GIS PROJECT ANALYSIS:
Los Angeles Metro Rail - Gold Line 2015

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PDD 631 Geographic Information Systems for Public Policy, Planning & Development
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November 30, 2014
Planning Issues

The Metro Rail consists of a rapid transit subway, Red/Purple Line, and four light rails, Expo, Blue, Green and Gold Lines, serving 80 stations in Los Angeles County. The average daily weekday ridership for the system was around 326,663 in 2010 (Hymon 2012). The public transit ridership in the “Car City”, Los Angeles (LA) is different from other metropolitans. The expansive, low-density communities have proliferated at the edge of many cities in the Greater LA region. Since the automobile traffic is favorable over public transit mode in LA, boosting ridership became an issue for the metro expansion project which is a transformation of the LA rail system. Under California Senate Bill 375, Southern California Association of Governments need to have 8% greenhouse gas (GHG) reduction by 2020. The effect of the transit expansion become the focus for both social and environmental issue. Among the six new lines that are opening between 2012 and 2020, the Expo Line Phase I between Downtown LA and Culver City is the first to operate. After the completed Expo Line in 2012, the weekday daily ridership has increased gradually each year based on the Metro Developer statistics.

![Average Estimated Ridership: All Lines for FY2014](http://iosrp.metro.net/MetroRidership/indexRail.aspx)
As the second operating project, the Gold Line 2015 highly expect an incremental ridership. The Metro Gold Line Foothill Extension will extend the existing Gold Line east from Pasadena. The first phase will travel more than 11 miles from Sierra Madre Villa Station, with stations in the cities of Arcadia, Monrovia, Duarte, Irwindale and Azusa. The analysis from GIS evaluation of the Metro Rail, focusing on the Gold Line, is important for the future ridership projection.

**Research Questions**

- Will the Metro Rail become a social class divider in Los Angeles County?
- What’s the key structures of the extension of the Gold Line 2015 to raise ridership for LA rail system?

**Data Selection**

- The U.S. Census Bureau, Los Angeles County GIS Data Portal, Metro Developer and City GIS Data Portal provide different data formats (Shapefile, KML, GeoJSON, WFS, and Spreadsheet). These are the data sources for the process of GIS analysis. The base map is a Shapefile of City Boundaries that derive from the Los Angeles County Cadastral Land base.
- The current Rail Line, Station, Portal and Bike Lanes Shapefiles on top of the county map could help to determine the region in the analysis. Since the data of future Metro Lines is not provided by Metro Developer, the extension of the Gold Line need to be digitized. By mapping the locations of 6 future Rail Station and link them with the current Gold Line by line segments to create the Gold Line 2015 on the layer.
- The census tracts of Los Angeles County, total population and median household income data were selected as demographic indicators for the research questions. In the 2010 census tracts and block groups spreadsheet, the column of GeoID were sorted by eliminating the front zero, in order to match the digits and import to the layer.
• The profile of residents’ daily trips could be studied from the indicator, points of interests around the Metro Rail. The Locations/Points of Interest Shapefile 2014 was selected and derived from the County’s Location Management System (LMS) Data. It contains 73,000 locations with more than 270 unique types. Among the points of interest data, 11 types of location were mapped along the Metro Rail, including banking and finance, beaches and marinas, child care, churches, colleges and universities, hospitals and medical centers, museums and aquariums, parks and gardens, post offices, public housing, and shopping centers.

• The Gold Line 2015 stations introduced commuter, oriented destinations by allowing for mixed-use redevelopment, higher residential densities, parking reductions, and increased height limits. In the environmental evaluation of the Gold Line, land use and planning Shapefiles from countywide land use policy, a general plan and land use codes in the corridor were selected to evaluate the land use of the transit nodes.

Layout Distribution & Analysis

Figure1. Metro Rail Lines in Los Angeles County
The layout shows the current 5 Lines of Metro Rail in Los Angeles County. The Gold Line connects with Red/Purple Lines at Union Station, and runs between Pasadena and East Los Angeles.

Figure2. Metro Rail Lines in Los Angeles County Gold Line Extension 2015
The current Gold Line completed in 2003 which connects 13 stations in the cities of Los Angeles, South Pasadena and Pasadena. In the phase I of the Gold Line expansion project, 6 new Metro Rail stations will be built at Arcadia, Monrovia, Duarte/City of Hope, Irwindale, Azusa Downtown, and APU/Citrus College. The construction between Pasadena and Azusa is expected to be complete in September 2015.

