# A NEW HINT TO TRANSPORTATION-ANALYSIS OF THE NYC BIKE SHARE SYSTEM

A project report submitted in partial fulfillment of the
requirements of the award of the degree of

Bachelor of Technology
in
Computer Science and Engineering
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## 1. INTRODUCTION

### 1.1 PROJECT OVERVIEW

Bike share programs have risen in popularity in recent years and have been promoted as a lower carbon alternative to other forms of transit. Interest in bicycle sharing has been growing exponentially over the past decade, resulting in a proliferation of bike share systems in 712 cities across the world, encompassing 806,000 bicycles and 37,500 stations (Shaheen et al., 2014).

This can be largely attributed to the successful incorporation of information technology in docking stations and mobile devices as well as improved logistics such as bicycle rebalancing to ensure responsive supply management. Cities often hope bike sharing will bring many benefits such as extending the reach of transit, substituting motorized trips, and encourage non-cyclists to try cycling (Shaheen et al., 2014).

The premise of bicycle sharing is that it is a short-term bike rental system, based on varying timed memberships. Members of the bike share network have access to stations, comprised of a pay-station and multiple bike docks, across the system where bikes can be checked out from one station and returned to another ne narest to their destination.

The appeal of membership is 24/7 access to an automated bike rental network and utility of bikes in completing “last-kilometer connections” (Shaheen et al., 2014) without the worry of storage or maintenance. The price system is set to encourage shorter trips (less than 30 minutes in time), with additional fees for any time used over that maximum.

There is evidence that bike share users switch to bike share from motorized transport, such as bus and auto (Shaheen et al., 2014), creating the potential for significant reductions in transportation related greenhouse gas or CO2e emissions.

However, there is significant heterogeneity between different cities (Shaheen et al., 2014), showing that there is not a guaranteed CO2e reduction benefit from instituting bike share, especially if the trips would not have been made otherwise or are substituting walking and private bicycle trips.

**1.2 PURPOSE**

Many bike share systems make available their trip data for those who want to understand how their systems are used.

The bike share system in New York City, Citi Bike, is one of them, but they don't provide much more than the data. I've got some experience in obtaining and preparing their data for visualization, so in this article I will show you how to get started with this rich data source.

In the Before Times I commuted from suburban New Jersey to my job as a Product Manager in New York City at an office, now shuttered, ab';ove Penn Station. To get around in the City at lunch or after work I often relied on Citi Bike, New York's bike share system.

I found I could get to destinations in midtown and even further afield faster than walking and cheaper than the bus or subway. When I discovered that Citi Bike made trip data publicly available I thought that it might provide an interesting use case for the data preparation product that I managed.

The trip data files contain one record for each ride, around two million records per month, depending on the season. It's a traditional bike share system with fixed stations where a user picks up a bike at one dock, using a key fob or a code, and returns it at another.

Using the large table graphic, the moderator was able to show participants images of the kiosk, membership key, smart phone apps, and more.

The features section allowed DOT to solicit participant options on the usefulness of these features, and collect suggestions for additional features.
Sites must have unrestricted, 24/7 public
access.
• Sites should ensure maximum visibility and
access.
• Sites must not impede the use of any existing .

## 2.LITERATURE SURVEY

### 2.1 EXISTING PROBLEM

Bike sharing is an emerging industry and it is very popular in western countries, while people have tried to start the same in India, we will look into some of the stats regarding how many people use bike sharing systems. According to Wikipedia by August 2014 only 600 cities in the world had bike sharing systems and most of them were in western countries with a fleet of about 500000 bicycles with them. There is a sharp
increase in NextBike,Cogo BikeShare are some of the leading Bike Sharing systems that are currently in operation in the world.

While considering Indian perspective in the Bike Share industry, India has not yet adapted the application of this emerging industry. Currently there are a few bike share
systems.

### 2.2 REFERENCE


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**"Glorification! The Cities Celebrate the Work That Makes Them One". Brooklyn Daily Eagle. May 24, 1883. p. 12. Retrieved June 26, 2019 – via Brooklyn Public Library; newspapers.com open access.**
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**Caro, Robert (1974). The Power Broker: Robert Moses and the Fall of New York. New York: Knopf. ISBN 978-0-394-48076-3. OCLC 834874.**
**U.S. Census Bureau, American Community Survey 2006, Table S0802.**
**Metropolitan Transportation Authority. "The MTA Network". Retrieved July 15, 2016.**
**Bureau of Transportation Statistics, U.S. Department of Transportation (2001). "Highlights of the 2001 National Household Travel Survey". Archived from the original on October 2, 2006. Retrieved May 21, 2006.**
**Bellafante, Ginia (July 12, 2019). "New York Was Supposedly Getting Better for Cyclists. What Happened?". The New York Times. ISSN 0362-4331. Retrieved November 5, 2019.**

## 2.3 PROBLEM STATEMENT DEFINITION

1)The government needs a way to analyze the NYC bike share system so that they can enhance the system and give residents and visitors a fun, safe, affordable and convenient alternative to walking, taxis, buses etc.

2) The goal of this analysis is to create an operating report of Citi Bike for the year 2018.

3) Citi Bike officials are pushing to make the program more robust and to broaden its reach. Financial viability increases with such larger bike-sharing programs. This could be seen by analyzing the total number of trips.

