Final Report

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Project: A pragmatic multi-objective planning approach for medium and long range projects

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EXECUTIVE SUMMARY

The proposed research is motivated by the need to develop practical approaches that can be employed to conduct periodic planning forecast evaluations for medium to large projects. The research has been completed in two tasks. In the first task, we summarize an exhaustive review of transportation and urban planning studies that conducted project planning forecasts. In the second task, based on the literature review, the research team has compiled the data sources encompassing various dimensions that are useful for conducting periodic project evaluation. The different data sources identified have been compiled for three major projects in the District 5 region - I-4 Ultimate project, SunRail and Wekiva Parkway.

With respect to literature review, a total of thirty research studies were selected and reviewed by the research team. A comprehensive summary of each study is provided in the report, by presenting the study region, dimension that is being analyzed (such as traffic forecast and ridership forecast), conceptual methods adopted in the study, information on whether the project used any before after comparison, whether calibration factors were considered, and different categories of exogenous variables used in the forecasting process. In terms of data collection, we have assembled variables from five broad categories including: demographics, economic and policy conditions, transportation infrastructure attributes, emerging trends in transportation and weather factors. Moreover, the research team has also incorporated the effect of external factors such as COVID19 in the current analysis as these factors might affect transportation demand substantially. The data is compiled for the three-research projects over a 5 year period (whenever possible) starting from the existing planning forecast study year.

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CHAPTER 1: BACKGROUND

1.1 Introduction

Florida, currently the 3rd most populous state in the US, is experiencing population growth that is twice the national average since 2000 (FDOT, Office of Policy Planning Trends 2016). In fact, from 2011 to 2015 the population of Florida increased by 1 million and is expected to increase by 7.4 million by 2045. The Central Florida region is no exception. From 2010-2017, the population in Orange County, Osceola County, Lake County and Seminole county increased by 17.4%, 30.5%, 16.2% and 9.4% respectively. At the same time, Florida is a major tourist destination for domestic and overseas visitors. Since 2011, the number of tourists visiting Florida has consistently increased from about 87 million to about 118 million – a remarkable increase of about 35% (Visit Florida Research, 2018). Of these visitors, nearly 70 million are destined to the Central Florida region annually.

The two trends - growing population and increasing visitors – contribute to increasing traffic volumes on roadways. Florida Department of Transportation (FDOT) is considering investments in multi-modal projects to alleviate the burden of the growing traffic on Central Florida facilities. These projects include major infrastructure projects such as the I-4 Ultimate corridor, Wekiva Parkway, the I-95 Widening and SunRail Commuter rail project. Given the nature and scope of these projects under consideration, the timeline from project conceptualization to project completion could potentially take several years. Traditionally, a planning analysis of the impact and viability of the project is typically conducted in the conceptualization phase. Given the project timeline, it is possible that the planning analysis is not reflective of the conditions at the time of the project completion. For instance, I4-Ultimate project is scheduled to be in the construction phase for 6 years (2015-2021). The planning exercise was conducted even earlier. The vicinity of the project location would have undergone substantial change over the years and thus, the planning forecasts made prior to 2015 might not be readily applicable. Thus, any changes in the vicinity of the region and their ramifications cannot be incorporated into either modifying or updating project design and/or construction process.

1.2 Research Context

The proposed research is motivated by the need to develop practical approaches that can be employed to conduct periodic planning forecast evaluations for medium to large projects. The proposed framework will focus on providing District 5 and other local agencies easy to run planning forecast modules to conduct a periodic update, review and revise planning forecasts for various projects. The framework relied on considering the updated socio-demographic and socio-economic characteristics (such as population composition, employment status, migration), economic and policy conditions (such as employment, GDP, housing conditions), transportation infrastructure attributes (such as transportation facilities, traffic signal plans, vehicle fleet composition, mode preferences, and travel characteristics), emerging trends in transportation (such as Mobility as a service, autonomous cars, shared economy) and weather factors (such as extreme weather events and their impact). The research team identified three major projects in District 5 for the current analysis including: I-4 Ultimate project, SunRail and Wekiva Parkway. The research team illustrated how the various data had changed for the project under consideration every 5 years over the project horizon in response to changes in the vicinity of the project with time.

1.3 Project Tasks

The research is geared towards developing practical framework to conduct periodic planning forecast evaluations for medium to large projects. The research is envisioned to be completed in two tasks. The specific details of the two tasks are described below:

1.3.1 Task 1: Literature Review

This task was focused on conducting an exhaustive review of transportation and urban planning studies that generated project planning forecasts. The review examined how socio-demographic and socio-economic characteristics, economic and policy conditions, transportation infrastructure attributes, emerging trends in transportation and weather factors were considered in the planning forecast process and the associated computational burden. Finally, the team examined if prior research developed planning forecasts after project completion and compared to the pre-construction evaluation.

1.3.2 Task 2: Data Collection

In this task, based on the literature review, the research team compiled the data sources from the various dimensions - socio-demographic and socio-economic characteristics, economic and policy conditions, transportation infrastructure attributes, emerging trends in transportation and weather factors – that are useful for conducting periodic project evaluation. The different data sources identified were compiled for three major projects in the District 5 region including: I4 Ultimate project, Wekiva Parkway and SunRail.

1.4 Report Organization

The rest of the report is organized as follows: Chapter 2 provides a detailed summary of earlier literature that conducted project planning forecasts. A description about the projects identified for the current analysis is provided in Chapter 3. Chapter 4 summarizes the data collection and data preparation procedures. Chapter 5 provides a discussion of the data compilation results for a subset of the data compilation conducted. Finally, Chapter 6 concludes the report.

CHAPTER 2: SUMMARY OF REVIEWED LITERATURE

In this section, we review studies that generated transportation planning forecasts for various transportation projects and investments. The proposed review focused on identifying and documenting the various indicators employed in earlier work. The effort also identifies studies that proposed and employed forecasting approaches that are less resource intensive. These identified studies will provide a foundation for the research team's approach of developing a pragmatic framework for transportation forecasting in the short to medium term.

2.1 Earlier Literature on Projects with Planning Forecast

As the reader would be aware, different projects are aimed at modifying/improving/developing different components of the transportation system. In our review, we examined different projects on roadway infrastructure, transit facility and combination of multiple infrastructures (see Figure 2.1). For the ease of presentation, the studies are further categorized along sub-streams based on the type of the infrastructure. Roadway projects together with bridge and tunnel projects' are considered in the roadway infrastructure section while rail projects are considered in the transit facility section. In the multiple infrastructure group, studies considering more than one type of transportation components such as rail, bridges and tunnels were discussed.

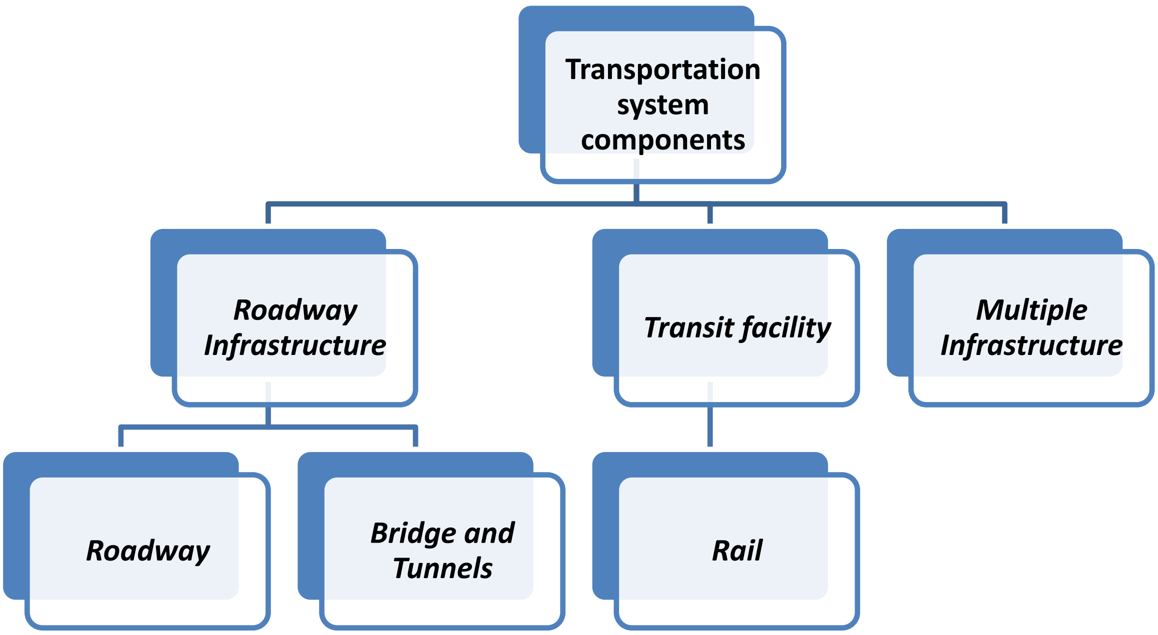


Figure 2.1: Transportation System Components Chosen for Review

To offer an easy to review of earlier research, a concise summary on project planning forecast studies is presented in tabular format in the following sections. The tables provide information on the study region, the dimension that is being analyzed (such as traffic forecast, ridership forecast), conceptual methods adopted in the study, information on whether the project conducted any before after comparison, whether the study adopted a calibration factor; and different categories of exogenous variables considered in the forecasting process.

2.1.1 Roadway Infrastructure Projects

From our review, we have found that there is vast empirical literature on the effects of improved accessibility brought about by new or improved roadway infrastructure (such as roads, bridges and tunnels). Table 2.1 lists the studies that we reviewed in this category.

Several observations can be made from the Table 2.1. First, among roadway facility types considered, the most commonly investigated projects to estimate forecast are interstate highway projects. Examples include District 5 part of I-4 interstate (FDOT, 2000), I-95 interstate (VDOT, 2007 for lane extension and FDOT, 2019b for Indian River-Florida/Georgia state line connection), I-70 (CDOT, 2010) and I-10 from I-295 to I-95 (FDOT, 2017b). A small number of studies explored state and county roads (URS, 2009, FDOT, 2003, 2015, Lasley et al. 2017), and road intersections (Volkert, inc., 2015, Neel, Schaffer, 2009). Second, the main performance measure considered in this class of analysis is traffic forecasts. Other measures employed include congestion cost (Lasley et al., 2017) and changes to land use (Conway et al., 2017). Third, the most commonly adopted frameworks in the planning studies presented in table 2.1 include sketch planning tool, travel demand models including the four step model, regression model, Group ordered logit model, linear regression, and linear interpolation. Fourth, the literature review explored if before-after comparison of performance measures was undertaken. The review summary indicates that that most of the studies do not perform any before-after comparison. The lack of before-after studies can be attributed to the resource intensive nature of the forecast process. Fifth, among earlier studies, only a few studies used calibration factor in their project (FDOT, 2000, 2003). Finally, a number of independent variables are considered in the planning forecast process including socio-demographic and socio-economic characteristics (such as population composition, employment status, migration), economic and policy conditions (such as employment, GDP, housing conditions), transportation infrastructure attributes (such as transportation facilities, traffic signal plans, vehicle fleet composition, mode preferences, and travel characteristics), and emerging trends in transportation (such as Mobility as a service, autonomous cars, shared economy).

Table 2.1 Literature on Roadway Infrastructure

Study	Study Region (Infrastructure Analyzed)	Dimensions Analyzed	Methodology	Before-After Study	Use of Calibration factor	Factors Considered			
						Socio Demographic	*Economic and Policy*	*Transportation Infrastructure*	*Emerging Factors*
Roadway Infrastructure									
FDOT, 2000	Orange and Seminole Counties, District 5, Florida (I-4 Interstate Highway)	Traffic forecast	OUTAS model	No	Yes	--	--	√	--
FDOT, 2003	Hernando County, District 7, Florida (Cobb Road (CR 485) / US 98 PD&E)	Traffic forecast	Travel demand model	No	Yes	--	--	√	--
URS, 2009	US 36 (Denver)	Traffic Forecasts	Travel demand model	No	No	--	--	√	--
Neel-Schaffer, Inc., 2009	Road Infrastructure (Lake County, Florida)	Traffic Forecasts	Travel demand model	No	No	--	--	√	--
CDOT, 2010	I-70 Mountain Corridor	Traffic Forecasts	Travel demand model	No	No	√	--	--	--
FDOT, 2015	US 301 (GALL BOULEVARD) FROM SR 56 TO SR 39 (PASCO COUNTY, FLORIDA)	Traffic Forecasts	Linear Interpolation	No	No	--	--	√	--
Volkert, Inc., 2015	Intersection (Pinellas County, Florida)	Traffic Forecasts	Regression model	No	No	√	--	--	--
Conway et al., 2017	Randstadt, Netherlands (Transit and land-use accessibility)	Transit and land use forecast	Interactive Sketch Planning	No	No	--	√	√	--

Lasley et al., 2017	Texas (highway)	Congestion benefits	Sketch planning tool	No	No	--	√	√	--
VDOT, 2017	I-95 Express Lane Extension	Traffic Forecasts	Linear Interpolation	No	No	--	--	√	--
FDOT, 2017a	I-10 (SR 8) from I-295 to I-95 widening (Duval County, District - 2)	Traffic Forecasts	Travel demand model	No	No	--	--	√	--
FDOT, 2019a	Tampa Interstate	Traffic Forecasts	CORSIM (CORridor SIMulation)	No	No	--	--	√	--
FDOT, 2019b	I-95 (From the Indian River / Brevard County Line to the Florida / Georgia State Line)	Traffic Forecasts	Travel demand model	No	No	--	--	√	--
Bridge and Tunnels									
Skamris and Flyvbjerg, 1997	Denmark	Traffic Forecasts	Before-after study	Yes	No	--	√	√	--
Flyvbjerg, 2008	Denmark, France, Germany, Sweden, and the U.K (Edinburgh Tram and other projects)	Traffic Forecasts	Reference class forecasting	No	No	--	√	--	√
FDOT, 2017b	US 98/John Singletary Bridge	Traffic Forecasts	Linear Interpolation	No	No	--	--	√	--

2.1.2 Transit Infrastructure Projects

We examined various rail transit projects in our review. Rail transit systems considered comprised of heavy rail, commuter rail, rapid/high speed rail, metro/subway, and/or light rail. Table 2.2 provides a summary of the studies we reviewed in this category. Several observations can be made from the Table 2.2. First, all the reviewed studies analyzed ridership or traffic volume for the forecasting purpose in the planning period. Second, a majority of the studies in literature focus on light rail transit (Upchurch and Kuby, 2014; Duggal, 2016; Arndt et al., 2009; ST, 2010; UTA, 2002). Third, several frameworks were adopted in the planning studies including sketch planning tool, regional travel demand model including the four step model, and regression model. Fourth, for transit studies, before-after comparison in the planning period has been performed for two of the reviewed studies (Arndt et al., 2009; UTA, 2002). Fifth, of the transit studies, only one study (Kaplan et al., 2003) employed calibration factors. Finally, in terms of independent variables, the most commonly used variables include socio-demographic and socio-economic characteristics (such as population composition, employment status) and transportation infrastructure attributes (such as distance to CBD, presence of stations, transportation facilities, parking spaces and travel characteristics).

