Evaluating Community Building Effectiveness of Transportation Investments: Knowledge Transfer Webinar Series

Webinar I: Measures of Effectiveness Data Preparation and Analysis

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Outline

- Introduction
- Project Objectives
- Measures of Effectiveness
- Data Preparation for MOEs
- GIS Data Analysis
- Conclusion
- Acknowledgements

Introduction

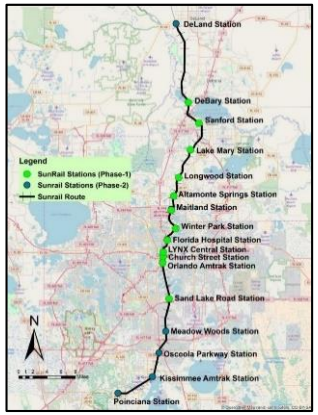
- Transportation infrastructure investments are designed to enhance the movement of people and goods
  - Impact land use, urban residential location decisions and activity patterns, economic growth, and overall quality of life.
- Transportation infrastructure projects
  - Build connections across regions,
  - Catalyst for developing, shaping, guiding, and strengthening community life.
- With emerging transportation infrastructure (such as connected vehicles and infrastructure, driverless cars, electric cars) and analytics (social media and big data approaches, machine learning methods) is likely to play a major role in building true Smart Cities.

Project Objectives

- The proposed research effort is geared towards examining the role of transportation infrastructure investments in community building measures.
- Examining the role of transportation infrastructure investments in community building measures.
  - **Objective 1: Identify Data Sources -** *Identify* publicly accessible databases for identifying indicators of community development achieved through transportation projects.
  - **Objective 2: Develop Custom Queries for Social Media -** The research will develop custom queries for extracting social media data reflecting the influence of several current and proposed transportation infrastructure investments on community building.
  - **Objective 3: Assess Projects –** Quantify the impact of transportation infrastructural changes using traditional and big data oriented analytical approaches

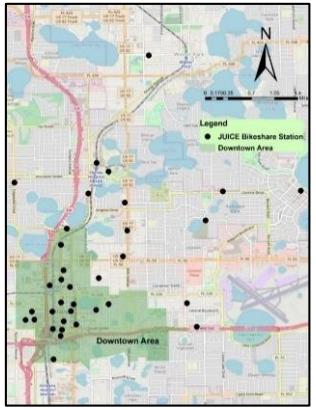
Projects for Evaluation

- We selected the following 3 projects for evaluating community building impacts and developing the Measures of Effectiveness (MOE):
  1. SunRail commuter rail extension
  2. I-4 expansion
  3. JUICE Orlando Bikeshare



SunRail

I-4 Expansion



JUICE Bikeshare

Projects for Evaluation

- For our project, we divided Sunrail stations into 3 categories:
  - Phase-1 stations (Outside Downtown) - 9 stations
  - Phase-1 stations (Core Downtown) - 3 stations including LYNX Central, Church Street and Orlando Amtrak stations
  - Phase-2 stations
- The construction area of I-4 Expansion is divided into 4 stretches:
  - Attractions area (5.7 miles)
  - Downtown Orlando area (4.2 miles)
  - Ivanhoe area (4.9 miles) and
  - Altamonte area (6.4 miles)
- For our analysis, the bikeshare stations were divided into two segments:
  - Stations located within Downtown area
  - Stations located outside of downtown area

Data Preparation by MOE and project

Measures of Effectiveness (MOE)

- **Measure 1: Property value change**
  - Disaggregate parcel level data layers will be employed to compute the change in property value
- **Measure 2: Changes to job accessibility**
  - Census bureau data will be used to examine how the number of employment has varied
- **Measure 3: Commuting time change**
  - American Community Survey data will be used to measure changes to commute travel times
- **Measure 4: Land use type change**
  - Disaggregate parcel level data layers will be employed to identify the land use change from vacant to residential, industrial and commercial
- **Measure 5: Changes to travel patterns for zero car households**
  - Census bureau data will be used to measure job accessibility around MOE

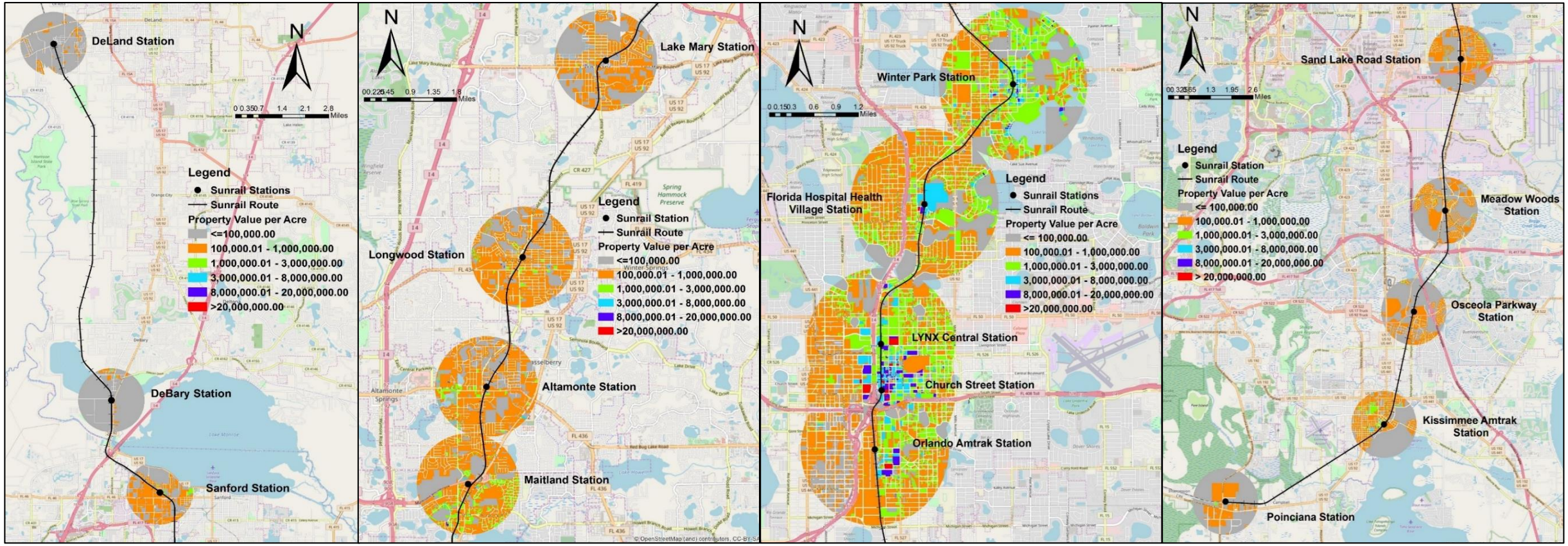
MOE 1: Property Value

Measure 1: Property Value Change

- A combined county layer was created using the GIS shapefiles provided by FDOR
- Parcel level data from the NAL files was added to this layer matching the unique GEOIDs
- In calculating the change in property values, we consider Just Value reported by FDOR as a surrogate measure for direct property value
- We wanted to investigate the property value change across different land use types
- We consolidated the land use types reported by FDOR into the following 12 categories and the values for the selected 5 out of the 12 categories were reported

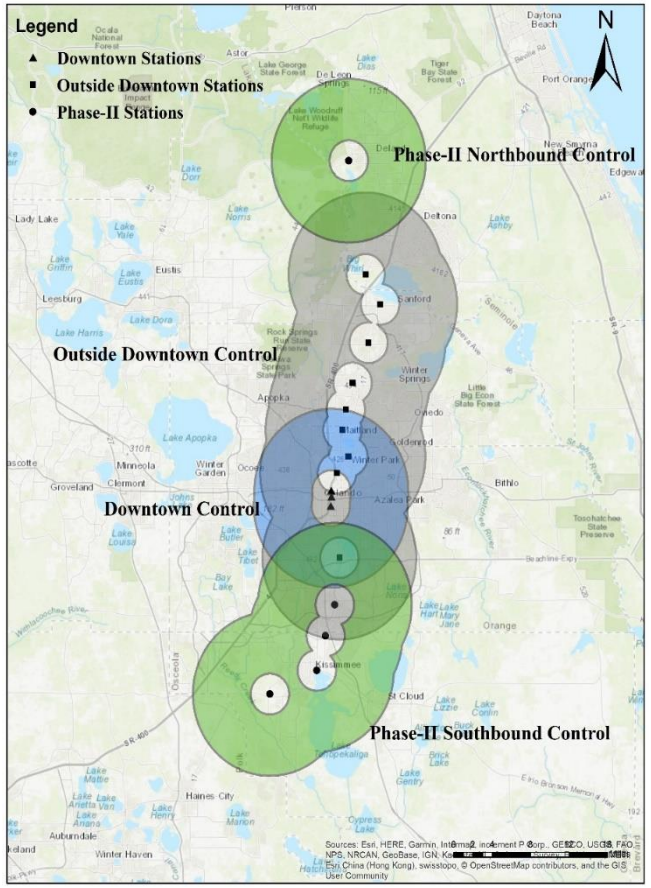
DORUC	Land Use	DORUC	Land Use
1	**Single Family Residential**	71-79, 81, 84	**Institutional**
3,8	**Multifamily Residential**	83, 85-91	Public
2,4-7,9	Other Residential	82, 97	Recreational
11-39	**Retail/Office**	95	Water
41-49	**Industrial**	0, 10, 40, 70, 80	Vacant
50-69	Agricultural	92-96, 98, 99	Other

SunRail Stations (Case Area)



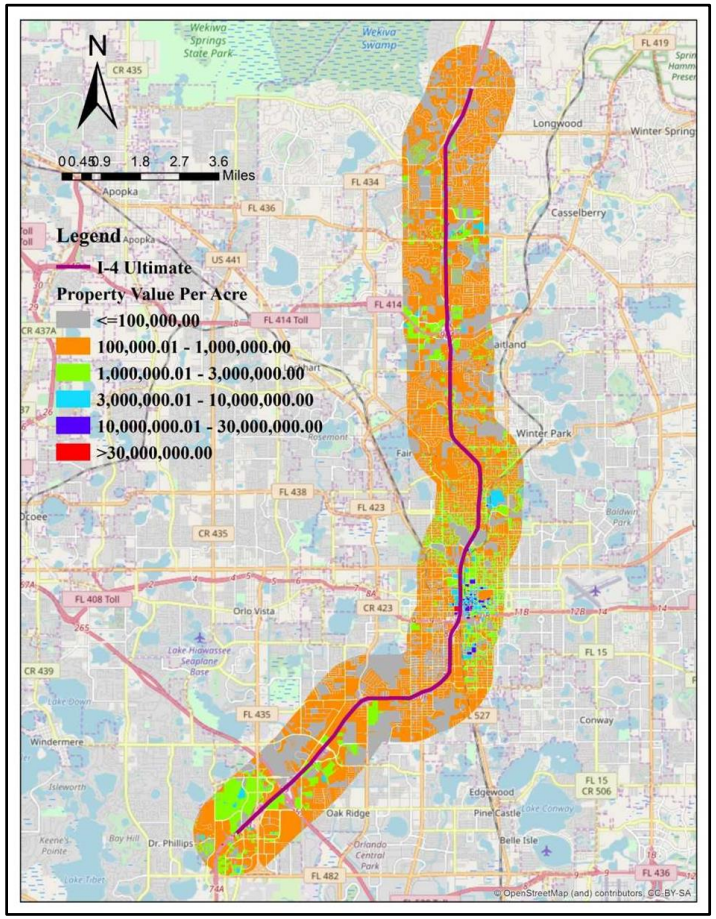
SunRail Stations (Control Area)

