Automotive Parking Analysis

Raksha Muddegowdana Koppalu
Prakasha
MSc. In Data Analytics
National College of Ireland
Dublin, Ireland
x19193181@student.ncirl.ie
Group R

Abstract— **In this paper we analyze the parking space facilities for bicycles, meter motors and aircrafts in San Francisco. As Bicycle is being used more in recent days there is scarcity of parking space. An analysis was made to understand how measures are taken by San Francisco Municipal Transportation Agency (SFMTA) to install parking spaces all over the city. Analysis was done to understand the system of aviation parking at San Francisco airport and help the future developments in the Stand Guidance System at an airport. This includes explorations of various entities associated with aviation parking like - parking space, aircraft type, airlines, duration of the park, parking spot in the airport. Metered Motor Cycle parking is one of the major parking systems which is now being employed in most of the places in San Francisco. Meaningful insights such as distribution of metered motor parking among the various locations, characteristics of meter and the agencies managing them are being analyzed.**

Keywords— meter motor cycle, San Francisco Municipal Transportation Agency (SFMTA), bicycle, aircraft, port.

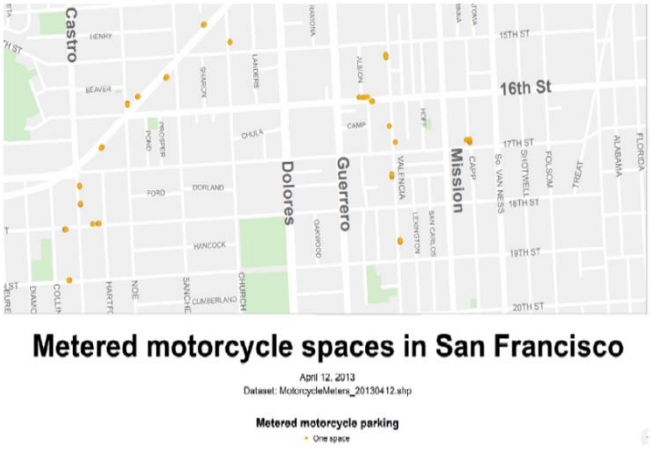
I. INTRODUCTION

Increasing urban population, has seen a high spike in the use of automotive, which in turn has lead to a huge demand for proper parking facilities. In order to keep up with the demand, analyzation of the parking patterns and trends plays a significant role in efficient planning and development of these facilities. In this paper, we analyze the trends and patterns of parking of three different automotive in the city of San Francisco.

San Francisco has experienced remarkable and unexpected, shifts in the two-wheeled landscape with the recent rise of personal mobility devices such as bikes and scooters. As there is an increase in the auto-mobility, a scarcity of parking arises. In recent years 16% of residents in San Francisco are cyclist [2]. The compact urban structure of the city allow cyclist to quickly reach their destination. SFMTA monitors the count of bicycles based on the annual count reports and aims to install bicycle racks in public places for short-span and in garages for long term. Citizens can request for bicycle rack if there is a need. Here, we analyse SFMTA bicycle parking installation in public spaces in recent year [3].

San Francisco Airport, the second largest in the Bay Area is one of the busiest airports in the US. It has seen a huge increase in the aircraft movements in the past 2 years which led to the demand for expansion of runway, terminals and apron space at the airport. Apron Spaces are the designated spaces where aircrafts are parked, loaded/unloaded, refuelled and boarded. They are usually designed such a way that they are near the runways and airport terminals for easy access of the passengers. San Francisco airport's Apron is designed, by taking into consideration the type of aircraft that can be accommodated in the apron spaces [4]. Here we analyse the Parking trends at San Francisco Airport which includes the records of parking activities of various aircrafts of airlines, the models of aircrafts that were accommodated in the various parking spots at the airport as a way to further enhance the Stand Guidance System at the airport and further plan and design the expansion of Apron so as to keep up with the increasing aircraft activities.