2.1.3 Multiple Infrastructure Projects

In contrast to roadway and transit infrastructure only, it was surprising to find that only a handful of studies have investigated forecasting for multiple infrastructure projects. Table 2.3 lists the studies that we reviewed in this regard. The following observations can be made from these tables.

First, one research effort examined both rail and roadway projects like bridge, tunnel and freeways and accuracy analysis was used to analyze ridership forecasting in the planning period (Flyvbjerg et al, 2005) while other studies investigated multiple roadway projects for cost analysis (Van Wee, 2007; Cantarelli et al., 2012). Second, in this stream of studies we did not find any study conducting before after analysis or using calibration factors. Finally, accuracy and statistical analysis are the preferred methods to analyze traffic demand and cost.

Table 2.2 Literature on Transit Projects

Study	Study Region (Infrastructure Analyzed)	Dimensions Analyzed	Methodology	Before-After Study	Use of Calibration factor	Factors Considered			
						Socio Demographic	*Economic and Policy*	*Transportation Infrastructure*	*Emerging Factors*
Rail Projects									
Rice, 1970	San Luis Obispo, California (Urban rail)	Ridership forecast	Sketch planning tool	No	No	√	--	√	--
Quade, 1996	Multiple US regions	Ridership forecast	Sketch planning tool	No	No	√	--	√	--
UTA, 2002	Utah (Light rail)	Ridership forecast	Before-after study	Yes	No	√	--	√	--
Kaplan et al., 2003	St. Clair County, Illinois (Metrolink)	Ridership forecast	Travel demand model	No	Yes	√	√	--	--
Lane et al., 2006	17 US region: Chicago, New Jersey etc. (Commuter and light rail)	Ridership forecast	Sketch planning tool	No	No	√	√	√	--
Boyle, 2006	North America (transit and rail)	Ridership forecast	Four step model, regression analysis	No	No	√	√	√	--
Flyvbjerg, 2007	North America, Europe, Other developing nations: Japan (urban rail)	Traffic forecast	Accuracy analysis	No	No	--	√	√	√
Arndt et al., 2009	Texas (Light rail)	Ridership forecast	Sketch planning tool	Yes	No	--	√	√	--

ST, 2010	Seattle, WA (Light rail)	Ridership forecast	Sketch planning tool	No	No	√	--	√	--
Upchurch and Kuby, 2014	Phoenix (Light rail)	Ridership forecast	Sketch planning tool	No	No	√	√	√	--
Duggal, 2016	Edmonton city, Canada (Light rail)	Ridership forecast	Sketch planning tool	No	No	√	--	√	--

Table 2.3 Literature on Multiple Infrastructure Projects

Study	**Study Region (Infrastructure Analyzed)**	**Dimensions Analyzed**	**Methodology**	**Before-After Study**	**Use of Calibration factor**	**Factors Considered**			
						Socio Demographic	*Economic and Policy*	*Transportation Infrastructure*	*Emerging Factors*
Rail Projects									
Flyvbjerg et al., 2005	Multiple Countries including Brazil, Egypt, India, Mexico, Sweden, U.K., and U.S. (Rail, bridge, tunnel, freeways)	Traffic Forecasts	Accuracy Analysis	No	No	√	√	√	--
Van Wee, 2007	North America, Europe, Other developing nations: Japan (Large infrastructure)	Cost and Demand forecast	Accuracy analysis	No	No	--	√	√	--
Cantarelli et al., 2012	Netherlands (Large scale road, tunnel and rail projects)	Cost	Statistical analysis	No	No	--	√	--	--

2.2 Research Methods of Interest

Given our research motivation, we provide a concise summary of the commonly used methods in transportation planning studies in this section. As several studies reviewed employed the same approach for analysis, we focus our attention on the most common methods illustrated through appropriate case studies. Specifically, we focus on two methods: (1) Travel demand model approach and (2) sketch planning model approach.

2.2.1 Travel Demand Model

The most common approach employed for transportation planning project forecasts involves the adoption of a regional travel demand model. Typically, the travel demand model employed is the four step model. For our review, we select two relevant research studies examining the impact of various infrastructure in the Central Florida region.

The first study conducted by Florida DOT (FDOT, 2000) applied The Orlando Urban Area Transportation Study (OUATS) 2020 model to forecast traffic for I-4 section of District 5 (Orange county to Volusia county via Seminole county). The geographic area covered by the OUTAS model are Orlando Urban Area (i.e., Orange, Osceola and Seminole counties) along with the western portion of the Volusia County, Lake county network and northeastern portion of the Polk County network (see Figure 2.2).The model chain of OUTAS model is shown in Figure 2.2. As is evident, the model is an adapted four step model framework. Traffic volume data from 1996 was obtained from the FDOT traffic count program that were used to demonstrate project development in terms of traffic network improvements. In terms of traffic variables, the study considered traffic characteristics data e.g. peak hour design volumes derived from existing volumes and Traffic counts (historical and existing traffic volumes on roadway segments) with or without turning movement counts (intersections). Traffic operational performance were also computed to demonstrate forecast year network performance for the existing freeway, intersections and ramps.

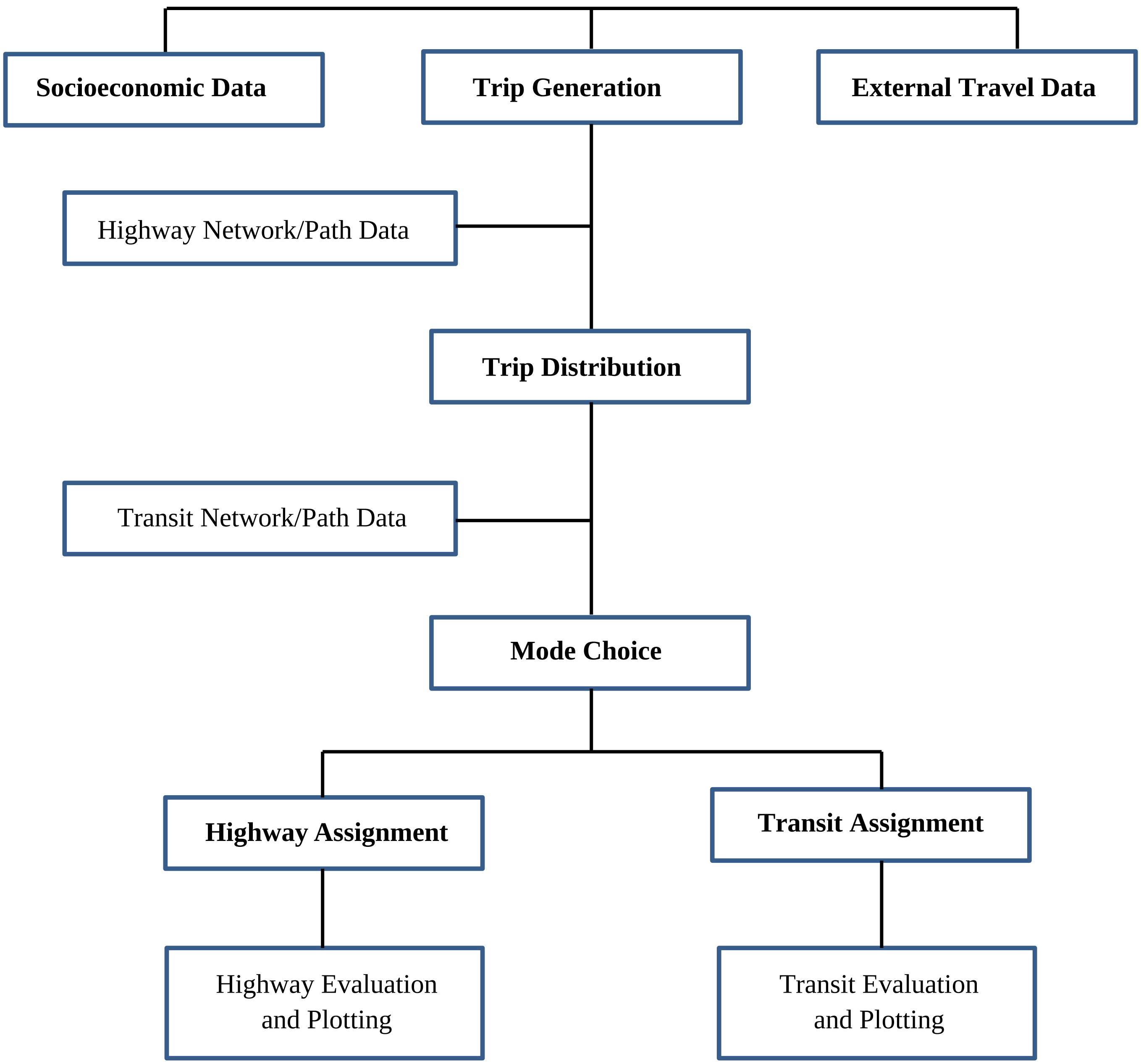


Figure 2.2: Model Chain of OUTAS Model[1]

In the research effort by Eluru et al., 2018, a slight variant of the four step trip-based approach is employed to study the benefits of investments on public transit and non-motorized transportation in the Central Florida region. With growing emphasis in Florida's urban regions on non-auto mobility – public transit, pedestrian, and bicyclist modes – it is useful to develop methods that accommodate the potential adoption of non-auto modes within the mobility planning process.

[1] Technical Report 8: Model Development and Application Guidelines (https://metroplanorlando.org/wp-content/uploads/2040-LRTP-TR8-Model-Validation-Guidelines.pdf)

Toward this end, the research effort employed an existing regional model framework to study multi-modal mobility. The study effort provided frameworks to estimate transit and non-motorized mode demand and identify policies to alleviate auto-related travel burden while enhancing non-auto mobility. The component of public transit ridership evaluation of the research effort is mainly focused on the coverage area of Lynx and SunRail network systems for the greater Orlando area. For developing different models and measures for the project, the research team has considered 2010 as the base year. With respect to transit ridership analysis, the study estimate and present four different sets of ridership models: for Lynx network system – (1) stop level average weekday boarding bus ridership analysis, and (2) stop level average weekday alighting bus ridership analysis; finally, for SunRail network system – (3) daily boarding rail ridership analysis, and (4) daily alighting rail ridership analysis. Lynx ridership models were estimated by using grouped ordered logit model framework while SunRail ridership models were estimated by using linear regression based approach. For the empirical analysis, A number of explanatory variables are considered including: temporal and seasonal variables, transportation infrastructure, land use variables, sociodemographic variables, and weather variables.

2.2.2 Sketch Planning Tool

Traditional four step model, as discussed above, is one of the most commonly used methods to estimate and forecast traffic and evaluate project feasibility. However, this method is resource and time intensive. To address this shortcoming, several researchers have proposed sketch planning models that are less resource intensive. Interestingly, we can observe from the literature that the use of such planning tool is more common for transit infrastructure projects compared to other projects (roadway and multiple infrastructure). For our review, we select relevant research studies adopting the sketch planning tool in forecasting the ridership in transit infrastructure projects. TCRP report 16 (Quade, 1996) developed a national level sketch ridership model to predict the number of boardings for light and commuter rail. Building on this study, Lane et al., 2006 incorporated the reverse commute trips and relevant transportation system variables to forecast the light and commuter rail ridership in 17 US regions. The authors developed regression based multivariate sketch planning models for both modes as the light rail mode worked best for densely populated areas whereas commuter rail mode worked well on regions with a concentrated downtown with larger industrial and office areas.

The study by Upchurch and Kuby, 2014 applied a sketch planning tool based on the light rail ridership data for 268 stations in nine US cities. The developed framework was employed to demonstrate whether the implementation of light rail opened in December 2008 would succeed or not in Phoenix. The study adopted a station level regression based sketch planning tool to predict boardings before and after the construction period. In terms of independent variables, the study considered station specific variable including population and employment; intermodal access variables including park and ride spaces, bus lines; and transportation infrastructure variables including transfer station, network structure, average travel time and finally, climate factors including average monthly heating and cooling degree days. Finally, the study compared its prediction with the actual boarding data and found that the model over predicts ridership at two downtown stations and under predicts ridership at two terminal stations. The study concludes that number of sports centers, universities, bus lines and temporal inconsistencies appear to be the significant factors behind the discrepancies between the prediction and actual boarding.

CHAPTER 3: PROJECT DESCRIPTION

3.1 Introduction

Based on the literature review, the research team has compiled the data sources encompassing various dimensions including- socio-demographic and socio-economic characteristics, economic and policy conditions, transportation infrastructure attributes, emerging trends in transportation and weather factors – that are useful for conducting periodic project evaluation. The different data sources identified have been compiled for three major projects in the District 5 region - I-4 Ultimate project, SunRail and Wekiva Parkway (see Figure 3.1). A brief discussion of each of these three transportation investments is provided in the current chapter.

