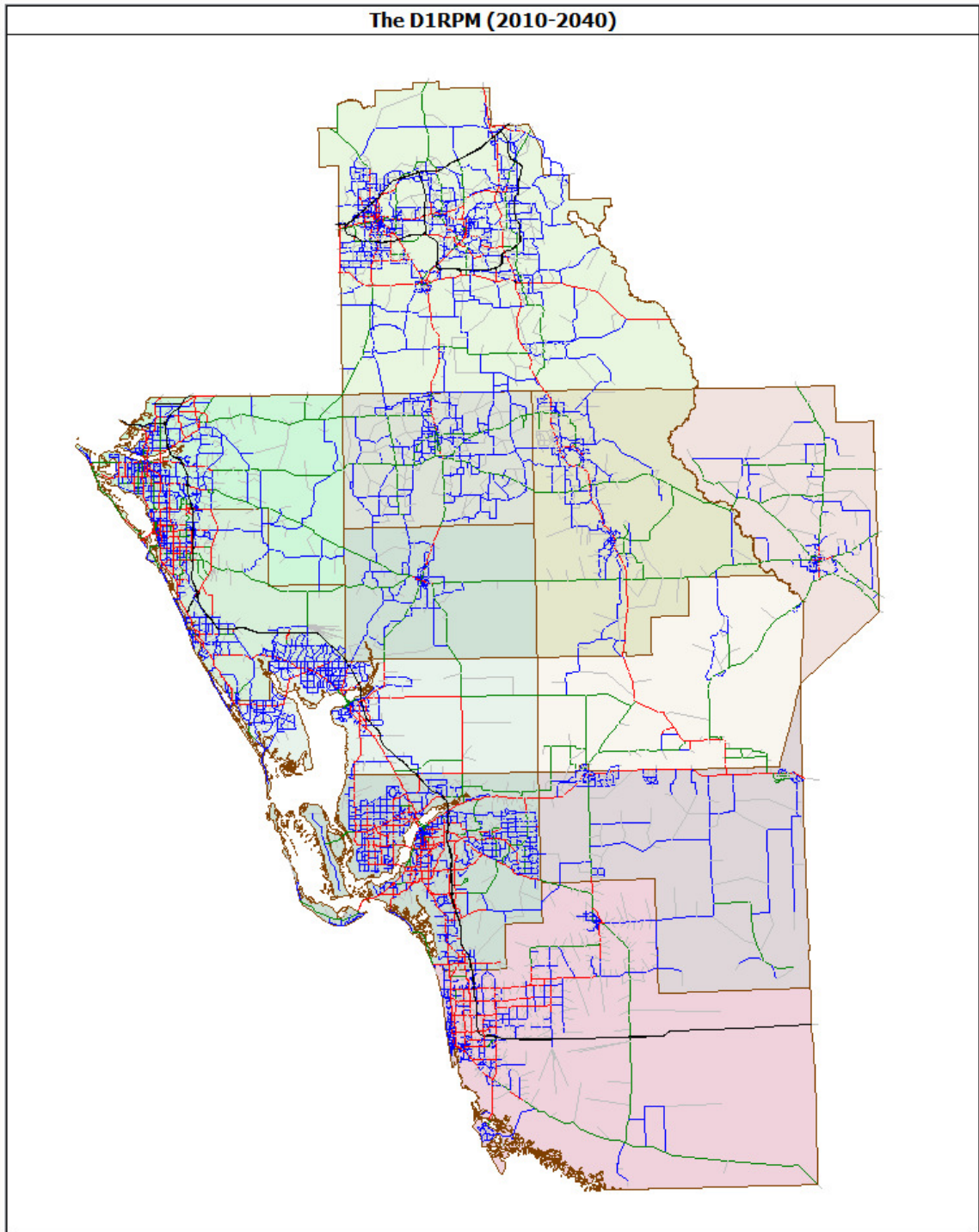


TM-1 District One Regional Model (2010-2040)

Executive Summary

February 2016



This report: “*TM-1 Introduction to the DIRPM and Validation Report*” provides an overall reviews of the model and contains summary statistics for the validation year of 2010. Companion reports, “*TM-2 Introduction to the DIRPM and Validation Report*” discusses the model's development, and contains mode detailed statistics for the validation year of 2010; and, “*TM-3 DIRPM Technical Resource Guide*” gives technical users / model developers with a more detailed review of certain critical steps (and associated scripts) within the model and discusses mode choice theory and application. These reports are included in the model's \documentation folder..