In San Francisco as of 2012, there were 2,250 Motor Cycle Parking spaces [10]. If a request is sent for setting up a motor cycle parking, the location is evaluated to find the most appropriate areas for parking along with the number of spaces and also public's opinion is taken into consideration. Motor cycles parking is pro-rated when compared to other auto mobiles in San Francisco. Parking spaces are made right next to the Ferry building to make commute easier. Other than on street parking spaces there also garages that offer exclusive parking for motorcycles. There are open sources maps which show the metered parking spaces, one such map is shown below.



II. RELATED WORK

It is important to have safe and convenient place to park bicycle. As bicycle safety is concerned, theft have significant impact. SFMTA plays a major role in encouraging people to travel by bicycle more by providing racks for parking. Because in San Francisco major cause of road injuries are speeding motor vehicles [3].

A study was conducted on bicycle tracks and parking system in China. Few bicycle parking places were scanned to analyze the services and security provided. It was found that there was a lack of security, no shed, less parking spaces and no parking order, if this is improved people tends use more bicycle [11].

Based on the study in Australia it was found that people want the parking space near to the entrance of public transport stations to minimize walking. To encourage open-air parking visibility of CCTV cameras in the street space, visibility from the platform and bus stops plays a major role. This provides the surveillance to bicycles which are parked as a protection against theft [1].

Multiple research and approaches have been proposed in the field of the Apron design and Stand Guidance System. The Apron areas are the designated areas where the aircraft can be parked, and there can be different types of Aprons in an airport [5]. The different types of aprons can be Holding aprons and Loading or Terminal aprons. Holding aprons are the parking spots that are in adjacent to runways where aircraft park briefly before taking off. Loading or Terminal aprons are the parking areas provided adjacent to or opposite to terminal buildings. This type of apron space is prominent as they are boarding and unloading locations for passengers, freight, or cargo.

As the world moves towards automation, there is a high scope for efficient automation of aircraft parking. An approach has been proposed to reduce human errors and increase efficiency in the Stand Guidance System, which describes the use of LDR sensor-based Automatic Aircraft parking[6]. Automation is the key feature of the proposal.

Another proposal [7] talks about the use of an external apparatus/vehicles as a means of effective parking when a significant number of aircraft at an airport is involved. Aircraft can be moved to the direction of the park by tow vehicles, aircraft-moving transfer apparatus, after landing, to park in an efficient orientation relative to an airport terminal. Aircraft freed for departure can be shifted and transferred to the direction to a takeoff runway, using the aircraft-moving apparatus. Airport terminal aircraft traffic and parking are effectively managed when external vehicles are involved in moving a significant number of aircraft at an airport.

Monitoring the On-Street parking has always been a tough task in huge cities. The author examines the suitability of taxi fleets of various sizes to crowd sense on-street parking availability. He has considered all the road segments in San Francisco and computed the taxi transit frequency for each and thus by combining this frequency with the parking data from SFPark, to estimate the crowd on-street parking .The author states that the quality of the sensors also play a major role and Kalman filter did not give much of improvement [12].Thus he concludes that before the costly deployment of static parking sensors, the traffic management authorities should consider crowd sensing parking via probe vehicles as an alternative.

ParkPGH provides real time information on garage parking spaces in Pittsburgh's Cultural District. The author collects the information of real time parking by tapping the garage's gate count. This application would be helpful for the garage owners as they can know the demand for parking which would help them in managing lease holders. The author [13], states that one main advantage is that this application would be a relatively low budget, and its open source platform will help the cities to lower the investment in setting up a managing similar smart meter.

III. Methodology

The dataset for all the three-parking analysis was obtained in JSON format from the San Francisco Open Database (DataSF):

https://data.sfgov.org/Transportation/Bicycle-Parking/hn4j-6fx5

https://data.sfgov.org/Transportation/Aircraft-Parking-Activity-Records-at-SFO/5rkh-waic

https://data.sfgov.org/Transportation/Metered-motorcycle-spaces/uf55-k7py

Bicycle parking data contains 1000 records with the installation information of bicycle parking like id, installed year, month, object id, address, location, street, placement, number of racks, spaces, latitude, longitude and some neighborhood details [8].

