Bike Route Analysis in the most congested city around the World, New York City

Network Analysis in ArcGIS Pro

Shreyas Madapura Chandraiah
Golisano College of Computing and Information Sciences
Rochester Institute of Technology
Rochester, NY, USA
Sm1233@rit.edu

ABSTRACT

Traffic congestion in New York City has always been/will always be a linear escalation. Given how expensive is New York City, renting a parking space or paying parking charges for a small interval of time is an extra burden to anyone's pocket [1]. New York City's public transportation is reliable but not the ideal solution in terms of commute travel time [2]. My Analysis will explore the possibilities of using a bike as a replacement for the commute. Can bike commute help in reducing travel time and can bike commute be extensively used anywhere in New York City. Methods to assess these probabilities will require bike tracks around New York City or creating protected cycle tracks by visual inspection on an imagery spatial map in ArcGIS Pro. Comparing this data with the traffic congestion in New York City, in order to evaluate whether bike commute will be any benefit.

KEYWORDS

New York City, Traffic congestion, Bike Route Network Analysis, Vehicle commute, public transportation commute, Bike Parking, Vehicle Parking

PROBLEM DOMAIN

Traffic and Parking are the most painful daily activity that every individual with a vehicle has to undergo, especially in highly populated cities or congested cities. People find different ways to skip these two activities but end up spending a couple of hours daily. Traffic in any congested city is quite high at any given time and Finding a parking spot is an uphill battle in densely populated areas. Parking charges are being a burden on everyone who owns a vehicle, not all apartments in New York City come with free parking.

Everybody believes using public transportation is a better solution to avoid traffic and parking, which is true but doesn't work out for everyone. Not every school or office is having connectivity to each and every apartment in the city. New York City has good and broad public transportation around the city. Because of the extensive availability of public transportation, most people rely on public transportation, including millionaires. Due to this particular reason, public transportation such as Buses and Subways are also congested most of the time, especially in demanded routes. Which may not be convenient for students who cannot afford to be late to their classes and also for employees who cannot afford to be

late to a meeting. This leads to using their own source for transportation which is the main cause of this project.

Figure 1: Parking Regulations

One other problem with the major cities and towns in the Parking Regulations. Parking Regulations are mainly meant for cleaning the street and the parking spaces. In New York City Parking Regulation is indicated by the Alternative side Parking (ASP) sign on the parking board with the time parking regulations are in effect. Parking Regulations are also in effect during major Holidays like New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day. Basically, if parking regulations are in effect, no one is supposed to park their vehicles in the parking space. Figure 1 shows the parking regulations applicable spots around New York City, which illustrates that almost all the parking spaces in New York City are going to be under parking regulation in sometime the day. This means that parking regulations are to be monitored before parking the vehicle and parking regulations won't be applicable on bike parking spaces.

LITERATURE REVIEW

There are numerous research on Transportation, unsurprisingly in New York City, as it is one of the most populated and demanded city in the world. Parking in major urban cities are been highly studied to solve the issues [1-2,5]. There are also a few case study which suggests bike infrastructure around major urban cities are quite useful in all aspects [3,5].

GOALS

Performing a Network Analysis in New York City to explore the possibilities of using a bike as a replacement for the vehicle commute and public transportation commute. Could bike commute be extensively usable around New York City as compared to the public transportation available in New York City.

OBJECTIVES

1. Analyzing bike commute tracks or paths around New York City.
2. Analyzing bike parking availability around New York City.
3. Analyzing public transportation routes around New York City.
4. Comparing the bike Network Analysis with other vehicle commute and public transportation commute.

DATASETS

The main Data Source for the analysis was freely available in the New York state government web portal, ny.gov.com, and a few other well established web portals. The Data Sources included in this Analysis are Parking Regulations around New York City [10], Bike track or path around New York City [7], Bike parking areas around New York City [10], Subway routes around New York City [8] and Bus routes around New York City [9]. The Data Sources that were available were quite new and updated ones, this made it easy for analysis, because bike commute infrastructure has been improved over the last 5 years.

METHODS

There are several methods involved in this Network Analysis. The first method is to determine the bike route around New York City, which is done visually by the data available. Placing a shapefile on a map in ArcGIS Pro which consists of a bike route. This is done to determine whether the initial assessment of bike routes is available in order to continue Network Analysis around New York City.

The second method is to determine bike parking availability around New York City. This is an important aspect in the Network Analysis because as long as the source and destination have dedicated parking, using the bike for commute would be possible. The dataset for bike parking assessment should a shapefile which consists of data in points. These points will allow making a valuable assessment as to how bike parking spots are available in New York City.