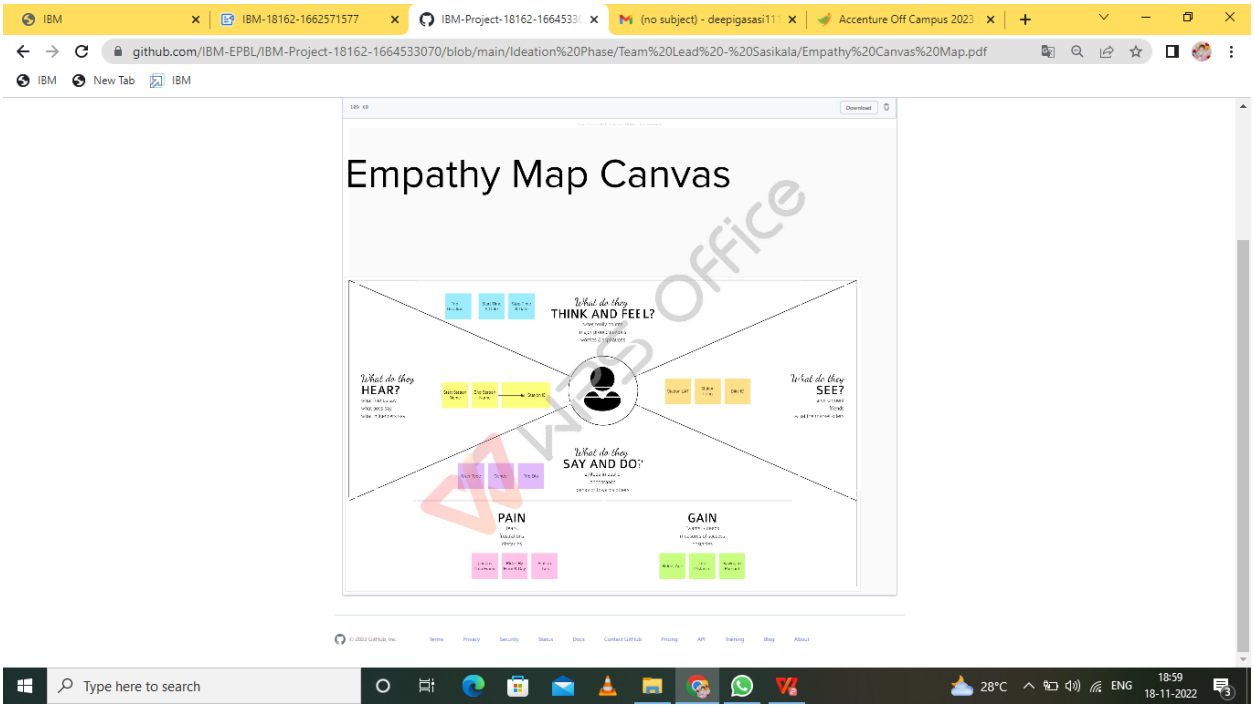
4) The top bikes used with respect to trip duration could be found by this analysis so that more of these bikes can be produced and more users can be attracted.

5) With the help of this analysis, the top 10 Start station names with respect to customer age group could be found so that the government can broaden the bike sharing system by increasing the number of bikes in those stations to make them readily available to all the potential users.

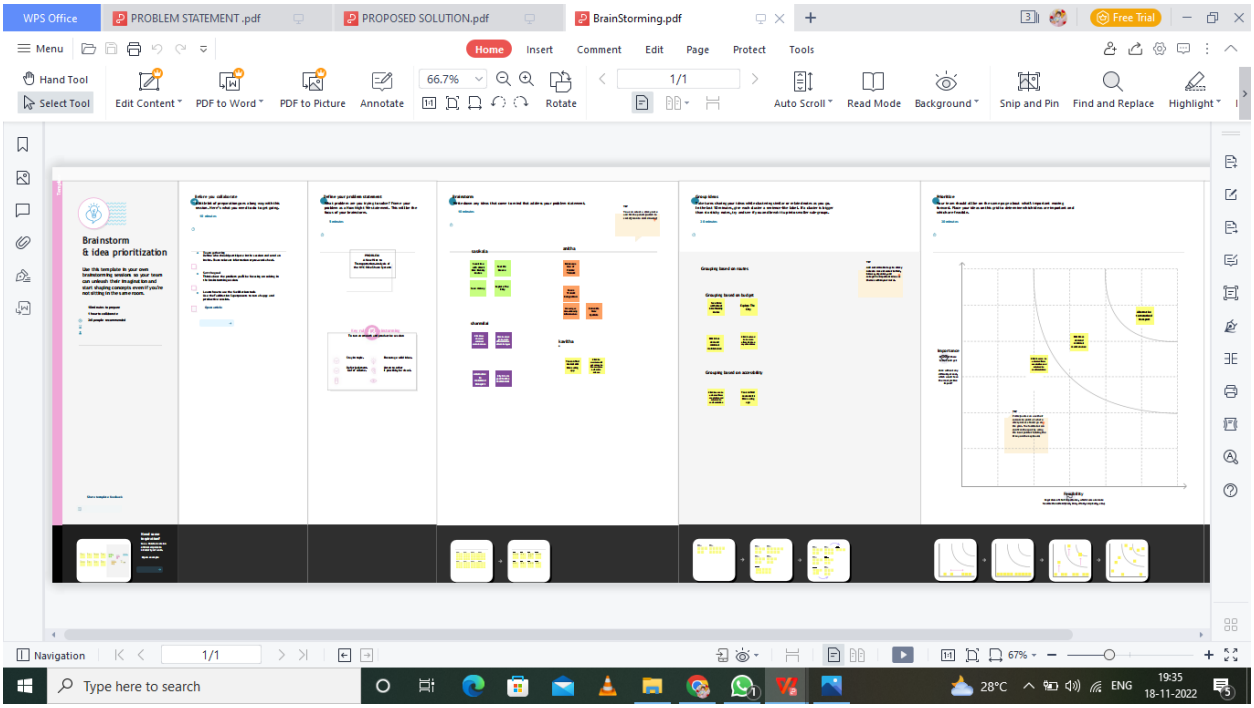
6) The gender of the customer as well as the subscriber could be assessed and the number of bikes used by respective age groups could also be computed.