OVERVIEW

The District One Regional Planning Model (DIRPM), shown on the cover of this report, is one of the larger models in the state of Florida. With 5,628 traffic analysis zones (TAZ) covering 12,400 square miles in a 12 county area, it represents the travel characteristics of a population of approximately 4.1 million. And, since all of District One is now represented in one model, it is now possible to forecast *regional* highway and transit alternatives. This is also the first time one model has been used, simultaneously, by all Metropolitan Planning Organizations in District One for their Long Range Transportation Plans (LRTP).

The DIRPM is a ‘traditional’ Florida Standard Urban Transportation Structure (FSUTMS) four-step, trip-based model that has been updated with many of the recommendations provided by the FDOT Transit Model Update project. Sponsored by FDOT Systems Planning, in 2012: “The purpose of the Transit Modeling Update project is to specify, within FSUTMS and associated support systems, the changes necessary to improve the preparation of transit demand forecasts to a point consistent with federal expectations, and to incorporate state of the practice techniques and tools through a prototype model application.”¹

TMU model included:

- New (Florida) trip generation rates from 2010 from ACS, NHTS and Census.
- New trip purposes split trips into 40 “travel markets”.
- Diurnal factors split highway assignment into four time periods (AM, MD, PM, NT).
- A travel time feedback loop allows congested speeds from highway assignment to be utilized in trip distribution.
- New CUBE processes to replace the AUTOCON program -- requiring the use of CUBE 6.1, but eliminating the need to customize CUBE resource files.

There are also features included in the DIRPM that are not in the TMU model:

- A procedure for generating and distributing vehicle trips at Southwest Florida International Airport, previously incorporated into the Lee/Collier model, is also used for the Sarasota-Bradenton Airport (SRQ).
- The DIRPM incorporates heavy-truck trip matrix from the Florida Statewide Model (FLSWM). This model, contains procedures for estimating tons of goods movement by water, rail, highway and air to/from Florida from the U.S. (and around the world) providing origins and destinations for truck trips within the DIRPM area.
- A procedure for addressing unemployment and correcting for under-estimation of vehicle trips in future years. Florida's unemployment rate (10.9 percent in 2010) was much higher than Florida's historical long-term unemployment rate of about 5 percent, and the downturn in the economy did result in fewer vehicle trips in 2010 (with no corresponding decrease in employment in InfoUSA database).

Development of the model was achieved within the CUBE/Voyager transportation planning environment, version 6.1.1 CUBE is a Windows based program, so the DIRPM is run via a graphical user interface (GUI) whereby a mouse-click or a function key, activates a “pop up” menu from which the user chooses options to run the model. CUBE programs and features are documented in the CUBE/Voyager help system and on-line classes are available at FDOT's internet site: www.fsutmsonline.com.

¹ *Trip Generation Review and Recommended Model Development Guidance, Parsons Corp, May, 2012.*

DATA DEVELOPMENT FOR THE D1RPM

Traffic Count Data

The validation of any travel demand model relies upon the existence of traffic count data for the base year. The volume-to-count ratio generated by the model is a measure used to evaluate the ability of the travel demand model to simulate known traffic conditions. Traffic counts for a variety of different roadway categories are distributed throughout the study area in order to validate highway assignment performance among screen-lines and along roadway corridors. The FSUTMS standard is for the model to assign trips to the highway network for peak-season weekday average daily traffic (PSWADT). Count sources included are: The 2007 Florida Traffic Information CD from FDOT, County MPOs (for non-state roads) and The Florida Turnpike Enterprise for toll roads.

Additionally, peak hour counts on the FDOT traffic count CD for 2010 were matched to 1,266 links on the 2010 network and summarized by period: "AM" (6AM-9AM), "MD" (9AM-3PM), "PM" (3PM-6PM) and "NT" (remainder) to guide the adjustment of diurnal factors by time period and by trip type (auto, truck, heavy truck). Additional peak hours counts, however, would be needed to be able to confidently validate each of the four peak periods in the model.

Screen-lines and Corridor Volumes

Screen-lines were drawn across a model network to measure travel flows, as an aggregate volume between sub-areas within the model. Key corridors were also identified among all of the U.S, State and County (numbered roads) within the model.

The graphic, below, shows deviation from the expected standard. Note that the D1RPM exceeded performance expectations for all categories of roadways.

