Creating a Transit Supply Index

Transport Chicago Session C- Measuring Up
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Presented by: Andy Keller
Presentation Outline

- Purpose
- Framework and Guidelines
- Methodology
- Results
- Next Steps
Goals for Transit Supply Index

- Create a metric to measure level of transit service for northeastern Illinois
  - Based on publicly available data
  - Calculated at various geographic regions
  - Useful for analysts but meaningful to non-experts
  - Automated process for large transit systems and regular updates
Framework and Guidelines
Framework

- Assignment for Master’s course
- Measures net persons served
  - frequency of service x percentage of population served
- Based on frequency counts for CTA rail stations and population data from census blocks
Guidelines

- Guidelines taken from the *Transit Capacity and Quality of Service Manual*
  - User-based rating system based on frequency of service
  - Suggested Catchment Areas for rail stations and bus stops
What is TSI- (Transit Supply Index)

- Aggregate measure of transit trips supplied by bus and rail in zones normalized by percentage covered in zone
- The TSI is a measure of the frequency of service for a geographic zone
  - TSI= 
    - Frequency of Service x (Service Buffer Area/ Total Zone Area)
  - Example 40 buses x .5 miles/ 1 mile = 20 TSI

- Peak AM Period (6-10 am)
  - Headway for 4 hour period = 60/ (20 TSI/ 4 hours) = 12 minute headways

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Coverage</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Route</td>
<td>Buses</td>
<td>Service Buffer Area</td>
</tr>
<tr>
<td>1</td>
<td>24</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>48</td>
<td>0.5</td>
</tr>
<tr>
<td>Total</td>
<td>84</td>
<td>2</td>
</tr>
</tbody>
</table>
Grade System

- Transit grade based on headways to measure attractiveness of transit to riders
- Previous Example
  - 12 minute headways = B level of service

<table>
<thead>
<tr>
<th>LOS</th>
<th>Headway (min)</th>
<th>Veh/h</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt;10</td>
<td>&gt;6</td>
<td>Passengers don’t need schedules</td>
</tr>
<tr>
<td>B</td>
<td>10-14</td>
<td>5-6</td>
<td>Frequent service, passengers consult schedules</td>
</tr>
<tr>
<td>C</td>
<td>15-20</td>
<td>3-4</td>
<td>Maximum desirable time to wait if bus/train missed</td>
</tr>
<tr>
<td>D</td>
<td>21-30</td>
<td>2</td>
<td>Service unattractive to choice riders</td>
</tr>
<tr>
<td>E</td>
<td>31-60</td>
<td>1</td>
<td>Service available during hour</td>
</tr>
<tr>
<td>F</td>
<td>&gt;60</td>
<td>&lt;1</td>
<td>Service unattractive to all riders</td>
</tr>
</tbody>
</table>

Exhibit 5-5
Service Frequency LOS: Urban Scheduled Transit Service
Guidelines - Catchment Area

¼ mile buffer - bus stops

½ mile buffer - rail stations
Data Sources

- General Transit Feed Specification
  - Text files used for Google Transit.
  - Geographic coordinates for all transit stops
  - Data for each transit trip that occurs at all stations, for all trips along all routes
  - Universally formatted tables

- Census Tiger Files
  - Shapefiles for census blocks and tracts
Key Questions for TSI

- How can frequency be counted for every stop?
- How large a coverage area is appropriate for each transit stop?
- How to accommodate for areas with overlapping service?
Methodology-
Prepare Data for GIS Analysis

- Text files are imported to Microsoft Access and joined based on shared fields
- Records are queried based on day of the week of service and/or time of day
Methodology -
Calculate Frequency by Station and Route

Remaining Records exported as a database file (dbf) for use in ArcGIS
Dissolve feature used to calculate frequency of transit trips for each stop by route
Methodology - Project Transit Stops

- GIS projects transit stops using X, Y coordinates from GTFS tables
Methodology -
Buffer Transit Stops

- Buffers dissolved by route and frequency
- Overlap areas are given highest frequency
Results-
Block Level
Results - Block Level Local
Challenges and Next Steps
Challenges-
Buffer Transit Stops

- How accurately do the aerial buffers realistically account for catchments areas?
- What factors impact riders willingness to walk to transit?
- How can these factors be accounted for?
Challenges - Buffer Transit Stops

- Pedestrian Factors (from *Transit Capacity and Quality of Service Manual*):
  - Street network
  - Population factors
  - Street grade (not in Chicago)

- Next Step
  - Adjust buffer based on these factors as recommended in TCQSM
Examples of Street Grids

Grid

Hybrid

Cul-de-sac

<table>
<thead>
<tr>
<th>Network Connectivity Index</th>
<th>Street Pattern Type</th>
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<tbody>
<tr>
<td>&gt;1.55</td>
<td>Type 1—Grid</td>
</tr>
<tr>
<td>1.30-1.55</td>
<td>Type 2—Hybrid</td>
</tr>
<tr>
<td>&lt;1.30</td>
<td>Type 3—Cul-de-sac</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Street Pattern Type</th>
<th>Street Connectivity Factor, $f_{sc}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1—Grid</td>
<td>1.00</td>
</tr>
<tr>
<td>Type 2—Hybrid</td>
<td>0.85</td>
</tr>
<tr>
<td>Type 3—Cul-de-Sac</td>
<td>0.45</td>
</tr>
</tbody>
</table>
Challenges- Adjust Buffers

- Use GIS tools to calculate ratio of street segments to intersections
- Adjust buffers based on network connectivity index (NCI)
- Run visual check to see if results of NCI matches examples of street patterns
Visual Check- Grid Pattern

- Buffer matches grid example
Visual Check- Hybrid Buffer

- Buffer matches hybrid example
Visual Checks- Street Patterns

- Buffer matches cul-de-sac example
Next Steps

All transit trips are created equal in the TSI, but...

- Capacity
- Accessibility
- Auto access to transit
- Call-n-Ride
Next Steps

- Incorporate accessibility to attractions
  - Establish transit travel times between zones or stations
  - Create accessibility score based on travel time and access to attractions
    - More attractions = more accessibility
    - Greater travel time = less accessibility
Conclusions

- Who can use the TSI?
  - Transportation planners
  - Government agencies planning facility locations
  - Business owners
  - Real estate professionals