## 3.IDEATION & PROPOSED SOLUTION

## 3.1 EMPATHY MAP CANVAS




## 3.2 IDEATION AND BRAINSTORMING



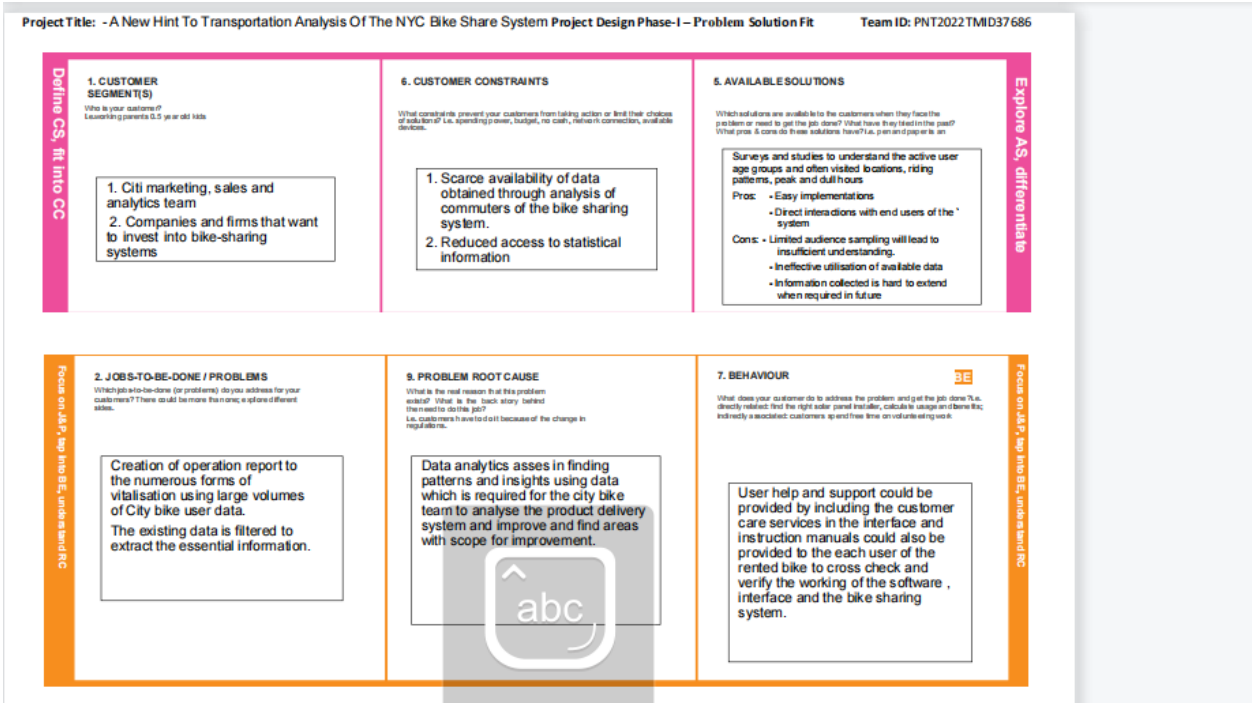
## 3.3 PROPOSED SOLUTION

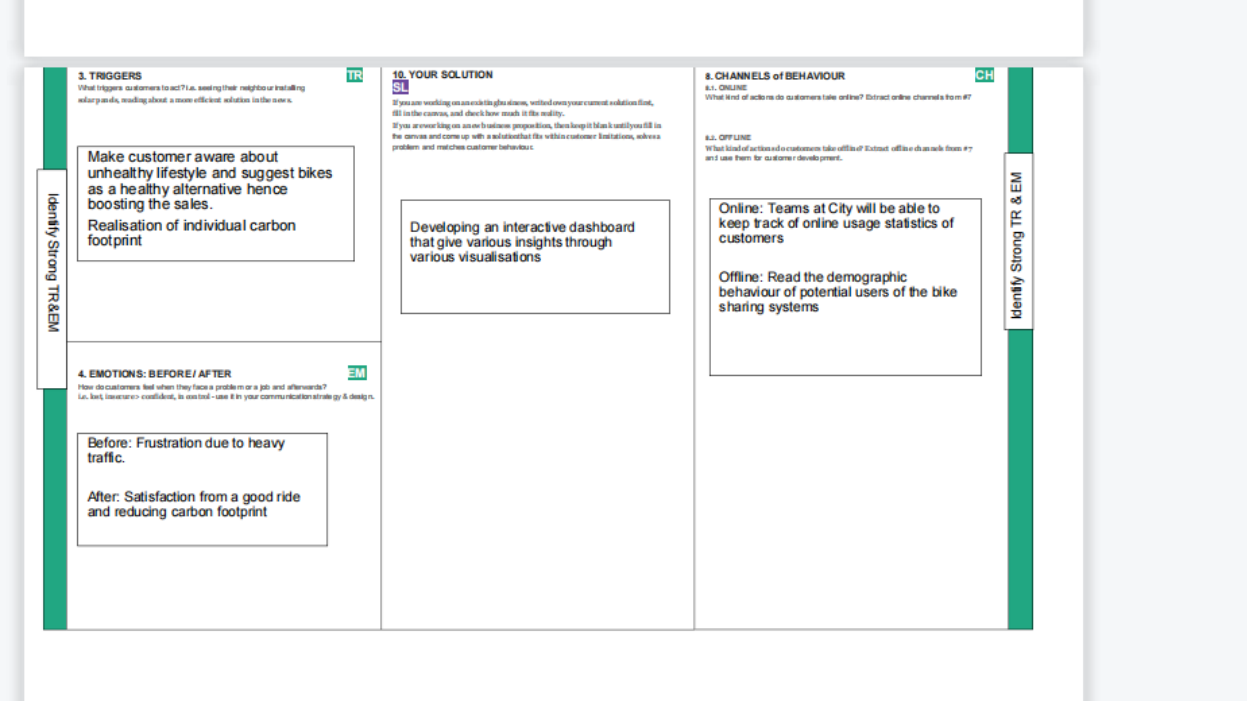
**Proposed Solution Template:**

Project team shall fill the following information in proposed solution template.

| S.No. | Parameter | Description |
|---|---|---|
| 1. | Problem Statement (Problem to be solved) | The goal of this analysis is to create an operating report of Citi Bike for the year 2018. To create data visualizations to understand<br><br>1. Total Number of Trips<br><br>2. What is Customer and subscriber with gender<br><br>3. Find the top bike used with respect to trip duration?<br><br>4. Calculating the number of bikes used by respective age groups.<br><br>5. Top 10 Start Station Names with respect to Customer age group. |
| 2. | Idea / Solution description | This project is focused of analyzing some visuals and creating dashboard that will be accessible to users to get the insight of the usage of city bikes using IBM Cognos platform. |
| 3. | Novelty / Uniqueness | 1. Predict the best station.<br>2. Check the reliability of the bike,privacy protected.<br>3. user experience unique and efficient. |
| 4. | Social Impact / Customer Satisfaction | By regularly monitoring the top 10 areas we can supply more bikes to the areas and satisfy the demand. |
| 5. | Business Model (Revenue Model) | Revenue is generated on renting the bike with the analyzed data we can alter the pricing according to the demand of the customer. |
| 6. | Scalability of the Solution | More addtional features can be added like the condition of the bike whether it can be relied or not ,map feature,traffic analysis. |

## 3.4 PROBLE SOLUTION FIT






# 4. REQUIREMENT ANALYSIS

## 4.1 FUNCTIONAL REQUIREMENT

Following are the functional requirement of the proposed solution

**User Stories**

Use the below template to list all the user stories for the product.

