GTFS and Measuring Access to Transit

ANDREW FRASIER
AARON McKEON
Introduction: Work Link

TRANSPORTATION OPTIONS FOR LOW-INCOME WORKERS
Project Purpose

• Measure & map gaps in the transit system for low-income, low-skill workers in the region

• Where are the jobs?
  • Which jobs are accessible / inaccessible by bus?

• Look at possible solutions and determine which ideas are feasible in our region
Overview

• Syracuse has several areas of concentrated poverty in and around the core of the city

• Poverty is not new in Syracuse, but the region got a wake-up call in 2015
ISSUE BRIEF

THE ARCHITECTURE OF SEGREGATION

Civil Unrest, the Concentration of Poverty, and Public Policy

Paul A. Jargowsky | August 9, 2015
## Highest Black Concentration of Poverty

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## HIGHEST HISPANIC CONCENTRATION OF POVERTY

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Transportation is part of the problem

- Good jobs for low-skill workers are spread all around the region
  - 61% of the region’s jobs are more than three miles from Downtown Syracuse

- Many low-income workers rely on transit
  - 7,200 workers in the City don’t own cars
  - 13,000 workers with incomes near or below the poverty line take transit to work

- Where are the workers?
- Where are the jobs?
Getting to work without a car
Syracuse workers

- 34% use transit
- 24% walk
- 20% drive someone else’s car
- 11% use a cab, motorcycle, bike or other means
- 9% carpool
Where are the workers?

We looked at four variables to identify neighborhoods with the greatest need for support in getting to and from work:

◦ Unemployment
◦ Poverty level
◦ Educational level
◦ Car ownership
Unemployment

Census Tracts shaded in red have the highest levels of unemployment in the SMTC’s planning area, 10.3% to 39% unemployment (75th percentile and above).
Poverty

Census Tracts shaded in red have the highest levels of poverty in the SMTC’s planning area, 23% to 68.8% poverty (75th percentile and above).
Census Tracts shaded in red have the highest levels of low educational attainment among people 25 years and older in the SMTC’s planning area, 52% to 77% (75th percentile and above).

Low educational attainment is defined as having no more than a high school diploma or GED.
Census Tracts shaded in red have the highest levels of “vehicle light” households in the SMTC’s planning area, 29% to 79.5% (75th percentile and above).

A “vehicle light” household is one with more workers than vehicles.
Census Tracts in the highest quartile for all variables

- Unemployment
- Poverty level
- Educational level
- Car ownership
Census Tracts in the highest quartile for all variables
Where are the jobs / employment centers?
Off-hours work

Shift Breakdowns (weekdays)

- According to Census data, most people (78%) get to work between 5 AM and 10 AM

- In Onondaga County, this leaves a non-trivial number of workers who get to work at non-peak hours:
  - 27,800 workers arrive at work between 10 AM and 4 PM
  - 25,600 workers arrive at work between 4 PM and 5 AM
Key question:

Where and when is transit service available to the employment centers?
Where are the buses? “Spatial” Service Area

• More complex to get from journey origin to transit mode – First Mile, Last Mile problem

• Measures of transit accessibility improve the closer you are to transit

• What is a “reasonable” walking distance?

• What other pedestrian travel factors come into play?
Spatial Service Area Factors

Centro’s Title VI Report (2016)

• Urban Area – at least 3,600 people / square mile – 0.25 mile
• Suburban Area – 1,800 to 3,600 people / square mile – 0.5 mile
• Rural Area – Less than 1,800 people / square mile – 0.5 mile
Determining Spatial Service Area

- Most service area calculations are done through a buffer analysis in GIS software.
- But – not all buffers are created equal.
Traditional Buffers around Bus Lines

- Uses straight-line distance
- Resulting buffer can be misleading – one can only get on or off the bus at stops, not at anywhere on the bus line!
Traditional Buffers around Bus Stops

• Uses straight-line distance
• More accurate than buffers around lines, as it better represents transit accessibility
• Distance between stops becomes a factor
Problems with Traditional Buffers

• We can’t often walk in a straight line to our desired destination.

