SPATIAL AND COST ANALYSIS FOR ADA PARATRANSIT ELIGIBILITY

ASSESSMENT SITES

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Word count: 4,217 words text + 11 tables/figures x 250 words (each) = 6,967 words

August 1, 2015
ABSTRACT
Public transit agencies regularly face operational decisions about how to provide high-quality customer service while minimizing agency cost. The number of people eligible for ADA paratransit in the United States has increased significantly in the last several years, and there has been a corresponding nationwide increase in ridership. ADA paratransit is the most costly type of transit service for agencies to operate, so agencies need to ensure that eligible participants receive service while enabling those who are not eligible to access other forms of fixed-route transit. The Regional Transportation Authority (RTA) in Chicago requires individuals interested in using ADA paratransit service to apply and participate in in-person interviews and assessments, after which agency staff make an eligibility determination. The RTA provides free transportation for applicants to one of five assessment sites throughout the six-county region. In 2014, the RTA Mobility Services Department embarked on an initiative to expand services available to applicants while reducing the number of assessment sites. A team of RTA staff conducted analysis to determine the optimal number of sites and location of sites based on travel time and applicant demand throughout the region. The RTA then prepared a spreadsheet model to compare the cost of different operating models based on the combined cost of site operations and applicant transportation. The results indicated that two sites located in Cook County would provide the lowest agency cost. This research finding was a key factor in the RTA Mobility Services Department’s decision to implement a two-site model by mid-2016.

Keywords: ADA paratransit, eligibility assessment, site analysis, optimization, ArcGIS, cost, cost model, public transit, transit agency, people with disabilities
INTRODUCTION

Public transit agencies regularly face operational decisions about how to provide high-quality customer service while minimizing agency cost. The number of people eligible for ADA paratransit in the United States has increased significantly in the last several years, and there has been a corresponding nationwide increase in ridership (1). ADA paratransit is the most costly type of transit service for agencies to operate, so agencies need to ensure that eligible participants receive service while enabling people who are not eligible access other forms of fixed-route transit. The Regional Transportation Authority (RTA) in Chicago is responsible for determining eligibility for ADA paratransit service operated by Pace. Pace operates service for both the Chicago Transit Authority (CTA) and Pace service areas. The RTA requires individuals interested in using ADA paratransit service to apply and attend in-person interviews and assessments, after which agency staff make an eligibility determination. The RTA provides free transportation for applicants to one of five sites throughout the six-county region. In 2014, the RTA Mobility Services Department embarked on an initiative to expand services available to applicants while reducing the number of assessment sites.

In spring of 2015, a team of staff from the RTA Planning and Mobility Services Departments (the RTA project team) conducted a series of analysis to determine the optimal number of sites and location of sites based on travel time and applicant demand throughout the region. The project began with a GIS analysis utilizing ESRI’s Network Analyst software. The RTA project team mapped the anonymized addresses of 2013 ADA Assessment applicants, created a network overlay of potential sites for the region, and used the model to determine optimal locations for varying numbers of sites throughout the region. The model results, including the number of applicants assigned to each site and the combined travel times, were used as inputs to a spreadsheet cost analysis.

A spreadsheet model was then developed to compare agency cost for each combination of sites. The model was created because the comparative advantage of different numbers of sites are not immediately obvious: Fewer assessment site results in lower operating costs but higher transportation costs; a higher number of assessment sites results in higher operating costs but lower transportation costs. The cost model was needed to determine the optimal combination. The cost model considered total agency cost for each operating model, which included three components: site operating cost (variable), transportation cost (variable), and applicant processing cost (fixed for all scenarios because the number of applicants do not vary). The cost model was also used to project costs five years into the future as the applicant demand increases and costs inflate.

The results indicated that 93% of applicants resided in Cook County, within the City of Chicago. Thus, locating sites in the City of the Chicago would provide the most convenient option to travelers and to Pace, the ADA paratransit provider transporting applicants to interviews. The results also indicated that two sites would be the optimal number of sites because the Total Annual Agency Cost is lower than one or three site models by a small margin. This appears to be particularly true five years into the future when applicant demand will increase and costs will rise.

