Alternate Methodologies for Origin-Destination Data Collection

presented by

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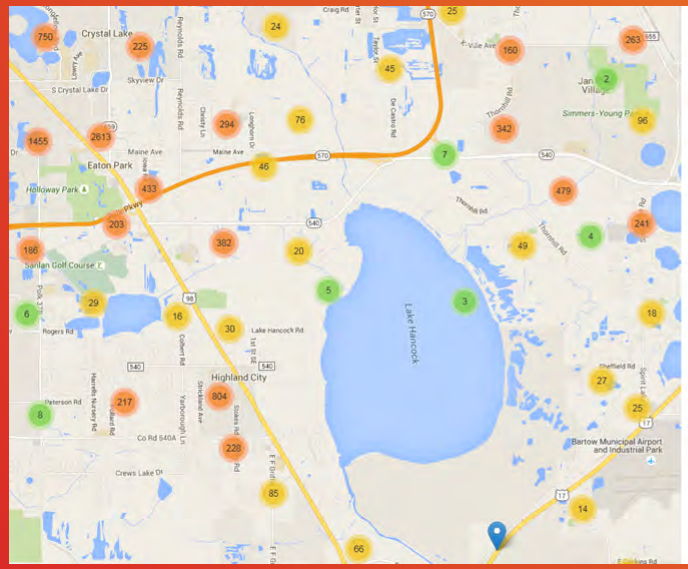

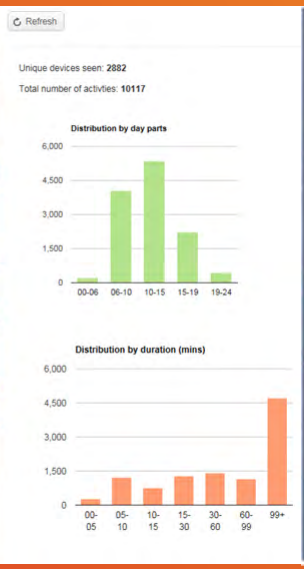

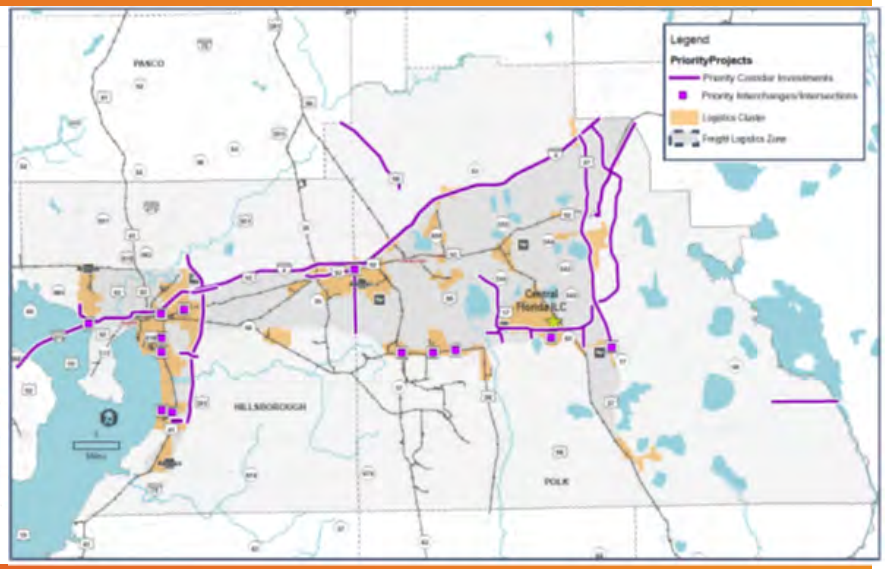

Tennessee Model Users Group

February 6, 2017

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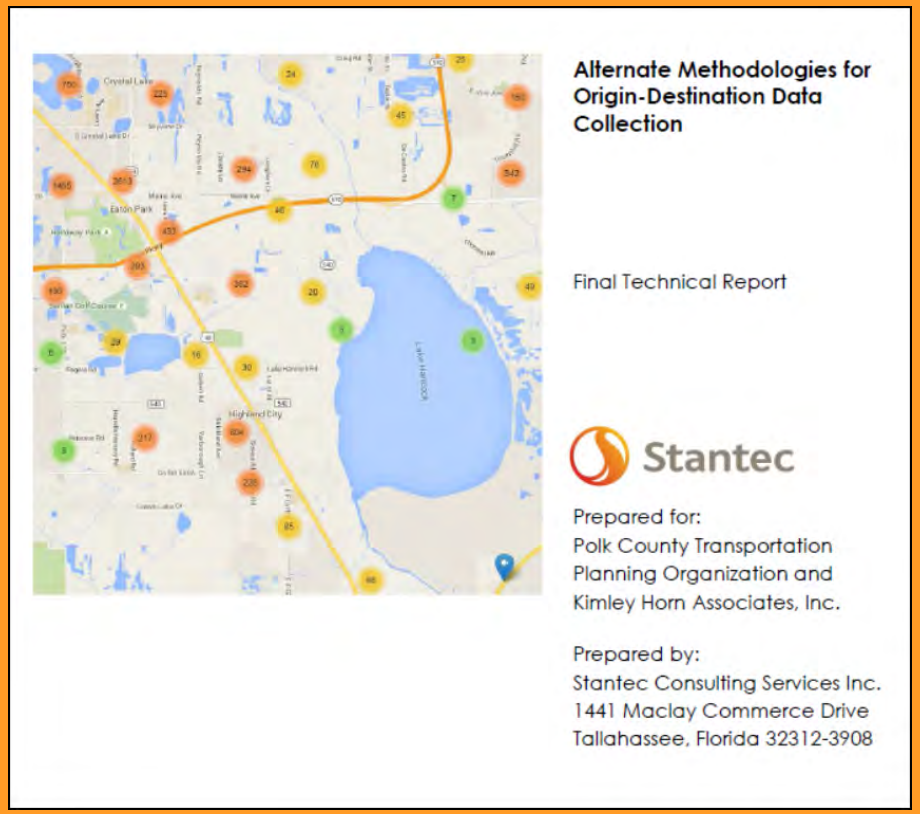
Presentation Overview