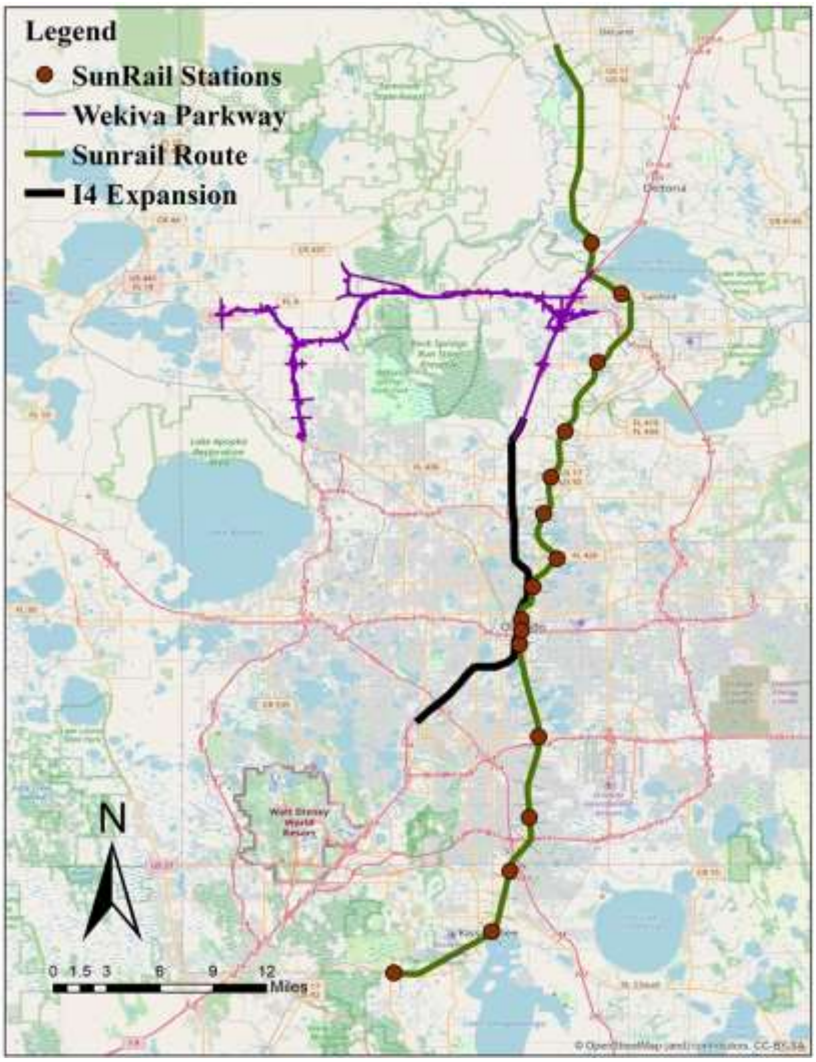


Figure 3.1: Major Transportation Investment Projects
(I-4 Ultimate Expansion, SunRail, and Wekiva Parkway) in Central Florida Region

3.2 I-4 Ultimate Expansion

Expansion of the Interstate 4 (I-4 Ultimate) (see Figure 3.1) is one of the largest and most ambitious interstate road construction projects in Florida transportation history. This long-awaited project involves improving, expanding and reconstructing the 54-year-old "Orlando Expressway", and is termed as I-4 Ultimate. The 21-mile long expansion (west of Kirkman Road in Orange County to east of State Road 434 in Seminole County), started in February 2015 and is expected to be completed by 2021 with four dynamically tolled express lanes. The construction plan is divided into 4 stretches of 4-6 miles each: attractions (5.7 miles), downtown Orlando (4.2 miles), Ivanhoe (4.9 miles), and Altamonte (6.4 miles). The Attraction stretch starts at west of Kirkman road in Orange County while the Altamonte stretch ends east of State Road 434.

The interstate renovation will be further extended in the future in both north and south bound directions. The southbound extension is proposed to be 21.2 miles long from Kirkman Road to US 27 in Polk County and the express lanes are proposed to be extended further north from State Road 434 to State Road 472 (19 miles). The project will have substantial short and long-term economic impact in the regions that the interstate will pass through. It will make transportation more efficient - improving regional productivity and mobility, improved traveling experience for tourists visiting Orlando attractions, positively impacting local economies, and enhancing freight movement.

3.3 SunRail

SunRail is the commuter rail system for the Central Florida region inaugurated in Spring 2014 with 12 stations in three counties (City of Orlando, Volusia, Seminole, and Orange). The first phase of SunRail is 32 miles long connecting DeBary road of Volusia County to Sand Lake road of Orange County. In the second phase, the service was planned to expand both in north and south directions with 5 additional stations. The proposed north segment is 12 miles long with one station while the south segment is 17.2 miles long with 4 stations. The construction of phase-2 stations in the south started in 2016 and these stations became operational in 2018. All of the phase-1 (already opened) and phase-2 SunRail stations are shown in Figure 3.1.

3.4 Wekiva Parkway

In early 2015, the Central Florida Expressway Authority (CFX) began construction of the $1.6 billion Wekiva Parkway project to complete the Central Florida beltway while protecting the natural resources around the Wekiva river. The parkway is proposed to be 25 miles long toll road starting from State Road 429 (Daniel Webster Western Beltway) and State Road 414 (John Land Apopka Expressway) interchange at US 441 in Apopka, going to north and eastern part of the State Road 46 alignment in east Lake County and a portion of Seminole County, before connecting State Road 417 and I-4 in Sanford in the south. In addition to the construction of the toll road, widening the State road 46 (from west of US 441 in Mount Dora to east of Round Lake Road and in Sanford from west of Center Road to International Parkway) is also included in the project.

The project consisting of five parkway sections is envisioned to be completed in multiple phases. Among these phases, the first two phases are completed and opened to travelers. The remaining phases are expected to be completed by the year 2022. In the first phase, State road 429 was extended by 5 miles from the connector road near US 441 to an interchange near Kelly Park road. This phase was open to the traffic on July 2017. The second phase of the project was open to the traffic on March, 2018 which includes the following: a multi-level interchange extending the expressway northwest from Ondich Road to the Lake County line; a new extension from the interchange to County Road 435, and extension of the expressway from Orange and Lake county to a loop interchange at State Road 46.

The project will have substantial short and long-term economic impact in the regions that the parkway will pass through. Besides completing the Central Florida beltway, it is expected to reduce the traffic congestion on State Road 46, US 441 and other area roads resulting from increasing traffic between Orange, Lake and Seminole Counties. Further, the parkway might improve traffic safety by mitigating vehicular crashes, particularly on State Road 46.

CHAPTER 4: DATA COMPILATION AND PREPARATION

4.1 Introduction

In terms of data collection, we have assembled variables from five broad categories that are useful for conducting periodic project evaluation including: demographics, economic and policy conditions, transportation infrastructure attributes, emerging trends in transportation and weather factors. These variables are collected from publicly accessible data sources such as U.S. Census Bureau, American Community Survey (ACS), Regional Integrated Transportation Information System (RITIS), LYNX system (https://www.golynx.com/lynxmap/DataDownload/index.htm); FDOT Roadway Characteristics Inventory, Florida Department of Revenue (FDOR), Florida Automated Weather Network (FAWN) and Florida Geographic Data Library (FDGL). In addition, the research team have also compiled uber travel time data at a census tract level and traffic analysis zone resolution available for Orlando region from 2016 (https://movement.uber.com). The research team employ the travel time data as a supplemental measure of how travel times change over time. The data is compiled for the three-research projects mentioned above over a 5 year period starting from the existing planning forecast study development year. Figure 4.1 provides a brief overview of the various factors likely to impact future transportation planning efforts. Further, the research team has also incorporated the effect of external or uncontrollable factors affecting the transportation system by considering the influence of Corona Virus Diseases 2019 (COVID-19). A discussion on the data compilation and preparation process for each variable group are discussed in the subsequent sections of this chapter. Finally, a table added in the appendix (Table A.1) provides details of the complete set of data the research team has compiled that is relevant for the project analysis.

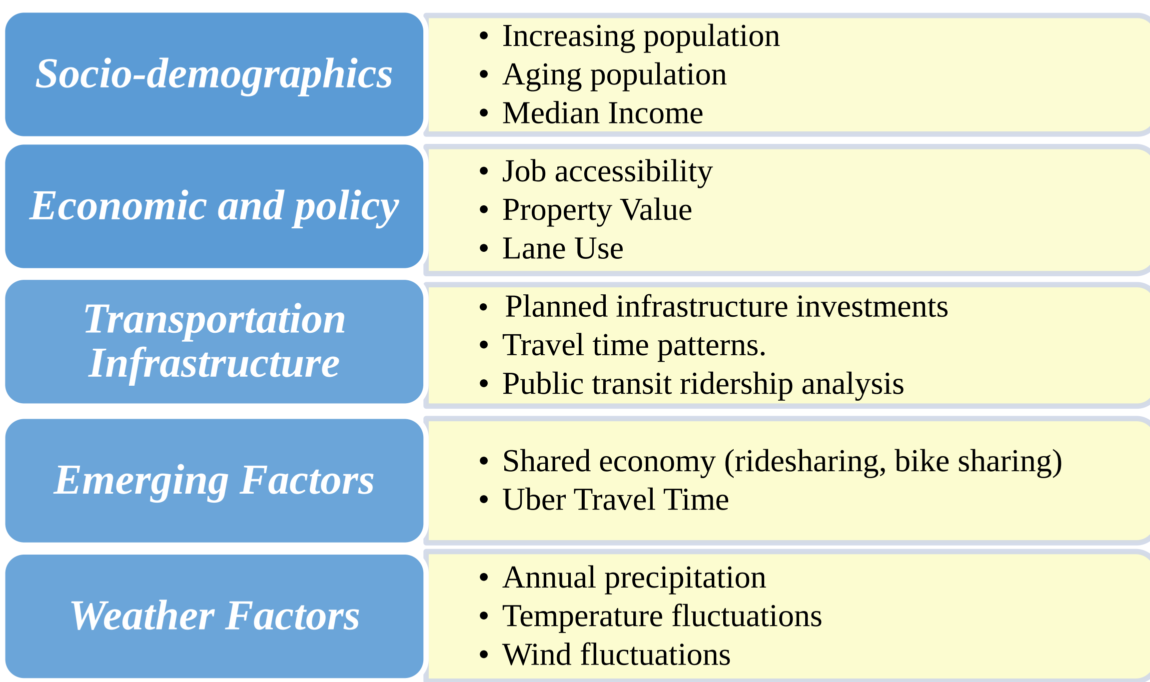


Figure 4.1: Various Factors Affecting Future Transportation Planning Efforts

4.2 Variables Considered

4.2.1 Demographics

We collect demographic information for the chosen investment projects from American Community Survey (ACS) for both 2012 and 2017 using the census level data. The data includes information on total population, number of people by gender, age, race, income, household density and number of households by different vehicle ownership. These data were merged with the Central Florida census tract shapefile using the unique ID created by concatenating county and census tract IDs.

We identify the census tracts that the infrastructure passes through for each of the three projects (I-4 Ultimate, SunRail, Wekiva Parkway). For these selected census tracts, we calculate several measures including age distribution by gender and income distribution. For example, we first compute how many census tracts I-4 ultimate project passes through. In the current research effort, we find that I-4 Ultimate project pass through 30 (SunRail-51; Wekiva Parkway-16) census tracts. Then, total number male and female by different age group including age<15, 15-24, 25-34, 35-44, 45-54, 55-64 and senior people (>65 years old) are aggregated for those census tracts. Finally, we calculate the share for each age group for both male and female by taking the ratio of the above numbers with the total number of male and female. In addition, we compute the median income for those census tracts. We performed similar analysis for all the three projects over the 5 year interval (2012-2017).

4.2.2 Economic and Policy Variables

For the economic and policy related variables, we identify two measures: property value and job accessibility. We will discuss these measures in the following sections.

4.2.2.1 Property Value by Land Use Type

To capture the change in property value, parcel data (for 2012-2017) obtained from Florida Department of Revenue (FDOR) were utilized. Each parcel is assigned a unique ID (Parcel ID) linking it with equivalent parcel level attribute information such as property/feature value, land value, land area in square feet, land use codes (DOR-UC), owner name, owner address, physical address, physical zip code, building details and so on contained in the Name-Address-Legal (NAL) file. The transportation infrastructure projects considered in our research passes through five counties: Orange, Osceola, Seminole, Lake and Volusia. Hence, we prepared the property data layer by merging the parcel data information for these five counties. Please note that Just Value (land just value, building value, and special feature value) of a property includes: present cash value; use; location; quantity or size; cost; replacement value of improvements; condition; income from property; and net proceeds if the property is sold. The net proceeds equal the value of the property minus 15% of the true market value. This accounts for the cost of selling the property. In calculating the change in property values, we consider Just Value reported by DOR as a surrogate measure for direct property value and in the following sections, we will refer to this value as the property value for simplicity. Our preliminary analysis showed that the property value for the majority of the parcels in Volusia and Osceola counties are less than or equal to $50,000/acre. As expected, the largest variation in property values is observed for Orange and Seminole counties.

We wanted to investigate the property value change across different land use types because the impact of transportation projects may have differential impact on different property types. For example, retail/office space values might be more affected than the residential property values. DOR reports in excess of 100 land use types. For our analysis purpose, we consolidated the land use categories reported by DOR into 12 land use categories. These are Single Family Residential, Multi-Family Residential, Retail/Office, Industrial/Manufacturing, Agriculture, Institutional/Infrastructure, Public, Recreational, Water, Vacant, and Others. We found that land use is more heterogeneous in Seminole County and the western part of Orange County. Higher percentage of residential and commercial parcels are also observed in these two counties. On the other hand, land usage pattern is more homogenous in Osceola County – agricultural and industrial being the most predominant land use type.

