDIS include traffic counts, population, and employment. Examples of data generated by the models that can be brought into the MDIS include future year traffic and congestion. Depending on the structure and capabilities of each individual model, additional datasets can also be integrated into the MDIS.

To facilitate the interoperability of these data, at a minimum, a set of linking attributes that would allow database joining between FSUTMS datasets and other MDIS datasets would need to be established and maintained. These linking attributes would not need to be novel. Rather, they could already be attributes in use by one or more of the existing datasets. It would just be necessary that the FSUTMS datasets maintain the same attributes. Examples could include segment IDs, station IDs, Census geographic IDs, as well as others. This would allow for seamless passing of data between datasets. It would also be necessary to rectify the extents of the data so that they align between datasets. While it is not necessary that one highway link correspond to one roadway segment or that one TAZ correspond to one Census Block Group, it would be beneficial at a minimum that multiple links could be grouped into a single segment, or that multiple Census Blocks could be grouped into one TAZ.

Another consideration is the possibility of converting specific model data into universal data types like DBF or CSV formats that can be housed in a SQL database. By using universal data formats for model data that is being uploaded to or downloaded from the MDIS, it allows individuals who may not have access to the modeling software used to develop the model to still review the model data. It also makes it easier to share data between models as they would not be dependent on proprietary data formats.

5 Putting it All Together

FSUTMS NextGen is envisioned to be a guidance document that will inform the development and application of travel demand models in Florida. The previous sections of this white paper discussed some of the challenges to standardization facing FSUTMS NextGen as well as some of the new possibilities that are available to Florida models. Ultimately, the process of deciding which aspects of Florida modeling to standardized and how to develop those standards and guidelines will be undertaken by the MTF.

5.1 FSUTMS NextGen Working Group

An FSUTMS NextGen working group will oversee the development of FSUTMS NextGen. The use of a focused working group is intended to allow progress on developing the new guidelines and standards to be both efficient and effective. The working group should include individuals active in the MTF committees, and each of the committees should be represented on the working group. The specifics of who should be in the working group and how many people should be involved should be left to the MTF though some recommendations follow. Working group members should:

- Be active in MTF and have an interest in shaping FSUTMS NextGen.
- Have availability to attend working group meetings and review FSUTMS NextGen recommendations.
- Cover a range of FSUTMS experience including not only individuals with decades of experience but also those with only a few years of experience.

Supporting this working group will be a technical team working at the behest of the Department. The technical team will be made up of individuals with subject matter expertise in various aspects of travel demand modeling in general and FSUTMS in particular. The technical team members will be composed of Department staff and their contractors. This technical team will develop the technical recommendations for the FSUTMS working group to consider. The work of the technical team will include:

- Reviewing the most recent work related to FSUTMS that has been sponsored by the Department,
- Assessing the current state of the practice in Florida with a view toward understanding the various techniques recent models have used and how they differ from past practices,
- Identifying new/emerging practices and resources that could enhance FSUTMS, and
- Present findings and make recommendations to the working group.

The working group is expected to meet three times over the course of the following year. At these meetings, the working group members are expected to provide feedback and direction to the technical team concerning the development of FSUTMS NextGen. It is expected that the technical team will provide working group members with materials to review in advance of each meeting. The topics of each meeting are expected to be:

- Meeting 1 – Overall Structure and Framework of FSUTMS NextGen
- Meeting 2 – Prioritized Methods, Data, and Other Standards
- Meeting 3 – Proposed Guidelines and Standards for Full MTF Consideration

The working group members are expected to come to the meetings prepared to discuss the topics covered in each meeting and provide feedback and direction to the technical team. At the end of this process, the technical team will present the proposed FSUTMS NextGen to the full MTF for consideration. In addition to the working group consisting of MTF committee members, the MTF itself will be regularly updated on the progress of FSUTMS NextGen during each MTF committee meeting. This will keep the MTF up to date throughout the process so that final consideration of FSUTMS NextGen at the next full MTF (expected to be in 2023) can be made in an informed manner.