- Background – Polk County TPO Phase I
- Methods
- Pros & Cons
- Polk County TPO Implementation Phase II – underway
- Recent Stantec Studies using StreetLight Data
- Acknowledgements



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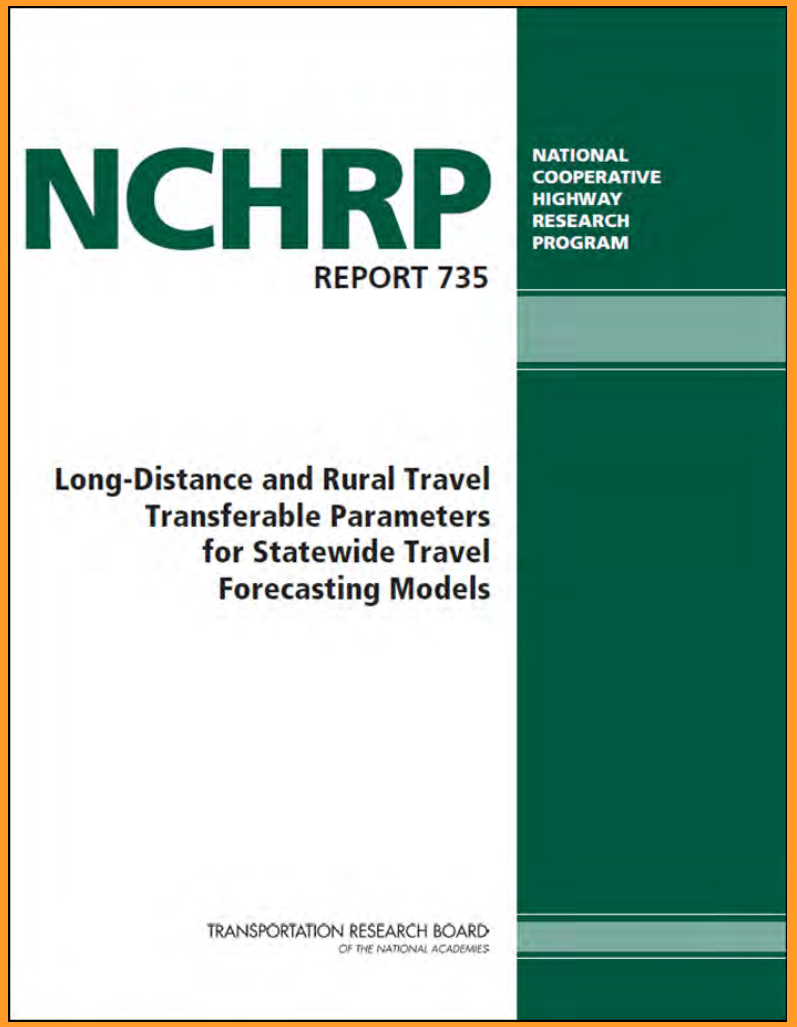
Background

- Polk County Transportation Planning Organization Task Order
- Stantec experience with methodologies for Traffic & Revenue Studies
- Author's prior personal experience with alternate methodologies
- Vendor contacts, demos, and examples, *circa Fall 2015*



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Methods

- Tag Matching with High Speed Videotaping of License Plates
- Positioning of Bluetooth Readers to Match Devices
- Tracking of Anonymous Cellular Data
- Truck GPS Tracking
- Aerial Tracking of Vehicles
- GPS Data Extraction

Table D.2. Capabilities of various new and emerging technologies.

Information Needs	Traditional Methods	GPS	Smartphone	License Plate	Bluetooth	Cell Phone	Web-Based	Social Media/ Networking
Origin-Destination	Y	Y	Y	Y	Y	Y	Y	Y
Mode: Main/Access/Egress	Y	M	Y	Y-auto	Y-auto	Y	Y	Y
Trip Purpose	Y	M	Y	M	N	M	Y	Y
Routes	Y	Y	Y	Y	Y	Y	M	M
Trip Frequency	Y	Y	Y	Y	Y	Y	Y	Y
Travel Season	Y	Y	Y	Y	Y	Y	Y	Y
Trip Duration	Y	Y	Y	Y	Y	Y	Y	Y
Itinerary and Side Tours	Y	Y	Y	M	M	M	Y	Y
Trip Cost and LOS	Y	M	M	M	M	M	Y	Y
Travel Party Size	Y	M	M	M	M	M	Y	Y
Traveler Characteristics	Y	M	M	M	N	M	Y	Y
Domestic or International	Y	M	M	N	N	N	Y	Y
Other Considerations								
Passive Data Collection	N	Y	M	M	Y	Y	N	M
Major Privacy Concern	M	M	M	N	N	M	Y	Y
High-Respondent Burden	Y	M	M	N	N	N	Y	Y
Sampling Bias	M	M	M	N	Y	M	Y	Y
Sufficient Sample Size	M	M	Y	Y	M	Y	Y	Y

Note: "M" (maybe) implies that although the information cannot be directly collected with a specific technology, it may be estimated based on other data sources and/or data post-processing algorithms.