| User Type | Functional Requirement (Epic) | User Story Number | User Story / Task | Acceptance criteria | Priority | Release |
|---|---|---|---|---|---|---|
| Customer(Analysts at Citi, Government) | Registration | USN-1 | I ought to be able to sign up as a user to access the dashboard as a brand-new user | Successful Registration | High | Sprint-1 |
| Customer(Analysts at Citi, Government) | Login | USN-2 | I ought to be able to sign up as a user to access the dashboard as a brand-new user. | Successful Login with correct credentials | High | Sprint-1 |
| Customer(Analysts at Citi, Government) | Accessing the dashboard | USN-3 | I should be able to see the visualisations as a user. | Should be able to view the following analysis among others :<br>1. Total number of trips<br>2. Subscriber and Customer with gender<br>3. Top Bike used with respect to duration<br>4. Number of bikes used by different age groups<br>5. Top start station name with respect to customer age group | High | Sprint-1 |
| Customer(Analysts at Citi, Government) | Manipulating the data | USN-4 | I should be able to alter the data as a user and observe how the resulting visualisations change. | I should have the permission to manipulate the data | High | Sprint-2 |

## 4.2 NON FUNCTIONAL REQUIREMENT

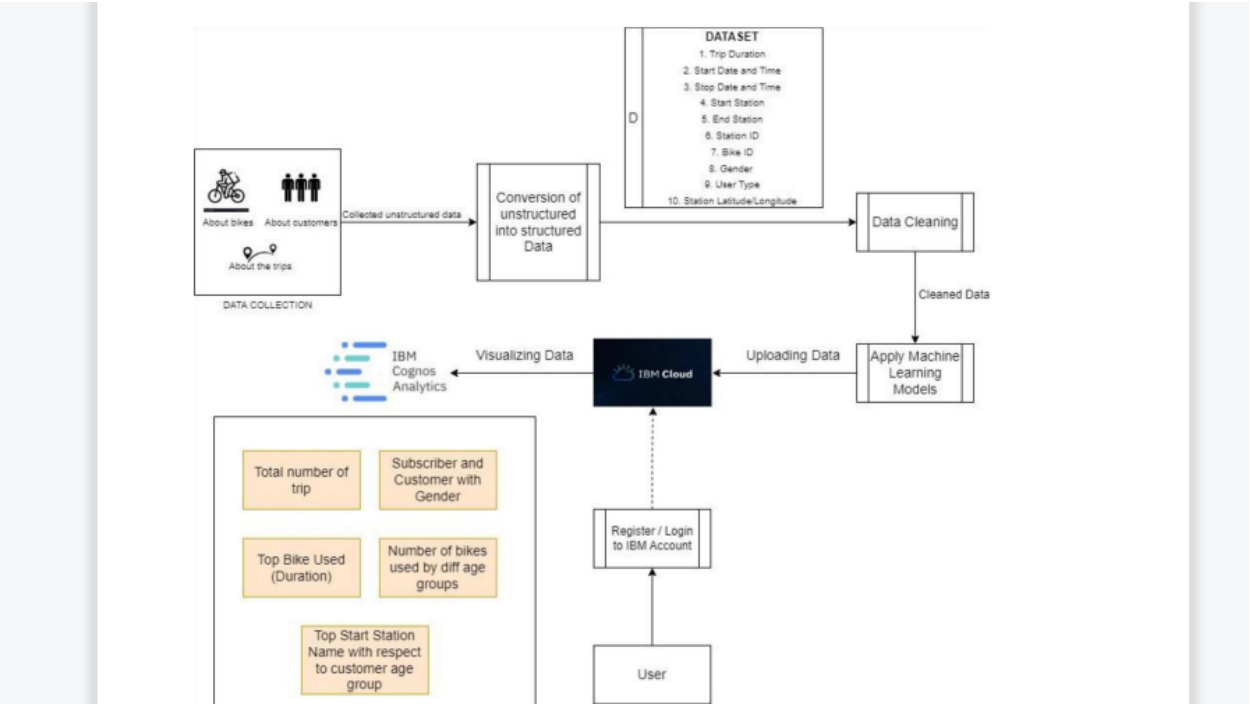
Following are the non functional requirement of the proposed solution

| FR No. | Non-Functional Requirement | Description |
|---|---|---|
| NFR-1 | **Usability** | The dashboard gives users access to an operational report that is simple to read and useful for understanding market trends and company insights. Data can be examined from various angles and in more depth by using an interactive dashboard to drill down and filter operating information. |
| NFR-2 | **Security** | Based on the Citi Bike utilisation data and its analysis, several important business decisions will be made, which will be appropriately secured. Data and visualisation reports are only available to a certain group of clients/users. |
| NFR-3 | **Reliability** | This research offers a trustworthy and effective way to understand how well this bike-sharing programme performed in 2018. Utilizing the IBM Cognos Platform ensures operational report production, upkeep, and accessibility with industry-standard reliability (dashboard). |
| NFR-4 | **Performance** | The effectiveness of a bike-sharing system in terms of both its spatial and operational efficiency. In order to increase the operational effectiveness of the bike-sharing system, it is critical to assess the state of bike lanes from the viewpoint of public bike riders. The characteristics of bike stations and the distance between bike stations and other amenities are examined by the bikesharing system dashboard. The evaluation findings can be used to enhance the public bike-sharing service. |
| NFR-5 | **Availability** | The bicycle-sharing programme is a form of shared transportation in which people can rent bicycles at a reasonable cost for a limited amount of time. CitiBike offers two different kinds of docking systems: docking systems, which allow customers to borrow a bike from one dock and return it to |

# 5. PROJECT DESIGN

A data flow diagram is traditional visual representation of the information flow with in a system. A neat and clear DFD can depict the right amount of the system requirement graphically.It shows how enters and leaves the system ,what changes the information and when data is stored.