- Property values can be influenced by many factors
  - Population expansion, economic growth, improved accessibility to amenities
- To examine if the changes in property values is truly influenced by SunRail's development, control areas were systematically selected
  - **First,** we created 2 and 8 mile buffers, respectively around the stations
    - The parcels located within this 6 mile buffer were selected to be the candidate control areas
    - Based on land use type and property value range (within 15% of the mean property value found for each land use type for case areas), control areas for analysis were identified
    - The same number of control parcels were selected for each land use type
  - **Second,** the control parcels were assigned to a unique station by using the nearest distance analysis
  - **Third,** the average property values per land use category were computed



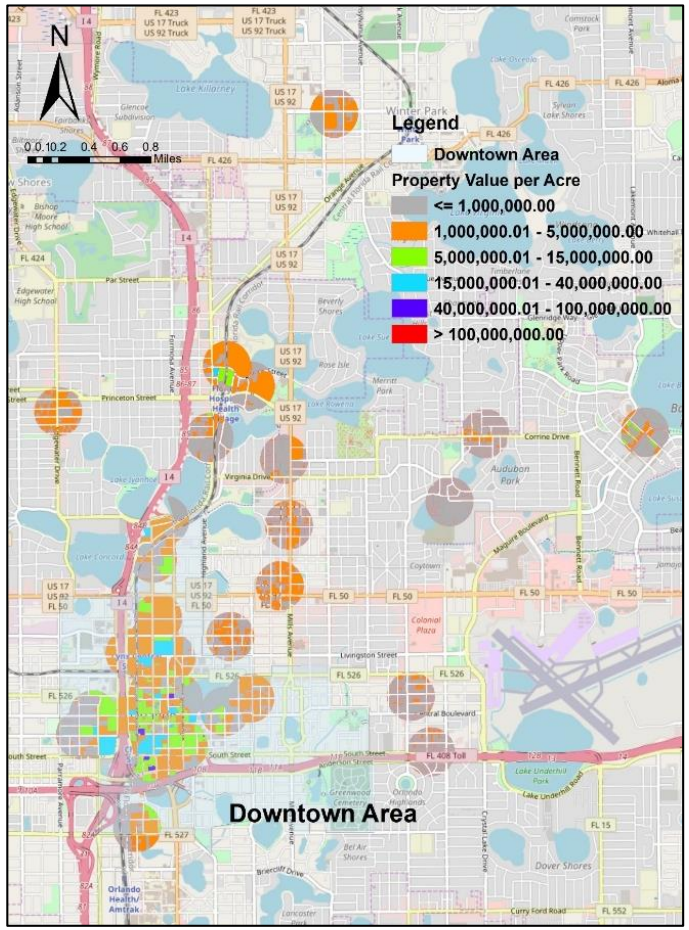
I-4 Expansion

- To evaluate the property value changes, 1-mile buffer was created around the I-4 site
- The Nearest Distance tool was again used to assign parcels to a particular I-4 stretch (Attraction, Downtown, Ivanhoe and Altamonte)
- Control area selection
  - Control areas are selected following the same procedure described for the SunRail Stations



JUICE Orlando Bikeshare

- To evaluate the property value changes, a 250-meter buffer was created around each bikeshare station
- The Nearest Distance tool was again used to assign parcels to a unique bikeshare station
- Control area selection
  - The majority of the bikeshare stations are located in and around downtown areas; non-downtown stations are chosen as control stations



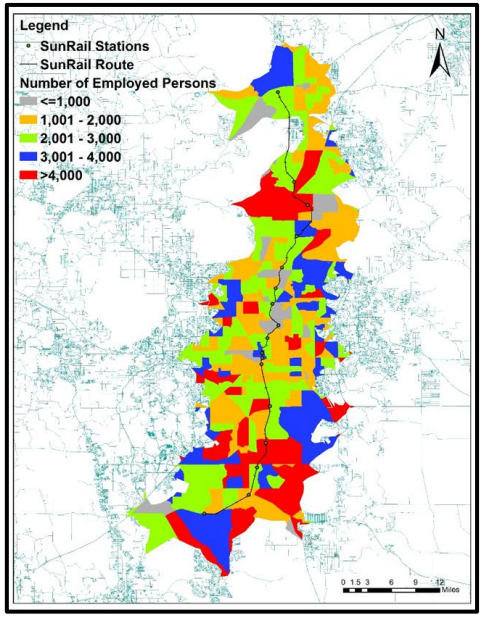
Measure 2: Accessibility to Employment

- Job accessibility can be defined as number of jobs accessible from a desirable point.
- The data for employment for the years 2011-2016 was collected from American Community Survey (ACS) and merged with the Florida census tract shapefile
- 10 minutes driving area has been selected from each SunRail station or from each I-4 segment's midpoint
- Using proximity analysis (similar to property value estimation), each census tract was assigned to one unique station
- Total employment count was obtained by summing the employment counts within the census tracts bounded within the buffer for all census tracts for each station

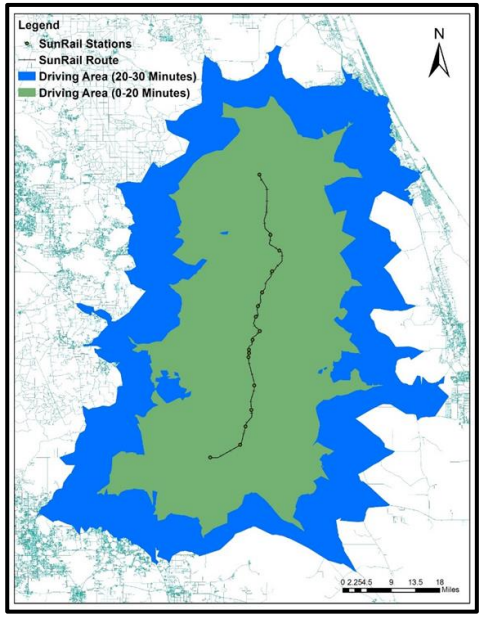
Measure 2: Accessibility to Employment

- Control Area Selection
  - **First,** travel time between the 20 to 30 minute car driving time was selected as control threshold
  - **Second,** the census tracts located within this 10 minute threshold area (at least 20 minutes away and within 30 minutes) were selected to be the control parcels

SunRail and I-4 Expansion

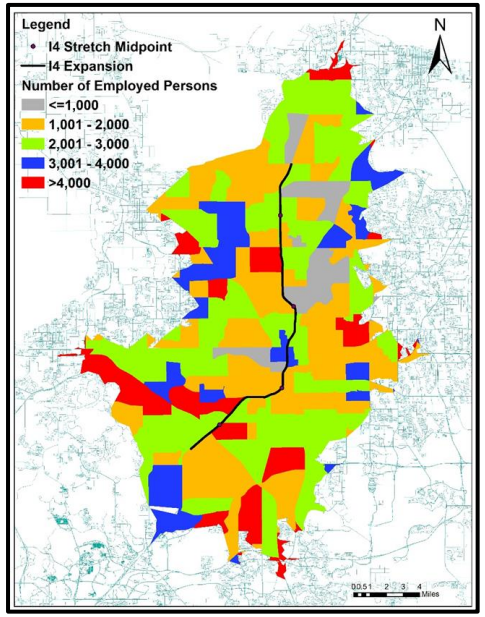


Case Area

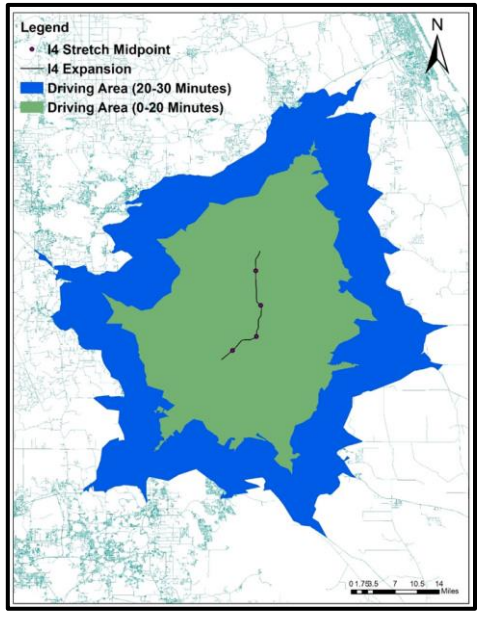


Control Area

SunRail Stations



Case Area

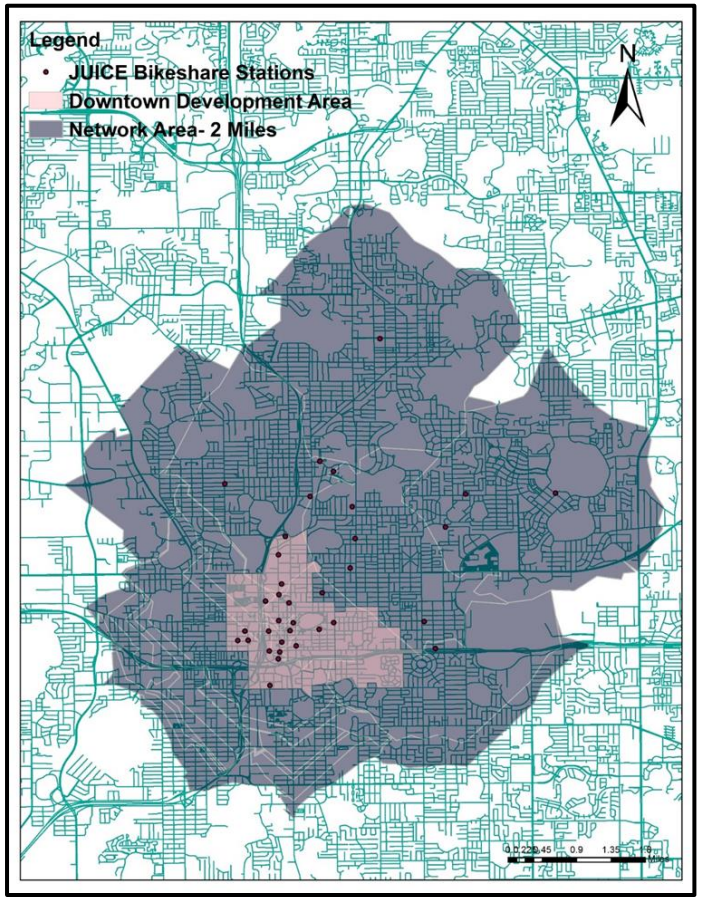


Control Area

I-4 Expansion

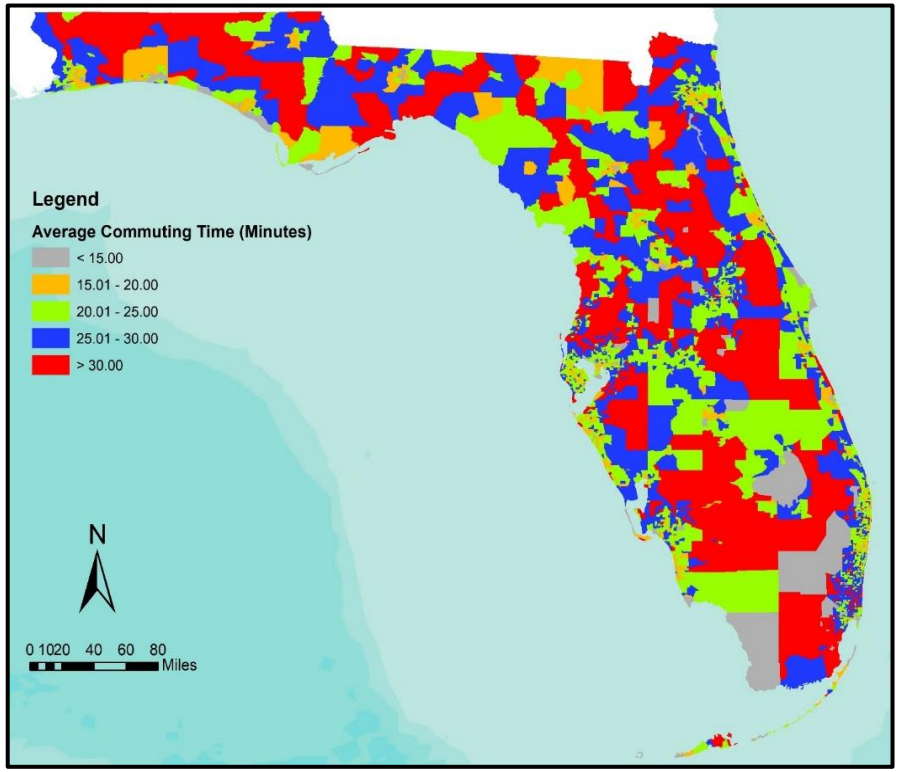
JUICE Orlando Bikeshare

- Instead of using a 10 minute driving distance, a 2 mile distance band is considered.
- For a flat, paved road in good condition 20 km/h or 12.4 mph is considered as average bike speed. With average speed of 12.4 mph, a bicyclist can travel 2.067 miles in 10 minutes. With 12.4 mph speed a bicyclist can travel in 10 minutes = 12.4*10/60 = 2.067 miles
- Control Area Selection
  - We will limit our comparison analysis between downtown and non-downtown stations