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Methods (cont'd)

- Tag Matching with High Speed Videotaping of License Plates
  - Numerous data collection firms have needed equipment
  - Videotaping of license tags along cordon line; typically one camera per lane
  - Transcription of license tags into a database
  - Matching of tags passing through multiple points, during a specified duration
  - Simultaneous traffic counts to identify percent of trips captured by video
  - Optionally, using tag information to contact vehicle owners to participate in follow-up survey (no longer passive)

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Methods (cont'd)

- Positioning of Bluetooth Readers to Match Devices
  - Numerous data collection firms have needed equipment – purchase or leasing of Bluetooth readers
  - Permanently affix Bluetooth readers for continuous tracking or install temporarily for specific study
  - Anonymous identification of Bluetooth devices that pass through 2 or more points in a specified period of time
  - Simultaneous traffic counts to identify percent of trips captured via Bluetooth readers

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Methods (cont'd)

- Tracking of Anonymous Cellular Data (AirSage)
  - AirSage has contracts with two major U.S. cellular providers to continuously retrieve and analyze anonymous cellular devices
  - Algorithms are used to triangulate locations of each device
  - Data retrieval can occur at multiple locations along the path the device is following
  - Flexibility to analyze the data by number of days, days of the week, different locations and study areas, etc. though AirSage has established minimum number of days threshold

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Methods (cont'd)

- Truck GPS Tracking (ATRI)
  - Outgrowth of American Transportation Research Institute's (ATRI) research for the nation's trucking industry
  - Continuous tracking and collection of a sample of truck GPS signals
  - Similar to AirSage, data retrieval can occur at multiple locations along the path the device is following
  - Flexibility to analyze data by number of days, days of the week, different study areas and corridors, etc.

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Methods (cont'd)

- Aerial Tracking of Vehicles (Skycomp)
  - Skycomp deploys aircraft to take high definition aerial photos of traffic in a specified study area
  - Photos are subsequently analyzed by Skycomp staff to trace travel patterns of individual vehicles
  - Skycomp then prepares an estimated origin-destination matrix and distribution percentages among multiple entry and exit points

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Methods (cont'd)

- GPS Navigation Extraction (StreetLight Data)
  - StreetLight Data has partnered with INRIX to use their database of GPS navigation data
  - While INRIX uses these data for estimating travel speeds, StreetLight Data uses these same data for origin-destination matrix estimation
  - Since commercial fleet navigation systems use different technologies from personal vehicles, trips can be differentiated by vehicle type (auto vs. truck)

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Pros & Cons

- Tag Matching with High Speed Videotaping of License Plates
- Positioning of Bluetooth Readers to Match Devices
- Tracking of Anonymous Cellular Data
- Truck GPS Tracking
- Aerial Tracking of Vehicles
- GPS Navigation Data Extraction

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Pros & Cons (cont'd)

- Tag Matching with High Speed Videotaping of License Plates
  - Pros: collection of license tag data does allow for subsequent survey analysis (e.g., sending out a subsequent postcard survey with help of DMV)
  - Cons: Videotaping and matching of license tags is potentially expensive and cumbersome

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Pros & Cons (cont'd)

- Positioning of Bluetooth Readers to Match Devices
  - Pros: Bluetooth data collection does allow for the flexibility of one time use or continuous data collection at established sites at a lower cost than videotaping plates
  - Cons: Matching Bluetooth movements is still limited to enabled devices and unlike cellular flows, Bluetooth is limited to locations where readers are located

Table 2. Example Output from BlueTOAD (Source: TrafficCast BlueTOAD)

Origin	Destination	Waypoint	Map/Graph Color	Number of matches	Percentage of matches
I-295 & SR-15 (Park Ave) (u1118 POE)	I-295W (NB) @ I-95	I-295 & SR-228 (Normandy Blvd) (u1276 POE)		713	8.19%
I-295 & SR-15 (Park Ave) (u1118 POE)	I-295W @ US1 (Kings Rd)	I-295 & SR-228 (Normandy Blvd) (u1276 POE)		1309	15.04%
I-295 & SR-15 (Park Ave) (u1118 POE)	I-295 & SR-228 (Normandy Blvd) (u1276 POE)	I-295 & Wilson Blvd (u1279 POE)		6680	76.76%
Total				8702	100%

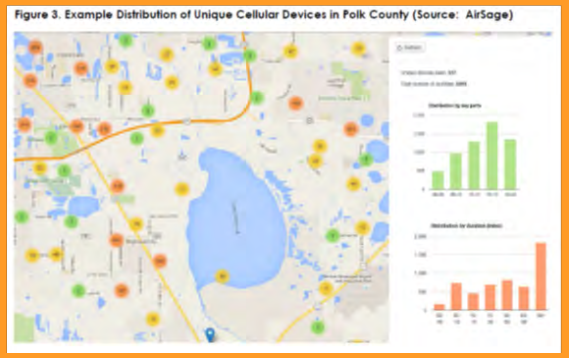
Figure 1. BlueTOAD Map of Example O/D Movements (Source: TrafficCast BlueTOAD)

Pros & Cons (cont'd)

- Tracking of Anonymous Cellular Data (AirSage)
  - Pros: The cost of AirSage data is very inexpensive with a flexible pricing calculator to further refine the data budget and coverage is only limited by cellular provider market penetration
  - Cons: AirSage data only includes two national cellular carriers and thus could be somewhat biased and it is nearly impossible to distinguish vehicle type, travel mode, etc.

