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Caltrans Division of Research, Innovation and System Information

Research Notes

Dock-based and Dockless Bikesharing Systems: Analysis of Equitable Access for Disadvantaged Communities

This study analyzes the spatial distribution of bikeshare trips and trip usage for dock-based and dockless bikeshare systems, and quantifies the service level (e.g., bikeshare usage and bike distribution areas) for disadvantaged populations.

Planning, Policy& Programming

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Project Title:
Dock-based and Dockless Bikesharing Systems: Analysis of Equitable Access for Disadvantaged Communities

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WHAT IS THE NEED?

Currently, most of the bikeshare systems in the USA are dock-based. These systems require users to pick up and return a bike to a specific bikeshare station; and users need to check out a bike through a kiosk. However, the advent of advanced technologies such as mobile payment and real-time positioning and tracking, have allowed the development and commercialization of a new system that doesn't require a dock. These dockless bikeshare systems are becoming more and more prevalent around the world. With dockless systems, bicycles can be located and unlocked using a smartphone app, be parked within a restricted area at a bike rack or along the sidewalk.

This new system originated in China, where multiple companies competed to launch their own dockless systems even in the same city. At the busiest time, there were around 40 different concurrent companies. Meanwhile, local governments in China held a neutral-positive attitude towards this new system (Gu, Kim, and Currie 2019), which meant no regulation on the total number of bikes allowed to operate by a single company. However, a laxed regulation resulted in serious unregulated operations and irregular parking problems. Consequently, the Chinese central government developed guidance to regulate dockless systems. Because of the Chinese experience, many local municipalities in the US have had a negative attitude towards dockless bikeshare, with some strictly regulating operating permits and the total number of bikes allowed ("SFMTA Requires Permit for Dockless Bike Share" 2017).

There is lack of research about the performance and impacts of these systems. Gu, Kim, and Currie (2019) conducted an empirical analysis for dock-based and dockless bikeshare systems in China.

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They concluded that dockless bikeshare is a good option for cities with well-developed cycling facilities and strong supervision and enforcement capabilities, though there are challenges such as financial sustainability, vandalism and theft. Recently, Mooney et al. (2019) pointed out the potential of dockless systems to offer equitable spatial access to all communities. However, there is no additional research to quantify the direct and indirect benefits, or comparative analyses between dockless and docked systems regarding equitable accessibility improvements.

WHAT ARE WE DOING?

In a previous study, the research team identified potential (dock-based) bikeshare locations to serve disadvantaged populations in Chicago. The team found that a well-designed bikeshare system could generate accessibility improvements for disadvantaged communities, though current bikeshare systems usually underserve these communities. The work laid down a robust theoretical framework to evaluate the potential benefits of dock-based system (Qian and Jaller 2018; Qian and Niemeier 2019). The objectives of this project are to expand the previous work to evaluate the potential benefits of dockless systems to improve accessibility to disadvantaged communities and compare with dock-based systems. Specifically, the project will analyze the difference in service levels among dock-based and dockless systems for cities in California. Quantitatively, the team will study the trip patterns and user characteristics under dockless and dock-based systems. The analyses will help public and local governments to understand, regulate and manage these systems. The study objectives are:

- Conduct comparative assessment of current travel behaviors between dockless and dock-based bikeshare trips;
- Quantify the service level for dockless bikeshare in disadvantaged areas; and,
- Provide suggestions for the development of dockless bikeshare systems that address equity issues for both public and local governments.

WHAT IS OUR GOAL?

The objective of this work is to conduct a quantitative analysis to compare the service levels between dock-based and dockless systems and provide planning recommendations.

WHAT IS THE BENEFIT?

Dockless systems with no spatial distribution restrictions and low membership fees could help mitigate dock-based systems' limitations and improve accessibility. However, considering the unsuccessful experiences in China, local governments are hesitant about the potential impacts from dockless systems, even though they could provide an improved mobility option, and address equity barriers for disadvantaged and underserved communities and communities of concern (CoCs) (MTC, 2018).

This research will quantify the benefits of dockless bikeshare systems on accessibility improvements for disadvantaged communities and social justice. The work will also analyze dockless and dock-based users' behaviors to better understand shared mobility activities in disadvantaged areas and provide estimates about the potential demand. The research would inform State agencies such as Caltrans, and local (Metropolitan) planning organizations about how to develop and regulate dockless bikeshare systems and would have implications for infrastructure planning.