## 5.1 DATA FLOW DIAGRAM

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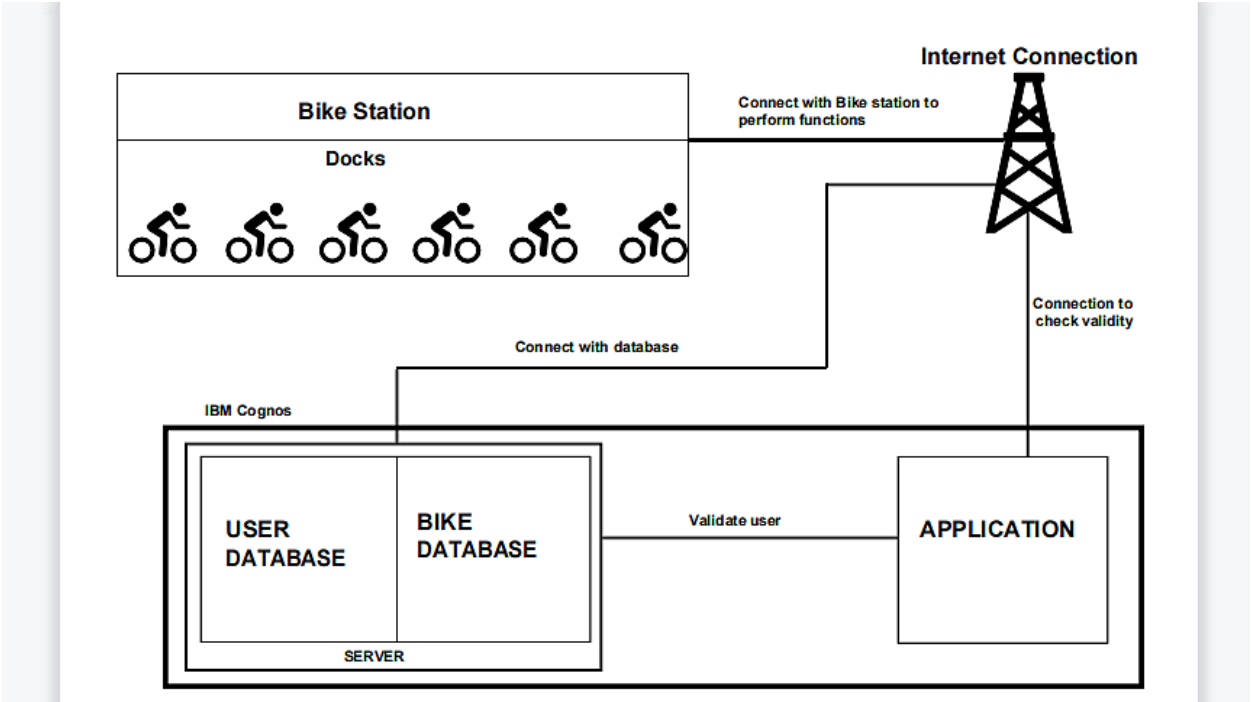
| Customer(Analysts at Citi, Government) | Manipulating the data | USN-4 | I should be able to alter the data as a user and observe how the resulting visualisations change. | I should have the permission to manipulate the data | High | Sprint-2 |

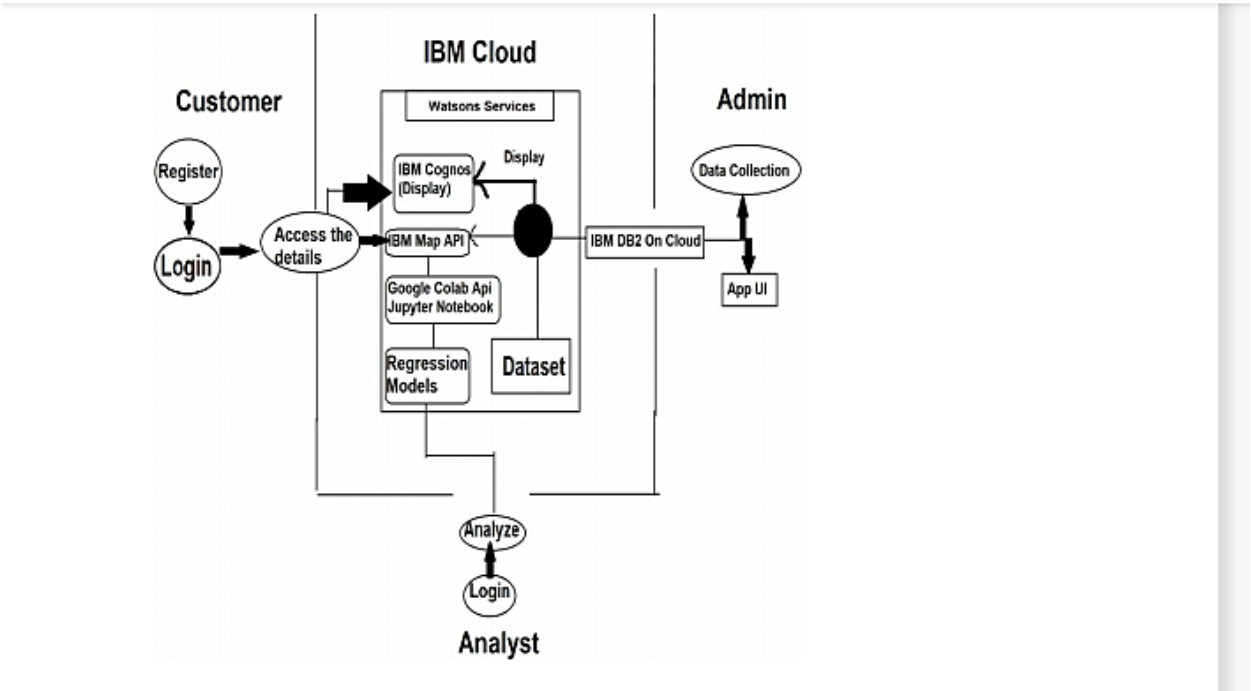
## 5.2 SOLUTION AND TECHNICAL ARCHITECTURE