Figure 2. AirSage Pricing Calculator (Source: AirSage)

Figure 3. Example Distribution of Unique Cellular Devices in Polk County (Source: AirSage)



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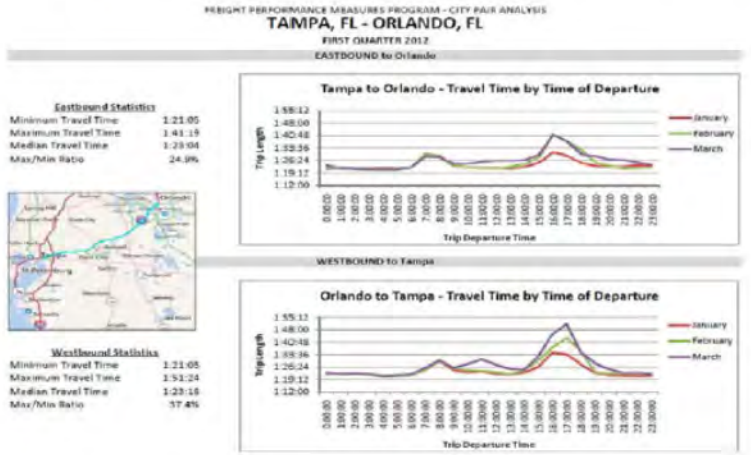
Pros & Cons (cont'd)

- Truck GPS Tracking (ATRI)
  - Pros: As a not for profit research center, the cost of ATRI truck GPS data is inexpensive with a willingness to meet tight budgets
  - Cons: ATRI GPS data are limited to a sample of trucks only; hard to determine percent sample

Figure 5. Truck flows from Miami during a 7-day period. (Source: ATRI)

Figure 6. Truck travel time data between Orlando and Tampa for January-March 2012. (Source: ATRI)



Pros & Cons (cont'd)

- Aerial Tracking of Vehicles (Skycomp)
  - Pros: Skycomp provides a permanent record and also processes data into origin-destination matrices and images of distribution patterns so post-processing is unnecessary
  - Cons: Cost of data collection and extraction can get expensive with multiple dates and time periods

Figure 8. Skycomp Distribution (AM / PM Peak) – Bruckner Expwy NB (Source: SkyComp)

Table 3. Percentage of Origination Volume (Source: SkyComp)

Assignment Line	Origin Code	Total Percentages	SB Destinations						
			1	1A	2	3	4	10	14
AL60	6	100%	81%	2%	6%	10%			
AL62	8	100%	56%	1%	3%	14%	25%		
AL64	12	100%	45%	1%	3%	9%	9%	33%	
AL66	16	100%	61%	2%	3%	8%	8%	11%	8%
AL68	18	100%	56%	1%	4%	14%	7%	16%	2%
AL70	20	100%	64%	0%	2%	12%	6%	11%	5%

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Pros & Cons (cont'd)

- GPS Data Extraction (StreetLight Data)
  - Pros: StreetLight Data is powered by INRIX GPS data so its metrics are based on an unusually large sample size and data can distinguish between autos and trucks
  - Cons: Cost of data extraction can get expensive for a large no. of zones and while less expensive in most cases, StreetLight Data are not as precise as aerial photo tracing (precision issues can be problematic along roadways with extreme congestion, sharp curvature, or dense street patterns)


Figure 9. Example of Density of INRIX GPS signals (Source: StreetLight Data)

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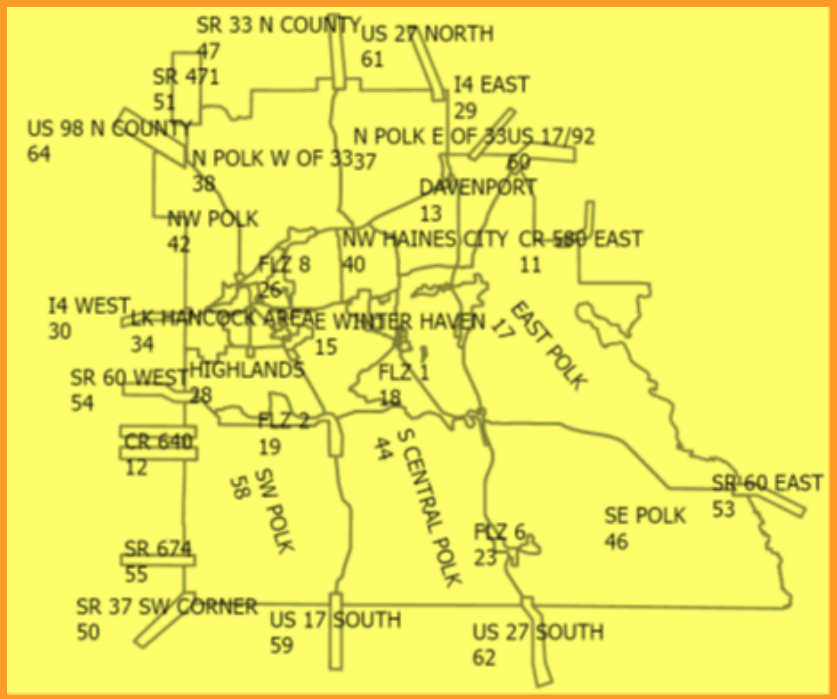
Implementation Phase II – *underway*

- Obtained O/D data from AirSage on passenger travel flows
- Obtained O/D data from the American Transportation Research Institute (ATRI) on truck travel flows
- Analyzed datasets for completeness, accuracy, and usefulness
- Completed draft project documentation