Aircraft parking Activity Records includes airlines, aircraft types, parking spot, and dates [9].

Metered Motorcycle Parking dataset contains information about various metered motor parking spaces in San Francisco as of 2013 April. The data set is in json format with 1001 records each having 17 attributes [10].

In order to perform analysis under the domain of parking, raw data were obtained from San Francisco Open Data (DataSF) sources. Three different databases were created in MongoDB in order to store the JSON data. The connection was established with MongoDB using python's PyMongo. After which the JSON data is being inserted into the respective databases. The data from MongoDB was extracted into a data frame using python and pre-processing was done. The connection to PostgreSQL was established using psycopg2. SQLAlchemy was used to write dataframe to postgres table. Using queries, data in postgres were analysed and interpreted through visualization.

IV. Results

A. Bicycle Parking Space Analysis

Figure. A1. and A2. explains the number of bicycle parking installed and spaces available in past years based on the request received from SMFTA. It observed that every year there is an abrupt change in number of parking installation and in the year 2015 more number of parking spaces were installed.

The top 10 street which has more parking racks is observed from figure. A3. in this location there is high demand for parking spaces. It is observed that there are many parking racks in MISSION street.

From figure. A4. the placing of parking racks was analyzed. Usually a greater number of racks were placed on sidewalk as it is for short-span parking. There are only few long-term parking racks that are installed in Garages.

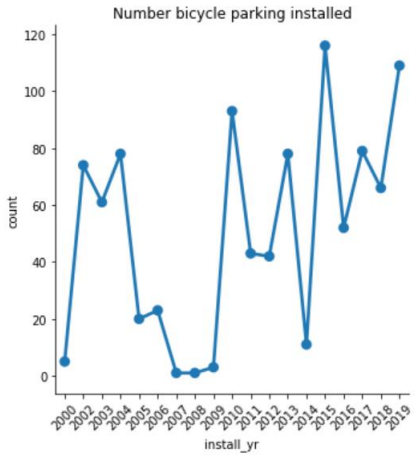


Fig. A1. Parking Installation

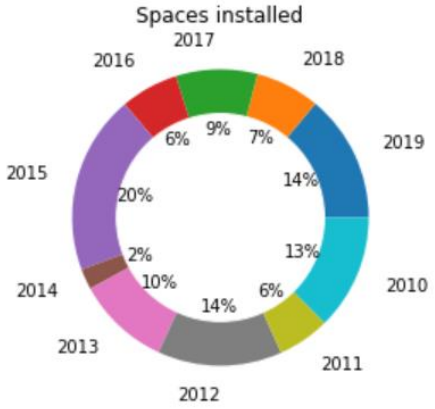


Fig. A2. Number spaces installed

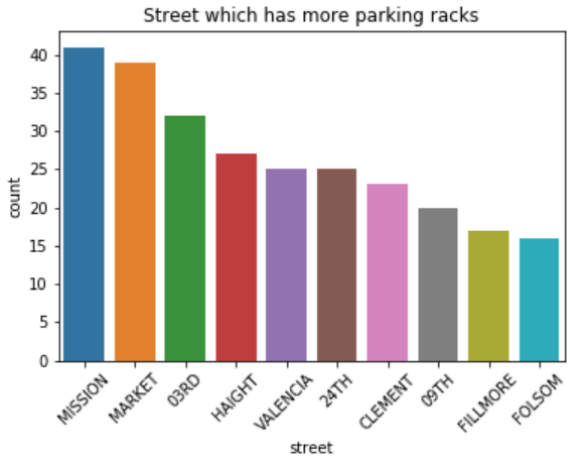


Fig. A3. Street with more parking racks

Fig. A4. Placing of parking racks

In figure. A5. the analysis was made to observe the top 15 street with more neighborhoods utilizing the parking spaces. From analysis it was identified that the neighborhoods count was more for the parking space in MARKET street.