The background, methodology and detailed results are described throughout this document.
LITERATURE REVIEW

There is a wealth of literature containing information regarding regulatory eligibility practices, case studies from various cities, coordination of paratransit services, but there is a limited amount regarding eligibility/assessment site location, cost or operational efficiency.

The most comprehensive document on the subject of ADA paratransit assessment facilities is TCRP Synthesis 116: Practices for Establishing ADA Paratransit Eligibility Assessment Facilities. This document was published in March 2015 and included a survey of 28 transit agencies, along with in-depth reviews of current practices at five transit agencies. It includes information pertinent to this analysis such as floor plans and build-out and operating costs. Each city has unique floor plans utilized to administer the eligibility testing in addition to unique staffing requirements. Build-out and operating costs also varied greatly between each of the five agencies detailed in the report (2).

TCRP Report 163: Strategy Guide to Enable and Promote the Use of Fixed-Route Transit by People with Disabilities briefly provided information on costs associated with conducting in-person interviews and functional assessments, costs associated with setting up an assessment site (includes set-up and build-out), ongoing site costs, and transportation costs (3).

TCRP Synthesis 30: ADA Paratransit Eligibility Certification also provides case studies from various agencies detailing procedural approaches to paratransit eligibility certification and does include some cost information such as screening costs per interview and assessment test. This document also discusses the administrative advantages and disadvantages of locating all services at one site versus more than one (4).

ESRI Network Analyst documentation served as the primary source for information regarding the location analysis. ESRI provides numerous help pages, forums, and instructional videos to help users of the Network Analyst extension set up and execute defined problems. Using GIS Network Analyst to Solve a Distribution Center Location Problem in Texas by Texas A&M University also examines facility location practices completed elsewhere (5).

Other methods and tools have also been used in special location analysis for different applications. For example, the Strategic Location of Satellite Salt Storage for Roadway Snow and Ice Control In Vermont published by Vermont Agency of Transportation and the University of Vermont (UVM) Transportation Research Center in January 2015 used TransCAD™ and manual analysis to optimize the location of satellite salt facilities in Vermont (6).

Much of the data utilized in the cost analysis in this project came from RTA staff experience, existing agency agreements and contracts, in-person visits of numerous transit agencies by RTA staff.

METHODOLOGY

The RTA project team began the project by conducting a location-allocation analysis using ArcGIS and Network Analyst to locate facilities based with the goal of minimizing average travel times for a specified number of facilities. The output of the analysis was then inputted into a cost model which calculated an estimated annual cost based on fixed and variable inputs. The methods for both the location-allocation analysis and the cost model are described in this section.
The RTA project team carried out several different analyses over time, involving a range of site numbers (including one to five sites) and locations (including sites located based strictly on demand and sites located based on fixed county jurisdictions). The RTA project team also modeled both morning (AM) peak traffic and evening (PM) peak traffic scenarios. The RTA Mobility Services Department was briefed on findings along the way to guide the study. The final analysis used to aid in decision-making was focused on one to three sites located anywhere in the RTA six-county region based on 2013 demand and evening (PM) peak traffic patterns. This was chosen to represent the most realistic and efficient set of site options during the worst traffic conditions. A future year projection of these scenarios with 8% annual increases in demand and 2% cost inflation five years into the future was also used for decision-making.

Results of Location-Allocation Analysis

The location-allocation analysis consisted of three steps: Mapping current demand; creating a network overlay ('fishnet') of possible location sites; and then running the analysis several times to determine the optimal location and the combined travel time for the specified number of sites.

