Bikeshare Impact Tool

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Introduction and Problem Statement

The National Operations Center of Excellence (NOCoE) along with other U.S. departments and programs are hosting a competition for the sixth year in a row allowing students to work directly with public agencies to solve real-world transportation problems. The Chain Reaction team will have the opportunity to work with a state department of transportation to define a challenge problem for 2023. Out of the possible challenge problems, Chain Reaction has selected the Bikeshare Impact Tool for Washington, DC to focus on. The team will work with mentors and watch training programs to learn about possible ITS solutions. Using the combined experiences and education of every student in Chain Reaction, the team will ultimately develop a solution to address the defined problem.

The defined problem for the Bikeshare Impact Tool is as follows, "Using available data sources, develop a quantitative analysis tool for evaluating the impacts of new developments on the existing Capital Bikeshare network and develop justification to support DDOT-requested bikeshare stations as mitigation for new developments." To summarize, the Chain Reaction team will provide a quantitative analytic tool to assess the effects of new projects on Capital Bikeshare and justify DDOT-requested bikeshare stations as mitigation.

Description of Problem

i. Scoping Dynamics of Site

Capital Bikeshare is the bike sharing program that serves Washington, D.C. and surroundings counties of metropolitan areas. As of 2023, it had more than 700 stations and more than 5,400 bicycles. Capital Bikeshare is designed to take riders from one point to another like bus or train for short term or long-term destination. By becoming a member, anyone using a mobile app can

unlock the bike and make a trip to their favorite destination. Since its first introduction in 2010, Capital Bikeshare published their first development plan in 2015 which was later updated in 2019 based on the survey in 2016. They published their updated plan in 2020. The District Department of Transportation (DDOT) embarked on the Capital Bikeshare Development Plan in 2019 to understand how the program is performing and how the new development plan would affect the community. Our main objective would be supporting the DDOT with a quantitative analysis tool for evaluating the impacts of new developments on the existing Capital Bikeshare network and develop justification to support DDOT-requested bikeshare stations as mitigation for new developments.

ii. Identifying Requirements for the Solution

Bike sharing is getting popular as a mode of green transportation and for its health benefits and availability. However, a successful bike sharing program depends on lots of factors like the user's riding pattern, weather, meeting supply and demand of availability of bikes during peak time of the day, continuous re-balancing the system network, redistribution of bikes in every station, location and placing of bike stations. For developing a bike sharing system we must consider all these variables to make the system effective. Besides that, we should also place emphasis on the safety and environmental impacts and how it incorporates with the existing transportation system and city planning.

iii. Identifying Stakeholders

Mainly the whole program consists of the company, riders, DDOT, Government, City Council, urban planning division, and neighborhoods. They are the stakeholders of this project. It combines everything together and will most definitely have an impact on city development. So, any kind of

expansion plan must comply with each department for the successful implementation of the system.

Description of Solution

i. How this Addresses the Problem

The analytical tool our team created offers a comprehensive solution to the issue of analyzing the effects of new developments on the capital's bike-sharing network. Using a custom ArcGIS modeling tool, this method combines static data from 2017 with real-time public bike-share data to visualize extant bike-sharing locations and cross-reference them with population, members, and users. The resulting map provides valuable information regarding population density and demand for bike-sharing services, allowing for the identification of areas that may require additional bike-sharing stations. Moreover, by analyzing changes in bike-share membership and user percentages before and after new developments, this methodology enables precise assessments of the impact of new developments on the extant bike-sharing network. Overall, this approach provides a robust and efficient solution to the issue at hand. The data we used was from 2017 first quarter, but this tool would work more efficiently if we had access to the 2023 first quarter data. Information from any year can be used in our tool to assess any effects. Figure one and two below shows just two of the maps produced from the ArcGIS program.