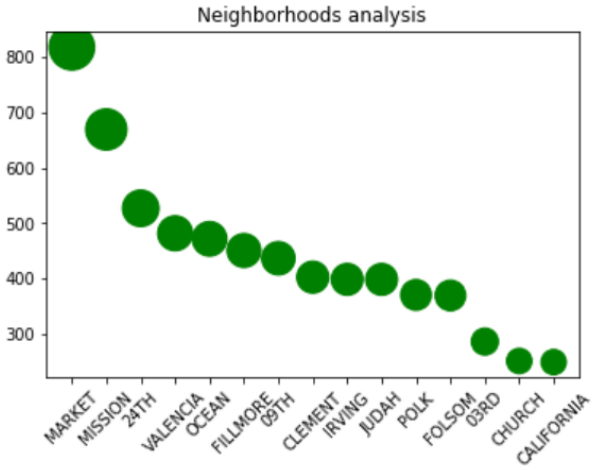


Fig. A5. Neighborhoods of parking racks

B. Aircraft Parking Anaysis

Pie Chart was plotted in order to identify which top 5 Airlines to utilizing the parking space at the San Francisco airport. Bar Graphs were plotted to analyze which model type of aircraft is most occupied at airports and to analyze the parking spot in the airport which was most used. Donut chart was plotted to analyze the calling request type for parking by the aircrafts. Area chart was plotted to analyze the combined effect of aircraft model and parking spot at the airport.

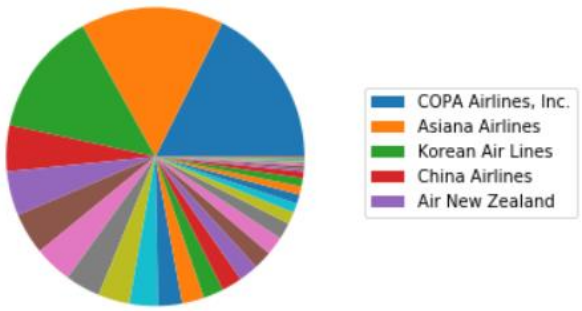


Fig. B1.

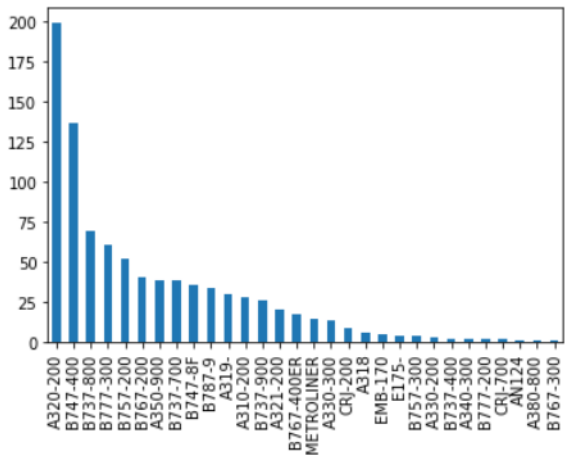


Fig. B2.

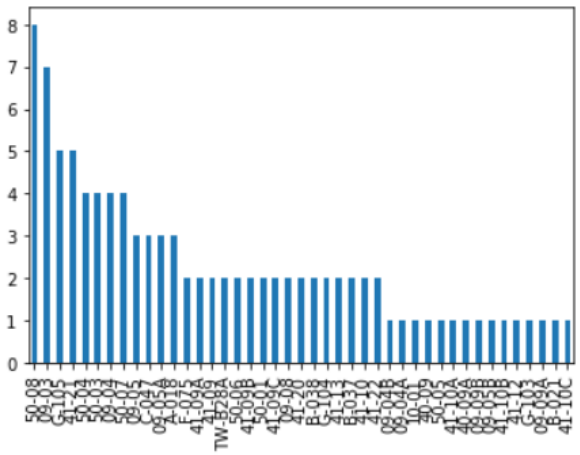


Fig. B3.