WHAT IS THE PROGRESS TO DATE?

We have finished the following tasks as planned in our proposal.

01/31/2020 Task 1: **Comprehensive Literature Review**
The team has conducted a comprehensive literature review to understand the current research in dock-based and dockless bikeshare

systems regarding travel behavior and equity barriers. This task gathers a deeper understanding of the differences in addressing equity problems between the different systems.

02/28/2020 Task 2: Data Gathering, Compiling, and Mapping

The research team has collected bikeshare trip data for both dock-based and dockless systems in San Francisco. In this task, the team also gathered location suggestion data from the online portal. After collecting all the data, the team mapped bikeshare trip data and suggested location data and created heatmaps for bikeshare activities for both systems.

03/31/2020 Task 3: Service Level Analysis

The team calculated the service level (including demand coverage, bikeshare usage, and accessibility improvement) for different areas. All the service levels have been mapped across service areas for two systems.

IMAGES

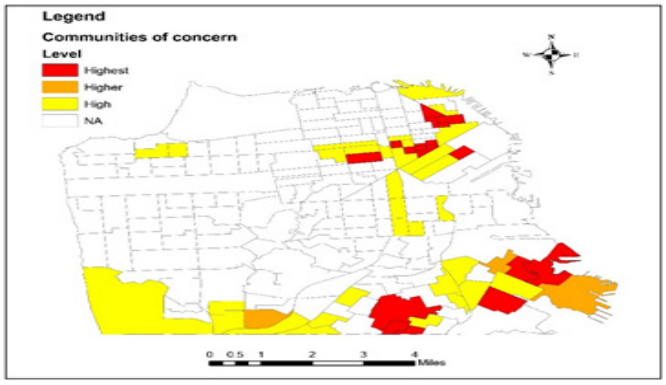

Image 1: Map for CoCs

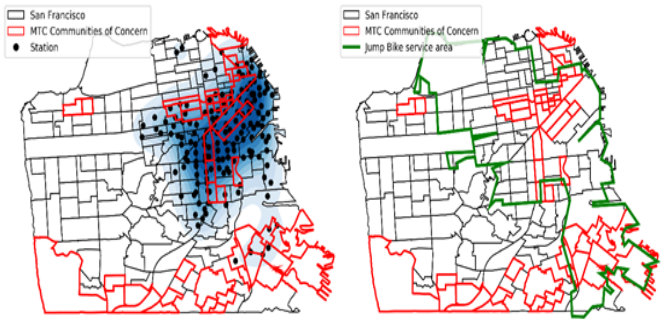

Image 2: Service areas of Ford GoBike (left) and JUMP Bike (right).

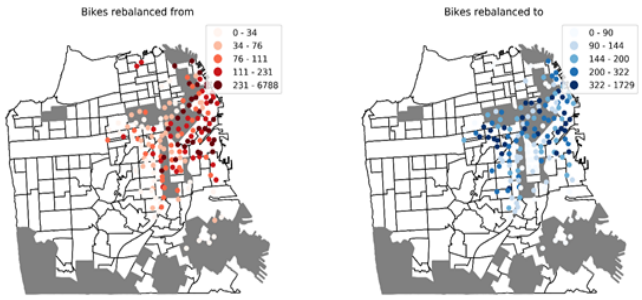

Image 3: Distribution of bike rebalancing origins and destinations in Ford GoBike.

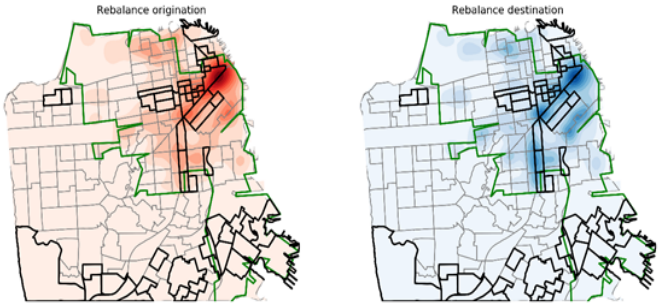

Image 4: Kernel density estimation of the distribution of bike rebalancing origins and destinations in JUMP Bike.