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Shahrzad Ainkeshavarzi
University of Alabama in Huntsville, sa0072@uah.edu

Hamed Soleimani
Islamic Azad University, Iran, hamedsoley@gmail.com

Improvement Assessment of Bus Serviceability by Proposing Route Revision (Case Study: Memphis, Tennessee; Zip Code Area:38126- MATA Route Number 57)

S. Ainkeshavarzi[1] and H. Soleimani

1- Shahrzad Ainkeshavarzi, Master`s Student in Civil and Environmental Engineering Department, The University of Alabama in Huntsville, Huntsville, Alabama; sa0072@uah.edu

2- Hamed Soleimani, Civil Engineer, Islamic Azad University of Kermanshah, Iran; hamedsoley@gmail.com

ABSTRACT

Public transit is an essential part of a city's transportation. An efficient transit system makes a city more sustainable by reducing the number of single occupancy vehicles leading to a reduction in emissions, energy consumption and less congestion on streets. Public serviceability is an important indicator to indicate how good a transit route is determined; however, it could change during the years since population density is variable. This study is intended to do a comparison between serviceability of a bus line in Memphis, Tennessee for one zip code area to point out the necessity of considering route revising in short-term transportation plans.

Introduction

MATA (Memphis Area Transit Authority) is a public transportation provider in Memphis, Tennessee covering 319 square miles with 33 fix bus routes and 7.7 million passenger trips per year ("MATA Transit Bus").

MATA`s main usage is for travel trips to downtown of Memphis which is one of the strongest markets for transit users and there are some places that are covered by several bus routes. The idea of this study is to reroute the line that has serviceability overlap with other lines to an area which is not covered at all.

A peer review while conducting MATA short-range transit plan in 2012 found that while MATA is a productive and cost-effective system, but the services have been shrunk over time in terms of ridership and service hours (NELSON NEGAARD, 2012). The study also determined that MATA does not have a clear service design and structure and on a per capita basis MATA`s population uses less transit as compared to the peer group.

Various analysis can be done to evaluate a transit system including cost efficiency, cost-effectiveness and service effectiveness. This paper aims to increase service effectiveness by rerouting line 57 in a zip code area in downtown. Jin and Lee

examined the same topic in North Korea by reforming bus routes in a small-medium sized city (Jin & Lee, 2013). They used GIS as a tool to study serviceability of the new proposed route compared to the old one. The results show that with the same number of buses more geographic areas are coved which leads to an increase in the number of bus users who are accessible to the bus service. analyzed the positive effect of rerouting bus lines at the metropolitan level, focusing on suggesting far-reaching reform policies (Jin & Lee, 2013).

Improving bus service is a popular concept among transportation researchers consequently different criteria for evaluating the improvement effects were defined which are related to bus users and operating companies. 15 indices for evaluating bus service route based on the survey results targeting public transportation agencies are established in "Bus Route Evaluation Standards" book, the book also provided the simulation framework for evaluating the level of bus service (Synthesis of transit practice 10: bus route evaluation standards,1995). In addition, the literature has emphasized the important role of the transit-oriented development to decrease the use of private vehicle use as one of the most contributing factors of climate change (Meignan et al., 2007). Several analyses have been done on bus route evaluation and reforming while all of them emphasized the necessity of doing them for making decisions on bus reforming (Chapa, 2003; Jin & Lee, 2013; Crooks, 2013).

This study focused on a part of line 57 (Park) of MATA bus connecting park place mall in the east of Memphis to downtown in the north-west of Memphis. The target part is located in zip code area 38126 which is shown in figure 1. Figure 2 shows the bus route in the area, it gives an overview of current accessibility and coverage of MATA in the specific zone. From the map, it is obvious that central to the northeast part of this region does not have access to transit. One suggestion would be to reroute the Park line (Route 57) in a way that covers those areas which lack the accessibility to transit.

Figure 1 38126 Zip Code Area, Memphis, TN

Figure 2 MATA Bus Route 57 in 38126 Zip Code, Memphis, TN

Various demographic maps have been explored for the target area. These maps were retrieved from Policy Map trial version and they include median household income, number of households, population density, household vehicle ownership and those who use transit as the dominant mode to reach work zones in 2011. The demographics from figure 3, 4, and 5 show median household income, number of households, population density relatively. Median household income in this region is very low as it can be seen from fig.3 which is 33547 $ or less while fig.4 and 5 show the high number of households and a high ratio of density which are located in this area.
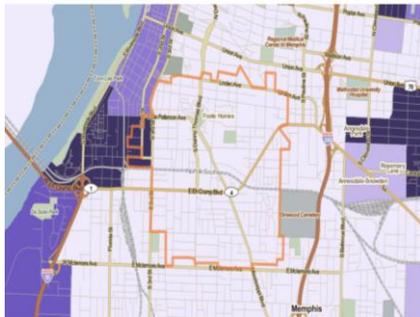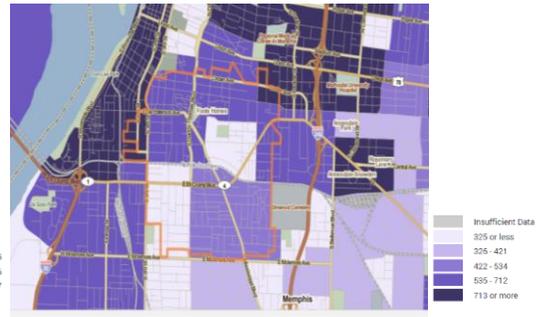