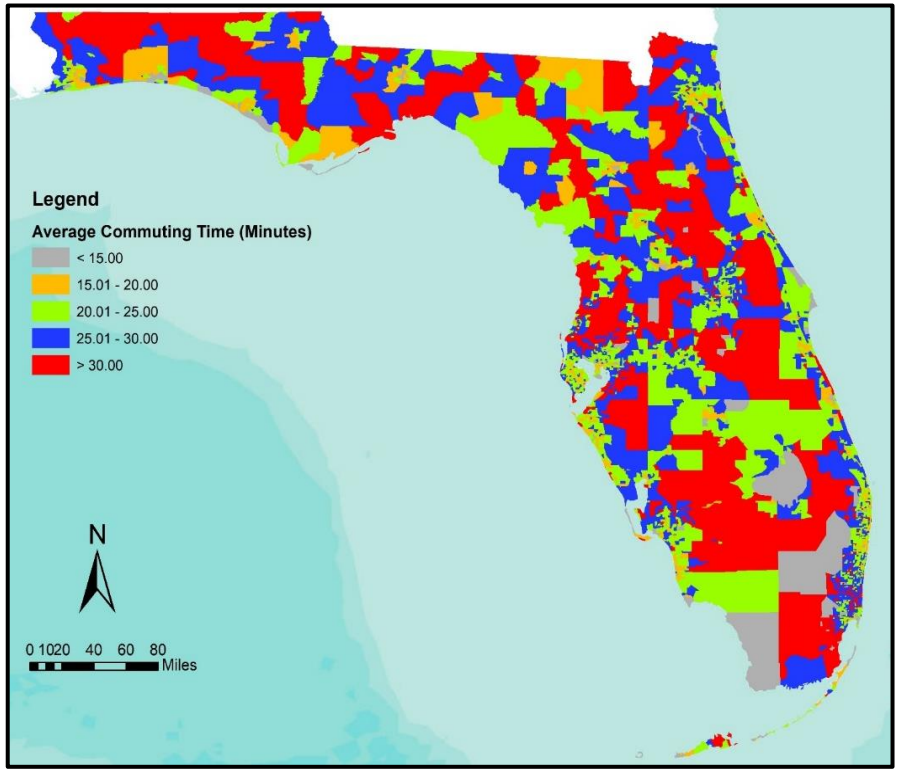
Measure 3: Commuting Time Change

- Commuting time refers to journey to work in minutes
- The data for average commuting time per census tract of Florida for 2011-2016 was extracted from American Community Survey (ACS)
- Case group areas
  - Census tracts within 1-mile radius of the station buffers/I-4 Expansion were selected
  - Using proximity analysis each census tract was assigned to one unique station/I-4 segment
  - After assigning all census tract to a unique station/I-4 segment, we compute the average commuting time for each station



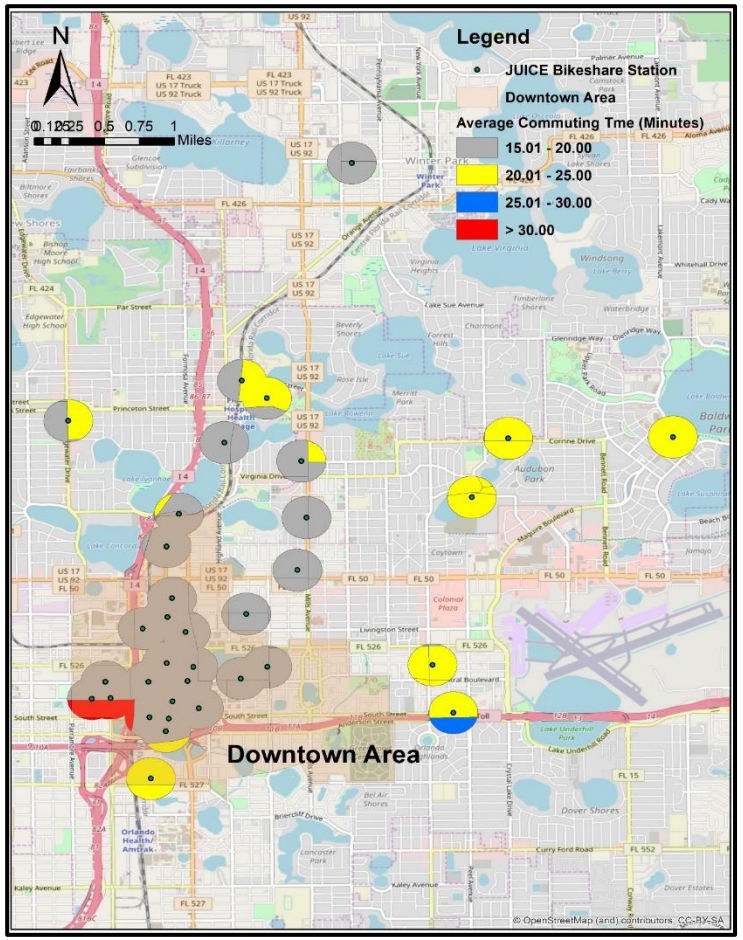
Measure 3: Commuting Time Change

- Control Area Selection
  - **First**, we created 2 and 8 mile buffer, respectively around the stations/I-4 segment. The census tracts located within that 6-mile buffer were selected to be the candidate control census tracts
  - **Second**, based on the similarity of population density and percentage of mode shares (with a range of 15% of the mean population density and 5% of the mean mode share within the case areas), control census tracts for analysis were identified



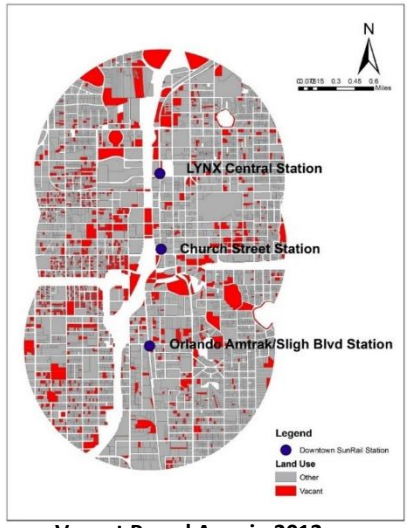
JUICE Orlando Bikeshare

- Case group areas (census tracts) within 250-m radius of the station buffers were selected
- Using proximity analysis each census tract was assigned to one unique station
- After assigning all census tract to a unique station, we compute the average commuting time for each station
- It can be seen from the Figure that downtown area stations have average commuting time of 17 to 21 minutes
- The procedure will repeated for creating layers for other years.
- Control Area Selection
  - Comparing downtown stations with non-downtown stations.

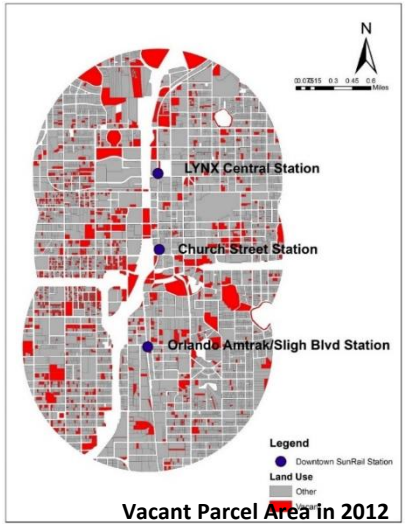


Measure 4: Land Use Type Change

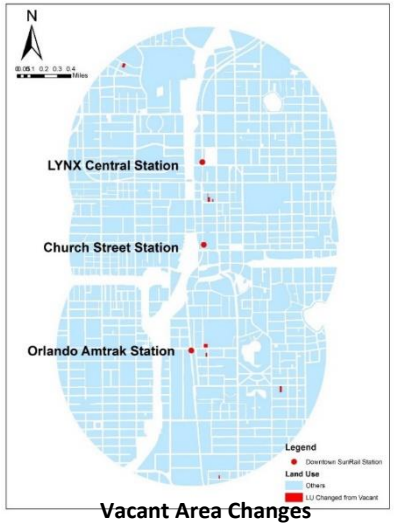
- Case group areas (census tracts) within 1-mile radius of the station buffers/I-4 expansion were selected
- We identified the vacant parcels for the years two consecutive years respectively
- Vacant parcels changed from vacant to other land use categories in 2nd year were identified
- Aggregated the area of the transformed parcels by land use type for each SunRail station/ I-4 expansion area



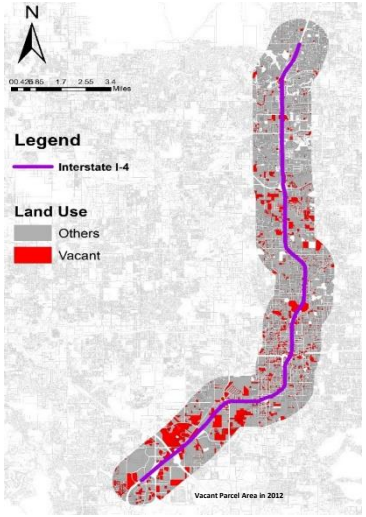
Vacant Parcel Area in 2012



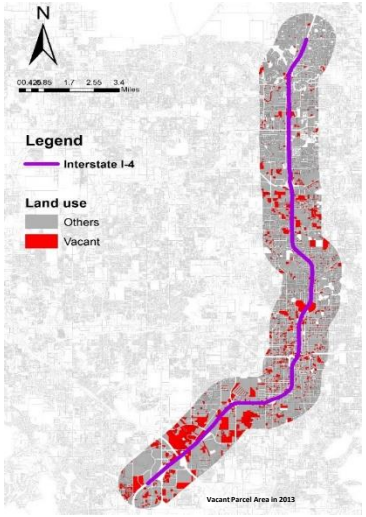
Vacant Parcel Area in 2013



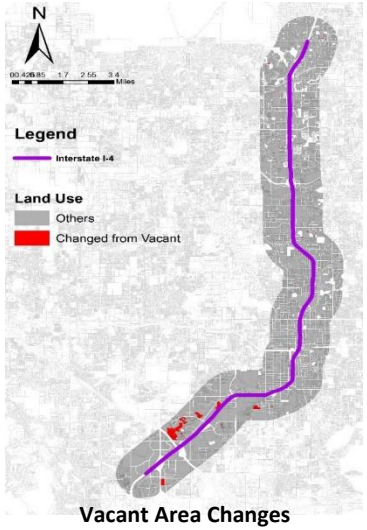
Vacant Area Changes from 2012 to 2013



Vacant Parcel Area in 2012



Vacant Parcel Area in 2013



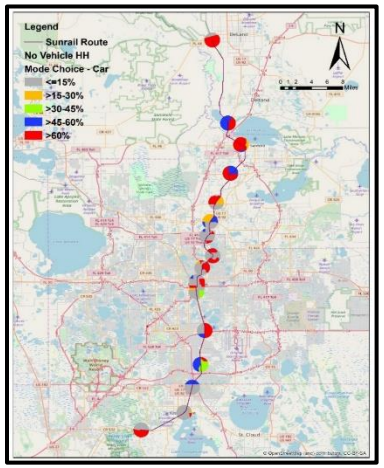
Vacant Area Changes from 2012 to 2013

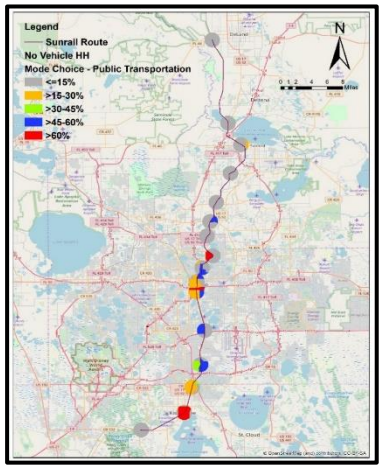
Measure 5:Travel Pattern for Zero Car HH