Figure3. Population Distribution
The relationship between the current Metro Rail and total population distribution in Los Angeles County is not statistically significantly. High population density clustered at locations with public transit, especially subway/rail systems is the phenomenon in many metropolitans. The high efficiency which provided by well-developed public transit will vibrate cities and promote the land value close to transit stations. Due to the suburban sprawl, Los Angeles County contains a spread out population and limited public transit ridership which is very different from other metropolitans.

**Figure 4. Income Distribution**

The intellectual concept of social class in United States divides to 5 different levels by Thompson & Hickey in the table below. Other than education levels, the concepts of the lower class, work class, lower middle class, upper middle class and upper class are defined by their household incomes. The income distribution is a key factor to households’ daily trips and travel behaviors in LA. Based on the social class academic model, I classified 5 levels of household income distribution.

<table>
<thead>
<tr>
<th>Class</th>
<th>Typical Characteristics</th>
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<tbody>
<tr>
<td>Upper class (1%)</td>
<td>Top-level executives, celebrities, heirs; income of $500,000+ common. Ivy league education common.</td>
</tr>
<tr>
<td>Upper middle class (15%)</td>
<td>Highly-educated (often with graduate degrees) professionals &amp; managers with household incomes varying from the high 5-figure range to commonly above $100,000.</td>
</tr>
<tr>
<td>Lower middle class (32%)</td>
<td>Semi-professionals and craftsmen with some work autonomy; household incomes commonly range from $35,000 to $75,000. Typically, some college education.</td>
</tr>
<tr>
<td>Working class (32%)</td>
<td>Clerical, pink- and blue-collar workers with often low job security; common household incomes range from $16,000 to $30,000. High school education.</td>
</tr>
<tr>
<td>Lower class (20%)</td>
<td>Those who occupy poorly-paid positions or rely on government transfers. Some high school education</td>
</tr>
</tbody>
</table>

median income in featuring descriptions. Sub-levels of each social class are mapped as the poor in red that is under $16,000, the working class in orange that is from $16,000 to $50,000, the middle income class in blue that is from $50,000 to $100,000, the rich in purple that is above $100,000. With the GIS income distribution map, the distribution of social class in LA could be visualized. The poor and working class centralized along the current Metro Rail and dispersed less at Los Angeles county edges. The further the region is from Metro Rail, the higher residents’ income and social class is. Since the poor and many working class households could not afford a vehicle, the public transit is their only travel mode for most of their daily trips. Their travel range are limited by the structure of the Metro Rail. For instance, it will take hours or even half day for one to travel from Long Beach to Santa Monica by public transits. Thus, poor and working class need to stay close to the transit to ensure their accessibility. For the middle income and rich class, private vehicles are necessities for their daily lives. The distance to Metro Rail is an independent factor to the selection of their residential addresses. The poor and working class are the majority of current Metro Rail riders. The planning of rising ridership need to have different target groups which focusing on different social class. The middle income communities should be the attracted to ride Metro Rail in this planning issue.

*Figure 5. Gold Line Buffer Region & Population*

The buffer zones are created to analyze the walkability of the Gold Line stations as “Station Node” regions. Each Gold Line stations are the center of the buffer zones, a Buffer 1 with quarter-mile radius and a Buffer 2 with a half-mile radius are created and dissolved for the station node walkability. From the 2 buffer zones, the population are not dense at walkable station nodes, and the station with the densest population in the buffer zone is at Azusa station. The east extension connects eastside communities and the population in the station nodes would be potential riders after the Gold Line 2015 open. Buffer 3 with 1.5 miles radius are the
zone for potential riders such as cyclists and bus riders travel from further neighborhood communities to switch travel mode and travel further.

**Figure 6. Gold Line Buffer Region & Income**

Since the poor and working class are the consistent distribution of high transit-dependent residents, the extension of Gold Line is an attempt to reach to other social classes. The buffer zones display the Gold Line 2015 pass through medium income and rich communities beyond Pasadena. After the opening of the 6 new stations, the probability of different social class riders on Metro Rail are increased. In the long run, the Metro Rail extension project will encourage more residents from middle class neighborhoods to reduce private vehicle trips by providing a more developed LA rail system.

**Figure 7. Gold Line Buffer Region & Bikeways**

Many bike lanes in central LA, Pasadena and Azusa cross in Buffer 3 zone along the Gold Line 2015. It illustrates an improving infrastructures for cyclists since the Gold Line 2015 will connect the east and west bike lanes in the county. The new function of Gold Line will promote a greener LA from connecting Metro Rail and bike lanes program.