The third method would be comparing the bike routes around New York City with the public transportation like subway routes and bus routes around New York City. This is would be a helpful comparison in order to measure the bike routes again public transportation routes in New York City. The comparison will be done across the entire New York City and not just in a few congested parts of the city.

The final method is the Network Analysis, where a source point and a destination point would be picked on the map, and these points will be used to make a route Network in ArcGIS pro. The Network analysis will also provide the time taken to travel from source to destination, which would be used to compare with the time duration for vehicle commute, public transportation commute (subway or bus, whichever is the fastest route between source and destination), and walking. This comparison can provide a solid justification as to whether bike commute can be any beneficial around New York City as compared to vehicle commute and public transportation compute.

RESULT

Figure 2: Bike Route

The result of uploading the bike route dataset on an ArcGIS Pro is shown in Figure 2. As per the figure, New York City Bike route is fairly available in the most congested parts of the city. Bike routes are notably available in areas like Manhattan and Brooklyn, areas like Queens have fairly fewer bike routes in comparison with Manhattan and Brooklyn. This illustrates that bike routes are found in New York City, but everywhere around the City.

Figure 3: Bike Parking

The Bike Parking around New York City is shown in Figure 3 using a dot shapefile. As

bike routes in Manhattan are highly available, this figure focuses on the bike parking around the Manhattan area. The bike parking can be of different types, which includes, bike rakes, bike bollards, bike lockers, bike lockups, and a few others. Based on the figure, it can be stated that bike parking shouldn't be an issue around the Manhattan area. There are no such important rules that have to be followed while parking the bike as seen in vehicle parking, which can be finable if not followed appropriately. There are some companies and schools that allow parking the bike anywhere on the campus as long as the bike is parked in a safe and appropriate way.

Figure 4: Subway and Bus Routes

The Figure 4 illustrates the Subway and Bus Routes around New York City. The figure is obtained by attaching a line shapefile into the ArcGIS Pro map. The green line on the map is the Bus Route and the purple line on the map is the Subway Route. Based on the Figure, it can be interpreted that Bus Routes around New York City are more available when compared to Subway Route. Subways are compared to be a faster way to commute from one place to another place, but unfortunately, they aren't found everywhere around New York City. However, based on the analysis, the public transportation in New York City is reasonably available.

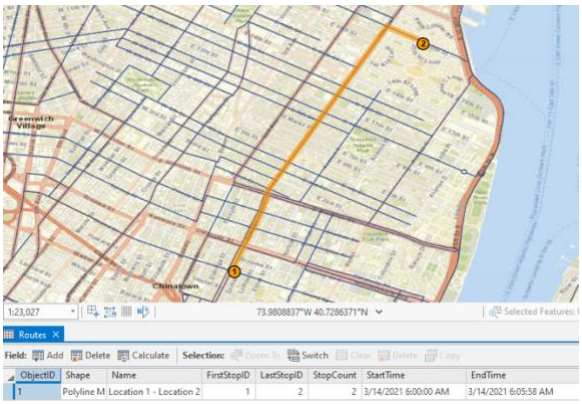

Figure 5: Bike Route Network Analysis

For Analysis purpose, a source point and a destination point has been picked, considering a hypothetical scenario. The source point here is the Lower Manhattan Art Academy, and the destination point is the Stuy Town, assuming students are trying to go home after college, which in this case the college is Lower Manhattan Art Academy and Stuy Town is their home. Figure 5 shows the Bike Route Network Analysis computed in ArcGIS pro. The bike parking shapefile was modified to consist the source and destination points, by applying condition using a query. These points were then assigned to stops in Network Analysis as the two points (source and destination) which were taken from the bike parking shapefile. The particular reason for considering the source point and destination point was to make sure that bike parking was available at both ends. The Network Analysis also computes the time taken to travel between the two points, which can be observed from the attribute table shown in Figure 5. The time taken to travel from source to destination is around 5 minutes 58 seconds, as indicated in the figure if the source was left at 6:00:00 PM, the destination would be reached by 6:05:58 PM. This should be presumed to be an approximate time duration, as the commute time travel involves a lot of variables. The distance

between Stuy Town and Lower Manhattan Art Academy is 1.6 miles, covering 1.6 miles in around 6 minutes is considered good in commute standards.