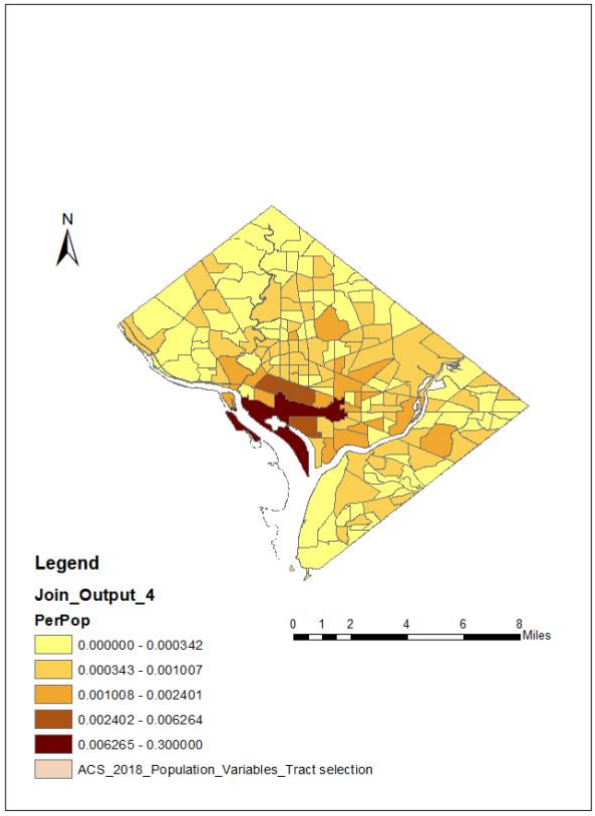


Figure 1. Users per Population

This map gives a representation of the number of users per population. This is a useful tool in showing where the highest number of users are located within the city. Using predicted populations for future years could be useful in seeing where systems may need to be placed in the future. This allows the DDOT to determine where the optimal locations for system expansion should occur.

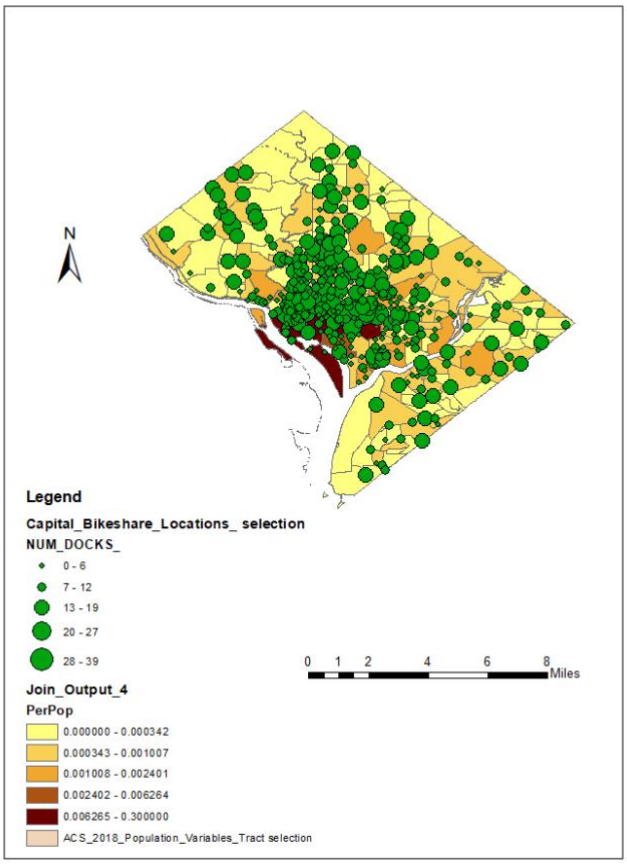


Figure 2. Number of Docks per Population

This map gives a representation of the number of docks per population. This is a useful tool in showing where the biggest population density is in the city, and how many docks are stationed in that area. This map also allows the DDOT to determine where the optimal locations for system expansion should occur.

ii. Who the Players are within the Solution

The success of this solution depends on the collaboration of several key players to accomplish the intended result. The software developers of ArcGIS, who provide the instrument for modeling and analyzing the data, are in the lead. Alongside them are City Officials who are

responsible for supervising new developments and administering the city's bike-sharing network. In addition, bike-share operators play a vital role in assuring the efficient administration and maintenance of bike-sharing stations. Equally essential are the data analysts who analyze the data generated by the modeling tool and provide City Officials and bike-share operators with valuable insights and recommendations. Lastly, bike-sharing consumers themselves are essential to the solution. Their input is crucial for designing a system that ultimately fulfills their requirements and assures their gratification. By collaborating, these parties can produce a viable solution to the problem of new developments on the bike-sharing network.

Concept of Operations for Solution

Because our solution involves solely using the analytical tool, ArcGIS, there is no real high-level functional, physical, or enterprise architecture that needs to be incorporated in the solution design. This is because, the only information necessary for the analytical tool to work efficiently is to have relevant data. Since Capital Bikeshare already has a means of obtaining this data, there is nothing else needed to incorporate into the design for the solution to work.

Solution Estimates

i. Cost Estimate

The tool developed presents few initial costs for the user. The primary cost of using this quantitative tool is access to ArcGIS. Most departmental agencies have access to ArcGIS, however, for the purposes of this cost estimate it will be assumed that any assets required for this tool will have to be purchased.