Current Demand

Demand for this analysis was derived by geo-coding the anonymized household locations for all 2013 ADA applications in the RTA database (15,376 applicants) as shown in FIGURE 1. TABLE 1 shows the geographic dispersion of the demand and the demand by county, quantified as follows:

<table>
<thead>
<tr>
<th>County</th>
<th>Applicants</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cook</td>
<td>14,291</td>
<td>93.0%</td>
</tr>
<tr>
<td>DuPage</td>
<td>305</td>
<td>2.0%</td>
</tr>
<tr>
<td>Kane</td>
<td>88</td>
<td>0.6%</td>
</tr>
<tr>
<td>Lake</td>
<td>425</td>
<td>2.8%</td>
</tr>
<tr>
<td>McHenry</td>
<td>21</td>
<td>0.1%</td>
</tr>
<tr>
<td>Will</td>
<td>243</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

The location dispersion of 2013 applicants was assumed to be a reasonable proxy for near-future demand, given that population projections are not currently available to the level of detail required to carry out an analysis of this detail.

Facility Locations

The Create Fishnet tool in ArcGIS was utilized to break up the six-county region into a grid of rectangular cells (60 rows and 60 columns). The centroids of the output polygons were then utilized as potential facility locations in the analysis (see FIGURE 2). This step was done to place potential locations evenly dispersed throughout the six-county region.
FIGURE 1  2013 ADA Applicants
FIGURE 2 Facility Location Fishnet
Location-Allocation Analysis Runs

The next step of the analysis was to determine the optimal location of sites on the network. This was carried out using the ArcGIS Location-Allocation analysis tool. The tool offers different tools for answering specific network questions. For this analysis, the minimize impedance tool was utilized, which locates/selects facilities such that the weighted impedances (demand allocated to a facility multiplied by the impedance to the facility) is minimized. Travel time was used as the impedance in the RTA Planning analysis.

The ArcGIS Network Analyst requires the input of a street network dataset. This analysis utilizes ESRI’s StreetMap Premium 2014 NAVTEQ street network dataset street and includes variables such as miles per hour, one-way streets, and turn restrictions. Most importantly for this analysis, the network dataset can be used to quantify travel times (minutes) to the site, based on historic traffic conditions.

Upon a scan of recent news articles and reviewing historical traffic data using Google Maps, the Wednesday AM commute and the Friday PM commute were selected for modeling because they demonstrated the highest amount of congestion.

All default settings in the Location-allocation properties menu were utilized except for some changes to the analysis settings where time was used as the impedance, start times were set to Friday 4:30pm 2014 traffic, and u-turns were restricted.

ArcGIS Network Analyst was run for 1, 2, and 3 site scenarios. For each scenario, the model output a location for each site, the number of applicants assigned to each site, and a travel time for each demand point (or applicant). The travel times for all applicants can be used to calculate a mean travel time and a total combined travel time for all applicants.

Cost Analysis

The RTA project team then developed a spreadsheet model to compare the combined agency cost for the various site models. The cost model included three types of costs – Site Operating costs, Transportation Costs, and Screening Costs – that are described in this section.

The Site Operating cost estimates included all costs related to operating the site, including rent, electricity, administration, and office supplies. The RTA’s contractor operating the sites currently passes these fees on to the RTA, based on the number and location of sites included in the most recent contract. The costs considered included:

- Rent costs, based on the size (square footage) of the site and the annual rental cost (per square foot). The rental cost per square foot was derived from an analysis of office lease data in the Chicagoland region using LoopNet.com. The size of the sites required in each operating model were estimated using a separate sub-analysis developed by the RTA project team to estimate space requirements based on the number of applicants being served at the site (FIGURE 3). The sizing sub-model considered the size of variable spaces that change size with the number of people (such as waiting room and interview offices), as well as fixed-size spaces that would require specialized equipment and/or do not vary with the number of people (such as the Functional Assessment of Cognitive Transit Skills (FACTS) testing area). Spacing information came from RTA’s existing assessment sites, data from
facilities elsewhere in the United States, industry best practices, and planning judgment. These assumptions were intended to determine the general size of facilities needed in different scenarios, in order to compare costs among them.