Several data preparation steps are followed to calculate the property value along each project (I-4 Ultimate, SunRail, Wekiva Parkway). First, we identify the influence area for each project. For our current research, we assume that a one-mile buffer area around a project is the influence area of that particular project for property value impact computation. As a result, a 1-mile buffer was created around the site. The parcels within the influence area (1-mile buffer) labeled as case parcels and the property value evaluation was carried out for these parcels only. Second, we assigned each case parcels to a particular segment of each project by estimating straight line distance from each parcel to the nearest roadway stretch using proximity tool from ArcGIS. The parcel nearest to the stretch was assigned to that particular stretch. Third, for these case parcels, we computed property value by six land use types identified above. Finally, we compute the average property value per acre for every land use type. We employed this procedure for both 2012 and 2017 to capture the property value variation across the 5-year interval for all the three projects identified in Section 1.

4.2.2.2 Accessibility to Employment

Job accessibility can be defined as number of jobs accessible from a desirable point. To capture the change in number of jobs accessible around the chosen investment projects, the employment (number of workers in the labor force) data for the years 2012-2016 was drawn from American Community Survey (ACS). This data contains information on total employment of individuals aged 20 through 64 years. These data were merged with the Florida census tract shapefile using the unique ID created by concatenating county and census tract IDs. For our analysis we observed that within the state of Florida. the highest concentration of number of employed persons are in the Central Florida region.

In this study, job accessibility was computed using jobs accessible within a particular driving distance. Several travel time values are potentially used in literature to identify job accessibility (Fan et al., 2012, Manaugh et al., 2010) In our study, we used 10 minutes' drive time from our origin of interest as the appropriate threshold. The driving distance was computed using weekday peak period (8am on Tuesday). Street network of Florida has been used to draw driving area for both driving time and driving distance. 2012-2016 street network of 'NAVSTREET' data was used. To estimate driving time, we need speed limit of the corresponding street. We define a fixed speed for a street from variable called 'Speed Category'. Conversion of speed from defined speed limit range is shown in Table 4.1. Travel time (in minutes) needed to travel the corresponding street was estimated by using equation, T = (L/V) *60 where T is travel time needed to travel the total length of street in minutes, L is total length in miles and V is speed in mph (as mentioned in Table 4.1).

Table 4.1 Speed Definition

Speed Category	Definition (MPH)	Speed, V (MPH)
1	Above 80	80
2	65-80	70
3	55-64	60
4	41-54	50
5	31-40	40
6	21-30	30
7	6-20	20
8	Below 6	6

The data preparation steps for each project are as follows: First, 10 minutes driving area has been selected from each stretch (segment of I-4 Ultimate/ Wekiva Parkway or SunRail station) from street network of Florida by using network analyst tools in GIS. Census tracts within first 10 minutes driving network area were selected. For SunRail, we compute the driving area for each station which is presented in Figure 4.2. However, for I-4 Ultimate and Wekiva Parkway, we created midpoint for stretches to create a car driving area around it. Second, each census tract of the driving area zone was assigned to the nearest stretch. Then total number of jobs for those census tracts was accumulated for each stretch. Note that, we want to capture all possible jobs that are accessible from each stretch, so it is possible that we counted the same job in multiple stretches.

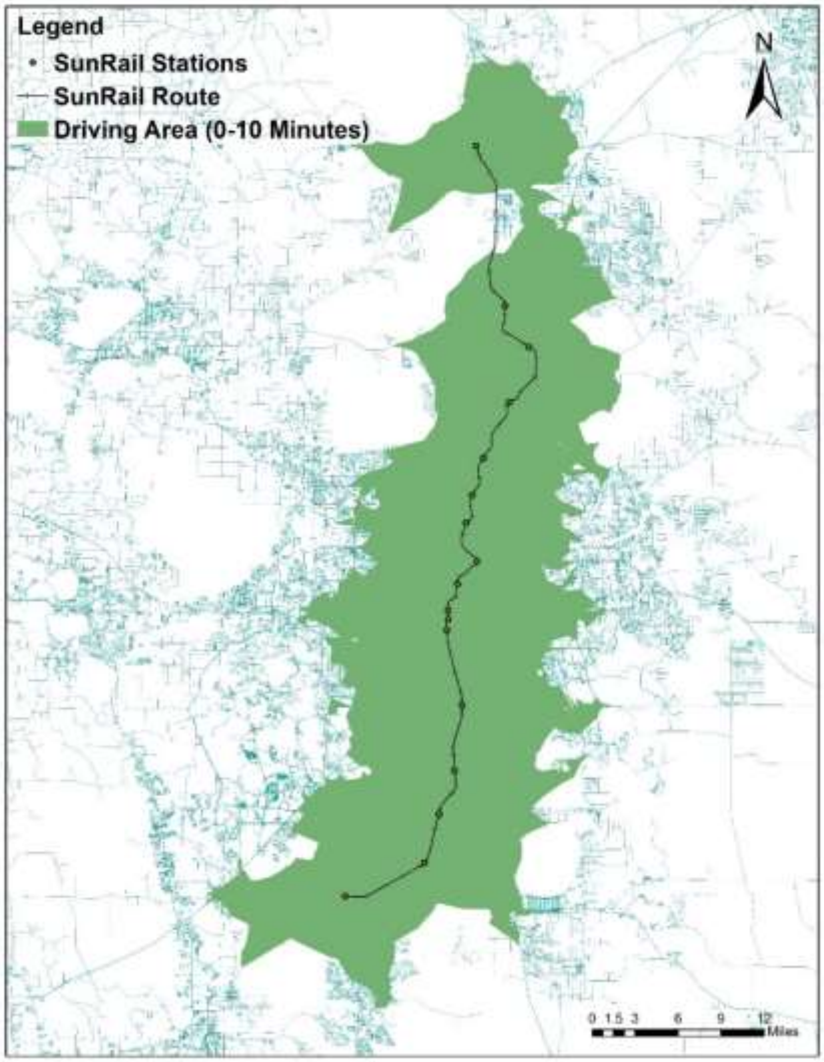


Figure 4.2: Driving Area Around SunRail Stations

4.2.3 Transportation Infrastructure Attributes

In terms of the transportation infrastructure attributes, we collect information regarding the road inventory as well as the travel time patterns and ridership data around the chosen investment projects. The road inventory data are obtained from the Florida Department of Transportation (FDOT). Roadway attributes considered include number of intersections, number of traffic signals, average annual daily traffic, speed limit, number of lanes etc.

On the other hand, to capture the travel time patterns across the years, we collect Here travel time data. Here travel time data is compiled from Regional Integrated Transportation Information System (RITIS) for the year 2014 and 2019. The RITIS database is an automated data sharing system which includes real time data feeds. The dataset provides information on average vehicular speed as well as the average travel time at different time periods including minute, hourly level, daily basis and annually. As the database includes the travel time information from September 2013, we select 2014 and 2019 as the 5-year interval for our analysis.

For identifying public transit demand, public transit ridership (for bus) data is also collected and documented. The component of public transit ridership evaluation of the research effort is mainly focused on the coverage area of Lynx network systems. Lynx is a public bus system that is operated in the city of Orlando with the connection between Orange, Seminole, and Osceola counties along with limited service in Polk County. The bus transit system serves approximately 2,500 square miles with a population more than 1.8 million. The system has several services, including fixed route Bus, LYMMO, Xpress Bus, Vanpool, FastLink, Access Lynx, NeighborLink and Knight Lynx. Among these services, fixed route bus provides service seven days a week including holidays. In our current research effort, the bus ridership analysis is focused on only fixed route bus service systems. As of January 2020, there are total 4,353 active LYNX bus stops in total five counties: Orange (3,272 stops); Seminole (502 stops); Osceola (513 stops); Lake (6 stops) and Polk (60 stops).

4.2.4 Emerging Factors

4.2.4.1 Uber Travel Time

Ride hailing has undergone a rapid transformation in the recent decades in response to the transformative technological changes including smart mobile availability, ease of hailing a ride using mobile applications, integration of seamless payment systems and real-time driver and user reviews. In fact, the convenience offered by transport networking companies (TNC) such as Uber, Lyft, and Via has allowed for a tremendous growth in ride hailing demand.

The TNC travel patterns and associated data can provide a snapshot of travel times in the urban region. For this purpose, average travel time data in minutes for census tract level for central Florida region was extracted from Uber Movement data (https://movement.uber.com/). To evaluate the travel time, the census tract closest to the beginning and end of the particular transportation infrastructure was considered as the origin and destination respectively. We estimated average travel time required to traverse I-4, from one end of I-4 (close to Census Tract 148.12) to the end (close to Census Tract 215.05) (See Figure 4.3) was considered as an origin-destination.

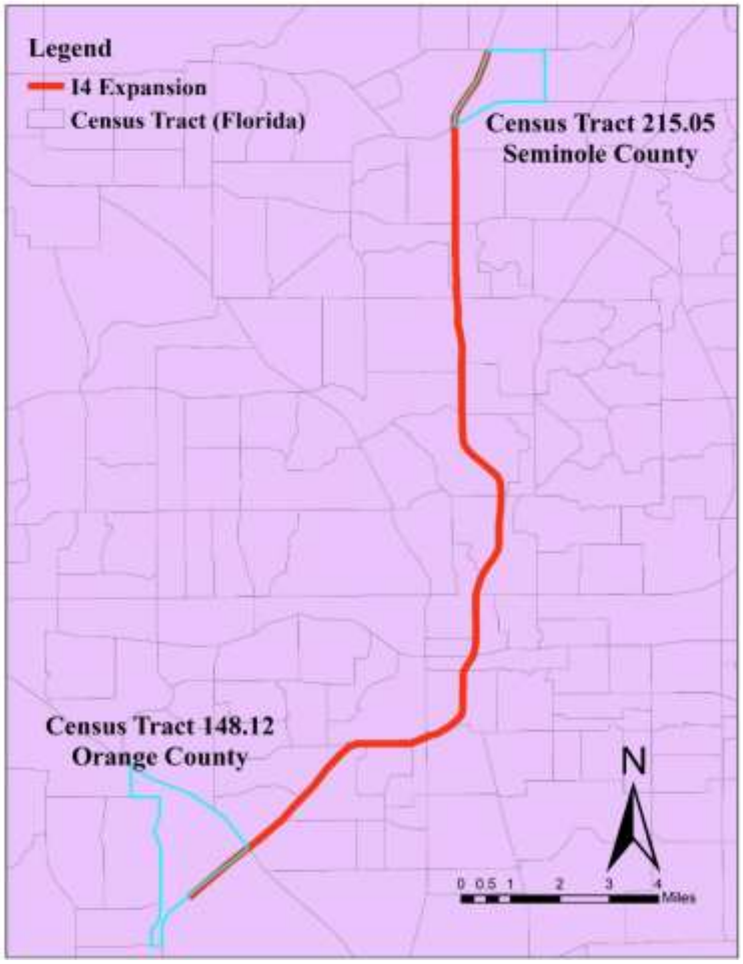


Figure 4.3: O-D Selection for Uber Travel Time

4.2.5 <u>Weather Data</u>

For the current research effort, we also collect information about the temporal attributes for the chosen infrastructures including I-4 Ultimate, SunRail and Wekiva Parkway. Information about the temporal attributes are collected from Florida Automated Weather Network (FAWN). The dataset includes total 44 weather stations where each station provides information on temperature, average precipitation, wind speed, relative humidity and dew point temperature at an hourly level. Using the ARCGIS proximity tool, we identify the closest weather station for every infrastructure project (I-4 Ultimate, SunRail and Wekiva Parkway). Once the station is identified, we compute average temperature (^{0}C) and maximum wind speed (mph) over 12 month period. We repeated the same process for both 2014 and 2019 just so we can observe if and how the weather changed overtime around the chosen infrastructures.

4.2.6 External Factors

In addition to the five categories of variables mentioned above, the research team also incorporated the impact of external factors, such as COVID-19 on transportation demand forecasts. Because of the pandemic guidance provided by local, state and federal agencies, a majority of the population are staying at home affecting overall transportation demand adversely. This is a perfect example how an external factor can have a substantial impact on transportation demand. To illustrate the effect of COVID-19, we have calculated the hourly travel times along the three projects for the entire day for the 2nd Tuesday of April 2019 and 2020; and compared the resulting travel time patterns.

CHAPTER 5: FINDINGS

In this chapter, we provide a discussion of the data compilation results for a subset of the data compilation conducted. We analyzed the trend of all the variables mentioned in the previous chapter for all the three identified projects, but for the sake of brevity in presentation, we limit ourselves to presenting a subset of variables for some projects.

5.1 Demographics

The research team identified the census tracts through which the various projects pass through. For these census tracts, by project, we computed the share of demographic characteristics for 2012 and 2017. The characteristics considered include gender and age distribution, and income distribution. Figure 5.1 represents the summary of gender and age distribution over the 5 year period for the three identified projects while the income trend is presented in Figure 5.2. From Figure 5.1, we can clearly see the similarities in demographics along all the three infrastructure projects. For example, we find a higher percentage of male group relative to female group for both 2012 and 2017 around all the three projects. This gender difference reflects the lower preference of woman residing around these three infrastructure projects. One interesting thing to notice is that, over the 5 year period, irrespective of the gender, number of young residents reduces around all the three projects while the percentage of senior residents increased drastically, particularly along the Wekiva Parkway corridor. In 2017, around two fifth of the residents belong to the senior age cohort along the Wekiva Parkway corridor which is almost a 5% increase from 2012.

In terms of the median income, we observed similar trend along all the three projects over the 5 year interval (Figure 5.2). As expected, median income increased from 2012 to 2017 around all the three infrastructure projects. Across the three projects, we observed that median income is higher for the Wekiva Parkway Census tracts while the median income is the lowest for I-4 Ultimate project census tracts. The results are along expected lines based on the distribution of the urban population in Central Florida.