ii. Work Estimate

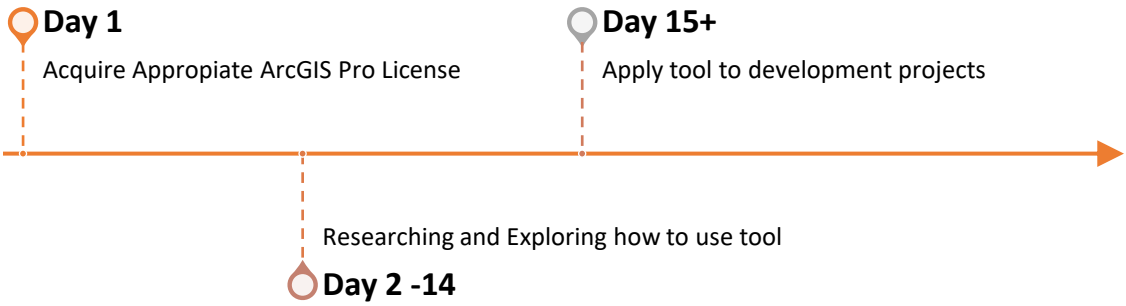
The main work for this tool is the time it takes to learn about the tool and how to use it, time cost. The time cost required to learn how to use a quantitative analysis tool within ArcGIS Pro can vary depending on the complexity of the tool and the level of experience of the user. Learning how to use a quantitative analysis tool in ArcGIS Pro can take anywhere from a few hours to several weeks of dedicated practice and experimentation. Factors that may impact the learning curve include the user's familiarity with ArcGIS Pro, their background in quantitative analysis, and the amount of time they are willing and able to devote to learning the tool. However, with consistent effort and practice, most users can become proficient in using quantitative analysis tools within ArcGIS Pro and leverage its capabilities to derive valuable insights from their data. A conservative estimate of two weeks is assumed for a user to become proficient.

iii. Cost Breakdown

The primary cost of this tool is the license requirements to use ArcGIS Pro. The price points of ArcGIS Pro licenses vary depending on several factors, such as the edition of the software, the number of licenses required, and the intended use of the software. Esri, the company that develops ArcGIS Pro, offers different licensing options to meet the needs of various types of users, including individuals, organizations, and governments. Some of the license types available for ArcGIS Pro include Basic ($765/year). Standard ($3,025/year), Advanced ($4,150/year), and Enterprise. Organizations and governments may be able to negotiate volume discounts for multiple licenses. It's worth noting that some ArcGIS Pro functionality may require additional licenses or subscriptions, such as access to premium data and services.

iv. Timeline

Learning how to use the quantitative analysis tool within ArcGIS Pro can be time-consuming, especially if the user is not familiar with GIS software or quantitative analysis concepts. However, once the user becomes proficient with the tool, the time required to perform a task will decrease significantly. This is because the user will have already gained an understanding of the tool's capabilities, interface, and functionalities. With repeated use, the user can develop a workflow that streamlines their analysis and reduces the time needed to perform each task. Additionally, as the user gains more experience with the tool, they may discover shortcuts, workarounds, and tips that can further increase their efficiency. Therefore, while the initial learning curve may be steep, the time investment can pay off in the long run, enabling the user to perform more complex and nuanced analyses with ease. The timeline for a rough estimate is shown below.



Anticipated Impacts

i. Health Benefits

Stations will be placed in optimal locations around the city and increase fitness amongst those who previously may not have had access to bikes. These bikes will be more balanced between stations and will serve as an addition to the city's existing transportation infrastructure. Additionally, college campuses will benefit from bikeshare networking as it can help students tour around the city.

ii. Operational Benefits

With this solution, the bikeshare system can better efficiently run. DDOT can use the tool to optimize where station dock expansion should occur, keep a better balance between station typologies, ensure suitable capacity in the core neighborhoods, and maintain a minimum station density when possible. These factors are important to the DDOT because these are the factors driving the bikeshare expansion plan. The bikes themselves also have operational benefits such as the different unlock, ride, and return method techniques used to make it easier to ride and return the vehicle. Also, features of the E-Bike include pedal assist technology and the classic bike has adjustable handling and seating to make it easy to maneuver.

iii. Safety Benefits

Different rules of the road like riding with traffic, obeying traffic laws, yielding to pedestrians, and using hand signals are a few of the safety features that ensure to keep our drivers and those in the community safe.

iv. Mobility Benefits

The mobility benefits of the system incorporating our solution includes that it should be easier for users to gain access to bikes by being able to better keep a balance of bikes between stations.

v. Environmental Benefits

Using our solution, stations can be better expanded throughout the city and core neighborhoods. This allows more citizens better access to be able to use the system and thus providing them with an eco-friendlier mode of transportation.

vi. Other benefits are included in the privacy policy.

Privacy concerns (Jan. 7th, 2017) of this operation system share their system through the District of Columbia, the City of Alexandria, Montgomery County, Maryland, Prince George's County, MD, Arlington County, Virginia and Fairfax County, Virginia.

I. Personal information from the consumer is collected.

II. Security measures that are set in place and designed to prevent accidental, unauthorized destruction, loss, alteration, access, disclosure or use.

III. The only data we use in our solution is the data that is collected from the system and publicly shared. For this reason, our solution should have no privacy concerns.