2010 Volume-over-Count Performance:				
Facility		Acceptable	Preferable	D1RPM
Freeway Volume-over-Count	±	6%	± 5%	± 0%
Arterial Volume-over-Count	±	10%	± 7%	± 2%
Collector Volume-over-Count	±	15%	± 10%	± 1%
Frontage Rd Volume-over-Count	±	20%	± 15%	± 3%

Source:

Presentation to the FDOT Model Task Force, "Model Calibration Standards", CSI, December, 2007
D1RPM 2010 model, "Summary_D1.pm", December 2015

External Trips

Development of the model also required that automobile and truck trip volumes be assigned to roadways that exit the study area at "external stations" (shown as red dots, to the right). There are special considerations that are taken into account at these locations. Obviously, for 2010 traffic count data were used to establish external station volumes at these locations.

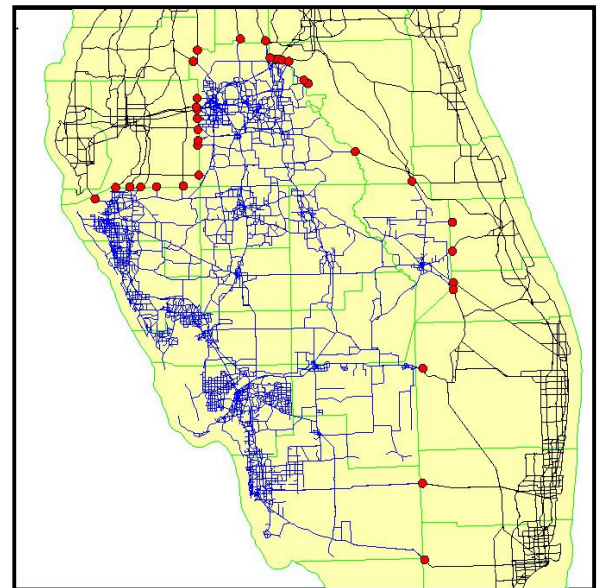
For the future year, however, the D1RPM must be coordinated with the adjacent FDOT district models. Loaded model networks from the latest adopted (YR2040) models for FDOT Districts 4, 5 and 7 were provided for this purpose. Total vehicle trips were identified for: drive-alone and shared-ride auto, as well as for light, medium and heavy trucks.

These data were presented to each of the MPO's in The District, for discussion and to determine if these volumes agree with expectations of development for their area.

Special consideration was given to:

Internal-to-External vehicle trips to attractions near the model area:

- NE Polk County, where approximately 20% of the home-based trips are attracted to Orange County's Theme-Parks.
- Manatee County, where HBW trips are attracted towards Pinellas and Hillsborough County.
- Trips from Rural Areas head East, towards the Florida Coast on SR 70, US 98 and US 27.



Additionally, discussion and agreement was provided on the status of other type of "external station" trip: through-trips. Special consideration was given to:

External-to-External or "through trips" along the following corridors:

- I-4 east-to-west vehicle trips (autos and trucks),
- I-275-to-I-75 vehicle trips (autos and trucks),
- I-75 north-to-south truck trips from Tampa to Miami.

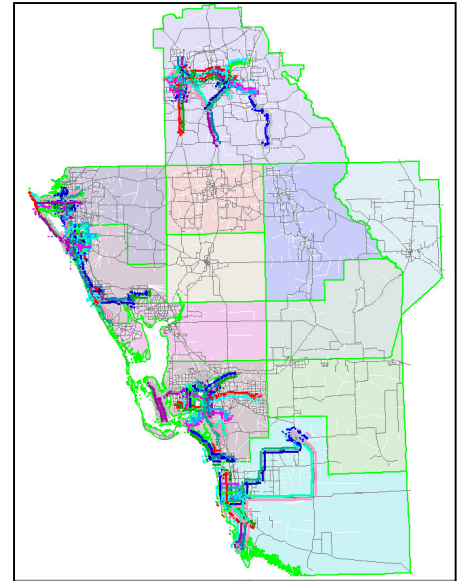
It was concluded that "external-stations" traffic volumes would grow at a rate of 3% per year, slightly higher than socioeconomic growth within the D1RPM model area. Exceptions were for higher growth were allowed on SR60, and roadways serving NE Polk county in the vicinity of I-4 east.

Transit Routes

For 2010 the "TROUTE_10A.LIN" contained a total of 183 directional, line-haul bus-transit routes (inbound and outbound) for seven transit service providers.

Each transit system provided monthly or/and annual ridership and revenue reports from which daily boarding's and average fare were calculated.