- Staff Travel costs, to cover nominal travel reimbursements (e.g. mileage) to staff required to go to sites beyond their assigned locations. This was estimated at $1,500 annual cost per additional site based on RTA staff memory of previous contracts, even though it may or may not be included in future contracts.

- Administrative and Facility cost, including the need for a receptionist, computer equipment, utilities, maintenance and items not included in rent. This cost was estimated based on the existing contract.

- Build-out costs, to cover the interior construction of the space. Staff used $30 per square foot to estimate build-out costs, which was an average of modification build-out costs from one of the RTA’s current sites and new build-out costs provided by another peer agency. The build-out costs were then annualized over 5 years (the assumed duration of a contract) with a 5% discount rate.

Transportation Costs included all costs associated with transporting applicants to and from the assessment site, as required by ADA. Transportation cost inputs were derived from the agreement between RTA and Pace, as well as invoices received by RTA for services provided by Pace.

<p>| Look-up Table - Space Required for Number of Applicants/Hour Needed to Serve |
|---------------------------------------------------------------|----------------------------|</p>
<table>
<thead>
<tr>
<th>Variable Spaces</th>
<th>Incremental SF Added per additional person</th>
<th>Time needed (hr)/person</th>
<th>Number of People Who Can Use that Space/hr</th>
<th>Number of Applicants Per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting Inbound</td>
<td>80</td>
<td>40</td>
<td>0.25</td>
<td>4</td>
</tr>
<tr>
<td>Interview Office</td>
<td>150</td>
<td>N/A</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Transit Test</td>
<td>600</td>
<td>N/A</td>
<td>0.25</td>
<td>4</td>
</tr>
<tr>
<td>Track (By Usage)</td>
<td>0</td>
<td>0</td>
<td>0.25</td>
<td>8</td>
</tr>
<tr>
<td>Waiting Outbound</td>
<td>80</td>
<td>40</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Interior Restroom</td>
<td>136</td>
<td>42.5</td>
<td>0.17</td>
<td>6</td>
</tr>
<tr>
<td>Entryway &amp; Reception</td>
<td>252</td>
<td>25</td>
<td>0.28</td>
<td>5</td>
</tr>
<tr>
<td>Fixed Space Subtotal</td>
<td>1756</td>
<td>1948</td>
<td>2776</td>
<td>2971</td>
</tr>
<tr>
<td>Fixed Spaces</td>
<td>Total SF Needed</td>
<td>Default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FACTS Area</td>
<td>520</td>
<td>520</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel Training Room</td>
<td>800</td>
<td>400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff Break Room</td>
<td>150</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Call Center</td>
<td>500</td>
<td>500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track (Ideal)</td>
<td>2800</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reception Restrooms</td>
<td>56</td>
<td>56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Space Subtotal</td>
<td>4826</td>
<td>4826</td>
<td>4826</td>
<td>4826</td>
</tr>
<tr>
<td>Hallways, closets, equipment room</td>
<td>15%</td>
<td>988</td>
<td>1014</td>
<td>1141</td>
</tr>
<tr>
<td>TOTAL SPACE REQUIRED</td>
<td>7570</td>
<td>7788</td>
<td>8742</td>
<td>8990</td>
</tr>
<tr>
<td>Buildout Cost (per SF)</td>
<td>$ 30.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FIGURE 3** Excerpt from Site Size Estimation Model
Screening Costs include costs associated with the assessors interviewing and testing applicants. A contractor currently provides such services to the RTA and invoices the RTA monthly based on the number of individuals interviewed and the types of tests they were given, allowing the RTA project team to estimate average screening costs of $97.63 per person. These costs do not vary across the models because they are based on the number of total applicants. However, they were included in order to provide a comprehensive estimate of agency costs.