From “Fig. B1” we can identify that COPA Airlines Inc is the major airline to use the Airport’s Parking Space, followed by Asiana Airlines. “Fig. B2” and “Fig. B3” gives us an insight into the airline models and parking spots available for the aircraft at the airport and accordingly most common aircraft model observed is “A320-200” and most used parking spot at the airport is “50-08” . “Fig. B4’ gives us an insight into the type of call for parking, requested by an aircraft, and accordingly the maximum type was the “callin”. “Fig. B5” represents the extent of effect, the model and spot of aircraft combinedly play.

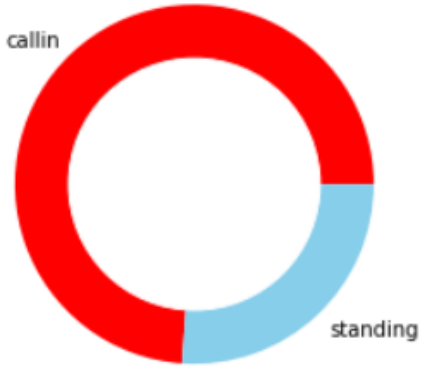


Fig. B4.

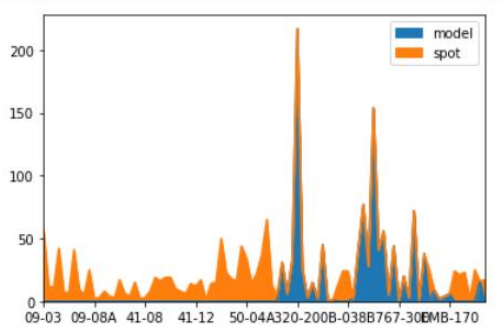


Fig. B5.

C. Metered Motorcycle Parking Space Analysis

Figure. C1. depicts which hourly rate zones have installed high number of meters for motorcycle parking. It 2is evident that MC5($0.25 to $6) has maximum number of meters installed for motorcycles parking and PortMC2($0.50) has the minimum number [10]. The reason could be that more motorcycles are being parked in MC5 zone and thus in order to manage them, more meters are being installed.

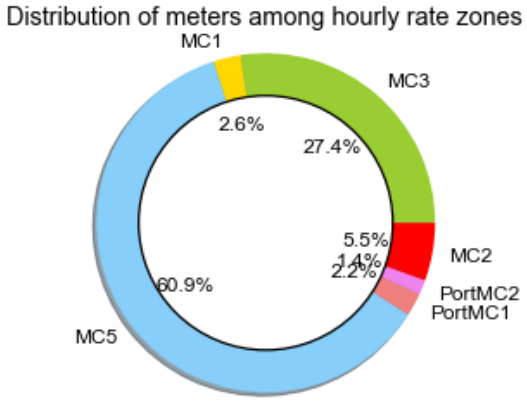


Fig. C1.

Figure. C2. depicts that agency SFMTA manufactures majority of parking meters which clearly shows they are having a monopoly business in this domain.

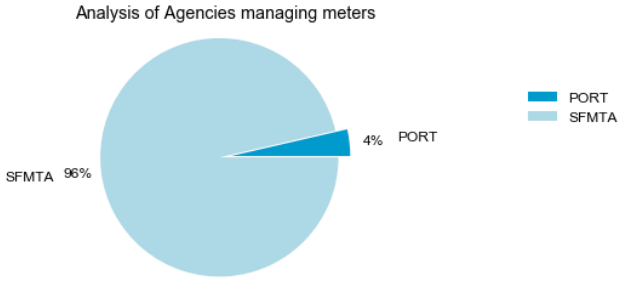


Fig. C2.