These data were used to calibrate the Mode Choice sub-model within the D1RPM. Ridership estimates are indicated in the graphic:



Socioeconomic Data Development

Household data from the 2010 US Census was supplemented with ACS 5 year household surveys and converted into geographic points for (GIS) for processing. Employment data, obtained from FDOT and InfoUSA were similarly processed:

- The D1RPM, traffic analysis zones (TAZ) were created from an aggregation of the nine previous FSUTMS models in The District. TAZ were carefully adjusted to match census block and tract boundaries, resulting in a model with 5,628 internal zones for which data must be prepared.
- Socioeconomic data from all sources were aggregated to the new D1RPM model's TAZ and tabulations prepared.
- Data were adjusted to match BEBR (medium) totals.

A summary of the data is shown in the following graphic:

2010 Socioeconomic Data							
Census	(grphome)	Population	Employment	Hotels	Schools	University	
				2010	2010	2010	
159,978	3,172	156,798	Charlotte	64,776	2,075	26,412	1,220
321,520	4,546	315,030	Collier	173,832	8,007	73,130	12,220
34,862	3,794	33,915	DeSoto	13,504	120	6,770	260
12,884	3,097	12,637	Glades	4,561	10	3,200	40
27,731	377	26,753	Hardee	11,260	135	7,060	80
39,140	2,026	37,229	Hendry	18,698	250	12,890	380
98,786	222	95,046	Highlands	38,093	1,040	18,960	12,280
618,754	8,328	606,332	Lee	285,831	12,380	85,526	17,988
322,833	3,154	319,923	Manatee	154,595	3,193	57,330	34,100
39,996	0	34,959	Okeechobee	14,102	415	8,520	200
602,095	12,261	586,882	Polk	256,795	5,684	97,395	31,008
379,448	7,041	374,086	Sarasota	213,156	4,845	55,452	12,311
2,658,027	48,018	2,599,590	District 1	1,249,203	27,457	321,883	107,887

Note: residents of group homes (nursing homes and correctional facilities) are not expected to generate traffic volumes.

2010 MODEL PERFORMANCE

Trip Generation

The trip generation model, was developed for the TMU project² uses a combination of techniques to estimate the number of trips bound to, or destined from, each Traffic Analysis Zone. The process factors seasonal and permanent populations by the appropriate trip generation rate, which is determined by a cross-classification lookup table of trip rates, using the number of occupied dwelling units and auto ownership in each market segment.

A trip's purpose is important in determining trip length during the trip distribution module. For example, people generally do not travel as far on a shopping trip as they would commuting to work. Trip purpose also plays a significant part during the mode choice module. When estimating transit use, the propensity to use public transit and carpools is higher for work trips than for other trip purposes. When converting person-trips to vehicle-trips in the mode choice module, average vehicle occupancies differ by trip purpose. For example, people commonly drive alone to work although they rarely drive alone to the beach or other recreational activities. In the traffic assignment module, trip purpose has been used in some specialized models to help time-of-day travel estimates. Analysis for toll roads and high-occupancy vehicle facilities often focuses on work trips, which predominate during peak hours.

2010 Statistic:			
Trip Purpose	Low	High	D1RPM
% HBW	12	24	18
% HBSH	10	20	13
% HBSR	9	12	11
% HBSC	5	8	5
% HBO	14	28	16
% HBNW	45	60	49
% NHB	20	33	24

Source:

"Model Calibration Standards", CSI, December, 2007

Trip Distribution

Trip distribution relies on a "Gravity Model" to distribute trips. All trips starting in a TAZ are attracted to all other TAZ, proportional to the number of attractions and inversely proportional to the distance. Friction factors control the probability of making a certain trip length, for a certain trip purpose. For instance, going to work is relatively insensitive to how long the trip is while shopping depends much more on travel time in selecting possible destinations. These factors are developed based on observed trip lengths for the local population and come from Census and survey data.

As shown in the graphic, calibration of the Trip Distribution yielded average trip lengths that compare favorably with household travel time surveys.

2010 Statistic:			
Avg Trip Length	Low	High	D1RPM
% HBW	12	35	14
% HBSH	9	19	13
% HBSR	11	19	15
% HBSC	7	16	10
% HBO	8	20	13
% NHB	6	19	12
% IE	26	58	42

Source:

"Model Calibration Standards", CSI, December, 2007

The TRANSITMODEL

The "TRANSITMODEL" developed by AECOM for FDOT in 2008³ was retained by the TMU project and is retained in the D1RPM. It consists of four parts: a *Transit Prep module*, which links transit routes to the model's highway network; a *Transit Path module*, which generates zone-to-zone travel times and costs; a *Mode Choice module*, which is a multi-path/single-period "nested-logit" sub-model, and a *Transit Assignment module*. Most of the effort in validating the transit accessibility and path building focused on ensuring that the transit network accurately reflected base year conditions. Calibration of Mode Choice insures that auto occupancy rates, by trip purpose compare favorably to household travel time surveys, and, estimated transit system ridership is accurate.