The three cost components were then added to estimate a “Total Annual Agency Cost.” The purpose of the cost comparison was to evaluate different quantities, locations, and sizes of assessment sites if operated under today’s assessment model. Some potential future costs that are currently unknown (such as for-profit contractor overhead) or are the same across all models (such as fees for no-shows, fees related to taking calls and scheduling assessments) were excluded. Thus, the Total Annual Agency Cost estimated through this exercise is useful for the purposes of comparing among models but is an otherwise theoretical concept that cannot be confused with an independent cost estimate or agency budget.

Given the national and local growth trends in ADA paratransit demand, as well as the need to make informed decisions for the future, the RTA project team also developed a future cost scenario. This scenario accounted for future demand and increases in associated costs. Staff assumed an 8% growth in the number of applicants (based on local trends) and 2% inflation on all costs five years out from the base year scenario. As noted previously, the location for the applicant demand (as associated average travel time to each site) is assumed to be the same as in the base year, as no detailed population projections are available.

RESULTS
The results of location-allocation analysis and cost-analysis indicated that 2 sites located in Cook County would be the most cost-effective for the RTA. The detailed results of both analyses are presented in this section.

Location-Allocation Analysis
The results of the location analysis are summarized in TABLE 2. The “Average Travel Time” for all applicants was a model output used by the RTA project team to assess the overall inconvenience to travelers under each model. Travel Time histograms were also created from model output (see FIGURE 4) to understand the distribution of travel times for all applicants. The number of applicants disproportionately inconvenienced by the site operating model was captured in the “Percent of Travel Time Greater than 40 minutes,” which could be compared across all models. The “Percent of Demand at First Site” was also used to compare the models, as it indicates how much of the applicant demand was assigned by the model to the first (and largest) site created by the model. This was an indication of how much of the applicant demand would be conveniently diverted to additional sites if they were provided.

The 1-site analysis placed the facility on the south side of Chicago and had a mean travel time of 30 minutes. Travel times for each applicant covered a wide range with 29% of residents having to travel in excess of 40 minutes (see TABLE 1 and FIGURE 4).
TABLE 2 Percent of Demand at Initial Site and Travel Times

<table>
<thead>
<tr>
<th>Number of Sites</th>
<th>Percent of Demand at First Site</th>
<th>Average Travel Time (minutes)</th>
<th>Percent of Travel Time Greater than 40 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100%</td>
<td>30</td>
<td>29%</td>
</tr>
<tr>
<td>2</td>
<td>64%</td>
<td>21</td>
<td>7%</td>
</tr>
<tr>
<td>3</td>
<td>59%</td>
<td>18</td>
<td>5%</td>
</tr>
</tbody>
</table>

The 2-site analysis placed an additional site on the northwest side of Chicago and shifted the existing southside location a further south (FIGURE 5). The addition of the second site reduced mean travel time by 9 minutes to 21 minutes. In addition, the number of applicants with travel times in excess of 40 minutes was greatly reduced from 29% to 7%. The largest share of applicants had travel times between 10 to 20 minutes.

The addition of the third site made nominal shifts to the locations of the two previously located sites and placed the third location in western Cook County, near the Chicago’s western border (FIGURE 6). The addition of the third site did not significantly influence mean travel times or significantly reduce the number applicants with high travel times. Mean travel times were reduced by 3 minutes to 18 minutes. The number of applicants with travel times in excess of 40 minutes was reduced from 7% to 5%.

FIGURE 4 Histogram of Applicant Travel Times for 2-Site Model
RTA Mobility Services and Planning staff made two key observations from the location-allocation analysis. The first is that there was a significant decrease in mean travel times between the 1-site and 2-site scenarios and very little change with the addition of a 3rd site. This observation indicates that 2 sites may offer the most convenience for the least fixed cost, a theory that had to be tested in the cost analysis. The second observation is related to location: All three model runs placed the facilities in Cook County, demonstrating the high density of demand in the county (primarily the city of Chicago). In each of the modeled site location analyses, the number of applicants allocated specifically to the first site located in the southside of Chicago was much higher than other locations. This observation indicated that locating the sites in Cook County, likely in the City of Chicago, would make the most sense for applicant convenience and agency efficiency.
FIGURE 5  1-Site Facility Location
FIGURE 6 2-Site Facility Location and Travel Time Histogram
FIGURE 7  3-Site Facility Locations and Travel Time Histogram
Results of Cost Analysis