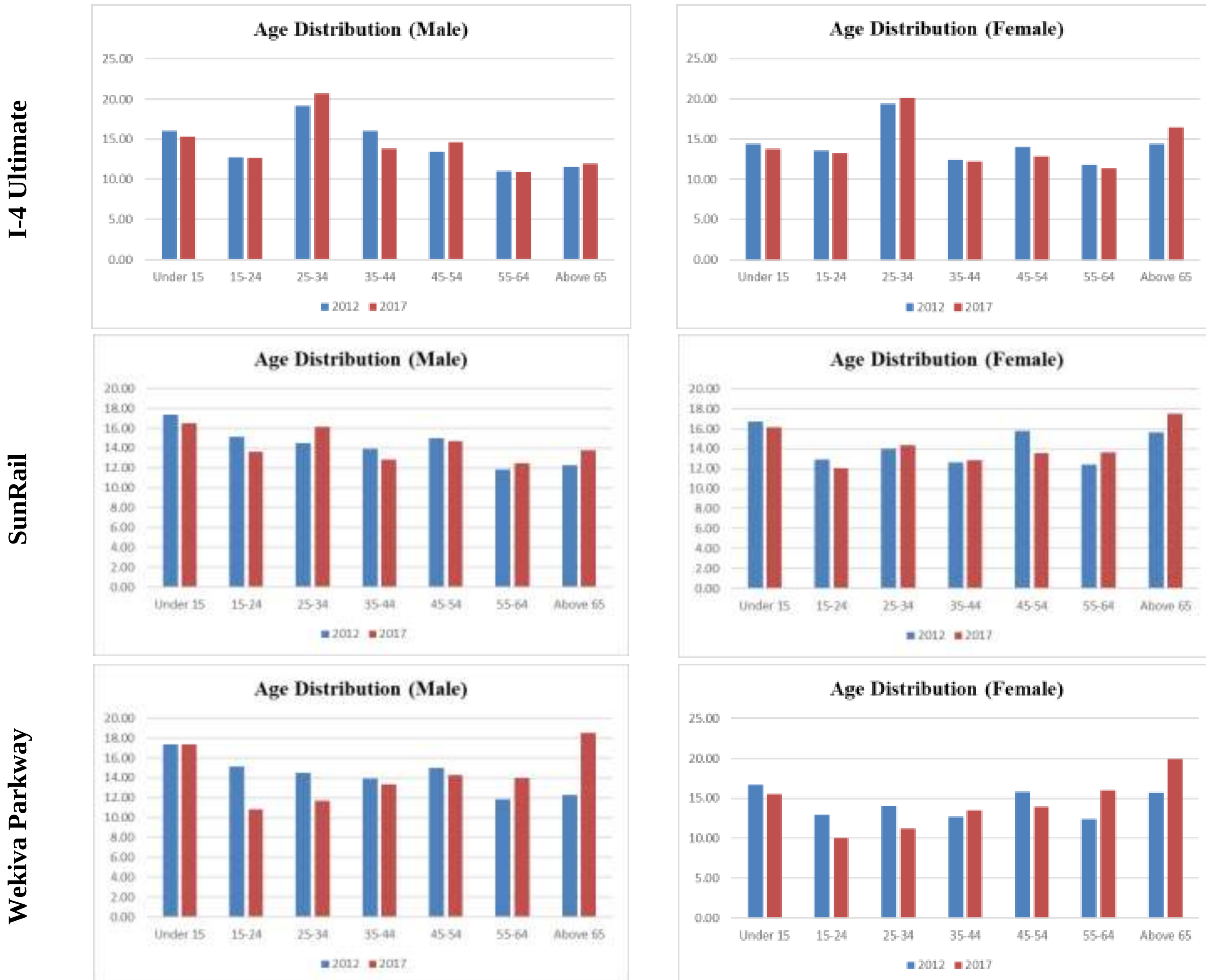


Figure 5.1: Age Distribution by Gender Across Three Projects

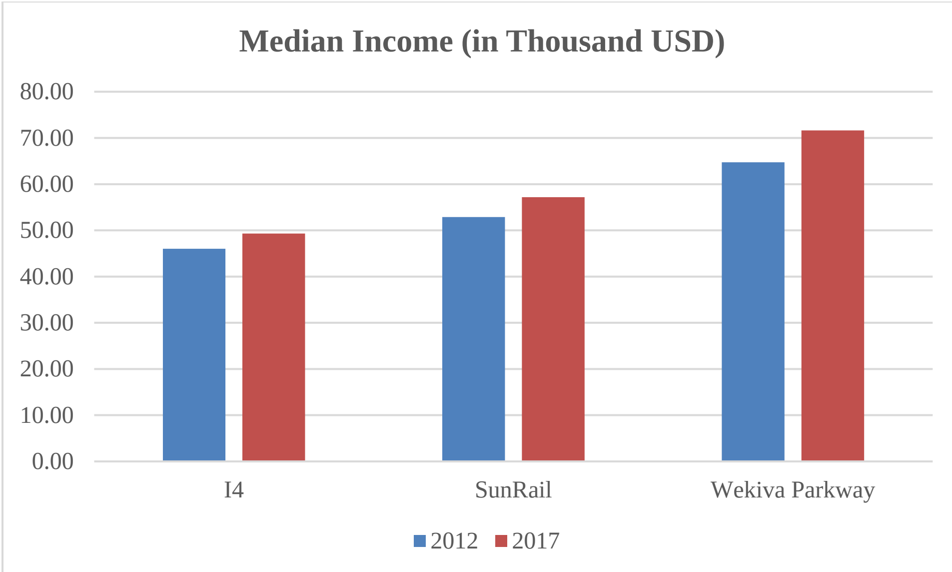


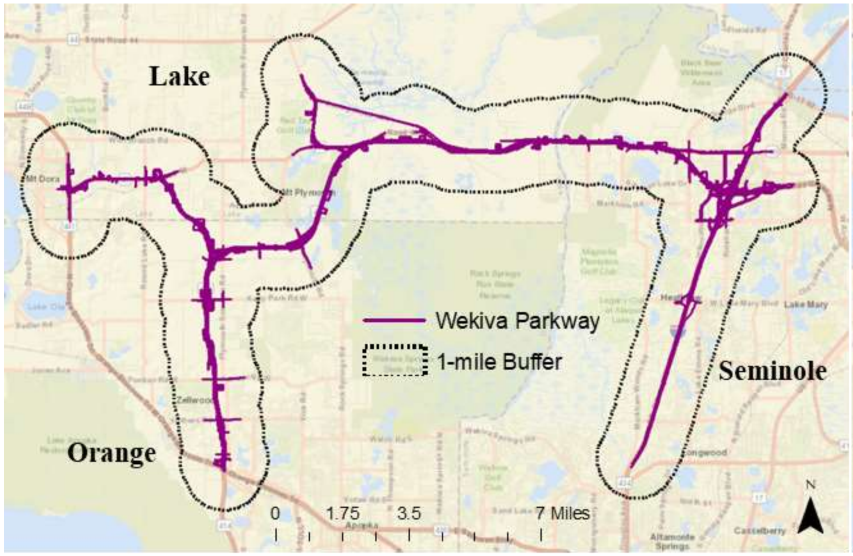
Figure 5.2: Median Income Across Three Projects in 2012 and 2017

5.2 Economic and Policy

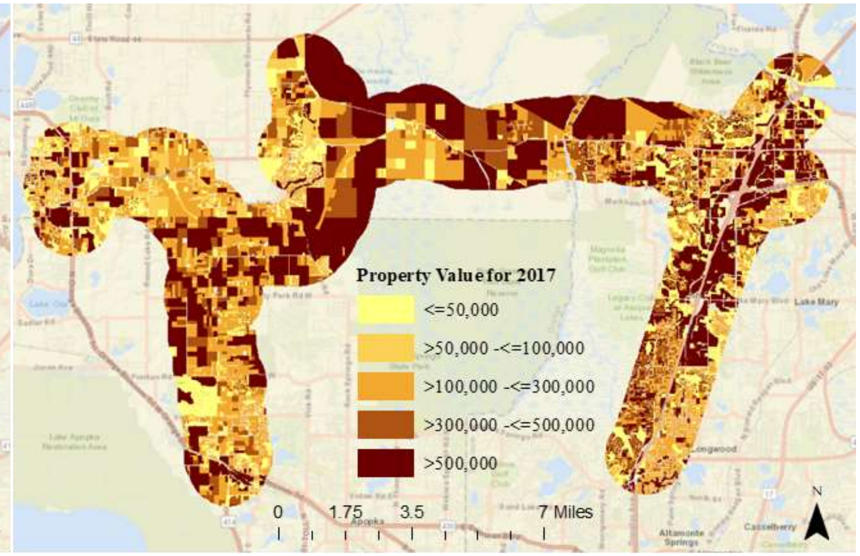
5.2.1 Variation in Property Value by Land Use Type

We compute the property value variation for all the three projects, but for the ease of presentation, we limit ourselves to presenting the results for Wekiva Parkway project only in Figure 5.3. Figure 5.3a represents the influence area (1-mile buffer) for the parkway while 5.3b shows the property values around the parkway in 2017. The property value variation over 5 year period for the parkway are shown in Figure 5.3c. From Figure 5.3a, we can see that the Wekiva parkway passes through three counties: Orange, Lake and Seminole county. Among these three counties, the highest property prices are observed in Lake county as shown in Figure 5.3b. Majority of the parcels in the lake county are over $300,000/acre whereas most of the parcels in other two counties belong to the lower price group (less than or equal to 100,000).

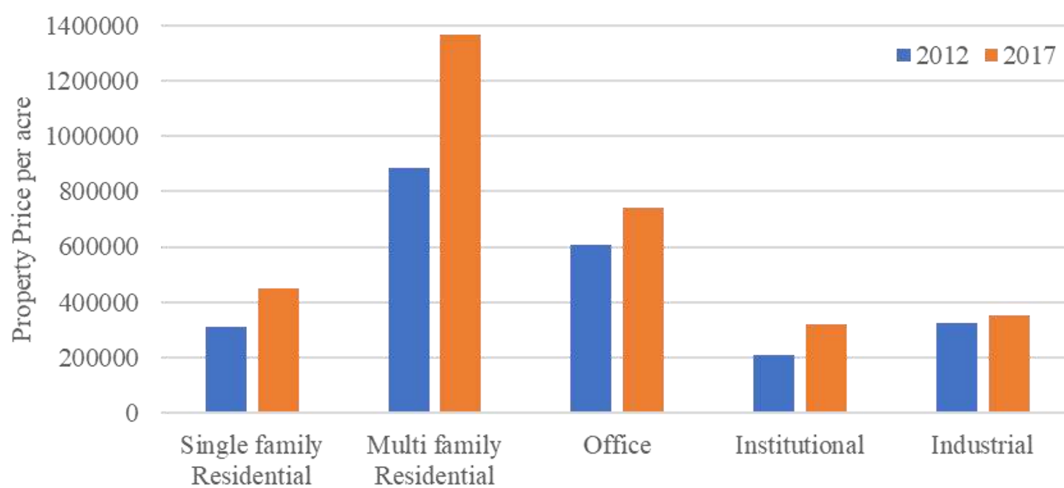
In terms of the property price variation over the 5 year period, we find expected results. Property value per unit area (acre) had increased over the years (from 2012 to 2017) for every land use category around the Wekiva parkway. However, the largest increase (around 54%) is observed for multifamily residential and office areas followed by the single family residential (approximately 45%). On the other hand, property price did not change much (only 9%) for the industrial area over the years.



a. 1-mile Buffer Area around Wekiva Parkway



b. Property Value around Wekiva Parkway in 2017



c. Variation in Property Value in Wekiva Parkway

Figure 5.3: Property Price Evaluation for Wekiva Parkway

5.2.2 ***Variation in Accessibility to Employment***

We computed the job accessibility for all three projects, but for the sake of brevity we only present the findings from the SunRail project in Figure 5.4 and 5.5. The number of jobs available for 2012 in the census tracts that coincide with driving area of SunRail stations are presented in Figure 5.4. For the ease of presentation, we divide the stations into three segments based on the phase and location of the stations : (1) Downtown Stations including Lynx Central station, Church Street station, and Orlando Health/Amtrak station; (2) Outside Downtown Stations comprised of DeBary, Sanford, Lake Mary, Longwood, Altamonte Springs, Maitland, Winter Park, Florida Hospital Health Village, and Sand Lake Road stations; (3) Phase- II stations including Meadow Woods, Osceola Parkway, Kissimmee Amtrak, and Poinciana stations. As expected, employment accessibility is higher around the downtown stations while phase-II stations have lower accessibility. The highest accessibility is observed for Church Street station followed by Orlando Amtrak Blvd. station (Downtown) and Florida hospital station (Phase-I outside downtown).