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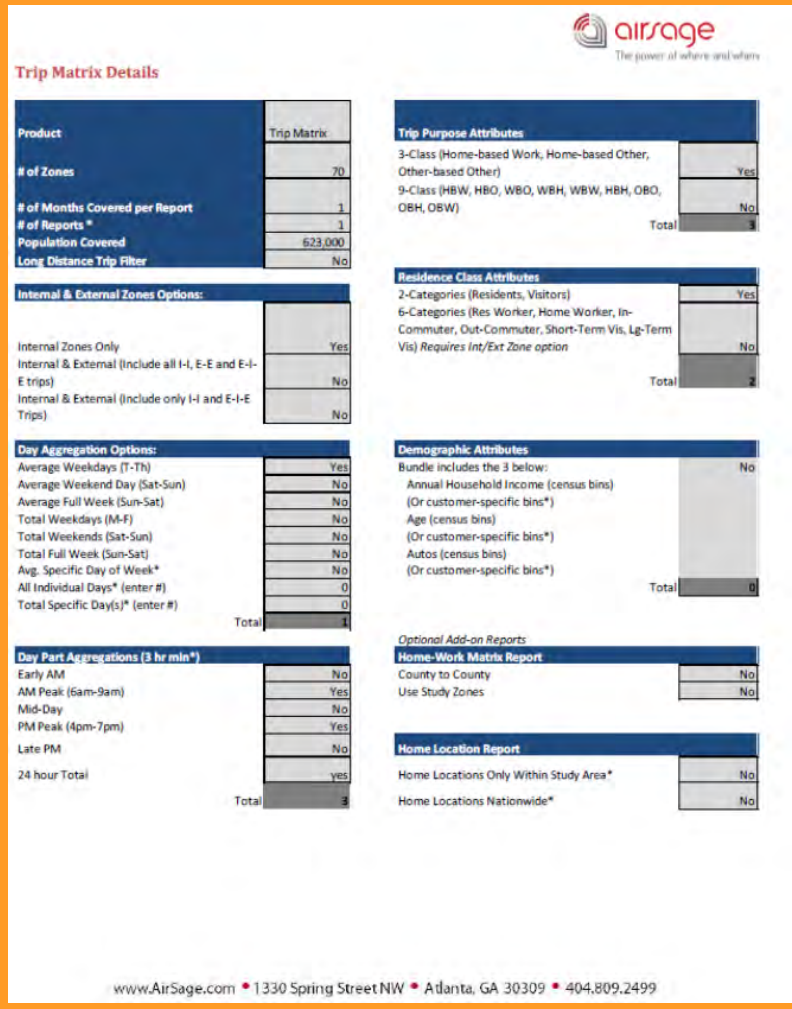
Implementation Phase II (Cont'd)

- AirSage data $13,740 specs:
  - 70 TAZs
  - 1 month of data
  - Average weekday conditions
  - Daily, AM peak, PM peak
  - HBW, HBNW, NHB purposes
  - Residents vs. visitors
  - No demographic attributes
  - No optional add-on reports



airsage
The power of where and when

Trip Matrix Details

Product	Trip Matrix
# of Zones	70
# of Months Covered per Report	1
# of Reports *	1
Population Covered	623,000
Long Distance Trip Filter	No

Internal & External Zones Options:	
Internal Zones Only	Yes
Internal & External (Include all I-I, E-E and E-I-E trips)	No
Internal & External (Include only I-I and E-I-E Trips)	No

Day Aggregation Options:	
Average Weekdays (T-Th)	Yes
Average Weekend Day (Sat-Sun)	No
Average Full Week (Sun-Sat)	No
Total Weekdays (M-F)	No
Total Weekends (Sat-Sun)	No
Total Full Week (Sun-Sat)	No
Avg. Specific Day of Week*	No
All Individual Days* (enter #)	0
Total Specific Day(s)* (enter #)	0
Total	1

Day Part Aggregations (3 hr min*)	
Early AM	No
AM Peak (6am-9am)	Yes
Mid-Day	No
PM Peak (4pm-7pm)	Yes
Late PM	No
24 hour Total	yes
Total	3

Trip Purpose Attributes	
3-Class (Home-based Work, Home-based Other, Other-based Other)	Yes
9-Class (HBW, HBO, WBO, WBH, WBW, HBH, OBO, OBH, OBW)	No
Total	1

Residence Class Attributes	
2-Categories (Residents, Visitors)	Yes
6-Categories (Res Worker, Home Worker, In-Commuter, Out-Commuter, Short-Term Vis, Lg-Term Vis) *Requires Int/Ext Zone option*	No
Total	2

Demographic Attributes	
Bundle includes the 3 below:	No
Annual Household Income (census bins) (Or customer-specific bins*)	
Age (census bins) (Or customer-specific bins*)	
Autos (census bins) (Or customer-specific bins*)	
Total	0

Optional Add-on Reports

Home-Work Matrix Report	
County to County	No
Use Study Zones	No

Home Location Report	
Home Locations Only Within Study Area*	No
Home Locations Nationwide*	No

www.AirSage.com • 1330 Spring Street NW • Atlanta, GA 30309 • 404.809.2499

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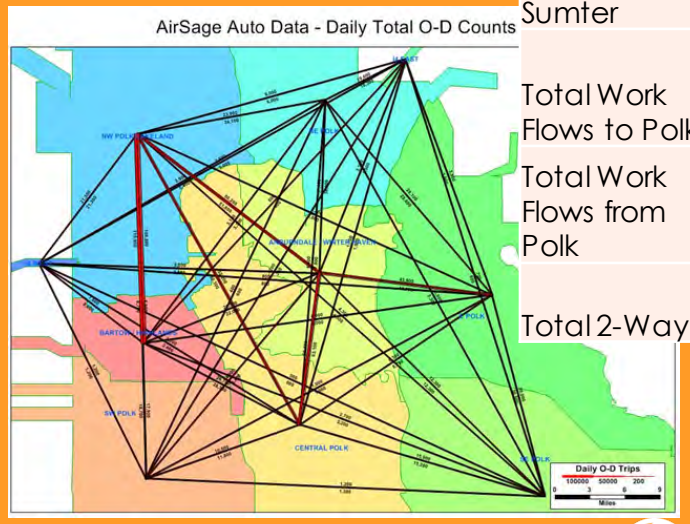
Implementation Phase II (Cont'd)