• Treats all space as “equal”

Using Network Distance

• The distance between origins and destinations measured along a transportation network
• Helps more accurately define a “walkshed” for transit stops

Network Distance Based in part on Levinson, David and Ahmed El-Geneidy (2009) "The minimum circuity frontier and the journey to work" Regional Science and Urban Economics Volume 39, Issue 6, November 2009, Pages 732
Network Distance vs. Euclidean Distance

• Compare Euclidean distance (red) to network distance (green hashed)

• Paints a better picture of actual traveling distance to a transit stop
Transit stops with a 0.25 mile network buffer across the whole system
When are the buses?
“Temporal” Service Area

- Is the bus service available at the time I need it?
- Can I use transit on all legs of my trip?
- Am I going to have to schedule my day around my transit trip?
Spatial vs. Temporal

Spatial Service Area

Temporal Service Area

?
How do you map or analyze this?
What is GTFS?

• “General Transit Feed Specification”
• Common format for public transportation schedules
• Started by Google employees in the mid-2000s
• Series of .txt files
The Strengths of GTFS

• Popular and widely used
• Transparent, open documentation
• Evolving design schema
  • Over 20 changes since original adoption of specification in 2006

https://www.mapnificent.net/rochester
Some Applications of GTFS

• Food desert research (2014)
• Measuring transit connectivity (2012)
• Effects of land use patterns on transit demand (2013)
Using GTFS Data in ArcGIS

Better Bus Buffers

- Count Trips for Individual Route
- Count Trips in Polygon Buffers around Stops
- Count Trips at Points
- Count Trips at Points, Online
- Count Trips at Stops
Count Trips in Polygon Buffers

• Generates network-based polygon buffers around transit stops
• Fills information about the transit system in that area into those buffers based on time of day

• Output:
  • Number of Trips
  • Number of Trips per Hour
  • Number of Stops in Range
  • Max Wait Time
Using the Output in the Work Link Study

• When are there gaps in service?

• Census data shows most people (78%) get to work between 5 AM and 10 AM

• In Onondaga County, this leaves a non-trivial number of workers who get to work at non-peak hours:
  • **27,800** workers arrive at work between 10 AM and 4 PM
  • **25,600** workers arrive at work between 4 PM and 5 AM

• Employers w/lots of entry-level jobs tend to also have lots of off-hours jobs (retail, food service, warehousing)
6:00 AM – 8:00 AM

[Map showing the number of trips in different areas during 6:00 AM – 8:00 AM. The map is color-coded to indicate the number of trips: 0, 1, 2-5, 6-10, 11-50.]

**Number of Trips**
- 0
- 1
- 2-5
- 6-10
- 11-50
10:00 PM – 12:00 AM

Number of Trips

- 0
- 1
- 2 - 5
- 6 - 10
- 11 - 50
- 51 - 232
When is transit available?

Lots of Buses

6:00 a.m. – 7:59 a.m.

4:00 – 5:59 p.m.

After 8:00 p.m.

No Buses

4:00 AM - 5:59 AM

6:00 AM - 7:59 AM

8:00 AM - 9:59 AM

10:00 AM - 11:59 AM

12:00 PM - 1:59 PM

2:00 PM - 3:59 PM

4:00 PM - 5:59 PM

6:00 PM - 7:59 PM

8:00 PM - 9:59 PM

10:00 PM - 11:59 PM

12:00 AM - 1:59 AM

2:00 AM - 3:59 AM
Where & when are the gaps?

**WEEKDAYS**
- Transit service starts to thin out after 6:00 p.m. in the outer suburban employment centers and after 8:00 p.m. in the inner ring

**WEEKENDS**
- Reduced bus service to suburbs on weekends:
  - Route 57: 3 runs in, 3 runs out
  - Henry Clay Boulevard: No service
  - Baldwinsville: No Service
Study outcomes

Extend fixed-route bus service times?
- Highly inefficient
- Proportions of off-hours workers are small, employment sites are scattered, shift times vary from workplace to workplace

On-Demand Service
- Subsidize Uber / Lyft
- Use scheduled vanpool service
- Try to get the cost of each ride as low as possible
Measuring Access to Transit: Take-home points

• Network buffers will paint a more realistic picture of a service area – where buses run.

• *When* buses are available is also an important factor when doing transit-related studies.
Questions?

afrasier@smtcmpo.org
amckeon@smtcmpo.org