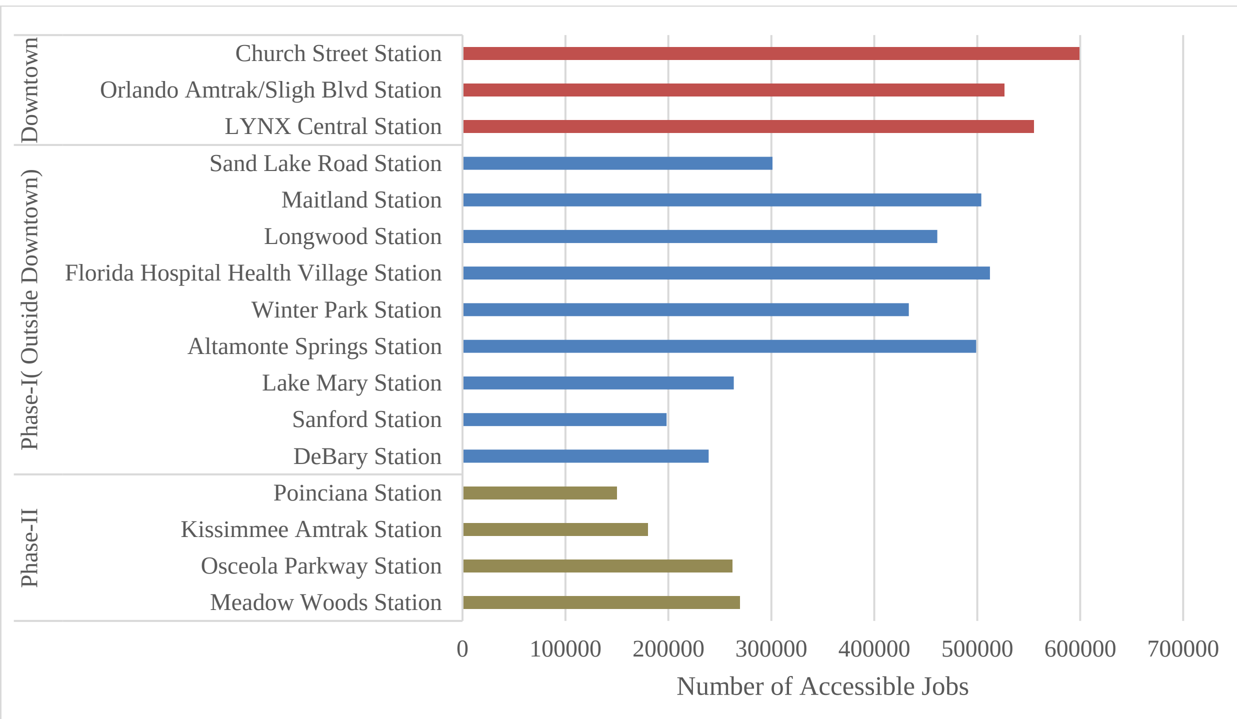


Figure 5.4: Number of Accessible Jobs Across SunRail Stations in 2012

With respect to the change in job accessibility, we capture the variation across the three segments (downtown, outside downtown and phase-II) instead of capturing it across every station. Hence, we followed two steps: 1) we computed the total number of job counts for every station in both 2012 and 2016; and 2) we computed the average job counts per station for above three segments by dividing total job count for all stations with number of stations within three segments. For example, within downtown segments, we have 3 stations. So, if the total number of job counts in the downtown segment is 150,000, then the average job count will be 50,000 (150,000/3) per station. Figure 5.5 represents the job count variation from year 2012 to 2016 across the three segments of the SunRail stations. From the Figure, we can clearly see anincrease in average number of accessible jobs across all the three segments of SunRail stations over the 5 year period. Notably, the largest increase (15%) occurs around the Phase- II stations.

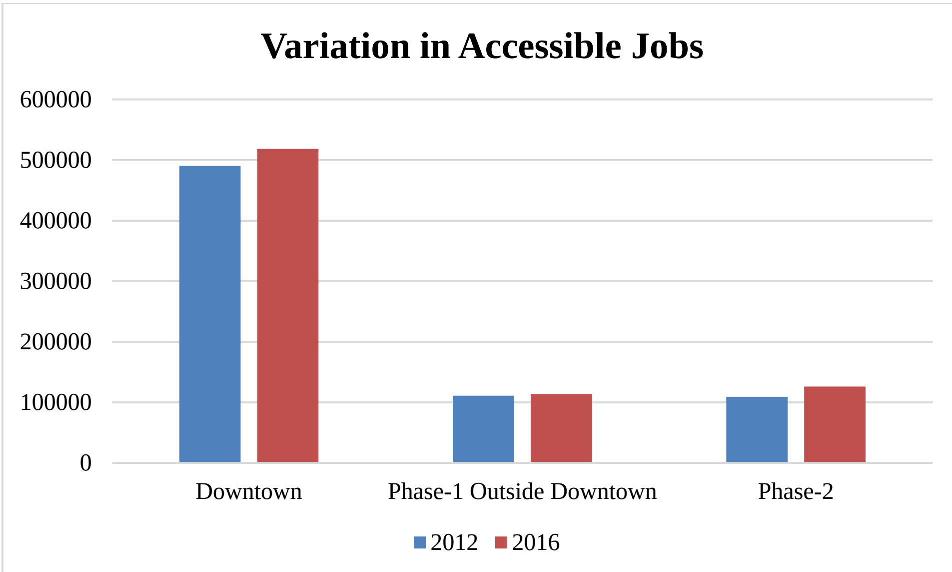


Figure 5.5: Average Number of Accessible Jobs
Across Three Segments of SunRail Stations for 2012 and 2016

5.3 Transportation Infrastructure Attributes

5.3.1 Variation in Travel Time Patterns

The procedure discussed in section 2.3 was repeated for year 2014 and 2019 to compute average travel time by weekdays and weekends for all the three identified projects. However, for ease of presentation, we limit ourselves to presenting the results for I-4 Ultimate projects only in Figure 5.6 and 5.7. Figure 6.6 represents the average travel time along the I-4 corridor for weekdays while the average travel time during weekends are shown in Figure 5.7. As expected, we find lower average travel time during weekends relative to weekdays. Figure 5.6 clearly shows that Altamonte I4 stretch has longer travel times for 2019 than 2014 compared to the other regions for weekdays. Considering weekends, travel time for 2019 are much lesser than 2014. Over the years, the travel time in general have decreased (except for Altamonte for both weekdays and weekends).

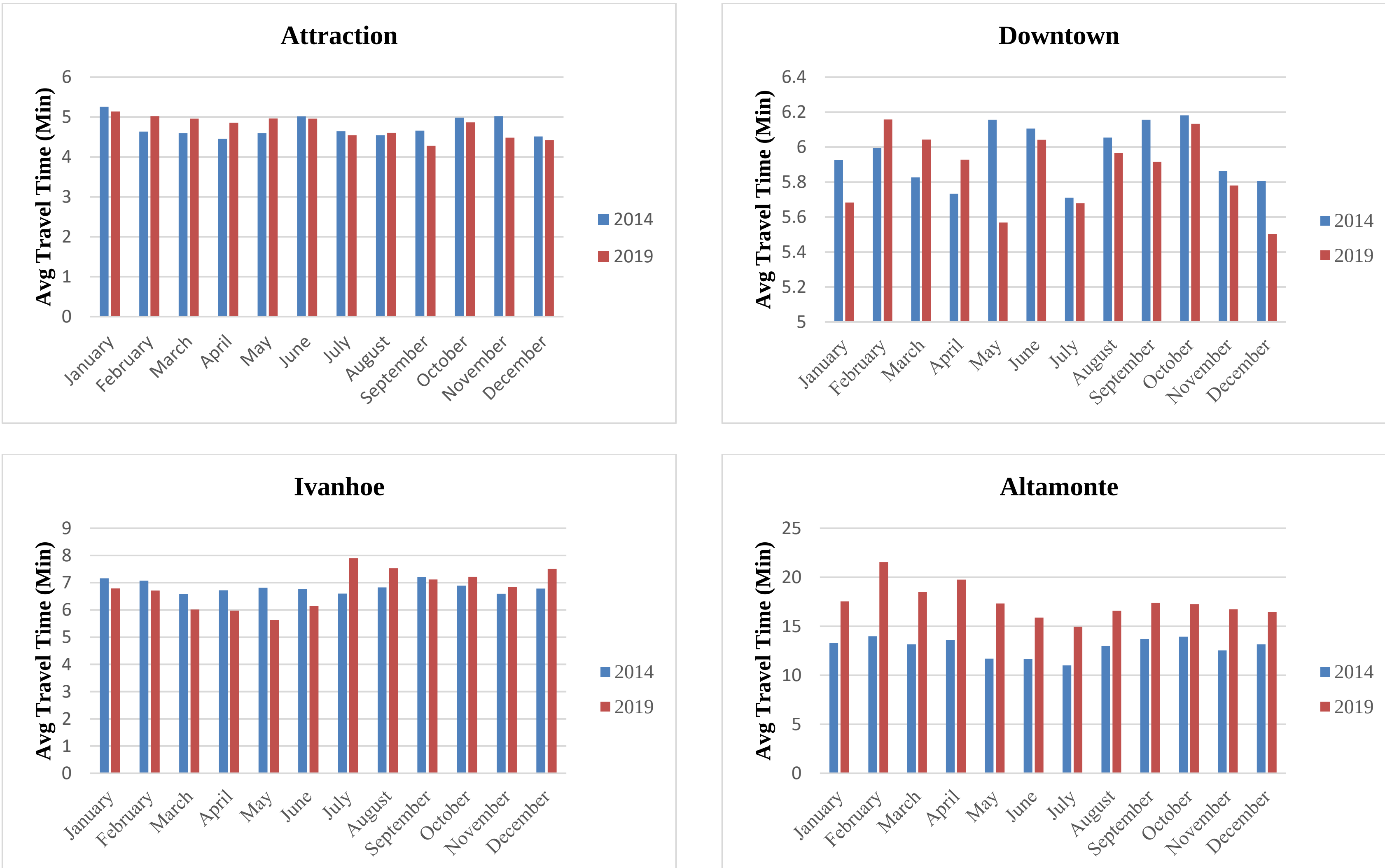


Figure 5.6: Travel Time Patterns in Four Phases of I-4 Ultimate for Weekdays

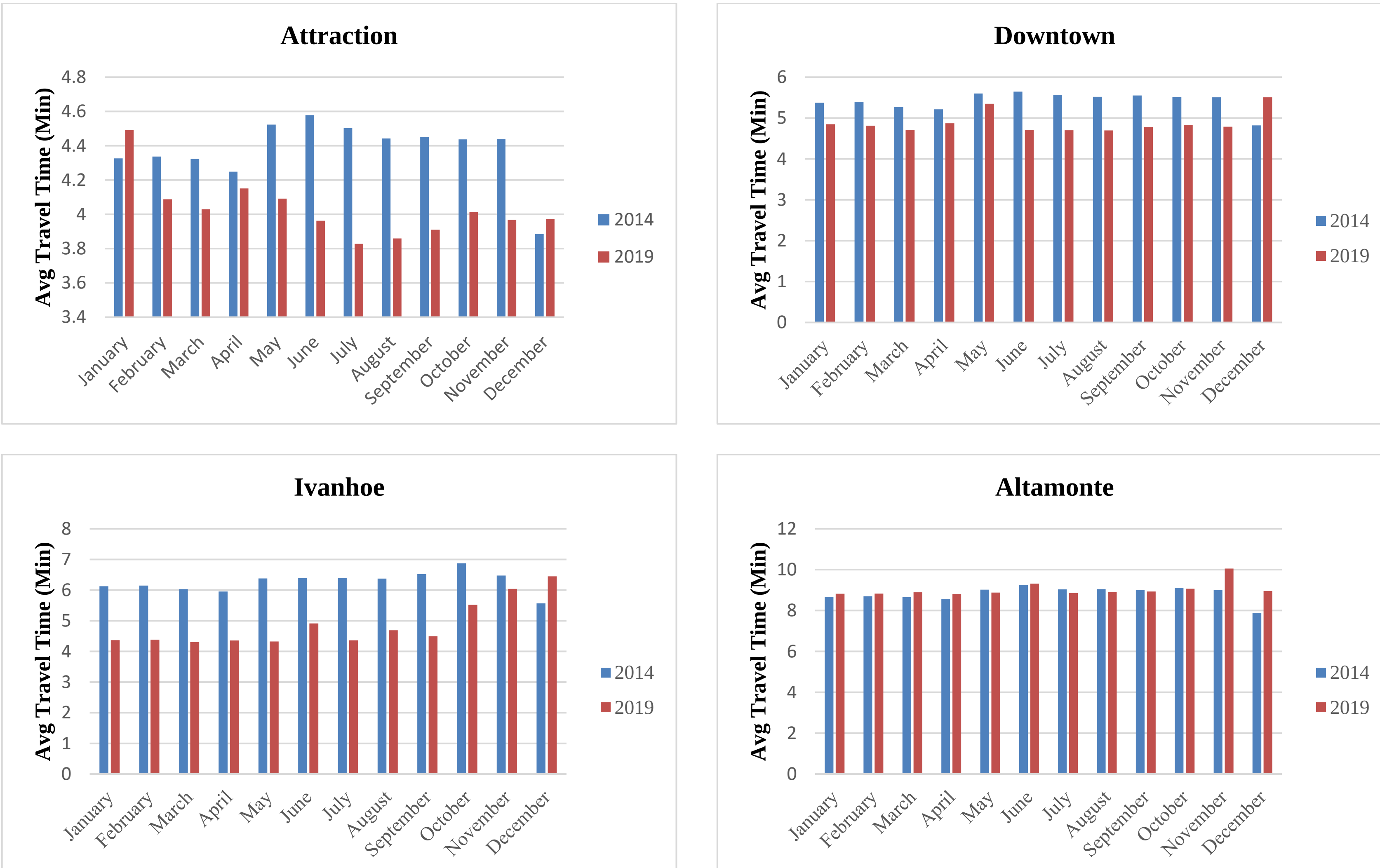


Figure 5.7: Travel Time Patterns in Four Phases of I-4 Ultimate for Weekends

5.3.2 Variation in Ridership

The yearly bus ridership for five fiscal years for the whole Orlando region is shown in Figure 5.8. From the Figure, we can clearly see that the yearly ridership is declining every year. In 2015, more than 29 million people used LYNX system for their daily travel whereas in 2019, the number reduced by around 14% with a total ridership just over 25 million.