Figure. C3. shows the top streets on which smart meters have been installed. Word Cloud is another way of visual representation of data based on their occurrences. This would help the agencies to analyze the streets in which smart meters have to be installed in future and where it can be minimized.

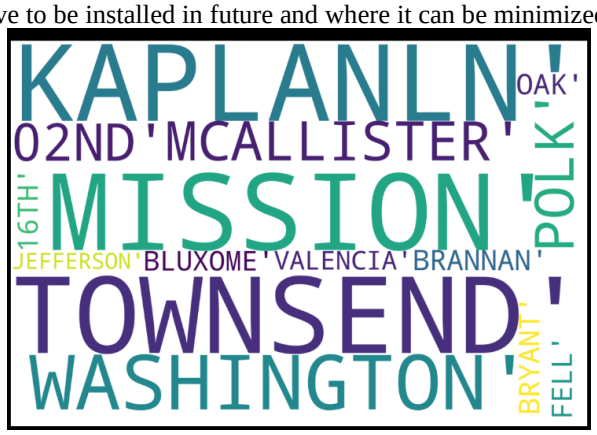


Fig. C3.

Figure. C4. shows the meter type which is majorly employed by different agencies This insight complements the insight from figure. C2 and more specifically depicts the type of meter (multi meter) being installed by the agency.

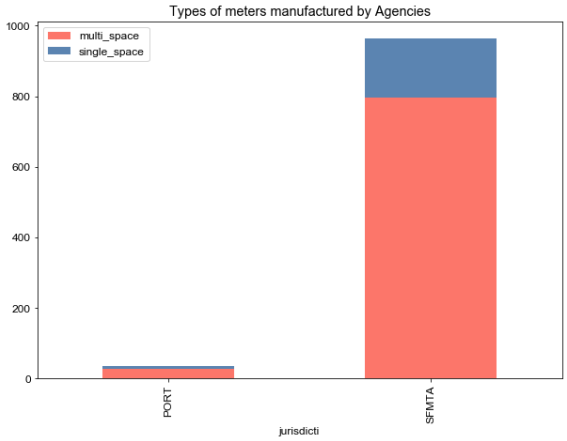


Fig. C4.

Figure. C5 – shows how are the meter types distributed among various hourly rate zones This insight complements insight from fig. C1. and more specifically depicts the major type of meter being installed in each of the hourly zone.

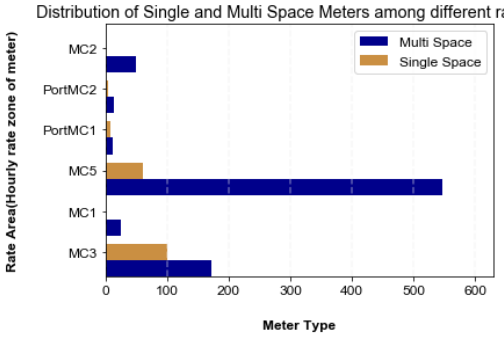


Fig. C5.

Figure. C6. shows the top 5 areas which has on street parking. MAIN ST has the highest on-street parking among all and the rest of the streets do not have much variation in them.

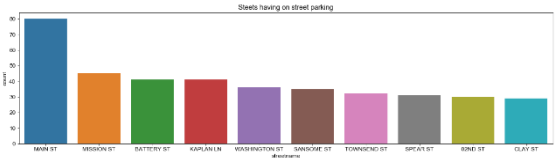


Fig. C6.

V. Conclusion and Future Work

From the analysis of Bicycle parking spaces in San Francisco. It is observed that SFMTA has installed parking racks based on request and need but it has abrupt changes. It was also analyzed that which street has more racks and majority were placed on sidewalk. The neighborhoods for the parking space were analyzed. Based on this analysis SMFTA can install the parking spaces where there is a need with better facilities.