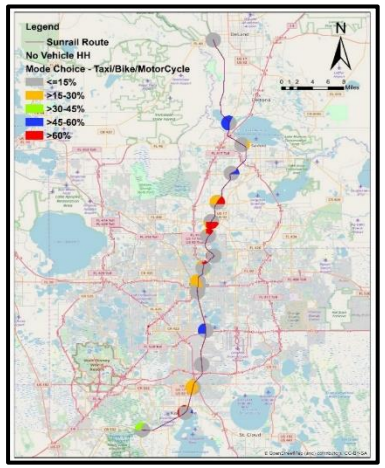
- The alternatives provided for mode choice are:
  - Car, truck, or van - drove alone
  - Car, truck or van - carpooled
  - Public transportations
  - Walk
  - Taxicab/bike/Motorcycle

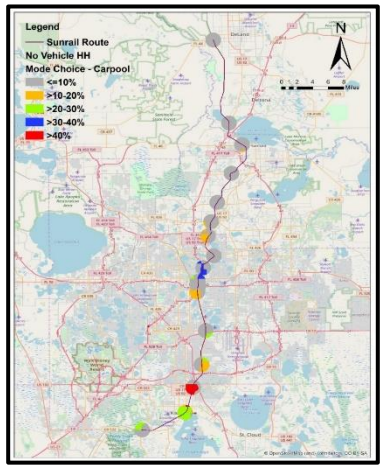
SunRail Station

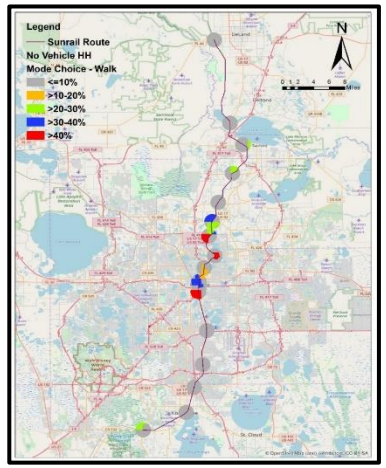
- First, case areas were selected by using 1-mile buffer.
- Second, the average percentage of each mode used by workers of zero vehicle households for each station was computed.
- Control area selection:
  - The selection procedure of control area around SunRail Stations is similar to procedure used for commuting time.
- Observation: Downtown station areas are likely to consider mixed mode systems while non-downtown station areas are predominantly car reliant.





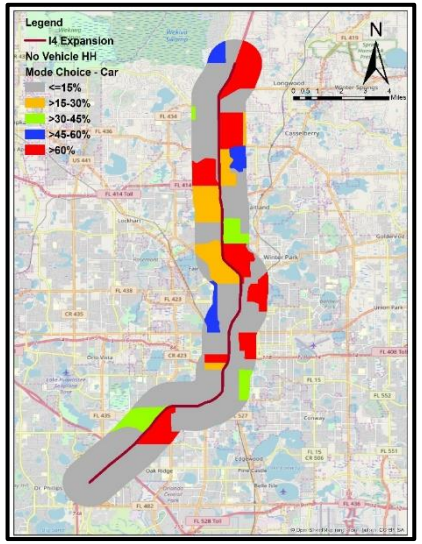


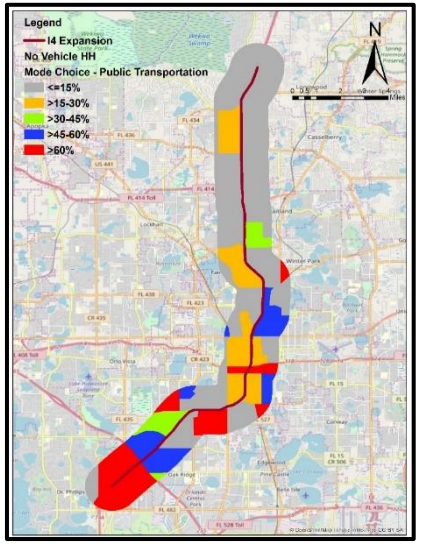


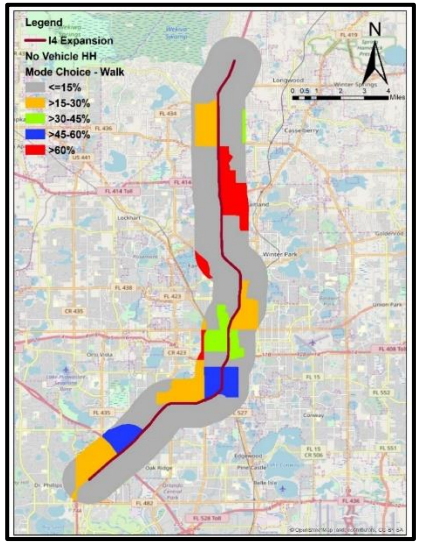


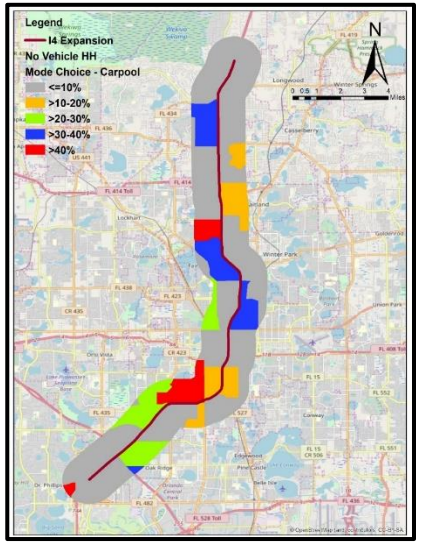
I-4 Expansion

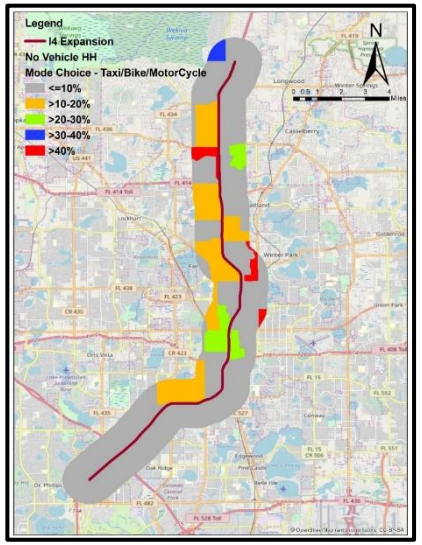
- The same procedure of using 1-mile buffer around SunRail stations is applied for I-4 expansion area buffer for four different segments (Attraction, Downtown, Ivanhoe and Altamonte).
- Control Area Selection: Same as SunRail Station.
- Observation: Downtown area had the variation on mode choice distribution while other areas are car reliant.





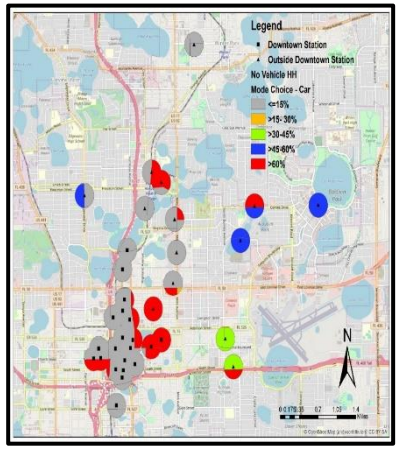


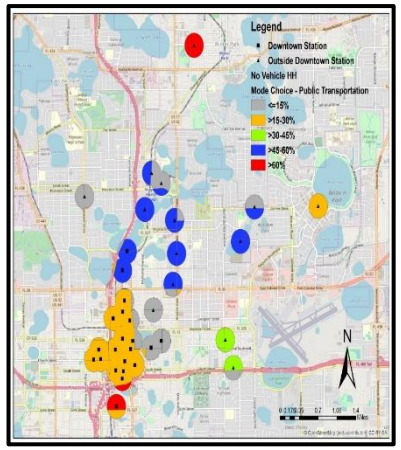


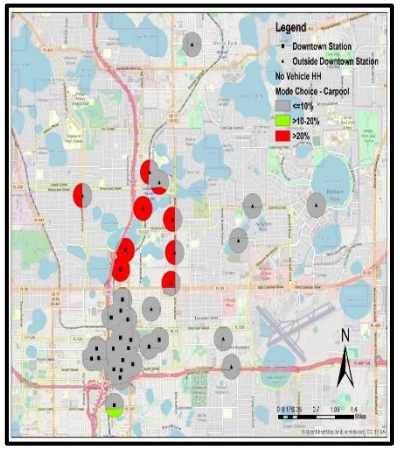


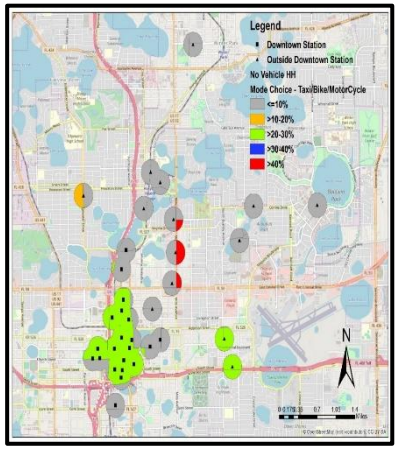
JUICE Orlando Bikeshare

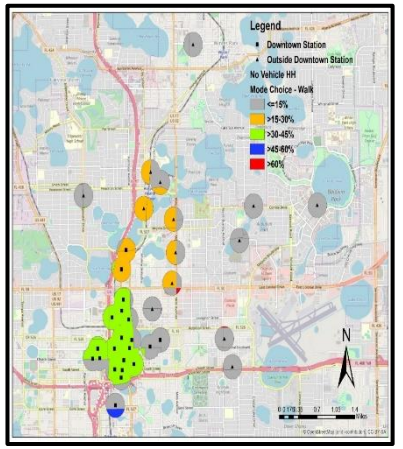
- A 250-meter buffer was created for estimating average mode distribution within the bikeshare station.
- The analysis is limited to comparing the changes between downtown and non-downtown stations.
- Downtown and outside downtown areas exhibit higher usage of public transportation relative to other modes.
- The results also highlight about 20% share has been distributed among walk and taxi/bike/motorcycle category for both groups.
- Public transportation is the preferred mode for zero car household workers.