- AirSage data received:
  - Data dictionary of field names
  - Matrix of day part trips (9,311 records in trip_leg_matrix_cusWDDP.csv)
  - Matrix of weekday trips (11,353 records in trip_leg_matrix_cusWDH.csv)

HBO	HBW	NHB	Total	ALL
1,545,828	409,185	1,909,012	3,864,025	Trips
40.00%	10.60%	49.40%	100%	Percent
Residents Only				
1,309,000	368,716	1,122,820	2	2010
46.74%	13.17%	40.09%		
Visitors Only				
236,828	40,469	786,192	1	
22.27%	3.81%	73.93%		

ACS Journey-to-Work Trips CTPP 2006-2010 to Polk		
from:	Estimate	Marg of Error
Hardee	746	198
Highlands	1,476	385
Hillsborough	11,135	833
Lake	1,058	327
Osceola	2,926	504
Pasco	1,443	293
Polk	184,244	2,734
Sumter	127	94
Total Work Flows to Polk	203,155	only from neighboring
Total Work Flows from Polk	209,898	only to neighboring
Total 2-Way	413,053	



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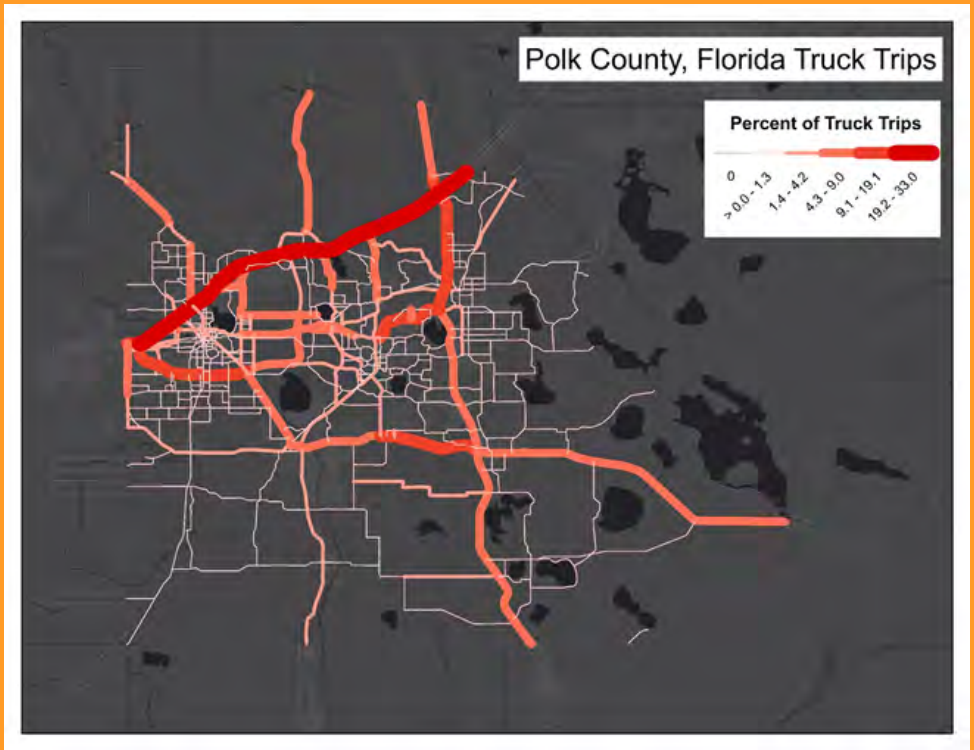
Implementation Phase II (Cont'd)

- ATRI data $11,000 specs:
  - Truck trip table at aggregated zone level to include exit stations to show where trips enter/exit Polk County
  - Map/shapefile that shows relative use of routes for truck GPS to derive trips within the study area
  - Illustrations (maps) of freight generators and route use



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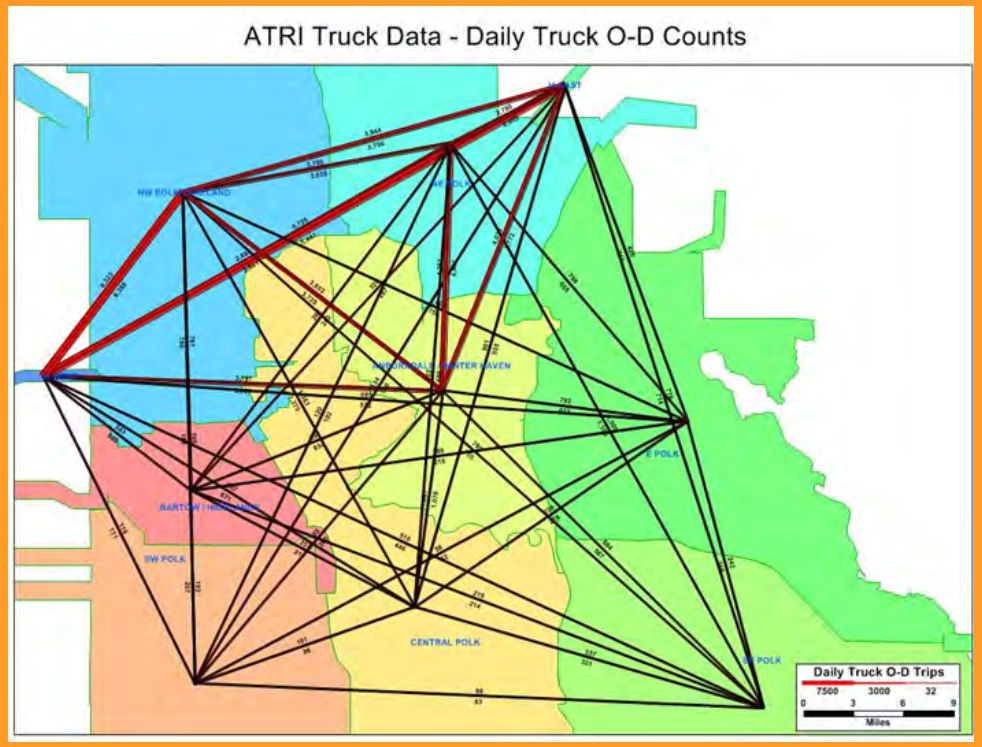
Implementation Phase II (Cont'd)