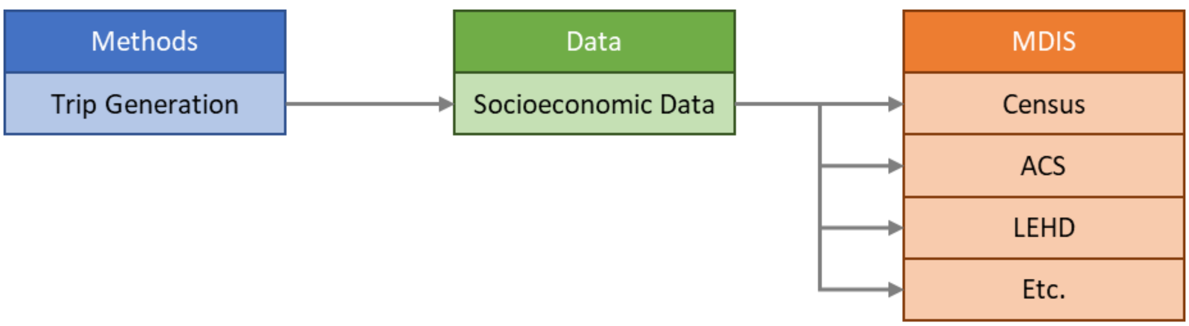
5.2 Documenting FSUTMS NextGen

FSUTMS NextGen is expected to have three principal elements as shown in **Figure 5-1**.

Figure 5-1. Elements of FSUTMS NextGen Document

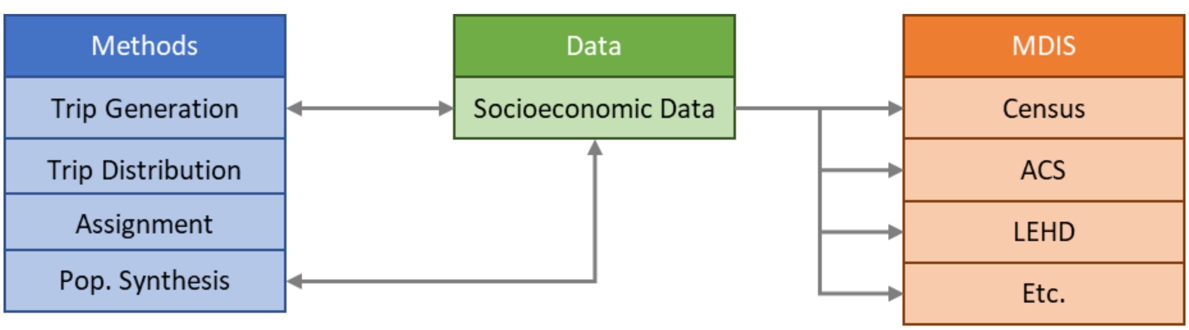
These three elements are meant to be cross-referenced with each other such that a discussion in a particular method should be able to lead the modeler to a discussion on associated data needs. This in turn should lead the modeler to a discussion on accessing the relevant data from the MDIS element. **Figure 5-2** shows an example of this for trip generation.

Figure 5-2. FSUTMS NextGen Document Linkages Example for Trip Generation



This cross-referencing should not be seen as flowing only one way. For example, when looking at the discussion on socioeconomic data from the data element, the user may then be referenced back to other methods that may use the socioeconomic data, such as population synthesis for ABMs as shown in **Figure 5-3**. This approach would be similar for other methods and their associated data needs.

Figure 5-3. FSUTMS NextGen Document Linkages with Interrelatedness Example for Trip Generation and Population Synthesis



The interrelatedness of these components for FSUTMS NextGen make a traditional static document problematic. A hard copy printout would prove cumbersome and would unnecessarily complicate the process of navigating the elements of FSUTMS NextGen. To address this concern, FSUTMS NextGen should be documented in an interactive digital format. Already, Florida models such as SERPM 8 and CFRPM 7 are being documented in this way. By documenting FSUTMS NextGen as a wiki (or similar structure) it allows for easy navigation for the user. Links to associated FSUTMS NextGen methods, data guidelines, and MDIS references can all be embedded within the relevant articles in the document. Furthermore, documenting FSUTMS NextGen in this way will make it easy to expand and amend as needed. FSUTMS NextGen could then be an integrated part of the FSUTMSOnline.net portal.