### SOLUTION ARCHITECTURE




### TECHNICAL ARCHITECTURE

The Deliverable shall include the architectural diagram as below



## 6 .PROJECT PLANNING AND SCHEDULING

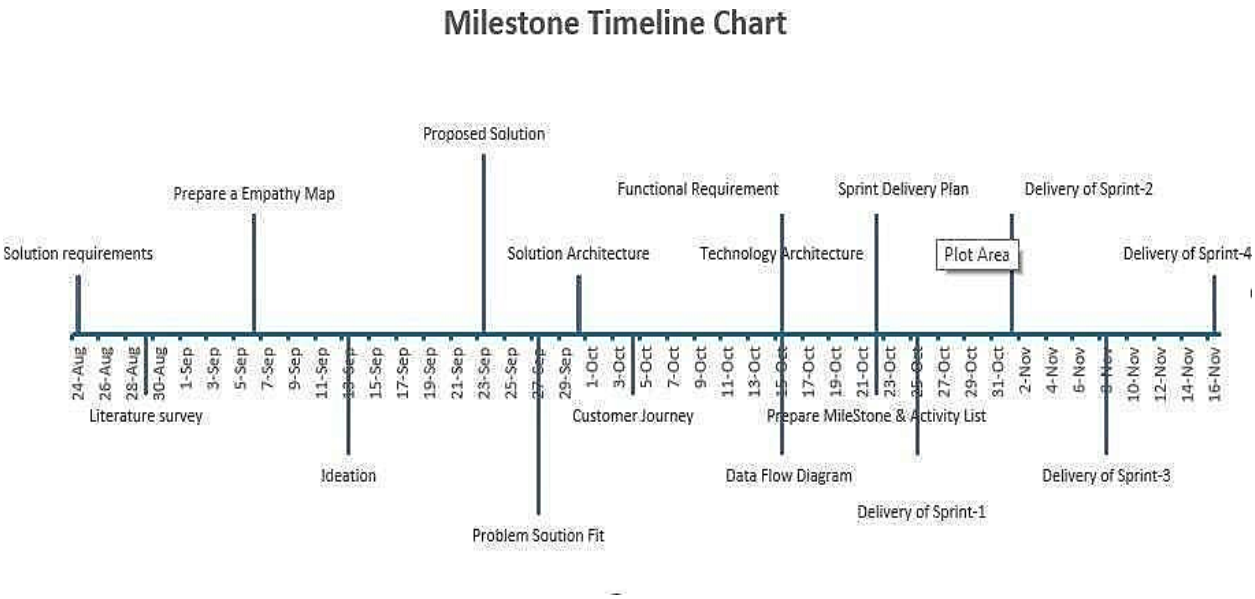
### 6.1 SPRINT PLANNING AND ESTIMATION

| Activity Name | Activity Number | Activity Description | Tasks Assigned | Status |
|---|---|---|---|---|
| Preparation Phase | 1 | a) Access the resources in projectdashboard<br>b) Explore the dataset provided inworkspace<br>c) Create GitHub account & collaborate with Project Repository inproject workspace<br>d) Set-up the prerequisites for theproject | SASIKALA<br>ANITHA<br>SHARMILA<br>KAVITHA | Completed |
| Ideation Phase | 2 | a) Literature survey relevant to theselected project<br>b) Preparation of Empathy Map toidentify the user pros and cons<br>c) List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility& importance | SASIKALA<br>ANITHA<br>SHARMILA<br>KAVITHA | Completed |
| Project Design Phase-I | 3 | | | |
| Problem Solution Fit | 3.2 | Prepared problem solution fit which provides effective solutions for the problem | SHARMILA<br>KAVITHA | Completed |
| Solution Architecture | 3.3 | Develop effective architecture for the proposed solution | SASIKALA<br>ANITHA<br>SHARMILA<br>KAVITHA | Completed |
| Project Design Phase-II | 4 | | | |
| Requirement Analysis | 4.1 | Identify the Functional and Non-Functional requirements | ANITHA | Completed |
| Customer Journey | 4.2 | Preparation of customer journey map to understand the user interactions & experiences with the application from the entry level to exit level | SASIKALA | Completed |
| Data Flow Diagram and User stories | 4.3 | Generate Data flow diagram of the project | KAVITHA | Completed |
| Technical Architecture | 4.4 | Develop effective technical architecture for the proposed solution | SHARMILA | Completed |
| Project Planning Phase | 5 | | | |
| Milestones & Activity List | 5.1 | Prepare Milestone and Activity list of the project | ANITHA<br>SHARMILA | Completed |
| Sprint Plan | 5.2 | Prepare Sprint Delivery plan of the project | SASIKALA<br>KAVITHA | Completed |
| Project Development | 6 | | | |

| Phase | | | | |
|---|---|---|---|---|
| Delivery of Sprint-1 | 6.1 | Implement the coding phase of Sprint-1 | SASIKALA | In Progress |
| Delivery of Sprint-2 | 6.2 | Implement the coding phase of Sprint-2 | SHARMILA | In Progress |
| Delivery of Sprint-3 | 6.3 | Implement the coding phase of Sprint-3 | ANITHA | In Progress |
| Delivery of Sprint-4 | 6.4 | Implement the coding phase of Sprint-4 | KAVITHA | In Progress |

**Milestone Timeline Chart:**

A milestone schedule, or milestone chart, is a timeline that uses milestones to divide a project schedule into major phases. Due to its simplicity, it's used when project managers or sponsors need to share an overview of the project schedule with stakeholders or team members without going over every detail.



## 6.2 SPRINT DELIVERY SCHEDULE

Use the below template to create product backlog and sprint schedule

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|---|---|---|---|---|---|---|
| Sprint-1 | Registration | USN-1 | As a user, I can register for the application by entering my email, password, and confirming my password. | 2 | High | Sasikala kavitha |
| Sprint-1 | | USN-2 | As a user, I will receive confirmation email once I have registered for the application | 2 | High | Sasikala Anitha |
| Sprint-1 | | USN-3 | As a user, I can register for the application through Gmail | 2 | Medium | Sharmila sasikala |
| Sprint-2 | Login | USN-4 | As a user, I can log into the application by entering email & password | 2 | High | Anitha Sasikala Kavitha sharmila |

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|---|---|---|---|---|---|---|
| Sprint-2 | Collection of user data | USN-5 | I can access and collect the citi bike share system data from Lyft citi bike's official website that has the published files. | 2 | Medium | Sasikala Anitha Sharmila kavitha |
| Sprint-2 | | USN-6 | I can use the citi bike share system data for analysis purposes | 5 | High | Sasikala kavitha |
| Sprint-3 | Analysing the user data | USN-7 | The data is used as input for creating various types of visualizations and analysis is done. I can view the analysis of the citi bike | 8 | High | Sasikala Sharmila anitha |
| Sprint-3 | Dashboard | USN-8 | I can register & access the dashboard created based on the analysis by logging in | 3 | Medium | Kavitha Anitha sharmila |
| Sprint-3 | | USN-9 | As a user I can view the dashboard that displays the top bike used with respect to trip duration | 5 | High | sasikala |
| Sprint-4 | | USN-10 | As a user I can view the dashboard that displays the top 10 Start Station Names with respect to customer age group | 5 | High | anitha |
| Sprint-4 | | USN-11 | As a user I can view the dashboard that displays the customer and subscriber with respect to gender | 5 | High | sharmila |
| Sprint-4 | | USN-12 | As a user I can view the dashboard that displays the total number of trips | 5 | High | kavitha |