- ATRI data received:
  - Data dictionary of link attributes
  - truck GPS point data for 2 weeks from each of the following months in 2016: March, May, July and October
  - Matrix of 186,960 truck trips (70 x 70 matrix table in polkCountyTripMatrix.csv)



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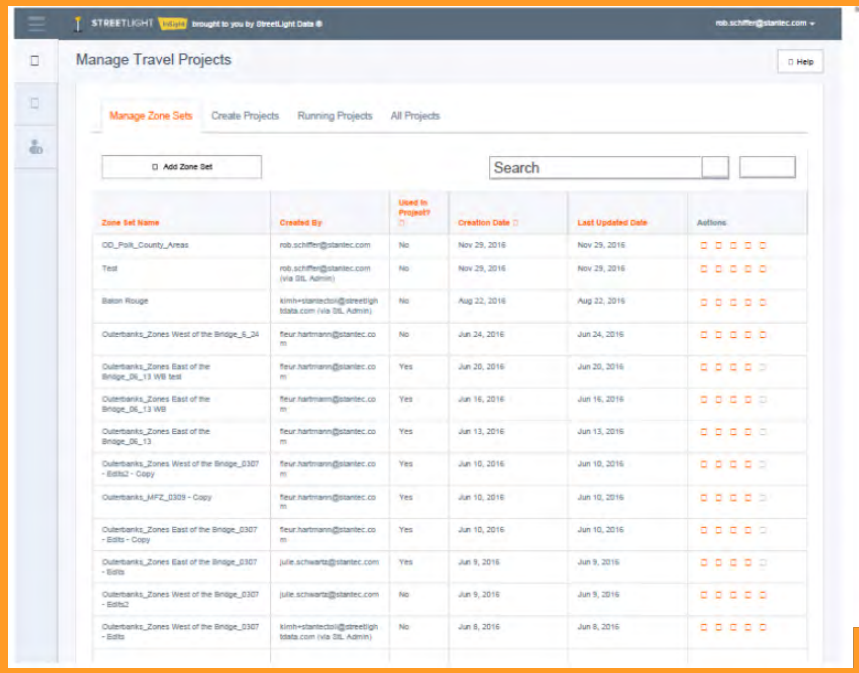
Implementation Phase II (Cont'd)

- Recent Stantec Studies using StreetLight Data:
  - Stantec has recently used StreetLight Data on a number of corridor projects, most (but not all) related to traffic & revenue studies
  - StreetLight Insight allows us to query data summaries from any of our previously purchased datasets



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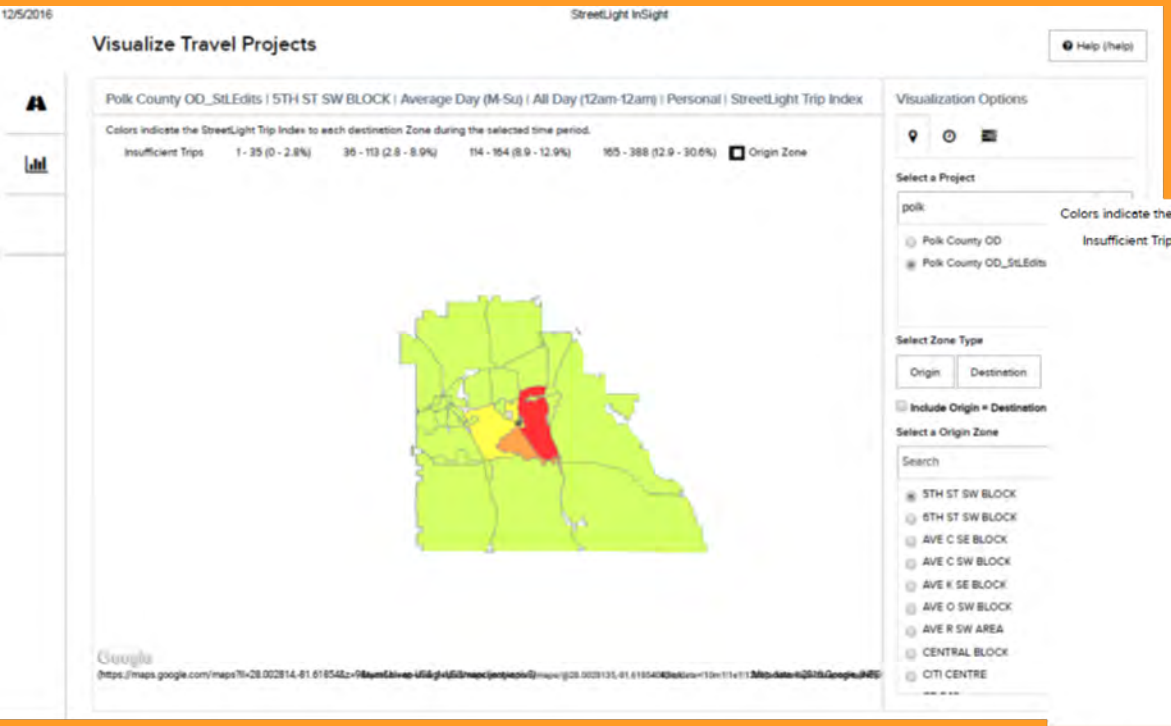
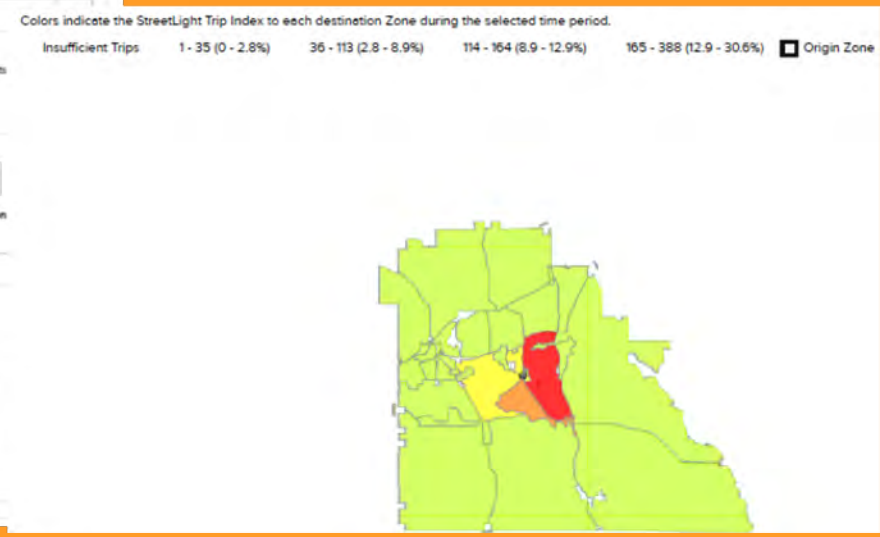
Implementation Phase II (Cont'd)