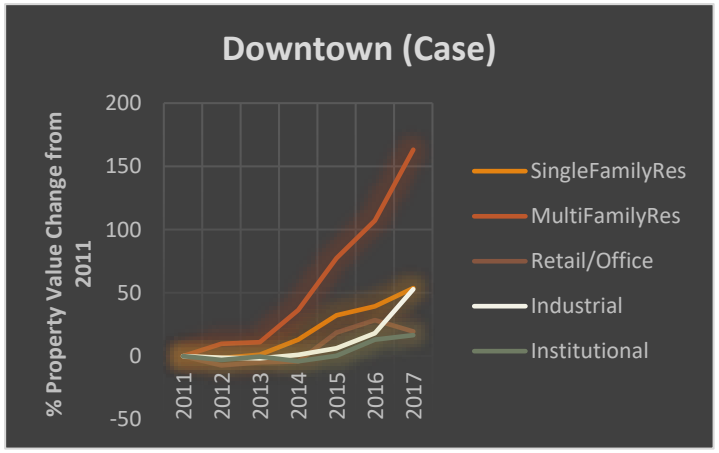


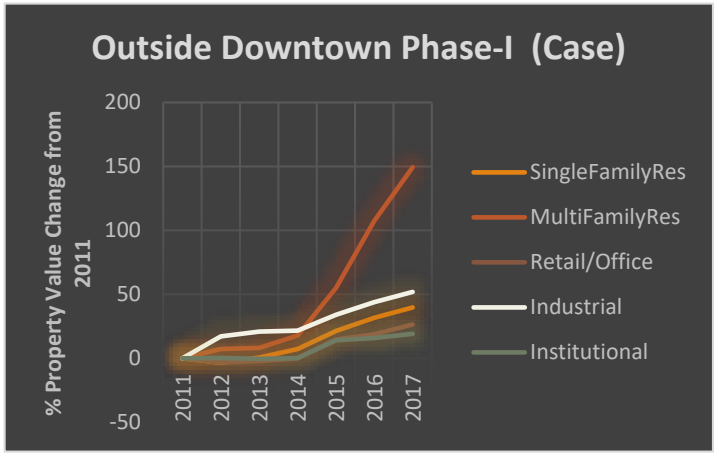
MOE Results by Project

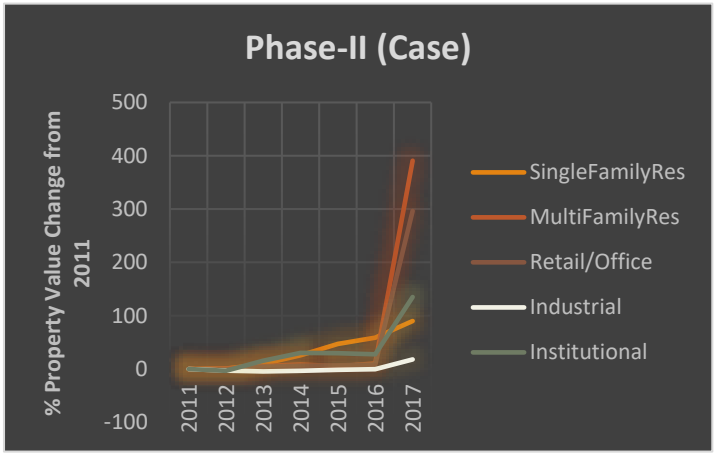
1. Property Value Variation (SunRail)

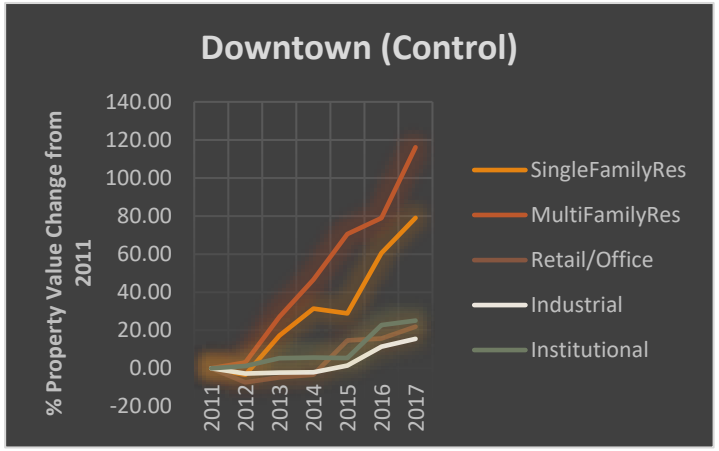
- Property value for all land use types increase significantly from year 2014.
- The improvement in the local economy coupled with the opening of SunRail stations may be responsible for the increase.
- The trends highlight that the increase is almost 140% for multi-family residential land use type from 2014 for downtown and outside downtown stations.
- Phase 2 stations show more than 300% increases for multi-family and office land use type for 2017 .
- The general trend for control parcels is also found to be similar to the case parcels.
- However, the magnitude of change is substantially different from changes to case parcels.

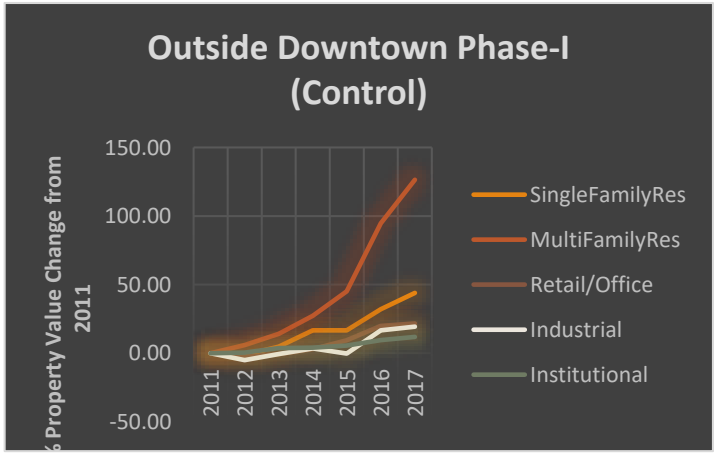
1. Property Value Variation (SunRail)

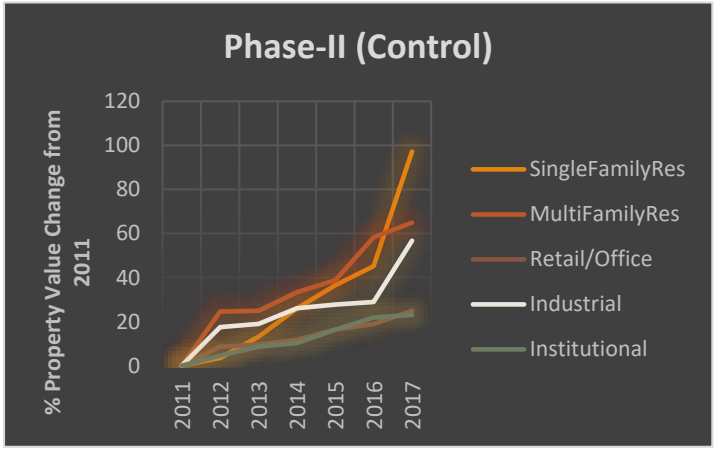








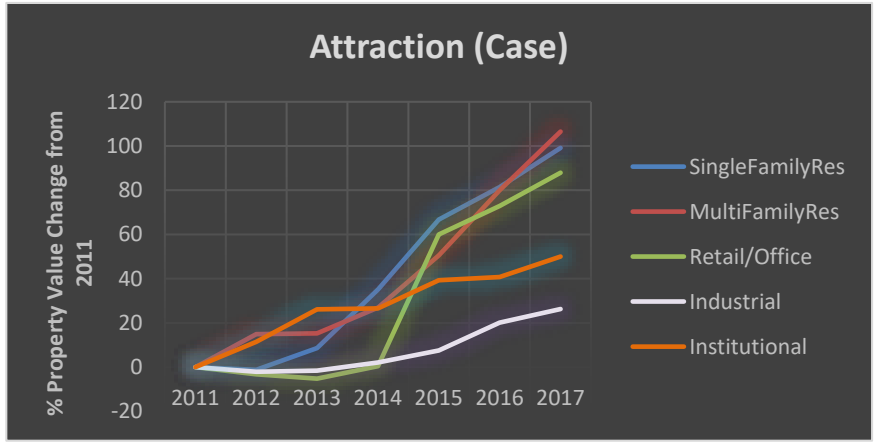


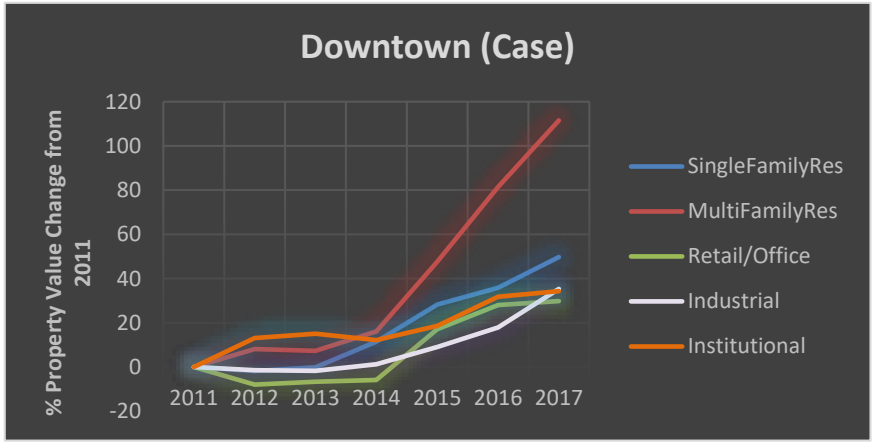


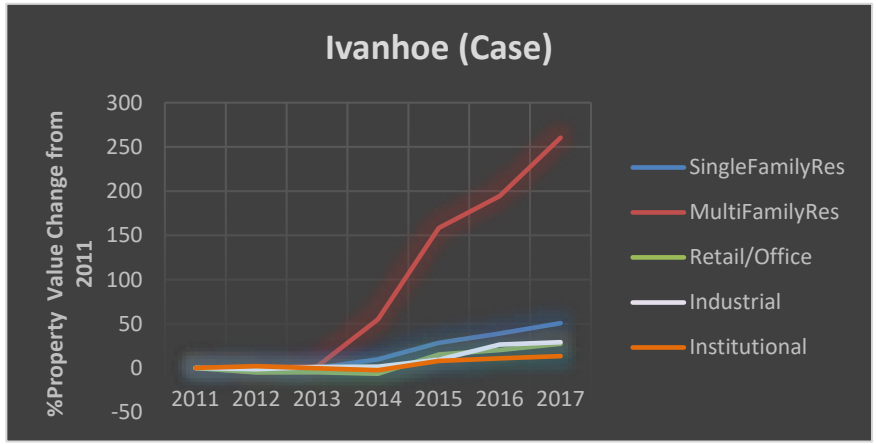
1. Property Value Variation (I-4 Expansion)

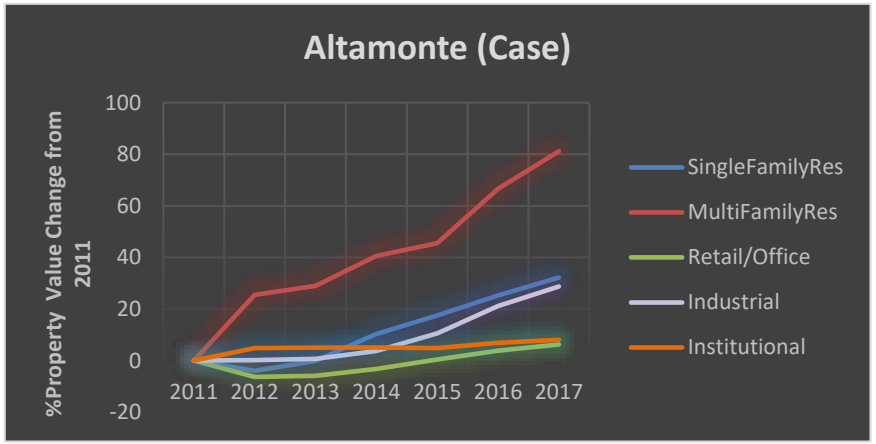
- Across all sections, multifamily land use type parcels have experienced significant price increases.
- For the Ivanhoe section, the increase in multifamily land use type is quite large (nearly 250%) while for other sections increases are about 100%.
- For control parcels, the change in property values offer trends very similar to the case parcels.
- For Attraction and Altamonte control buffer, multifamily residential property value increased by around 125% from 2014 to 2017 that was around 40% for case buffer.