**Project Tracker, Velocity & Burndown Chart: (4 Marks)**

| Sprint | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Point Completed Planned En |
|---|---|---|---|---|---|
| Sprint-1 | 6 | 6 Days | 24 Oct 2022 | 03 nov 2022 | |
| Sprint-2 | 9 | 6 Days | 31 Oct 2022 | 05 Nov 2022 | |
| Sprint-3 | 16 | 6 Days | 07 Nov 2022 | 12 Nov 2022 | |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov 2022 | |

## 7.CODING & SOLUTIONING (Explain the features added in the project along with code)

### 7.1 FEATURE

People use bike-share for various reasons. Some who would otherwise use their own bicycle have concerns about theft or vandalism, parking or storage, and maintenanc**e.**
The Citi Bike System Data page describes the information provided. The specific information for each ride is:

- ◊ Trip Duration (seconds)
- ◊ Start Time and Date
- ◊ Stop Time and Date
- ◊ Start Station Name
- ◊ End Station Name
- ◊ Station ID
- ◊ Station Lat/Long
- ◊ Bike ID
- ◊ User Type (Customer = 24-hour pass or single ride user; Subscriber = Annual Member)
- ◊ Gender (Zero=unknown; 1=male; 2=female)
- ◊ Year of Birth

### 7.2 FEATURE

**EASY INSTALLATION**

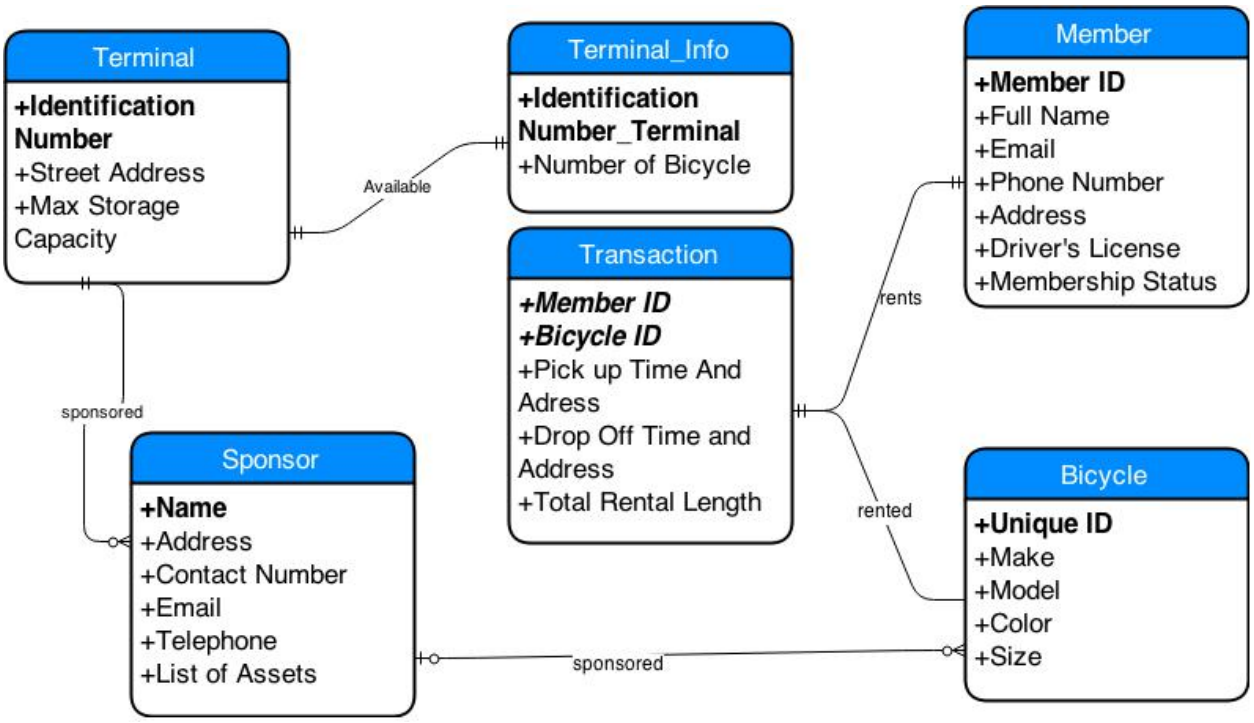
- ◊ Stations install in under an hour
- ◊ Solar powered and wireless
- ◊ No digging or roadwork required

**BUSINESS PLAN**

- ◊ NYC Bike share pays for all system costs- revenues from users and sponsorship
- ◊ Sponsorship in NYC is highly valued
- ◊ Profit split 50/50 between NYC Bike Share and the City
- ◊ Bike Share in NYC will help spread the word about safe,respectful cycling

**7.3 DATABASE SCHEMA**

The database schema is the structure of a database described in a formal language supported by the database management system. The term "schema" refers to the organization of data as a blueprint of how the database is constructed.




**8.TESTING**

Testing is the process of evaluating and verifying that a software product or application does what it is supposed to do. The benefits of testing include preventing bugs, reducing development costs and improving performance.

## 8.1 TEST CASES

Test case includes information such as test steps, expected results and data while a test scenario only includes the functionality to be tested.

- ◊ UI Test Cases for Bike
- ◊ Positive Test Cases for Bike
- ◊ Negative Test Cases for Bike

**UI Test Cases for Bike**

- ◊ Verify that design and dimension of the application are as per the specifications.
- ◊ Verify that the different colors used in the bike are of the correct shades as per the specifications.
- ◊ Verify that the weight of the bike is as per the specifications.
- ◊ Check the material used in different parts of the bike – outer body, tires, seat, etc.

**Positive Test Cases for Bike**

- ◊ Check if the bike is of type electric start, manual start or both.
- ◊ Verify that the bike starts smoothly using the available options.
- ◊ Check the amount of force to kick-start the bike.
- ◊ Verify that bike runs smoothly and attain desired speed when accelerated.
- ◊ Verify that the maximum speed attained by bike is as per the specification.

**Negative Test Cases for Bike**

- ◊ Check if the bike starts when fuel other than prescribed fuel is filled in the bike.
- ◊ Check the condition of the bike when tires are filled with pressure less or more than specified.

- ◊ Check the condition of the bike when both the tires have different air pressure.
- ◊ Check the bike's condition when it is ridden at high speed on first gear only.