Figure 1 Median Household Income
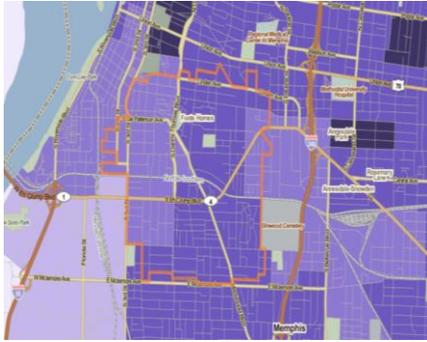

Figure 2 Number of Households

Figure 5 Population Density 2010

Figure 6 Average Vehicles per Households

Figure 6, 7 and 8 offer more evidence for the area need of a better-planned transit by determining the low rate of vehicle ownership among households and high dependency on transit to reach work destinations. Regarding aforementioned characteristics, this zone is a good candidate for public transit route.
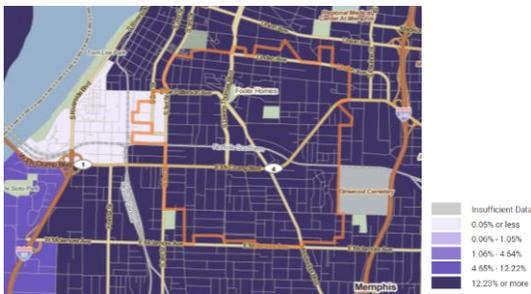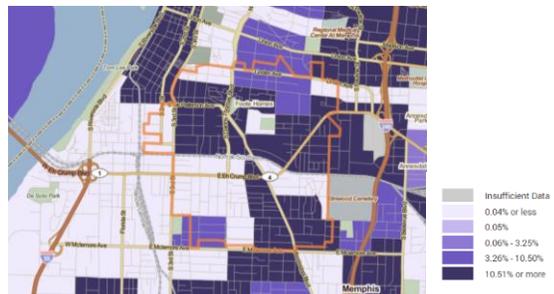

Figure 7 Percentage of Housing Without Vehicle

Figure 8 Percentage of People Who Uses Transit to Work

AutoCAD software was used to visualize the existing route and the designated route at the same scale on a similar background. Routs are drawn and three buffers were placed around them within 0.1, 0.2 and 0.3 miles of them. The Buffers are determined to show the coverage areas of each route for a defined distance from the route. The serviceability of each route has been estimated by calculating total population coverage, total Hispanic and non-Hispanic population coverage, non-Hispanic white, and African-American population coverage within the buffers.

The current route is depicted in Fig.9 and the designated route can be seen in Fig.10, this route is selected among different alternatives based on better serviceability and shorter mileage. Although the existing route seems to be more straight, the reason of the new route being a little deviated is because it has been designed along the existing

street; consequently, to have a more undeviating route new infrastructures will be needed.
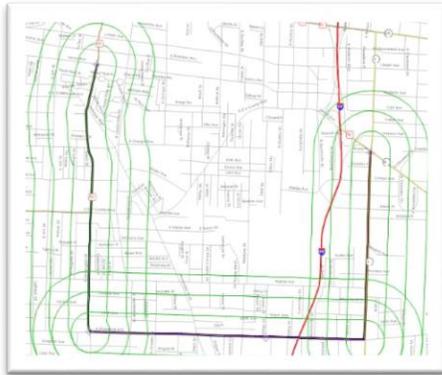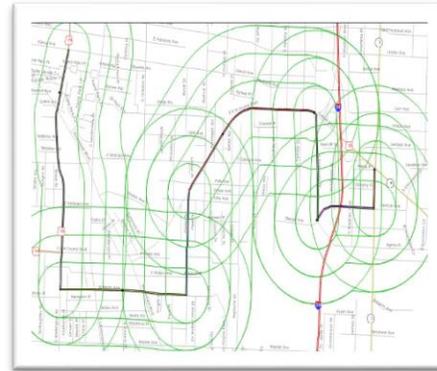

Figure 9 Existing Route

Figure 10 Designated Route

Regarding the significant overlaps among buffers; it is logical to consider the buffer within 0.1 miles from the route to prevent double counting of population and land under coverage. Results of the bus coverage for both routes are driven from TransCAD and summarized in table 1.An increase can be noted in all under study indicators. The land area under cover is increased by 7% using the new suggested route and it should be noted that the length of the new route is even shorter than the current one. The most notable result is associated with the higher accessibility for not Hispanic white users with a significant increase of 65 percent, total number of Hispanics who can access the transit is increased by 37 percent following by 14.5 % and 10 % increase in total number of not Hispanic travelers and African Americans passengers relatively

Table 1 Comparison Table

	Total Population	Total Hispanics	Total Not Hispanics	Not-Hispanic White	Covered Acre	African-Americans
Current Route	3379	27	3351	219	533	3100
Designated Route	3866	37	3835	363	574	3417
Increase (%)	14.4	37.04	14.44	65.75	7.69	10.23

A question may arise regarding those population that were covered before by the previous route: what are they going to do in absence of the route? As it can be perceived from Fig.2, route 57 is located close to route 17 and 4, also route 17 and 4 intersect

route 13 which is along the previous location of route 57, so these lines would compensate the absence of Park line and users would still have access to the transit however in a little further distance.

The research findings offer proofs that rerouting 57 would be a good idea in zip code 38126 area in order to significantly increase the accessibility of MATA in the downtown of Memphis.

Conclusion

The serviceability improvement of a part of MATA bus route was examined in this study by the current route division without any further economic investments. The serviceability was studied based on the evaluation of a number of people who have access to the bus transit within the current route and the designated route. The designing process and evaluating the number of users were done using TransCAD software which is a GIS-based software.Results show a significant improvement in the serviceability by reforming the route. The study revealed that due to the fast change in urban demographics especially in downtowns, monitoring and re-evaluation of the bus routes on yearly basis could help to increase the performance of the transit system.

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