The results of the Cost Analysis are shown in FIGURE 7 in terms of a “Total Annual Agency Cost.” As previously mentioned, the Total Annual Agency Cost combines all three cost components for the purposes of comparing different site/location scenarios. It is an otherwise theoretical concept, as it ignores other costs to the agency (such as administration of the program) and any other changes to the operating model that may developed at (e.g. offering more services at the assessment site). Thus is cannot be confused with a contract cost estimate or agency budget, but is appropriate for comparing site/location scenarios within the context of this exercise.

The Total Annual Agency Cost varied with the number of sites, as expected, but the cost of each component varies at a different rate. The screening cost is the same for all three models, as expected. The site operating cost increases with the addition of each site. The agency transportation cost decreases with the addition of sites. Transportation costs comprise a larger portion of the Total Annual Agency Cost and the transport time savings gained from moving from 1 to 2 sites decrease such that the Total Annual Agency Cost for the 2-site model is less than that for the 1-site model. However, there was less transport time savings by adding a third site (recall from the location analysis previously described) and the cost of such was not reduced enough to balance for the additional cost of the additional site. Thus, the Total Annual Agency Costs were lowest with the 2 site model by a small margin.

The scenario that accommodated for future growth in demand and inflated costs also indicated that total costs would be lowest with a 2 site model (see FIGURE 8). Similar to FIGURE 7, screening costs remain the same regardless of number of sites and site operating costs increase with additional sites. The site operating cost increases with the addition of each site (though not as much as there is a latent space in the base year to accommodate additional applicants without increasing site size). The agency transportation costs decrease with the addition of sites. However, transportation costs comprise an even larger portion of the Total Annual Agency Cost in the future because of increased demand and inflated transportation costs. Thus, the 2-site provides the lowest agency cost, by a small margin.
FIGURE 8  Total Annual Agency Cost by Number of Sites
FIGURE 9  Total Projected Annual Agency Cost by Number of Sites

APPLICATION
The results of the site and cost analysis conducted by the RTA project team – indicating that 2 sites in Cook County would offer the lowest total agency cost – provided key information to the RTA Mobility Services Department staff as they considered changes to the assessment model. The RTA Mobility Services Department also reviewed peer ADA paratransit eligibility assessment models and developed a vision for changing the service offerings at the sites. The combined findings of the analysis and research led them to the conclusion that they would indeed reduce the number of assessment sites to two, and locate them in Cook County. The Director of the Mobility Services Department then educated the RTA Board and key stakeholders about the opportunity and is issuing a Request for Proposals (RFP) for the new contract in the second half of 2015, to be operational by mid-2016.

The methods used in this analysis are applicable to other transit agencies as well, for any type of problem that involves a trade-off between fixed cost of operating multiple sites and transportation impedance of customers traveling to the locations. The methods can be used for the same application, ADA Paratransit assessment sites. They can also be used to evaluate siting for other facilities, such as bus garages, customer service centers, and ticket sales locations.
ACKNOWLEDGEMENTS
Jessica Hector-Hsu, Director – Planning and Market Development, and Hersh Singh, Principal Analyst – Data Services and Analytics, are responsible for authoring this report. Valuable assistance in the analysis was provided by Michael VanDekreke, Director – Mobility Services, Rosemary Gerty, General Manager – Regional Accessibility, Anne Lefevre, Manager – ADA Paratransit Certification Programs, Peter Fahrenwald, Manager – Regional Planning and Corridor Planning, Brad Thompson, Manager – Data Services and Analytics, Tony Manno, Project Manager – Local Planning and Programs, and Sidney Kenyon, Intern – Strategic Planning.
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