**USER ACCEPTANCE TESTING**

User Acceptance Testing (UAT), which is performed on most UIT projects, sometimes called beta testing or end-user testing, is a phase of software development in which the software is tested in the "real world" by the intended audience or business representative.

- ◊ Before product goes live.
- ◊ Done by end users.
- ◊ Fix usability issue.
- ◊ Ensures viavle product.

**UAT test cases will look like this:**

- ◊ Are testers filling out the correct information in bike?
- ◊ Do they understand what's happening when being redirected to the in bike system?

## 9.RESULTS

### 9.1 PERFORMANCE METRICS

The main metrics are used to judge the performance of bikeshare systems: average number of daily uses per bike and average daily trips per resident (of the coverage area). These two metrics tend to have an inverse relationship.

A system with a low number of bikes could have high per-bike usage because demand is high, but fail to meet that demand and therefore have a lower number of trips per resident. On the other hand, a system could have a high number of trips per resident but also a very high number of bikes, and therefore a low number of trips per bike.

Both of these extremes are inefficient; a sustainable system should find a balance of having just enough bikes to satisfy demand with around 4 daily trips per bike share system.

**Average daily trips per bike**

Target: 4-8 daily uses per bike

Turnover is critical to a successful bikeshare system, and this metric gets at how efficiently the bikes are being used. Fewer than four daily uses per bike can result in financial unsustainability for the operator (i.e., user fees not able to cover cost to operate each bike), while more than eight daily uses can indicate limited bike availability, especially during peak hours. New York City (6.4), Barcelona (6.4), Mexico City (5.4), and Guangzhou (5.0) showed solid daily usage numbers in 2017.

**Average daily trips per 1,000 residents (in service area)**

Target: city-generated, improvement over time

This is a metric of market penetration, that is, how many people in the service area are using the system. A high number of uses spread across residents in the service area is key the increasing bicycle mode share, decreasing vehicle and transit network congestion, and promoting safe, clean, healthy modes of transport.

Trips per 1,000 residents should be monitored as the system matures, with the goal of increasing market penetration over time (a more prescriptive target for annual improvement in market penetration could be created from baseline trip numbers). An increase in trips per 1,000 residents indicates more trips being taken by bike, and can help to evaluate progress toward citywide mode shift goals.

## 10. ADVANTAGES AND DISADVANTAGES

### 10.1 ADVANTAGES

1. **Convenient Mode of Transportation**

The most common benefit of this program is its accessibility. If you are fond of cycling, you will find this method helpful as there are numerous systems just about everywhere for you to use. Bigger cities are supporting the use of bike-sharing. This is why it is common to find bike-sharing systems in downtown areas. Driving a car through congested avenues can be frustrating and irritating. This makes bike sharing very convenient.

### 2. Healthy Method for Traveling

Wellness, fitness, and health are an essential part of your life. You should care about what you consume and what your daily activity is. Bike-sharing systems can help and encourage you to live a better and healthier life. They help you stay in shape even when you are away from home vacationing.

### 3. Environmental Benefits

Maintaining a clean environment is as important as maintaining your health. Living in a heavily polluted environment can cause various health issues. Bikes do not release greenhouse gases, unlike buses and cars. So, if you are renting a bike from a bike-sharing system, you reduce the carbon footprint and take measures to keep your environment safe.

## DISADVANTAGES

### 1. Congestion in the Users of Bike Sharing

As bike-sharing systems can help you travel throughout the city, they do not exist in infinite numbers. Waiting can be annoying if the bike is not available. You may face this problem during peak hours.

### 2. A Helmet is a Requirement

When you are planning to ride a bike, you need to keep safety measures in your mind. Therefore, wearing a helmet is essential. Some bike sharing systems may require you to use a helmet but might not provide them for you. Sometimes you will need to bring your own which can be a hassle.

### 3. Bikes Are Not Clean

Shared bikes can be unhygienic as many people have probably used it before you. The seat and handlebars are a particularly high-traffic area for germs, so cleanliness is always a concern.

## 11. CONCLUSION

Bicycle sharing systems can be the new boom in India, with use of various prediction models the ease of operations will be increased.The four algorithms are applied on the bikeshare dataset for predicting the count of bicycles that will be rented per hour. We got some good results and accuracy with random forest and by using TuneRF function with the original randomforest algorithm.The accuracy and performance has been compared between the models using Root Mean Squared Logarithmic Error (RMSLE).
If these systems include the use of analytics the probability of building a successful system will increase.

## 12. FUTURE SCOPE

One aspect of the data that I did not explore in great detail is the intra-day variation in usage of the system. This is also a key aspect that bike share system operators are interested in because knowing the variation in demand on an hourly basis is another very useful metric for identifying the times of the day when the need for artificial rebalancing is maximum.

Additionally, this work will feed into a larger study calculating the life cycle environmental impacts of a bikeshare system and its ability to substitute other modes of transit with the aim of reducing the overall Greenhouse gas (GHG) emissions due to transportation.

## 13. APPENDIX

### Research Methodology and Framework

### Methodology and Data Sources

Using spatial data primarily from the United States Census54 and New York City's Department of Information Technology & Telecommunications,55 ridership and station activity data from New York City Department of Transportation and NYC Bike Share, LLC,56 and station location data from NYC Bike Share, LLC, this study used ArcGIS software57 to analyze and show connections between Citi Bike and public transit. Data from Divvy Bikes,58 Chicago Open Data Portal,59 Capital Bike Share,60 the District Department of Transportation,61 Hubway,62 the Massachusetts Bay Transportation Authority,63 Nice Ride,64 and MetroGIS65 allowed for comparisons in station coverage area and station density in New York City, Chicago, Washington, DC, and Minneapolis/St. Paul. Researchers conducted interviews with New York City Department Transportation and NYC Bikeshare LLC staff.

### Framework

We examine connections between New York City's bike share program, Citi Bike, and the previously existing transportation options in New York City. After observing the system's success in its first year of operation, this study analyzes connections between bike share stations and from stations to transit options. New York City's bike share system offers a solution to the "last mile"66 problem, the problem of getting riders short distances, under a mile, to and from transit stations. A key component of this "last mile" analysis came through calculating the number of Citi Bike stations with 100, 200, 500, and 1320 feet67 of subway station entrances and comparing the proximity and density of bike share stations in New York City, Washington, DC, Chicago, Boston, and Minneapolis/St. Paul.