1. Property Value Variation (I-4 Expansion)

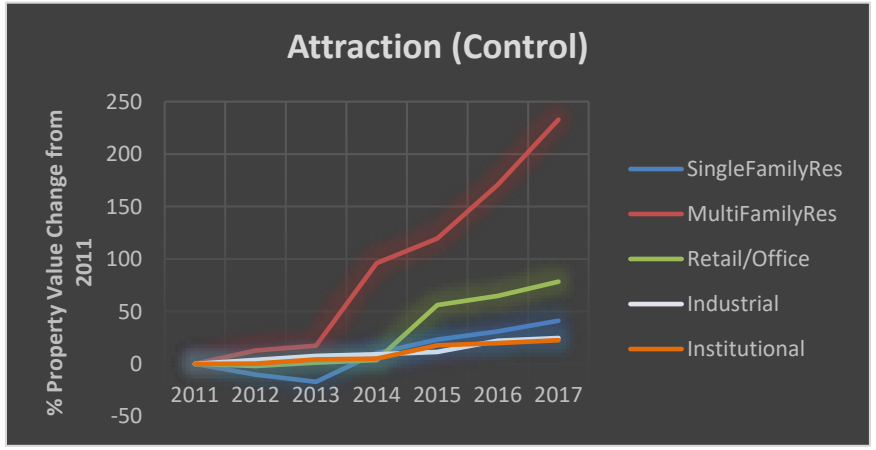


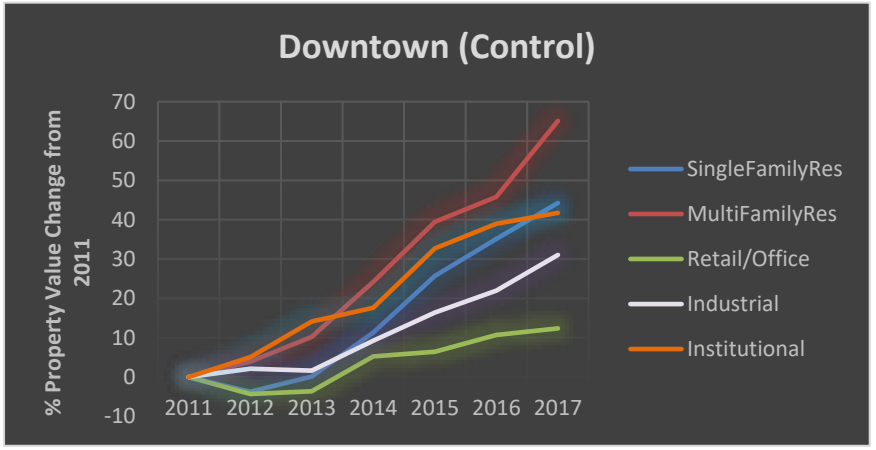


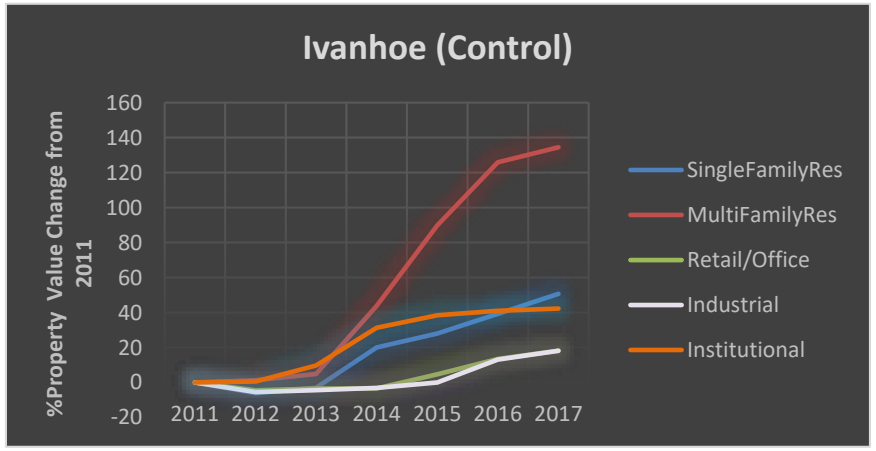


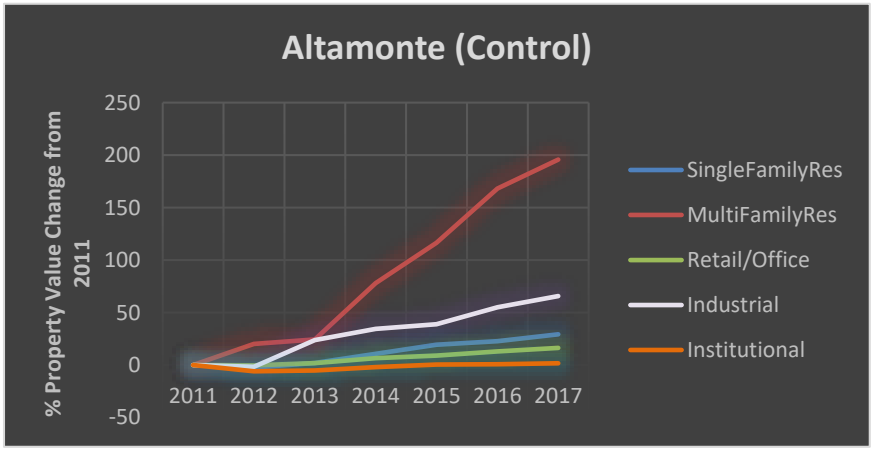


1. Property Value Variation (I-4 Expansion)



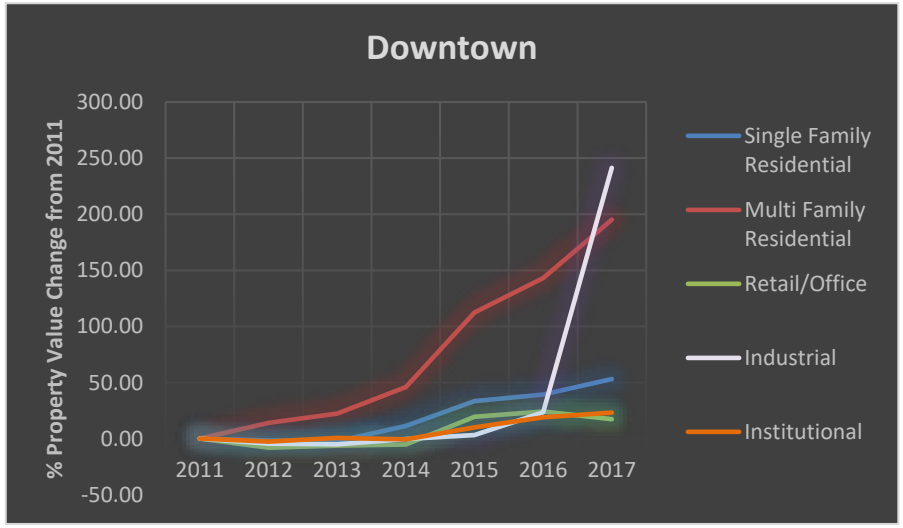


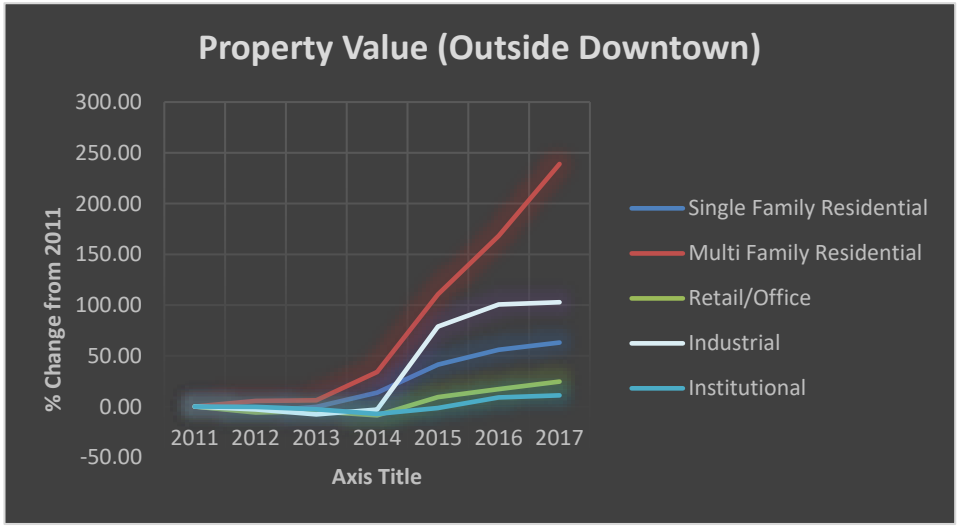




1. Property Value Variation (JUICE)

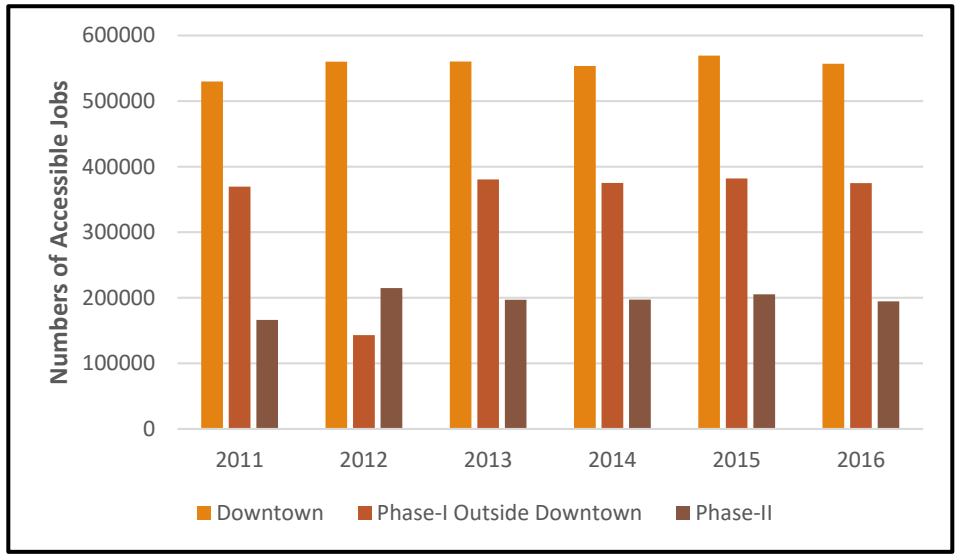
- The property increase trends are similar to the results from previous analysis for downtown regions.
- A significant increasing trend is observed for multi-family land use type across years (nearly 200% increase).
- The only anomaly is the substantial spike in price for industrial land-use in 2017 that sudden increase is more than 200%.