**Figure 8. Gold Line Buffer Region & Points of Interest**

The current Gold Line connects from Chinatown to Highland Park to Old Town Pasadena which are unique communities in the region with many points of interest. Other than regular transit users, history and culture trips could be provided by riding the Gold Line. Some of the region’s most treasured destinations are close to the buffer zones, such as Olvera Street, Dodger Stadium, Caltech, and the Rose Bowl. Among 270 unique types, I selected 10 popular trip destinations such as banks, post offices, child care centers, medical centers, churches, colleges, beaches, parks, museums, public housing and shopping centers. The layout shows the consistency with the income distribution in figure 6. Since public housing is for the poor and working class, the location of most of public housing are in the buffer zones. Most of the red
icon of public housing are in the buffer zones of current Gold Line, and the extension of Gold Line will cross higher income regions where do not contain public housing.

*Figure 9. Land Use Code*

The land use layouts extracted from 3 sets of data: the East LA community plan, the LA land use code and the Pasadena general land use policy. The current Gold Line pass through communities which could be selected from the LA land use code which including 6 regions: Northeast LA, Boyle Heights, Silver Lake - Echo Park – Elysian Valley, Central City and Central City North. The line begins from the yellow residential areas of East LA to the brown manufacturing areas of Boyle Heights, to some blue industrial and residential areas in Silver Lake - Echo Park – Elysian Valley and continuously passing through mainly residential areas to Pasadena. For the extension line project, a mixed land use are promoted in the station nodes. In coherence with the Points of Interests Figure 8, more shopping malls and parks fall in the buffer zones which reflects more commercial and public land use in the extension Gold Line. The current Gold Line provides trips for daily work from residential areas, and the extension parts will provide leisure trips and link communities to the center of urban area such as downtown LA.

**Limitation**

- An experimental evaluation of the Gold Line is needed for further study in the research topics. By conducting household survey to residents at Gold Line station notes, and collecting data such as 7-day travel diary, socio-demographics and attitudes toward environment, safety for the analysis.

- In the digitizing process of the future gold line, the flow of the line segments is traced from the Metro Rail expansion project photo, which is not in the exact shape of route due to human error.
• The incomplete census data results in some blank spaces in the mapping process. Different form the City of Pasadena which provides the land use data for the public. The city of South Pasadena website provides only the PDF of the land use map in their general plan. The plan data are not provided by either the city or Los Angeles County GIS Data Portal either. Therefore, the land use around the South Pasadena station left blank in the map.

• The LA Countywide Land Use Policy Shapefile is adopted in 1980 and does not covered by a community, neighborhood or area plan. Some cities offer interactive GIS map system on their websites such as Azusa, but these data could not be downloaded by individuals. A better comparison of land use for the Gold Line 2015 could be made, if more data could be downloaded to map the land use of cities where 6 future stations are.

Conclusion

• The Los Angeles County has been evaluated by many scholars as the paragon of polycentrism for which the area population is difficult to serve from a transit perspective. The Metro Rail’s obstacle to increase ridership is because of automobile are still the most attractive mode of transportation (Mo 2012). From the automobile to transits, the obstacles lies on the change of the local residents’ travel behaviors. The structure of the Gold Line 2015 will expand the transit to higher income communities. From the collaboration of the infrastructure of bike lanes, points of interests and mixed land use plan, the rail extension project is going to encourage middle income people to ride the public transit for certain trips. The vehicle per miles for each households will be decreased from the small difference from each household. In the long run, residents from all social class will consider transits for more daily trips gradually.
From the analysis of the income distribution, the social classes are divided apparently by the current Metro Rail. The poor and working class are in the central of LA county and the middle income and rich are located at further form the transits. The more clear the separation is, the harder for higher income people to ride the rail, because travel mode will become an indicator of the social class in the metropolitan. The concept that public transit is only for the poor needs to be changed in order for more of the middle income class and even rich to use transits. The Metro Rail expansion project has a good intention to bring riders from different social classes to public transport systems based on the analysis of Gold Line 2015 projects. With more lines open in the Metro Rail, the social class divider will be dissolved from riders from different social class communities. A fully developed LA rail system will be completed and the projection of an increased transit ridership is in the near future.
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Metro Rail Lines in Los Angeles County
Gold Line Extension 2015
Gold Line Buffer Region (Figure 7)