Analyzing the Aircraft Parking Records from San Francisco Airport we were able to attain insights such as the leading traffic generator Airlines at the airport and mostly used parking spots at the airport, the type of aircraft model a parking spot can hold. All these outcomes can be taken into consideration to conduct further analysis on assigning a parking spot at an airport for a specific model of aircraft by an airline. Also, further Machine Learning methodologies can be used to predict the next income of an airline type and its need for parking and build an automation system of guidance for Aircraft Parking at various airports and airfields across the globe.

From analyzing San Francisco's metered motorcycle parking spaces, it is seen that SFMTA is the agency which has installed more number of multi space parking meters in the hourly rate zone area, MC5.The street MAIN ST has high number of on street metered motorcycle parking and the street KAPLANLN has high number of smart meters installed. With the help of all this analysis, metered parking system can be improvised by taking into consideration the operation and sustainability. It can be helpful in guiding the decisions on setting the time limits for hourly rate zones. It would be helpful for the agencies to manufacture meters with better facilities and install them in more appropriate places.

Based on these analyses, further an automation system can be built with more accessibility over wide range to maintain different parking spaces.

References

[1] D. Arbis, T. Rashidi, V. Dixit and U. Vandebona, "Analysis and planning of bicycle parking for public transport stations", INTERNATIONAL JOURNAL OF SUSTAINABLE TRANSPORTATION, vol. 10, no. 6, pp. 495-504, 2016.

[2] J. Henderson, "The Spaces of Parking: Mapping the Politics of Mobility in San Francisco", The Author Journal compilation, vol. 41, no. 1, pp. 70-91, 2009. [Accessed on: Apr. 23, 2020].

[3] "SFMTA 2019 Bike Program Report", 2019. [Online]. Availabe: https://www.sfmta.com [Accessed on: Apr. 23, 2018].

[4] Wikipedia, "Asteroids in fiction." [Online]. Available: https://en.wikipedia.org/wiki/Stand_Guidance_System

[5] R Rastogi, Class Lecture, Topic: "Aprons Aircraft Parking", Department of Civil Engineering, Indian Institute of Technology – Roorkee.

[6] R. Prema, K. Subramanian, B. Senthilvel, "Automatic Aircraft Parking Systems", International Journal of Scientific Research in Science and Technology, vol 3, no 3, 2017.

[7] I. Cox, J. Cox, "Airport terminal traffic and parking management system", United States Patent US14/341755, Jul. 25, 2014.

[8] "Bicycle Parking", DataSF, 2019. [Online]. Available: https://dev.socrata.com/foundry/data.sfgov.org/hn4j-6fx5. [Accessed on: Apr. 23, 2020].

[9] "Aircraft Parking Activity Records at SFO", DataSF, 2016. [Online]. Available: https://dev.socrata.com/foundry/data.sfgov.org/5rkh-waic. [Accessed on: Apr. 23, 2020].

[10] "Metered motorcycle spaces", DataSF, 2012. [Online]. Available: https://dev.socrata.com/foundry/data.sfgov.org/uf55-k7py. [Accessed on: Apr. 23, 2020].

[11] C. Yuan, Y. Sun, J. Lv and A. Lusk, "Cycle Tracks and Parking Environments in China: Learning from College Students at Peking University", Int. J. Environ. Res. Public Health, vol. 14, 2017. Available: http://www.mdpi.com/journal/ijerph. [Accessed on: Apr. 23, 2020].

[12] F. Bock,S. Martino,A.Origlia, "Smart Parking: Using a Crowd of Taxis to Sense On-Street Parking Space Availability", IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS, vol 21, no 2, pp 496-508, Feb. 2020.

[13] T. Fabusuyi, R. Hampshire, V.Hill, K. Sasanuma, "Decision Analytics for Parking Availability in Downtown Pittsburgh", INFORMS, vol 44, no 3, pp 286-289, May-June 2014.