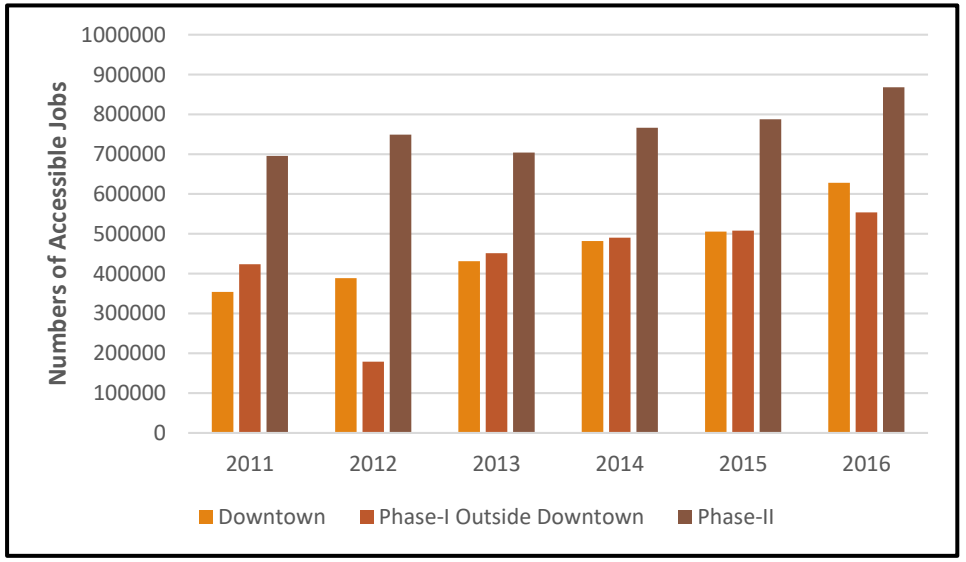


2. Accessibility to Jobs (SunRail)

- For case region, the number of accessible jobs from downtown stations are substantially higher than other two regions.
- The trends reveal a reversal of the trends for control parcels. Specifically, the highest job accessibility is observed for Phase II.



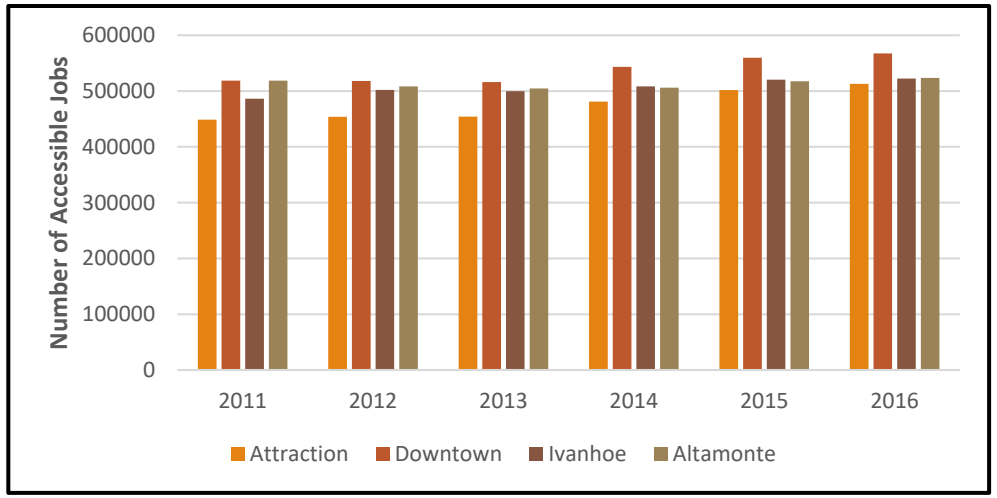
Case



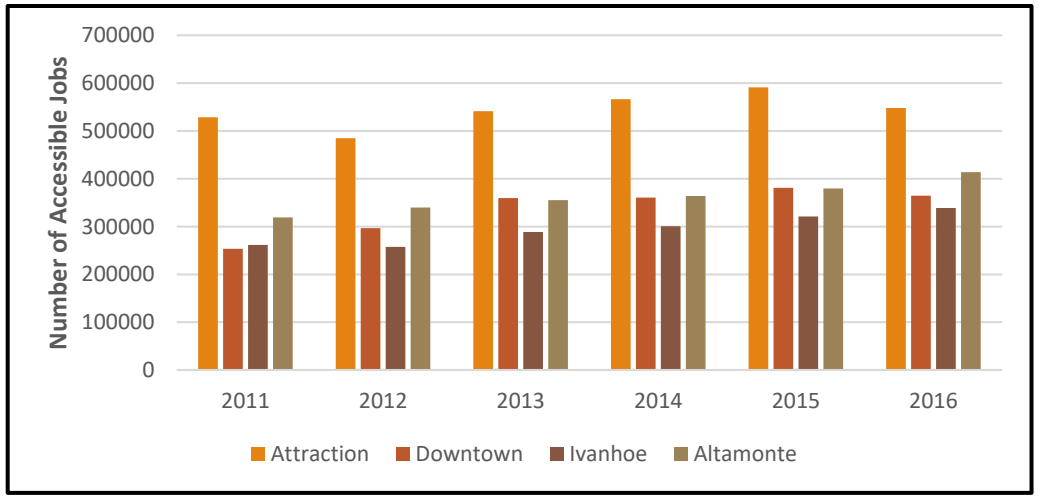
Control

2. Accessibility to Jobs (I-4 Expansion)

- Threshold segment of downtown has higher job accessibility followed by Ivanhoe segment from 2011 to 2016.
- Attraction region experienced substantial increase in job accessibility over the study period.
- For control areas, Attraction segment has 200,000 more job accessibility than second highest zone of Altamonte at 2011 while the difference reduced to 100,00 in 2017.
- Similar to the SunRail case, there is no clear increase in job accessibility as a result of the I4 project



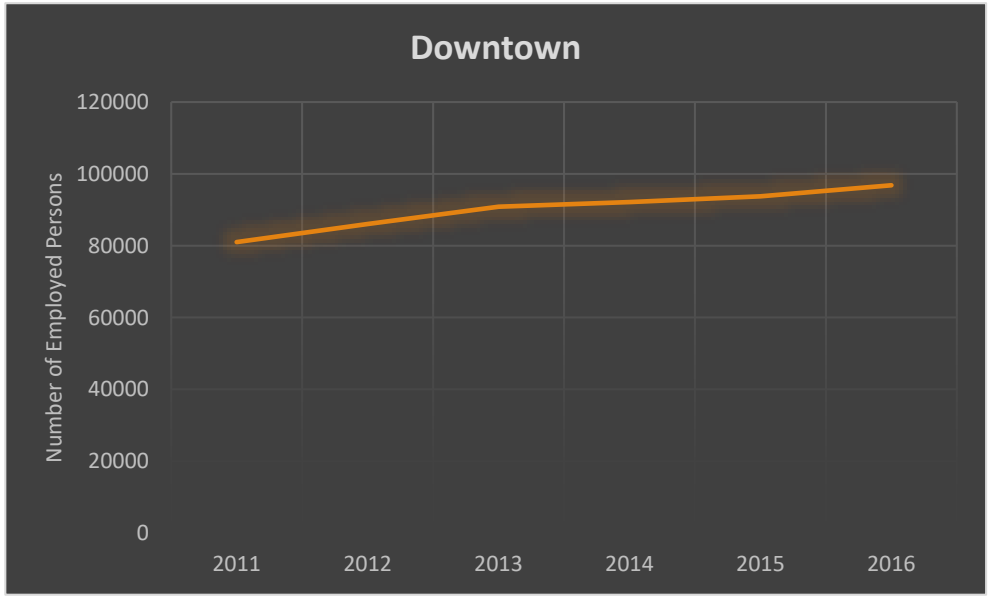
Case

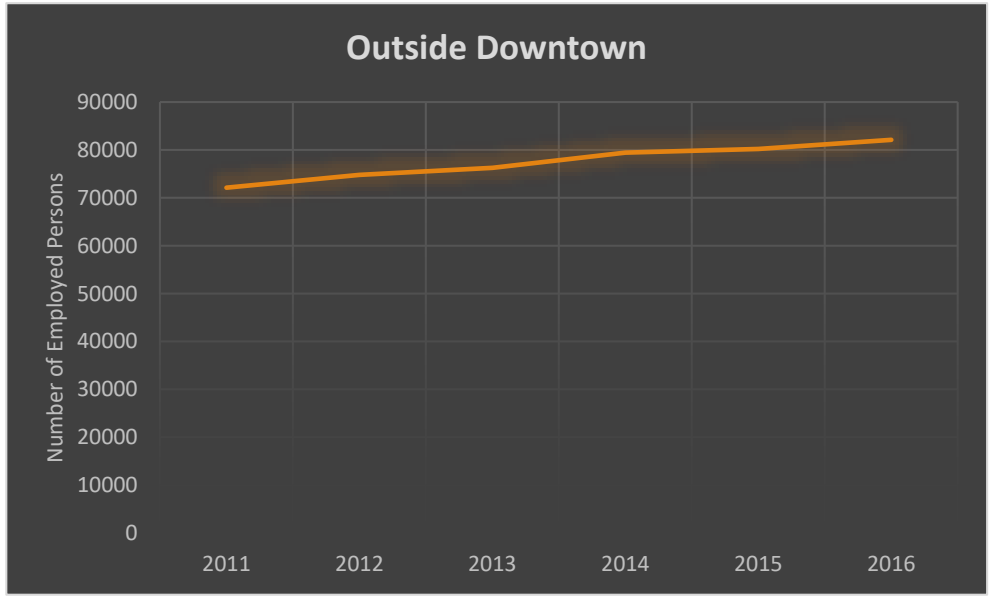


Control

2. Accessibility to Jobs (JUICE)

- The average number of accessible jobs in downtown area has gradually increased across years from around 82,000 to 97,000.
- The average number of accessible jobs from outside downtown stations is increased in a gradual manner across the years from 72,000 to 82,000.



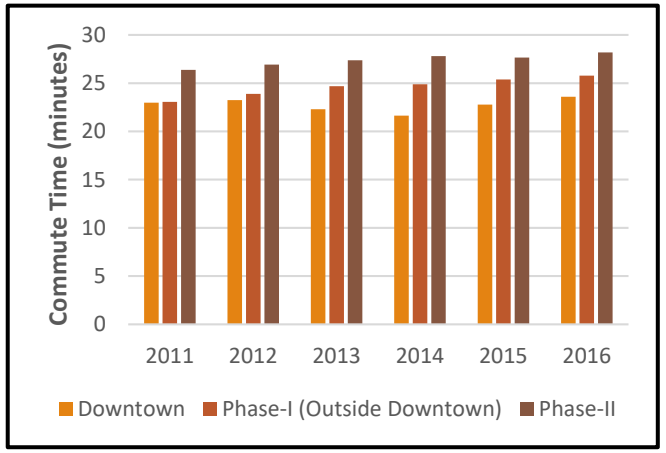


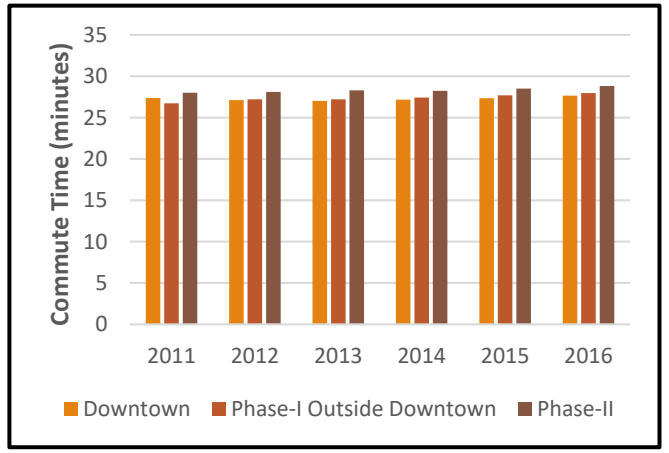
3. Commuting Time Variation

- SunRail Station
  - Commuting time of downtown stations is lower than the commuting time for the other two case areas. Car, truck or van - carpooled
  - Phase-II stations have longer commute times compared to the other regions.
  - Commute times around SunRail stations are consistently lower than the corresponding values from control areas.
- I-4 Expansion
  - Census tracts in case locations have lower commute times compared to the census tracts from control locations.
- Juice Orlando Bikeshare
  - In the earlier years of the study period, commute times were longer for downtown stations
  - Over time, the differences have narrowed significantly.

