Background and Analysis Goals

Denver’s Light Rail system is a 35-mile electric light rail network extending from downtown Denver to Littleton, CO. Completed in 1994, Light Rail is the quickest way to move about the Denver metro area and is also the cheapest form of public transportation for riders. It has been lauded as one of the major success stories of the region's transportation system. However, the majority of these stories have focused on ridership and have largely ignored other factors contributing to a successful public transportation system. These factors include indicators of overall coverage such as the number of neighborhoods within walking distance to stations, accessibility to commercial and residential areas, the percentage of the total population within a 0.5 mile distance to a Light Rail station, and the demographics of the population served by light rail. Other considerations include user affordability, cost efficiency to manage and operate the system, and the speed and efficiency of the system itself as whether or not the RTD is getting the most coverage possible from the least amount of stations. Additionally, there are both safety and environmental impact considerations.

The goal of my analysis was to evaluate the success of the RTD Light Rail system based on some of these considerations. My main research question was what percentage of the Denver metro population is served by the Light Rail system?

Analysis Steps

GIS data was gathered from two sources: the Denver Regional Transportation District's own GIS database and the City and County of Denver's GIS information database. Raw data consisted of a point shapefile of Light Rail stations, a line shapefile of Light Rail lines, a polygon shapefile of census data grouped by neighborhoods, and a polygon shapefile of economic information grouped by neighborhoods.

1) Project Light Rail Data: I projected Light Rail data points into a Geographic Information System (GIS) coordinate system to match neighborhood census data

2) Clip Light Rail Data to Boundaries: I clipped the projected Light Rail data within the Denver metro boundary

3) Join Neighborhood Census Data to Economic Data: I report shapefile of economic information aggregated by neighborhood as a base layer and perform a spatial join

4) Buffer Light Rail Stops by 0.5 mile: I defined a buffer area within a 0.5 mile radius to reveal areas within walking distance to stops, thereby identifying areas best serviced by Light Rail in step 2

5) Re-aggregate the Neighborhood Census Data into the Serviced Areas: I calculated an area weighted statistic that represents the ratio of the area of interest to the census area (neighborhood census data) and destination (buffered station) and the area of the source itself (neighborhood census data). This ratio (area of intersect/area of source) is then used to estimate the population that falls within the service area.

Conclusions

The Denver Light Rail system appears to meet my personal criteria for a good public transit system in the following ways:

- **“Key” areas and districts are accessible:** The high concentration of stations located in the downtown or commercial district provides transportation to several key tourist destinations including the Denver Art Museum, the Colored State Capitol, the Denver Performing Arts Center, and the Colorado Convention Center. Additionally, the Light Rail coverage between 15th Street and 16th Street which is the main business district in the Denver metro area.

- **Environmentally Friendly:** Although, this is highly dependent on ridership, as a whole light rail systems have a smaller carbon footprint than buses or cars due to their reliance on electricity rather than gasoline

- **Speed:** Light Rail remains the quickest way to navigate the downtown Denver area as it avoids heavily congested roads and maximizes distance between stops as opposed to bus travel

- **Affordability:** In terms of the distance and efficiency per $, Light Rail remains the most affordable way to travel around Denver

In other areas, the Light Rail system falls short. The following are gaps in the system as well as recommendations and considerations for future planning for the Light Rail System:

- **Coverage Area:** Currently, light rail service is focused in the downtown and commercial district and wealthier suburbs such as Cherry Creek and Englewood located south of downtown. There is a need for coverage in both the neighborhoods West of downtown and the Northeast neighborhoods. Currently, the Regional Transportation District is the inside of a construction program that will add a new line to the line to run West of downtown towards Golden, CO. The hope is that this new project and expansion coverage to the Western portion of the city.

- **Population Served:** Only 9.8% of Denver’s metro population lives within walking distance to Light Rail. A recent article in the Denver Post reiterated this issue when it cited that only 14 riders per mile ride Light Rail, compared to a national average of 24 riders.

- **Demographics of Population Served:** As previously mentioned, there remains serious gaps in Light Rail coverage that impact low-income neighborhoods. The construction of a line towards the Northeast corner of the metro boundary that would connect Northwest Park, Alls Park, and Denver to the downtown could solve this issue.

Is Light Rail Serving Low Income Neighborhoods?

Somewhat. Low income neighborhoods in proximity to the downtown district have adequate coverage such as Aurora, Larkspur, Jefferson Park, and North Capitol Hill. However, some of the poorest neighborhoods in the periphery of the metro area continue to lack coverage. Additionally many of these neighborhoods such as West Colfax and East Colfax are not easily walkable due to both safety concerns and spotty development patterns. My analysis suggests that Light Rail access is low income neighborhoods could be improved through an extension of the Light Rail system Northwest and Northeast.

What is The Relationship Between Public Transportation Use and Access?

From both a GIS analysis of coverage versus percent population utilizing public transportation as well as a regression analysis between percentage population utilizing public transportation versus number of stations within walkable distance, there appears to be a trend linking public transportation use to access (Figure 4, p.40-41). However, the cause behind this relationship isn’t necessarily clear. On one hand, increased access to Light Rail services could be encouraging a greater number of individuals to use public transportation. On the other hand, previous trends in public transportation use during the early 1990's may have driven the placement of Light Rail stations.

9.8% of Denver’s Population is Served by Light Rail

Most likely, it is a combination of both scenarios whereby the Light Rail system was constructed with the intent to serve areas of high public transportation use, and the presence of Light Rail service areas has perpetuated that use. There are several anomalies to this trend such as Capitol Hill, Cheesman Park, and Congress Park. One of the main limitations to my analysis was that I defined “serviced” as living within a 0.5 mile distance to a Light Rail station. Additionally, through a more qualitative analysis, I evaluated potential improvements.

1) Define “serviced” as living within a 0.5 mile distance to a Light Rail Station. Additionally, through a more qualitative analysis, I evaluated potential improvements.

2) Consider whether or not the Light Rail system is adequately serving low and moderate income areas as well as areas where a high percentage of the working age population relies on public transportation versus number of stations within walkable distance, there appears to be a trend linking public transportation use to access (Figure 4, p.40-41). However, the cause behind this relationship isn’t necessarily clear. On one hand, increased access to Light Rail services could be encouraging a greater number of individuals to use public transportation. On the other hand, previous trends in public transportation use during the early 1990's may have driven the placement of Light Rail stations.

3) Consider whether or not the Light Rail system is adequately serving low and moderate income areas as well as areas where a high percentage of the working age population relies on public transportation as function of the number of stations within a 0.5 mile radius of that neighborhood. Additionally, through a more qualitative analysis, I evaluated potential improvements.

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