2010 Transit Services:				
Service Area	Operator	Transit Service	Actual	Estimate
Lakeland	1	Citrus Connection	4,367	4,361
Winter Haven	2	WHAT	860	1,308
Polk County	3	PCTS	544	357
Collier County	4	CAT	3,498	3,331
Lee County	5	LeeTran	11,696	8,355
Charlotte County	6	CCTS		
Manatee County	7	MCAT	4,147	6,240
Sarasota County	8	SCAT	9,011	7,770
total			34,123	31,720

Highway Assignment

The purpose of highway assignment models is to load auto trips onto the highway network. This results in traffic estimates on individual links to simulate general vehicular travel throughout the study area. Validation of the highway assignment involved the adjustment of the speeds, capacities, penalties and other parameters related to travel time.

² "Task 06, Transit Modeling Update, Technical Memorandum 1, Trip Generation Review and Recommended Model Development Guidance, Florida Standard Urban Travel Model System, May 2011"

³ Please refer to the "FSUTMS Transit Model Application Guide, AECOMM, 2008".

Diurnal Factors split into four time-of-day (TOD) matrices - "AM" (6am-9am), "MD" (9am-3 pm), "PM" (3pm-7pm) and "NT". These are loaded onto the highway network by means of an iterative equilibrium highway load program based on an all or nothing capacity restrained assignment, which determines *route choice* for Origin-Destination pairs. A *feedback loop* is utilized, whereby, congested speeds from the initial highway assignment are fed back into the next trip "distribution-transitmodel-highway assignment" processes (minimizing differences in congested speed between trip distribution and assignment). Convergence criteria were compared until the differences in travel time and travel distance were minimized.

This graphic of assignment statistics indicates that the D1RPM has exceeded expectations of model performance for all categories of roadways measured.

2010 Volume-over-Count Performance:						
Facility		Acceptable		Preferable		D1RPM
Freeway Volume-over-Count	±	7%	±	6%	±	0%
Arterial Volume-over-Count	±	15%	±	10%	±	2%
Collector Volume-over-Count	±	25%	±	20%	±	1%
Frontage Road Volume-over-Count	±	25%	±	25%	±	3%
Freeway Peak Volume-over-Count	±	20%	±	10%	±	7%
Major Arterial Peak Volume-over-Count	±	30%	±	15%	±	24%
Assigned VMT-over-Count Areawide	±	5%	±	2%	±	1%
Assigned VHT-over-Count Areawide	±	5%	±	2%	±	0%
Assigned VMT-over-Count by FT/AT/NL	±	25%	±	15%	±	1%
Assigned VHT-over-Count by FT/AT/NL	±	25%	±	15%	±	0%

Source:
 Presentation to the FDOT Model Task Force, "Model Calibration Standards", CSI, December, 2007
 D1RPM 2010 model, "Summary_D1.ppt", December 2015

This graphic of assignment statistics indicates that the D1RPM has exceeded expectations of model performance for all categories of RMSE measured.

2010 Root Mean Squared Error			
Facility	Acceptable	Preferable	D1RPM
RMSE – LT 5,000 AADT	150%	45%	69%
RMSE – 5,000-9,999 AADT	45%	35%	38%
RMSE – 10,000-14,999 AADT	35%	27%	25%
RMSE – 15,000-19,999 AADT	35%	25%	20%
RMSE – 20,000-29,999 AADT	27%	15%	16%
RMSE – 30,000-49,999 AADT	25%	15%	13%
RMSE – 50,000-59,999 AADT	20%	10%	10%
RMSE – 60,000+ AADT	19%	10%	2%
RMSE Areawide	45%	35%	34%

Source:
 Presentation to the FDOT Model Task Force, "Model Calibration Standards", CSI, December, 2007
 D1RPM 2010 model, "Summary_D1.ppt", December 2015

CONCLUSION

A review of the D1RPM model's performance, compared to model calibration standards had determined that the 2010 model's socioeconomic data and travel demand forecast is within expected ranges and suitable for use in forecast year models used for the development of Long Range Transportation Plans.