3. Commuting Time Variation

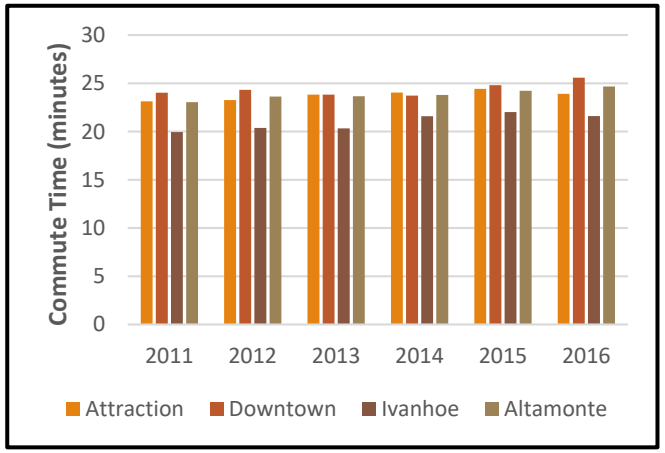
SunRail Case

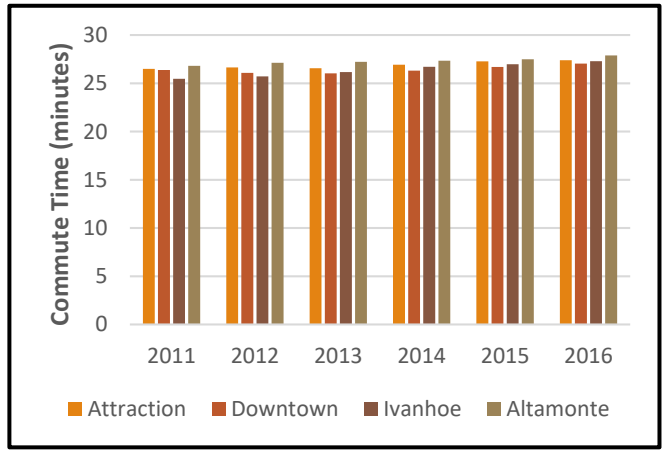




SunRail Control

I-4 Case





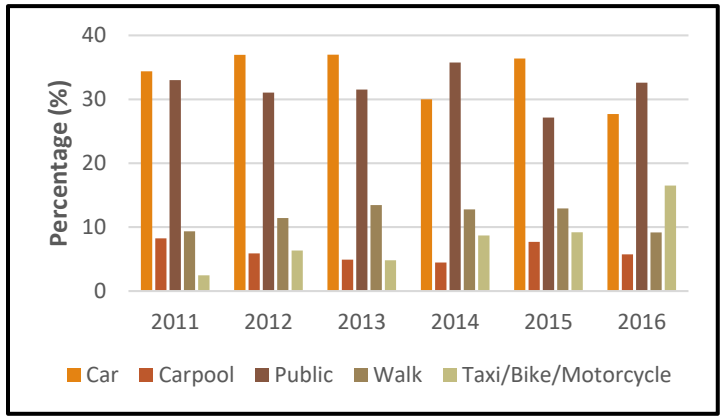
I-4 Control

4. Land Use Variation

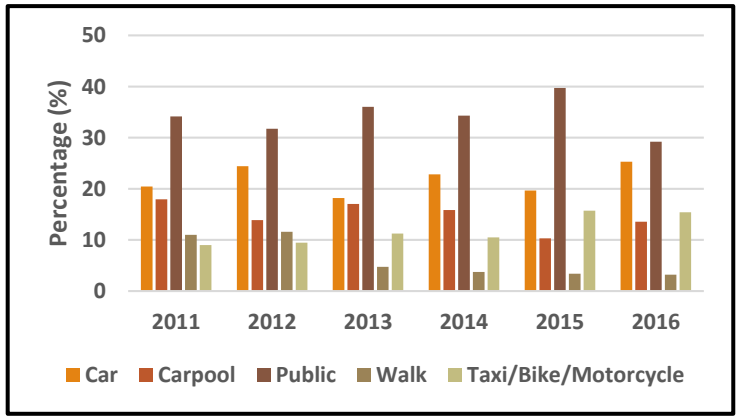
- SunRail Station:
  - Single family residential and office are the major land use type that converted from vacant each year for all three case buffers.
  - Similar to case buffer, single family residential and office area are the major land use type conversions from vacant type.
- I-4 Expansion:
  - Single family residential and office area are the major land use type conversions from vacant area for each year.
  - The results are quite similar for control area.
- Juice Orlando Bikeshare:
  - Very small percentage of area for each land use type has changed for both downtown and outside downtown parcels.
  - Within these small changes, office area is the major land use type changing from vacant type.

5. Travel Pattern Variation (SunRail)

- Use of public transport increased by 10% and 5% around downtown and Phase-II stations respectively from 2015.
- Taxi or bike or motorcycle have increased by almost 14% around downtown stations from 2011 to 2016.
- Public transportation use has reduced by 5% around downtown control buffer area.
- For downtown control taxi or bike or motorcycle mode have increased by 5%.



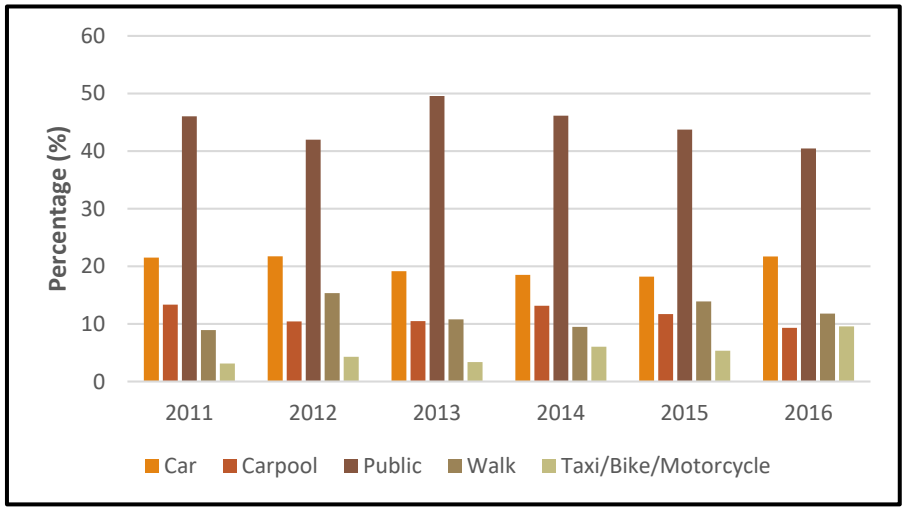
Downtown Case



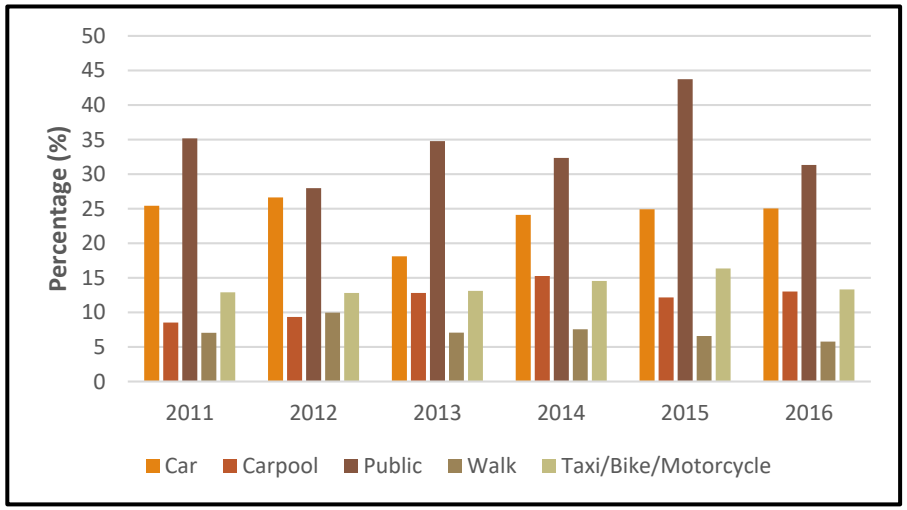
Downtown Control

5. Travel Pattern Variation (I-4 Expansion)

- For households with zero vehicles, public transportation is the main mode of transportation in attraction and downtown regions.
- The results for control segments indicate that for downtown region, the share of public transportation is lower.



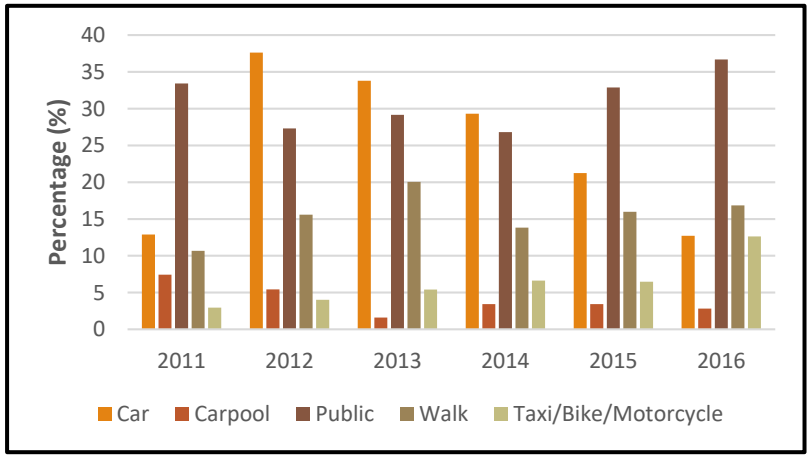
Downtown Case



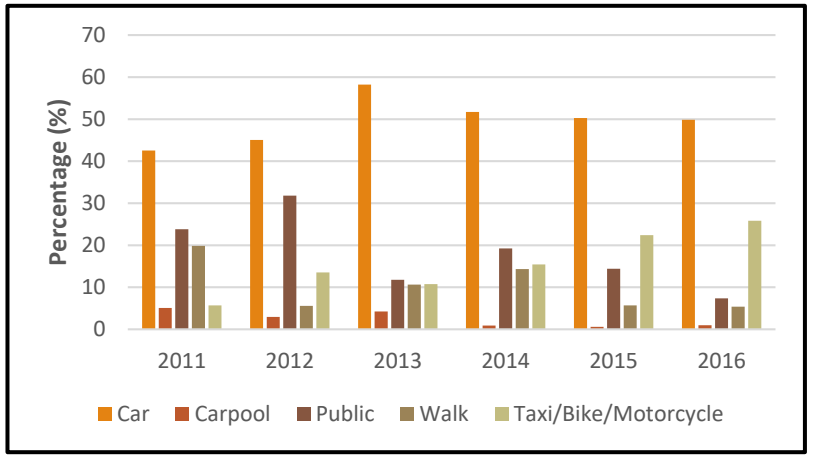
Downtown Control

5. Travel Pattern Variation (JUICE)

- Share of public transportation presents an increasing trend for downtown while showing a decreasing trend for non-downtown buffer areas.
- Taxi/bike/motorcycle mode share increased by around 10% and 20% respectively for downtown and outside downtown stations' buffer.
- Walk mode has increased by 5% for downtown and reduced by 15% for outside downtown stations buffer.



Case Buffer Area



Control Buffer Area

Conclusion

- 3 projects e.g. SunRail commuter rail extension, I-4 expansion and JUICE Orlando Bikeshare was considered for evaluating community building impacts
- Five Measures of Effectiveness (MOE) considered to evaluate impact of these three projects around their corresponding neighborhood
- Presented data preparation steps for MOE generation
- Generated and compared the values for case and control over multiple years
- In the upcoming webinar (3), we will present project benefit evaluation using the MOEs generated based on multi criterion decision making
- Webinar 2 will provide information on social media

Acknowledgements

- Former research team members
  - Sabreena Anowar
  - Bibhas Kumar Dey
  - Tanmoy Bhowmik

Questions