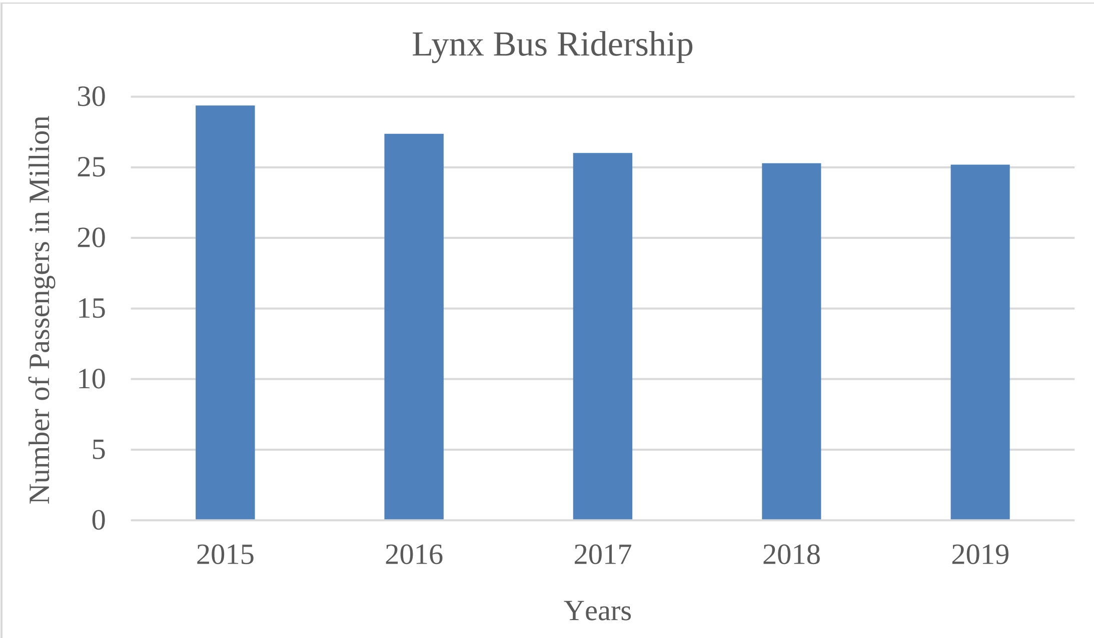


Figure 5.8: LYNX ridership

To further investigate and confirm the reduction in transit ridership, we conducted an analysis of National Household Travel Survey (NHTS) data that provides a snapshot of a representative dataset for travel mode choice. Specifically, data 2009 and 2017 NHTS data were employed to understand mode choice trends in Greater Orlando region.

The 2009 and 2017 NHTS data collected detailed information on millions of trips undertaken individuals from households sampled from all over the country. The database provides detailed information at the household level, person level, and trip level. For our analysis, Metropolitan area of Orlando have been selected. Trip percentage by transit mode were estimated from the data to evaluate transit usage. The corresponding weights provided in the NHTS data were employed to generate population representative values. Figure 5.9 presents the percentage of transit mode share for 2009 and 2017 NHTS respectively considering weekdays, weekends and in total. From these results, we can confirm that transit usage has reduced for weekdays significantly while the usage for weekends increased slightly. Overall, transit mode share has reduced significantly supporting our ridership findings from Figure 5.8.

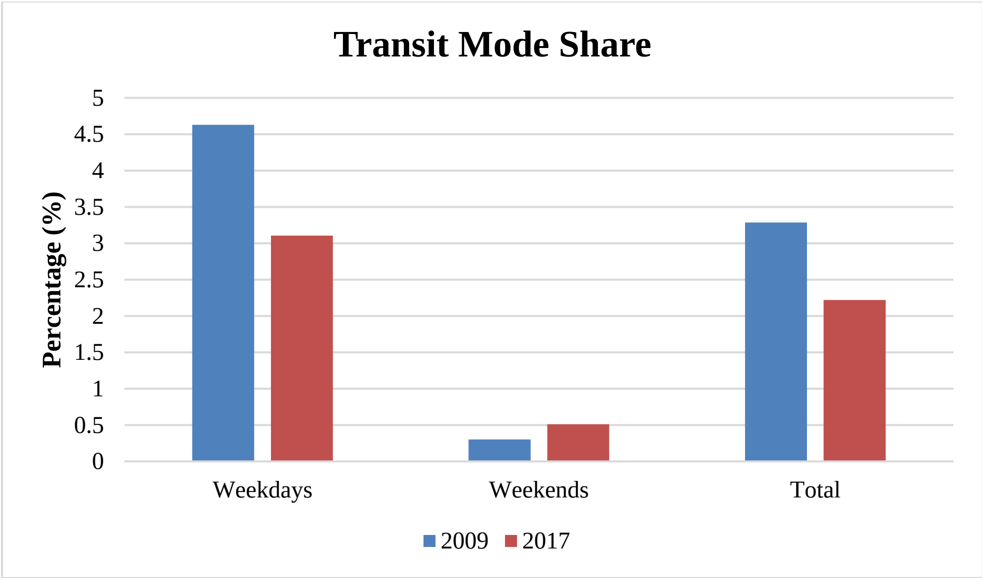


Figure 5.9: Transit Mode Share

5.4 Emerging Factors

5.4.1 Variation in Uber Travel Time

We computed the variation in Uber travel time for all three projects. However, for the ease of presentation, we only present the results for the I-4 Ultimate project in Figure 5.10. Travel time using Uber was computed between two census tracts that correspond to the end points of I-4 stretches without considering any route assignment. Average, lower and upper bound travel time required to cover the stretch was computed for January for the year of 2018 and 2019 respectively to illustrate the differences. Travel time was compared based on different time-periods of the day for weekdays and weekends (See Figure 5.10). The results can be summarized as follows: (a) PM peak period has the maximum travel time between the two census tracts considering average, lower and upper bound for weekdays and weekends; (b) for weekdays both AM and PM peak periods have longer travel times than other time periods; (c) During weekends also PM peak and evening periods experience longer travel times possibly reflecting preference for discretionary travel during these time periods and (d) no significant difference was found in travel time patterns for both weekdays and weekends over the 2 year period. The reader would note that Uber movement data was available for the Orlando region from 2018 and hence analysis of earlier years was not feasible.

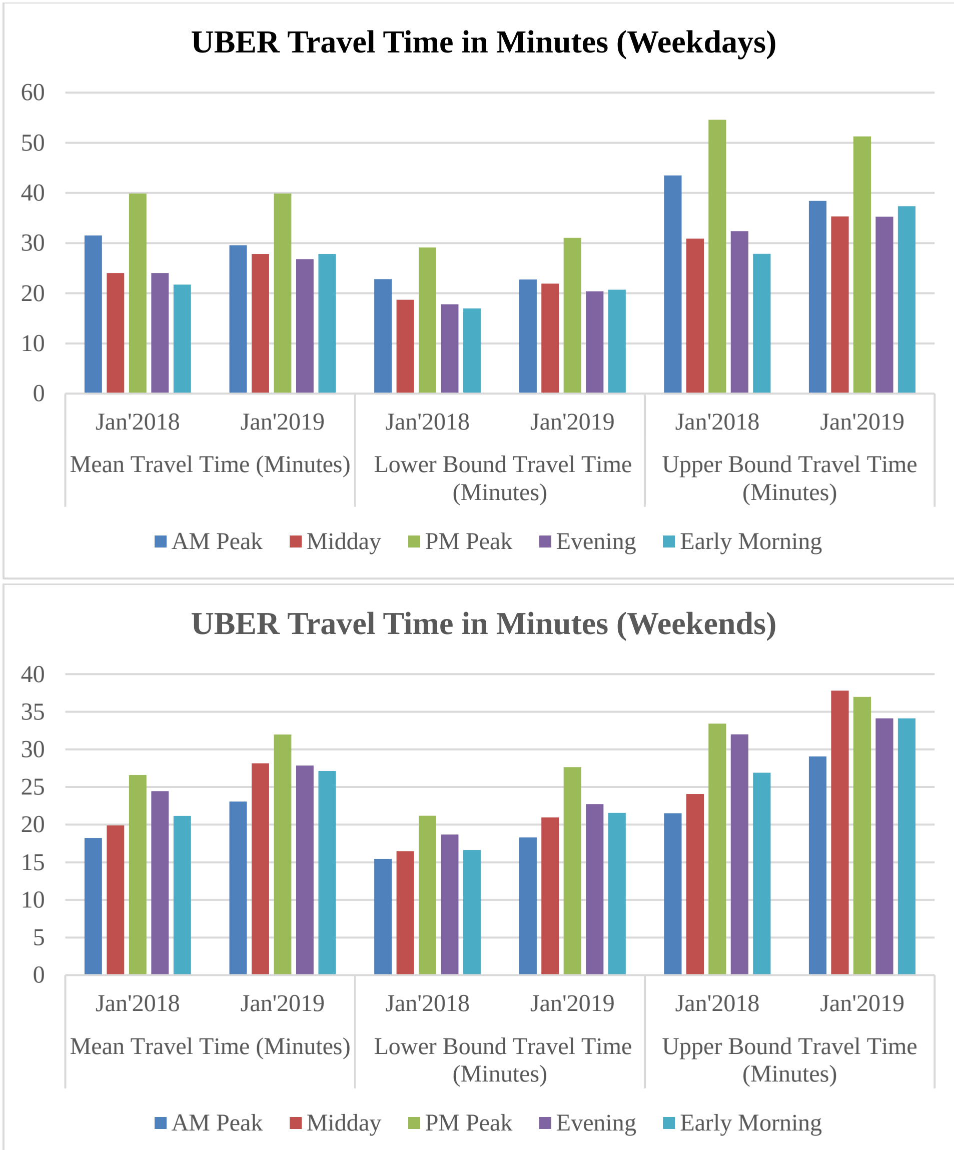


Figure 5.10: Uber Travel Time for I-4 for Weekdays and Weekends

5.5 Variation in Weather

We capture the variation in weather across all three projects, but for the sake of brevity we present the findings from the I-4 Ultimate project only in the current deliverable. Figure 5.11 represents the variation in average temperature and maximum wind speed around I-4 Ultimate over 12 months period for 2014 and 2019. From the Figure, we can clearly see that the average temperature trend is quite similar for both 2014 and 2019 over the 12 months period. However, compared to 2014, the weather is slightly warmer in 2019 for all the months except for August. Similarly, we observe a similar and stable wind speed in both 2014 and 2019 over the years ranging from 3mph to 25mph except for the month of August. Interestingly, the maximum wind speed jump drastically to 73mph in August 2019, perhaps due to the occurrence of hurricane Dorian during that time in Central Florida region.

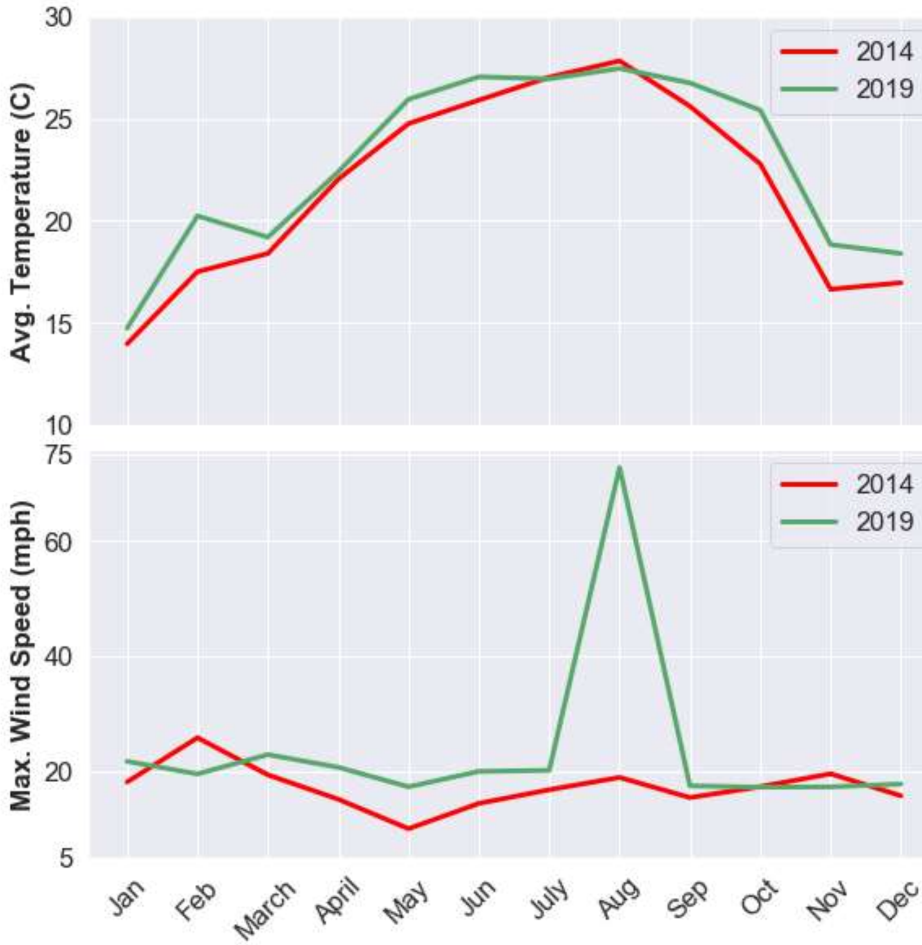


Figure 5.11: Variation in Temperature and Wind Speed around I-4 Ultimate

Further, we compute the effect of weather on crash occurrence along the three identified project corridors. For the sake of brevity, we are limiting ourselves to presenting the results for I-4 corridor in Figure 5.12. The procedure is as follows: First, we identify the crashes around the influence area of I-4 Ultimate (1-mile buffer) considering evening peak period (4pm-7pm) only. Second, we classify those crashes by different weather conditions considering total crashes and crashes by different severity levels. For example, let us consider, there were total 100 crashes around the 1-mile buffer of I-4 Ultimate with 70 crashes resulting in no injury, 20 crashes sustained injury and 10 crashes resulted in fatality. We compute how many crashes out of these 100 occurred during clear weather and how many crashes occurred during rainy weather. Further, we followed the same procedure for no injury (out of 70, how many occurred during clear and rainy weather), injury and fatal crashes. Third, using the FAWN weather data, we identify the number of hours in the evening peak period (4-7 pm) with and without rain across every year. Fourth, we compute the crash rate for every severity levels and total crashes by taking the ratio of the total number of crashes (for every level) for the corresponding weather condition by the number of hours for that particular weather condition. For instance, if in 2015, we have rain in 100 hours during evening peak period (in I-4 corridor) and total number of crashes during rainy weather were 100, then the total crash rate for rainy hours (evening peak only) is 1 (100/100). Fifth, we also compute the percentage of injury crashes for each weather condition by taking the number of injury crashes to the total number of crashes for the corresponding weather condition. For example, if there are 25 crashes occurring in rainy weather along the I-4 corridor in 2015 and out of these 25 crashes, 5 results in fatality then the percentage of fatal crashes is 20% (5/25). Finally, we followed each step (1-4) for every year starting from 2015 to 2019.