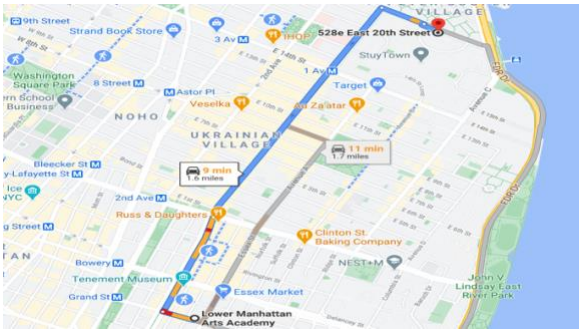

Figure 6: Vehicle commute

The Figure 6 represents the commute path and time between the same source and destination points considered for bike route analysis, which is Lower Manhattan Art Academy and Stuy Town respectively. The time duration for the same source and destination points is around 9 minutes, which is again good according to commute standards. There are a lot of variables that might can play during the vehicle commute when compared to bike route analysis. Although the path is the same as the bike route network analysis, the time taken to cover the same distance in vehicle commute is around 9 minutes as compared to around 6 minutes in bike commute. If the difference for a small route, which is 1.6 miles, is around 3 minutes, the difference can a lot bigger for around 3 to 5 miles commute. This commute time doesn't include finding a parking space or carefully move the car out of the parking space, this would at least add a few couple of minutes to the commute time.

Figure 7: Bus commute

The figure 7 represents the commute path and time between the same source and destination used in bike route analysis and vehicle commute analysis. The best choice google maps selected was the 21 minutes one, because the 18 minutes bus commute involved 8 minutes of walk commute. Since the subway option wasn't feasible for the selected source and destination, only bus commute will be considered for the public transportation commute analysis. The time interval to travel 1.6 miles for a public transportation commute is around 21 mins. The map also suggests that the bus frequency is every 20 minutes, which also means, if a scheduled bus is to be missed due to unforeseen reasons, then 20 minutes has to spend waiting for the next bus. So, the bus commute for a small distance in New York City is quite expensive timewise.

Based on the Network Analysis and other route comparisons, the bike route dominates as the best commute. For bike commute it would take around 6 minutes, vehicle commute would take around 9 minutes, public transportation commute would take around 21 minutes and the walking commute would take around 30 minutes. The cost for the transportation plays an important role choosing between the commute options. The most expensive commute option is the vehicle commute, not only the initial investment, buying the car is high, the gas cost and parking charges adds

to become the most expensive commute. The public transportation would be a variable cost commute, there are several plans to optimize the cost as long as the public transportation is used frequently. The bike commute will have initial cost, which is also a variable cost, buying an electric bike would be expensive when compared to normal bike. Apart from the initial cost, there are no or minimal parking charges. A bike can be reliably used for at least 2-3 years, based on the usage and maintenance of the bike. In long terms, bike commute would be the most cost-effective commute.

By comparing the time travel and other parameters that could change the time duration of the travel with the cost factor in consideration, the bike route would be the wise option to choose.

CONCLUSION

To sum up everything that has been stated so far, bike commute is the best option in terms of time travel and money invested in the daily commute. There are several factors that can play around during a daily commute, which can make the bike commute better or worse. Bike commutes require some energy in order to commute from one place to another place, spending energy or ability to ride the bike may not be for every individual, especially for elderly people. The solution for this problem would be to use an electric bike, which again can bear the problem of investment, that is a part of vehicle commute and public transportation commute. In terms of Vehicle commute, a road blockage can affect in many ways. Road blockage shouldn't be a problem for bike commuters. Bike parking is not a big deal when compared to vehicle parking. Parking a bike is not as similar as parking a vehicle, parking a vehicle involves the need for appropriate parking space for the vehicle and appropriate space to move the vehicle in and out. Whereas vehicles can be parked in a tight space, as long as it is reserved for bikes, or the bikes can be carried inside the building can be parked in a safe place. There can be apartments that don't charge for parking provide free parking with the apartment and then there are apartments that charge for parking, but bikes can be carried inside the house and kept anywhere safe. There are several other factors that can be played in favor of either bike commute or other commutes, but factors that hamper bike commute are negligible as compared to vehicle commute and public transportation commute. The analysis also answers the question of whether the bike is extensively usable around New York City as compared to public transportation. Public transportation is not found everywhere around New York City, and may not be time convenient for everyone. The bike routes cover almost all the routes covered by public transportation and don't matter when the commute begins, and when the commute ends as long as it is safe to ride the bike. Using bike to commute could also play a role in Environment pollution, as there is no emission emitted from the bikes.

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