- Recent Stantec Studies using StreetLight Data:
  - Streetlight were kind enough to allow me to pull up a Polk County matrix of data in the interest of ongoing comparative passive data research





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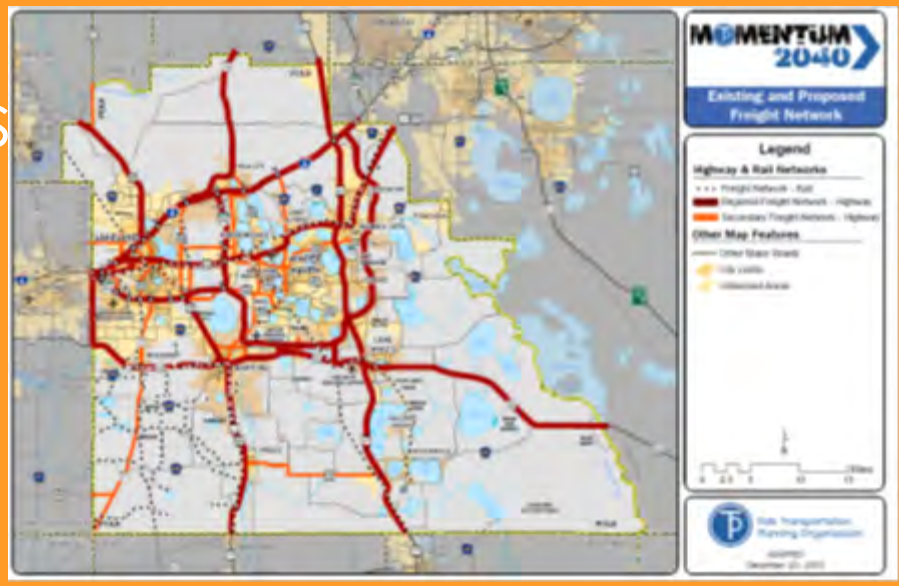
Acknowledgements

- Polk County TPO
- Kimley Horn Associates *(TPO on-call prime)*
- NCHRP 735
- AirSage
- All Traffic Data
- ATRI
- TrafficCast (BlueTOAD)
- Skycomp
- StreetLight Data



It is important also to acknowledge that the availability, cost, and limitations of passive data are continuously changing in response to new technologies and the competitiveness of vendors!

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Questions?

	ALTERNATIVE ORIGIN-DESTINATION (O/D) DATA SOURCES					
	PASSIVE TRAVEL SURVEY DATA COLLECTION					
Unique Characteristics of Methodology	High speed videotaping of license plates	Positioning of Bluetooth readers to match devices	Tracking of anonymous cellular data	Truck GPS tracking	Aerial tracking of vehicles	Tracking of multiple GPS device types
Vendor/Product Names (where applicable)	n/a	TrafficCast BlueToad	AirSage	ATRI	SkyComp	StreetLight Insight
General Description of Survey Approach	Tracking of vehicles by plate using videotaping	Tracking of vehicles using Bluetooth readers	Tracking of anonymous mobile devices	Tracking movement of trucks via GPS	Tracking vehicles using aerial photography	Tracking vehicles using GPS navigation data
Survey Sampling Unit	Vehicles	Bluetooth Device	Cellular Devices	Truck with GPS	Vehicles	Vehicles with GPS
Survey Period Typically Covered	Single trip (poss. followup survey)	Single trip (poss. tracking of day)	Single trip (poss. tracking of day)	Series of linked truck trips	Single trip within limited study area	Single trip (poss. tracking of day)
Relative Vintage of Approach	Well Established	Relatively Recent	Relatively Recent	Relatively Recent	Relatively Recent	Relatively Recent
Pros/Benefits to Approach	Can be first step in detailed survey	Flexibility to move or station readers	Very inexpensive; easy to self price	Inexpensive and flexible pricing	Creates permanent record	Piggybacked onto INRIX GPS data
Cons/Disadvantages of Approach	The most costly passive option	Requires equip. purchase or lease	Limited to two cellular carriers	Only a sample; mode limited	Potentially costly; small study area	Some issues with precision
Other						
Relative Cost	Relatively High	Moderate	Low	Low	Moderate	Low

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