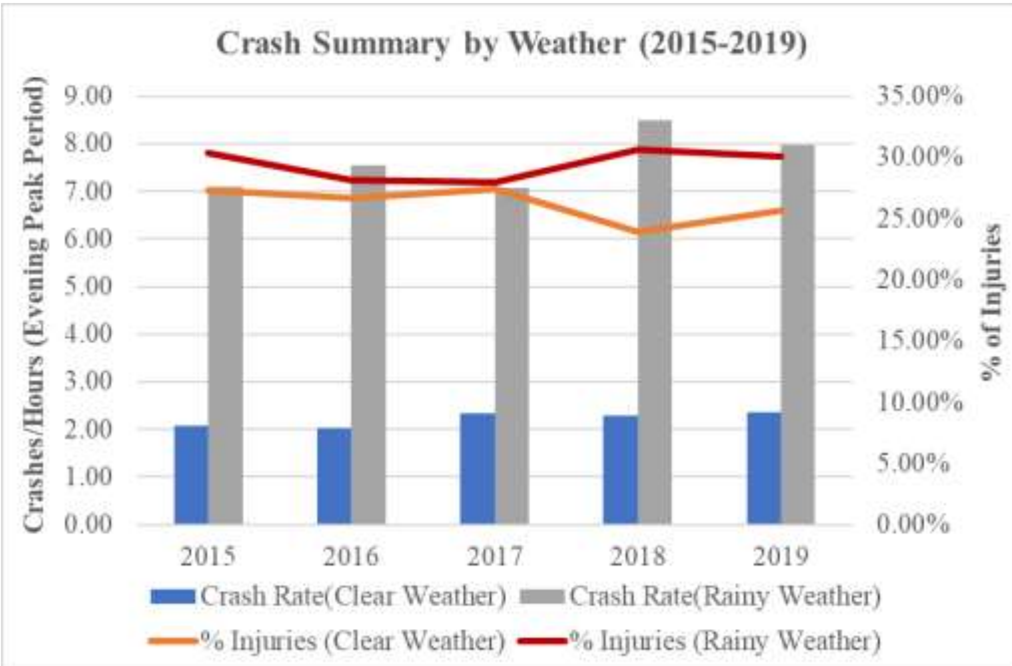


Figure 5.12: Effect of Weather on Crashes and Injuries Around I-4 Ultimate

In Figure 5.12, we present the total crash rate (for evening period) and the ratio of injury crashes. From the Figure, we can clearly see that during evening peak hours, the likelihood of being involved in a crash is much higher in rainy weather relative to clear weather. A plausible explanation is associated with the reduced visibility of the drivers during rainy weather that increase the risk of crash occurrences. Further, given a crash occurred, the chance of being injured is higher in rainy weather as indicated by the plotted line. In terms of temporal trend, the crash rate in rainy weather increased after 2017 while the crash rate for clear weather reduced marginally.

5.6 External Factors

We compute the effect of COVID-19 on travel time patterns along all the three identified projects, but for the ease of presentation, we limit ourselves to presenting the results for I-4 Ultimate project only in Figure 5.13. From the Figure, we can clearly see a large reduction in travel time during peak period (both morning and evening) in 2020 relative to 2019. The pattern clearly illustrates the how one external factor (unexpected) can affect the travel demand substantially and the importance of considering (or being aware of) such factors in demand modeling.

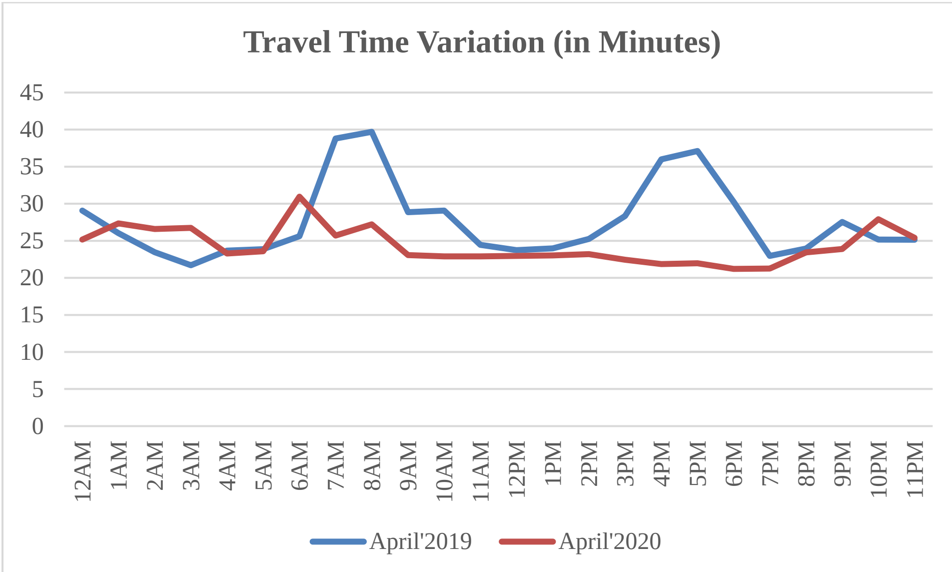


Figure 5.13: Variation in Travel Time Along I-4 Corridor for COVID-19

CHAPTER 6: CONCLUSIONS

The proposed research is motivated by the need to develop practical approaches that can be employed to conduct periodic planning forecast evaluations for medium to large projects. The research is conducted in two tasks. In the first task, we summarize transportation and urban planning studies that conducted project planning forecasts. In the second task, based on the literature review, the research team has compiled the data sources encompassing various dimensions that are useful for conducting periodic project evaluation. In this chapter, we will present our concluding thoughts from the two tasks.

6.1 Task 1- Literature Review Summary

Thirty (30) research studies were selected and reviewed by the research team. A comprehensive summary of each study is provided in the report, by presenting the study region, dimension that is being analyzed (such as traffic forecast and ridership forecast), conceptual methods adopted in the study, information on whether the project used any before after comparison, whether calibration factors were considered, and different categories of exogenous variables used in the forecasting process. The studies are categorized along sub-streams based on the type of the infrastructure including roadway infrastructure, transit facility and combination of multiple infrastructure. Several interesting observations are made based on the literature review. First, majority of the studies analyzed ridership and traffic for the forecasting purpose. Second, several frameworks are adopted in the planning studies including sketch planning tool, travel demand models including the four step model, regression model, Group ordered logit model, linear regression, and linear interpolation. Third, most of the studies do not perform any before after comparison in the planning period. Fourth, only a few studies used calibration factors in their analysis. Fifth, a number of independent variables are considered in the planning forecast process including socio-demographic and socio-economic characteristics (such as population composition, employment status, migration), economic and policy conditions (such as employment, GDP, housing conditions), transportation infrastructure attributes (such as transportation facilities, traffic signal plans, vehicle fleet composition, mode preferences, and travel characteristics), and emerging trends in transportation (such as Mobility as a service, autonomous cars, shared economy). Finally, we observe from the literature review that the use of sketch planning tool is more common in the transit infrastructure project forecasting relative to other projects (roadway and multiple infrastructure).

6.2 Task 2- Data Findings Summary

Based on the literature review, the research team has compiled the data sources encompassing various dimensions that are useful for conducting periodic project evaluation. The different data sources identified have been compiled for three major projects in the District 5 region - I-4 Ultimate project, SunRail and Wekiva Parkway. In terms of data collection, we have assembled variables from five broad categories including: demographics, economic and policy conditions, transportation infrastructure attributes, emerging trends in transportation and weather factors.

Moreover, the research team has also incorporated the effect of some external factor in the current analysis (COVID-19 for example) as it might affect transportation demand substantially. The data is compiled for the three-research projects over a 5 year period (whenever possible) starting from the existing planning forecast study development year. A summary of all the data compiled for the project is listed in Table A,1 in the Appendix.

We collect information on all the variables mentioned above for all three projects, but for the ease of presentation, we limit ourselves to presenting the results of each variable for one project only (except demographic trends). With respect to demographic trends, we consider gender, age and income distribution for all the three projects. From the analysis, we find a higher percentage of male relative to female group for both 2012 and 2017 around all the three projects. Further, we find that, over the 5 year period, irrespective of the gender, number of young residents reduces around all the three projects while the percentage of senior residents increased drastically, particularly along the Wekiva Parkway corridor. As expected, median income increased from 2012 to 2017 around all the three infrastructure projects. In terms of economic and policy variables, we identify two measures: property value and job accessibility. We capture the property value variation along the Wekiva Parkway. We observe that property value per unit area (acre) had increased over the years (from 2012 to 2017) for every land use category around the Wekiva parkway. However, the largest increase (around 54%) is observed for multifamily residential and office areas followed by the single family residential (approximately 45%). On the other hand, we compute the variation in job accessibility for SunRail stations and found a slight increase in average number of accessible jobs across all the three segments of SunRail stations over the 5 years period.

For transportation infrastructure variables, we identify two measures: travel time patterns and variation in bus ridership. We capture the travel time variation for both weekdays and weekend along the I-4 corridor while we compute the variation in LYNX ridership for the Greater Orlando region. From the results, we observe that over the years, the travel time in general have decreased except for the Altamonte region (I-4 Ultimate) for both weekdays and weekends. In terms of the ridership, our results show that the yearly ridership is declining every year and compared to 2014, bus ridership reduced by 14% in 2019. To further investigate and confirm the reduction in transit ridership, we conducted an analysis of National Household Travel Survey (NHTS) data that provides a snapshot of a representative dataset for travel mode choice. The results further confirm the reduced transit share over the years, particularly during weekdays. With respect to emerging factors, we consider Uber travel time and we estimate the change in Uber travel time along I-4 corridor from 2018 to 2019. From the analysis, we find no significant difference in travel time for both weekdays and weekends over the 2 year period. For the weather related variables, we consider average temperature and maximum wind speed for every month in 2014 and 2019 along the I-4 Ultimate corridor. We find that compared to 2014, the weather is slightly warmer in 2019 for all the months except for August. Interestingly, the wind speed jump drastically to 73mph in August 2019, perhaps due to the occurrence of hurricane Dorian during that time in Central Florida region. Further, we compute the effect of weather on crash occurrence along the I-4 Ultimate corridor. We find that during evening peak hours, the likelihood of being involved in a crash along the I-4 corridor is much higher in rainy weather relative to clear weather.

Finally, we compute the effect of COVID-19 (external factors) on travel time patterns along I-4 corridor by estimating hourly travel times for the entire day of 2nd Tuesday of April 2019 and 2020. From the analysis, we find a huge drop in travel time, particularly for peak period in 2020 relative to 2019 which illustrates the effect of such unexpected factor on transportation demand.

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APPENDIX

Table A.1 Complete List of Data

Data	Source	Region	Year	Description
Demographics	ACS, U.S CB	State of Florida	2011-present	The data includes information on total population, number of people by gender, age, race, income, household density and number of households by different vehicle ownership.
Property Value, Land use Area	FDOR	State of Florida	2011-present	This data includes the parcel level data encompassing lane use category with the corresponding property value
Job Accessibility	ACS	State of Florida	2011-present	This data contains information on total employment of individuals aged 20 through 64 years.
Roadway Characteristics	FDOT	State of Florida	2014-present	Roadway attributes considered include number of intersections, number of traffic signals, average annual daily traffic, speed limit, number of lanes
Travel Time, Travel Speed	RITIS	State of Florida	2013-present	The database is an automated data sharing system, which includes real time data feeds.
Traffic Volume	FDOT	State of Florida	2014-present	Traffic volume data includes the average annual daily traffic (AADT), average annual daily truck traffic (truck AADT), vehicle miles traveled (VMT), truck vehicle miles traveled (truck VMT) and proportion of heavy traffic
Crash data	FDOT, CARS, S4A	State of Florida	2011-present	The crash records compiling the information of crash types and the corresponding severity outcomes.
Incident data	FDOT	State of Florida	2014-present	Incident information includes abandoned vehicles, adverse weather, spilled loads, highway debris, and traffic crashes. For incident duration, we collect: Notification time, Response time, Clearance time and Traffic recovery time
LYNX ridership	LYNX System	Greater Orlando	2014-present	The dataset includes the stop level boarding and alighting at a daily basis.
SunRail Ridership	FDOT/SunRail management	Greater Orlando	2014-present	SunRail comprises of 31-mile rail length along with 12 active stations. We have daily ridership as well as monthly ridership data.
Uber Travel Time	Uber Movement Data	Orlando	2018-present	The dataset includes the average Uber travel time at census tract level
Temporal Factors	FAWN	State of Florida	2011-present	The dataset includes total 44 weather stations providing information on temperature, average precipitation, wind speed, relative humidity and dew point temperature

* U.S. CB = U.S. Census Bureau; ACS = American Community Survey; FDOR = Florida Department of Revenue; FDOT = Florida Department of Transportation; RITIS = Regional Integrated Transportation Information System; CARS = Crash Analysis Reporting System; S4A = Signal Four Analytics databases; FAWN = Florida Automated Weather Network